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Faculty of Environmental and Life Sciences

School of Geography and Environmental Science

Subjective and Objective Wellbeing in the Context of Spatial Environmental Characteristics and Climatic Risk: A comparative case study on the Volta Delta, Ghana

by

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Thesis for the degree of Doctor of Philosophy

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University of Southampton

Abstract

Faculty of Environmental and Life Sciences

School of Geography and Environmental Science

Doctor of Philosophy

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This thesis aims to improve the understanding of the relationships between environmental conditions, such as climatic risks and landscape characteristics, and objective wellbeing (OWB), subjective wellbeing (SWB), and the association between the two concepts in Volta Delta, Ghana. Despite growing interest in the measurement and conceptualisation of wellbeing, the integration within sustainability research, and the understanding of how different wellbeing outcomes relate, remains limited. Many studies focus on singular, often objectively measured outcomes, without acknowledging the breadth of available measures. This approach can result in crucial subjective information, which can be explored to understand actors' behaviours and responses, being omitted from research and policy. Furthermore, empirical evidence supporting the interconnection between environment and wellbeing remains limited; in particular, there is an underutilisation of SWB in research based in lower-middle-income countries.

This thesis uses various quantitative and qualitative methods, including regression modelling, exploratory survey analysis, semi-structured focus groups and interviews, and participatory weighting exercises. Alongside collecting primary qualitative data, this project incorporates secondary sources such as remote sensing data and household survey data from the Deltas, Vulnerability and Climate Change: Migration & Adaptation (DECCMA) project.

The mixed method approach yields several key contributions and findings across the four result chapters. Firstly, wellbeing measurements are sensitive to methodological and conceptual decisions. OWB and SWB measures are related, yet not interchangeable, emphasising the importance of methodological transparency within wellbeing research. Secondly, climate hazards often negatively associate with wellbeing; however, landscape characteristics and the relational context can alter these relationships. Thirdly, different community subgroups and district planning officers display different wellbeing priorities. By collecting weightings for different basic need indicators, this analysis highlighted the sensitivity of wellbeing measurement to weighting selection, and also emphasised the importance of *where* and from *whom* weightings are collected. Fourthly, when exploring opposing OWB/SWB outcomes, a broad distinction is found between “poor but happy” inland agricultural areas impacted by drought and erosion, and “non-poor but unhappy” coastal/riverine, peri-urban landscapes exposed to flooding and salinisation. These results highlight how environmental conditions can potentially influence OWB and SWB through different mechanisms.

This thesis also contributes to the literature by producing a new conceptual framework to support future research on environmental relationships with OWB and SWB. Overall, this study provides evidence to justify including objective and subjective measures when implementing and monitoring sustainable development policy to comprehensively capture, and improve, wellbeing in environmentally vulnerable locations.

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List of Accompanying Materials

Cannings, L, Hutton, C.W, Sorichetta, A & Nilsen, K (2024). Is the fulfilment of objective wellbeing reflected in subjective wellbeing? A case study of vulnerable communities in Volta Delta, Ghana, *International Journal of Wellbeing*, 14(2), 1-35, <https://doi.org/10.5502/ijw.v14i2.3149>

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Ethical Approval

University of Southampton provided ethical approval (ERGO: 77828), and University of Ghana's (UoG) Regional Institute for Population Studies (RIPS) granted access to the existing DECCMA ethical agreement for the fieldwork component of the study.

Data availability

The DECCMA household survey dataset is openly available at Mendeley Data (<https://data.mendeley.com/datasets/223z53kwnm/1>).

Research Thesis: Declaration of Authorship

Print name: LAURENCE CANNINGS

Title of thesis: Subjective and Objective Wellbeing in the Context of Spatial Environmental Characteristics and Climatic Risk: A comparative case study on the Volta Delta, Ghana

I declare that this thesis and the work presented in it are my own and has been generated by me as the result of my own original research.

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
7. Parts of this work have been published as:

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Definitions and Abbreviations

AIC.....	Akaike Information Criterion
API.....	Application Programming Interfaces
BND	Basic Needs Deprivation
CCI	Climate Change Initiative
CI.....	Community Interview
DECCMA	Deltas, Vulnerability and Climate Change: Migration & Adaptation
DHS	Demographic and Health Survey
DPO	District Planning Officer
DPSIR.....	Driver–Pressure–State–Impact–Response
DPSWR	Driver–Pressure–State–Welfare–Response
EA.....	Enumeration Area
ECW	Environment & Comprehensive Wellbeing
EEE	Environmental Endowments and Entitlements
ES.....	Ecosystem Service
EVI	Enhanced Vegetation Index
FAO	Food & Agricultural Organisation (UN)
FCUBE	Free Compulsory Universal Basic Education
FDI.....	Foreign Direct Investment
FG.....	Focus Group
GDP	Gross Domestic Product
GH¢	Ghanaian Cedi
GHS	Ghana Health Service
GSS	Ghana Statistical Service
HIC	Higher-income Country
IHME.....	Institute for Health Metrics and Evaluation
ILO.....	International Labour Organisation
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
JLIFLC	Joint Learning Initiative on Faith & Local Communities

Definitions and Abbreviations

LEAP	Livelihood Empowerment Against Poverty
LMIC	Lower-middle income country
LRT	Likelihood Ratio Test
MCA.....	Multiple Correspondence Analysis
MEA	Millenium Ecosystem Assessment
MICS.....	Multiple Indicator Cluster Surveys
NGO	Non-Governmental Organisation
OECD.....	Organisation for Economic Co-operation and Development
ONS	Office for National Statistics
OWB	Objective Wellbeing
PCA	Principal Component Analysis
PRA.....	Participatory Rural Appraisal
RA.....	Research Assistant
RIPS	Regional Institute for Population Studies
RQ	Research Question
SDG	Sustainable Development Goal
SLF	Sustainable Livelihoods Framework
SOAS	School of Oriental and African Studies
SSA.....	Sub-Saharan Africa
SWB.....	Subjective Wellbeing
TEEB	Economics of Ecosystems and Biodiversity
UAE.....	United Arab Emirates
UOG	University of Ghana
UN	United Nations
UNDP.....	United Nations Development Programme
UNECE.....	United Nations Economic Commission for Europe
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNICEF	United Nations Children's Fund
VPC	Variance Partition Coefficients
WeD.....	Wellbeing in Developing Countries
WHO.....	World Health Organisation

Chapter 1 Introduction

This chapter introduces the research context and outlines the importance of engaging with multidisciplinary wellbeing interpretations within sustainable development¹. The research aims and overarching thesis structure are presented, alongside a description of the study site.

1.1 Research context

Research on measuring and conceptualising wellbeing, defined as a “favourable state of life, desirable for every human being in the world at all times” (Böhnke & Kohler, 2010;5), has increased due to its growing importance as a policy outcome (White, 2010). Wellbeing is a vital prerequisite, and outcome of, long-term sustainable development within lower-middle-income countries (LMICs) (Helne & Hirvilammi, 2015), illustrated by all UN Sustainable Development Goals (SDGs) implicitly or explicitly incorporating “wellbeing”.

However, the assumed universality of SDGs does not acknowledge how “wellbeing” is understood differently across disciplines (White, 2016). Wellbeing sits within two broad categories: objective (OWB) and subjective wellbeing (SWB). OWB, including income poverty, is primarily used in economics and development studies (Eid & Larsen, 2008), whereas SWB, incorporating happiness, features within psychology (Cooke et al., 2016). However, despite different disciplinary backgrounds, OWB/SWB are not independent, with different outcomes capable of influencing one another (Böhnke & Kohler, 2010).

Wellbeing is influenced by multiple interconnected social, political, economic, historical and environmental processes (Scoones, 1998). This study acknowledges these macro-scale factors, yet focuses on the relationship between “wellbeing” and “environment” (section 2.4).

“Environmental conditions” are interpreted as climatic hazards *and* landscape characteristics, with different landscapes capturing information on ecosystem services (ES); “processes through which natural ecosystems and...species...sustain and fulfil human life” (Daily, 1997).

There is a global discrepancy between locations responsible for increasing climatic hazards, and those facing the greatest threats (Althor et al., 2016). Anthropogenic warming in West Africa

¹ defined as “development that meets the needs of the present, without compromising the ability of future generations to meet their own needs” (UN, 2022).

is predicted to be greater than the global average (+3-6°C by 2100²) (Niang et al., 2014), contributing towards current, and future, climate hazards (section 1.3.2). These impacts are pronounced within low-latitude LMICs due to lower adaptive capacity (Tompkins et al., 2020), higher exposure and greater reliance upon vulnerable ESs for employment and food security (Kuenzer & Renaud, 2012).

Environmental conditions can be interpreted as wellbeing constituents and/or determinants (Schleicher et al., 2018a). The former suggests “environment” is a wellbeing “end”, supported by studies showing SWB to incorporate individuals’ environmental connections (Albrecht et al., 2007). The latter implies “environment” is a means to an end; for example, provisioning ESs (i.e., crop productivity) are required for good health. This study acknowledges the capacity for “environment” to be a wellbeing constituent, yet as is common with the literature, and to align with selected methodologies (sections 4.2-4.3), “environment” is primarily interpreted as a wellbeing determinant.

Environmental conditions predominantly impact rural livelihoods and wellbeing in LMICs by influencing primary productivity (i.e., crop yield and fish stocks) (Cazcarro et al., 2018). However, environmental conditions, and associations with wellbeing, are heterogeneous across space (Ericksen et al., 2013), with household-level differences in environmental “vulnerability” (section 2.4.2.6) creating diverse outcomes. By exploring OWB *and* SWB, this study investigates various mechanisms linking environment and wellbeing. The next subsection outlines the rationale for studying environment-wellbeing associations, incorporating OWB/SWB, and focusing on Volta Delta, Ghana.

1.2 Rationale

1.2.1 Environment & Wellbeing

Despite a broad acceptance of environment-wellbeing relationships, and the expansion of research within social and natural sciences in response to increasing hazards (Thomas et al., 2019), empirical evidence supporting the interconnection remains limited (Schleicher et al., 2018a). Consequently, the integration of wellbeing research, and the understanding of how different wellbeing outcomes relate to one another, within the field of sustainability is limited (Voukelatou et al., 2021).

² RCP4.5 and RCP8.5

The numerous, complex environmental mechanisms which can impact wellbeing (Heger et al., 2018) mean sustainability research needs to expand beyond traditional material and financial approaches (Helne & Hirvilammi, 2015); especially when acknowledging the weak relationship between economic measures and happiness (Easterlin, 1974). Consequently, a more-comprehensive understanding of wellbeing is required within sustainability studies to address the impacts of climatic hazards and widening global inequalities (O'Mahony, 2022).

1.2.2 Objective & Subjective Wellbeing

The focus on OWB *and* SWB within an environmental context is justified as most existing environment-wellbeing studies incorporate singular outcomes which are implicitly assumed to capture overall wellbeing (Hallegatte & Rozenberg, 2017). For instance, SDG1 is measured by the proportion of people with <\$1.25/day (UN, 2022). This indicator alone does not capture how other OWB and/or SWB dimensions contribute towards sustainable overall wellbeing (Kezer & Cemalcilar, 2020). In particular there is an underutilisation of SWB within LMICs (Dzokoto et al., 2019), with most research exploring environmental impacts upon SWB located in higher-income countries (HICs) (Sulemana et al., 2016). For example, despite research exploring OWB elements in Volta Delta (Atiglo et al., 2022), few studies allude to SWB (Duku et al., 2022) or examine how OWB/SWB interrelate.

Limited focus in LMICs could be attributed to Maslow's "hierarchy of needs", with poorer countries hypothesised to prioritise immediate physical needs over the "bonus" psychological needs encompassed within SWB (Chumo et al., 2023). Similarly, others suggest environmental quality is a "luxury good", and therefore not a priority within LMICs (Sulemana et al., 2016). However, this study interprets "environment" more broadly than "ES quality" by acknowledging the strong interconnectivity between climate, landscape, livelihoods, food security, service access, and wellbeing (Cazcarro et al., 2018).

The importance of encompassing SWB within sustainable development is underscored by research showing that the psychological impacts of climatic hazards can outweigh physical effects (Hayes et al., 2018). Therefore, understanding SWB determinants, and acknowledging the need for SWB within development policy (section 3.5.2.1), can increase the scope of potential wellbeing improvements. Omitting SWB can also overlook hidden costs; for example, unhappiness negatively impacting employment and productivity (Knapp, 2003, Trautmann et al., 2016). Furthermore, incorporating SWB is crucial due to the "increasing realization that...to survive psychological, economic [and environmental] challenges, one must have resiliency culture" (Addai et al., 2014a;874). Happy communities are resilient; therefore, by investigating

the driving factors behind actors' happiness and unity, communities can be supported in generating and maintaining environmental resiliency.

Inconsistencies in the literature regarding whether OWB/SWB align or oppose one another in different contexts (section 2.3) justify this study's focus on local-specific wellbeing controls. Furthermore, analysing OWB *and* SWB can increase research validity. For example, if an environmental condition associates with both measures, the evidence supporting its potential influence on overall wellbeing is strengthened (Sacks et al., 2010). In contrast, opposing outcomes justify the need to incorporate OWB *and* SWB initiatives within policy to prevent negative trade-offs that could hinder community buy-in and policy's long-term sustainability (Ravallion, 2014).

Incorporating multidisciplinary wellbeing conceptualisations, and target communities' experiences (Chapters 5-6), creates a space for locally-valued wellbeing components to be negotiated within research, minimising the influence of external assumptions and methodologies. By acknowledging OWB/SWB to be associated, yet not interchangeable (sections 2.3 & 3.10), this study highlights the importance of including multiple wellbeing measures within sustainability research and policy, rather than assuming single measures capture wellbeing in its entirety.

1.2.3 Study site selection

The understanding of environment-wellbeing relationships at multiple spatial/temporal scales within deltas is poor. Therefore, continued research is essential to achieve sustainable development objectives (Foufoula-Georgiou et al., 2013).

Deltas are low-lying dynamic coastal environments (Nicholls et al., 2020), disproportionately located in low-latitude LMICs (Edmonds et al., 2020). Deltas possess multiple benefits which have historically attracted human settlements, such as flat and fertile land for agriculture (Woodroffe et al., 2006), high biodiversity and various tradable resources (i.e., mangroves, reeds, forests) (Foufoula-Georgiou et al., 2013), and cheap coastal transportation (Kuenzer & Renaud, 2012). For these reasons, deltas are often defined as economic hubs (Szabo et al., 2016a); containing 500+ million people globally despite covering 1% land (Ericson et al., 2006). However, deltas face numerous risks, creating "one of the most vulnerable environments threatened by climate and human-induced changes" (Foufoula-Georgiou et al., 2013;4) (Table 1.1). The numerous challenges create a space for research to explore the multiple mechanisms influencing different wellbeing elements.

Table 1.1 A selection of documented climate hazards faced within global deltas, primarily sourced from (Ericson et al., 2006; Kuenzer & Renaud, 2012; Syvitski, 2008)

Climate hazard	Information
Flooding	▪ Low gradients increase exposure to sea-level rise and flooding (Van Soesbergen et al., 2017). ▪ Flat topography allows floodwaters to spread through tributaries and impact different locations (Wisner et al., 2012). ▪ Estimated 50% increase in area vulnerable to flooding by 2100 (Foufoula-Georgiou et al., 2013).
Subsidence	▪ Natural subsidence rates may be exacerbated by groundwater or oil extraction from coastal aquifers (Addo et al., 2018a).
Soil/water salinisation	▪ Coastal flooding can salinise cultivated land and aquifers. ▪ Saline intrusions into rivers can salinise riverine soils (Edmonds et al., 2020; Nicholls & Cazenave, 2010). ▪ Crop species may not tolerate salinity changes.
Soil/coastal erosion	▪ Coastal/river flooding can induce erosion, exacerbated by reductions in sediment input (i.e., dam construction). ▪ Sediment reductions recorded in 70% of global deltas.
Storm surges	▪ Increase in storm surges, driven by warming land/ocean temperatures, will expand flood risks in deltas.
Cyclone exposure	▪ Increased frequency due to warming temperatures. ▪ Most deltas are in low-latitude locations with greater exposure to tropical cyclones.

Climatic threats are predicted to increase in frequency/magnitude this century, with increased sea-level (2.5-6m) (Niang et al., 2014), drought days ($\approx 20\%$), people negatively impacted by drought (50-90%) and riverine flooding (12-29%) estimated by 2080 (Hallegatte, 2016). These environmental threats are often exacerbated by anthropogenic actions due to increasing demands from large, growing populations (Kuenzer & Renaud, 2012). Examples of these anthropogenic actions include: i) deforestation and informal settlement expansion; reducing soil infiltration and increasing flooding/erosion, (ii) agricultural expansion; water pollution, biodiversity reductions and land degradation, (iii) groundwater extraction; land subsidence/flooding, salinized aquifers (Addo et al., 2018a), (iv) dam construction; disrupted flood schedules, natural defences and nutrient transfer, lower soil moisture, fish productivity and water quality (Edmonds et al., 2020).

The combination of high population density, economic potential, environmental vulnerability, and livelihood dependency upon ESs (Kuenzer & Renaud, 2012), means international sustainable development often targets deltas (Figure 1.1). The next subsection describes the study site and justifies its selection.

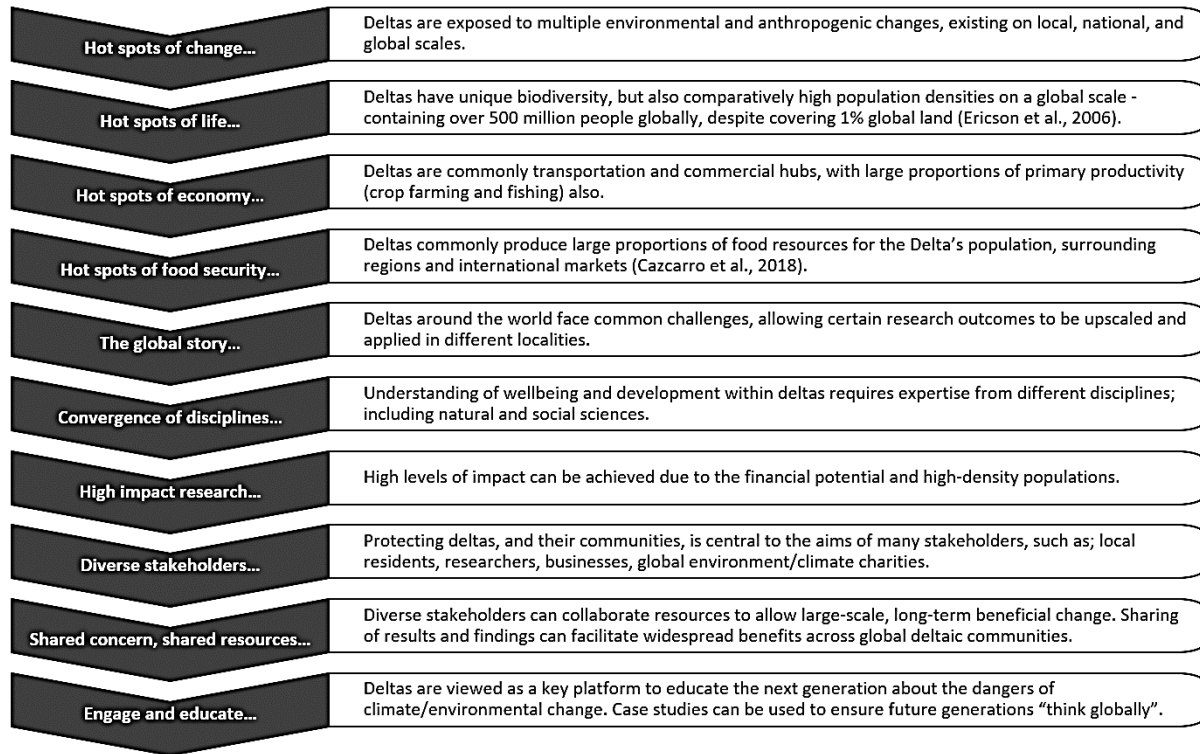


Figure 1.1 Ten reasons deltas are recognised as hotspots for sustainable development research, adapted from Foufoula-Georgiou et al. (2013, p.5)

1.3 Volta Delta

1.3.1 Location

Volta Delta is located across Volta and Greater Accra regions in southern Ghana (Figure 1.2). The delta is defined by the area <5m elevation within the Volta River basin; stretching across six countries including Burkina Faso and Ghana (Addo et al., 2018a). The delta contains ten administrative regions and 181 towns and villages (Adjei et al. 2018), located between three major cities; Lomé (Togo capital) in the East, and Accra (Ghana capital) and Tema (industrial hub) 40km and 30km west respectively.

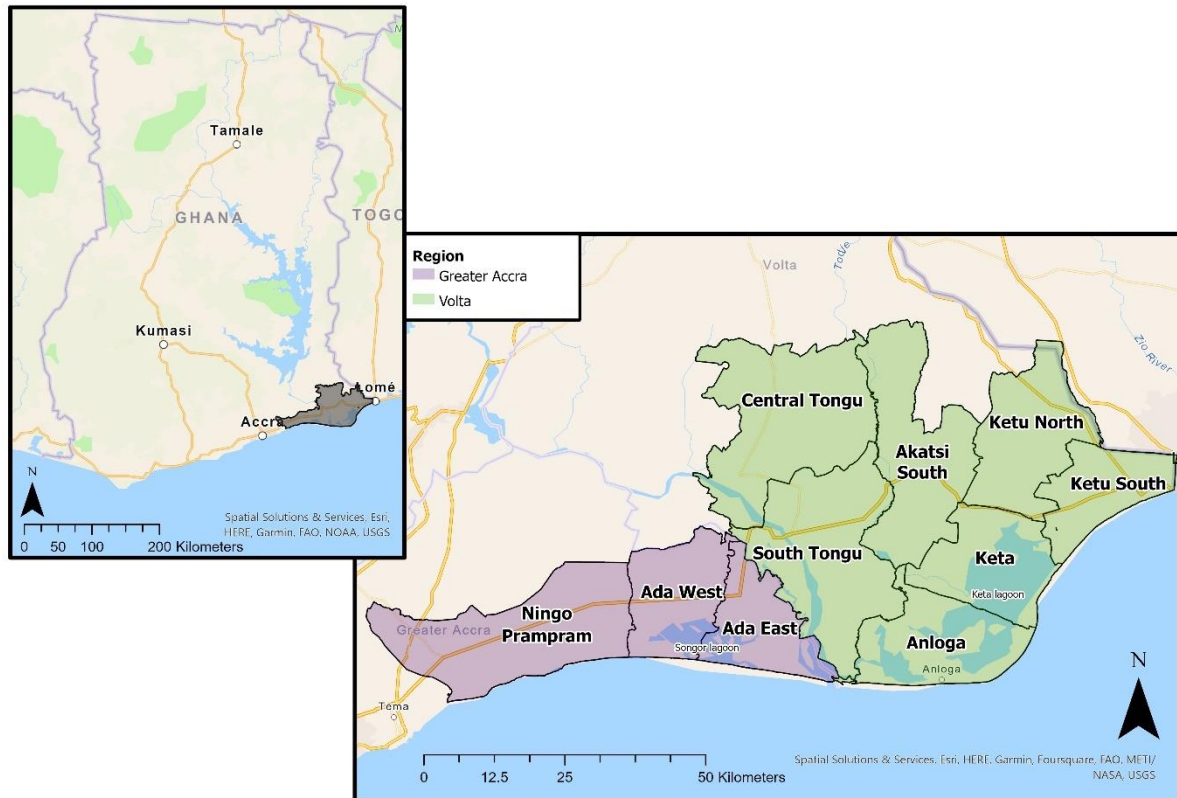


Figure 1.2 A map of Volta Delta, with regional (Volta and Greater Accra) and district boundaries

The study area covers 4,562km², containing 4% national population (945,827). Landcover consists predominantly of cropland, grassland, wetland and lagoons, with a spit (27 x 2km) separating Keta lagoon from the ocean (Awadzi et al., 2008). These various landscapes provide a space to research how different environmental mechanisms may associate with varying elements of wellbeing. Increasing population pressure has resulted in natural vegetation being replaced by agricultural and settlement expansions, which alongside increased livestock herding, vegetation burning/clearance and shortened fallow periods, have contributed towards land degradation. Consequently, nearly all available land in Volta Delta is occupied/owned (Addo et al., 2018a).

Volta Delta was selected due to the absence of comprehensive wellbeing research in the area. Additionally, despite financial poverty being concentrated in North Ghana, higher levels in Volta oppose this national trend (section 2.2.4.1). Additionally, the two regions possess different histories, industries, landscapes, and investment levels (Awanyo & Attua, 2018), facilitating the exploration of how SWB varies across the OWB spectrum (section 2.2.4.2).

1.3.2 Climate

The West African monsoon and Inter Tropical Convergence Zone (Nkrumah et al., 2014) create a bimodal precipitation pattern in Ghana: major (March-July) and subsidiary (August-November) rainfall seasons, and a prolonged dry season (November-February). Average annual precipitation is 146–750mm (Awadzi et al., 2008), with monthly averages ranging 10.6mm (January) to 187.5mm (June). Precipitation rates only exceed evapotranspiration in June, applying year-round pressure to groundwater recharge and irrigation resources (Yidana & Chegbeleh, 2013). Temperatures in Volta Delta rarely drop below 25°C, with the hottest months (March-April) coinciding with the major rainy season (Andah et al., 2003).

Environmental threats to deltas are driven by anthropogenic temperature increases (Niang et al., 2014). Warming temperatures increase air solubility, resulting in prolonged droughts and more infrequent, yet intense, rainfall (Stern, 2006). Increasing temperatures also influence land-ocean thermal gradients (Raj et al., 2019), altering monsoonal intensity/timing which many agricultural communities rely upon (Codjoe et al., 2020a). Despite facing the gravest consequences of atmospheric warming on a global scale, low-latitude areas are minor contributors (Roberts, 2001). Althor et al. (2016) showed 30, predominantly tropical, countries to be within the bottom two quintiles for carbon emissions, yet the top two for climate change vulnerability (2010)³. Ghana is estimated to experience the highest vulnerability level by 2030.

Oceanic thermal expansion and meltwater inputs contribute towards an estimated 3.3mm/yr. (1974-2005) sea-level rise along the Accra coast (Nicholls & Cazenave, 2010; Sagoe-Addy & Addo, 2013). Land subsidence exacerbates flooding, estimated at 1-2mm/yr. (Syvitski, 2008), primarily caused by tubewell irrigation extracting groundwater from coastal aquifers (Addo et al., 2018a). Warming temperatures also intensify storm surges, with energetic swell waves and strong longshore drift along the Accra coast increasing coastal flooding and erosion (Addo et al., 2018b; Almar et al., 2015). Terrestrial inundation from flooding and storm surges, and the disruption of freshwater lenses from tubewell extraction, also increases cropland and groundwater salinisation; key sources for drinking water and farming (Namara et al., 2010).

Flooding also contributes towards coastal erosion, estimated at 0.53m/yr. (1986-2013) along the Accra coast (Addo, 2015). Rock groynes and sea walls have been deployed, yet despite localised improvements in Keta, these methods have increased erosion further eastwards, with rates as high as 17m/yr. (Angnuureng et al., 2013). Anthropogenic actions have aggravated these

³ Vulnerability defined by the Development Assistance Research Associates (DARA, 2012) metric which includes “22 indicators across four Impact Areas (Environmental Disasters, Habitat Change, Health Impact, Industry Stress).

issues, with Akosombo dam on the Volta River, Ghana's largest hydroelectric project (Miescher, 2021), reducing sediment supply to Volta Delta by 90% (Boateng, 2012), river runoff (87.5mm/yr. to 73.5mm/yr.), disrupting natural flooding, and lowering soil moisture in cultivatable floodplains (Addo et al., 2018a; Oguntunde et al., 2006). These concerns are exemplified in Fuvemeh, near the river mouth, where erosion removed 37% land, demolished schools, eliminated fish habitats (Addo et al., 2018b), and destroyed 5,000 houses since 1960 (Boateng, 2009).

1.3.3 Socioeconomic information

Global deltas have high-density populations, including Volta Delta where population density is greater than the national average (151 v 103 people/km²). However, population growth is lower than the national average (1.6% vs 2.1%/yr. [2000-2010]), driven by limited land access, increasing degradation and dwindling fishing opportunities causing high emigration (-41,000 net migration [2000-2010]). However, migration is spatially variable, with positive net migration in Ada West, Ada East and South Tongu districts (Figure 1.2) due to diverse opportunities within tourism, commercial oil/salt extraction and aquaculture (Abu & Codjoe, 2018; Addo et al., 2018a). Nevertheless, negative net migration of working-age males has influenced Volta Delta's demographic make-up. The dependency ratio, proportion of people aged 65+ and female-headed households has increased, whereas the fertility rate and sex ratios have reduced (Table 1.2).

Table 1.2 Key demographic characteristics of Volta Delta and Ghana. Data from the 2010 Ghana National Population and Housing Census (GSS, 2013), sourced from Codjoe et al. (2020a)

Demographic characteristic	Volta Delta	Ghana
Proportion of population <15 years	38.0%	38.3%
Proportion of population 65+ years	7.1%	4.7%
Dependency ratio	81	76
Sex ratio (male:female)	87.0	95.2
Proportion of female-headed households	41%	34%
Population density (people/km ²)	151	103
Total fertility rate	3.6	4.0
Population growth rate	1.6%	2.1%
Proportion of urban landcover	33%	52%

Households are primarily Christian, with Traditional religions and Islam also practiced across the two major ethnic groups; Ewe and Ga-Dangme. Both groups are patrilineal, meaning male bloodlines inherit assets and property/land rights, resulting in gendered imbalances in land ownership and human capital (Codjoe et al. 2020a; Kutsoati & Morck, 2014). For example, educational attainment in Volta Delta is low, with 30% 15+ year olds being illiterate, yet males have higher literacy levels (GSS, 2013). Low education persists despite state-led “Free Compulsory Universal Basic Education” (FCUBE) for all (6 years primary, 3 years secondary [Junior High School]) since 1995. However, debates persist as to whether school is “free”, with payments for uniforms and transport restricting access amongst the poorest households (Palmer, 2005).

Financial performance, measured by GDP/capita, in Volta Delta is lower than the national average (\$1,048/capita v \$1,215/capita). Primary sector livelihoods, involving raw material extraction, contribute most to delta GDP (29%); agriculture (22%) and fishing (7%). Trade, transport and industry (inc. salt mining and food processing) contribute 20% each, and construction 11% (Arto et al., 2020). Males primarily work within agriculture (41%), whereas females dominate trade/service sectors (44%). Agriculture, centred around maize, cassava and rice, is integrated within the wider economy. Cazcarro et al. (2018) estimate 32% GDP loss if all agriculture was removed; 22% directly linked to agriculture, and 10% attributable to its integration with trade, transport and industry.

Approximately 1/3 individuals work within agriculture, higher than the proportion of GDP generated. This disparity is driven by widespread subsistence farming, and low productivity and

technology access curtailing financial returns (Arto et al., 2020). The prominence of subsistence agriculture accentuates the interconnectivity between livelihoods, wellbeing and environment in Volta Delta (Duku et al., 2022). However, with increasing hazards, land shortages, and emerging mining/oil opportunities, manufacturing may soon exceed agriculture (Adjei et al., 2018). Other growing industries include; forestry, charcoal burning, salt/sand mining and aquaculture (Anim et al., 2013).

Most labour (68%) satisfies final demand within Volta Delta, whereas the remaining output satisfies other Ghanaian (17%) and international (15%) markets (Cazcarro et al., 2018). Nevertheless, internal labour does not satisfy all requirements, meaning Volta Delta remains a net-importer of goods such as food, energy and labour; with 25% residents being migrants (Addo et al., 2018a). See section (2.2.4) for additional information on wellbeing in Volta Delta.

1.4 Problem statement

Deltaic communities' livelihoods and wellbeing are exposed to multiple social, political and environmental challenges (Ericson et al., 2006). This study explores how environmental conditions associate with communities' OWB and SWB. Researching the complex mechanisms through which climatic hazards and landscape characteristics impact different outcomes, and the relationships between wellbeing measures, can support policy in improving "comprehensive wellbeing" (White, 2016).

1.5 Research aim, questions & objectives

The research aim is:

To understand the association between environmental conditions (climatic hazards and landscape characteristics) with OWB and SWB, and to interpret how OWB and SWB associate within an environmentally vulnerable context.

Four research questions (RQs), and corresponding objectives, address the aim.

1. How are OWB and SWB measured within an environmental context?

- a. Construct, and evaluate, a conceptual framework for researching environment-wellbeing relationships.
- b. Critique pros and cons of different OWB and SWB methodologies within LMICs.
- c. Identify and compare results of different methodological approaches to OWB and SWB.
- d. Select appropriate wellbeing measures for further analysis on environment-wellbeing relationships.
- e. Examine associations between different OWB and SWB measures.

2. What are the spatial environmental associations with OWB and SWB?

- a. Identify how environmental and control characteristics explain the spatial distribution of OWB and SWB, and how the drivers of OWB and SWB outcomes vary.
- b. Understand relationships between OWB and SWB within an environmental context.

3. How do different socioecological groups conceptualise and weight components of wellbeing?

- a. Compare weights given to basic needs deprivation components across livelihood groups, genders and community/district planning officers.
- b. Assess if the different weightings alter the overall deprivation rate, or spatial distribution of basic needs deprivation across Volta Delta.

4. What drives the divergence between OWB and SWB within an environmental context?

- a. Investigate communities' perceptions of the mechanisms underlying opposing outcomes in expenditure poverty (OWB) and unhappiness (SWB).
- b. Determine if experiences of communities, local governments and other actors support quantitative evidence.

1.6 Study organisation

1.6.1 Overarching approach

This study aims to comprehensively understand wellbeing, and its relationship with environmental conditions, in Volta Delta. Incorporating various wellbeing measures minimises potential disciplinary biases, whereas the adapted explanatory sequential mixed methods approach (Figure 1.3) adds value and depth to wellbeing research (Creswell & Creswell, 2017).

The “comprehensive wellbeing” strategy is defined as “the most influential method of defining and operationalising wellbeing within public policy” (Walsham, 2020;48). “Comprehensive wellbeing” incorporates three elements (White, 2016): (i) broad indicators, (ii) relevance to people’s lives, (iii) subjective *and* objective measures. These elements are addressed by (i) analysing multiple measures, (ii) undertaking qualitative fieldwork to gather communities’ wellbeing priorities, (iii) analysing environmental relationships with OWB/SWB, and associations between these measures.

The major component of this research is quantitative analysis, with qualitative fieldwork guided by statistical outputs. However, qualitative information is vital in validating, challenging and/or refining original quantitative findings. Furthermore, qualitative methods are crucial for understanding SWB, as interacting with local communities restores the “person” into analysis, which could otherwise be lost when using external, quantifiable surveys (White, 2016). See Box (1.1) for further mixed method benefits.

Nevertheless, challenges may arise when using mixed methods. Firstly, interpreting conflicting quantitative and qualitative results is challenging. However, hypotheses about why quantitative survey and qualitative findings differ, such as interview bias, can be presented (Groves et al., 2011). Furthermore, Doyle (2016) notes the danger of tokenistic qualitative methods within a field historically dominated by quantitative approaches (Althor & Witt, 2020); however, linking qualitative findings back to all quantitative steps (Figure 1.3) addresses this concern.

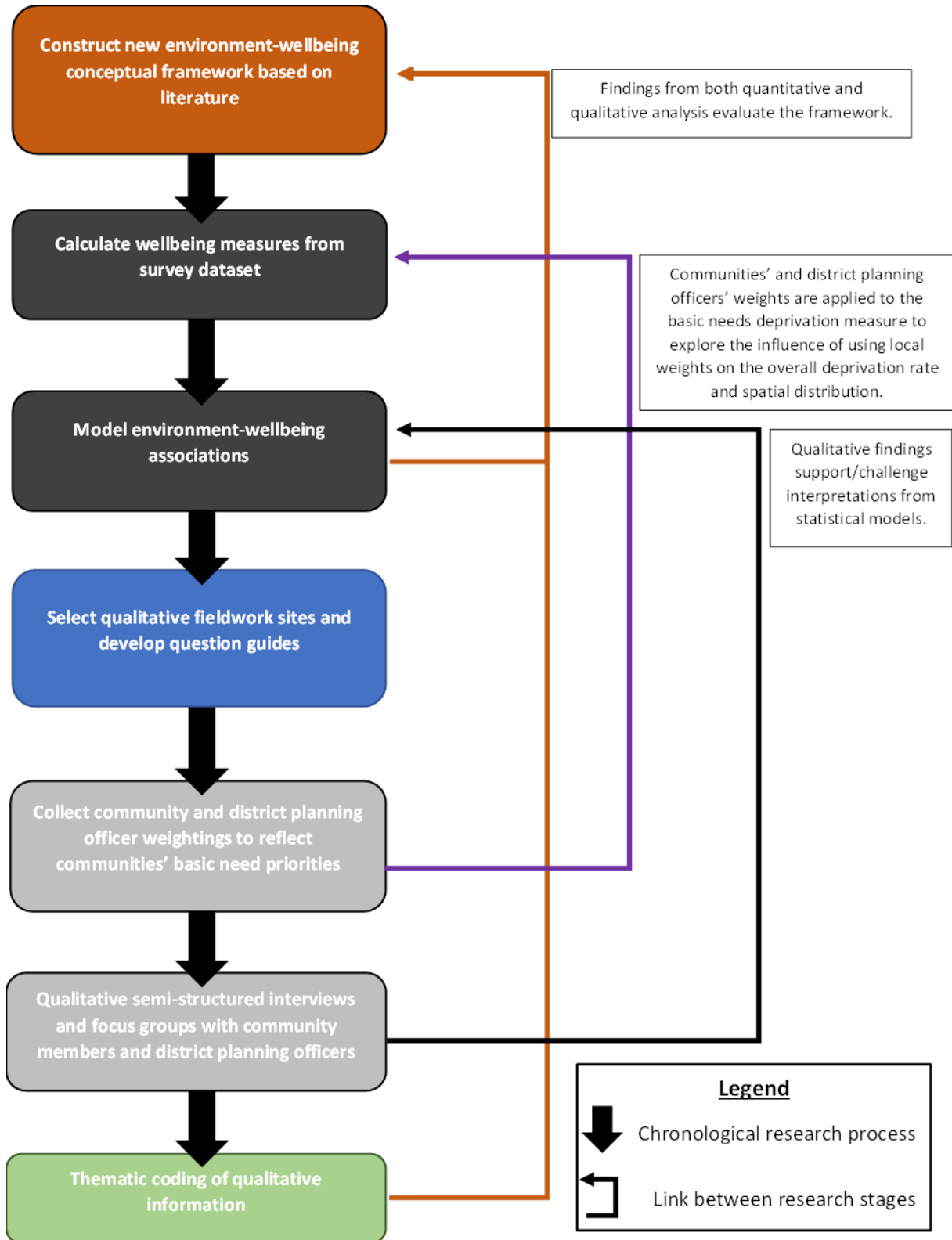


Figure 1.3 The study's mixed method approach, adapted from Doyle et al. (2016). The thin arrows illustrate how qualitative results feedback to influence previous stages of the research. The thick black arrows represent the chronology of the overarching project

Box 1.1. Benefits of using an explanatory sequential mixed method approach when researching wellbeing.

Doyle et al. (2016)

- Add additional insights and local context/meanings to interpretations, unobtainable through quantitative results alone; adding “meat on the bones” (Bryman, 2006;106).
- Assess validity of modelled results, use qualitative methods to triangulate findings.
- Different methods can address different research questions (Creswell, 2015).

Shaffer (2013)

- Help understand counter-intuitive quantitative results (Place et al., 2007; Rao et al., 2017).
- Interpret the direction of causality of statistical associations.
- Compare local definitions of wellbeing with documented measures.
- Adjust measure weights or model parameters to align with locally-defined priorities.
- Quantitative methods primarily focus on wellbeing outcomes, whereas qualitative methods can interpret the process/journey.
- Capture livelihood or adaptive practices/processes that were absent from the original household survey.

Bryman (2006)

- Offset weaknesses associated with quantitative and qualitative approaches.
- Quantitative findings can guide the qualitative sampling strategy; for example, which communities to visit.

Atkinson (2013)

- Mixed methods can shed light on the benefit of qualitative methods within policy, which is often dominated by tangible, objective measures of success.

White (2016)

- Force the researcher to reflect upon the subjective decisions and preconceptions made within the quantitative approach.

1.6.2 Thesis structure

The remainder of this thesis comprises of six chapters; literature review, four result chapters, and a synthesis. Table 1.3 illustrates how each chapter addresses the RQs.

Chapter 2: Literature review assesses different wellbeing conceptualisations, introduces the environment-wellbeing nexus and evaluates existing frameworks. Presents documented environment-wellbeing relationships, and the new framework.

Chapter 3: Wellbeing conceptualisation and measurement introduces the survey dataset and summarises general, and LMIC-specific, advantages/disadvantages of OWB/SWB measures. Different wellbeing measures are calculated and evaluated, with select measures recommended for regression analysis (Chapter 4). Statistical associations between measures explore aligning/opposing OWB/SWB relationships.

Chapter 4: Environment-wellbeing associations presents eight binary logistic models exploring associations between environmental and control characteristics, and singular (OWB/SWB) and combined outcomes (i.e., “objectively poor & subjectively happy”).

Chapter 5: Qualitative fieldwork: wellbeing weighting documents a participatory weighting exercise. Different subgroups’ wellbeing priorities are compared and mapped to evaluate the sensitivity of “basic needs deprivation” to weighting selection.

Chapter 6: Qualitative fieldwork: unaligned OWB/SWB uses semi-structured interviews and focus groups to support/dispute quantitative results, focusing on households with opposing OWB/SWB.

Chapter 7: Synthesis collates quantitative and qualitative results to address the RQs and evaluate the conceptual framework. Limitations and future research areas also discussed.

Chapter 1

Table 1.3 An overview of how the four research questions are addressed in the remaining six chapters of this study

Chapter	Research questions			
	RQ1	RQ2	RQ3	RQ4
Chapter 2	a) Drawing on critical evaluations of existing environment-wellbeing frameworks and documented environment-wellbeing relationships, a newly constructed framework, applicable to studies of LMIC wellbeing, is constructed.			
Chapter 3	b) Critically evaluates OWB and SWB measures, both generally, and within an environmental, LMIC context. c) Multiple measures of OWB and SWB are calculated from the DECCMA survey dataset, and evaluated using methodological literature. d) Four wellbeing measures, two OWB and two SWB, are recommended for regression analysis in Chapter 4. e) Statistical associations between the four wellbeing outcomes are explored.			
Chapter 4		a) Binary logistic models exploring significant environmental, and control, associations with two OWB and two SWB measures. b) Binary logistic models exploring significant environmental, and control, associations with four combined poverty-happiness outcomes.		
Chapter 5			a) Community/expert weightings of basic needs deprivation components are compared across livelihood, gender and decision-making groups. b) Community/expert weightings are applied to the wellbeing components incorporated within the basic needs deprivation measure to analyse sensitivity to weighting selection.	
Chapter 6				a) Focus groups and interviews explore how environmental challenges and control characteristics potentially associate with diverging outcomes of expenditure poverty (OWB) and unhappiness (SWB). b) Community interviews/focus groups, and district planning officer interviews, drew upon the modelled environmental associations with opposing OWB/SWB.
Chapter 7	a) Quantitative and qualitative evidence used to evaluate the constructed conceptual framework, drawing on survey results and local perceptions of environment and wellbeing.			

Chapter 2 Environment & Wellbeing: a literature review

2.1 Introduction

This chapter provides information on environment-wellbeing associations. Firstly, wellbeing is defined; incorporating OWB and SWB. General methodological and conceptual advantages/disadvantages are presented, alongside contextual insights from wellbeing studies in Ghana and Volta Delta. This is followed by an exploration of the relationship between OWB and SWB.

Next, the “environment-wellbeing” nexus is introduced, before existing frameworks are evaluated. A review of environmental mechanisms which (in)directly influence OWB and SWB is presented, structured using Sustainable Livelihood Framework capitals (section 2.4.2.5). The chapter concludes with a new conceptual framework (RQ1a); created to structure this, and future, research on interrelationships between environment, OWB and SWB.

2.2 Wellbeing: an introduction

2.2.1 What is wellbeing?

Wellbeing is a “favourable state of life desirable for every human being in the world” (Böhnke & Kohler, 2010;5). However, the conceptualisation and measurement of wellbeing is debated across disciplines (de Chavez et al., 2005; Dodge et al., 2012), including three broad, yet overlapping, philosophical theories (Table 2.1).

Table 2.1 Description of the three broad philosophical theories of wellbeing (Ravallion, 2014)

Theory	Description
Hedonism	Wellbeing is the experience of more pleasure than pain, with the actions that constitute pain and pleasure often defined by the individual.
Desire-fulfilment	Wellbeing is defined by whether actors’ desires are satisfied.
Objective list	Concepts are inherently good or bad, and wellbeing is defined through achieving the “good” and avoiding the “bad” (Parfit, 1984).

All three theories are applicable when viewing environment as a wellbeing “determinant”. However, only the objective-list approach allows environment to be interpreted as a wellbeing “constituent”, as the other two interpret ESs as instrumental for humans to experience pleasure/pain or fulfil their desires (Schleicher et al., 2018a).

Within these overarching theories, two conceptual perspectives exist; OWB and SWB. The chosen approach depends on the research aims (Vaznonienė, 2014). OWB is often utilised when comparing wellbeing trends over large spatial/temporal scales, whereas SWB is used to understand local context-specific effects (Böhnke & Kohler, 2010). These two distinct, yet interconnected, ideas are captured in the phrase “doing good, feeling well”, which describes wellbeing from a LMIC perspective (White, 2010). “Doing good” corresponds with the need to “live a good life”, often grounded in religion and social norms, whilst “feeling well” reflects the importance of achieving a suitable living standard, health, relationships and financial comfort (Addai et al., 2014a).

Different wellbeing measures produce different results, potentially influencing which communities are supported by policy (Laderchi et al., 2003). These differences may emerge due to the seven core measurement challenges (Figure 2.1). However, there is no requirement for a consensus on wellbeing measurement. Instead, multidisciplinary approaches that draw on different ideas are favourable to overcome each measurement’s limitations (Addison et al., 2008; Nunan, 2015). Furthermore, the absence of an agreed-upon, narrow definition allows wellbeing to be discussed freely within communities, ensuring needs are addressed within the local context (Atkinson, 2013).

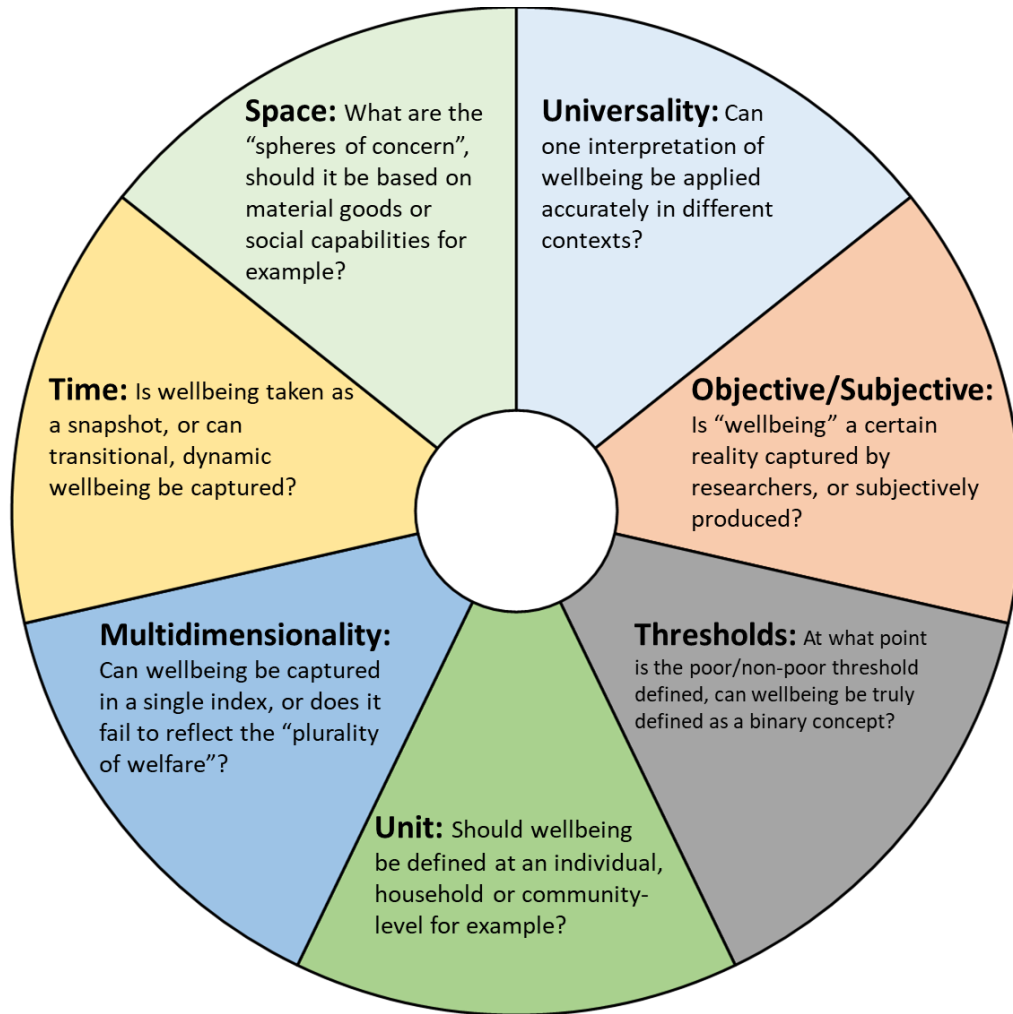


Figure 2.1 The seven challenges of wellbeing measurement, defined by Laderchi et al. (2003)

2.2.2 Objective wellbeing

OWB incorporates quantifiable, tangible concepts relating to quality of life. These concepts often capture desirable social norms and attributes (Vaznonienė, 2014), such as material income/assets, education and health (Western & Tomaszewski, 2016). However, despite theorists’ attempts to define a universal “fulfilling life” (Nussbaum, 2001), objective outcomes differ across time and space. See Table 2.2 for examples of how OWB is captured in the literature.

Table 2.2 Examples of OWB measures from the literature. Note, based on the data available in the DECCMA survey, this thesis focuses on financial poverty and multidimensional basic needs wellbeing

OWB concept	Measures & References
Financial poverty	SDG8 targets growth in GDP per capita, while SDG1 targets a reduction in the proportion of people living below the international poverty line (\$1.25) (UN, 2022). OECD (2023) measures financial wellbeing through disposable income, and GSS (2018) defines poverty using a national poverty line based on the cost of essential food and non-food items (GH¢1,760.8/adult equivalent/year).
Multidimensional basic needs	The multidimensional approach acknowledges that wellbeing consists of overlapping facets. Many studies often form indices based on several indicators, most notably the Alkire-Foster (2011) method. While Streeten (1984) proposed five universal needs, multidimensional measures are often tailored to specific contexts (Datt, 2019; de Kruijk & Rutten, 2007; Libório et al. 2022). For example, the GSS (2018) multidimensional measure consists of various indicators referring to living standards, education and health.
Health indicators	Health indicators are captured in various ways in Ghana-based research, including infant mortality (Dwomoh et al., 2019; Kallah-Dagadu et al., 2024) and life expectancy (Abubakari et al., 2019; Gunu, 2022). The Demographic & Health survey (DHS, 2023) captures objective information on specific health issues such as HIV and malaria, alongside individuals' BMI to evaluate general health. Mental health can be captured objectively through medication prescriptions within contexts with established services and monitoring – for example the Small Area Mental Health Index in the UK (PLDR, 2024). In contexts such as Ghana, research often uses subjective proxies. For example, Sipsma et al. (2013) estimated mental health outcomes using the Kessler Psychological Distress Scale.
Employment	The employment rate is a common measure of OWB, often linked to political, societal and economic stability (Voukelatou et al., 2020). SDG8 captures the importance of sustainable and decent work for all (UN, 2022).
Asset wealth	The DHS (2023) creates a wealth quintile based on the ownership of various assets such as; TVs, cars, quality housing materials, sanitation and water facilities. A study by Hillesland (2019) also used individual-level asset data from The Gender Asset Gap Project to explore gendered differences in ownership of assets such as land and livestock in Ghana.

Traditionally, OWB is defined economically (Kingdon & Knight, 2006). For example, SDG1 measures “eradicate extreme poverty” through the proportion of people with <\$1.25/day (UN, 2022). This neoclassical approach is situated within utility theory, where financial capital is interpreted as a universal right, permitting individuals to act with freedom in a capitalist society (van Parijs, 1992), and satisfy their needs by consuming goods/services (Rasool et al., 2011).

OWB can alternatively be captured through “objective-list” basic needs approaches (Dolan & White, 2007). Basic needs vary spatiotemporally, ranging from “survival”, with access to

food/water, to “productive survival” with employment, education and political opportunities (Streeten & Burki, 1978); reflecting the “universality” challenge (Figure 2.1). For example, different environments can produce different needs. Flood-impacted communities may incorporate “quality housing” as a core need due to inundation threats, whereas drought-impacted villages may include “irrigation” (Williams, 2021).

Multiple international agencies monitor policy through basic needs measures. For example, the UNDP Human Development Index and OECD (2022) Better Life index include health, employment, socioeconomic development, environment, safety, and political participation (Voukelatou et al., 2021). Basic needs measures are an “Objective-List” approach, yet different theories can overlap (Table 2.1). For example, financial OWB sits under “Desire-Fulfilment”, where financial capital is an end and means to fulfilling human desires, *and* “Objective-List”, where poverty thresholds are constructed based on the costs required for basic living standards (Schleicher et al., 2018a). The next section evaluates the methodological advantages/disadvantages of OWB measurements.

2.2.2.1 *OWB: General evaluation*

This section explores overarching advantages/disadvantages of OWB measurement, drawing on financial and “basic needs” approaches. Sections (3.3.2 & 3.3.4) present specific challenges within environmentally vulnerable LMICs.

Financial OWB is unidimensional, meaning unquantifiable, non-market components are excluded (Ravallion, 2014). This approach can produce bias if the relative value of financial capital differs across socioecological groups (Kofinti & Annim, 2016). For example, poorer populations may value improved health and education over private incomes (Arndt et al., 2016; Dowling & Yap 2012) due to limited public service accessibility, and the threats to survival from climatic, social (i.e., civil unrest) or health shocks (Haq, 2015). These findings oppose utility theory, with Sen (1999) claiming wellbeing outcomes are constructed within social interactions, not markets. Furthermore, if public services are prioritised, this suggests basic needs approaches may more accurately mirror LMIC communities’ desired outcomes (Dolan & White, 2007). In contrast, a sole focus on financial OWB can oppose communities’ goals. For instance, increased cash cropping could boost incomes, yet detriment health if favoured over subsistence agriculture during climate-induced scarcity.

Context-specific poverty lines can mitigate the “universality” challenge (Figure 2.1) (Falkingham & Namazie, 2002). For example, Ghanaian Statistical Service (GSS, 2018) produces two national-specific thresholds; extreme (minimum food requirements) and upper poverty (food

and essential non-food items). By incorporating estimated costs of different objective requirements, these poverty measures arguably capture multidimensional wellbeing (Ravallion, 2014). However, financial requirements can differ across small scales; for example, lower seasonal crop yields increasing relative food costs for net-importing communities. Therefore, national poverty lines are not “one size fits all” (Davis, 2014;25). However, some economists argue that without an observable metric which captures how different individuals/groups value different wellbeing components, an easy-to-collect, single proxy, such as income, is required (Stiglitz et al., 2009).

Nevertheless, poverty lines are theoretically questioned as “no theory...clearly differentiates the poor from the non-poor” (Laderchi et al., 2003;249). Binary measures simplify statistical analysis and targeted policy interventions, yet artificially compartmentalise a dynamic spectrum. This limitation is pronounced in vulnerable LMICs due to the risk of falling into poverty following climatic or health shocks (Davis, 2014), yet binary measures do not capture poverty risk over “time”; a key measurement challenge (Figure 2.1). Additional measures can mitigate this challenge, for example “poverty depth/severity” calculate how “far away” households are from poverty (Atkinson, 2019).

Another limitation of financial OWB, based on Sen’s capabilities approach, is that money is a means, not an end, of wellbeing. Money represents “potential wellbeing”, yet skills, rights and institutional support are required to translate “potential” into “realised” wellbeing (Gasper, 2007). However, research often favours "potential" measures due to easier data collection (Donaldson et al., 2013). The potential/realised dichotomy is illustrated by multiple studies suggesting a disassociation between economic and social development (Chamboko et al., 2017; Noble et al., 2014; Vollmer et al., 2014). For example, Ghanaian GDP boomed this century (World Bank, 2021a); yet, unemployment and poor water access remain (Adams et al., 2016; Addai et al., 2014a). Climate hazards may deepen this divide; for example, flooding can restrict “realised” wellbeing by damaging healthcare infrastructure, regardless of “potential” wellbeing. Therefore, basic needs approaches capturing broader OWB elements, such as healthcare access, may better represent “realised” wellbeing by disassociating outcomes from financial wealth (Sen, 2005). Additionally, financial measures, such as income, are not universally applicable (i.e., retirees), whereas basic needs approaches capture everyone’s wellbeing, not just the economically active (Streeten, 1979).

However, despite limitations, financial OWB remains an important measure, as financial capital is vital in accessing broader OWB, such as health and food security (Adjei & Kyei, 2013; Boyce et al., 2009; Braimah & Oduro-Ofori, 2005; Gennetian et al., 2010). These relationships led to the phrase “wealthier is healthier” (Pritchett & Summers, 1993); supporting economists’ arguments

that financial OWB incorporates multidimensional information (OECD, 2013; Voukelatou et al., 2021).

Relative financial poverty measures also provide valuable information on social exclusion and inequality (Davidson & Carr, 2010). Understanding inequality is crucial as it can influence SWB (section 2.2.3) and reinforce low OWB; for example by encouraging overexploitation (Adger et al. 2002) and increasing relative costs for natural resources, such as water, amongst poor households (Kangmennaang et al., 2019). Therefore, financial OWB should be included alongside other wellbeing measures within sustainability research to capture communities' "comprehensive" wellbeing, and identify areas of low wellbeing that are unaligned with unidimensional financial measures.

When measuring OWB using a "basic needs" approach, it is preferential for communities, rather than external researchers, to define their own needs (Decancq, 2013). Nevertheless, objective-lists are presented in the literature, with Alkire & Foster (2011) claiming strong normative arguments for including certain needs is valid justification. Using predetermined lists ensures research focuses on improving "normative ideals of...society" (Diener & Suh, 1997;194), and minimises the influence of individuals' assumptions. Streeten (1984) proposed five universal needs; nutrition, education, health, shelter and sanitation. Other needs have been presented, with the International Labour Organisation (ILO) incorporating "employment", Tay & Diener (2011) proposing "social support", "respect", and "autonomy", and Böhnke & Kohler (2010) including "leisure time" and "media access" from a HIC perspective. These differences highlight how objective goals should be framed within the social contexts they are created within (Fleuret & Atkinson, 2007).

2.2.3 Subjective wellbeing

Despite the greater availability of objective data, there is a growing presence of "people-centred" approaches within wellbeing research and policy (Diener & Biswas-Diener, 2002). SWB captures individuals' internal assessments, cognitive judgments and affective reactions, with outcomes generated from (i) "affects"; emotions and moods, (ii) "thoughts"; individuals' life evaluations in relation to socially-constructed expectations and aspirations (Veenhoven, 2009). There is no consensus on defining SWB (Vladisavljević & Mentus, 2019), with theories situated across three broad, yet not mutually exclusive, categories (Table 2.3). For example, "eudaimonism" and "experience" commonly correlate (Fadiji et al., 2021), as autonomy, an innate positive, enables individuals to act in a way that maximises positive emotions (Lent, 2004; Seligman, 2002).

Table 2.3 Different conceptual theories of subjective wellbeing, defined by Dolan et al. (2011)

Theory	Description
Evaluation	• Focused on general assessments of “life overall” or different life domains such as health, job security and education. • Most common approach in social research/policy.
Experience	• Measures the balance of positive and negative emotions. • Represents a Hedonistic approach (Schleicher et al., 2018a).
Eudaimonic	• Inherent psychological positives that all individuals strive towards to give their life meaning (Addai et al., 2014a). • Non-substitutable elements important to individuals’ identities and livelihoods (Schaafsma, 2021). • Wellbeing may not necessarily result from pleasure, rather wellbeing is achieved by acting virtuously and growing as a human (Ayerakwa et al., 2015).

Different theories exist regarding eudaimonic SWB; for example, Jax et al. (2018) suggest “caring for nature” is an absolute positive, whereas Deci & Ryan (2012) record three universal elements; autonomy, relatedness (social connection), and competence (mastery of skills/environment). The latter two are particularly important within collective agricultural communities (Markussen et al., 2018). Within the context of Sub-Saharan Africa (SSA), “autonomy” refers to “freedom of choice”, not “independence”, as “relational morals” mean social interactions and mutual dependence can improve community wellbeing (Metz, 2012).

However, elements of SWB may differ across space between individualistic and collective communities. For example, Cooke et al. (2016) claim “family/community functioning” is often excluded from SWB measures within Western, individualistic contexts, whereas in rural Ghana, SWB is commonly defined through personal connections, community functioning (Dzokoto et al., 2019) and reciprocal family relationships (Tsai & Dzorgbo, 2012). However, a hard distinction between collectivism/individualism may not exist within environments experiencing temporally variable challenges and aspirations (White, 2016). Nevertheless, this study references collective/individualistic differences when comparing wellbeing conceptualisations across rural/urban landscapes.

“Happiness” and “life satisfaction” are commonly used interchangeably when defining SWB; however, Kahneman & Deaton, (2010) note a distinction between everyday happiness, driven by emotions, and longer-term satisfaction, incorporating thoughts around one’s life. Nevertheless, Cooke et al. (2016) claim the terms are indistinguishable, and using a single term minimises confusion. Therefore, this study uses “happiness” throughout (see section 3.7.4). See Table 2.4 for examples of how SWB is measured in the literature. Whilst acknowledging the wide range of

available OWB and SWB measures, this study is restricted by the data available in the DECCMA survey (section 3.6).

Table 2.4 Examples of SWB measures from the literature. Note, based on the data available in the DECCMA survey, only measures relating to happiness and subjective poverty are captured in this thesis

SWB concept	Measures & References
Happiness	The World Happiness Report uses the Cantril Ladder to evaluate happiness (Helliwell et al., 2024). The Cantril Ladder asks respondents to evaluate their current life as a whole using the image of a ladder, with the best possible life for them as a 10 and worst possible as a 0.
Life satisfaction (hedonic)	Diener et al.'s (1985) Satisfaction with life scale. A 5-item measure capturing hedonic elements such as: "the conditions of my life are excellent" and "in most ways my life is close to ideal". The scale is used in an exploratory study in Ghana by Fadiji et al. (2021).
Psychological wellbeing (eudaimonic)	Ryff & Singer's (1996) measure of eudaimonic psychological wellbeing consists of six elements; autonomy, environmental mastery, personal growth, positive relations with others, purpose in life, self-acceptance.
Positive & Negative Experiences (hedonic)	Diener et al.'s (2009) Scale of Positive and Negative Experience (SPANE) captures the balance between positive (positive, good, pleasant, happy, joyful, contented) and negative (negative, bad, unpleasant, sad, afraid, angry) feelings.
Subjective poverty	Respondents are asked to self-report their perceived financial status. This could be captured by asking individuals to rate their situation on a Likert scale, or report the minimum income required to make ends meet (Mahmood et al., 2019).
Meaning in Life	Steger et al.'s (2006) Meaning in Life measure is a 10-item scale designed to capture elements of eudaimonic wellbeing, including the presence of meaning and search for meaning. Fadiji et al. (2021) illustrated meaning in life to be higher than life satisfaction amongst Ghanaians with lower objective living standards.

Multiple studies have explored determinants of happiness. For instance, Frey & Stutzer (2010) propose five quantifiable factors; personality (i.e., extraversion) (Steel et al., 2008; Weiss et al., 2008), socio-demographic (i.e., age (Blanchflower, 2021), marital status (Crowley, 1998) and ethnicity (Addai et al., 2014a)), economic (i.e., income), contextual (i.e., health), and institutional (i.e., political participation). SWB research is therefore not entirely devoid of objective/financial concepts; for example, subjective poverty research (Marks, 2007; Wang et al., 2020) captures individuals' perceived financial status rather than using pre-determined thresholds (Mahmood et al., 2019).

Individuals' perceptions of inequality (Sulemana, 2016), and relative comparisons to reference points, including neighbours, past time periods or social expectations, are also key SWB determinants (Addai et al., 2014a; Akay & Martinsson, 2011; Kangmennaang et al., 2019; Reyes-García et al., 2016; Ravallion, 2014; Tibesigwa et al., 2016). Temporal comparisons to the past, and future expectations, are hypothesised to be important factors within uncertain environments where changing climates continuously alter natural resource access and material/financial wealth⁴, with “happiness...not the result of being rich, but a temporary consequence of...becoming richer” (Inglehart, 1990;212). Perceived inequalities can also feedback to influence environmental conditions by reducing environmental awareness and promoting overexploitation in an attempt to reach “better-off” reference points (Navarro, 2017), reinforcing existing inequalities and lowering long-term SWB (Boyce, 1994; Dewu & Røskaft, 2018; Khan et al., 2022; Pata et al., 2022).

The impact of relative comparisons upon SWB is hypothesised to be greater in areas, like Ghana, where rapid economic development (Lloyd, 2018) has led to an increasing proximity of rich/poor communities (Box 2.1). Furthermore, inequalities can increase during climatic hazards due to varying levels of exposure, sensitivity and adaptive capacity (Adger et al., 2002). Visibility of unobtainable wealth lowers SWB by creating a perceived inadequacy (Hirata, 2001) and damaging one's public status (Schneider, 2016); important components of a Ghanaian “good life” (Dzokoto et al., 2019). Furthermore, Wilkinson & Pritchett (2011) argue financial inequality plays a more crucial role in determining poor SWB and health outcomes than absolute income, due to the stress and anxiety individuals experience regarding their societal standing; pronounced in regions with well-defined hierarchies. These relationships draw on Sen's (1999) capabilities approach, where wellbeing is not linked to “what you have”, but rather “what you can do with it”; therefore, inequality may restrict individuals from acting freely to achieve a flourishing life (Marmot, 2013). For example, inequality, defined by Alesina et al. (2004) as “a social evil”, can limit happiness within collective communities by disrupting social cohesion (Schneider, 2016) and generating feelings of shame (Backlund et al., 1999; Kangmennaang et al., 2019). Despite LMIC communities often prioritising objective basic needs (Nanor et al., 2021), studies suggest these non-tangible, post-material elements remain important SWB determinants (Ng & Diener, 2014).

⁴ Nevertheless, without longitudinal data the ability to understand changes in wellbeing, and environmental vulnerability, across time is limited (Addison et al. 2008).

Box 2.1. Increasing inequality within Ghana (Male participant, Northern Ghana)

“You find some of the best cars in the world on the street of Accra and you also find all these slum areas where poor people live and begin to wonder whether some of us are human.”

(Kangmennaang et al., 2019, p.6)

However, the impact of relative comparability is not universally negative (Berg & Veenhoven, 2010; Rözer & Kraaykamp, 2013). Inequality may increase SWB in certain contexts by highlighting the potential for future upward mobility (Reyes-García et al., 2016; Senik, 2004), generating optimism that better-off households will provide support during hardships, or producing altruistic responses to others’ success (Atsebi & Ferrer-i-Carbonell, 2022; Kingdon & Knight, 2007). The positive/negative response may depend upon communities’ development, with Hirschman’s (1973) “tunnel effect” suggesting inequality reflects “opportunity” at the start of economic growth, and “injustice” within HICs. In contrast, others state inequality unanimously lowers SWB during growth due to fears of being “left behind by those who climb the social ladder” (Schneider, 2016;6).

2.2.3.1 SWB: General evaluation

This section explores the overarching advantages/disadvantages of SWB measurement. Sections (3.4.1 & 3.5.2) present methodological and policy-related challenges specific to environmentally vulnerable LMICs.

In contrast to unidimensional financial measures, SWB captures wide-ranging information, including emotions towards health, future opportunities and material assets (Marks, 2007; Narayan & Petesch, 2002; Ravallion & Lokshin, 2002; Wang et al., 2020); addressing the “multidimensionality” challenge (Figure 2.1). Therefore, SWB arguably better captures the complexity of wellbeing; however, this can restrict policymakers from pinpointing specific needs (section 3.5.2.2). Nevertheless, Flik and van Praag (1991) state “individuals themselves are the best judges of their own situation” (p.313), therefore SWB measures minimise the influence of external assumptions, and provide more accurate, context-specific understandings (Nunan, 2015). SWB research also facilitates mutual learning (Cornwall, 2002) and ensures the poverty discourse is not controlled by the non-poor (Narayan & Petesch, 2002); partly opposing criticisms that wellbeing research is rooted within individualistic, Western spheres (Osei-Tutu et al., 2020).

Despite SWB capturing a wealth of information, limitations exist. Firstly, despite Ghanaians typically comparing themselves within communities/administrative units, as resources are allocated at these levels following national decentralisation (Owusu, 2005), individuals' reference points will differ depending on information access (Ballas et al., 2007). For example, remote households may be isolated from higher living standards, whereas media access in urbanised areas can create global reference points (Ng & Diener, 2014). Inconsistent reference points and “scale heterogeneity” (Ravallion, 2015), meaning respondents may interpret SWB differently from one another and the researchers (White, 2014), can limit comparability across households and prevent SWB measures from guiding broad policies (section 3.5.2.2). For example, Hirons et al. (2018) suggest Ghanaians interpret “subjective poverty” differently depending on their income quintile. However, Dasgupta (2022) argues “happiness” is a universally understood human emotion, ensuring comparability across SWB measures (Diener & Suh, 1997). Nonetheless, without calibration questions this potential comparability issue is unavoidable (Benjamin, 2023); therefore, individuals must be interpreted as “experts” on their own SWB (Lent, 2004).

SWB is also criticised for being abstract (Dolan & White, 2007), with no natural scale preventing meaningful differences from being quantified (Ahmed, 2013). Furthermore, Kabote (2017) claims the inconsistency and impermanence of SWB limits its validity. For example, “set point theory” claims SWB temporarily alters from a baseline level controlled by personality⁵ and contextual factors (Dowling & Yap, 2012; Tibesigwa et al., 2016), therefore not reflecting a “stable inner state of wellbeing” but rather “judgements...formed on the spot” (Schwarz & Strack, 1999;61). However, others criticise “set point theory” for being overly-deterministic and disregarding how individuals experience long-term, substantial shifts in SWB (Veenhoven, 1993). For example, Luechinger & Raschky (2009) showed flooding to permanently reduce European communities' SWB. Furthermore, if SWB survey questions are not temporally framed, response volatility can be minimised. For example, “general” happiness is more stable than happiness “last week”, due to the latter's sensitivity to one-off, responsive events (Lent, 2004).

Lastly, SWB can be influenced by different biases (Figure 2.2). Studies suggest bias increases when the domain is more proximate to the individual. Therefore, happiness with one's personal finances may contain greater bias than happiness with broader environmental conditions (Cummins et al., 2003). Nevertheless, biases are inevitable when SWB is captured retrospectively, a common approach in social research due to the cost and practical constraints associated with measuring “in-the-moment” wellbeing (Durayappah, 2011;

⁵ This study controls for household head personality by incorporating a clustered index within regression analysis.

Helliwell, 2008; Kahneman, 1999). The next section provides an overview of OWB and SWB in Ghana and Volta Delta.

Positivity bias	• Focus on current areas of high satisfaction and ignore detrimental emotions (Dolan & White, 2007; Dowling & Yap, 2012). • Undervalue past happiness and exaggerate current happiness by using lower reference points (Bjørnsen, 2005; Gough & McGregor, 2007). • Tendency to define oneself as superior to others (Cummins et al., 2003).
Cognitive bias	• Decisions are made from a simple set of factors without full consideration of all the components which impact wellbeing (Dowling & Yap, 2012).
Temporal bias	• Focus on the result rather than the emotions felt during the process (Dowling & Yap, 2012).
Perceived utility bias	• Attach positive emotions towards normality and negative emotions towards unpredictable, unknown events (such as climatic risks, or previously unexperienced environmental conditions) (Durayappah, 2011).
Modesty bias	• Different cultures over/understate happiness based on social norms and cultural expectations, for example understating is common in East Asian cultures, whilst overstating is common in the US (Gough & McGregor, 2007; Lent, 2004; Sachs, 2022).
Social desirability bias	• Excluding stigmatised incidents or emotions, particularly in face-to-face interviews (Conti & Pudney, 2011; Ravallion, 2014).

Figure 2.2 Examples of biases which may arise when measuring subjective wellbeing in surveys

2.2.4 Wellbeing in Ghana and Volta Delta

2.2.4.1 Objective wellbeing

Ghana is referred to as World Bank's "star pupil" (Crawford & Abdulai, 2009) due to absolute income poverty⁶ reducing >50% 1991-2012 (47.4% to 13.6%) to below the global LMIC rate

⁶ Measured against the original global poverty line (<\$1.90/day/capita)

(World Bank, 2020). Yet, using the Ghana-specific poverty line, national rates were higher; 24.2% (2012) and 23.4% (2017) (GSS, 2018).

However, despite poverty reductions and GDP growth, inequality and poverty severity⁷ increased (2012-16); suggesting comparatively lower improvements amongst poorer households. Furthermore, improvements in objective basic needs, such as increased protected water and electricity access (1991-2016), were not holistic, as 2/3 “poor” households remain without safe latrines. Additionally, despite good education access in Ghana (11.6 expected school years) compared to SSA (8.1 years) and LMICs (10.4 years), lower World Bank (2020) Human Capital Project test scores suggest poorer education quality.

Spatial differences in financial OWB also exist (Figure 2.3), with 80% income poverty, using the GSS upper poverty line, existing in rural areas, despite containing only 50% population (GSS, 2018). Regional rates (2016/17) ranged from 70.9% in Upper West to 2.5% in Greater Accra (Figure 2.4). The highest poverty rates and severity exist in northern Ghana; attributed to unfavourable climates, high net emigration and political isolation (Al-Hassan & Diao, 2007; Awanyo & Attua, 2018). However, southern Volta Region is an exception to this pattern.

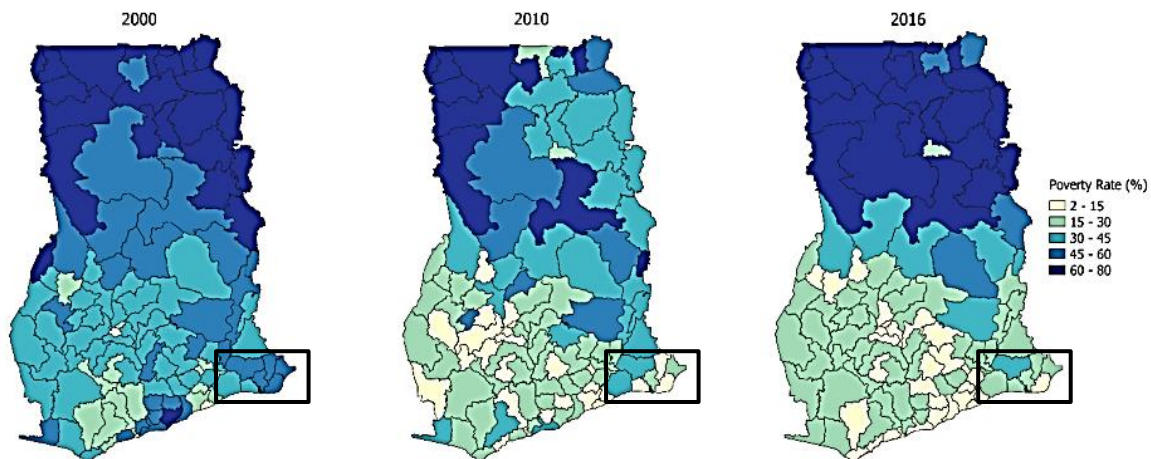


Figure 2.3 Upper poverty rates by district in Ghana. Sourced from World Bank (2020, p.48), using GSS (2018) regional estimates. The approximate location of Volta Delta is displayed

⁷ Poverty severity squares the average gap between impoverished households' income/expenditure and the poverty line (poverty depth), as a proportion of the poverty line; placing a greater weight on households further from escaping poverty (Foster et al., 2010).

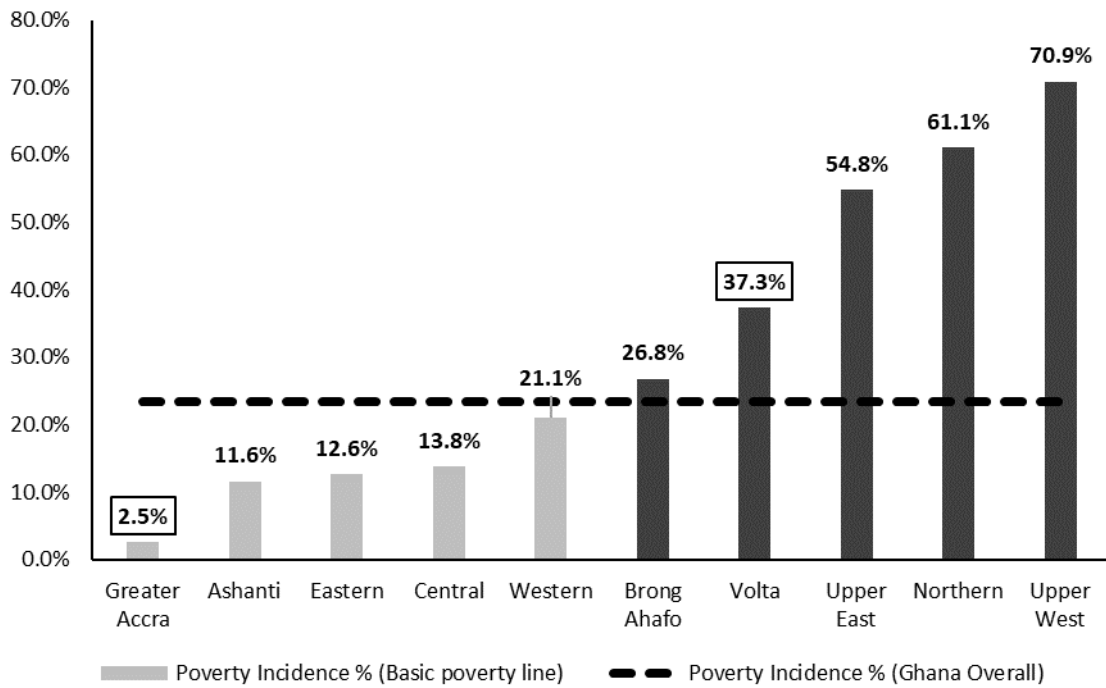


Figure 2.4 Upper poverty rates by region in Ghana (2016/17). National average presented for comparison (GSS, 2018)

Volta Delta is contained within Greater Accra and Volta regions (Figure 1.2). Volta is one of five regions with an increasing (2012-16) extreme poverty rate (11.4%) higher than the national average (8.2%) (GSS, 2018). In contrast, Greater Accra had the lowest extreme poverty rate (0.0%) in 2016/17⁸. Similar trends are recorded for poverty severity, with rates increasing in Volta beyond the national average, whilst Greater Accra levels reduced (Table 2.5). Increasing poverty in Volta is not driven by inequality in capital distribution, which reduced 2012-16, but rather low economic growth. In contrast, inequality reduced and consumption increased in Greater Accra (World Bank, 2020).

⁸ Note: the survey dataset used in this research does not contain households within Accra City. The capital city heavily contributes towards the lower poverty rates within Greater Accra Region (World Bank, 2020).

Table 2.5 Poverty gap index and poverty severity by region in Ghana (2016/17, and 2012-2016 absolute change). National average recorded for comparison

Region	Poverty Gap index	Poverty gap change (2012-16)	Poverty severity index	Poverty severity change (2012-16)
Greater Accra	0.5	-1.1	0.1	-0.5
Ashanti	2.7	-0.8	1.0	-0.3
Eastern	3.1	-2.7	1.2	-1.2
Central	3.6	-2.0	1.3	-1.2
Western	4.9	-0.8	1.7	-0.6
Brong Ahafo	8.8	+1.4	4.2	+1.3
Volta	13.0	+3.2	6.4	+2.4
Upper East	23.8	+6.6	13.2	+4.2
Northern	26.7	+7.4	14.9	+5.1
Upper West	37.6	+4.4	24.6	+5.8
Ghana (overall)	8.4	+0.6	4.3	+0.7

GSS (2020) Living Standards Survey (2011-18) also reports basic needs OWB; including 7 living standard, 3 education and 2 health indicators (Appendix 2.1). 45.6% households were defined as multidimensionally deprived⁹; the most frequent deprivations being “safe latrines” and “health insurance”. Again, regional variation existed, with 58.2% deprived in Volta and 22.5% in Greater Accra. Similarly, Volta is one of four regions with a rate higher than the national average; driven by low health insurance, poor nutrition, unsafe latrines and poor school attendance/attainment. In contrast, Greater Accra had the lowest regional deprivation rate, with comparatively higher proportions of adequate housing, clean water and electricity/cooking fuel. See Appendix (2.2) for further regional differences.

The capacity for different OWB measures to capture varying wellbeing elements is highlighted by multidimensional deprivation being double income poverty (46% v 23%) (GSS, 2020). This difference could reflect the potential/realised wellbeing dichotomy, where financial OWB may

⁹ Each indicator group was weighted equally (“nested” weighting). A household had to experience 1/3 of weighted deprivation indicators to be classified as multidimensionally deprived.

not translate into basic needs due to insufficient capabilities (Sen, 2005). Nevertheless, 19% national households were multidimensionally deprived *and* impoverished; 30% in Volta and $\approx$ 2% in Greater Accra.

2.2.4.2 *Historical influences on OWB*

To understand regional OWB differences, an overview of past governance and investment patterns is required. During pre-colonial periods, resources and populations flowed towards the North Africa trade routes (Kambala, 2023). In contrast, the modern-day North-South divide (Figure 2.3) traces back to British colonial (1821-1957) investment, with the south favoured due to its less-arid environment being suitable for cash crop cultivation, greater mineral resources and access to maritime trade routes (Dickson, 1968; Shaffer, 2017).

The perception of limited economic potential in the north reduced public investment, illustrated by the North having 8 schools and 6 hospitals (1931), compared to 325 and 24 in the south (Kambala, 2023). Railways and class one roads¹⁰ were also exclusively in coastal and Ashanti regions, yet southeast Ghana was excluded (Figure 2.5). Transport infrastructure attracted labour from within and outside Ghana, lowered transportation costs, and encouraged human capital investment. Kambala (2023) outlines potential reasons for the persistence of the North-South divide today:

- Preference to invest into existing hubs (i.e., cheaper and easier to expand current railway networks than build new infrastructure)
- Political stability created by colonial developments provide more suitable investment environments
- Colonial investment in human capital and infrastructure, such as schools, created a competitive advantage over other areas
- Infrastructure, including roads, have long lifespans; therefore, previous benefits have persisted into post-colonial periods

¹⁰ Highest quality roads which are paved and capable of being used all year round (Fafchamps & Shilpi, 2021).

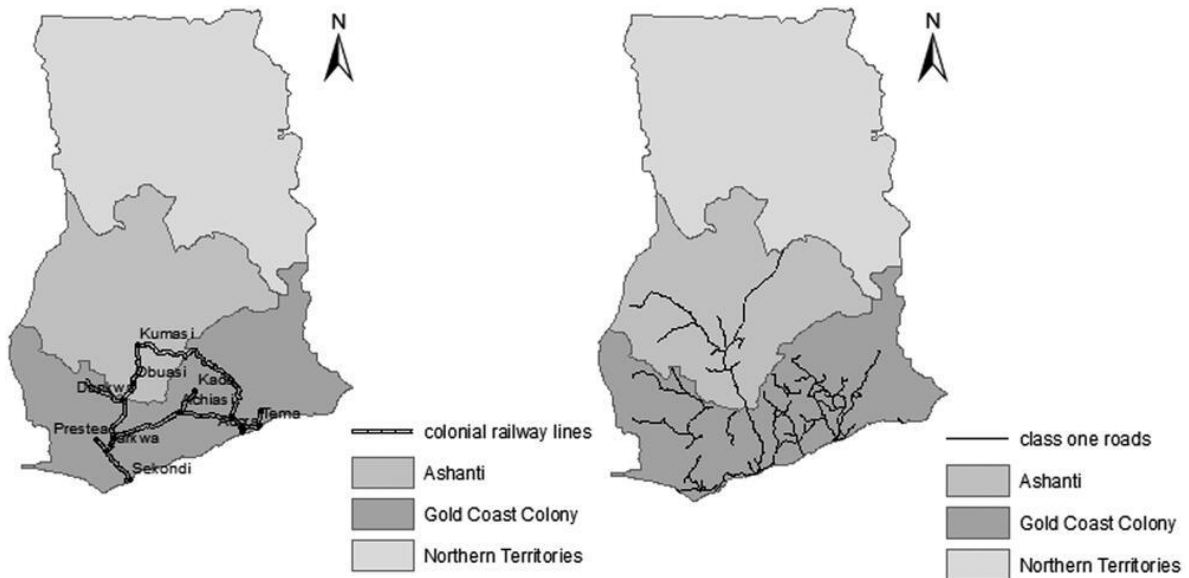


Figure 2.5 Colonial railway lines (left) and class one roads (right) were primarily located in the southern Golden Coast colony, with none in the Northern Territories. Sourced from Kambala (2023, p.195-196)

Structural readjustment policies, “required by the International Monetary Fund, World Bank, and western capitalist aid donors as a condition for financial assistance” (Kraus, 1991;19), introduced in the 1980s, followed similar patterns as colonial investment. Due to this “current policy...allowing market forces to determine prices and allocation of resources” (p.986), the greater natural and physical capital in south Ghana reinforced existing inequalities (Awumbila et al., 2017). The neocolonial influence is further illustrated by early international development agencies employing colonial leaders, maintaining existing market ties, and using similar colonial imaginations to justify market interventions (Craggs, 2014; Goldsmith, 2002).

However, investment in south Ghana was not homogenous, with historic and modern-day disparities between Greater Accra and Volta. Investment flowed into Greater Accra due to the port being central to the cocoa trade; resulting in Accra’s population increasing 722% (1877-1960). Growing populations stimulate human capital improvements and economic activity; illustrated by the distribution of foreign direct investment (FDI). 73% FDI was channelled into Greater Accra, and 1% into Volta (2007-15), with Greater Accra containing capital investment projects totalling US\$3.5 billion in 2013. This disparity has resulted in different regional livelihood strategies and environmental vulnerability, with 70% national manufacturing occurring in Greater Accra, and <1% in Volta (Awanyo & Attua, 2018).

In contrast to Greater Accra, continued agricultural dominance in Volta potentially contributes to its greater multidimensional deprivation (Appendix 2.2). The increasing postcolonial value of exports to the Ghanaian economy, driven by structural readjustment programmes, resulted in “territorial specialization in food crop agriculture [becoming] a disadvantage” (Awanyo & Attua,

2018;186). Due to a minority of the rural poor engaging with exportable products such as cocoa, crude oil and metals (Konadu-Agyemang & Adanu, 2003), and the limited spillover of benefits, such as road infrastructure, from export-focused colonial hubs, inequalities between neighbouring areas have persisted (Roessler et al., 2022).

These broader economic challenges are partnered by Volta's colonial legacy of “unsustainable, environmentally damaging agricultural systems” (Craggs, 2014;8). For example, the British developed chieftaincies to facilitate indirect ownership of large proportions of land, previously owned by clans (Lanz et al., 2018). Replacing traditional land management strategies, perceived as “unsustainable”, with intensive, export-driven practices (Boateng, 2017), potentially still contributes towards environmental vulnerability in agricultural landscapes. Consequently, despite macroscale OWB improvements being recorded after the implementation of structural readjustment programmes (Konadu-Agyemang, 2000), (post)colonial factors potentially uncover why regional and community-level inequalities exist.

2.2.4.3 *Subjective wellbeing*

Localised SWB studies in Volta Delta are unavailable¹¹, yet national-level reports have been published. There is great variability in the recorded SWB levels in Ghana depending on the methodology and survey sample. For example, The World Happiness Report 2024 placed Ghana 120th/146 globally, based on responses to the Cantril ladder question¹² (Helliwell et al., 2024), yet when accounting for life expectancy and the land size required to sustain an average individual's consumption, Ghana placed 100th (Happy Planet Index 2019). Similarly, the Gallup (2014) “State of Global Well-being report” ranked Ghana 136th/155, with particularly low physical and financial wellbeing scores. In contrast, scores from the World Database of Happiness 2003 ranked Ghana 7th for life satisfaction (Veenhoven, 2005), and the World Value Survey 2010, capturing individuals' values and social/political views, positioned Ghana 51st/97 countries (Dzokoto, 2012).

The inconclusive results from these reports highlight the sensitivity of SWB measurement to methodological choices. Furthermore, the premise of comparing “happiness” across countries has limitations, with “happiness” understood differently depending on the economic, social and cultural context. For example, Dzokoto (2012) links reports of high *and* low happiness to specific

¹¹ Duku et al. (2022) potentially incorporate SWB dimensions within their review of human wellbeing in Keta and Anloga regions; however, the outcome variable methodology is unclear.

¹² Rating 0-10 based on their own current life in relation to the worst (0) and best (10) possible life.

Ghanaian tropes. Firstly, lower happiness may result from: (i) a “good life” suppressing negatives, rather than intensifying positives (Dzokoto et al., 2018, Fadiji et al., 2021), (ii) less emphasis placed on one’s own happiness compared to collective wellbeing, (iii) less focus on experiencing and expressing emotions compared to more-individualistic HICs, with “happiness” primarily captured within social interactions and everyday actions.

In contrast, despite economic, environmental, and social challenges, higher reported happiness in Ghana may persist due to:

- Akan cultural teachings showing life to consist of “ups and downs”, minimising negative impacts from difficult life events (Dzokoto et al., 2018, 2019)
- Greater acceptance of external constraints, such as political or spiritual powers, compared to HICs such as USA, where there is a belief of limitless opportunities and agency
- Being tolerant, and finding alternative solutions, when faced with adversity and uncomfortable situations due to “the social reality of little environmental control and slow socioeconomic and infrastructural development” (Dzokoto, 2012;318)
- Laid back sense of time mitigating negative impacts from time pressures
- Lower thresholds for a “good life”, such as the contentment with simply being alive; exemplified by the proverb; “if the head has not fallen off, you keep putting a hat on it” (Dzokoto, 2012)

Therefore, SWB must be explored within the relational context (White, 2016), as contextual differences may explain variations in reported outcomes and influence how policies should be implemented to overcome communities’ broad challenges. The spatial variability of OWB across Ghana, and the context-specific nature of SWB, justify the small-scale focus of this study. Following this review of wellbeing in Ghana, the next section provides a general exploration of how OWB and SWB may interact across different settings.

2.3 Are OWB & SWB related?

By examining complex relationships between OWB and SWB, this section provides contextual information to address RQ1e. This review, and exploratory analysis (section 3.10), are justified by the tendency of traditional environment-wellbeing studies to implicitly assume single measures capture “overall” wellbeing (Barbier & Hochard, 2018; Nanor et al., 2021; Voukelatou et al., 2021).

Böhnke & Kohler (2010) present two theoretical models (Figure 2.6). Firstly, the “objective approach” views SWB and OWB as independent; allowing for opposing outcomes. Secondly, the “subjective approach” claims objective resources influence overall wellbeing, which is reflected in SWB; suggesting OWB/SWB align. Wellbeing is “relational”, meaning it is constructed within a specific time/space (Gough & McGregor, 2007), therefore the OWB/SWB relationship may differ across varying contexts. This study explores “objective” *and* “subjective” approaches to capture different relationships across varying contexts.

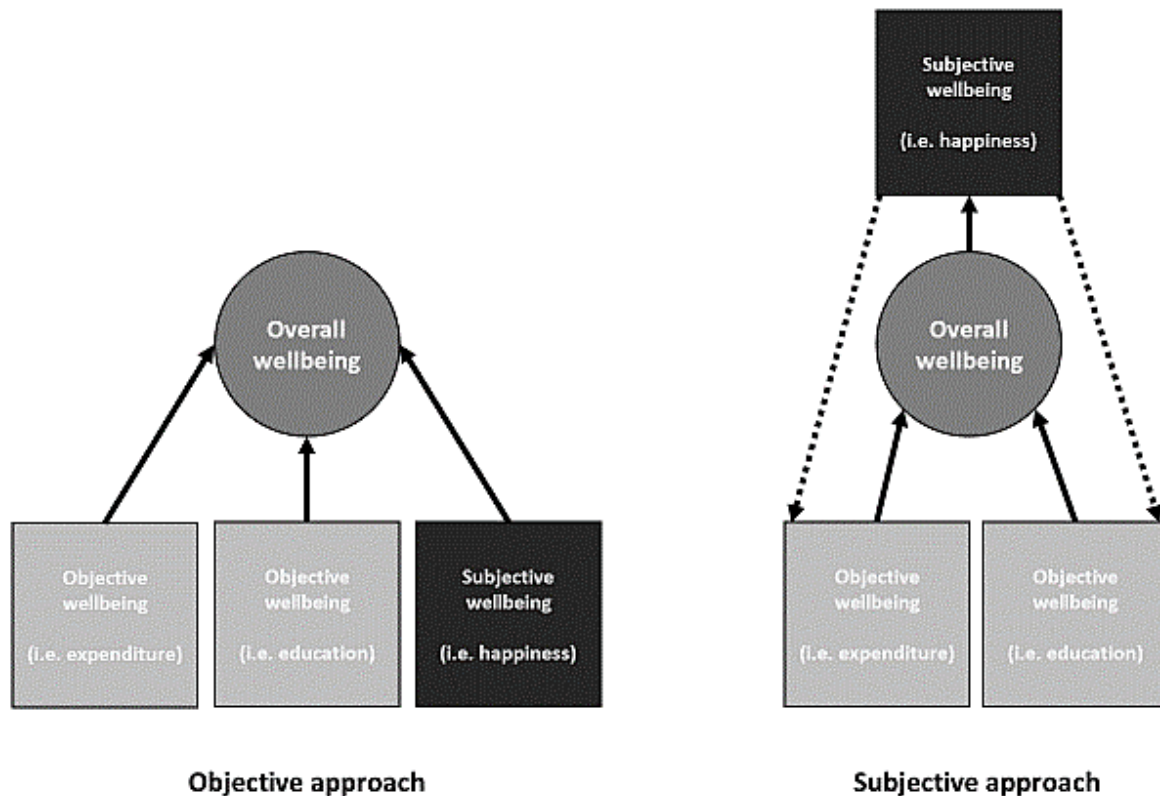


Figure 2.6 Visualisation of Böhnke & Kohler's (2010) objective and subjective approaches to the OWB/SWB association. Dashed arrows incorporated to illustrate the capacity for SWB to also influence OWB outcomes

Contradicting theories across disciplines (Box 2.2) further justify the focus on how OWB/SWB associate within an environmental context; an under-researched topic within sustainability studies. Improved understanding at the local level is required to ensure research and policy comprehensively benefit target communities (Sachs, 2022).

Box 2.2. The debate over whether OWB and SWB are related or not.

“Does money buy happiness? Answers to this question differ, depending, in part, on whether one asks an economist or a psychologist”

(Oswald & Wu, 2009)

2.3.1 Opposing relationship

Many studies illustrate opposing OWB and SWB (Alem et al., 2014; Bradshaw & Finch, 2003; Graham & Pettinato, 2006; Posel & Rogan, 2016; Ravallion et al., 2013; Sacks et al., 2010). This dichotomy features in the eminent Easterlin (1974) Paradox, where national-level economic growth increases short-term happiness, yet has reduced long-term returns due to heightened incomes increasing aspirations and creating constantly repositioning gaps between desires and fulfilment (White, 2016). An inability to reach aspirations is a pivotal SWB determinant (Zhang & Churchill, 2020), particularly within countries experiencing rapid economic growth such as Ghana (Kangmennaang et al., 2019). Therefore, financial OWB may only influence SWB until absolute poverty is avoided (Duku et al., 2022; Dzokoto et al., 2019) and basic needs are consistently met; “once subsistence income is guaranteed, making people happier is not easy” (Layard & Layard 2011;4). From a “happiness economics” perspective, the weak correlation between income and happiness in certain contexts is due to money providing “consumption” and “relational” roles. The former refers to the fulfilment of individuals’ desires, whereas the latter suggests financial capital controls how individuals are relatively positioned in society. If these different roles are unaligned, opposing OWB/SWB could be produced (Clark et al., 2008).

Additionally, financial OWB may only represent “potential” wellbeing (section 2.2.2.1); therefore, without the required skills, institutions and environments, individuals may be unable to translate OWB into SWB. For example, insufficient transport infrastructure could limit healthcare access and happiness, regardless of objective wealth (Addai & Adjei, 2014).

The OWB/SWB relationship may also differ spatially. Well-connected urban populations with greater media exposure and mobility may possess higher material aspirations, and prioritise relative positionality more than remote communities when defining SWB due to greater visibility of higher living standards (Corazzini et al., 2011; Ng & Diener, 2014; Ravallion, 2014). In contrast, rural communities may achieve material needs through non-market channels (i.e., community trading), or target the lower financial levels required to fulfil their non-material needs, including social relationships, cultural identity and purpose (Ward & King, 2016). Different conclusions in the literature regarding whether relative financial/material comparisons

are important SWB determinants in LMICs (Fafchamps & Shilpi, 2008; Guillen-Royo, 2011; Knight et al., 2009; Reyes-García et al., 2016) justify the context-specific focus on Volta Delta.

Furthermore, studies illustrate subjective financial stress to commonly exceed objective rates. One potential reason being external assumptions, such as pre-defined poverty lines (Haughton & Khandker, 2009) are unharmonized with communities' requirements (Datt, 2002). OWB/SWB relationships are also non-linear, therefore low SWB could be experienced across the financial spectrum (Ravallion et al., 2013). For example, objectively non-poor households may encounter subjective financial stress if flooding causes their current situation to be relatively worse-off than before, or compared to neighbours; particularly in societies with unequal adaptive capacities (Haughton & Khandker, 2009). Graham & Pettinato (2006) state that households often use higher reference points when self-defining financial wellbeing, especially when in the middle of the financial distribution. Alternatively, others show historically deprived households to continue to negatively self-evaluate, regardless of OWB improvements (Alem et al., 2014; Biewen, 2009).

OWB/SWB differences could also be determined by survey timing. For example, households experiencing increased seasonality may not immediately experience objective poverty, yet fears of future financial insecurity could induce financial stress (Bradshaw & Finch, 2003). Certain SWB measurements may also be sensitive to shifts in respondents' mood, potentially creating differing OWB/SWB across time (Ravallion, 2014).

Different measure dimensionalities could also produce different outcomes. Financial OWB is unidimensional, whereas SWB is multidimensional, including feelings around current/past expenditure, future opportunities, employment and health (Posel & Rogan, 2016). These differences highlight how research incorporating OWB *and* SWB is required to comprehensively understand environment-wellbeing relationships.

2.3.2 Aligning relationship

In contrast, studies also illustrate aligning OWB/SWB (Addai et al., 2014a; Brown et al., 2021; Gyampoh et al., 2009; Helliwell, 2008; Kangmennaang & Elliott, 2019; Miñarro et al., 2022; Pollnac & Poggie, 2008). For instance, Ravallion (2015) suggests underlying personality traits can increase happiness, and thereby economic productivity. However, this relationship can be bidirectional, as objective resources shape individuals' perceived SWB (White, 2010), whilst subjective emotions and social expectations may also impact which objective resources are strived for (Appadurai, 2004).

Dunn et al. (2011) state “money can buy many...if not all...the things that make people happy” (p.123), with utility theory suggesting wealthier people are happier because they can satisfy more of their preferences (White, 2016). Reyes-Garcia et al. (2016) illustrate absolute income to significantly increase happiness amongst rural African households, and Van der Geest (1997) defines money as a prerequisite for happiness in rural Ghana by facilitating access to domestic care. Furthermore, Dzokoto et al. (2019) refer to money as a “social glue”, forging “kin relations even where there are no blood ties” (p.13); potentially heightening SWB by improving eudaimonic “relatedness”. In contrast, households with high financial OWB, yet low SWB, are potentially “using it the wrong way” by prioritising material success over intrinsic goals such as social relationships (Ward & King, 2016).

Studies also suggest financial/material OWB can boost SWB by stimulating self-growth (Osei-Tutu et al., 2020), improving social status, autonomy and freedoms, facilitating “things of intrinsic worth” (Gasper, 2007; Sen, 1983), and aiding adaptation and recovery from climate hazards (Markussen et al., 2018; Tay et al., 2018). Furthermore, objective basic needs are often encapsulated in SWB evaluations within LMICs where many experience multidimensional deprivation (Layard & Layard, 2011); see Figure 2.7. For instance, good-quality housing may increase happiness by providing a secure space for valuable family relationships (White, 2016).

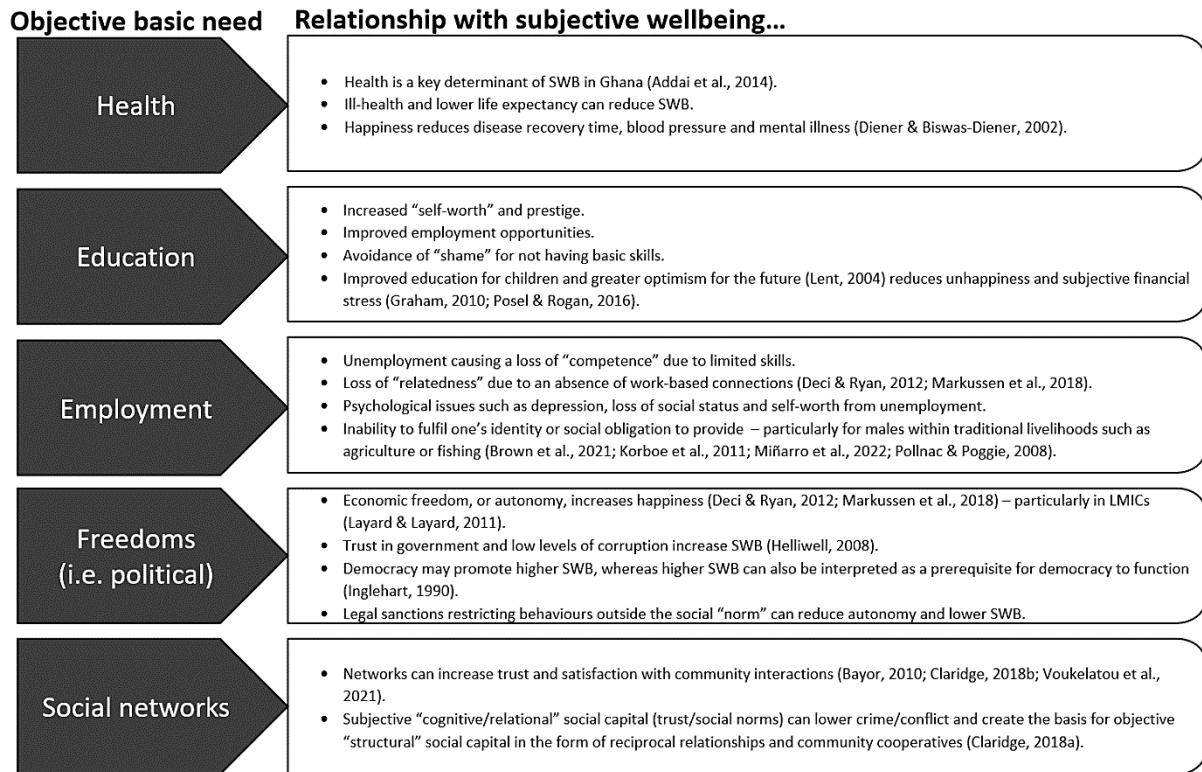


Figure 2.7 Examples of the interrelationship between objective basic needs and SWB, based on Dowling & Yap (2012)

Existing studies support aligning *and* opposing OWB/SWB relationships within LMICs. Regardless of the relationship, incorporating different wellbeing measures can mitigate individual limitations, improve research validity and support “comprehensive” wellbeing policy (Sacks et al., 2010; White, 2016). For example, if policy positively associates with OWB *and* SWB, the evidence supporting its success is strengthened. Both wellbeing concepts also intertwine with various environmental conditions in Volta Delta and Ghana; outlined by the environment-wellbeing nexus.

2.4 Environment & Wellbeing

2.4.1 Environment-wellbeing nexus

The environment-wellbeing nexus acknowledges the interconnectivity between human and environmental wellbeing. Firstly, “downward spiral” theory suggests an inevitable causal link (Reardon & Vosti, 1995); for example, Jehan & Umana (2003) state low OWB promotes land degradation, and encourages economic growth and basic needs provision to be prioritised over environmental protection. This hypothesis was exemplified in eastern China where intensified

agricultural practices were introduced as a poverty alleviation strategy, yet resulted in biodiversity loss, water pollution and soil instability (Zhang et al., 2015). Deprived individuals are also more likely to risk living in unfavourable environments (Navarro, 2017).

Nevertheless, this theory is overly-deterministic, with complex and multidirectional associations preventing causal relationships from being defined (Heger et al., 2018). The “vicious circle” concept suggests poor households cause environmental deterioration, yet despite some local actions such as groundwater extraction exacerbating flooding, global actions primarily produce environmental hazards (Szabo et al., 2016b). Furthermore, other studies suggest wealthier farmers contribute more to degradation due to higher fertiliser use and more-intensive farming practices (Bhattacharya & Innes, 2013). “Downward spiral” theory aligns with “time preference” theory, where poor communities prioritise short-term survival over future sustainability. However, this is disputed, with SSA communities shown to reduce current food consumption to preserve resources for following years (Gray & Moseley, 2005).

Less-deterministic environment-wellbeing theories are also proposed. For example, Porter Hypothesis suggests economic prosperity and environmental protection are compatible (Mol & Spaargaren, 2000). The environment should be protected for its intrinsic value, and to stimulate innovative, efficient solutions (Jehan & Umana, 2003). This hypothesis is arguably less applicable to rural LMICs where access to the resources required for innovation is limited (Arthur & Turkson, 2021). Nevertheless, it highlights how environment-wellbeing relationships are not necessarily negative.

This study acknowledges the multiple feedback effects within the environment-wellbeing nexus, and how “environment” is one of many contextual factors potentially influencing individuals’ wellbeing (Scott, 2006). Quantitative analysis controls for these broader effects (Chapter 4); however, this study specifically focuses on environmental impacts on wellbeing.

The nexus’ complexity emphasises the importance of using conceptual frameworks to guide research, and to ensure interrelations between environment and different elements of wellbeing are acknowledged.

2.4.2 Environment-wellbeing frameworks

A framework is a “tool for analysis” (Nunan, 2015;21) which structures ideas to help conceptualise complex systems through dynamic interrelations between scales, processes and actors, whilst giving meaning to abstract, data-driven metrics (Vazonienė, 2014). Multiple frameworks explore relationships between wellbeing, environment, landscape and ESs (Fisher

et al., 2013); the latter incorporating regulating (i.e., water quality maintenance), supporting (i.e., soil formation), provisioning (i.e., crop productivity), and cultural services (i.e., spiritual benefits) (Power, 2010).

Nunan (2015) differentiates between “livelihood” and “wellbeing” frameworks. Despite both approaches broadly focusing on improving wellbeing and understanding complex human-environment interrelationships, the approaches differ. Livelihood approaches aim to identify general trends and groupings, whereas wellbeing approaches aim to understand actors’ emotions and positionalities. Livelihood approaches favour quantitative research, whereas wellbeing approaches support mixed methods. Arguably “livelihoods” are nested within “wellbeing”, as livelihood type influences environmental sensitivity and how wellbeing is conceptualised.

This section evaluates influential frameworks which implicitly/explicitly explore environment-wellbeing relationships: Millennium Ecosystem Assessment, Environmental Endowments and Entitlements, Economics of Ecosystems and Biodiversity, Driver–Pressure–State–Welfare–Response, Sustainable Livelihoods/Vulnerability, and Wellbeing in Developing Countries. However, irrespective of the framework, it is important to recognise “regardless of the direction of drivers, poor people are...disproportionately vulnerable to environmental...stressors” (Fisher et al., 2013;1099).

Frameworks attempt to conceptualise complete systems; however, targeted studies may focus on select components (Nunan, 2015). Drawing on existing frameworks, and documented environment-wellbeing associations (section 2.5), a new conceptual framework is presented in section (2.6).

2.4.2.1 *Millennium Ecosystem Assessment (MEA)*

MEA focuses on how ESs can impact wellbeing (Figure 2.8). Five wellbeing components, defined by “voices of the poor” research (Narayan & Petesch, 2002), are included; financial/material, health, security, social relations and freedom of choice. ESs are categorised into four groups to delineate the various channels they can connect with multidimensional wellbeing. MEA (2005) also presents indirect and direct drivers of change, functioning at different spatial/temporal scales. Indirect drivers include economic market changes, whereas direct drivers include landcover change or climate hazards. The framework also suggests institutions/community groups can protect ES through ecosystem management, capacity building and knowledge sharing (Thiry et al., 2018).

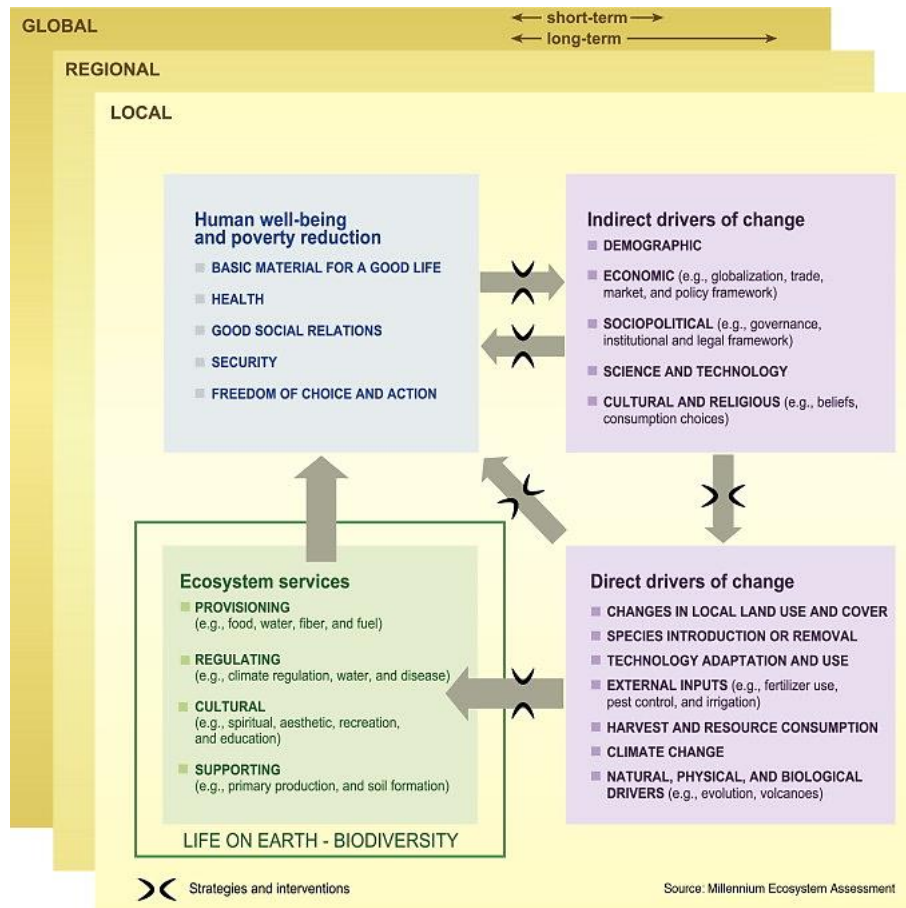


Figure 2.8 Millennium Ecosystem Assessment (MEA) framework. Sourced from Fisher et al. (2013, p.1103) and MEA (2005)

However, MEA is criticised for its macroscale focus oversimplifying the different climatic impacts in LIMCs (Fisher et al., 2013). By not connecting “indirect drivers” and “ESs”, contextual differences in natural resource access, which can influence whether actors can translate ESs into wellbeing outcomes, are also overlooked (Daw et al., 2011). The absence of a feedback between “wellbeing” and “ESs” also ignores how wellbeing could influence environmental quality (Jehan & Umana, 2003).

2.4.2.2 Environmental Endowments and Entitlements (EEE)

Contrasting macro-scale MEA, EEE (Figure 2.9) suggests household-level wellbeing differs due to varying endowments and entitlements to environmental resources, governed by multi-scale institutions. “Endowments” refer to households’ rights to resources/services (i.e., land ownership), whilst “entitlements” are the “set of utilities derived from environmental goods/services over which...actors have legitimate...command and are instrumental in achieving wellbeing” (i.e., access to market value for resources) (Leach et al., 1999;233).

Therefore, endowments alone are insufficient to achieve wellbeing. For example, in certain contexts, women may be unable to mobilize their labour to profit from their land (endowments) due to societal restrictions on female labour (entitlements). EEE also acknowledges how cross-scale institutions' govern households' endowments and entitlements; such as macro-level controls over resource exploitation permits, or household-level controls over gendered expectations (Leach et al., 1999).

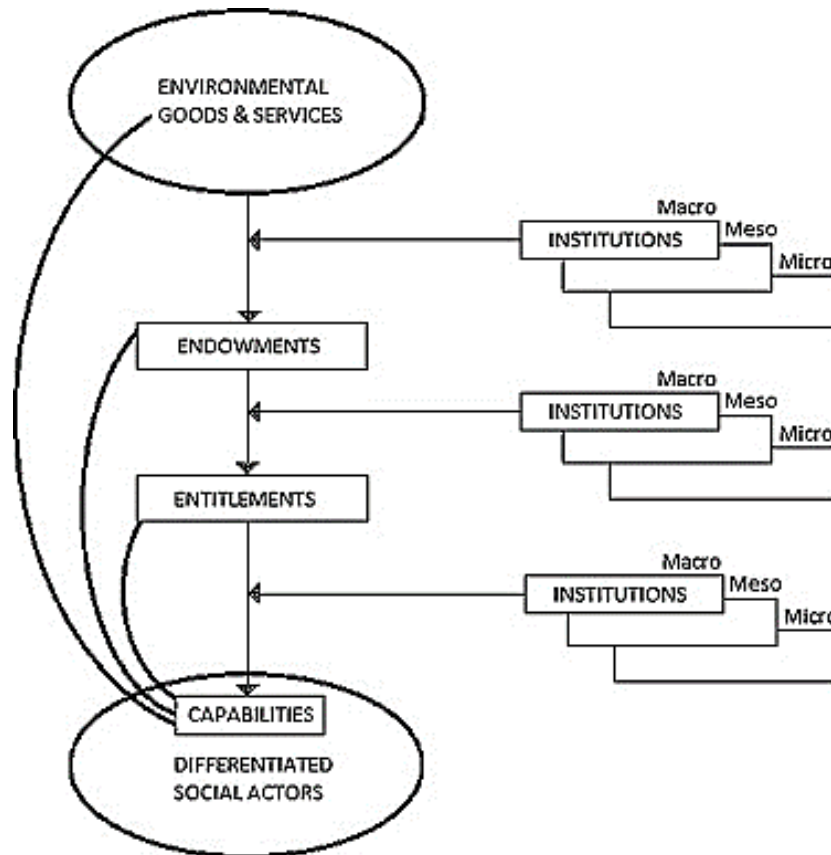


Figure 2.9 Environmental Endowments and Entitlements (EEE) framework. Sourced from Fisher et al. (2013, p.1101) and Leach et al. (1999)

However, EEE only incorporates environmental “positives”, overlooking how climate hazards can negatively impact households’ capabilities and wellbeing. Nevertheless, EEE beneficially facilitates qualitative research on power relations and institutional constraints to understand how social differentiation and inequality may shape environment-wellbeing relationships (Fisher et al., 2013).

2.4.2.3 Economics of Ecosystems and Biodiversity (TEEB)

The overarching principle of TEEB (2022) is to “draw attention to the invisibility of nature in the economic choices we make” by quantifying ES values. TEEB parallels MEA by illustrating ESs to influence wellbeing alongside direct, indirect and external drivers, and governance structures (Figure 2.10). However, the frameworks differ, with TEEB separating ecosystem functions and services, and disaggregating economic, social and ecological wellbeing outcomes.

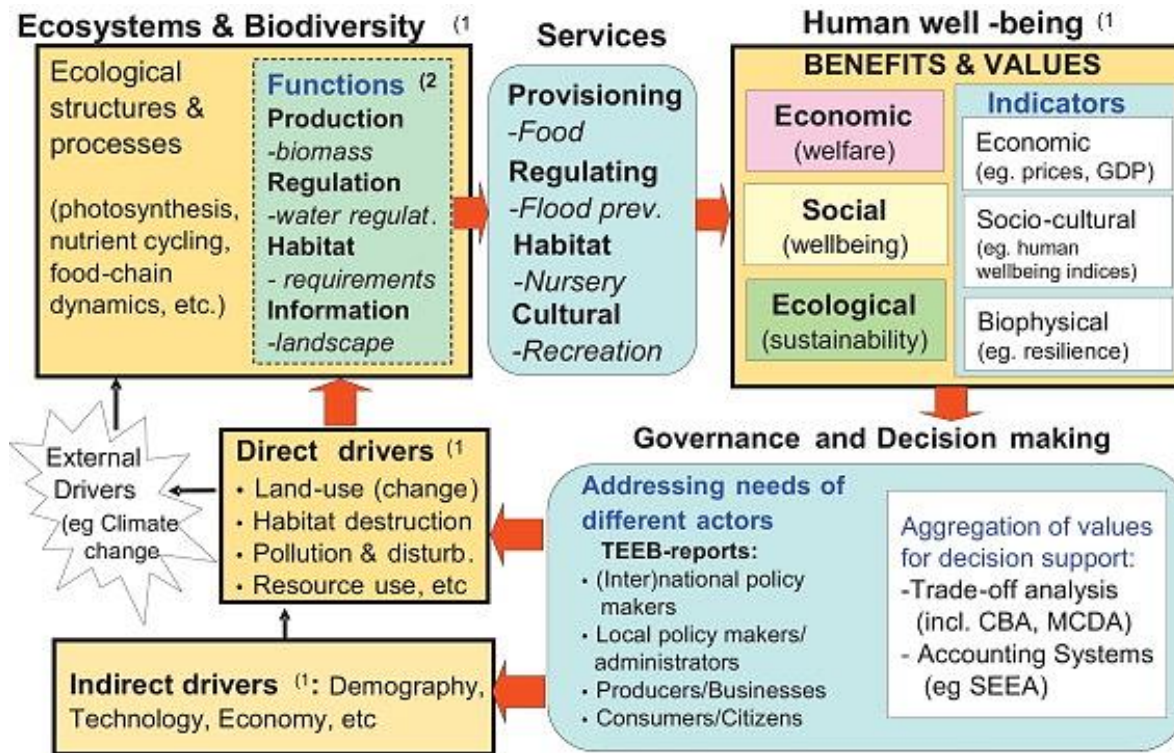


Figure 2.10 The Economics of Ecosystems and Biodiversity (TEEB) framework. Sourced from Fisher et al. (2013, p.1106) and TEEB (2010)

Yet, applying financial values to ESs faces challenges when attempting to quantify intangible spiritual benefits (Small et al., 2017). Monetary valuations may also not be contextually meaningful to subsistence communities, therefore TEEB is more applicable in HICs.

Furthermore, the framework neglects feedback effects by being unrealistically linear; for example governance structures should influence all other components (Fisher et al., 2013).

2.4.2.4 Driver–Pressure–State–Welfare–Response (DPSWR)

DPSWR is a tool, containing five elements (Table 2.6), to identify the causes of (Gari et al., 2015), and manage, environmental issues (PERSEUS, 2022). The framework shows “Response” to

influence all other elements (Figure 2.11); for example, introducing low-carbon technology (“Response”) impacts the “Driver” of climate change, and improves “Welfare” by increasing productivity. These relationships are bidirectional, with “Welfare” influencing which “Response” is taken depending on how communities value different wellbeing elements (Cooper, 2013).

Table 2.6 Descriptions of the different components of the DPSWR framework, adapted from Cooper (2013) and PERSEUS (2022)

Framework component	Description
Driver	• Broad-scale development in a social system which aims to improve human welfare. • Example of eutrophication ○ The “demand for increased crop productivity”
Pressure	• The more “direct” actions of humans on the environment. • Example ○ Using artificial fertilisers in coastal/riverine locations
State	• The undesired negative influence upon the environment that arises from the drivers and pressures, which influence wellbeing. • Example ○ Loss of biodiversity and/or trophic productivity
Welfare	• The change in human wellbeing based on the environmental change or “state”. • Example ○ Contaminated food supply and health issues
Response	• The actions taken by the community to mitigate or overcome the negative effect on either their wellbeing (welfare) or state (environmental health).

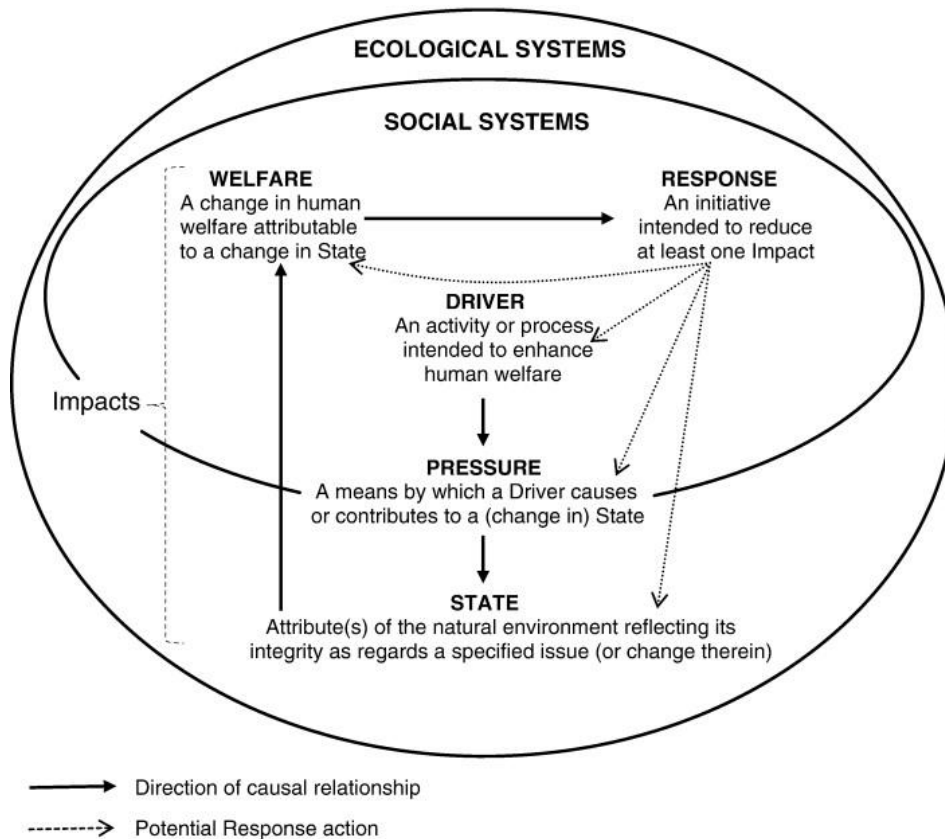


Figure 2.11 The Driver–Pressure–State–Welfare–Response (DPSWR) framework. Sourced from Cooper (2013, p. 111)

DPSWR is an adaptation of DPSIR (Driver–Pressure–State–Impact–Response). “Welfare” replaced “Impact” to differentiate between impacts upon ecosystems (state) and humans (welfare), and illustrate the complex relationship between the two outcomes (Cooper, 2013). However, the underlying framework is arguably oversimplified and ignores complex relationships (i.e. state/welfare outcomes could be influenced by multiple pressures/responses), while unclear definitions may limit research comparability (improved in DPSWR) (Gari et al., 2015; Rekolainen et al., 2003). Furthermore, the focus on negative environmental impacts minimises the focus on sustainable activities which maximise ecosystem/human wellbeing (Kelble et al., 2013).

2.4.2.5 Sustainable Livelihoods Framework (SLF)

SLF (Figure 2.12) depicts livelihoods to function within vulnerability contexts (political, historical, socio-economic, climatic), which alongside overarching institutions and policy restraints, control access to different resources and livelihood outcomes (Scoones, 1998). SLF uses an “objective-list” approach by bundling livelihood resources into financial, human, social,

physical and natural capitals (Table 2.7). However, the framework does support participatory approaches, where communities can define context-specific outcomes, historical influences and “subjective notions” (Schleicher et al., 2018a) within pre-defined compartments (Adato & Meinzen-Dick, 2002). Yet, the “institutions/organisation” component, similar to EEE, does allude to how social or formal hierarchies may limit communities’ access to their desired resources and outcomes (Morse et al., 2009). SLF is also flexible to incorporate other frameworks; for example, including “legal capitals” (i.e., land rights) within “livelihood resources” addresses issues of social differentiation, as referenced in EEE. These benefits address the criticism that SLF overlooks the underlying influence of power and entitlement upon wellbeing (Fisher et al., 2013).

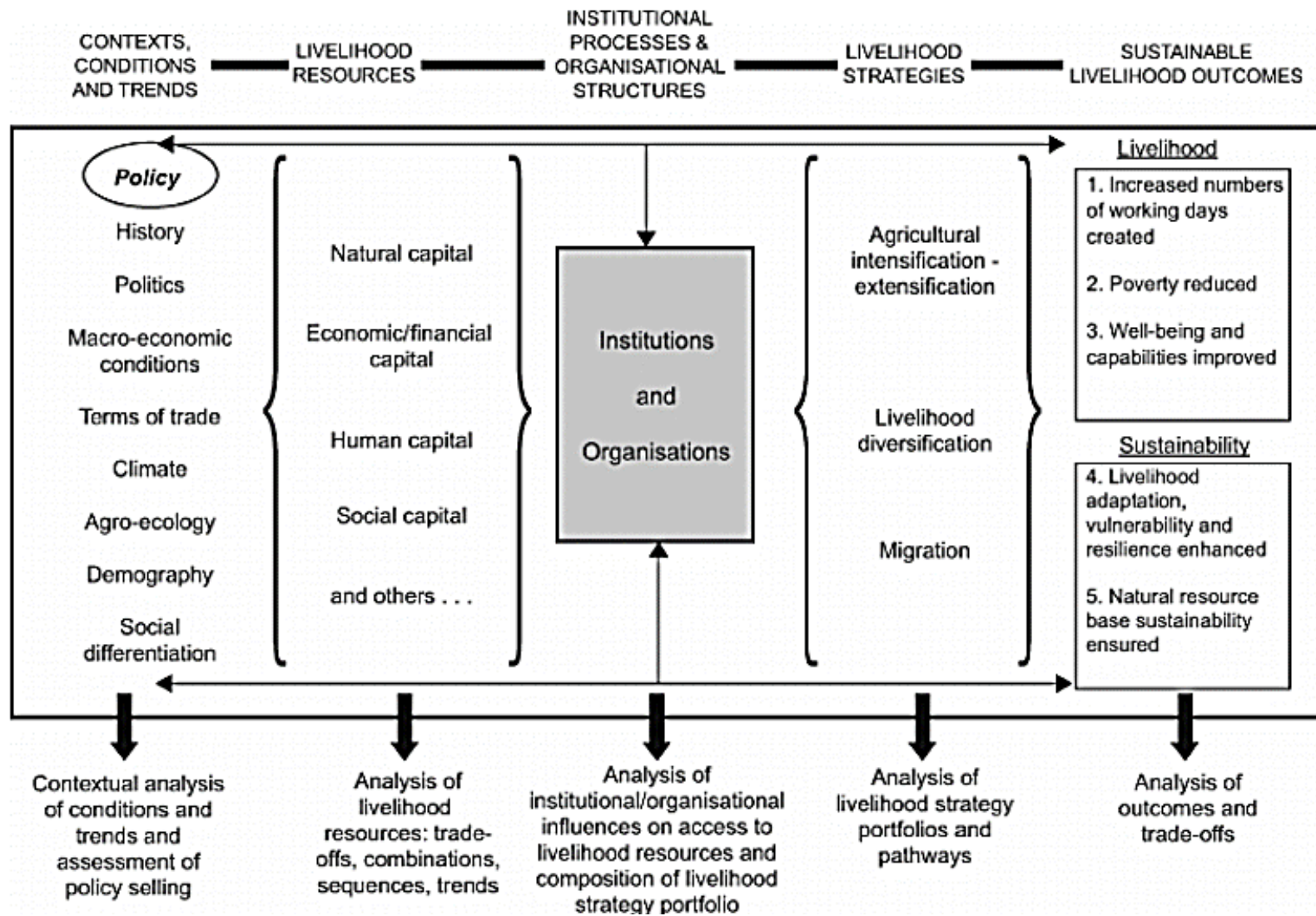


Figure 2.12 The Sustainable Livelihoods Framework (SLF). Sourced from Scoones (1998, p.4)

Table 2.7 The five capitals incorporated within SLF which influence livelihood strategies and wellbeing outcomes. Definitions based on Fisher et al. (2014) and Scoones (1998)

SLF capital	Definition
Financial	Economic capital available to the household including income, savings and debt. Employment is viewed as a key source of financial capital.
Human	Skills, knowledges and physical/mental capacity/health to pursue livelihoods.
Social	Resources such as networks, reciprocal relationships and trust. Three types of social capital: linking, bridging and bonding (section 2.5.4.1).
Natural	Natural resources and ESs (including supporting, regulating, provisioning and cultural services).
Physical	Infrastructure and physical goods that support livelihoods, including technology. For example, harvesting equipment, fishing boats or roads/transport infrastructure.

SLF also facilitates cross-scale analysis to aid policy implementation, as often there is a divide between “policy programmes (targeted at the community-level) and...expected outcomes (household-level)” (Berchoux & Hutton, 2019;109). For example, rural wellbeing, within an environmental context, can be influenced by household-level farming experience and resource access (Mabe et al., 2014), community-level support networks (Di Falco & Bulte, 2009), regional institutions’ land tenure policies, and national/global market prices (Adato & Meinzen-Dick, 2002). However, SLF is criticised for framing livelihood capitals at the household-level. Yet, the framework’s flexibility can facilitate the inclusion of community-level capitals, such as road networks (Kerapeletswe & Lovett, 2001; Okwi et al., 2007), when exploring key determinants of livelihood strategies (Berchoux & Hutton, 2019). Therefore, SLF can be used to investigate environment-wellbeing relationships, and guide policy, at multiple scales.

Others have critiqued the importance placed on quantifiable capitals, and how indicators could be measured differently within varying contexts (Morse et al., 2009). Nevertheless, there are opportunities across the framework for qualitative work to complement quantifiable capitals. For example, SLF views environment (natural capital) as a determinant of livelihood outcomes (Schleicher et al., 2018a); however, participatory methods could enable communities to challenge pre-defined ideas and interpret “environment” as an end in itself. Therefore, despite SLF constituting a “livelihood”, rather than “wellbeing”, approach (Nunan, 2015), it does identify key areas of investigation within environment-wellbeing research; the climatic context, wellbeing capitals, cross-scale influences, and the role of institutions (Agarwala et al., 2014).

2.4.2.6 *Vulnerability framework*

Vulnerability framework (Figure 2.13) adapts SLF by incorporating wellbeing, rather than livelihood, outcomes (Scott, 2006), and focusing on the environmental context (short-term climate shocks, long-term stresses and seasonality). The environmental context may influence the social, political and economic contexts. For example, land degradation could alter the political context by instigating conflict (Reuveny, 2007), and seasonal crop yield reductions may influence the economic context by discouraging rural investment (Badu et al., 2013).

Scott (2006) illustrates vulnerability as a three-pronged concept incorporating exposure, sensitivity and resilience (Figure 2.14). Sensitivity is influenced by “livelihood assets”; including the five SLF capitals. This interpretation of vulnerability differs to the IPCC risk framework (Cardona et al., 2012) which also incorporates “adaptive capacity”; see section (2.6.1.4) for information on the differentiation between “adaptive capacity” and “sensitivity”.

Using the IPCC definition, LMICs are often more vulnerable due to; (i) greater exposure to climatic hazards (Brown et al., 2007), (ii) higher sensitivity due to the economic reliance upon ESs (Sedda et al., 2015), (iii) lower adaptive capacity due to insufficient human capital, credit access, information systems and agricultural technology (Tompkins et al., 2020).

Furthermore, Scott (2006) defines exposure through “location” *and* “functional group”, whereas the IPCC framework interprets the latter as influencing “sensitivity”. Arguably, different livelihood groups may implicitly incorporate information on spatial exposure; for example, fishing communities residing in areas exposed to flooding. However, different livelihood groups may all be exposed to a hazard; yet, the hazard only constitutes a risk if the community is vulnerable. For instance, floodplain communities may be exposed to flooding, yet their wellbeing may not be harmed if they have access to the resources required to improve their building construction, or adapt their livelihoods to incorporate flood-recession farming (Ofori et al., 2016).

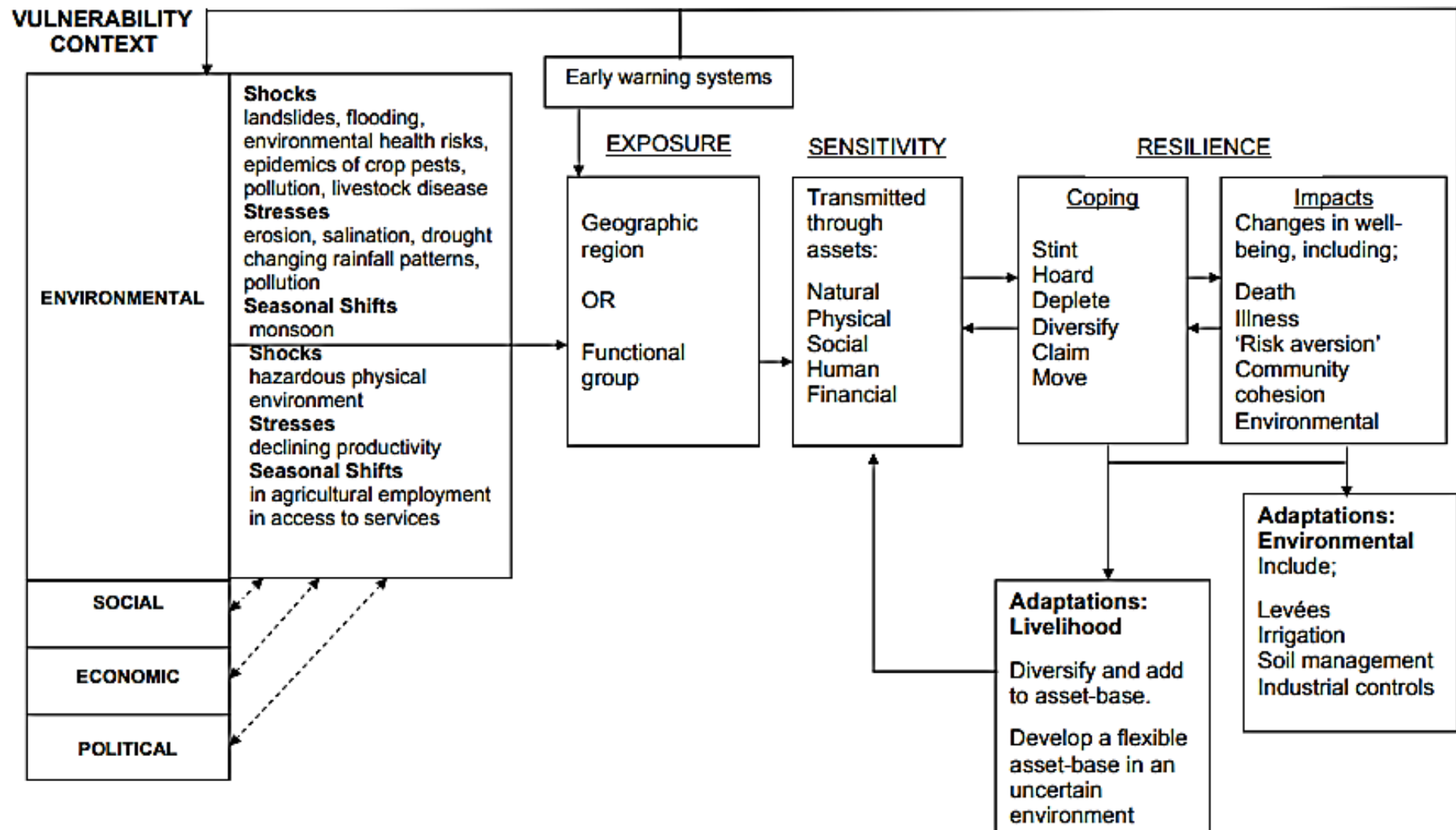


Figure 2.13 The Vulnerability Framework, which adapts SLF. Sourced from Scott (2006, p.5)

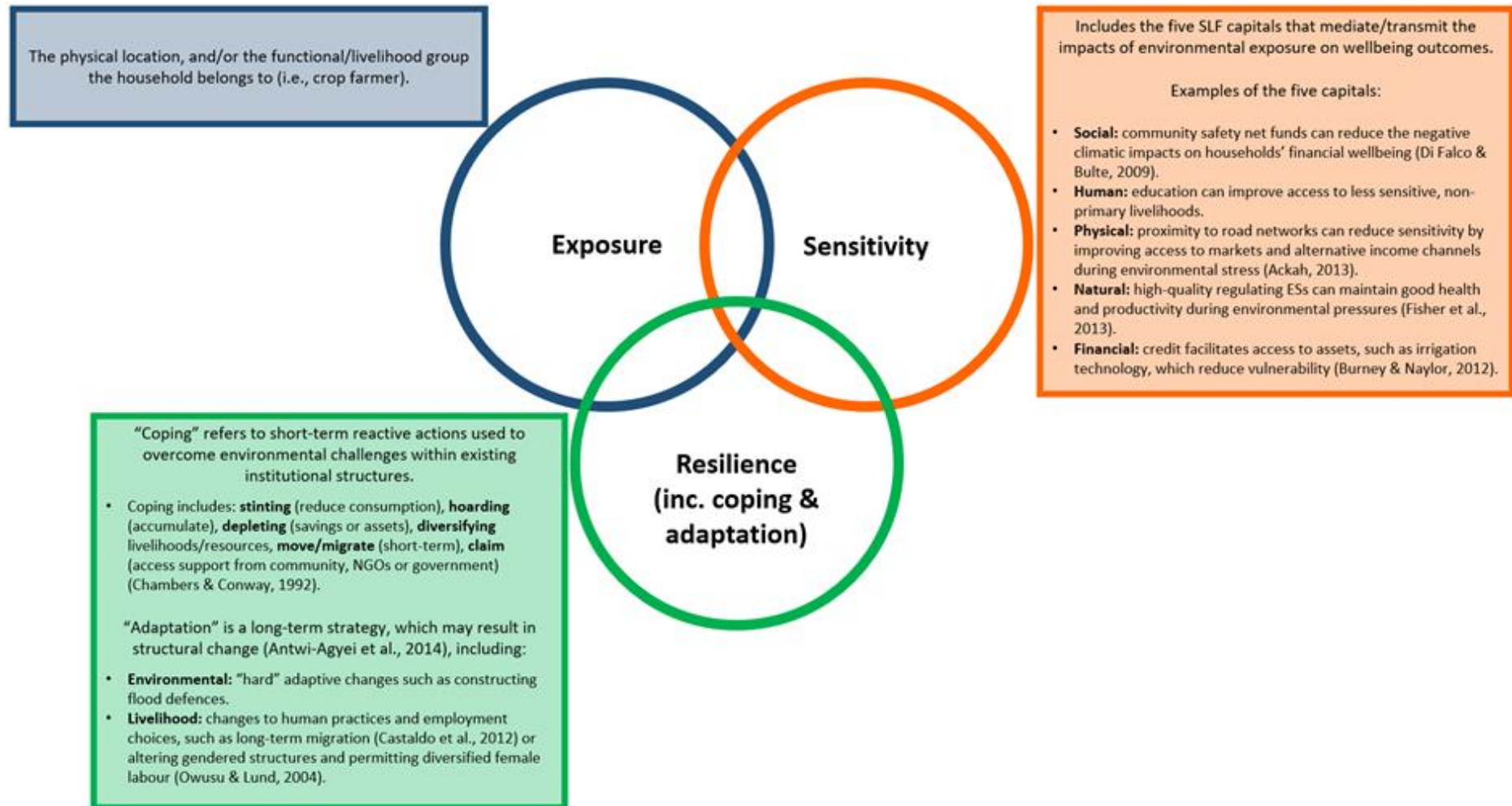


Figure 2.14 Descriptions of the different components of Scott's (2006) Vulnerability Framework

Despite the critiques of Scott's (2006) Vulnerability framework, the inclusion of various adaptations within the "resilience" component ensures the framework views impacted communities as active agents (Adger et al., 2003), rather than passive victims (Reardon & Vosti, 1995). "Resilience" incorporates coping, which results in static wellbeing, and adaptation, which targets poverty alleviation (Scott, 2006). "Environmental" adaptations also influence the environmental context; for example, terraced agriculture can reduce soil erosion and land degradation (Arnáez et al., 2015). Due to greater exposure and sensitivity, these strategies are crucial in controlling wellbeing within rural LMICs (Thomas et al., 2019).

Vulnerability is heterogeneous across scales, with environmental challenges creating "winners and losers" (Adger et al., 2002). For example, sensitivity to drought is greater in agricultural communities compared to peri-urban villages with less reliance on primary productivity. Furthermore, vulnerability is situation-specific, meaning a community may be vulnerable to one hazard, yet not another, depending upon their livelihood characteristics and resource access (Cardona et al., 2012).

Vulnerability may also vary *within* households; for example, women may be more sensitive to drought if their water collection demands increase (Asante & Amuakwa-Mensah, 2015; Schaafsma, 2021). Differences may also exist across age groups and ethnicities, with differing decision-making powers, and access to formal credit and common pool resources (Ray-Bennett, 2009; Shackleton et al., 2014). Consequently, environmental vulnerability can exacerbate inequalities, with those unable to adapt "losing", and those with low exposure or sensitivity, or high adaptive capacity, "winning" (Adger et al., 2002). Therefore, "attention to bottom-up, social and contextual determinants" (p.43) must be given to capture small-scale differences in vulnerability and wellbeing (Pörtner et al., 2022).

Vulnerability also varies over time; for example, sudden climate shocks may lower adaptive capacity by causing health issues and draining "safety net" savings (Dasgupta & Baschieri, 2010). Furthermore, communities may possess an underlying vulnerability which is only revealed when impacted by a certain hazard, or if repeated hazards have a cumulative effect (Patt, 2005). Therefore, "future vulnerability is embedded in the present conditions of the communities that may be exposed in the future" (Cardona et al., 2012;70). The framework's feedback effects illustrate the dynamic nature of vulnerability which is both a "condition and determinant of poverty" (Fisher et al., 2013;1106). For instance, "wellbeing" can influence how households "cope/adapt" to climatic hazards, which subsequently alters "sensitivity" (Figure 2.13).

2.4.2.7 Wellbeing in Developing Countries Framework (WeD)

Conclusively, WeD (Figure 2.15) incorporates ideas from psychology, economics and sociology (Gough & McGregor, 2007) to explore households' resource rights and access, and the meanings attached to resources (Agarwala et al., 2014). Wellbeing has etic (objective) and emic (subjective) components, defined as universally recognised “needs” and locally-formed, cultural “wants” (Gough & McGregor, 2007). Wellbeing is further split into three interlinked categories; material, subjective & relational (Figure 2.16). “Material” includes living standards and assets, “relational” captures social relationships and capabilities, and “subjective” incorporates individuals' perceptions of their material, social and human wellbeing, and their cultural values (White, 2016). The inability to divorce OWB/SWB supports mixed method research (White & Ellison, 2007).

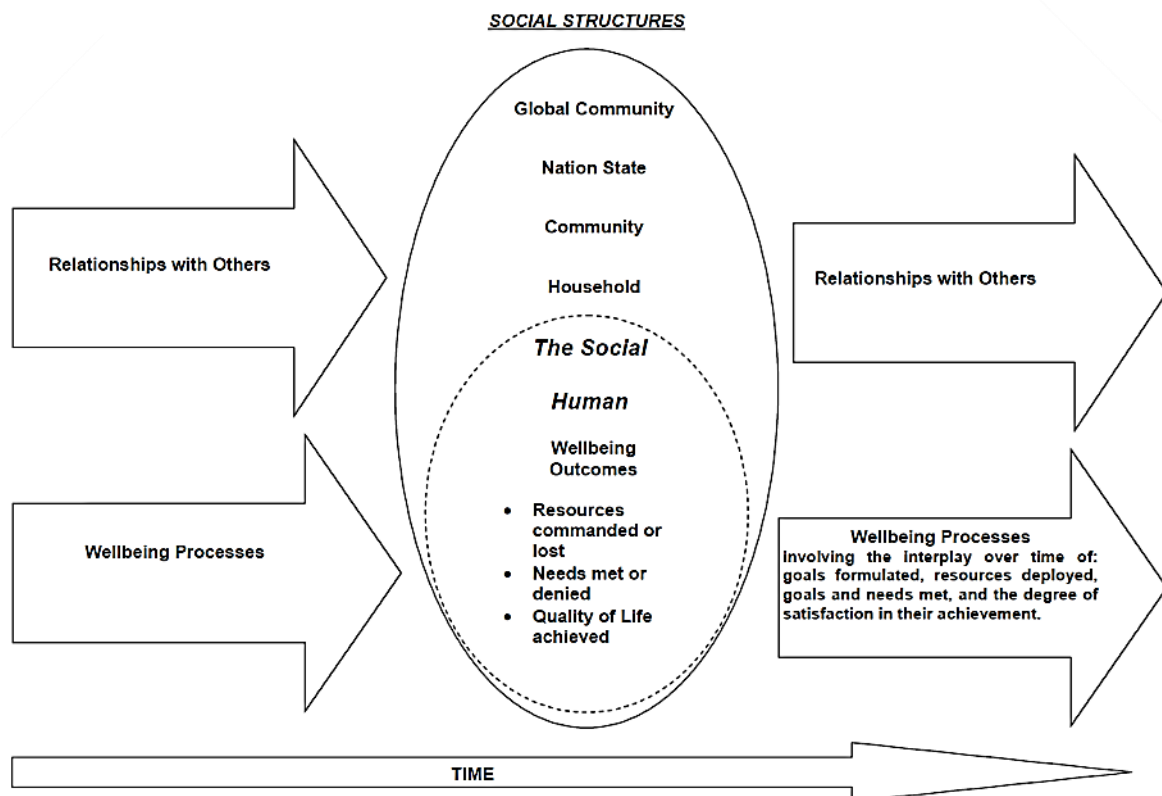


Figure 2.15 The Wellbeing in Developing Countries framework (WeD). Sourced from Gough & McGregor (2007, p.34)

Note, the explicit mention of material, human and social wellbeing outcomes are not made in this illustration, but are referenced in supporting text.

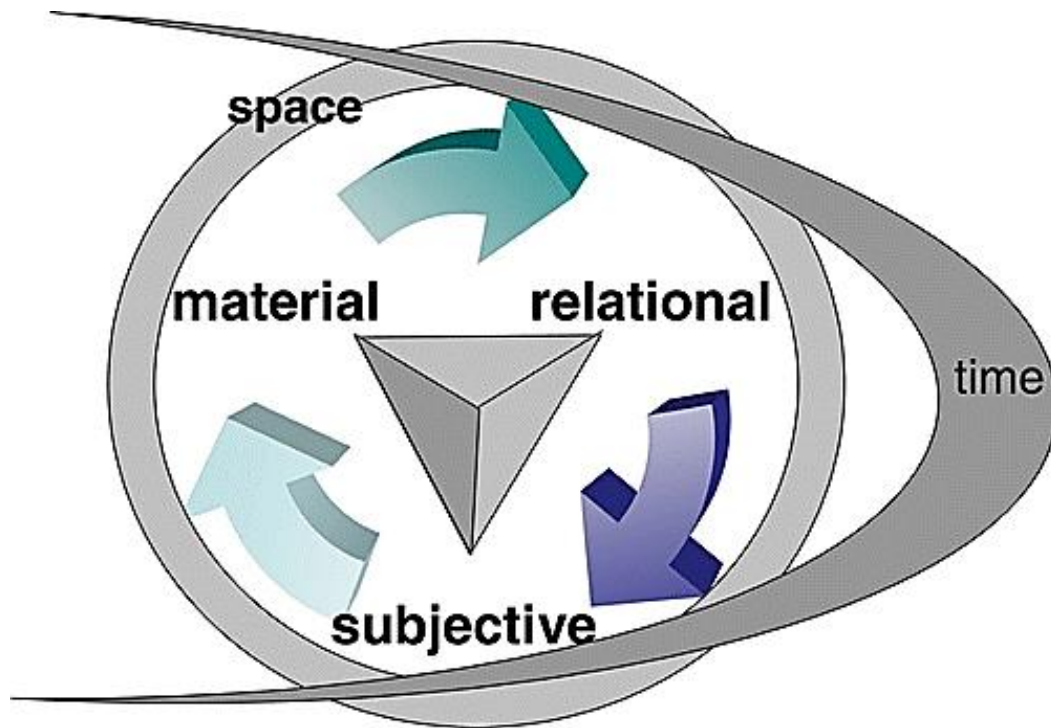


Figure 2.16 A dynamic visual highlighting how wellbeing incorporates material (objective) and subjective components, which are influenced by the relational context, space and time in which wellbeing is constructed. Sourced from White (2010, p.165)

Wellbeing exists within the “relational context”, meaning it is constructed by social/cultural meanings in time and space (Figure 2.16)¹³. For example, agricultural tools may help fulfil objective food security, yet also benefit SWB within certain contexts due to the value attached to fulfilling social obligations and providing for the family (Atkinson, 2013; Markussen et al., 2018). Therefore, actors do not passively experience wellbeing, but actively construct outcomes in time/space.

The relational lens prevents wellbeing from being exclusively viewed as individualistic, as collective expectations and beliefs, and broader social inequalities and governance structures within certain spaces, also affect wellbeing. Framing “wellbeing” within these wider structures incorporates elements of Sen’s (1999) capabilities approach, where the capacity for individuals’ to experience their desired wellbeing is controlled to an extent by social systems centred around age, gender and ethnicity (White, 2010).

¹³ “Grounding the human in the relational helps one to resist the individualism of much wellbeing literature, which misses out the social and cultural in settling on individuals as the locus of goals, perceptions, and traits” (White, 2010;164).

Wellbeing is also understood as a process over time. An individual's conceptualisation of wellbeing can alter over their life course with changing values and expectations, or how comparative reference points, used to define SWB, can shift with changing economic markets, political regimes, or environmental conditions. Similarly, current wellbeing perceptions can be influenced by past comparisons and expected future opportunities and/or challenges (White, 2010). Interpreting "wellbeing" as a process also implies it is not the "end goal", but rather a factor which can result in further goals being fulfilled. Nevertheless, "wellbeing" is not continuously a fluid process; everyday routines and practices can reproduce, rather than destabilise, wellbeing, enabling it to be consistently measured over time (Atkinson, 2013).

By including "universal" needs, WeD draws on eudaimonic SWB (section 2.2.3); therefore constituting a "wellbeing", rather than a "livelihoods", approach (Agarwala et al., 2014; Nunan 2015). Nevertheless, "wellbeing" approaches face criticisms; for example, the perceived injustice of focusing upon SWB when communities have more immediate material needs. Furthermore, WeD accepts the validity of existing collective values/goals and their influence on wellbeing, rather than challenging overarching systems (White, 2010).

The framework also facilitates a "local" focus. For example, Coulthard's (2008) WeD-based study of South Indian fishing communities contrasted results from macro-scale MEA-based research. The MEA approach assumed financial OWB positively influenced ES quality and adaptive capacity. However, the WeD approach uncovered better-off households to not reduce environmental vulnerability through livelihood diversification due to fears that moving from "specialisation" to "diversification" would reduce social prestige. This example emphasises the importance of a "relational lens" when understanding communities' behaviours.

Despite residing within social sciences, WeD recognises the need to integrate social/natural sciences to understand environment-wellbeing systems (Nuijten, 2011). The next section draws on mechanisms from these frameworks to investigate environment-wellbeing relationships.

2.5 Environment & Wellbeing (OWB & SWB)

This section, structured using the SLF capitals (Table 2.7)¹⁴, explores relationships between climate hazards, landscapes and OWB/SWB. Environmental conditions can (in)directly impact wellbeing, with wellbeing interpreted as an “outcome” *and* “part of a process towards other desirable goals” (Atkinson, 2013;139). For example, changes in asset ownership or happiness may influence additional wellbeing goals by controlling adaptive capacity and/or sensitivity (section 2.6.1.4).

The five capital groups are not independent (Appendix 2.3), for example education (human) can impact employability (financial). Therefore, financial capital is referenced throughout different sections of this review. OWB/SWB also influence one another (section 2.3), yet this review focuses on environmental mechanisms behind wellbeing outcomes.

Exploring OWB alone can result in vast information being missed; therefore, incorporating OWB *and* SWB within an environmental context is crucial for sustainable development (Grün & Grunewald, 2010). However, few studies examine environmental relationships with SWB in SSA, despite existing research emphasising the importance of local-specific effects on SWB (Sulemana et al., 2016). This review draws upon documented SWB controls in Ghana (Dzokoto, 2019), including the eudaimonic needs of autonomy, relatedness and competence.

This section begins by discussing climate hazard impacts upon OWB and SWB, before exploring how environmental conditions can affect human, physical, social and financial capitals; which can subsequently influence adaptive capacity and/or sensitivity.

2.5.1 Climate hazards & risks

Hazards refer to climate or weather events (Cardona et al., 2012), which depending upon the socioecological system’s vulnerability, can create “risks”. A risk has the “potential for adverse consequences for human or ecological systems”. Adverse effects include impacts upon livelihoods, health, relationships, infrastructure and ESs (IPCC, 2024); encompassing all five SLF wellbeing capitals. The IPCC definition also refers to how the “adverse effects” can be shaped by individuals’ and subpopulations’ diverse values (Reisinger et al., 2020); illustrating

¹⁴ The constructed framework, presented in section (2.6), also uses the SLF capitals; however, it differentiates between objective capitals (OWB) and subjective perceptions (SWB).

how vulnerability can be heterogeneous over space, and supporting the use of mixed methods to incorporate local voices.

This section explores the OWB *and* SWB risks associated with farmer and fisher livelihoods. The potential impacts upon interconnected industries, such as transport/trade (Cazcarro et al., 2018), are discussed in section (2.5.5.1).

2.5.1.1 *Drought*

Drought primarily impacts natural, and therefore financial, capital in rural LMICs by reducing primary productivity (Cazcarro et al., 2018). Reduced rainfall curtails crop yield by lowering soil quality, depth and nutrients (Garritty et al., 2010), increasing pest exposure (Heger et al., 2018), and shortening economically viable farming seasons (Antwi-Agyei et al., 2018). These conditions can exacerbate existing poor soil conditions in Ghana. The relationship with financial OWB is highlighted by strong correlations between soil nutrients and GDP/capita in 36 SSA countries (Barrett & Bevis, 2015), and rainfall volume and root crop/rice production in Ghana; the latter contributing 15% of national agricultural outputs (Asante & Amuakwa-Mensah, 2015). Drought-induced food insecurity may also lower SWB by preventing individuals from being self-sufficient (autonomy), fulfilling social obligations to provide for the family, and reducing “peace of mind” by threatening health (Osei-Tutu et al., 2020).

Drought also impacts livestock farmers, with increased livestock mortality in SSA linked to low water and grazing land availability (Serdeczny et al., 2017). Livestock mortality can produce long-term financial impacts, with households storing savings in livestock assets due to high costs and/or geographic isolation from formal banking (Gray & Moseley, 2005). Lost savings prevent households from undertaking productive/adaptive investments, and can lower SWB due to a Ghanaian “good life” being growth-orientated (Osei-Tutu et al., 2020).

Reductions in regional productivity can also raise food prices in LMICs (Datt & Ravallion, 2011; Heger et al., 2018; Schneider & Gugerty, 2011); with low-productivity scenarios estimating staple food costs to increase 60% by 2030 (Hertel et al., 2010). This challenge may be intensified within net-importing regions, such as Volta Delta, as communities’ “terms of trade” weaken during periods of scarcity, increasing the already high proportion of household expenditure on food. In contrast, households possessing the financial means to deploy adaptive technologies, and maintain higher productivity, may offset the higher consumption costs by selling at higher prices (Hertel et al., 2010); underscoring how rising food prices can enhance rural inequalities (Adger et al., 2002) and contribute towards relative financial stress (Ravallion,

2014; Kangmennaang et al., 2019). Reductions in financial success compared to past reference points can also reduce community-wide SWB (Lampitey & Ofori-Danson, 2014).

During droughts, poorer health (section 2.5.2.1) and reduced water security may also lower the autonomy and SWB of women and children if increased water collection demands limit the time/energy available for productive activities (Guardiola et al., 2013; WHO/UNICEF, 2005). Sensitivity to water insecurity is particularly pronounced amongst rural households reliant upon open-water sources for domestic and agricultural use (Atiglo, 2017).

2.5.1.2 *Seasonality*

Rainy season timing is crucial for agricultural households' food security and trade incomes (Wossen & Berger, 2015). Crop failure may result from premature cultivation, where delayed rains mean there is insufficient soil moisture, or late sowing, due to seeds being washed away by intense rains (Reason et al., 2005). Uncertainty threatens OWB in smallholder communities as local knowledge and/or past experiences become less applicable to current practices (Sarku et al., 2020). These challenges can also damage SWB due to traditional climatic knowledges being intertwined with individuals' identities, which if challenged, can reduce self-worth (Adger, 2010). Similarly, SWB could be lowered if uncertain rainfall disrupts culturally significant social events which coincide with seasonal changes (Jennings & Magrath, 2009).

Uncertain seasonality may also lower happiness and induce subjective financial stress (Ng & Diener, 2014) by creating a sense of loss; "when certainties move you feel a loss of control of your life, which is demoralizing" (Jennings & Magrath, 2009;12). Large, abrupt climatic changes compared to the "norm" can also lower SWB by reducing actors' perceived agency to adapt to unforeseen conditions (Mkrtchyan et al., 2018).

Temperature changes can also impact OWB as certain crops are sensitive to change. For example, maize, a key crop in Volta Delta, experiences 1% yield reductions for every 1°C increase beyond 30°C (Lobell et al., 2011). Cropland may also become uncultivable if optimum altitudes increase with warming temperatures (Jennings & Magrath, 2009). However, negative impacts may be offset by increased atmospheric CO₂ boosting certain crop yields; for example, rice, another key Volta Delta crop, is predicted to increase 11-19% under future CO₂ conditions (550ppm) (Long et al., 2006). Other crops, such as maize, are intolerant to CO₂ changes (Stern, 2006), exemplifying the heterogeneity of vulnerability, and how environmental shifts create "winners and losers" (Adger et al., 2002).

Environmental uncertainty requires flexible adaptation, with bet-hedging strategies (i.e., intercropping) common in Ghana (Moraiti et al., 2014; Yengoh et al., 2009). Different gendered roles can also mitigate the adverse effects of seasonality, with seasonal “male” agriculture in Volta accompanied by diverse, year-round “female” activities, such as cleaning, to dampen financial fluctuations (Tolhurst et al., 2008). Further information on adaptation is presented in section (2.5.6).

2.5.1.3 *Erosion & flooding*

Intensified rainfall due to warming temperatures can disrupt livelihoods, threaten food security and lower financial OWB by causing soil erosion (Chalise et al., 2019; Siteur et al., 2014), damaging crops, and bleaching soil nutrients (Barrett & Bevis, 2015). Coastal flooding and erosion can also damage infrastructure (section 2.5.3.1) and lead to the loss or inaccessibility of cropland, resulting in households losing agricultural incomes and valuable assets that could have otherwise been sold to facilitate shock recovery (Zakari et al., 2014). These impacts potentially amplify the harm caused by flood risks due to their rapid onset restricting opportunities for pre-emptive adaptation (Kuenzer & Renaud, 2012).

Flood damage, cropland loss or displacement may lower happiness due to “*solastalgia*”, “distress that is produced by environmental change impacting on people while...directly connected to their home environment” (Albrecht et al., 2007; S95). This concept captures how rural communities’ social identities, relationships (Brown et al., 2021) and spiritual beliefs (Bimrah et al., 2022) often intertwine with their landscapes and associated ESs (Adams et al., 2020). Therefore, greater place attachment may increase communities’ sensitivity to hazards and amplify SWB reductions, particularly when acknowledging the importance of religiosity in Ghana (Addai et al., 2014b).

However, attachment to place and/or nature can mitigate negative SWB impacts caused by material deprivation (Box 2.3). For example, an affiliation with nature and environmental satisfaction can boost physical and mental health (Grinde & Patil, 2009; Heerwagen, 2009; Ingulli & Lindbloom, 2013; Wolsko & Lindberg, 2013), illustrating a positive relationship between subjective perceptions of nature and objective human capital (Table 2.7).

Box 2.3. Natural affiliations may offset individuals' material deprivations.

“natural contexts of place are being constructed by poor people as compensatory factors that are capable of offsetting some of the material problems associated with life on a low income in rural areas.”

(Milbourne, 2014, p.578).

Others suggest individuals living in areas exposed to flooding and erosion, with low natural capital, are more aware of their material deprivations, resulting in lower SWB (Milbourne, 2014). Yet, place attachment can also encourage communal sustainable practices (Leviston et al., 2018), with collective, rather than individualistic, communities suggested to value “environmental harmony” higher when conceptualising wellbeing (Schaafsma, 2021). Consequently, sustainable practices can improve OWB by boosting long-term food security and trade opportunities, *and* SWB if interpreting environmental health as a wellbeing constituent (Jax et al., 2018).

2.5.1.4 *Salinisation*

Soil and water salinisation can also impact OWB/SWB. Coastal inundation can salinize nearby land and aquifers, whereas saline intrusions into river systems during storm surges (Darko et al., 2022) can influence soil salinity within inland areas (Salehin et al., 2018). Saline soils reduce provisioning ESs (Singh, 2018), harvest quality (Williams et al., 2020), certain crop yields, soil nutrients (Lawson et al., 2012; Shrivastava & Kumar, 2015) and restrict diverse livelihood strategies such as shrimp farming (Belton, 2016) and mangrove harvesting (Chen & Ye, 2014). Furthermore, due to limited water storage and irrigation technology in Volta Delta, many communities occupy floodplains to ensure sufficient water access; however, this inexorably increases exposure to flooding, soil/groundwater salinisation and erosion (Atiglo, 2017). These challenges persists despite the Government prioritising the expansion of irrigation access in the 2011 National Climate Change Adaptation Strategy (Antwi-Agyei et al., 2018); reflecting the interconnection between physical, natural, social (political) and financial capitals.

2.5.1.5 *Fishing*

Fishing activities, contributing 7.4% Volta Delta GDP (Cazcarro et al., 2018), are also vulnerable to climatic shifts. Fish productivity, a key provisioning ES, is declining across the Ghanaian

coast due to rising sea-surface temperatures and acidification (Koomson et al., 2020; Nieto & Mélin, 2017). Warming temperatures also impact biodiversity, with reduced *Sardinellas*, a key export product, recorded this century (Tanner et al., 2014). Low-quality physical capital may also contribute towards increased environmental vulnerability (Koomson et al., 2020) and reduced fish catches during strong tides and storm surges, with insufficient sea defences failing to protect landing sites (Addo & Addo, 2016), and substandard fishing equipment being prone to damage (Rahman & Schmidlin, 2014). Reduced catches and changing species contribute to lower financial OWB and livelihood autonomy within coastal communities. Furthermore, as 50-60% animal protein is provided by fish in Ghana (Lauria et al., 2018), lower fish resources can also contribute towards food insecurity.

Anthropogenic actions also exacerbate climatic threats to fishing livelihoods. Akosombo Dam (1964), Kong Dam (1982) and Bui dam (2013) (Addo et al., 2018a; Adjei et al., 2018) all disrupted the Volta River flow and natural flood pattern, preventing the natural water quality changes required for certain fish species to migrate and spawn, and removing opportunities for flood-recession floodplain farming (Ofori et al., 2016). Reduced runoff also increased sedimentation in the estuary, restricting access to marketable marine species available during high tides (Dankwa & Gordon, 2002). These challenges, coupled with broken promises of government support for dam-affected communities, reflect the political remoteness of fishing communities within Volta, and the perceived incompatibility between fishing practices and regional water security by national government (Béné & Friend, 2011).

Furthermore, reductions in mangroves (-24% in Ghana 1980-2006) (Corcoran et al., 2007) due to coastal erosion and/or anthropogenic actions, exacerbate pressures on fishing communities. Mangrove harvesting in Volta Delta provides materials for alternative livelihoods (i.e., fish smoking and construction); however, removing mangroves increases erosion exposure (Blankespoor et al., 2017) and removes habitats for marketable fish (Tanner et al., 2014).

2.5.1.6 *Climate awareness & fears*

This subsection reviews how subjective perceptions of nature (section 2.6.1.3) may influence SWB (Navarro-Carrascal, 2014). Many studies illustrate an association between psychological damage, such as post-traumatic stress, and climate hazards (Doherty & Clayton, 2011; Neria et al., 2008). For example, Sekulova & Van den Bergh (2016) found personal, or community-wide, experiences of flooding, and fears of future flooding to be linked to long-term SWB reductions. The uncertainty of future hazards is also associated with emotional distress and a perceived loss of personal security (Kidner, 2007; Stokols et al., 2009); disrupting the calmness needed for

a Ghanaian “good life” (Osei-Tutu et al., 2020). Furthermore, an assumed powerlessness to combat climate hazards can lessen subjective autonomy and environmental mastery (“competence”). In contrast, the aesthetic benefits of living and working within a healthy, protected landscape can boost community SWB by providing cultural ESs, such as heritage values and spiritual connectivity (Balzan et al., 2021; Tengberg et al., 2012).

Debates exist regarding whether past experiences of climate hazards mitigate or amplify SWB damage. Using flooding as an example, repeated past experiences can cumulatively impact SWB (Walker-Springett et al., 2017) by creating a sense of hopelessness (Leviston et al., 2018) “especially when exposure...[is] prolonged and unrelenting” (Stokols et al., 2009;187), guilt (if previously unprepared) (Hudson et al., 2019), and nervousness due to knowledge of past damage (Pörtner et al., 2022). Yet, in contrast, others suggest frequent hazards lead to acclimatisation, an acceptance of the risks and reduced SWB impacts (Brody et al., 2008; Navarro, 2017). Frequent climate hazards may also stimulate social cohesion (section 2.5.4.2), with collective emotional support and financial safety nets mitigating climate fears (Babcicky & Seebauer, 2017; Osei, 2016; Selman, 2001).

Conclusively, many studies examine relationships between environmental awareness and SWB. Sulemana (2016) suggests SWB in African communities is influenced by local concerns, whereas global concerns influence SWB in HICs due to greater information access and perceived responsibility. This finding supports the hypothesised importance of local environments to LMIC communities’ identity and culture (Albrecht et al., 2007). The next section explores relationships between environmental conditions, human capital and OWB/SWB.

2.5.2 Human capital

This section explores environmental impacts on health and education, and how these components can feedback to impact adaptive capacity and/or sensitivity in an environmental context.

2.5.2.1 Health

WHO (2020) estimates ¼ global deaths and disease are related to avoidable environmental hazards. For example, malaria, the most frequent cause of death across all ages in Ghana

(IHME, 2017)¹⁵, is predicted to increase due to rising temperatures and humidity, and flooding and intensified precipitation providing vector breeding grounds (Githeko, 2009; WHO, 2018). Hallegatte (2016) predicts a 5% global rise in malaria if temperatures increase 2-3°C, with vector-borne diseases also expected to accelerate during droughts due to reduced vector predators, and more available breeding environments as previously-flowing waters become static (Stanke et al., 2013).

Regulating ESs, such as water quality maintenance, are essential for human health; however, climatic hazards disrupt these services. For example, drought increases respiratory issues due to increased dust production, water-borne diseases due to increased chemical concentrations (Stanke et al., 2013), and malnutrition, particularly amongst children (FAO, 2019), due to reduced agricultural yields. Food insecurity is also linked to mental health challenges, especially amongst indigenous, agricultural groups (Pörtner et al., 2022).

Mental health is not interchangeable with happiness; however, research suggests poor mental health often contributes towards lower SWB (Keller, 2020). Increasing environmental threats to SWB and mental health occur against a backdrop of stigma and insufficient service provision in Ghana, with WHO (2023) reporting 98% Ghanaians with mental health conditions do not access medication or quality care. Furthermore, mental health issues and low happiness can increase environmental vulnerability (Cianconi et al., 2020), potentially entrenching inequalities and further reducing SWB by amplifying relative comparability (Kangmennaang et al., 2019).

Water insecurity during droughts can also reduce sanitation, increase disease spread and cause early-years issues such as stunting (Ngure et al., 2014). Increased travel times for water collection amongst women/children can also cause musculoskeletal injury, reduce the volume of water collected, and result in less frequent handwashing and poorer hygiene (Graham et al., 2016). WHO (2019) estimates unsafe water causes 1.4 million preventable deaths/year, particularly in rural areas. This example illustrates the interrelationship between the five wellbeing capitals; clean water (natural), water storage (physical), health (human), female-dominated collection (social) and reduced (financial) productivity.

Flooding also threatens health, with 96% deaths from natural hazards occurring in LMICs (1997-2007) due to greater exposure and lower adaptive capacity (Ahadzie & Proverbs, 2011; UNESCO, 2007). Furthermore, flooding spreads water-borne diseases such as cholera, particularly in areas without adequate latrine facilities (Mireku-Gyimah et al., 2018; Osumanu et al., 2019). Open/groundwater salinisation also has health implications, for example increased disease

¹⁵ Malaria also contributes 40% public health out-patient visits (2000-2011) (Asare & Amekudzi, 2017).

vector development within saline waters (Hillel & Hatfield, 2005). Furthermore, consuming or bathing within saline waters (Rahaman et al., 2020) is linked to hypertension (Ahmed et al., 2018; Nahian et al., 2018), strokes (Shammi et al., 2019) and maternal health issues (Desai & Begg, 2008). Rising temperatures also threaten health, with heatwaves linked to exhaustion, heat strokes and mortality across SSA (Azongo et al., 2012; Serdeczny et al., 2017).

Poor health can trap households within cycles of financial poverty and basic needs deprivation (OECD/WHO, 2003), with “good health” also a crucial SWB determinant (Osei-Tutu et al., 2020; Van Praag et al., 2003). Ill-health reduces individuals’ and households’ productivity due to care responsibilities taking precedence over paid labour, particularly for women (Rao et al., 2020; Serdeczny et al., 2017). For example, malaria in Ghana is estimated to cause a loss of 5-days work/episode (Hallegatte, 2016), and a 0.44% reduction in real GDP growth for every 1% increase in prevalence (Okorosobo et al., 2018). Health challenges may further lower SWB if they prevent actors from fulfilling their social obligations to provide for their household (Lambrecht, 2016). These issues could be comparatively greater in Volta Delta due to the higher dependency ratio (Table 1.2). Medical care also produces unplanned financial burdens, with malaria treatment costing on average \$0.41-\$5.98/person/month in SSA (Hallegatte, 2016). These impacts limit the capital available for productive investments in livelihood assets and human capital, potentially resulting in economic stagnation.

Many environment-health studies in LMICs use self-reported, rather than objective, health measures due to limited data availability (Ndabarora et al., 2014). Therefore, health may be interpreted as an OWB and/or SWB component; illustrating how the OWB/SWB divide can be blurred (White, 2016).

2.5.2.2 *Education*

Ghana has made large educational improvements through “FCUBE”; however, as the programme was launched relatively recently (1995), varying levels of adult education persist (Palmer, 2005). Firstly, climate shocks may restrict education access, evidenced in Fuvemeh where flooding and coastal erosion destroyed school infrastructure and reduced attendance (Addo et al., 2018a). Additionally, schools are often used as evacuation centres when flooding destroys community dwellings (Munsaka & Mutasa, 2020), further disrupting school attainment (Cadag et al., 2017; Thamtanajit, 2020). Intense rainfall, and consequent flooding, may also make roads and paths impassable, especially in remote areas, restricting school access for students and teachers (Amankwaa & Gough, 2023). These accessibility issues may contribute

to “brain drain”, where qualified professionals are discouraged from staying in such areas (Chang et al., 2013).

Furthermore, the “free” education programme is questioned, with payments for uniforms, books and transport still required (Palmer, 2005). Therefore, environmental pressures could disincentivize education investments in favour of production-boosting strategies to ensure food and financial security (Anyanwu, 2014; Dowling & Yap, 2012). This challenge can perpetuate gendered inequalities if households must select which children go to school (Senadza, 2012); resulting in long-term imbalances due to low social mobility in LMICs (World Bank, 2022). Additionally, difficulties in affording hired labour during low-productivity periods places greater demand upon family labour, especially if unfavourable conditions increase land maintenance requirements. Therefore, labour could be favoured over education, particularly due to the limited availability of graduate jobs and the status attached to the “farmer” identity (Brown et al., 2021; Markussen et al., 2018).

Education may also influence environmental sensitivity and adaptive capacity. Education raises aspirations for self-development (Anyidoho et al. 2012), and can improve access to higher-paid, less-vulnerable livelihoods (Morton, 2014). Education also boosts adaptive capacity by increasing access to technologies, such as irrigation (Limbu, 1999), land management strategies (Bugri, 2008), and the climatic/financial information required for long-term risk planning (Muttarak & Lutz, 2014). Basic education also advances the understanding of sanitation, mitigating the health, and subsequent financial, risks associated with climate hazards (Siri, 2014). However, these relationships are bidirectional, as access to “above-basic” education may reflect higher financial OWB (Korboe et al., 2011).

Subjective perceptions surrounding education can also influence SWB. The journey of self-improvement (Diener, 1999) and pursuit of meaningful activities are linked to increased SWB (Appiah et al., 2022; Schueller & Seligman, 2010; Sulemana & Agyapong, 2019). Furthermore, education can control perceived future opportunities (Lent, 2004). For example, within an environmental context, education may boost individuals’ financial optimism by enhancing adaptive capacity (Muttarak & Lutz, 2014), and improve autonomy by expanding their livelihood options (Borrero et al., 2013). In contrast, low education may generate pessimism and unhappiness regarding future financial viability, particularly within SSA with low social mobility (Azomahou & Yitbarek, 2016).

2.5.3 Physical capital

Physical capital incorporates material assets that support households' livelihoods and wellbeing (Scoones, 1998). This section examines the environmental impacts, and associated wellbeing outcomes, associated with housing, drinking water and physical remoteness.

2.5.3.1 *Housing quality*

Material assets can define households' living standards, with low-quality assets potentially reflecting low financial OWB (Klasen & Blades, 2013). However, poor physical capital can also feedback to increase financial poverty and subjective financial stress within an environmental context, as climate hazards can result in unplanned repairs (Atiglo & Codjoe, 2017; Diop et al., 2011). For example, flooding destroyed 1000s households in Keta over the last 50 years (Boateng, 2009). Furthermore, regular climate shocks may disincentivise investments in improved housing (Badu et al., 2013), especially if repairs are made using savings (Addo, 2018; Agyarko et al., 2012). Damage to dwellings or land can also impact long-term financial OWB, as assets can be sold to aid shock recovery (Moseley, 2001) or used as collateral when borrowing capital (Dasgupta & Baschieri, 2010). Additionally, due to the high upfront costs associated with mortgages/renting (Cobbinah & Niminga-Beka, 2017; Decardi-Nelson et al., 2012; Tufuor, 2009), rural communities often favour self-constructed dwellings (Parby et al., 2015) using local natural materials (Danso, 2013). Therefore, environmental degradation could also lower access to construction materials and increase environmental sensitivity.

Damaged or low-quality housing is also associated with other wellbeing elements. Household overcrowding, which may increase following the relocation of flood-displaced people, create unsuitable learning environments for children and increase health risks (Brimah & Lawson, 2014; Obeng-Odoom & Amedzro, 2011; Weeks et al., 2012; World Bank, 2020). Quality housing is also central to the "quest for a good life" in Ghana (Nanor et al., 2021). Therefore, if climate hazards damage housing, such as intense storms removing roofing (Adelekan, 2000), this could reduce SWB by generating "hopelessness" (Addai et al., 2014a) and preventing the fulfilment of individuals' aspirations. Additionally, Marcus (2006) defines housing as a "mirror of self", therefore low-quality housing may project negative characteristics upon oneself, creating a discrepancy between how one wants to be, and how one is, perceived. Carroll et al. (2009) also suggest flood-damaged, or repaired, dwellings become "houses", rather than "homes", by breaking individuals' place attachment. Furthermore, housing with insufficient defences may be "invaded" by floodwaters, violating individuals' perceived security; a key SWB component (Walker-Springett et al., 2017). Material inequalities can also impact SWB, therefore differences

in housing quality, ownership status, or climatic sensitivity within communities may exacerbate initial differences and contribute towards greater relative comparability (Addai et al., 2014a).

2.5.3.2 *Drinking water*

Limited access to drinking water facilities during water scarcity creates multiple wellbeing challenges, primarily linked to health (section 2.5.2.1). Furthermore, households may encounter lower financial OWB if the unavailability of open-sources increases the reliance upon high-cost water imports; with a growing presence of sachet water in Ghana (Stoler et al., 2012). Limited water infrastructure may also contribute to "time poverty", where by fulfilling their domestic collection obligations, women/children (Fisher & Carr, 2015) have less time for childcare, education/training or waged employment (Atiglo, 2017; Orkoh et al., 2020). These pressures are intensified within remote areas with poor road infrastructure and connectivity to public water sources (Blackden & Wodon, 2006).

2.5.3.3 *Physical remoteness*

Physical remoteness can result from limited rural construction/investment (Badu et al., 2013), or climatic hazards, with seasonal flooding/mass erosion making roads inaccessible (Afriyie et al., 2018; Li et al., 2020).

Firstly, remoteness can limit access to key markets, such as district capitals, and reduce trading opportunities. District capitals became hubs for market trade, social services and institutional capital (i.e., employment and hospitals) (Buor, 2004a) following national government decentralisation (Owusu, 2005). Despite decentralisation aiming to reduce rural/urban inequalities, rural communities do not always access the same benefits (Awuah et al., 2009; Kangmennaang & Elliott, 2019). Greater distance to markets can contribute towards lower financial OWB as longer travel times result in later market entry, fewer customers, lower bargaining power, and greater crop damage (Owusu & Lund, 2004; Porter, 2007). Furthermore, higher transactional and transport fees (Béné & Friend, 2011), and unreliable transport and communication infrastructure can limit remote households' capability to adapt and profit from changing market conditions (Bird et al., 2010).

These disadvantages may feedback to increase climatic sensitivity (Thomas et al., 2019), as remote households focus on subsistence, rather than cash crops (Stifel et al., 2003) due to proximate households providing larger quantities and better quality produce (Chamberlin,

2007). Additionally, peri-urban agricultural households are considered more innovative and open to new ideas due to their ability to combine farm/non-farm activities (Evans, 1992). Increased demand and competition for agricultural land near urban hubs may also incentivize individuals to boost productivity and ensure return-on-investment, more so than remote areas with greater land availability (Stifel et al., 2003).

Different landscapes may also influence SWB within an environmental context. For example, urban areas have “more-to-lose” from climatic hazards, with damage to higher-quality land and assets (Poku-Boansi et al., 2020) potentially affecting individuals’ social positionality (Bhandari, 2004). This concept is supported by studies in Anloga and Keta showing self-reported social position to predict SWB (Duku et al., 2022). Furthermore, an individual’s “capacity to aspire” is grounded within the cultural values of their local environment (Appadurai, 2004). For example, urban/peri-urban communities may possess higher material aspirations and place greater weight upon relative comparability when conceptualising SWB; especially if experiencing rapid development in relation to surrounding areas (Alem et al., 2014; Kingdon & Knight, 2007). In contrast, remote areas often focus less on financial and material wealth, instead targeting the living standards required to achieve safety, cultural identity and purpose (Ward & King, 2016). Furthermore, remote areas, such as marginal grasslands, may have lower awareness of higher living standards in better-connected, urban areas. Therefore, less relative comparability could mitigate negative impacts on SWB. However, limited accessibility could also harm SWB by inhibiting autonomy and mobility (Ferdman, 2021; Stein & Weisser, 2018), and generating distress if unable to reach markets or crucial public services (Li et al., 2020).

Remoteness can also associate with OWB *and* SWB by lowering “linking” social capital (Figure 2.17); including restricted access to political and banking services (Jordan, 2015). Evidence suggests Ghanaian banks are less likely to lend capital to remote households due to difficulties in collecting repayments (Ofori-Danson et al., 2013; Porter, 2007), with restricted credit access a crucial poverty determinant (Banerjee & Jackson, 2017). Remote areas are also infrequently targeted for public and private investment, with Ghanaian studies suggesting state-led investment into water infrastructure is limited outside urban hubs (Béné & Friend, 2011). These issues, exemplified by the disparity in FDI between urbanised areas of Greater Accra and agricultural Volta, illustrate the overlap between political and physical remoteness.

2.5.4 Social capital

This section defines “social capital”, before exploring how environmental challenges impact social relationships, and how social capital can shape wellbeing in LMICs. The section concludes by discussing the role of gender.

2.5.4.1 What is social capital?

Social capital is “the moral imperative of within-group sharing and redistribution” (Di Falco & Bulte, 2009;1); containing three interconnected elements (Figure 2.17). Social capital is also categorised by objective “structural” capital (i.e., social networks) and subjective “cognitive” and “relational” capital (i.e., shared values and norms) (Claridge, 2018a).

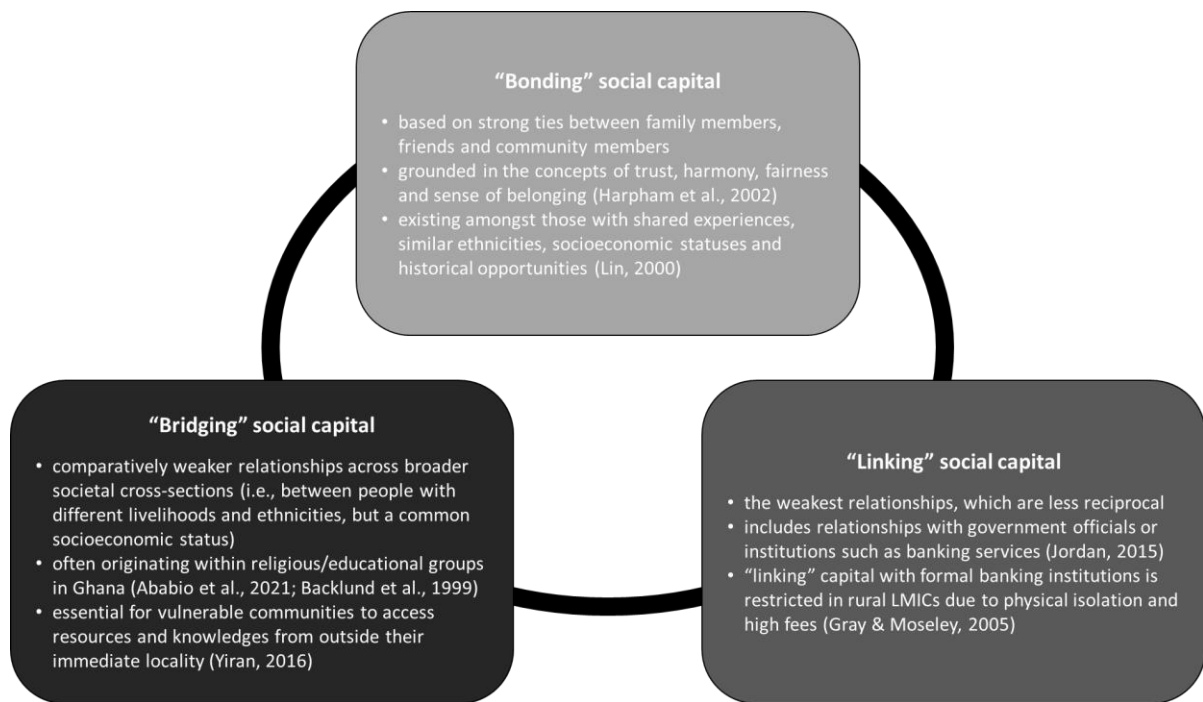


Figure 2.17 Different forms of social capital, based on Claridge (2018b)

Social capital is incorporated within the traditional African worldview of “Ubuntu”, meaning “a person is a person through other persons” (Bangura, 2005;31). This worldview promotes mutual respect, a desire to work with others, and the prioritisation of the community over the individual (Nafukho, 2006). Consequently, social capital is a crucial cultural norm within Ghana, which if unfulfilled could reduce community-wide SWB (Dzokoto, 2012). However, Chibvongodze (2016) notes “Ubuntu” does not only refer to human-human relationships, but rather a triecta of human-natural-spiritual connections. Therefore, residing within a productive landscape with

access to natural resources may be a “constituent” of communities’ collective wellbeing and happiness (Mawere, 2012; Shoko, 2016).

Studies have unveiled spatial variation in “bonding” social capital, with lower levels in south Ghana compared to the north, potentially attributable to successful cash-cropping producing individualistic, rather than collective, wellbeing (Amoako et al., 2021a). A similar individualistic/collective divide is hypothesised between urban/rural areas on smaller scales (Guillen-Royo & Velazco, 2012; Theodoropoulos, 1999). Evidence from Ghana supports this theory, with faster declines in trust found in “increasingly cosmopolitan” urban areas (Yiran, 2016), and NGOs facing greater difficulties when forming community groups in more mobile peri-urban towns (Porter & Lyon, 2006). This differentiation links to Gough & McGregor’s (2007) “relational” wellbeing. In urban areas, (post)colonial investment patterns and exposure to Ghana’s top-down economic development policies (Awanyo & Attua, 2018) may increase the emphasis on personal wealth for social status and SWB. In contrast, rural areas may exhibit a heightened focus on reciprocal networks and collectivism due to persistent exclusion from public sector investment, vulnerable livelihoods and slow socioeconomic growth (Owusu, 2005).

2.5.4.2 *Community relationships & cooperatives*

Structural social capital can mitigate environmental vulnerability and protect OWB, particularly among lower-educated individuals (Li et al., 2020), by facilitating the sharing of credit, assets, food, and ideas during periods of scarcity (Antwi-Agyei et al., 2014; Nosratabadi et al., 2020). Due to limited credit access in rural LMICs, strategies which pool resources and distribute risks over multiple households are more effective in maintaining wellbeing and encouraging new business ventures (Ndamani & Watanabe, 2015).

Social capital channels may also improve financial OWB during environmental pressures by providing information on employment opportunities (Ayentimi et al., 2021), lowering transactional costs, facilitating informal loans (Walsham, 2020), lubricating knowledge flow to enhance adaptive capacity (Gómez-Limón et al., 2014; Yiran, 2016), and incentivizing greater financial risks due to the trust placed in reciprocal relationships (Ababio et al., 2021; Bayor, 2010). Communities with high social capital may also objectively benefit from less elitist capture and crime, and improved educational attainment and health (Siisiainen, 2003); potentially linked to informal care relationships (Kawachi, 1999). However, relying upon others during periods of scarcity may negatively influence self-perceived status and financial stress (Alem et al., 2014). Yet, acting selflessly and providing support can boost SWB by strengthening

relationships and fulfilling religious obligations to “do the right thing” (Dowling & Yap, 2012; Fadiji et al., 2021).

“Bonding” capital, primarily functioning at the community level, is associated with short-term “coping”, rather than long-term “adaptation” (Jordan, 2015). If resources are constantly shared, less surplus capital is available for individuals to undertake productive/adaptive investments (Di Falco & Bulte, 2009). Furthermore, “compulsory sharing [and]...the expectation of future claims for financial support, significantly hinders entrepreneurial activity” (Castaing, 2021;508), meaning investments may be discouraged in favour of maintaining surplus capital to support the wider group. In contrast, “bridging and linking” social capital, commonly generated within religious spaces (Ababio et al., 2021), may facilitate long-term improvements by providing access to more diverse ideas and institutions outside the immediate community (Bott et al., 2019). The transition from “bonding” to “bridging and linking” capital could represent the shift in mobility, resources and information access between rural and urban communities.

Social capital and place attachment are crucial SWB elements in rural Ghana (Ayerakwa et al., 2015; Ma et al., 2022; Mihaylov & Perkins, 2014; Quinn & Halfacre, 2014), creating “purpose in life” (Lent, 2004) and “positive feelings” (Yiran, 2016;230). These elements relate to eudaimonic “relatedness”, often pronounced within thriving environments and spaces of ESs such as agricultural land, which provide platforms for belonging (Balzan et al., 2012), social interaction (Fagerholm et al., 2016), and knowledge-sharing (Schaafsma & Gross-Camp, 2021). Therefore, agricultural workers are often connected to the landscape and the wider community through their social status and obligated role as providers (Markussen et al., 2018). Consequently, climate hazards can reduce SWB (Bandauko et al., 2022; Rishworth et al., 2020) by damaging the cultural ESs which form the foundation of social norms and religious practices (Bimrah et al., 2022; Kankam et al., 2021), reducing employment opportunities, and changing the “place” that communities are attached to (Rollero & De Piccoli, 2010; Selfa et al., 2021). These impacts can be exacerbated if monetary wealth, a conduit for forging meaningful reciprocal relationships within Ghana, is also reduced (Dzokoto et al., 2019).

Studies suggest climatic hazards can positively or negatively impact social capital. Firstly, climate pressures, lower productivity and food insecurity can weaken trust and break relationships (Dolan & Walker, 2006; Prakash, 1997) by reducing the resources available to share (Craig et al., 2022; Di Falco & Bulte, 2009). “Vertical” trust in government organisations may decline during food insecurity if communities perceive these institutions to be failing in their obligation to provide. “Horizontal” trust within families and communities may also suffer due to increased competition for resources and disputes (Ager et al., 2018; Hatcher et al., 2022;

Smith et al., 2024). For example, increased dependency due to climate-induced ill-health or migration (Addai et al., 2014b) can create “emotional conflict” (Read et al., 2009).

Furthermore, climate hazards which restrict mobility (section 2.5.3.3) can isolate individuals from community networks (Beery et al., 2015; Jensen & Tiwari, 2021). For example, if flooding prevents access to meaningful activities, such as education, the capacity to build social resources is lessened; potentially reducing SWB (Appiah et al., 2022; Fredrickson & Joiner, 2002; Schueller & Seligman, 2010). Climate-displaced communities may also increase social tensions if groups migrate and compete for resources with existing communities (Doherty & Clayton, 2011). Conflict reduces SWB by disrupting social ties and threatening security, and lowers OWB by causing health risks and damaging financial assets (Leviston et al., 2018).

In contrast, climate hazards may stimulate social cohesion as a coping mechanism (Dussaillant & Guzmán, 2014). Frustrations with vulnerability or injustice can promote an “in it together” attitude (Bandauko et al., 2022; Calo-Blanco et al., 2017; Jordan, 2015) and trigger collective action (Cattell, 2001). Furthermore, trust creates a channel for emotional support during environmental pressures, mitigating SWB reductions (Lent, 2004). For example, Yiran (2016) suggests community networks in Ghanaian savannahs provide more timely, tailored support to buffer against climatic shocks than external government/NGO assistance. Therefore, collective adaptive strategies may produce win-win outcomes, with “meaning-focussed” activities aimed at overcoming environmental vulnerabilities also generating empowerment and improving SWB (Brown et al., 2005; Lawrance et al., 2021). This example highlights how targeting OWB outcomes can also serve as the “means” to achieving further desirable goals (Atkinson, 2013).

Further inconsistencies exist in how social capital and place attachment associate with adaptive capacity. Firstly, strong attachment can mitigate communities’ desire to migrate during unfavourable periods (Atiglo & Codjoe, 2017; Swapan & Sadeque, 2021), potentially increasing vulnerability and restricting financial opportunities. Furthermore, Castaing (2012) illustrated cooperative groups to create a “free-rider” effect, where the security of community networks disincentivizes individuals from investing in anticipatory adaptive practices. In contrast, high attachment may stimulate investments to protect the “place” they are emotionally connected to (Adger et al., 2013; Amoako et al., 2021a; Khanian et al., 2019; Leahy & Lyons, 2021). These social obligations to collectively maintain natural capital through sustainable and equitable practices may directly improve OWB if “environment” is considered a wellbeing constituent, or indirectly promote further wellbeing by reducing environmental sensitivity (Cheung & Hui, 2018). Moreover, “bonding” capital helps preserve memories of past hazards, whereas “bridging” capital provides widespread awareness (Dziatek et al., 2013); increasing climate preparedness, lowering risk perceptions, and therefore benefitting OWB *and*

SWB (Lo & Chan, 2017; Scolobig et al., 2012). “Bridging” and “linking” capital become more important when hazards impact the entire community, as external resources are required to adapt and maintain wellbeing (Coirolo & Rahman, 2014).

Additionally, collective communities can effectively lobby for improved resources, development schemes and climate adaptation support (Gómez-Limón et al., 2014). Shared experiences allow communities to “pull in the same direction”, contrasting individualistic communities with differing priorities and weaker political bargaining power (Kangmennaang et al., 2019). These differing examples highlight how researching interrelationships between climate hazards, social capital, adaptation and wellbeing requires a context-specific focus.

2.5.4.3 Gender

Gender can also shape wellbeing within an environmental context. Often women experience lower financial OWB in LMICs as their livelihoods intertwine with vulnerable ESs (Addo et al., 2018a; Shackleton et al., 2014). Furthermore, within patrilineal societies, restricted access to family land and credit limits their ability to make productive/adaptive investments; increasing environmental vulnerability (Afriyie et al., 2018; Fisher & Carr, 2015). These limitations are exacerbated amongst divorced/widowed women due to the loss of social capital and assets to the male bloodline, especially if land tenure is weak (Gray & Moseley, 2005).

These inequalities are replicated within education, with lower female attendance in Ghana (Heintz, 2004; Wolf et al., 2016) linked to the time/energy required for obligated domestic roles (Atiglo, 2017), prioritisation of male education, and higher withdrawal rates to support family business (Senadza, 2012). Difficulties in accessing formal employment, a by-product of lower education, can increase reliance upon informal work; impacting OWB *and* SWB by causing periodic unemployment and preventing capital accumulation (section 2.5.5.1).

In contrast, traditional male “breadwinners” have greater resource access and decision-making power (Lambrecht, 2016; Tolhurst et al., 2008). Fulfilling “masculine” responsibilities is crucial for SWB, with a Central Region study illustrating the embarrassment and dishonour received if female members contribute equally, or more, towards household finances (Carr, 2008). The pressure “to provide...the daily needs of their wives and family, as Ghanaian tradition demands” (p.71-72) can also substantially impact male happiness (Addai et al., 2015).

However, Ghanaian gendered dynamics are shifting, with Northern Region studies highlighting a dichotomy between male subsistence labour and income-generating female activities. Nevertheless despite this trend, development policy aimed at improving food production and

market activity still disproportionately targets males due to their greater land ownership (Vercillo, 2020). However, gender relations are context-specific, with Central Region studies noting subsistence as a female responsibility, with males focused on wealth generation (Carr, 2008). Additionally, southern regions, including Volta, possess different social norms that permit greater female ownership of land, credit, and cash crop cultivation. The increased female presence within the economic sphere is linked to rising living costs, increased demand for education, and the growing commercialisation of agriculture resulting in some communities shifting from subsistence to costly food imports (Lambrecht, 2016).

This gendered shift disputes the assumed “blanket feminisation of vulnerability” (Atiglo 2017;4), highlighted by greater female business ownership in Ghana (Oduro & Ackah, 2017) and lower female agricultural employment in Volta Delta (Cazcarro et al., 2018). Within Volta Delta, women primarily work in manufacturing, wholesale and trading (Hampel-Milagrosa, 2011), which despite being intertwined with primary productivity, provide less-vulnerable livelihoods. Female-dominated market spaces are also breeding grounds for “bridging” social capital; exposing women to new ideas and business opportunities (Owusu & Lund, 2004) which can reduce environmental vulnerability and increase financial autonomy.

2.5.5 Financial capital

Financial capital, including household income/expenditure, has been discussed throughout this chapter due to its interconnectivity with other capitals. Therefore, this section focuses on the relationships between hazards, employment within primary and interconnected sectors, and wellbeing.

2.5.5.1 Employment

Employment can be interpreted as an “end” of basic needs wellbeing (Streeten, 1984), and as a “means” to improved adaptive capacity and other wellbeing capitals. Seasonal/day labourers are most threatened by unemployment within uncertain environments (Hallegatte, 2016) as they are often let go first when scaling back hired labour (Lipton, 1986; Santiago et al., 2011). Furthermore, non-permanent workers commonly have fewer skills, reducing the alternative livelihoods available and entrapping them within sensitive economic sectors (Frazer, 2006).

Inconsistent employment during environmental pressures can deplete workers' savings, restricting shock recovery (Hudson et al., 2019), limiting long-term financial planning (Heintz,

2004), and contributing to prolonged poverty and financial stress (Veenhoven, 2007). In contrast, permanent employment, often less dependent on ESs, can produce positive outlooks regarding future financial security and provide the financial confidence required to borrow capital and make long-term human capital investments (Davis, 2014). Furthermore, stable employment can improve OWB and SWB by forging social networks, particularly within family/community-based agricultural enterprises (Voukelatou et al., 2021).

Primary industries are integrated within the wider economy, therefore climate pressures upon farming/fishing (section 2.5.1) may influence employment within trade, transport and food processing; key female sectors (Cazcarro et al. 2018). Damage to roads and ports from flooding/erosion can also restrict non-primary sectors; for example, limiting the transportation of construction materials (Afriyie et al., 2018). However, vulnerability is spatially and temporally heterogeneous, with urban public sector jobs less sensitive to climatic hazards than integrated sectors experiencing seasonal peaks/troughs (UNECE, 2017).

State-led initiatives in Volta Delta aim to reduce dependency upon ESs by encouraging private tourism investment; including marine turtle breeding sites and historical infrastructure (Abu & Codjoe, 2018). However, an estimated 50% tourist infrastructure across the Accra coast is threatened by sea-level rise, salinisation and erosion, and >50% surveyed facility managers have no adaptive plans (Sagoe-Addy & Addo, 2013). Damage to hospitality infrastructure may increase unemployment, sanitation and maintenance costs, and curtail financial success. These issues emphasise the need for climatic adaptation to be incorporated within economic development plans to prevent benefits from being undermined.

Examining relationships between employment and SWB, having a “good job” contributes towards personal growth, status and happiness. Being employed and accessing certain livelihood assets can reduce individuals’ perception of themselves as poor, regardless of their financial OWB (Alem et al., 2014). Therefore, low-paid or subsistence livelihoods can still improve SWB if they fulfil individuals’ societal obligations (Brown et al., 2021; Hossain et al., 2016; Osei-Tutu et al., 2020) and allow indigenous knowledges to be practiced (Schaafsma, 2021).

In contrast, unemployment may lower SWB by causing psychological distress, breakdowns in family/community relationships (Böhnke & Kohler, 2010), and reducing financial independence (Bhuiyan & Ivlevs, 2019; Chan et al., 2019); especially amongst landless workers (Falco et al., 2015). Financial stress may also arise amongst informal, non-permanent workers with lower job security due to agricultural uncertainty and the need for land owners to protect their own financial/food security, often resulting in non-permanent workers being paid below market value (Leavy & White, 1999).

Unfavourable climates which limit employment, or the capacity for livelihood diversification, may also reduce eudaimonic “competence” by restricting the ability to master a skill or the environment (Markussen et al., 2018). Yet, despite livelihood diversification being an effective adaptive practice, it can reduce SWB by lowering the social status associated with livelihood specialisation and weakening social networks (Coulthard, 2008; Markussen et al., 2018); especially within primary industries where livelihoods and associated ESs intertwine with workers’ identities (Brown et al., 2021; Cundill et al., 2017). The next section explores actors’ agency to respond to environmental and wellbeing changes.

2.5.6 Adaptation

Adaptive capacity is lower in LMICs, however adaptation remains crucial in maintaining OWB and SWB in vulnerable communities (Tay et al., 2018). This section explores the relationships between wellbeing and existing adaptive practices in Volta Delta, migration and maladaptation.

Adaptation ranges from “soft” educational or ecological strategies with minimal physical change, such as protected area allocation, to “hard” technological measures with changes to infrastructure or markets (Dovie, 2017); for example, installing coastal defences (Kuenzer & Renaud, 2012). Most households in Volta Delta undertake some form of adaptation, primarily through hired labour, non-domestic female employment (Antwi-Agyei et al., 2014) and modifying/moving home (Codjoe et al., 2020a). Other reported agricultural strategies in Volta Delta include (Sarku et al., 2020):

- changing sowing periods by identifying three, rather than two, growing seasons
- planting drought-resistant/early-maturing crops
- clearing cultivatable land in response to increased degradation (Antwi-Agyei et al., 2018)
- intercropping high-moisture crops with resistant cassava varieties as “insurance”
- abandoning cultivation during erratic rains to focus on land preparation

Short-term coping strategies aim to achieve “survival”, whereas adaptation can produce long-term financial OWB benefits; illustrated by irrigation farmers having higher net incomes in Ghana (Burney & Naylor, 2012). However, not all can adapt, with certain levels of financial and human capital required. Therefore, different adaptive capacities may exacerbate inequalities across genders, livelihoods and landscapes (Quisumbing & Pandolfelli, 2010). Entrenched inequalities may also increase environmental vulnerability by lessening communities’ capacity to pool resources and collectively respond to environmental challenges (Pörtner et al., 2022).

Adaptation also requires a knowledgeable relationship with the environment, yet unpredictable climate patterns threaten these connections. Furthermore, climatic variability may disincentivize proactive adaptation due to the uncertainty surrounding return-on-investment, and the need to maintain surplus capital for shock recovery (Cooper et al., 2008; Gollier & Pratt, 1996). Therefore, successful adaptation planning must consider individuals' subjective relationships with nature *and* the necessary financial/material requirements (Adger, 2010).

2.5.6.1 Migration

Common migration patterns amongst agricultural households include seasonal movements to urban areas for livelihood diversification, or more-productive land during dry fallow periods to maintain year-round access to basic needs and financial security through remittances (Falco et al., 2018). This is supported in Tanzania, where a 1% reduction in agricultural income increased the probability of migration the following year 13% (Kubik & Maurel, 2016). Temporary migration over short distances is often favoured due to the extensive resources needed for permanent migration (Flahaux & De Haas, 2016). However, better-off households also use local migration patterns to access remittances, boost savings, and fund livelihood assets (Mortreux & Adams, 2015).

Remittances are crucial inputs to LIMCs; exceeding development support *and* FDI in Ghana (Asiedu & Chimbar, 2020; World Bank, 2021a). Remittances are more-consistent and less dependent upon ESs than rural incomes; supporting financial safety nets and adaptive investments during periods of scarcity. Remittances in Ghana are key to achieving sustainable livelihoods, with studies showing remittances to fund debt repayment, education, livelihood diversification, water and latrine infrastructure, increased food consumption, and adaptive resources such as fertilizers (Awuse et al., 2020; Castaldo et al., 2012; Musah-Surugu et al., 2017).

However, remittances are not necessarily financial, with “knowledge” remittances such as new agricultural practices/technologies also influencing wellbeing (Ionesco & Chazalnoel, 2015). Experiencing different livelihoods and higher living standards may encourage return migrants to strive for self-improvement (Clemens, 2013), a core SWB component (Diener, 1999). Furthermore, established migration channels can generate a “brain gain”, where successful emigrants illustrate the benefits of mobility, and encourage origin communities to increase investment in education and migration opportunities (Gyimah-Brempong & Asiedu, 2015).

Despite common assumptions, little evidence of climate-induced mass emigration within rural Ghana exists (Mortreux & Adams, 2015; Van der Geest, 2011); however, dam construction did

cause large-scale displacement of fishing communities in Volta (Addo et al., 2018a). Insufficient skills and livelihood options may limit individuals' desire to migrate during environmental pressure; supported by interviewees from Totopé¹⁶ being reluctant to migrate inland due to employment uncertainty (DECCMA, 2014). Furthermore, climate hazards can prevent migration rather than act as push factors. For example, dwindling productivity during drought could discourage migration by removing surplus capital, lowering human capital investment, heightening perceived financial risks, and increasing labour demands at home (Falco et al., 2018). Place attachment may also reduce migration aspirations, even during environmental pressure, due to the OWB/SWB benefits associated with community relationships and cultural ESs (Amoako et al., 2021a).

Historically gender has also restricted migration, as younger males dominated migration networks due to greater capital access, decision-making power, higher-paid job opportunities and lower security threats (Atiglo, 2017; Mallick, 2019). However, a “feminisation of mobility” has emerged, with changing labour markets allowing women to escape domestic expectations. Therefore, female mobility is transitioning from “family relocation” to “independent economically-driven” migration; illustrated by the frequent North-South movements of young women to work as porters (Kwankye et al., 2009). Even if family reunions trigger female migration, studies in Volta suggest women still seek employment opportunities (Odotei, 2002).

The key migration channel in Volta Delta¹⁷ is Volta to Greater Accra; driven by the regional inequalities in investment (section 2.2.4.2). Economic differences explain these movements from a neoclassical perspective, however other push/pull factors exist, such as access to information about the destination, social networks, transport infrastructure, and the skills desired in the destination (Flahaux & De Haas, 2016; Henry et al., 2003).

2.5.6.2 *Maladaptation*

Despite adaptation often being required to maintain or increase wellbeing within unfavourable environments, unplanned negative OWB/SWB outcomes can also arise. Examples of maladaptation (Asare-Nuamah et al., 2021) include:

- Fertilisers: long-term contamination and degradation of cultivatable land and water (Antwi-Agyei et al., 2018).

¹⁶ a coastal village in Ada East threatened by coastal and Songor lagoon intrusions.

¹⁷ From DECCMA survey data; 68% households previously and/or currently have a migrant outside the household in Volta Delta.

- Irrigation: reduced water security, conflicts over resources for consumption, financial risk due to upfront costs, increased infectious disease (Klinkenberg et al., 2005)
- Reducing food consumption: disrupt cultural food practices, malnutrition
- Crop diversification: damage cultural identities associated with specific farming practices (Brown et al., 2021), increased costs for specific crop types
- Early/delayed/multiple-season farming: create periods of food insecurity, reduced soil fertility
- Cropland expansion: promotes use of damaging chemicals/fertilisers, land conflicts, deforestation increasing soil erosion
- Selling safety net assets (i.e., livestock): receive a temporary financial boost, yet increased vulnerability to future shocks (Gray & Moseley, 2005)
- Cooperative groups: can create financial stagnation and increase financial burdens if supporting others or repaying loans during periods of scarcity
- Livelihood diversification (i.e., mangrove harvesting): ecosystem damage, loss of culturally-valued assets, exacerbate coastal erosion and fish habitat loss (Darko et al., 2022; Tanner et al., 2014).
- Coastal defences (i.e., groynes): can transfer issues to other locations; for example, sea defences in Keta accelerated erosion eastward in Kedzi and Hlorve (Addo et al., 2018a)

Migration may also damage wellbeing; for example, a “return of failure” occurs if expected financial or employment opportunities are unattained, resulting in the costs of migration outweighing the returns (Cerase, 1974). Furthermore, a qualitative study of North-South migration in Ghana (Van Der Geest, 2011) illustrated further negative OWB/SWB outcomes: (i) perceived abandonment reducing social cohesion, (ii) labour shortages in origin, (iii) fears of social exclusion in destination, (iv) increased care responsibilities in origin, (v) failure to upkeep remittance obligations disrupting family relationships (Walsham, 2020), (vi) successful migration resulting in local enterprises being in favour of investing in outward migration (Szaboova et al., 2021).

Migration to areas with higher living standards may also reduce SWB by increasing the visibility of “unobtainable” reference points (Knight & Gunatilaka, 2010a). Furthermore, an overreliance on remittances, particularly if used for unsustainable consumption, may discourage initiatives aimed at boosting productivity in the origin (Adger et al., 2002). Livelihood diversification, via migration, may also restrict financial OWB by preventing specialisation (Eriksen et al., 2005), and lower SWB by stopping individuals from mastering specific skills (Markussen et al., 2018).

The success of adaptation therefore depends upon the trade-offs between multiple wellbeing dimensions (Schaafsma, 2021).

The next section builds on the environment-wellbeing relationships explored in this chapter to summarise the new conceptual framework. This framework is applied throughout the thesis to structure the findings that address the RQs shaped by the literature review:

1. How are OWB and SWB measured within an environmental context?
2. What are the spatial environmental associations with OWB and SWB?
3. How do different socioecological groups conceptualise and weight components of wellbeing?
4. What drives the divergence between OWB and SWB within an environmental context?

2.6 Conceptual framework

To address RQ1a, this section summarises and justifies a new framework's multiple components; drawing upon existing frameworks and documented environment-wellbeing relationships. A new framework was deemed necessary to overcome individual frameworks' limitations, and align with the study's aim of exploring local environmental associations with OWB *and* SWB (Schleicher et al., 2018b).

The new, novel framework is entitled the "Environment and Comprehensive Wellbeing" (ECW) framework. While existing frameworks address components of the environment-wellbeing system, they often do not incorporate "comprehensive" wellbeing within an environmental context. A "comprehensive" approach encompasses broad objective and subjective indicators, and acknowledges local community and governance priorities (White, 2016). The "ECW" framework addresses this gap, supporting research on the impacts of climate hazards, landscape characteristics, and environmental policy interventions upon wellbeing in LMICs. The framework is used to structure the complex ideas incorporated within wellbeing measurement (Chapter 3), multiple regression (Chapter 4) and qualitative analysis (Chapters 5-6).

2.6.1 Summary & justifications

The underlying foundation of the “ECW” framework is the IPCC *risk* framework, which illustrates how hazards can influence communities differently depending upon their exposure and vulnerability (sensitivity and adaptive capacity) (Cardona et al., 2012).

The “ECW” framework incorporates eight components; “global drivers”, “environment”, “exposure”, “wellbeing”, “adaptive capacity & sensitivity”, “livelihoods”, “response”, and “relational context” (Figure 2.18). The framework includes elements from MEA (2005), SLF/Vulnerability (Scoones, 1998; Scott, 2006), TEEB (2010), WeD (Gough & McGregor, 2007; White, 2010) and DPSWR (Cooper, 2013). Integrating frameworks creates a platform for multidisciplinary research (Nuijten, 2011).

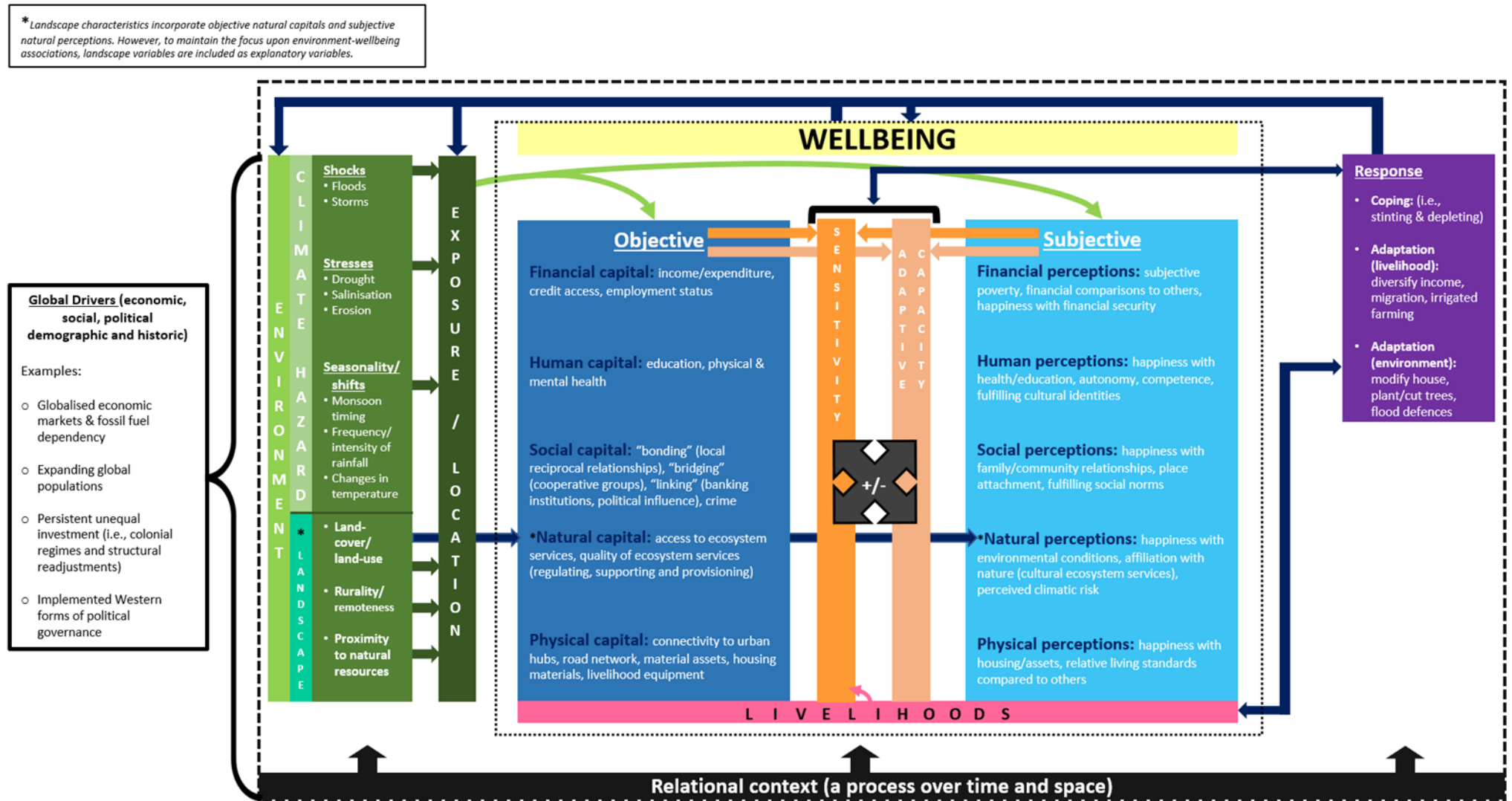


Figure 2.18 The Environment and Comprehensive Wellbeing (ECW) framework

2.6.1.1 *Global drivers*

Before discussing environment-wellbeing relationships, the framework draws upon MEA, TEEB, SLF/Vulnerability and DPSWR, to include “**Global Drivers**”. Despite being unable to accurately quantify “**Global Drivers**”, incorporating them within the framework and qualitative discussions acknowledges the broader economic, social, political, demographic and political contexts, and ensures environmental and wellbeing challenges are not interpreted as internally caused and experienced. For example, the British colonial influence on agricultural practices (section 2.2.4.2).

When addressing environment-wellbeing relationships, the spatial scale of the causes, impacts and solutions must be acknowledged. Including macroscale “**Global Drivers**” provides opportunities for research to address how broad, overarching controls integrate with local complexities and meanings. Therefore, similar to SLF and WeD, the framework aims to bridge gaps between scales (Newton, 2007).

2.6.1.2 *Environment*

To address the overarching research aim, the second component is “**Environment**”; incorporating climate hazards (shocks/stresses/shifts) and landscape characteristics, as outlined in SLF/Vulnerability frameworks. White’s (2010) adapted WeD includes environmental resources within “social wellbeing”. However, this study separates environmental and social wellbeing to facilitate a specific focus on the environmental context. Furthermore, despite this study primarily interpreting “**Environment**” as a wellbeing “determinant” (Schleicher et al., 2018a), the arrows between “landscape” and “natural capital/perceptions” offer flexibility to also interpret “**Environment**” as a wellbeing “constituent”.

2.6.1.3 *Exposure & Wellbeing*

“**Exposure**” illustrates how the “**Environment**” conditions differ in varying locations. Drawing on the IPCC (2024) “risk” definition (p.82), “**Exposure**” is a key component, yet not a determinant, of “risk”. Communities may be exposed, yet not at risk to hazards, depending upon their “**Sensitivity**” and “**Adaptive Capacity**” (section 2.6.1.4).

“**Wellbeing**” incorporates the five SLF capitals, within separate, yet connected, OWB and SWB concepts (Nunan, 2015); an idea borrowed from WeD. Subjective perceptions are aligned with

objective capitals to reflect the interdependence between OWB and SWB (Atkinson, 2013). The importance of capturing OWB *and* SWB is underscored by the growing recognition of cultural ESs in sustainable development research, with non-tangible services only existing through individuals' perceptions of tangible landscapes (Buchel & Frantzeskaki, 2015). Previous research illustrates SWB to be sensitive enough to capture wellbeing differences across landscapes and agricultural systems, "supporting the...inclusion of such measures in sustainability frameworks" (Brown et al., 2021;1).

Using broad capitals and perceptions provides an overarching structure for "**Wellbeing**" to be flexibly interpreted based on target communities' experiences, the study's aims, and the available data (Fisher et al., 2013). Detailed interactions between ESs and "**Wellbeing**", as presented in MEA (2005), are not incorporated within the "ECW" framework to maintain the study's broader focus on "environmental conditions", and to mitigate the challenges of accessing comprehensive ES quality data (Alcamo, 2003).

Incorporating subjective perceptions also addresses criticisms that SLF focuses on objective "checklists", fails to capture meanings attached to livelihood resources, and promotes neoliberalism within development studies (De Haan, 2012). Amending SLF to incorporate elements from a "wellbeing" framework approach (Nunan, 2015) supports mixed method research and challenges the traditional dominance of quantitative methods in sustainability and environmental justice studies (Althor & Witt, 2020). Furthermore, the framework is primarily designed to explore wellbeing at a household unit of analysis; acknowledging how resources and wellbeing can be accessed and experienced collectively (Laderchi et al., 2003). However, by including subjective perceptions the framework offers opportunities for in-depth research into how individuals' conceptualise wellbeing.

Objective capitals and subjective perceptions are interrelated. These associations can be positive and/or negative (illustrated by "+/-"). For example, education (human), cooperatives (social) and livelihood assets (physical) can *increase* financial capital, whereas social capital may grow in response to *decreasing* financial capital (Woolcock & Narayan, 2000). See Appendix (2.3) for examples of how OWB/SWB components associate generally, and within an environmental context.

Incorporating interconnecting OWB/SWB components overcomes the limitation of assuming singular wellbeing measures capture "comprehensive" wellbeing (White, 2016). By acknowledging potential relationships between capitals/perceptions, and permitting different elements to be flexibly interpreted within different categories, the "ECW" framework also partly addresses Gough & McGregor's (2007) criticism of frameworks that confine assets to single dimensions (i.e., SLF). Nevertheless, from a policy perspective it is recognised there is a

balancing act between using an adaptable framework to capture local complexities, and a structured model with broad categories to improve interpretability, facilitate analytical comparability and ensure key wellbeing elements defined within the literature are not overlooked (Loveridge et al., 2020).

The framework depicts **“Wellbeing”** as dynamic within time and space, see **“Relational context”** (section 2.6.1.6). However, unlike WeD which views **“Wellbeing”** exclusively as a process, the **“ECW”** model acknowledges how elements can serve as outcomes *and* processes. A wellbeing outcome is not a definitive endpoint, it can be reshaped and reconceptualised across time and space, or contribute towards further wellbeing goals by controlling **“Adaptive capacity”** and/or **“Sensitivity”**. However, from a pragmatic policy perspective, **“Wellbeing”** needs to be quantified as an achievable outcome so it can be monitored and evaluated at a given time (Sachs et al., 2019).

Another adjustment to White’s (2010) WeD model relates to how it includes social and personal relationships within **“relational”** wellbeing; **“relationships are not, as in a social capital approach, something that an individual ‘has’”** (p.164), but rather a process which shapes individuals’ identities and beliefs. Relationships can shape individuals’ values and how wellbeing is conceptualised; however, the **“ECW”** framework maintains social capital/perceptions as wellbeing outcomes to acknowledge how trusting relationships can innately improve SWB (Tsai & Dzorgbo, 2012), and how reciprocal networks can contain crucial resources to provide tangible benefits, such as improved food security (Craig et al., 2023).

Within the framework, **“Wellbeing”** can feedback to influence (i) **“Environment”**, for example increased financial OWB may encourage more-intensive agricultural practices and increase land degradation (Bhattacharya & Innes, 2013), (ii) **“Exposure”**, for example actors with higher financial and human capital often congregate within less-vulnerable landscapes (Navarro, 2017). However, the impact of **“Wellbeing”** upon **“Environment”** is beyond this study’s scope.

Accessing reliable LMIC data for environment-wellbeing research is challenging (Kamanda & Sankoh, 2015; Ndabarora et al., 2014). Appendix (2.4) outlines the ideal wellbeing measures required to study the **“ECW”** framework if data availability was not a limitation. Despite the framework containing ten distinct capitals/perceptions, certain measures overlap different groups.

2.6.1.4 *Adaptive capacity & Sensitivity*

Objective capitals and subjective perceptions are included as ends of wellbeing (SOAS, 2022), as means to further wellbeing goals (Atkinson, 2013), and as factors controlling “**Adaptive capacity**” and “**Sensitivity**” (vulnerability) (Cardona et al., 2012). This approach contrasts SLF which only incorporates capitals as means to wellbeing (Fisher et al., 2014), and does not explicitly include “**Adaptive capacity**”, “**Sensitivity**” or interconnecting OWB/SWB components. For example, financial OWB may generate trusting relationships (social perception), which can boost SWB (Dzokoto et al., 2019) and feedback to increase “**Adaptive capacity**” by facilitating access to community resources during environmental pressure (Ayentimi et al., 2021).

Many studies adjoin “**Adaptive capacity**” and “**Sensitivity**” within the concept of “vulnerability” (Moss et al., 2001; Scott, 2006); however a distinction can be made. Weis et al. (2016) defines “**Sensitivity**” as the “characteristics of a community that influence its likelihood to experience harm” (p.620); for example, low-quality housing materials (physical capital) increasing the potential for damage during intense precipitation (Atiglo & Codjoe, 2017). This definition suggests “**Sensitivity**” is controlled by objective assets and resources. However, the “ECW” framework highlights the capacity for subjective perceptions to also influence “**Sensitivity**”; for example, communities’ with a stronger affiliation to nature, or place attachment, may experience disproportionately larger SWB reductions following land degradation (Albrecht et al., 2007).

Next, “**Adaptive capacity**” refers to the ability for actors to adjust, or take advantage, of changing conditions (Pörtner et al., 2022); incorporating “asset-based components...[and] less-tangible aspects such as flexibility [and] innovation” (Weis et al., 2016;620). Therefore, similar to “**Sensitivity**”, “**Adaptive capacity**” can include objective and subjective elements. For example, education (human capital) can increase access to climate forecast information to support flexible farming (Muttarak & Lutz, 2014). Likewise, subjective perceptions may influence “**Adaptive capacity**” in several ways: (i) place attachment (social) deterring migration (Adger et al., 2013), (ii) perceived financial stress (financial) disincentivizing investment (Cooper et al., 2008; Gollier & Pratt, 1996), (iii) outgoing personality traits (human) increasing the willingness to change/innovate during environmental pressure (Rashid et al., 2020). These examples counter Nyamwanza’s (2012) assertion that “adaptive capacity is largely a function of [objective] resources or assets inherent in and accessible to a given system” (p.3). The “ECW” framework illustrates how the SLF capitals, and corresponding perceptions, do not only mediate actors’ environmental “**Sensitivity**”, as outlined in Scott’s (2006) Vulnerability framework, but also their “**Adaptive Capacity**”.

Different capitals and perceptions can influence “**Adaptive Capacity**” and “**Sensitivity**”; however, if a study aims to visualise the spatial distribution, or quantify communities’ “**Adaptive Capacity**” and “**Sensitivity**”, individual indicators must be assigned to *one* of these distinct concepts. The indicator classification can be governed by the research aims, or by what is considered most relevant to target communities. For example, within traditional agricultural communities, education (human capital) may increase “**Adaptive Capacity**” by improving access to new technologies, rather than reducing “**Sensitivity**” through the provision of alternative livelihood options which may not align with cultural identities (Brown et al., 2021). Nevertheless, the framework is flexible in allowing different capitals and perceptions to be allocated differently; for example, poor health, also representing human capital, may conversely be interpreted as impacting “**Sensitivity**” due to its capability to amplify the harm caused by hazards. Acknowledging households’ varying levels of OWB/SWB to control “**Adaptive capacity**” and/or “**Sensitivity**” also implicitly incorporates ideas of social differentiation in resources, rights and capabilities; noted in EEE (Fisher et al., 2013).

The framework also illustrates “**Adaptive capacity**” and “**Sensitivity**” to govern “**Response**”. For example, households with coastal cropland (natural/physical capital) may be more sensitive to salinisation, and therefore respond through afforestation or by constructing flood defences, provided household members possess the necessary skills (human capital). Additionally, how an individual conceptualises “**Wellbeing**” may shape which “**Response**” is desired (Appadurai, 2004).

This thesis references how objective and subjective elements can impact “**Adaptive Capacity**” and “**Sensitivity**”. Following the IPCC risk model, the “ECW” framework differentiates between these concepts to illustrate the two channels in which climatic impacts upon “**Wellbeing**” and “**Response**” are mediated.

2.6.1.5 *Livelihoods*

As outlined in SLF, access to different objective capitals governs livelihood practices (Scoones, 1998). For example, higher levels of education (human) and land rights (social/natural/physical) may influence rural workers’ land management strategies (Muttarak & Lutz, 2014), whereas access to high-quality transport infrastructure (physical) may affect whether crop farmers engage with subsistence or commercial agriculture (Chamberlin, 2007; Stifel et al., 2003). Furthermore, by connecting “**Livelihoods**”, OWB and SWB components together, the “ECW” framework acknowledges how livelihood type can control how communities conceptualise “wellbeing”, what capitals/perceptions are strived for, and how wellbeing is experienced

(Appadurai, 2004; Dzokoto et al., 2019); expanded upon in Chapter 5 when comparing wellbeing priorities across livelihood groups. In the other direction, the framework also illustrates how subjective perceptions can shape livelihood strategies; for example, intergenerational identities or social obligations may lead individuals to desire agricultural livelihoods (Brown et al., 2021).

By recognising wellbeing capitals and perceptions to govern livelihood practices, the “ECW” framework is novel in encompassing both “livelihood” and “wellbeing” approaches (Nunan, 2015); permitting the exploration of broad, quantifiable trends (livelihood approach), *and* in-depth understandings of individuals’ values and conceptualisations (wellbeing approach).

“**Livelihoods**” are also crucial in controlling environmental “**Sensitivity**”. For example, a subsistence farmer and public sector office worker may be exposed to drought; however, drought may only constitute a *risk* to the farmer due to the interconnectivity between ESs, food security and health (Kuenzer & Renaud, 2012). Therefore, incorporating “**Livelihoods**” can enhance the understanding of how similar hazards may impact households’ responses, OWB *and* SWB differently.

Households’ livelihood practices partly govern the most appropriate “**Response**” to environmental pressure. However, as illustrated by the bidirectional arrow in the framework, “**Response**” may also feedback to change “**Livelihoods**”; for example, by introducing new farming technologies, diversifying income streams, or migrating to a new location with different economic sectors (Funk et al., 2020).

2.6.1.6 *Relational context*

Wellbeing exists within the “**Relational context**” (White, 2010), as wellbeing conceptualisations and environmental associations, are influenced by the spatio-temporal context (Diener et al., 2009; Duku et al., 2022). Therefore, similar to “**Global Drivers**”, acknowledging the “**Relational context**” ensures environmental and wellbeing challenges are not viewed in a vacuum, but within the context of broader social structures and inequalities. This perspective contributes towards upholding cultural awareness within research by ensuring external assumptions are not unanimously applied in various contextual settings (Fadji et al., 2021).

By framing OWB/SWB within the “relational”, the framework ensures a “complete” view of wellbeing by recognising the “psychological linkages between the person and [their] primary membership groups” (Lent, 2004;489). Connecting the divide between individual and collective wellbeing is pivotal within environment-wellbeing research where the spaces in which wellbeing is experienced often link to cultural ESs and collective practices (Atkinson, 2013). Additionally,

acknowledging **"Wellbeing"** and **"Environment"** to be constructed within a specific temporal context supports research on how environmental change may reshape how wellbeing is conceptualised and experienced over different timescales.

The "ECW" framework adapts WeD by interpreting the "relational" as a mediating process, shaping how elements of OWB and SWB are valued and associate, and how environmental conditions associate with different outcomes (Figure 2.19). This interpretation bridges the gap between OWB and SWB, and contrasts WeD which incorporates "relational" as a component of the wellbeing trifecta (Figure 2.16). These ideas are supported by Atkinson (2013) who states relationships between wealth, health and happiness are influenced by how social norms determine what is valued within society. Therefore, the framework provides a broad overview of key wellbeing elements; however, whether all capitals/perceptions are incorporated within a community's wellbeing conceptualisation depends upon what is valued in the **"Relational context"**.

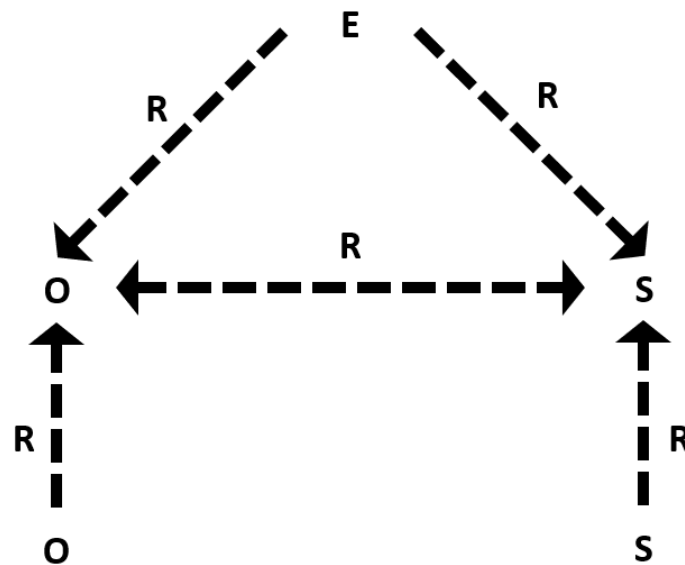


Figure 2.19 Visualisation of how the relational (R) acts as a mediating process within time and space, influencing the relationships between OWB (O), SWB (S) and environment (E)

Despite the "relational" appearing to be more relevant when interpreting SWB, it is also recognised how contextual processes can influence which objective capitals are perceived to be achievable and desirable within a given time and space (White, 2010). For example, differences in exposure to (post)colonial investment across Volta Delta may contribute to varying levels of importance being attached to financial capital (Kambala, 2023). This relational effect may result in communities requiring differing levels of wealth to achieve a similar SWB level, or climate hazards which reduce economic activity having a larger SWB impact in certain

locations. The extent to which climate hazards impact SWB may also be influenced by a community's temporal context (i.e., if similar events occurred before) (Figure 2.19).

By interpreting the "**Relational context**" broadly, the framework facilitates the inclusion of multidisciplinary ideologies; including political and black ecologies. Firstly, political ecology hypothesises environmental challenges, produced by "actors who pursue different interests and have unequal agency and power" (p.157), to result in marginalisation and inequality (Greiner & Sakdapolrak, 2016). For example, as illustrated in EEE (Figure 2.9), the capability to translate ESs into wellbeing outcomes could be restrained by authoritative natural resource governance, exemplified by the privatisation of Songor Lagoon (section 6.3.2.3), or social obligations such as gendered domestic roles, which form over time.

The "**Relational context**" can also be understood through black ecology, which suggests power-laden processes of colonisation have transformed environment-human relationships. West African land shifted from having "good use", meaning it is "a source of spiritual and material nourishment connecting families to past, present, and future" (p.8), to "rational use", with intense agricultural practices, privatisation and commodification (Davis et al., 2019; Millner, 1994). Therefore within the "**Relational context**", agricultural land within modern-day Ghana may contribute towards wellbeing through its capacity to produce tradable products, rather than its intrinsic value.

Incorporating current and historic processes of power and inequality (Ayanoore & Hickey, 2022) ensures studies do not assume communities' environment-wellbeing associations form in isolation (Tosam & Mbih, 2015). This perspective aligns with the IPCC risk framework which views "high vulnerability and exposure [to be] an outcome of skewed development processes", including uneven investment patterns and natural resource mismanagement (Cardona et al., 2012;70). Although unable to capture these broad, theoretical ideas within quantitative modelling, acknowledging their influence is necessary when attempting to decolonise research¹⁸ (Smith, 2021).

The "relational" view supports policy by incorporating individuals' multiple ways of valuing nature (Arias-Arévalo et al., 2018), improving understanding of communities' behaviours, and discouraging ineffective blanket approaches (Walsham, 2020). For instance, policies assuming unanimous benefits from cropland expansion may reduce SWB in contexts where communities' identities are attached to pre-existing landscapes (Gross-Camp et al., 2019). This impact on

¹⁸ It is recognised that this research project is not fully decolonized. Despite attempts to gather local voices and acknowledge past and current power dynamics, certain assumptions and methodologies including statistical modelling, are grounded in Western thinking and knowledge generation.

policy buy-in is exemplified in Tanzania, where despite community-based forest management projects increasing objective inequality, many disadvantaged communities supported the project due to the pride derived from engaging with external organisations and actively conserving their environment (Gross-Camp, 2017).

Examples of a Ghanaian "good life" are referenced throughout this thesis (Dzokoto et al., 2019; Osei-Tutu et al., 2020) to reflect the national "**Relational context**". For example, the prioritisation of health (Addai et al., 2014a) could reflect long-standing poor healthcare access in rural Ghana, or the increasing threats from climate-related diseases such as malaria (Fadiji et al., 2021; Glozah et al., 2021). Similarly, the importance of reciprocal relationships, particularly within religious settings (Sulemana, 2015), may relate to how insufficient credit access (Lyon, 2000) and limited social support services result in individuals placing greater value upon faith and collective forms of material and emotional support (Pokimica et al. 2012).

Figure 2.18 depicts "**Relational Context**" as a broad, all-encompassing concept across the environment-wellbeing system. This illustration is simplified to minimise the visual complexity of the "ECW" framework. "Relational" factors are interpreted as mediating processes, shaped over time and space; therefore, in practice the "relational" actually sits within each of the dynamic arrows within the framework, as illustrated by specific case studies (section 7.3).

2.6.1.7 *Response*

Lastly, adapted from DPSWR, SLF and Vulnerability frameworks, individuals' and communities' agency to respond to environmental and wellbeing changes is captured within "**Response**". This component incorporates households' tangible actions to address environmental, wellbeing or livelihood changes. The "**Response**" depends upon actors' "**Adaptive capacity**" and "**Sensitivity**"; contrasting traditional "vicious circle" theories which assume unavoidable negative environment-wellbeing relationships (Nunan, 2015).

"**Response**" is expanded to include short-term coping (Chambers & Conway, 1992), environmental and livelihood adaptations; adopted from Vulnerability framework (Scott, 2006). These actions can feedback to alter the environmental context, alongside households': (i) "**Exposure**", migrating to a location with favourable conditions or constructing flood defences, (ii) "**Sensitivity**", transitioning from rain-fed to irrigation farming reduces drought sensitivity, (iii) "**Wellbeing**", lower exposure and sensitivity can reduce the adverse effects of climate hazards upon individuals' financial and physical health (Fisher et al., 2013). However, the impacts of "**Response**" and "**Wellbeing**" upon "**Environment**" are beyond this thesis' scope.

Overall, the “ECW” framework is innovative in supporting research on the interaction between OWB *and* SWB, and how environmental conditions and the “**Relational context**” impact these relationships over various spatio-temporal scales. The following chapter introduces the survey dataset, evaluates OWB/SWB measurement within LMICs, and explores relationships between different wellbeing measures.

Chapter 3 Understanding wellbeing: Evaluating objective and subjective measures and their associations

3.1 Introduction

This chapter evaluates wellbeing measurements, focusing on the **“Wellbeing”** component of the framework (Figure 2.18), to illustrate the sensitivity of results to measurement selection and the importance of methodological transparency in research and policy. Firstly, general advantages/disadvantages of OWB and SWB measures are summarised, followed by a detailed evaluation within a vulnerable LMIC context. Benefits/challenges of using different measures when implementing and monitoring policy are outlined before select measures are recommended for further analysis, including regression modelling in Chapter 4.

As illustrated in the framework, OWB and SWB are distinct, yet interconnected, concepts. This chapter investigates how OWB/SWB relate; drawing on existing literature and associations within the survey dataset. This chapter does not explicitly test how one wellbeing outcome contributes towards another, but utilises association tests to support and structure conceptual discussions related to the following RQs:

1. How are OWB and SWB measured within an environmental context?

- b. Critique pros and cons of different OWB and SWB methodologies within LMICs.
- c. Identify and compare results of different methodological approaches to OWB and SWB.
- d. Select appropriate wellbeing measures for further analysis on environment-wellbeing relationships.
- e. Examine associations between different OWB and SWB measures.

Despite “wellbeing” being increasingly recognised as a policy outcome (White, 2010), and greater awareness of the intertwinement between human needs and pressures on supporting ecosystems (Schleicher et al., 2018a), studies examining different wellbeing conceptualisations, and how different measures associate, are limited within the field of sustainability. Consequently, sustainable development must contribute towards a comprehensive understanding of wellbeing, encompassing dimensions beyond traditional material and financial elements (Helne & Hirvilammi, 2015).

3.2 Introduction to measures

To evaluate OWB/SWB measurement methodologies (RQ1b), this section draws on different conceptualisations to summarise general advantages/disadvantages (introduced in section 2.2), and specific challenges within vulnerable LMICs. OWB encompasses tangible concepts relating to quality of life, such as monetary resources and access to essential services (Eid & Larsen, 2008), while SWB captures individuals' internal assessments and cognitive judgments (Veenhoven, 2009), including self-reported happiness and financial status.

A consensus on the “best” wellbeing measure has not been found, with contrasting approaches across different disciplines. Cooke et al. (2016) illustrate the breadth of available measures by identifying 42 wellbeing instruments in psychology literature alone. Nevertheless, regardless of the data or terminology, each wellbeing approach has the same overarching goal, “to identify what constitutes the good life or optimal functioning” (p.733).

This chapter explores strengths/weaknesses of wellbeing measurements by drawing on Laderchi et al.'s (2003) key challenges (Figure 2.1). Critically evaluating measures is necessary when interpreting reported outcomes and implementing effective policy at multiple scales (Cooke et al., 2016). The four wellbeing measures - financial wellbeing, basic needs deprivation (OWB), financial stress and unhappiness (SWB) - were selected based on the data available within the survey dataset (section 3.6). Additionally, these measures represent distinct conceptualisations, enabling an exploration of how different approaches influence research findings and policy priorities. For instance, examining financial wellbeing and basic needs deprivation can uncover differences between measuring “potential” and “realised” wellbeing (Gasper, 2007).

3.3 Evaluating OWB measurements

3.3.1 Financial wellbeing (OWB)

This section explores financial OWB, often defined by households' income/expenditure/consumption against a pre-determined poverty threshold (Kingdon & Knight, 2006). A general summary is presented (Figure 3.1), followed by specific challenges within an environmentally vulnerable LMIC context.

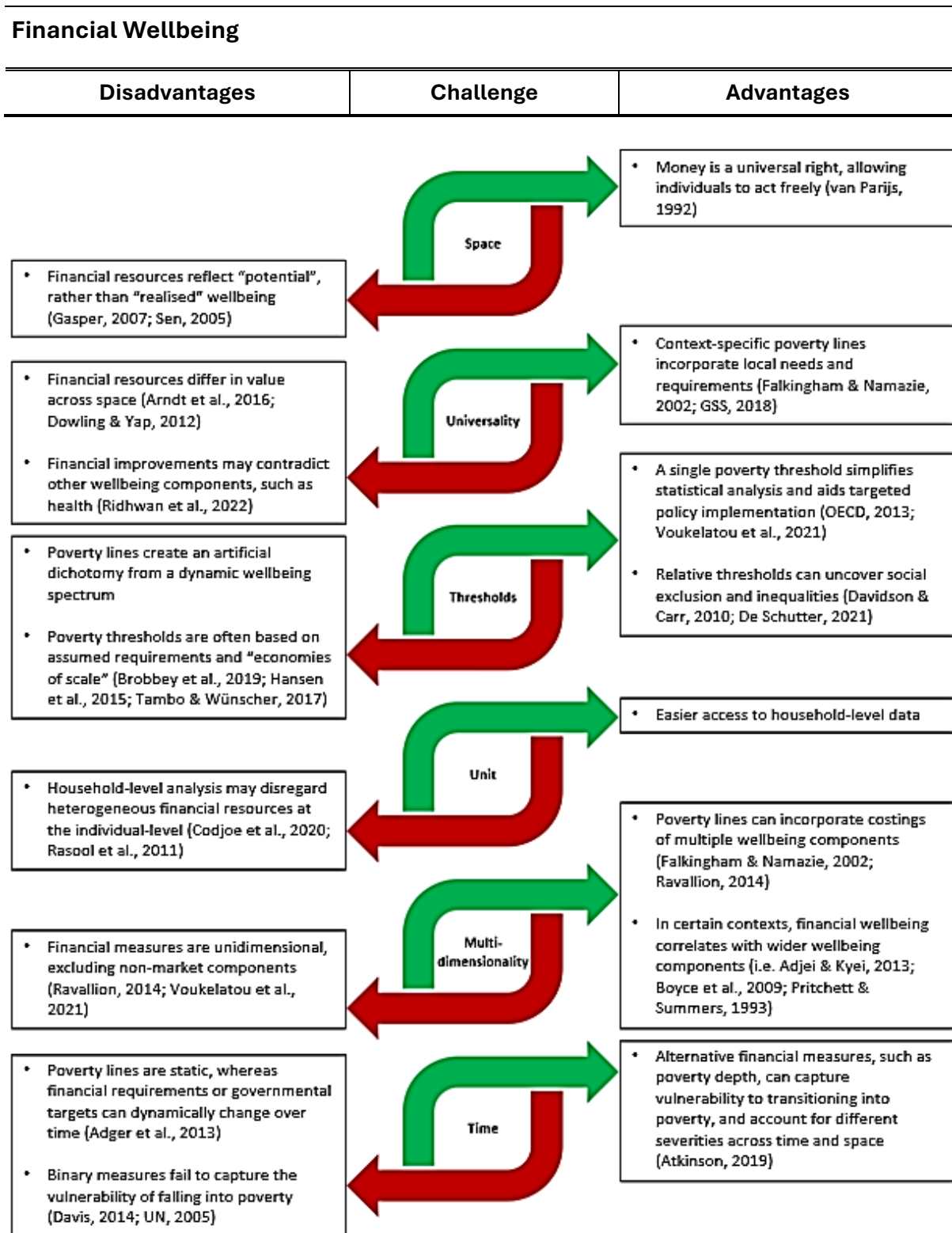


Figure 3.1 Summary of the key advantages and disadvantages of objective financial wellbeing measures, as detailed in section (2.2.2.1), grouped by Laderchi et al.'s (2003) core measurement challenges

3.3.2 Financial wellbeing in LMICs: challenges & choices

The overarching challenge of OWB measurement in LMICs is the “statistical tragedy” (Klasen & Blades, 2013); illustrated by revised GDP figures resulting in Ghana transforming from a low-income to middle-income country overnight (Jerven, 2013). All measures have advantages/disadvantages; “there is no ideal measure of wellbeing, approach all measures...with...caution, and...ask how measures are constructed” (Haughton & Khandker, 2009;34). The selected methodologies depend upon the research aims; however, certain measures are more appropriate within LMICs (Atkinson, 2019). This section explores challenges surrounding data type, thresholds, equivalisation and scale.

3.3.2.1 *Income, expenditure or consumption?*

Different data types (income/expenditure/consumption) can alter financial OWB outcomes and trends. Financial OWB is commonly defined by income in HICs where most work in formal employment with up-to-date financial records, contrasting LMICs with informal employment, poor records and non-monetary payments. Additionally, LMIC incomes are volatile due to seasonal labour and climatic uncertainty (Atkinson, 2019; UNECE, 2017), potentially producing inconsistent results. For example, households may experience poverty during fallow periods, yet not during harvests. Furthermore, income is susceptible to survey error due to recall and social desirability bias, and difficulties in quantifying non-monetary payments (Haughton & Khandker, 2009).

Expenditure, defined as the value of “goods and services directly satisfy[ing] a person’s [immediate] needs” (OECD, 2013;41), produces less-erratic measurements as it incorporates households’ use of savings and loans to maintain living standards (Davis, 2014). Nevertheless, expenditure can also follow seasonal patterns (Jolliffe, 2014; Korboe et al., 2011). Extending the survey question’s timeframe can mitigate seasonal fluctuations, yet brings additional recall burden, especially for individuals with varied spending habits. In contrast, short timeframes may introduce bias if capturing irregular one-off purchases (Atkinson, 2019). Furthermore, despite World Bank (2005) suggesting survey errors are lower for expenditure estimates than income in LMICs, expenditure can be underestimated when disclosing socially unacceptable purchases (Haughton & Khandker, 2009).

Expenditure also incorporates “choice”, therefore households may be incorrectly defined as experiencing poverty if they decide not to spend certain amounts (World Bank, 2005). Low expenditure may also not correlate with broader OWB; for example, homeowners with public

service access spend less on rent and private services (ONS, 2018; Wietzke, 2015). Cost-of-living also varies spatially and temporally, especially within volatile LMIC economies; therefore, outdated price indices for different goods/services can reduce accuracy (Ferreira et al., 2016).

“Consumption” is the third financial OWB measurement tool. Consumption incorporates services, such as healthcare, durable goods and domestic produce. Estimates are smoother over time, with “consumption” producing lower inequality estimates due to poorer households accessing public services and consuming their own produce. Therefore, “consumption” potentially better reflects financial OWB in subsistence economies (UN, 2005). The impact of data type is illustrated by Nicaraguan poverty (<\$1.90/day) reducing <10% (1990-2005) when using income, yet lowering 30% when using consumption (Atkinson, 2019). However, measuring “consumption” faces challenges, including data availability and attaching monetary values to durable assets (Ferreira et al., 2016).

3.3.2.2 *Thresholds*

Financial OWB can be defined using absolute or relative thresholds. The former uses a set poverty line, whereas the latter uses a threshold based on the population’s financial distribution (Haughton & Khandker, 2009). Relative measures provide information on social exclusion and inequality, yet may underestimate poverty in populations with widespread financial insecurity (Garroway & de Laiglesia, 2012). Consequently, absolute rates are favoured in LMICs, yet if improvements are made, shifting towards improving equality and relative poverty is justified (Falkingham & Namazie, 2002). Furthermore, absolute measures fulfil the key measurement axiom “changes in the non-poor should not influence poverty measurement”, contrasting relative measures where changes in the overall distribution can alter households’ outcomes. However, absolute measurements do not address the axiom: “an increase in a poor person’s income should reduce overall poverty” (UN, 2005).

3.3.2.3 *Equivalisation*

Equivalisation addresses “unit-scale” challenges (Laderchi et al., 2003), yet also influences financial OWB outcomes. Equivalisation permits household comparison by accounting for differences in household size, age composition and “economies-of-scale” (Batana & Cockburn, 2018; OECD, 2011). “Economies-of-scale” refer to how the financial resources required for certain living standards are inconsistent across households, and do not rise proportionally with household size. For example, five-person households do not spend five-times the amount on

durable assets as one-person households. Furthermore, larger households have higher productivity and efficiency; for example, similar resources are needed to cook for four-person and two-person households. Additionally, children have lower needs (i.e., food consumption); therefore, households with children require less expenditure than all-adult households of the same size (Nelson, 1988). However, equivalisation scales assume constant “economies-of-scale” across space, disregarding potential differences in efficiencies and social norms between households (Laderchi et al., 2003).

Multiple equivalence scales with varying “economy-of-scale” assumptions, exist (Table 3.1); ranging from “per capita” (i.e., World Bank international poverty estimates) to specific weights being applied to different household members. Financial OWB estimates are sensitive to scale choice (Éltető & Havasi, 2002; Lanjouw & Paternostro, 1998; Regier et al., 2019), exemplified by 2013 SSA poverty reducing 54.6% to 22.6% when adjusting a <\$1.90/day poverty line with the “OECD-modified” scale (Atkinson, 2019). In contrast, other studies suggest per-capita and equivalised poverty estimates can be similar (Haughton & Khandker, 2009; Streak et al., 2009). There is no consensus on the “best” scale, as measurements depend on context-specific practices and household structures (Atkinson, 2019); therefore, sensitivity testing is crucial.

Table 3.1 Examples of the different equivalation scales available, with an example of the scale used for a 4-person household with two adults and two children

Age category	Equivalence scale				
	Per-capita	Old-OECD	OECD-modified	Square root	Entire household
First adult (15+ years)	1	1	1	Square root of household size	1
Child (<15 years)	1	0.5	0.3		0
Additional adult (15+ years)	1	0.7	0.5		0
Example: 2 adults, 2 children	4	2.7	2.1	2.0	1

“Economies-of-scale” are commonly lower in LMICs than HICs due to larger proportions of expenditure spent on non-sharable resources (i.e., food) (World Bank, 2005); particularly during climate-induced scarcity where food prices rise (Adger et al., 2020). Nevertheless, many LMIC studies use Eurocentric OECD methods (Brobbe et al., 2019; Hansen et al., 2015; Tambo & Wünscher, 2017), potentially underestimating poverty by assuming higher “economies-of-scale”. In contrast, GSS (2018) attempts to capture national-specific “economies-of-scale” using a scale based on calorie-intake by age/gender (Table 3.2). However, this method uses

1989 dietary requirements, potentially misrepresenting modern consumption patterns (National Research Council, 1989). Furthermore, using calorie-intake may introduce bias by assuming “perfect resonance between all basic functionings” (Marivoet & De Herdt, 2015;333). If adults require double the calories of children, it assumes double the expenditure is required to achieve certain living standards; however, this ignores how other needs, such as healthcare, may require similar expenditure.

Table 3.2 Equivalation scale used by the GSS (2018), based on dietary requirements of different ages and genders - recorded by the National Research Council (1989)

Category	Age group (years)	Average energy allowance per day (kcal)	Equivalence scale
Infants	<1	650	0.22
Children	1 to 3	1,300	0.45
	4 to 6	1,800	0.62
	7 to 10	2,000	0.69
Adult males	11 to 14	2,500	0.86
	15 to 18	3,000	1.03
	19 to 25	2,900	1.00
	26 to 50	2,900	1.00
	51+	2,300	0.79
Adult females	11 to 14	2,200	0.76
	15 to 18	2,200	0.76
	19 to 25	2,200	0.76
	26 to 50	2,200	0.76
	51+	1,900	0.66

3.3.2.4 Scale

A common criticism of financial OWB is the household unit of analysis, often selected due to limited access to high-cost individual-level data, and difficulties in assigning expenditure to individuals (Laderchi et al., 2003). Household-level financial measures assume homogeneous access and capabilities (Haughton & Khandker, 2009); however, this assumption is countered by studies in rural India showing female poverty to rise 14% when using individual, rather than

household data (Klasen & Lahoti, 2021). Furthermore, household-level analysis may hide opposing wellbeing outcomes; for example, Das et al. (2013) illustrated higher household financial OWB in Bangladesh, driven by increased livestock access, to coincide with lower financial autonomy amongst women due to heightened labour demands. Additionally, wellbeing is often conceptualised “collectively” within LMICs; therefore, aggregating household-level wellbeing within communities may not reflect local interpretations (Schaafsma, 2021). Nevertheless, despite limitations, this study measures household-level financial OWB due to data availability (Codjoe et al., 2020a). The next section evaluates basic needs deprivation measurement.

3.3.3 Basic needs deprivation (OWB)

Basic needs deprivation (BND) uses objective-list theory (Table 2.1) to define OWB through the fulfilment of core human requirements; ranging from “survival” to “productive survival” (Streeten & Burki, 1978). BND can encompass various indicators to capture the capitals outlined in the framework (Figure 2.18). This section summarises general advantages/disadvantages (Figure 3.2) before exploring challenges within vulnerable LMICs.

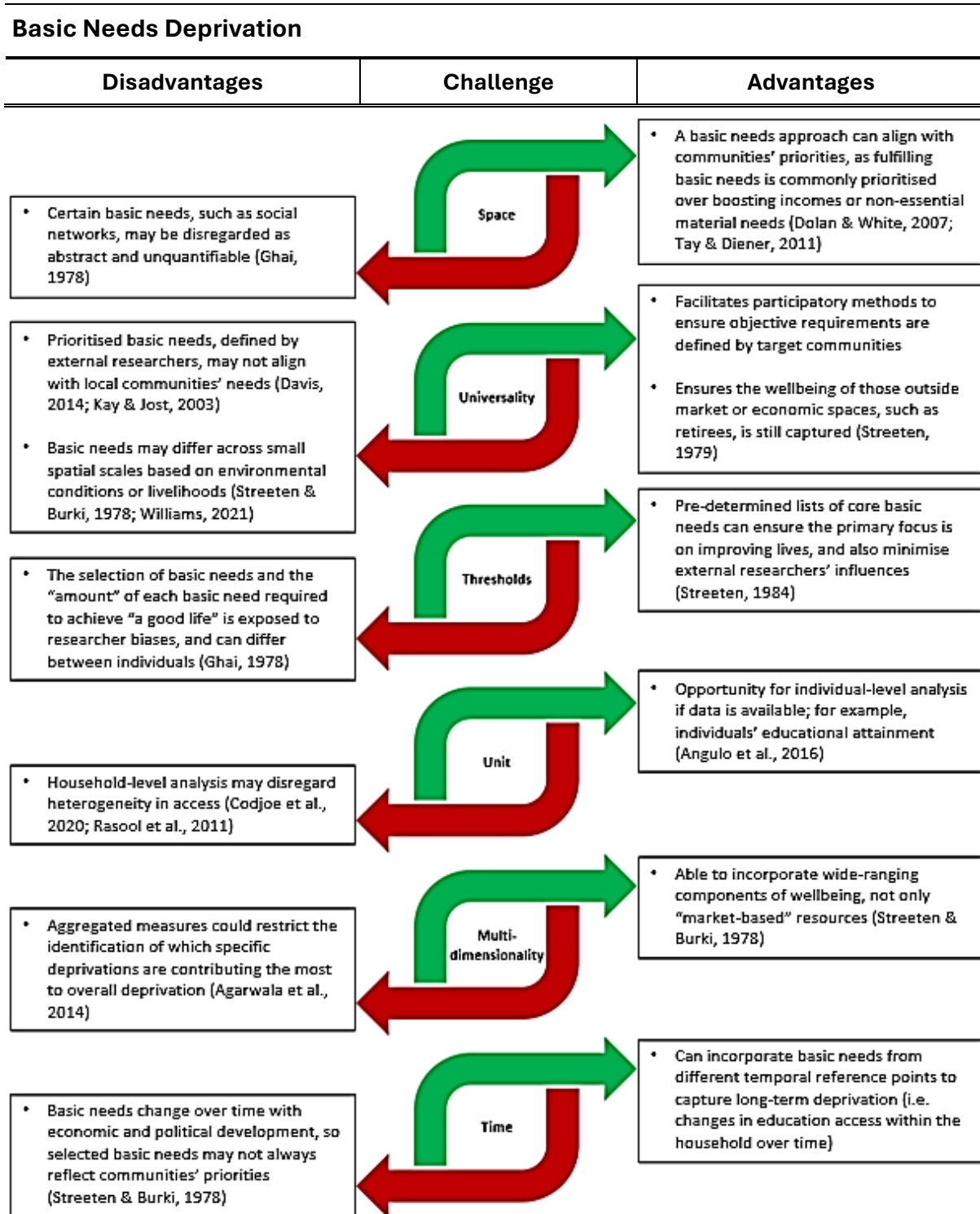


Figure 3.2 Summary of the key advantages and disadvantages of objective basic needs deprivation measures, as detailed in section (2.2.2.1), grouped by Laderchi et al.'s (2003) core measurement challenges

3.3.4 Basic needs deprivation in LMICs: challenges & choices

Wellbeing is multidimensional, with basic needs often prioritised over financial growth in LMICs (Addison et al., 2008; Alkire & Santos, 2010). Therefore, BND measures may more accurately reflect OWB than unidimensional financial measures. However, collecting timely BND data from LMICs, such as school attainment (Kamanda & Sankoh, 2015) and health information, is challenging (Klasen & Blades, 2013). Additionally, despite BND better reflecting “realised” wellbeing than financial OWB, BND may still only represent “potential” wellbeing if insufficient institutions, or climate hazards, restrict individuals from using their resources to maximise wellbeing (Gasper, 2007). This section focuses on the challenges of selecting indicators and weighting.

3.3.4.1 *Basic need selection*

Objective list approaches may fail to reflect local priorities if paternalistically pre-defined by external researchers without acknowledging the “relational context” (Davis, 2014). A disparity between researchers’ and communities’ goals may also lower policy buy-in (Kay & Jost, 2003).

BND measurement also encounters threshold challenges (Figure 2.1); for example, how much education is “enough” (Alkire & Foster, 2011)? Using externally-defined thresholds across space may introduce bias, as primary education may suffice for farmers, yet higher education is required amongst urban business owners. Individuals’ needs are also dynamic; for example, the prioritisation of “employment” may be superseded by “health” during climatic hazards. Therefore, BND measures within LMICs exposed to environmental, social and economic challenges must be interpreted within the current context (Wong, 2012). Nevertheless, if time/cost restraints allow, BND can flexibly incorporate communities’ self-defined needs or weightings to account for different communities’ and subgroups’ current priorities (Chapter 5); addressing the “universality” challenge (Figure 2.1).

3.3.4.2 *Weighting*

Weightings are applied to different components of multidimensional measures to reflect their value to “a good life” (Decancq & Lugo, 2013). Multiple weighting approaches are available (Table 3.3); however, weighting selection can influence measured outcomes and reduce objectivity (Diener & Suh, 1997). For example, if weighting is not explicitly included, all

components are assumed equally important, which may not reflect reality (Esposito & Chiappero-Martinetti, 2008).

Table 3.3 Different weighting approaches for multiple deprivation measurement, based on Decancq & Lugo (2013)

Weighting type	Description
Equal	Each measure is weighted equally.
Nested	Individual measures are nested within overarching categories/capitals. Overarching categories/capitals are weighted equally. Example: 10 measures allocated across 5 categories. Each category has a total weight of 2. Each measure in a category with 4 measures is weighted 0.5.
Frequency-based	Less-common deprivations are weighted higher than widespread deprivations. Example: 75% households are deprived in food security; a 0.25 weight is applied. 10% households have unsafe sanitation; a weight of 0.90 is applied.
Statistical	Principal components analysis (PCA) generates statistical loadings/weights based on the correlation of each measure to the overall principal component; which explains the most variation in the different deprivation indicators. A PCA “creates uncorrelated components, where each component is a linear weighted combination of the initial variables” (Vyas & Kumaranayake, 2006;451).
Community preference-based	Communities rank or order different components based on the self-evaluated importance to their overall wellbeing.
Expert-based	Scientific experts or policymakers rank different components of multiple deprivation, this may be done via a “budget allocation” exercise.

Equal weighting, as used in the UN Human Development Index, ensures consistency across studies and mitigates the influence of individual researchers’ assumptions. However, it fails to capture trade-offs and the “hierarchy of needs” across space (Decancq & Lugo, 2013). For example, piped water may be more essential for inland, drought-impacted communities than coastal villages with freshwater aquifers (Wong, 2012).

“Nested” weighting ensures each overarching category is equally weighted; however, if the number of corresponding indicators differs between categories, the relative importance of individual indicators can substantially differ. Nevertheless, this challenge is mitigated if indicators accurately reflect categories in their totality (Angulo et al., 2016).

Frequency-based weightings are useful when targeting pockets of deprivation, yet may underestimate BND within LMICs where large proportions have unfulfilled needs. Furthermore, this approach assumes each indicator’s importance is related to the populations’ relative deprivation, rather than interpreting them as absolute “ends” (Decancq & Lugo, 2013).

Statistical weighting avoids “double counting” by creating uncorrelated linear combinations from correlated indicators (Decancq & Lugo, 2013). However, this contradicts the benefit of multidimensional measurement in identifying different causes/solutions to individual deprivations (Brandolini, 2009). Furthermore, statistical weights may not reflect real-life importance (Bibi, 2005).

Lastly, community and expert weighting (Chapter 5) mitigate the influence of researchers’ assumptions by capturing real-life priorities. However, such data is commonly unavailable in surveys, with community members and experts also influenced by their own biases (Decancq & Lugo, 2013).

3.4 Evaluating SWB measurements

This section summarises the general benefits/challenges of SWB measurement (Figure 3.3). SWB is used as an overarching term, incorporating “financial stress” and “happiness”. Both concepts include various subjective perceptions, as outlined in the framework (Appendix 3.1).

Subjective wellbeing (financial stress and happiness)

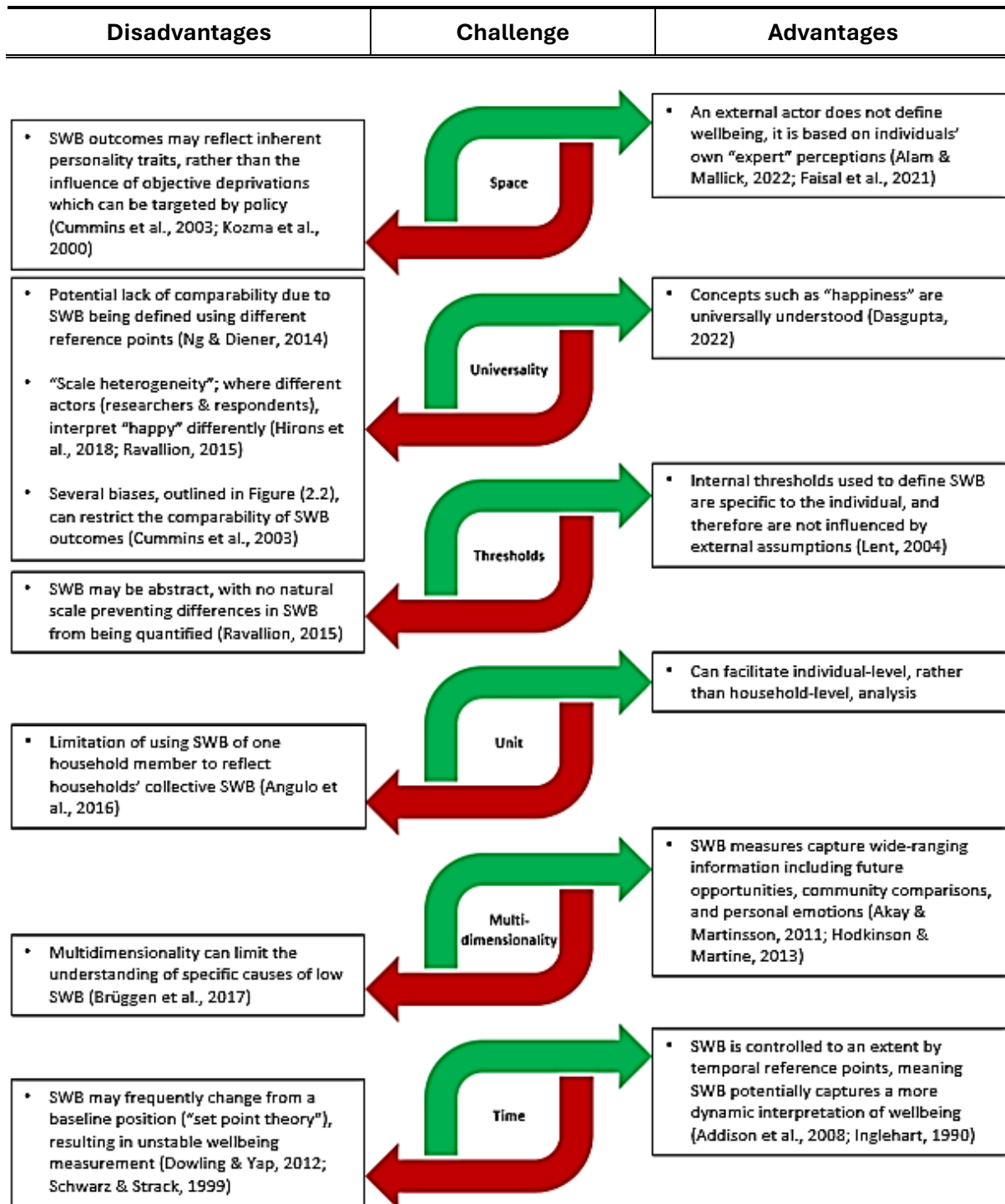


Figure 3.3 Summary of the key advantages and disadvantages of subjective wellbeing measurements, as detailed in section (2.2.3.1), grouped by Laderchi et al.'s (2003) core measurement challenges

3.4.1 SWB in LMICs: challenges & choices

The general challenges of SWB measurement (section 2.2.3.1) are universally applicable; therefore, fewer LMIC-specific challenges are presented. Firstly, subjective financial stress can be measured using the “Income Evaluation” approach, where respondents rate their income on a Likert scale, or the “Minimum Income Question”, where respondents define the minimum amount required to “make ends meet” (Mahmood et al., 2019). Quantifying a minimum income is challenging within subsistence economies due to non-monetary payments, domestic produce consumption and the acceptance of gifts/aid (Ravallion, 2014). Furthermore, Garner & de Vos (1995) suggest self-defined financial thresholds often reflect households’ current expenditures and lifestyles, rather than their minimum requirements. Long-term financial challenges within LMICs may also cause individuals to become accustomed to poverty, and understate their true minimum requirements (De Schutter, 2021). Due to these limitations, “adequacy” approaches, such as “*do you feel under stress with your current income?*”, are preferred in LMICs (Pradhan & Ravallion, 2000).

Next, “happiness” can be evaluated through “global” or multidimensional “life domains” approaches (Rojas, 2006). The latter assumes happiness with different components additively represent overall happiness (Figure 3.4). However, “life domains” measures can mirror criticisms of objective-list approaches if external researchers paternalistically define the domains (Dolan & White, 2007). See section (3.8.5) for further comparisons between “global” and “life domains” outcomes. This section highlighted general and LMIC-specific challenges and choices for various measures. The next section explores the benefits/challenges of OWB/SWB when implementing and monitoring policy.

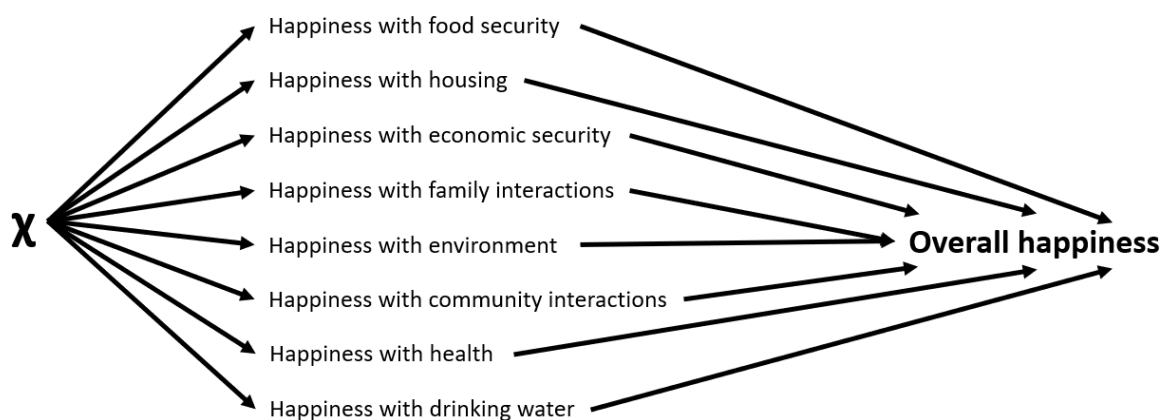


Figure 3.4 Visualisation of the assumption that “global” happiness is an aggregation of happiness with different life domains. Adapted from Van Praag et al. (2003, p.31)

3.5 Wellbeing in policy

Evaluating different wellbeing methodologies is crucial when applying and monitoring sustainable development policy (Adler & Seligman, 2016), as the measures used can influence which communities are targeted and which outcomes are achieved (Edwards et al., 2016). Furthermore, incorporating different measures reduces risks of misidentifying target communities and deploying “misguided interventions” (Schaafsma & Gross-Camp, 2021;2). Including multidisciplinary measures facilitates a more-holistic agenda with different perspectives on measuring progress, and prevents an “anti-development” discourse where targeting singular outcomes detracts the fulfilment of other needs (Copestake, 2008). This assessment of OWB/SWB within policy, alongside the methodological evaluation, provides a well-rounded review of wellbeing measurement (RQ1b).

3.5.1 OWB policy

All SDGs include OWB targets¹⁹, with wellbeing explicitly referenced in SDG3 (“ensure healthy lives and promote well-being for all”). Single, quantifiable measures (i.e., GDP/capita) are often preferred due to simpler interpretation, greater data availability and access to long-term time series (Dědeček & Dudzich, 2022). However, unidimensional OWB measures narrow policy focus by only incorporating a single capital from the framework (Figure 2.18). For example, focusing on expenditure poverty could frame low OWB as a household-level issue, rather than a societal injustice (Davis, 2014). Therefore, public service funding could be overlooked despite such improvements often being prioritised within rural LMICs (Tay & Diener, 2011).

As Copestake (2008) states, targeting financial OWB is not harmful in itself, yet if prioritised “other dimensions of wellbeing can be ignored [and] damaged” (p.591). Furthermore, if policy targets absolute poverty reductions, communities nearest the poverty line, rather than the most-deprived, could be prioritised to ensure quicker success (UN, 2005); emphasising the need for complementary poverty depth/severity measures (Atkinson, 2019). The true success of new policies and public services is more accurately captured through multidimensional, “realised” wellbeing measures, than unidimensional “potential” measures (Wong, 2012).

Using decomposable, multidimensional measures can also “help identify the weakest thread in the tapestry of human well-being” (Agarwala et al., 2014;441) and support targeted, rather than

¹⁹ For example, “reduce deaths from climate disasters” (SDG-13).

“blanket”, policy approaches (Angulo et al., 2016). Decomposability is important within locations with heterogeneous environmental challenges. For example, flood-impacted areas with disease outbreaks require different interventions to drought-impacted communities facing food insecurity (Alkire & Santos, 2010). In contrast, non-decomposable measures, such as composite indices, “mash together” deprivations with different causes and outcomes, and are less understandable to lay audiences (Atkinson, 2019; Howe et al., 2012).

Inconsistent relationships in the literature between financial OWB and BND raise the question: are basic needs ends in themselves, or means to an end? On one hand the dichotomy is irrelevant; for example, improved health has intrinsic worth and increases financial productivity (Chiappero-Martinetti & Sabadash, 2014). However, from a policy perspective, the difference can impact which subgroups are targeted. For example, if employment is a “means” to wellbeing, unemployed individuals would be excluded (Streeten, 1984). Therefore, interpreting basic needs as “ends” ensures all socioeconomic groups can benefit. However, some criticise BND policies for creating “false simplicity”; for instance, assuming wellbeing can be improved by building more latrines ignores the broader structural and social changes required to enable communities to benefit from material improvements (Ghai, 1978). Others also argue BND approaches focus heavily on current skills and consumption, and do not account for households’ savings and adaptive practices, particularly in uncertain environments where short and long-term climatic changes can alter wellbeing priorities and outcomes over time (Streeten, 1979).

3.5.2 SWB policy

3.5.2.1 Advantages

Incorporating SWB within sustainable development policy has multiple benefits. SWB measures create a channel for public voices to be reflected in policy (Diener & Suh, 1997; Dolan & White, 2007), improving community buy-in and policymaker accountability (De Schutter, 2021); particularly powerful in Ghana where historically top-down initiatives have neglected local knowledges (Domfeh & Bawole, 2009). Furthermore, high SWB is a crucial prerequisite for social stability and resilience during times of change (Addai et al., 2014a; Donnellan et al., 2009). Therefore, incorporating SWB within policy may contribute towards broader wellbeing objectives in Ghana due to the major changes experienced in recent decades, including increasing democracy, altering consumption patterns, global market absorption, and climatic variability.

SWB measures capture unquantifiable outcomes and feedbacks, ensuring all costs/benefits are acknowledged, while also uncovering barriers unidentifiable through OWB measures (Clare et al., 2017; Vaznonienė, 2014). For example, subjective perceptions of community hierarchies could inhibit public service access (De Schutter, 2021). Similarly, if two policy proposals provide similar OWB outcomes, SWB measures can detect which approach could achieve the highest “overall” wellbeing.

Despite a common association between SWB and qualitative research, happiness is often captured through an “evaluation” approach (Table 2.3) within quantitative social science surveys (Dolan et al., 2011). However, quantifying complex social phenomena brings challenges; for example, static statistical outputs juxtapose the fluidity of individual and societal processes, and broad quantifiable relationships potentially generalise personal experiences (Shaffer, 2013). Nevertheless, the importance of parsimony and pragmatism from a policy perspective is recognised (Laderchi et al., 2003; Lutz, 2022). An absence of a consensus on measuring “happiness” should not prevent action, with recent methodological improvements providing easy-to-understand, actionable metrics for policymakers (Sachs, 2019). The ability to use quantifiable “happiness” measures to create practical initiatives is illustrated by UAE’s Global Council for Happiness and Wellbeing which aims “to identify best happiness practices” for government institutions and businesses (Sachs, 2019;6).

Designing development policy through a “happiness” lens also ensures comparability and collaboration across different actors and departments (Helliwell, 2019), as despite discrepancies over its theoretical underpinnings, the concept of “happiness” is universally relatable and recognised as innately positive (Dasgupta 2022). Therefore, despite SWB being a multidimensional, personal outcome, calculating quantifiable metrics can facilitate its inclusion within spaces, such as sustainability and environmental justice studies, which are historically dominated by quantitative methods (Althor & Witt, 2020), and ensure research findings are practical.

Furthermore, if SWB is influenced by relative comparisons (Duku, 2022), incorporating SWB could shift policy focus from absolute wealth generation to reducing inequality (Siposné Nándori, 2011). Targeting SWB and reduced inequality could also be cost-effective; for instance, interventions focused on harnessing community togetherness are less capital and environmentally-intensive than income-generating initiatives (Dolan & White, 2007).

Individuals’ emotions and perceptions govern behaviour (Alam & Mallick, 2022); therefore, exploring SWB within policy evaluations can improve decision-makers’ understanding of communities’ priorities and actions, particularly if they do not align with targeted OWB outcomes. For example, Coulthard (2011) found coastal Indian communities continued to

support investments into local fishing, despite it failing to provide food and financial security, because of the dignity and status (SWB) received from fulfilling their desired livelihood identities.

Including SWB within policy does not negate the utility of OWB, rather SWB can be used alongside OWB (Dolan & White, 2007); illustrated by the Years of Good Life measure which combines objective financial and health measures with subjective life satisfaction to evaluate the sustainability of different developmental pathways (Lutz et al., 2021). Other measures combining OWB/SWB include the “Happy Planet Index” and “OECD Better Life Index”. However, despite using similar datasets, the indicators and results differ, highlighting how subjective and political decisions may influence wellbeing measurement and policy focus (White, 2016).

Similarly, the Bhutan Gross National Happiness multidimensional index incorporates OWB *and* SWB. However, caution must be taken when combining OWB/SWB within a single measure due to: (i) potential trade-offs, and ethical dilemmas, when balancing material and emotional needs, (ii) contrasting OWB/SWB potentially deterring policy action (Rojas, 2011), (iii) frame-of-reference differences, where SWB fluctuates quicker, and to a greater degree, than OWB, (iv) difficulty in weighting OWB and SWB components, with the Bhutan index weighting SWB lower than related OWB measures (Ura et al., 2012). However, wellbeing by definition requires a “person [to be] aware of it and...make it a human experience” (Rojas, 2011;177), therefore OWB measures should arguably not be given precedence.

SWB can also be impacted by, and influence the success of, environmental policies. SWB often reduces in the short-term following the introduction of environmental policies due to lower consumption being enforced (Kingdon & Knight, 2006). For example, there is low correlation globally between SWB and SDG12-13 progression²⁰ (De Neve & Sachs, 2020). However, van den Bergh (2010) suggests the slowing of economic growth due to climate policy may negligibly reduce happiness within certain contexts, with the avoidance of extreme hazards, the consequent health improvements, and the capacity for collective environmental action to empower communities (Brown et al., 2005; Lawrance et al., 2021), conversely stimulating long-term SWB improvements (FitzRoy et al., 2012; Qasim & Grimes, 2021). Incorporating SWB initiatives within environmental policies can mitigate the initial drop-off in SWB and improve community acceptance (Suárez-Varela et al., 2016). For example, research indicates happier people are more likely to support environmental policies (Gowdy, 2004; Zapata, 2021),

²⁰ SDG12 (“ensure sustainable consumption and production patterns”) and SDG13 (“take urgent action to combat climate change and its impacts”).

potentially further boosting SWB within communities that are connected to their local landscapes (Albrecht et al., 2007).

Historically, Ghanaian development policy has focused on tangible improvements (i.e., financial poverty and health). Therefore, attempts to incorporate SWB initiatives into economic-focused policies (Domfeh & Bawole, 2009) may need to emphasise the hidden costs of unhappiness, including reduced productivity (Knapp, 2003) and environmental resiliency (Addai et al., 2014a).

3.5.2.2 *Disadvantages*

Incorporating SWB within policy also provides challenges. Firstly, from a hedonistic perspective, happiness/pleasure could be achieved through unethical means, or in opposition to “universal” objective targets (Lent, 2004; OECD, 2020). For example, if happiness increases due to the misfortune of others raising one’s relative status (White, 2014). Using SWB to guide policy also assumes “happiness” is universally desired, however this could be challenged in certain cultures (Diener & Suh, 1997). Furthermore, due to the “relational context” of wellbeing, different assets and services may hold different values in varying social spaces, potentially limiting the geographical scope of SWB policies (Fadji et al., 2021).

An exclusive focus on SWB may also result in policy narrowly focusing on improving individuals’ emotions, rather than tackling broader structural inequalities which are assumed the “norm” (White, 2010). Additionally, SWB is controlled by multiple variables, therefore pinpointing specific issues and solutions may be challenging (Dolan & White, 2007). For example, job creation may improve relative positionality and autonomy, yet does not address how cultural ESs may associate with SWB (Ravallion, 2015). The exposure to various measurement biases (Figure 2.2) also raises questions about using SWB as a policy outcome, as survey responses may capture a “performance”, rather than actors’ meaningful experiences (Atkinson, 2013).

Individuals’ “horizons in life” (Ravallion et al., 2013) also impact SWB. If certain living standards have never been experienced, potentially due to physical remoteness, individuals may not be aware of the opportunities available, and therefore may have comparatively low reference points (Ravallion, 2014). Lower reference points result from “cognitive tax” (De Schutter, 2021), where deprived households focus on short-term survival and have “their desires...constrained by what seems possible” (Laderchi et al., 2003;253), potentially limiting the benefits of community-led interventions. Similarly, within an environmental context, communities persistently exposed to hazards may become accustomed to unfavourable conditions,

minimising negative impacts upon SWB, yet lowering local interest in tackling the issues (Brody et al., 2008; Navarro, 2017).

Furthermore, if policy only measures success through SWB, a “grumbling rich man” could be prioritised over a “contented peasant” (Sen, 1983;160). Defining objectively poor households as “content” can create “happy but poor” identities, romanticise financial poverty from a Western perspective (Crossley, 2012), rationalise inequality, and promote softer approaches based on social programmes and individuals’ psychology over more immediate material investments (Davis, 2014). If SWB-based policies fail to recognise how “happy but poor” individuals do not “love squalor, [rather] they make do with what they have” (Dowling & Yap, 2012;4), interventions can be depoliticized and aim to change how people view the world, rather than how the world is (White, 2010). This can result in long-term low multidimensional wellbeing in LMICs being blamed “on the dysfunctional thinking of the oppressed” (Franzblau & Moore, 2001;94), rather than the structural causes. Therefore, policies must acknowledge how SWB is interpreted differently across space, and incorporate OWB measures to achieve comprehensive improvements.

Despite the disadvantages of OWB *and* SWB within sustainable development policy, both remain important (Vaznonienė, 2014). The decision on which wellbeing measures to include depends on the aims of the research and/or policy. However, without up-to-date wellbeing data, often collected through time/cost-intensive surveys, the ability to monitor dynamic wellbeing changes following policy implementation is limited (Voukelatou et al., 2021). Identifying significant associations between wellbeing outcomes and readily-available data (i.e., remote sensing variables), could support real-time evaluations (Berchoux & Hutton, 2019). The next section outlines the survey dataset used to calculate OWB/SWB measures.

3.6 Data

Secondary data was collected from the Deltas, Vulnerability and Climate Change: Migration & Adaptation (DECCMA) household survey. The dataset was selected due to its open-source accessibility and extensive coverage of the delta population, in contrast to the Demographic and Health Survey (DHS, 2023) which surveyed only a limited number of communities in the study area (approx. 15). Additionally, the dataset is novel in capturing a wide range of SWB indicators, unlike the DHS which incorporates only a single happiness metric. DECCMA also includes self-reported climate perceptions, allowing for an exploration of the relationships

between individuals' lived environmental experiences - which may diverge from objective data - and their wellbeing outcomes.

The survey was undertaken with household heads during the 2016 growing season (April-June) using face-to-face interviews. A two-stage clustered sampling strategy attempted to survey 1,500 households. Households were stratified into five strata based on environmental risk²¹. Fifty enumeration areas (EAs)²² were randomly selected, proportional-to-size, from the strata. Thirty occupied residential dwellings from each EA were randomly selected. A 91% response rate was achieved (1,364 households) (Atiglo et al., 2022). The high response rate minimises non-response bias; however, without the original sampling frame, it is unknown whether missing households reflect specific subgroups (Atkinson, 2019). Despite the sample only containing a small proportion of the Volta Delta population, it is sufficient to provide robust results (Deressa et al., 2023).

Due to differing numbers of responding households in each EA, the sample is not “self-weighted”. However, as EAs were selected proportional-to-size and designed to have similar counts ($n \approx 150$) (Cordes et al., 2015), households had approximately equal selection probabilities. Therefore, the absence of survey weights is unlikely to cause analytical discrepancies (Groves et al., 2011).

The survey collected various data, including; households' finances, subjective evaluations, self-evaluated climate hazards, sociodemographic characteristics and adaptive practices (Appendix 4.3). A separate female-only questionnaire was conducted; however, this dataset was omitted due to missing SWB data and the study's “household” unit of analysis.

3.7 Methodology

This section introduces the wellbeing measures calculated to address RQ1c, including: (i) financial OWB, incorporating income/expenditure data, price adjustments and equivalisation, (ii) BND, using the Alkire-Foster method, (iii) subjective financial stress, including “adequacy” and “minimum amount” approaches, (iv) happiness, incorporating “global” and “life domains”

²¹ A standardised risk score was separated into quintiles; very low (12 clusters), low (10 clusters), medium (11 clusters), high (9 clusters) and very high (8 clusters) risk.

²² Classified during Census enumeration and have been used in GSS Living Standard and Demographic Health Surveys.

methods. See Appendix (3.1) for how these measures fit within the conceptual framework (Figure 2.18). The measures are defined as wellbeing “outcomes” throughout the thesis; however, as reflected in the framework, they are also “means” to further wellbeing (White, 2010). The association tests undertaken to explore RQ1e are also outlined.

3.7.1 OWB: Financial wellbeing

Financial OWB was calculated using income *and* expenditure data. Both measurements followed a similar methodology to GSS (2018), which used data from the seventh round of the Ghana Living Standards Survey. Household income was calculated by summing each household member’s income, whereas expenditure summed all household-level expenditure types (Table 3.4).

Table 3.4 Expenditure types included in the calculation of expenditure poverty. The mean percentage of household expenditure for each type, across all households, is also reported. Mean household expenditure (adjusted & equivalised) = GH¢ 3,115

Expenditure type	Mean % annual household expenditure
Food	59%
Household essentials (inc. electricity & transport)	12%
Education	9%
Health	4%
Livelihood inputs (inc. fertilisers & equipment)	4%
Sporadic house costs (inc. home improvements & repairs)	2%
Non-essential household costs (inc. furniture & clothing)	1%
“Other” (inc. funerals & weddings)	1%
Insurance	<1%
Supporting migrants in hardship	<1%

Despite GSS (2018) poverty estimates including housing expenditure, it is excluded to avoid “incorrectly identifying owner occupiers as experiencing poverty due to their...low spending on housing” (ONS, 2018); justified by 86% respondents have missing/no expenditure on renting property/land. Loan repayments are also excluded as they insufficiently relate to living standards (Arndt & Tarp, 2016). GSS exclude one-off expenditures, such as weddings (included

in “other”); however, 85% respondents had “other” expenditures, suggesting it incorporates relevant more-frequent purchases, and should therefore be included.

Income was recorded monthly, whereas expenditure was captured weekly/monthly/annually, potentially reducing errors as different individuals recall spending more accurately at different intervals (Steiger et al., 1997). Respondents with missing expenditure amount and/or frequency data were excluded. Yet, if at least one expenditure type was recorded, the other missing values were assumed to be GH¢0 to ensure sufficient sample size.

Income and expenditure were standardised to annual figures to facilitate comparison with the GSS poverty line, and adjusted for regional living costs (Appendix 3.2). Separate food/non-food adjustments were applied to expenditure, whereas the “overall” index was applied to income. Furthermore, households’ income/expenditure were equivalised using multiple scales (Tables 3.2-3.3) to give “equivalent adult per year” measurements.

Next, equivalised household income/expenditure was compared to GSS absolute poverty lines. To ensure consistency and avoid “shifting the goalposts” when addressing poverty challenges, GSS adjusts the 2012/13 threshold for changes in inflation and living costs in 2016/17 (Ferreira et al., 2016;143). GSS produces two poverty lines: extreme poverty, based on the finances needed to meet minimum food requirements²³ (GH¢982.2/adult equivalent/year), and upper poverty, including essential food and non-food items such as cleaning products and energy (GH¢1,760.8/adult equivalent/year). Households with equivalised income/expenditure below the threshold were classified as experiencing poverty. Relative poverty was also constructed against three thresholds: 60% median equivalised expenditure, as used in the UK, 50%, used by OECD (Haughton & Khandker, 2009) and 40%, used by ILO (2020).

3.7.2 OWB: Basic needs deprivation

The Alkire-Foster (2011) “dual cut-off” count method measures multidimensional BND. For each dimension, a “deprivation” threshold was applied. For example, a household was deprived in “education” if all household members aged 15+ had not completed a basic education; see Appendix (3.3) for all indicator thresholds. Next, a second threshold defining the proportion of deprivations needed to be deprived “overall” was applied (Figure 3.5). This method fulfils multiple measurement axioms, including “an improvement in a non-deprived component does

²³ 2,900 calories/adult equivalent/day

not compensate for deprivation in another”; ensuring basic needs are interpreted as “ends”. Furthermore, the method is decomposable. By exploring the contribution of different deprivations across the sample (Equation 3.1), and between subgroups (Ura et al., 2012), policy can be targeted to communities’ specific needs. However, this approach does not fulfil another axiom, as if deprived households experience further deprivations, the overall rate would not change (Foster et al., 1984).

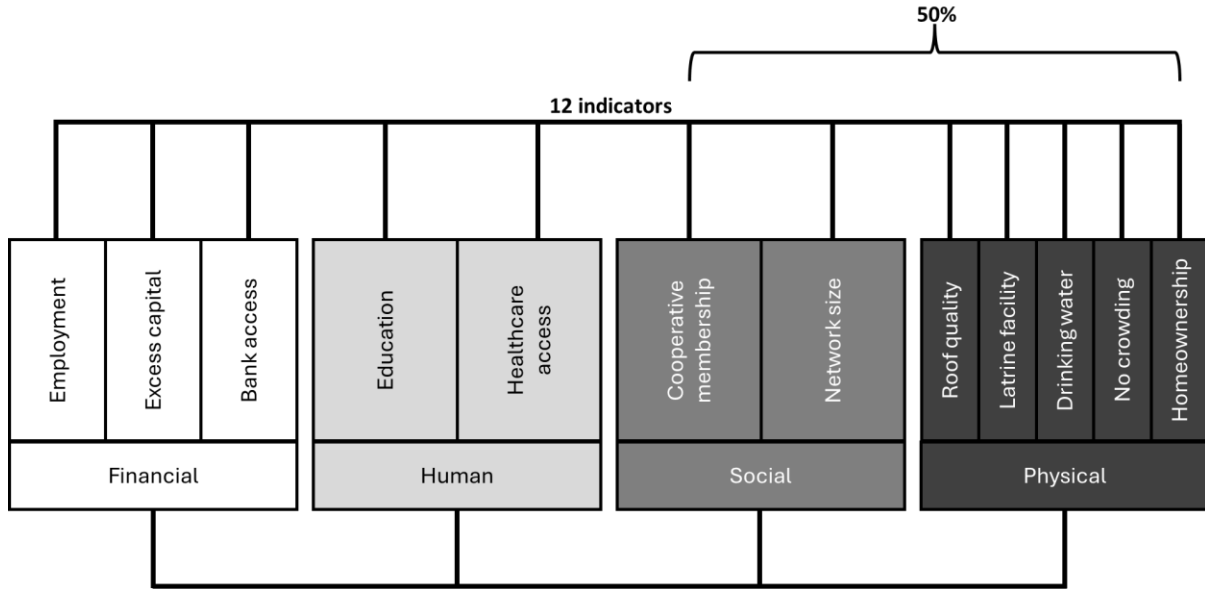


Figure 3.5 An illustration of the Alkire-Foster dual cut-off multiple deprivation method, using 12 indicators grouped within four nested groups and a 1/2 (50%) second cut-off threshold

Equation 3.1. Equation used to calculate the contribution of each individual deprivation indicator amongst households defined as deprived “overall”

$$\text{Contribution of deprivation}_j = w_j \frac{h_j(k)}{M_0}$$

w_j = Weight applied to individual indicator (see Table 3.6)

$h_j(k)$ = Proportion of households who are both deprived “overall” and simultaneously deprived in indicator (j), defined by the indicator threshold (k)

M_0 = Proportion of households deprived overall (0.49) * Average weighted deprivation score of households deprived overall (proportion) (7.4/12 = 0.62)

Twelve indicators were constructed from the DECCMA dataset, adapted from existing BND studies (GSS, 2020; Santos & Villatoro, 2018; Streeten, 1984), and grouped within the framework’s capitals (Table 3.5). Natural capital components are not included as they are interpreted as independent variables, maintaining the research focus on environment-wellbeing associations.

Table 3.5 Count and percentage of sampled households experiencing each basic needs deprivation

Capital	Indicator	Deprived household count (%)
Financial	One or more household members are unemployed	328 (24%)
	Monthly expenditure on food >60% total expenditure	776 (57%)
	No access to bank or loan service	823 (60%)
Human	All household members aged 15+ without basic education	453 (33%)
	>5km from nearest hospital	1,120 (82%)
Social	Not a member of a community cooperative	1,167 (86%)
	Under 3 family/friends outside household with migration experience	471 (35%)
Physical	Low-quality roof material	738 (54%)
	Unsafe latrine facility	557 (41%)
	Unsafe drinking water source	304 (22%)
	Overcrowded household	222 (16%)
	Home is not owned	195 (14%)

Drawing upon SLF capitals ensured the different resources which control livelihood and adaptive strategies (Burney & Naylor, 2012; Forkuo et al., 2021), and are depended upon to “durably sustain people’s basic needs” (Gaillard et al., 2009;120), were incorporated within the BND measure. Using broad capitals to structure the measure provides flexibility to include various relevant indicators available within the dataset. See Appendix (3.1) for a breakdown of how different BND indicators fit within the framework.

As the survey dataset was designed to examine migratory behaviour, proxy indicators guided by existing multidimensional studies were used to capture communities’ basic needs. For example, “distance to hospital” was included due to limited objective health data (Santos & Villatoro, 2018). The indicators do not capture SLF capitals in their totality; for example, despite livestock commonly being used as an income-generating asset (Lambrecht et al., 2021), or sold as a coping strategy in Ghana (Kuivanen et al., 2016), large proportions of missing data prevented its inclusion²⁴. However, within the dataset restraints, indicators were designed to capture key requirements within an LMIC context. Furthermore, individual-level data were

²⁴ Only one household in the entire sample was recorded as owning any livestock. Livestock ownership questions were towards the end of the questionnaire, and therefore research fatigue, or time restraints, may have resulted in this question being omitted.

aggregated into household-level indicators to enable comparisons with other wellbeing measures. However, the limitation of assuming homogenous access and rights within households is recognised (Angulo et al., 2016).

The Alkire-Foster (2010) method facilitates different weighting approaches (Table 3.6). Equal, nested, frequency and statistical²⁵ weightings (Table 3.3) were used to evaluate sensitivity. Community and expert-preference weights are incorporated in Chapter 5.

Table 3.6 Different weightings applied to each deprivation indicator. Equal and nested weightings sum to 12, as advised by Alkire & Santos (2010)

Capital	Indicator	Equal	Nested	Frequency	Statistical
Financial	One or more household members are unemployed	1	1	0.76	0.08
	Monthly expenditure on food >60% total expenditure	1	1	0.43	0.06
	No access to bank or loan service	1	1	0.40	0.51
Human	All household members aged 15+ without basic education	1	1.5	0.67	0.24
	>5km from nearest hospital	1	1.5	0.18	0.51
Social	Not a member of a community cooperative	1	1.5	0.14	0.13
	Under 3 family/friends outside household with migration experience	1	1.5	0.65	0.12
Physical	Low-quality roof material	1	0.6	0.46	0.30
	Unsafe latrine facility	1	0.6	0.59	0.52
	Unsafe drinking water source	1	0.6	0.78	0.04
	Overcrowded household	1	0.6	0.84	-0.03
	Home is not owned	1	0.6	0.86	-0.13

Next, multiple “second thresholds”, used to define “overall” deprivation, were tested (Ervin et al., 2018). Thresholds ranged from “union”, requiring one deprivation, to “intersect”, requiring all individual deprivations (Alkire & Santos, 2010). Other common cut-offs include 0.25 (Ervin et al., 2018), 0.33 (Angulo et al., 2016; Lopez-Calva & Ortiz-Juárez, 2009) used within GSS (2020) multiple deprivation analysis, and 0.5 (González et al., 2021; Hjelm, et al., 2016a; Ura et al., 2012). For example, with 12 indicators and a 0.5 cut-off, a weighted score of “6” is required to be deprived “overall”.

²⁵ Statistical-based weighting used loadings from logistic PCA (Landgraf & Lee, 2020).

3.7.3 SWB: Financial stress

Financial stress was measured using two different methodologies. Firstly, an “adequacy” approach, defined by “*do you feel under stress with your current income? (yes/no)*”. Secondly, a “minimum amount” approach, where households which defined themselves as financially stressed from an “adequacy” perspective, were also asked “*how many cedi/month does your household require to not feel under stress/pressure?*”. If non-equivalised annual household expenditure was lower than the self-defined threshold, the household was defined as financially stressed. To maintain sufficient sample sizes²⁶, households’ expenditure was also compared to the overall sample’s mean/median thresholds. Households with missing expenditure/threshold data were excluded.

Subjective financial stress rather than “subjective wealth”, also incorporated within DECCMA, was calculated to align with the research focus on low wellbeing. Furthermore, Ghanaian studies illustrate SWB to be governed by the “absence of negative affect...and less in terms of subjective experiences of positive affect” (Dzokoto et al., 2019;18).

To ensure analytical comparability, household heads’ SWB evaluations are assumed to represent the whole household. Therefore, qualitative analysis is pivotal for understanding the mechanisms and controls of individuals’ SWB (White, 2016).

3.7.4 SWB: Unhappiness

Using the “evaluation” approach (Table 2.3), “global” and “life domains” unhappiness measures were calculated. The former is based on responses to “*how happy are you with your life in general?*” (5-point Likert scale), with those responding “moderately/very unhappy” classified as “unhappy”. No happiness questions were temporally framed²⁷, reducing the measure’s sensitivity to recent, one-off events (Ehrhardt et al., 2000; Headey & Wearing, 1991).

Life domains happiness was constructed using ordinal PCA (Garcia Rodrigues et al., 2022)²⁸ to agglomerate eight correlating measures of happiness (5-point Likert scale); including household

²⁶ 187 households who responded “no” to the “adequacy” question were excluded from the “minimum amount” question.

²⁷ An example of a temporally-framed question would be: “how happy were you over the last week?”

²⁸ *Princals* R function

heads' happiness with financial, material, social and environmental components. The positive correlation between the ordinal variables is illustrated by the Kendall tau-B correlation coefficients (Table 3.7). The first principal component, capturing 37% variance, was used as the happiness index; a common approach when calculating socioeconomic indices (Howe et al., 2008; Martel et al., 2021). Each happiness domain positively correlated with the index (Appendix 3.4).

Table 3.7 Kendall tau-B correlation coefficients for the different life domains incorporated in the happiness index. A value >0.20 is interpreted as a moderate-strength association, and a value >0.30 a strong association (Mastrothanasis, 2020)

Life domain	Drinking water	Food security	Housing	Economic security	Health	Community interactions	Family interactions	Environment
Drinking water								
Food security	0.27							
Housing	0.20	0.31						
Economic security	0.17	0.34	0.32					
Health	0.18	0.36	0.24	0.27				
Community interactions	0.12	0.24	0.27	0.15	0.17			
Family interactions	0.13	0.28	0.30	0.21	0.24	0.58		
Environment	0.18	0.25	0.30	0.28	0.22	0.38	0.28	

The index was clustered into groups to improve interpretability (De Kruijk & Rutten, 2007). The index was *not* normally distributed; therefore, equal percentiles were inappropriate (Appendix 3.5). K-means clustering formulated three optimum groups²⁹ (Vyas & Kumaranayake, 2006). Households in the lowest-scoring cluster were defined as “unhappy” within the binary outcome variable. Transforming the index into a binary variable potentially reduced the amount of information captured, yet ensured comparability with other wellbeing measures, and reduced the significance of small index differences possibly resulting from measurement error (Lutz, 2022).

Despite studies suggesting individuals can comprehend “happiness” and “unhappiness” differently (Kobayashi & Hommerich, 2017; Uchida & Kitayama, 2009), this thesis interprets

²⁹ The “elbow method” (Appendix 3.6) and the *NbClust* R function, which brings together different statistical indices, were used to decide the number of optimum categories.

them as two ends of a single continuum; aligning with the DECCMA survey which presented “very unhappy” and “very happy” on the same Likert scale. Therefore, despite calculating a binary “unhappiness” measure, discussions will also allude to how determinants “increase/lower happiness”.

3.7.5 Association tests

After calculating the four recommended measures, chi-square association tests were undertaken for each combination of binary outcomes. This analysis examined whether significant associations existed between different measures and generated hypotheses as to whether OWB/SWB measures align/oppose. Additional chi-square tests between wellbeing outcomes and individual components of the decomposable BND measure are presented in Appendix (3.7) to further support the interpretation of OWB/SWB relationships. The following section evaluates the results of the various OWB/SWB methodologies.

3.8 Results & Discussion

This section compares, and evaluates, the four OWB/SWB measurements (RQ1c). The analysis is crucial for methodological transparency and ensuring each measure’s limitations are understood. Multidisciplinary literature is drawn upon to identify the most appropriate measures for researching Volta Delta. The measures recommended for further analysis are presented in section (3.9) (RQ1d).

3.8.1 Survey sample characteristics

The sociodemographic characteristics of the DECCMA sample are presented in Table 3.8. The most common household size is 4-5 people, with a mean child-to-adult dependency ratio of 0.65. Most household heads are male (59%) with a mean age of 47 years. Across all household heads, the majority have a below-basic education (29%), are permanently employed (69%), and have lived in their village their entire life (54%).

Table 3.8 Sociodemographic characteristics of the DECCMA survey sample

Sociodemographic characteristic	Descriptive statistics
Household characteristics	
Household size	1-person – 242 (18%) 2-3 person – 401 (29%) 4-5 person – 409 (30%) 6-7 person – 204 (15%) 8+ person – 108 (8%)
Number of dependants in household	0 dependants – 331 (24%) 1-2 dependants – 553 (41%) 3-4 dependants – 349 (26%) 5+ dependants – 131 (10%)
Mean child:adult dependency ratio	0.65
Religion	Christian – 979 (72%) Traditional – 305 (22%) Other (inc. Islam & Buddhism) – 77 (6%) Missing – 3 (<1%)
Household head characteristics	
Sex	Male – 802 (59%) Female – 558 (41%) Missing – 4 (<1%)
Age	18-33 years – 344 (25%) 34-45 years – 350 (26%) 46-60 years – 345 (25%) 60+ years – 321 (24%) Missing – 4 (<1%) Mean age – 47 years
Education	No schooling – 382 (28%) Primary & Lower Secondary (below basic) – 391 (29%) Upper Secondary (basic education) – 338 (25%) Higher education – 249 (18%) Missing – 4 (<1%)
Marital status	Married or Cohabiting – 815 (60%) Never married – 158 (12%) Previously married (divorced or widowed) – 385 (28%) Missing – 4 (<1%)
Employment status	Permanent – 937 (69%) Non-Permanent (i.e., seasonal) – 281 (21%) Dependant (i.e., student or retiree) – 125 (9%) Missing – 21 (2%)
How long have you lived in the village?	Entire life – 732 (54%) Migrated 10+ year ago – 360 (26%) Migrated <10 years ago – 265 (19%) Missing – 7 (1%)
Household member currently migrated	Yes – 603 (44%) No – 761 (56%)

3.8.2 Financial OWB

This section evaluates the influence of data types, thresholds and equivalence scales when measuring financial OWB. Firstly, income poverty exceeds expenditure poverty (Table 3.9);

supporting claims that income is more exposed to underreporting in LMICs (World Bank, 2005). Higher income poverty may also reflect issues with non-monetary payments and data collection within informal subsistence economies, with 10% households recording no income, yet all households recording expenditure. Different income/expenditure rates could also reflect the seasonality of employment (Ferreira et al., 2016) and the greater sensitivity of income to survey timing (UNECE, 2017). The survey was undertaken during the growing season; therefore, incomes may have been lower than during harvest, whereas expenditure on livelihood inputs may have been greater (Atkinson, 2019). Expenditure was also captured using different temporal reference periods, potentially reducing measurement error and recall bias compared to income which was only measured monthly (Steiger et al., 1997). These results support assumptions that expenditure provides a more accurate, stable measure than income in LMICs. Therefore, expenditure poverty is used throughout this thesis to capture financial OWB.

Table 3.9 Constructed objective financial wellbeing measures from the DECCMA survey dataset

Financial OWB measure	Poverty household count	Poverty household percentage	Sample size
Adjusted expenditure poverty (upper poverty line)			
Equivalised using:			
GSS dietary equivalence scale	506	37.2%	1360
Old-OECD equivalence scale	462	34.0%	1360
New-OECD equivalence scale	308	22.7%	1360
Squareroot equivalence scale	236	17.4%	1360
Per-capita equivalence scale	690	50.9%	1360
Household equivalence scale	84	6.3%	1360
Adjusted extreme expenditure poverty (GSS equivalisation)	184	13.5%	1360
Adjusted income poverty (upper poverty line, GSS equivalisation)	660	48.4%	1364
Adjusted extreme income poverty (GSS equivalisation)	383	28.1%	1364
Relative adjusted expenditure poverty (GSS equivalisation) – 40% median threshold	160	11.8%	1360
Relative adjusted expenditure poverty (GSS equivalisation) – 50% median threshold	242	17.8%	1360
Relative adjusted expenditure poverty (GSS equivalisation) – 60% median threshold	336	24.7%	1360

Expenditure poverty rates are sensitive to equivalisation; ranging from 6.3% to 50.9% (Table 3.9). Evidence of household inequalities in Volta Delta, including gendered differences (Afriyie et al., 2018; Codjoe et al., 2020a), rejects the “household” scale which assumes entire households access all resources (OECD, 2011). Similarly, the existence of “economies-of-scale” eliminates the “per capita” scale. Without detailed data on households’ efficiencies and shared practices, “economies-of-scale” are assumed to be lower than within OECD countries; therefore, OECD and squareroot scales are excluded. Therefore, to capture national-specific “economies-of-scale”, and ensure measurements are comparable to official poverty records, the GSS dietary scale is recommended (Table 3.2).

The third methodological decision relates to threshold type. All relative rates are lower than the absolute upper poverty rate (Table 3.9), suggesting relative rates may understate financial poverty when low financial OWB is widespread (Falkingham & Namazie, 2002; Haughton & Khandker, 2009)³⁰. Relative poverty is useful in capturing social exclusion and inequality; however, absolute improvements should be prioritised in LMICs (Garroway & de Laiglesia, 2012).

The final decision involves selecting an extreme or upper poverty threshold. From an analytical perspective, selecting the upper threshold ensures “specificity³¹” and a sufficient sample size for regression analysis; with 506 “poor” compared to 184 “extremely poor” households. Furthermore, defining financial poverty solely on minimum food costs is overly restrictive, especially when non-food needs are commonly unmet (Kingdon & Knight, 2007; Mahmood et al., 2019). Extreme thresholds could be used to allocate targeted support (Ravallion, 2015); yet, this study recommends using the upper threshold to align with documented GSS (2018) methodologies, and to capture households unable to fund “productive”, rather than “survival”, activities (Streeten & Burki, 1978).

3.8.3 Objective BND

The Alkire-Foster method was used to construct a decomposable, multidimensional BND measure. This section explores weighting sensitivity (Table 3.10) and threshold selection. Firstly, due to different numbers of indicators within each capital, “nested” weighting potentially over-

³⁰ The 60% median threshold (GH¢1,361.1) was substantially lower than the absolute upper poverty line (GH¢1,760.8).

³¹ how well [the measures] identify...households who do not have a given condition” (Rose et al., 2013;6)

weights indicators within groups with fewer corresponding dimensions; for example, human/social indicators are weighted 2.5x higher than physical indicators (Table 3.6). Nevertheless, existing studies have used “nested” approaches, despite uneven indicator counts, to ensure each capital group is valued equally (Aguilar & Sumner, 2020; Ervin et al., 2018; GSS, 2020); based on the assumption that the available indicators capture substantial proportions of each capital (Angulo et al., 2016). However, data constraints limit the ability to capture capitals in their totality; for example, objective social information such as religious participation (Addai et al., 2014b), is often limited in social surveys (Gannon & Roberts, 2020).

Table 3.10 Multiple “basic need” deprivation incidence rates using different weighting approaches; nested, equal, frequency-based and statistical (PCA)

	% households deprived "overall"			
	Weighting type			
Second cut-off threshold	Nested	Equal	Frequency-based	Statistical
Union (1 or more measure)	99.9%	99.9%	99.9%	99.9%
1/4 (0.25)	93.7%	94.0%	72.2%	90.1%
1/3 (0.33)	84.5%	84.5%	48.0%	84.5%
1/2 (0.50)	49.1%	44.5%	13.0%	64.9%
Intersection (all measures)	0.0%	0.0%	0.0%	0.0%

Note, union (1+ deprivations), 25%, 33%, 50% and intersection (all deprivations) second cut-offs are used to illustrate the effects of different weighting approaches.

In contrast, equal weighting potentially over-weights physical capital due to the higher indicator count (Ervin et al., 2018). However, grouping indicators within capitals arguably ignores how components interrelate (Figure 2.18). Therefore, equal weighting may not theoretically over-weight physical capital when recognising how the indicators influence multiple OWB components. For example, overcrowding (physical) can negatively associate with education, health (human) (Henaku, 2022; Nkosi et al., 2019) and relationships (social) (Gove et al., 1979). Furthermore, equal weighting mitigates the influence of individual researchers’ assumptions, yet overlooks trade-offs between deprivations (Wong, 2012).

Frequency-based weighting produces lower rates (Table 3.10), reflecting its unsuitability within an environment with widespread deprivation (Decancq & Lugo, 2013). For example, the large proportion of households distant from healthcare services should not minimise its importance

in achieving wellbeing. Furthermore, statistical weighting is deemed inappropriate due to low correlation amongst most deprivation indicators (Appendix 3.8), and the negative loadings applied to “overcrowding” and “homeownership” (Table 3.6) suggesting individual indicators have alternative causes/solutions (Parby et al., 2015). Furthermore, assuming correlation reflects the value of different indicators fails to interpret basic needs as wellbeing “ends” (Brandolini, 2009; OECD, 2008).

There is no consensus on weighting, decisions should be made on a study-by-study basis conditional on data availability, existing results and contextual information. For example, Santos & Villatoro (2018) increased the weight of “monetary resources” to reflect limited free, public services in Latin America. Due to weighting sensitivity, expert and community-preference weightings are recommended to avoid assumptions or statistical decisions inaccurately classifying households’ OWB. Nevertheless, at this stage a conservative “nested” approach, which produces intermediate deprivation rates, is recommended for further regression analysis, and as a comparative baseline for expert/community weightings (Chapter 5). Furthermore, the similarity of “equal” and “nested” rates across different thresholds (Table 3.10)³² increases the robustness of the baseline measure.

The second methodological decision relates to the “overall” deprivation threshold. Despite some arguing thresholds create an artificial dichotomy (Angulo et al., 2016), this study does not aim to calculate population-wide estimates; rather, an outcome variable is required for environment-wellbeing regression analysis (Chapter 4). Different threshold justifications are presented; 2+ full “nested” deprivations (or equivalent), as used in UNICEF Child Poverty reports (Alkire & Foster, 2011), 1+ full deprivation (or equivalent) (Ervin et al., 2018), or the majority of deprivations (Aguilar & Sumner, 2020).

“Overall” deprivation is sensitive to threshold selection (Figure 3.6). “Union” and “intersect” approaches are disregarded as too broad and restrictive, producing rates of 99.9% and 0.0%. In contrast, a 0.5 threshold provides a conservative result, mitigating concerns of over/underestimation and ensuring sufficient sample sizes for regression analysis. Furthermore, a 0.5 cut-off provides the most-comparable result to GSS (2020) national multiple deprivation estimates (45.6%), which despite using different measures/weightings, ensures results are logical. The 0.5 threshold also fulfils existing justifications by defining households

³² Despite similar overall rates, the households defined as “deprived” by the two methods differ. For example, 103 deprived households using nested weighting are not deprived when using equal weighting.

with the equivalent to two full “nested” deprivations, and the majority of deprivations, as deprived “overall”.

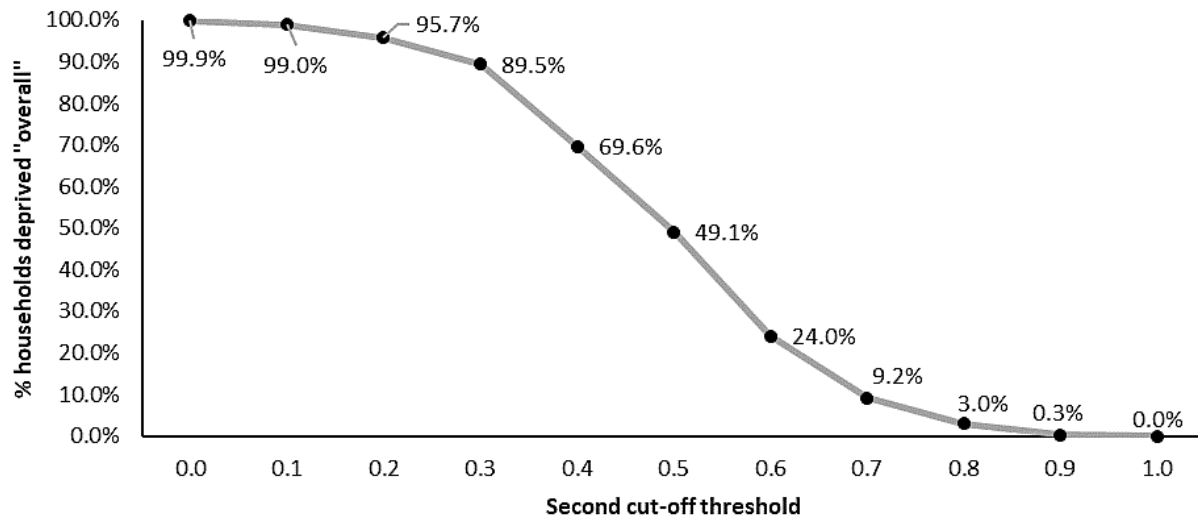


Figure 3.6 Multiple BND incidence rates using “nested” weighting, with second cut-off thresholds at 10% intervals

The decomposable method allows for the calculation of individual indicators’ contribution to “overall” deprivation (Ura et al., 2012). The contribution depends on the frequency and weight of the indicator (Alkire et al., 2015). Using Equation (3.1), “cooperatives” and “healthcare access” contribute most (Table 3.11). Contributions to “overall” deprivation can also be compared across subgroups (Appendix 3.9). For example, contributions are relatively consistent across household head genders, yet “bank access” and “roof quality” contribute more in Volta than Greater Accra, whereas “safe latrines” and “network size” contribute more in Greater Accra.

Table 3.11 A breakdown of the contribution of each deprivation indicator for households defined as deprived “overall” (n=667)

Capital	Deprivation	Contribution to households deprived “overall”
Social	Cooperative membership	20%
Human	Healthcare access	19%
	Education	11%
Social	Network size	11%
Financial	Bank access	10%
	Excess capital (food expenditure)	10%
	Employment	5%
Physical	Roof quality	5%
	Latrine facility	5%
	Drinking water	2%
	No crowding	1%
	Homeownership	1%
Social		31%
Human		30%
Financial		25%
Physical		14%

3.8.4 Subjective financial stress

This section evaluates “adequacy” and “minimum amount” financial stress measurements. Firstly, 87% households self-defined as financially stressed using the “adequacy” approach (Table 3.12). To overcome the smaller sample size of the “minimum amount” measurement, the sample’s median/mean thresholds were also applied; however, this arguably dilutes the measure’s subjectivity (Laderchi et al., 2003). This limitation is evident when comparing financial stress rates using median (60%) and mean (80%) thresholds to the “adequacy” approach (87%).

Table 3.12 Calculated subjective financial stress measures from the DECCMA dataset

Subjective financial stress measure	Household count	Household percentage	Sample size
Subjective income inadequacy (binary question)	1181	86.7%	1363
Using individual households' "minimum amount" threshold, non-equivalised, adjusted expenditure	763	64.9%	1175
Using mean household "minimum amount" threshold, equivalised, adjusted expenditure	1081	79.5%	1360
Using median household "minimum amount" threshold, equivalised, adjusted expenditure	811	59.6%	1360

Furthermore, asking subsistence communities to quantify their minimum requirements can produce errors (Mahmood et al., 2019), illustrated by only 65% households describing themselves as financially stressed having an adjusted expenditure below their self-defined threshold. The measure is interested in perceptions of financial security, not individuals' capability to quantify their needs. "Minimum amount" responses may also reflect respondents' current lifestyle, rather than their fundamental requirements (Garner & de Vos, 1995; Knight et al., 2009). In conclusion, to avoid sample size reductions and limit measurement errors, this study recommends using the adequacy question "*do you feel under stress with your current income?*" to capture subjective financial stress.

3.8.5 Subjective unhappiness

This section discusses "global" and "life domains" unhappiness measures, and evaluates the benefits/limitations of PCA indices. Using a "global" approach, 23% households were moderately/very unhappy, whereas 15% were unhappy from a "life domains" perspective (Table 3.13). This finding disputes existing studies showing greater positivity regarding "global" evaluations than narrower, domain-specific responses (Diener et al., 2000).

Table 3.13 Crosstabulation and chi-square test of association between life domains happiness clusters and responses to the “global” happiness question⁺

Subjective “life domains” happiness cluster	Global happiness evaluation			Total
	Very/moderately unhappy	Neutral	Very/moderately happy	
1 (low)	127 (63%)	17 (8%)	58 (29%)	202 (15%)
2 (medium)	158 (28%)	64 (11%)	345 (61%)	567 (42%)
3 (high)	35 (6%)	40 (7%)	520 (87%)	595 (44%)
Total	320 (23%)	121 (9%)	923 (68%)	1,364
Chi-square test statistic:	307.083***			

Nevertheless, the significant association between the two measures, and moderate/strong associations between general happiness and each life domain (Table 3.14), suggests domain happiness may influence global evaluations (Van Praag et al., 2003). However, contrasting responses, such as 29% low “life domain” happiness households being generally happy, challenge assumptions that global evaluations mirror aggregated domain responses (Figure 3.4). These contrasting results suggest “life domain” responses draw on different information and specific experiences, including non-material wellbeing components, that could otherwise be overlooked within abstract “global” responses (Kozma et al., 2000; Lent, 2004; Schwarz & Strack, 1999); justifying this study’s “life domains” approach.

Table 3.14 Kendall's tau-b correlation values for each life domain and general happiness, both measured on a 5-point Likert scale. Coefficient thresholds; >0.20 moderate, >0.30 strong (Mastrothanas, 2020)

Happiness with...	Kendall's tau-b correlation
Economic security	0.407***
Housing	0.387***
Food security	0.343***
Family interactions	0.272***
Environment	0.267***
Health	0.259***
Community interactions	0.202***
Drinking water	0.194***

⁺ *** p < 0.01, ** p < 0.05, * p < 0.1

The capacity for the decomposable “life domains” method to capture less-tangible components of collective wellbeing is illustrated by 78% generally unhappy households being happy with “community interactions”, yet only 11% being happy with more-tangible “economic security” (Appendix 3.10a). This distinction is further supported by the PCA loading plot, where the second principal component highlights a differentiation between “tangible” domains of happiness and “non-tangible” domains such as family/community interactions (Appendix 3.10b).

Nevertheless, global happiness correlates more strongly with the “economic security” and “housing” domains than with “community interactions” (Appendix 3.4). This finding counters studies showing non-material elements to strongly correlate with SWB in rural LMICs (Narayan & Petesch, 2002). However, due to the diverse cultural settings in Ghana, the most important domains are likely to differ spatially (Dzokoto et al., 2019).

Aggregating life domains happiness using PCA created a simple, interpretable measure, however limitations exist. Statistical loadings may not accurately reflect communities’ priorities, whereas large proportions of variation can be unaccounted for (Howe et al., 2008). Additionally, from a policy perspective, the technical, less-transparent process creates opportunities to challenge the measure’s validity (Decancq & Lugo, 2013). The measure’s subjectivity and contextual relevance is also reduced by the domains being pre-defined within the survey by external researchers (Rojas, 2006).

PCA treats each domain additively, meaning each component consistently contributes towards the index. This is a common social research approach when there is no individual-level data regarding the relative importance of each domain. However, this assumption is disputed; for example, happiness in one domain may influence, or substitute for another (i.e., social relationships dampening financial unhappiness) (Ayerakwa et al., 2015; Rojas, 2006). Furthermore, the contribution of each domain is assumed constant across respondents, termed “ordinal interpersonal comparability”; however, contributions may differ depending on baseline happiness. For instance, environmental happiness may contribute more towards overall happiness in historically drought-impacted areas than favourable environments. However, communities with shared languages may possess similar understandings, minimising differences in interpretation (Van Praag et al., 2003).

Similar to the Alkire-Foster (2011) method, “life domains” happiness is decomposable, facilitating additional analysis on specific domains and targeted interventions. However, a clustered PCA index was favoured over the Alkire-Foster method (Ura et al., 2012) due to the stronger correlation between domains (Table 3.7), the smaller number of “happiness” variables in DECCMA (n=8) meaning some subgroups, such as “human capital”, would only have one

relevant indicator (i.e., health), and the difficulty in applying deprivation thresholds to subjective responses (Rojas, 2011).

Overall, a single index was essential to ensure household comparability within environment-wellbeing analysis (Chapter 4). Both SWB measures assume household head responses represent household-level wellbeing; however, due to missing SWB information within the female-only dataset, and to facilitate comparative analysis with household-level OWB measures, the limitation of assuming homogenous household-level SWB was accepted.

3.9 Recommended variables

“The positive spin of *wellbeing* can...exclude negative experiences or dimensions” (White, 2010;167); therefore, this study focuses on relationships with low wellbeing, or “*ill-being*”, to advance the understanding of vulnerable communities’ challenges. Based on the above discussions, four measures are recommended for further analysis (RQ1d):

- OWB: financial wellbeing
 - absolute expenditure poverty (GSS upper poverty line), adjusted for regional cost-of-living, GSS-dietary equivalisation scale.
- OWB: basic needs deprivation
 - “nested” weighting and 0.5 second cut-off threshold.
 - baseline measure to compare against community/expert weighted rates (Chapter 5).
- SWB: financial stress
 - “adequacy” approach: “*do you feel under stress with your current income?*”
- SWB: unhappiness
 - life domains approach, constructed from PCA and cluster analysis.

Appendix (3.1) illustrates how the recommended measures fit within the “ECW” framework. Certain measures capture multiple capitals/perceptions; for example, financial stress incorporates information on future monetary (financial) and education (human) opportunities (Mahmood et al., 2019). The next section presents association tests between the selected measures.

3.10 Wellbeing associations

Drawing on Böhnke & Kohler's (2010) contrasting theories (section 2.3), this section examines whether different OWB/SWB measures align or oppose one another (RQ1e). There is no consensus on how OWB/SWB associate, therefore context-specific relationships must be investigated.

Chi-square association tests do not provide robust evidence of causal relationships between outcomes; instead, they offer an initial understanding of potential interrelations to help structure and ground conceptual discussions. This analysis is a crucial prerequisite before analysing OWB/SWB relationships through an "environmental" lens using regression analysis (Chapter 4). See Appendix (2.3) for examples of how different OWB and SWB components may associate generally, and within an environmental context.

Expenditure poverty associated with both subjective measures (Table 3.15), with higher proportions of households experiencing financial stress and unhappiness ($p < 0.01$) when in financial poverty. In contrast, BND did not significantly associate with any measure (Tables 3.15-3.16). However, the two subjective measures did significantly associate (Table 3.17), with a higher proportion of households defined as unhappy when also experiencing financial stress ($p < 0.01$).

Table 3.15 Crosstabulations and chi-square association tests between objective expenditure poverty and basic needs deprivation, subjective financial stress and subjective unhappiness⁺

	Expenditure Poverty		
Basic needs Deprivation	No	Yes	Total
No	448 (65%)	242 (35%)	690
Yes	404 (61%)	263 (39%)	667
Total	852 (63%)	505 (37%)	1,357
Chi-square test statistic:	2.757*		
Subjective financial stress	No	Yes	Total
No	130 (72%)	51 (28%)	181
Yes	724 (61%)	455 (39%)	1,179
Total	854 (63%)	506 (37%)	1,360
Chi-square test statistic:	7.286***		
Subjective unhappiness (life domains)	No	Yes	Total
Happy	744 (64%)	415 (36%)	1,159
Unhappy	110 (55%)	91 (45%)	201
Total	854 (63%)	506 (37%)	1,360
Chi-square test statistic:	6.571***		

⁺ *** p < 0.01, ** p < 0.05, * p < 0.1

Table 3.16 Crosstabulations and chi-square association tests between objective basic needs deprivation, and subjective financial stress and subjective unhappiness

	Basic needs Deprivation		
Subjective financial stress	No	Yes	Total
No	99 (55%)	81 (45%)	180
Yes	591 (50%)	586 (50%)	1,177
Total	690 (51%)	667 (49%)	1,357
Chi-square test statistic:	1.432		
Subjective unhappiness (life domains)	No	Yes	Total
Happy	586 (51%)	570 (49%)	1,156
Unhappy	104 (52%)	97 (48%)	201
Total	690 (51%)	667 (49%)	1,357
Chi-square test statistic:	0.075		

Table 3.17 Crosstabulation and chi-square association test between subjective financial stress and subjective unhappiness

	Subjective financial stress		
Subjective unhappiness (life domains)	No	Yes	Total
No	177 (15%)	985 (85%)	1,162
Yes	5 (2%)	196 (98%)	201
Total	182 (13%)	1,181 (87%)	1,363
Chi-square test statistic:	24.057***		

Despite significant associations between certain measures, numerous households opposed the general trends. For example, 36% happy households experienced expenditure poverty, whereas 55% unhappy households were objectively non-poor (Table 3.15). See section (4.4.1) for further information on the spatial distribution of these opposing outcomes.

3.10.1 Expenditure poverty (OWB) and financial stress (SWB)

The significant association between expenditure poverty and financial stress supports studies showing absolute financial capital to shape subjective evaluations (Mahmood et al., 2019). However, substantial differences were recorded, with 85% objectively non-poor households self-evaluating as financially stressed (Table 3.15); supporting research showing self-defined poverty to often exceed objective rates (Haughton & Khandker, 2009). These opposing outcomes may be due to individuals across the financial spectrum aspiring for greater wealth, externally-derived poverty thresholds understating communities' requirements, or fears of future financial insecurity, potentially due to uncertain climates, despite no immediate objective impacts (Bradshaw & Finch, 2003; Datt, 2002; Posel & Rogan, 2016; Sacks et al., 2010). Wellbeing by definition requires a person to “make it a human experience” (Rojas, 2011;177); therefore, despite the significant association, substantial differences in the overall rates highlight the inadequacy of objective financial measures in capturing comprehensive wellbeing.

3.10.2 Expenditure poverty (OWB) and unhappiness (SWB)

Expenditure poverty also significantly associated with unhappiness (Table 3.15)³³, supporting research indicating financial resources to potentially impact SWB in LMICs (Bookwalter & Dalenberg, 2004; Feeny et al., 2014; García-Quero & Guardiola, 2018; Mahadea & Rawat, 2008; Mateu et al., 2020; Reyes-García et al., 2016; Tauseef, 2022). This result corroborates claims that a Ghanaian “good life” is “growth-orientated” (Osei-Tutu et al., 2020), and suggests the threshold in which money stops increasing happiness, defined by the Easterlin Paradox, may not have been reached by certain households. However, future analysis exploring OWB/SWB relationships at different stages of the financial spectrum would be required to robustly examine the Easterlin Paradox. The association could also be controlled by happier people having greater financial productivity (Ravallion, 2015). Qualitative fieldwork is required to understand the mechanisms behind this significant association; for example, does financial capital indirectly (i.e., service access) (Ahmed, 2013), or directly (i.e., social status) (Ward & King, 2016) influence happiness?

³³ (Un)happiness was captured using an “evaluation” approach; however, discussions within this thesis, including qualitative analysis, will also draw on “eudaimonic” (Deci & Ryan, 2012) and “experience” concepts (Dolan et al., 2011).

Nevertheless, numerous households counter the general relationship, with 82% (415/506) objectively poor households categorised as happy. Opposing outcomes underline how, despite significant associations being recorded between OWB and SWB, different measures are not interchangeable, and therefore may be influenced by different mechanisms and require distinct policy interventions. These low OWB/high SWB households are primarily within agricultural locations (Figure 4.8), where social capital, place attachment and remoteness from higher living standards, can buffer against financial insecurity (Dowling & Yap, 2012; Ravallion, 2014). Experiencing happiness, despite low financial OWB, may also arise if individuals have no choice but to place greater weight on non-material components such as autonomy and identity when defining their SWB (Ahmed, 2013; Layard & Layard, 2011). “Identity” is particularly relevant in agricultural and fishing communities where being able to work, be self-sufficient, master a skill, and fulfil social expectations by providing for others, can increase social status and happiness (Brown et al., 2021; Markussen et al., 2018; Miñarro et al., 2022; Ohemeng et al., 2020; Osei-Tutu et al., 2020).

Regional differences further support this hypothesis. A significant association between expenditure poverty and unhappiness amongst households in Greater Accra, encompassing more urban locations and a higher proportion of business owners and salaried employees, contrasts the non-significant association amongst primarily farming households in Volta. This result supports studies suggesting communities within built-up locations place greater emphasis on financial success when conceptualising SWB (Guillen-Royo & Velazco, 2012). However, high SWB should not discourage material policy interventions or normalise low financial OWB (section 3.5.1)

Viewing opposing OWB/SWB in the alternate direction, 13% (110/854) objectively non-poor households were unhappy; primarily located in coastal/riverine peri-urban communities (Figure 4.8). Higher financial OWB may be attributed to non-primary livelihoods, such as tourism (Sagoe-Addy & Addo, 2013), offering more consistent, less-vulnerable income channels (Antwi-Agyei et al., 2018). In contrast, low SWB could be linked to: (i) formal livelihoods increasing material aspirations, which if unmet, can reduce happiness (Alem et al., 2014), (ii) greater individualism and lower social capital promoting inequalities, and creating relative comparisons to “better-off” households (Tibesigwa et al., 2016), (iii) experience/fears of coastal hazards (Sekulova & Van den Bergh, 2016). Opposing expenditure poverty and happiness across Volta Delta, explored further in Chapter 6, highlight how landscape characteristics and the “relational context” can alter the association between different wellbeing conceptualisations.

3.10.3 Expenditure poverty (OWB) and BND (OWB)

The non-significant association between expenditure poverty and BND (Table 3.15), and the supporting analysis exploring associations with individual BND indicators (Appendix 3.7), challenge assumptions that financial capital facilitates access to essential needs through market transactions (Rasool et al., 2011).

The non-significant result also opposes alternate hypotheses suggesting basic needs improve financial OWB. For example, the non-significant association between expenditure poverty and “safe latrine” deprivation (Appendix 3.7), opposes ideas that improved sanitation can increase financial OWB by reducing health risks and productivity losses (Atiglo, 2017; Mireku-Gyimah et al., 2018).

This result also suggests basic needs are “ends” in themselves, and not interchangeable with financial OWB. For example, an underrepresentation of “homeownership” amongst non-poor households (Appendix 3.7) suggests housing tenure is detached from financial OWB; potentially due to high rent/mortgage costs in built-up areas, and the preference for owning self-constructed dwellings in rural areas (Parby et al., 2015). Furthermore, less-than-expected objectively poor households expend >60% on food (excess capital deprivation); highlighting how basic needs can also be fulfilled through non-market channels such as reciprocal trading and subsistence farming (Corazzini et al., 2011; Ng & Diener, 2014). Non-significant associations between expenditure poverty and individual BND indicators could also reflect the difference between “potential” and “realised” wellbeing (Sen, 2005). For example, the non-significant association between expenditure poverty and “education” deprivation could reflect inadequate transport infrastructure or climatic hazards restricting school access, regardless of financial wealth.

3.10.4 BND (OWB) and financial stress/unhappiness (SWB)

BND did not significantly associate with either SWB measure (Table 3.16); challenging the assumption that fulfilling basic needs constitutes the foundation of SWB in LMICs (Bull et al., 2010; Drakopoulos, 2008; Guillen-Royo et al., 2013; Nanor et al., 2021). One potential explanation is financial stress and unhappiness are guided by relative comparisons to other households or past periods rather than absolute resources and skills (Kangmennaang et al., 2019). Additionally, the association between BND and SWB could be weakened by opposing OWB/SWB mechanisms within certain remote communities. For example, poor accessibility to peri-urban hubs can restrict access to profitable markets and public services, such as

education and healthcare, yet it may improve SWB by lowering individuals' material aspirations and relative comparability (Ravallion, 2014).

The non-significant association between BND and unhappiness could also reflect individuals' differing views on what basic needs are required for a "good life" (Dzokoto et al., 2019). For example, education may not be prioritised by individuals whose happiness is driven by fulfilling their socially-obligated farmer livelihoods (Brown et al., 2021; Dowling & Yap, 2012). This example highlights the limitation of using pre-defined BND indicators, and the benefit of collecting targeted communities' priorities to accurately capture their perceived wellbeing (Decancq & Lugo, 2013).

3.10.5 Financial stress (SWB) and unhappiness (SWB)

The two SWB measures significantly associated (Table 3.17); supporting studies showing pessimistic financial outlooks to reduce happiness by lowering social status, and inducing emotions of anger and envy (Fafchamps & Shilpi, 2008; Guillen-Royo, 2011; Hirata, 2001; Knight & Gunatilaka, 2012; Kollamparambil, 2020). However, the relationship may be bidirectional, as satisfaction with certain life domains, such as housing (Marks, 2007) and health (Wang et al., 2020), can improve individuals' current and future financial evaluations.

Despite the significant association, the overall incidence rates of unhappiness (15%) and financial stress (87%) are substantially different; suggesting different processes influence the outcomes. For example, lower unhappiness could be impacted by social desirability bias, with respondents unwilling to share their struggles to maintain a favourable public image (Reisinger, 2022; White, 2016). This effect is hypothesised to be pronounced in Ghana due to the importance of happiness in achieving a "good life" and the "relatively optimistic worldview" (Dzokoto, 2012;312). Dzokoto et al. (2019) also identify Ghanaian traits which may mitigate negative effects on happiness; for example, a higher tolerance for adversity and a laid-back sense of time (section 2.2.4.3). Alternatively, financial stress could have been exaggerated if respondents believed the survey enumerators worked for government agencies and could provide financial support (Dosu, 2021; Frey & Gallus, 2013). Different biases and cultural tropes could explain the different SWB rates; however, a significant association suggests unhappy households are still more likely to be financially stressed.

The different SWB rates underpin the importance of investigating different wellbeing measures, as even within the same broad philosophical approach, measures are not interchangeable. The

complex information incorporated within SWB evaluations could also explain the greater disparity in the SWB rates compared to the relative similarity of the OWB measures (Table 4.1).

This initial analysis highlights the importance of investigating OWB *and* SWB, rather than assuming singular outcomes within siloed disciplines, holistically capture wellbeing. Significant associations suggest different wellbeing conceptualisations are not mutually exclusive, yet opposing outcomes for certain households confirm different measures are not interchangeable (Edwards et al., 2016). These results justify the framework's separate, yet interlinked, OWB/SWB components.

3.11 Conclusion

Exploring different wellbeing measures, and their associations, is a crucial aspect of sustainability research to ensure policies effectively target comprehensive improvements for vulnerable communities. Wellbeing is understood differently across disciplines; however, a consensus is not required. Instead, a multidisciplinary approach incorporating various measures is favoured to overcome the limitations of singular measures.

When addressing RQ2b, OWB and SWB measures were evaluated from methodological and policy standpoints. For example, SWB measures encounter issues of bias and reference point incomparability, whereas financial OWB measures face challenges associated with data type, thresholds and equivalisation. From a policy perspective, OWB measures are simple to understand, yet can be criticised for being unidimensional or externally defined, whereas SWB measures allow the policy discourse to be driven by target communities, yet positive outcomes could discourage material improvements. Methodological decisions affect wellbeing results, therefore these decisions should be transparently presented and evaluated within sustainability research.

This chapter compared different methodological approaches (RQ1c) to assess how to best measure comprehensive wellbeing in Volta Delta (RQ1d). For example, financial OWB was calculated using expenditure, rather than income, to reduce the measure's seasonal volatility. The baseline BND measure was calculated using the Alkire-Foster method, with "nested" weighting and a 0.5 cut-off, to provide comparable results to official GSS reports. However, due to the sensitivity to weighting selection, expert/community-preference weights are recommended. Subjective financial stress used an "adequacy" method to reduce errors when quantifying financial needs, while unhappiness was calculated using a "life domains" approach to capture less-tangible wellbeing components.

Finally, when addressing RQ1e, chi-square analysis illustrated significant associations between expenditure poverty, financial stress, and unhappiness, whereas BND did not significantly associate with any other measure. These results suggest different wellbeing measures can be related, yet not interchangeable. Therefore, wellbeing studies using single measures risk excluding crucial information. For example, non-significant associations between BND and SWB measures challenge assumptions that SWB is primarily controlled by basic needs access in LMICs. Therefore, policy interventions targeting wellbeing solely through a basic needs approach may falsely assume increased services or assets translate into SWB. Therefore, further policy interventions are required to achieve broader wellbeing goals.

Furthermore, large proportions of households possessed opposing outcomes (i.e., “poor but happy”), suggesting OWB and SWB may have different underlying mechanisms. These exploratory results support the positive and negative relationships (“+/-“) between objective capitals and subjective perceptions depicted in the framework (Figure 2.18). Association tests provided key insights into how OWB/SWB may relate, with regression analysis (Chapter 4), exploring how environmental conditions may impact these associations.

Chapter 4 Environmental associations with objective and subjective wellbeing

4.1 Introduction

This chapter explores associations between environmental conditions, OWB *and* SWB, and how OWB/SWB associate, to address RQ2:

2. What are the spatial environmental associations with OWB and SWB measures?

- a. Explore how environmental conditions and control characteristics explain the distribution of OWB and SWB, and how the drivers of OWB and SWB outcomes vary.
- b. Understand relationships between OWB and SWB within an environmental context.

Many environment-wellbeing studies focus on singular outcomes (Barbier & Hochard, 2018; Nanor et al., 2021), whereas this chapter explores associations with multiple wellbeing measurements. Furthermore, studies examining relationships between OWB and SWB are rarely explored within an environmental context (Cummins, 2000; Mahmood et al., 2019). The environmental “lens” is crucial to understanding wellbeing within the study area due to the strong interconnectivity with livelihoods, food security and service access in rural LMICs (Cazcarro et al., 2018).

This chapter draws on the “ECW” framework (Figure 4.1) to explore how livelihoods, environment (climate hazards & landscape), and response (adaptation) associate with OWB, SWB, and their relationship. However, as the framework illustrates, other key wellbeing controls function within an environmental context. By incorporating wellbeing components (financial, human, social and physical capitals/perceptions) as explanatory variables, this chapter also investigates how wellbeing may be a “means” to wellbeing by influencing adaptive capacity and/or sensitivity. These control variables can also be interpreted independently; however, to preserve the research focus, relationships are discussed within an environmental context. Furthermore, despite recognising how wellbeing can feedback to influence environmental conditions, this chapter primarily interprets “environment” as a wellbeing determinant (Schleicher et al., 2018a).

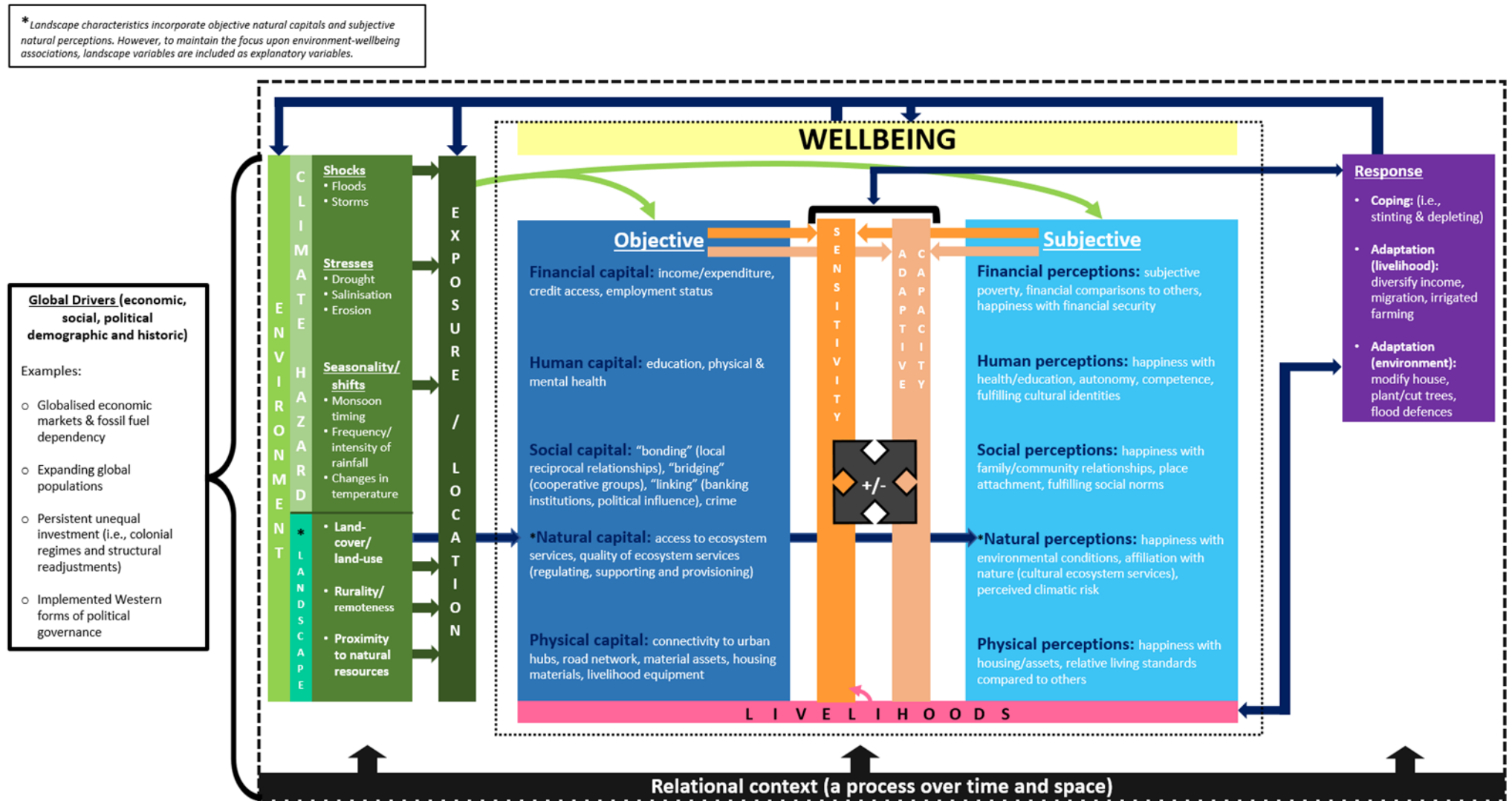


Figure 4.1 The Environment and Comprehensive Wellbeing (ECW) framework

This chapter outlines the datasets and statistical methodologies, and provides contextual information on the spatial distributions of wellbeing outcomes. Next, eight logistic regression models are presented; four investigating associations with singular wellbeing outcomes (RQ2a), and four with OWB/SWB combinations (RQ2b). Using the “ECW” framework to structure the results and discussion, key environmental themes are explored, followed by an investigation of how control characteristics can shape adaptive capacity, sensitivity and wellbeing.

4.2 Data

This section re-introduces the survey dataset, before outlining the outcome variables. Next, explanatory variables are summarised, with special attention given to environmental variables; captured through survey responses and remote sensing data.

4.2.1 Household survey dataset (DECCMA)

This chapter utilises the DECCMA survey dataset. The dataset incorporates responses from 1,364 households on various topics including self-evaluated climate hazards and sociodemographic characteristics. For more information, including the sampling strategy, see section (3.6).

4.2.1.1 *Wellbeing outcome variables*

As introduced in Chapter 3, four wellbeing measures, two objective and two subjective, were calculated from the DECCMA dataset (Table 4.1). These measures are spatially mapped and included within regression models to identify environmental relationships (RQ2a). The measures are household-level, with OWB measures incorporating information from the entire household, and SWB measures assuming household heads’ evaluations are representative.

Table 4.1 The four recommended wellbeing measures³⁴

OWB/SWB	Measure	Description	Sample sizes
Objective	Expenditure poverty	0 – Not in poverty 1 – In poverty Absolute expenditure poverty (GH¢1,760.8/adult equivalent/year), adjusted for regional cost-of-living, and equivalised using the GSS-dietary scale	0 – 854 (63%) 1 – 506 (37%)
	Basic needs deprivation	0 – Not deprived 1 – Deprived 12 deprivation components, with equal “nested” weighting across financial, human, social and physical capital groups. A household experiencing 50%+ weighted deprivations is deprived overall	0 – 690 (51%) 1 – 667 (49%)
Subjective	Financial stress	0 – Not stressed 1 – Stressed Based on the question “do you feel under stress with your current income?”	0 – 182 (13%) 1 – 1,181 (87%)
	Life domains unhappiness	0 – Happy 1 – Unhappy Captured using a “life domains” approach. Ordinal PCA agglomerated 8 correlating, ordinal measures of happiness (5-point Likert scale). K-means clustering formulated three clusters; with the lowest-scoring cluster defined as “unhappy” in the binary outcome variable	0 – 1,162 (85%) 1 – 202 (15%)

To address RQ2b, four additional binary variables were constructed, combining objective expenditure poverty, also referred to as “financial OWB”, and subjective unhappiness (Table 4.2). These variables were selected to reflect opposite ends of the objective-subjective spectrum³⁵. These combined variables are used to investigate the environmental mechanisms driving aligning/opposing OWB/SWB associations. Within the combined measures I use the term “poor” to define those experiencing objective expenditure poverty. I appreciate the negative connotations, and the capacity for this term to generalise different groups experiencing

³⁴ Note, different overall counts across the four wellbeing measures are due to missing data.

³⁵ Expenditure poverty is used as the “most objective” wellbeing measure due to its simplicity and the prominence of economic indicators within development research. It is recognised however that expenditure poverty may not be the prioritised OWB measure for all communities.

varying issues. However, the term improves the interpretability of results for lay audiences, and reflects the jarring reality that individuals do have low financial capital (Kripke, 2015).

Table 4.2 The four combined poverty-happiness measures constructed to understand OWB/SWB associations within an environmental context

	Life domains unhappiness	
	No	Yes
Expenditure poverty	No	Yes
No	“Non-poor & Happy” (n=744 [55%])	“Non-poor & Unhappy” (n=110 [8%])
Yes	“Poor & Happy” (n=415 [30%])	“Poor & Unhappy” (n=91 [7%])

4.2.1.2 Explanatory variables

Explanatory variables, sourced from DECCMA and remote sensing datasets, are grouped into environmental and control characteristics (Table 4.3). These groupings support the specific focus on environmental conditions, whilst still acknowledging the importance of control characteristics in explaining variation in OWB/SWB.

Table 4.3 Explanatory variable categories and number of variables; sourced from DECCMA, WorldPop and various remote sensing sources

Variable group	Category	No. variables	Data source
Environmental	Climatic hazards (shocks, stresses, shifts/seasonality)	18	DECCMA
	Landscape (remoteness, topography, landcover)	26	Remote Sensing
Control	Household characteristics	6	DECCMA
	Household head characteristics	6	DECCMA
	Adaptation	5	DECCMA
	Assets	4	DECCMA
	Subjective evaluations	2	DECCMA
	Community characteristics	1	WorldPop

Within “household characteristics” an additional “livelihood cluster” variable is constructed to account for differences in households’ environmental sensitivity (Appendix 4.1). Similarly, within “subjective evaluations”, two variables capturing household heads’ place/community attachment and personality (Appendix 4.2) are constructed to capture components of human and social perceptions (Figure 4.1). “Landscape” and “community characteristics” are contextual variables presented at the cluster-level, whereas all other variables are household-level. Information on all variables, including coding, is presented in Appendix (4.3).

“Environmental” variables incorporate remote sensing data and self-reported perceptions of exposure, impact and change within the DECCMA dataset. Analysing climatic perceptions, even if unaligned with meteorological evidence, is important as individuals’ observations motivate behaviour (Alam & Mallick, 2022; Bempah & Øyhus, 2017; Faisal et al., 2021). Incorporating self-reported evaluations also ensures environmental policies align with communities’ experiences, resulting in greater cooperation (Debela et al., 2015). However, self-reported variables are exposed to bias, for example perceptions of rainfall patterns may be influenced by recent extreme events (Waldman et al., 2019), and misinterpretation; highlighted by respondents’ interpretation of “storm surges” as both oceanic and precipitation-based events (Appendix 4.4). Nevertheless, certain environmental information, such as landcover characteristics, cannot be captured through surveys; therefore, remote sensing data is required.

4.2.2 Remote sensing data

Multiple remote sensing datasets were collected to create explanatory, contextual variables. GPS points for each EA facilitated the spatial join between survey and remote sensing data.

Firstly, EVI captures landscape “greenness” through land’s absorption and reflection of near-infrared wavelengths (NASA, 2022). EVI is used as a proxy for multiple environmental factors, including; rainfall (Farrar et al., 1994), maize yield (Wahab et al., 2018), soil moisture (Easdale et al., 2018), temperature (Liu et al., 2015) and land degradation (Barbier & Hochard, 2016). 250m resolution data for the growing season (April-June 2016) was obtained³⁶ (Appendix 4.5), alongside previous years’ values to analyse past change³⁷. Using *ArcGIS Pro*, mean pixel values were calculated with a scale factor (0.001) (Didan et al., 2015). Oceanic and inland water pixels

³⁶ Note: data is collected in 16-day periods; therefore, depending on the calendar some years also contained data from late-March and early-July.

³⁷ Data from 2006, 2011 and 2015 was also collected to calculate 1, 5 and 10 year % changes in EVI.

with 0 or negative values were removed. Mean values were calculated for all 50 EAs using a 2km buffer from the community centroid. DHS advises 2km buffers for urban, and 5km for rural areas (Perez-Heydrich et al., 2013); however, due to a rural/urban mix within Volta Delta, existing Ghanaian studies using 2km buffers (Krefis et al., 2011), and to minimise overlap between communities' associated environments, 2km buffers were applied throughout³⁸. Nevertheless, the potential for individuals to access environments outside their immediate community is acknowledged (Douxchamps et al., 2015). Furthermore, "land ownership", a potential determinant of vulnerability and wellbeing, was excluded due to >60% missing survey data.

Landcover information (Figure 4.2) was created from LANDSAT-7 30m resolution images, using FAO Land Cover Classifications (Jayson-Quashigah, 2016). Data from 2001 and 2015 was collected to examine relationships with current landcover and past changes. Other studies also incorporate 15-year periods to account for "lag effects" between landcover change and socioeconomic outcomes (Ampim et al., 2021; Baffour-Ata et al., 2021; Ustaoglu & Lavalley, 2017). The proportion of each landcover classification, and percentage change 2001-2015, was calculated for each EA. Appendix (4.6) presents descriptions of each landcover classification and coverage statistics.

³⁸ 2km buffers were drawn around each household in an enumeration area then merged together (using the *dissolve* tool); therefore, the overall area may differ depending on household dispersion.

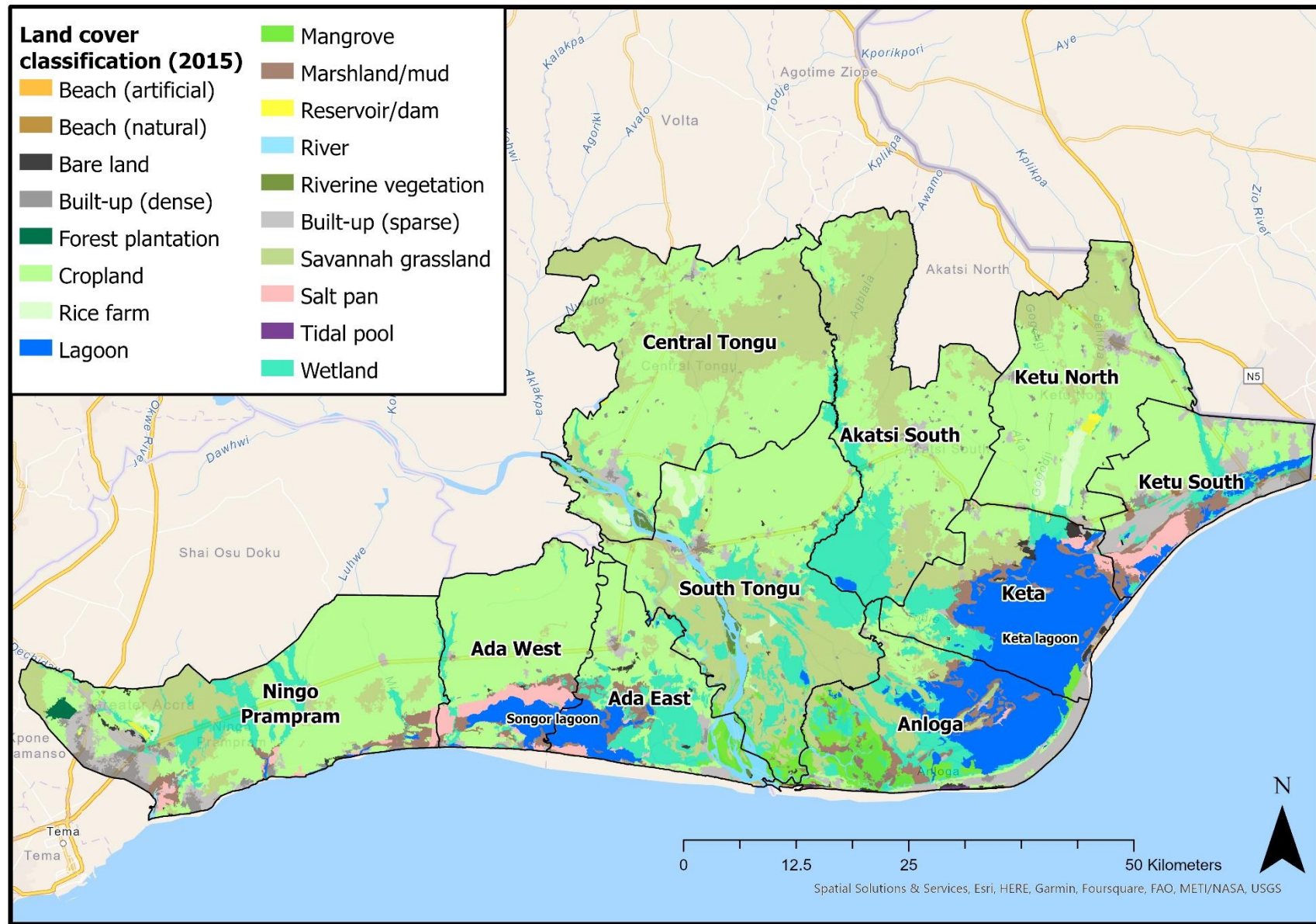


Figure 4.2 Landcover classification for Volta Delta. Classification created from LANDSAT 7 30m resolution images, using FAO Land Cover Classification System

Further landscape variables were collected from WorldPop (2016) Geospatial data, including; distance from major roads, road intersects (Christiaensen et al., 2003), inland water and coast (100m resolution), and elevation, slope and population density³⁹. Mean buffer values for each EA were calculated as contextual variables.

“Remoteness” variables were collected using Google API data, including travel time data⁴⁰ between each EA centroid and Accra/district capitals. The limitation of using car travel times is acknowledged, with low private vehicle ownership in Ghana (Armah et al., 2010); however it remains a suitable proxy for service access. Travel time, rather than Euclidian distance, is more effective in capturing remoteness in locations where accessibility is restricted by coastlines or physical barriers (Boscoe et al., 2012). However, other Ghanaian studies show Euclidian distance measures to be effective proxies (Nesbitt et al., 2014); justifying the use of travel time *and* Euclidian distance (i.e., inland water distance) measures.

See Appendix (4.3) for the coding of remote sensing variables. Due to the linearity assumption and minimum cell size requirements within regression models (section 4.3.2.1), certain variables have alternate categorisations to ensure these conditions were fulfilled in different models.

4.3 Methods

This section outlines the key methodologies, including exploratory spatial analysis and regression models examining associations between environmental and control characteristics, OWB and SWB (RQ2a), and aligning/opposing OWB/SWB combinations (RQ2b).

³⁹ Inland water distance was obtained from the European Space Agency CCI (Climate Change Initiative) LC (Land Cover project) (Lamarche, et al. 2017). Data on proximity to major roads and intersects was taken from OpenStreetMap. Distance to coast (2000-2020) was obtained from the US NASA Shuttle Radar Topography Mission (SRTM). Elevation and slope data (2000) was collected from the same source. Population density data (2016) used adjusted 2010 National Ghana Census figures.

⁴⁰ Based on a car travelling along recognised road networks as at December 3rd, 2021, at 8:00am

4.3.1 Spatial distributions

Using *ArcGIS Pro*, maps illustrating the spatial distribution of the four wellbeing measures were produced to provide contextual information and support discussions of modelled results (RQ2a). The proportion of households in each EA experiencing each outcome was calculated. Due to a similar range of community-level values for expenditure poverty and basic needs deprivation, the quartile thresholds for the latter were applied to the former to allow for direct comparison. The quartile categories were developed independently for the two SWB measures due to their distinct data ranges. Therefore, this analysis does not compare the magnitude of different SWB outcomes, but examines how each measure varies over Volta Delta⁴¹.

Two further maps were produced to illustrate the proportion of households within each EA experiencing aligning (non-poor/happy & poor/unhappy) and opposing (non-poor/unhappy & poor/happy) outcomes (RQ2b). The proportion within each community was compared to the sample average. Communities with “above-average” proportions are highlighted black/red. Communities “above-average” in both aligning/opposing outcomes are highlighted purple, whereas communities “below-average” for both outcomes are coloured white.

4.3.2 Regression modelling

4.3.2.1 *Model building strategy (single outcomes)*

To address RQ2a, multilevel, random intercept, binary logistic models were tested using forward stepwise selection to analyse associations with the four wellbeing outcomes (Table 4.1). All dependent variables possess a binary distribution, therefore, the logit link function was used (Agresti & Finlay, 2009). Binary analysis ensures a consistent focus on low wellbeing, rather than the entire wellbeing distribution, and facilitates comparability between measures.

Multilevel models were initially constructed to account for the hierarchical data structure (1,364 households within 50 clusters), and the unexplained variance between survey clusters (EAs). However, in all four models, inputted variables significantly explained between-cluster variance; therefore, all were transformed to single-level.

⁴¹ Smaller symbols are used to visually display wellbeing proportions within communities (to minimise overlap). However, community-level variables, such as landcover, were calculated from 2km buffers.

RQs and statistical associations guided the variable input order. Before constructing the full models, bivariate models between wellbeing and explanatory variables were built⁴², and variable significance and model AIC were recorded. Significant environmental variables were included first in the full models, followed by significant control, non-significant environmental and non-significant control variables. Within each subgroup, variables with the lowest AIC were included first.

Likelihood ratio tests (LRT) tested variable significance throughout the stepwise process. If a variable no longer significantly explained variance in the outcome, it was removed. LRTs were also carried out between multilevel and corresponding single-level models after each variable was added to test whether unexplained between-cluster variance remained, and therefore multilevel modelling was justified. As mentioned, all models were transformed to single-level, with most between-cluster variance⁴³ explained by contextual landcover and location variables (Appendix 4.7).

Tests for linearity between numerical variables and log odds of outcome variables were undertaken to ensure model assumptions were fulfilled. If non-linear, numerical variables were categorised into the optimum number of categories⁴⁴ using natural breaks (Chen et al., 2013). Some variables were categorised using logical increments, for example “travel time to Accra” in 1-hour groups. Categories were adjusted to ensure sufficient sample size (≥ 100) in each category, and cell sizes (10+) within regression analysis (Peduzzi et al., 1996). Certain variables have alternate categorisations to fulfil these conditions within different models (Appendix 4.3).

Once all variables were tested for significance at least twice, and no more variables significantly accounted for unexplained variance, the models were tested for multicollinearity⁴⁵. Collinear variables, contributing least to model fit, were removed.

⁴² Note: certain explanatory variables were excluded from the BND model due to variables being included as components of the outcome variable; for example, roof material and drinking water source.

⁴³ The proportion of variance explained was calculated using model VPC; the proportion of total variance attributable to variation within-clusters, compared to between-clusters ($\sigma^2_u/\sigma^2_u+\sigma^2_e$). A lower VPC value suggests the variable explains a higher amount of between-cluster variance.

⁴⁴ The optimum number of categories was defined using the *NbClust* R-function, whereas the category thresholds were defined by the *getJenksBreaks* R-function.

⁴⁵ Multicollinearity was tested using the *vif* R-function, with an intermediate threshold of 4 (Pan & Jackson, 2008).

Interaction terms, focusing on environment-control relationships, were incorporated to account for interconnections between environmental conditions and capitals/perceptions (Duku et al., 2022), and quantify the effects of “adaptive capacity”, “sensitivity” and “response” (Figure 4.1). Only interaction terms which logically followed theory, and maintained a minimum cell size (>10), were tested using LRTs. To ensure model parsimony, if a variable had 2+ significant interactions, a single interaction was chosen based on model fit, research relevancy, and existing literature.

Following the construction of BND and unhappiness models, further analysis was undertaken to uncover potential mechanisms behind modelled relationships. Both measures are decomposable, meaning relationships between explanatory variables and specific deprivations/domains could be explored. Chi-square tests between significant model variables and each deprivation/domain provided supporting information to aid discussions. Standardised residuals were interpreted to determine which explanatory categories were over/underrepresented amongst individual deprivations/domains. By examining associations with decomposed components, better-targeted wellbeing initiatives can be supported within contexts where communities experience different environmental and wellbeing challenges (Angulo et al., 2016; Costa, 2003).

4.3.2.2 *Combined OWB-SWB models*

To understand OWB/SWB relationships within an environmental context (RQ2b), households were categorised into four groups based on expenditure poverty and unhappiness (Table 4.2); following a similar methodology to Mahmood et al. (2019). Initially, multinomial models were constructed; however, due to excessive variables/interactions, and interpretability issues due to each group’s results being in relation to a single reference group, four independent binary models, comparing each group to the rest of the sample, were constructed instead. The same model-building strategy was used, with all models transformed to single-level due to between-cluster variance being explained by inputted variables.

4.4 Results

This section interprets the spatial distributions of the different wellbeing outcomes. Next, four multiple regression models, analysing associations with the different wellbeing outcomes

(RQ2a), and four models focusing on aligning/opposing OWB/SWB combinations, are detailed (RQ2b).

4.4.1 Spatial distributions

This section explores spatial distributions of the singular and aligning/opposing OWB/SWB measures. These visualisations support later discussions on the associations between location, landcover, climate and, wellbeing.

4.4.1.1 Singular wellbeing outcomes

Firstly, expenditure poverty is concentrated in Akatsi South district with cropland and wetland coverage (Figure 4.3). Communities north of Keta lagoon containing marshland and wetland also have higher proportions. Contrastingly, lower proportions exist in built-up locations near Volta River in Sogakope, Ada East and Anloga near the river mouth, Ketu South near the Togo border, and Ningo Prampram near Tema and Accra.

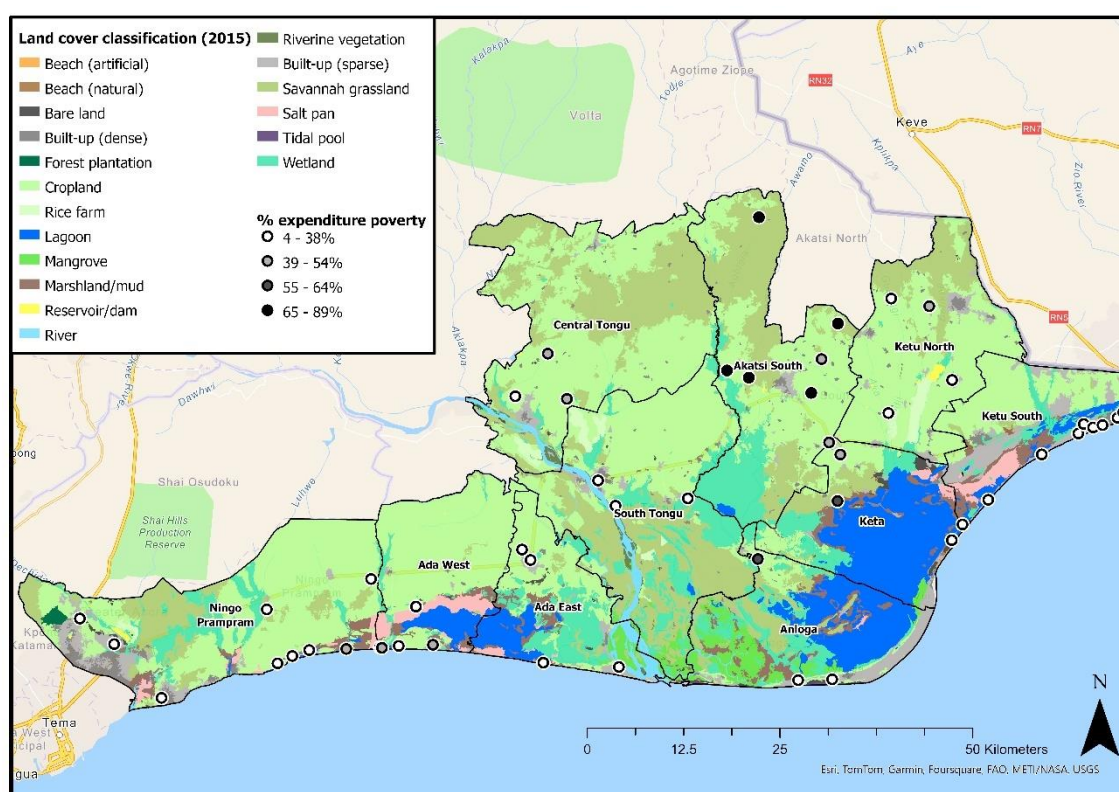


Figure 4.3 Proportion of households in each EA experiencing objective expenditure poverty

Secondly, higher BND proportions exist in two broad areas; west of Songor lagoon in Greater Accra, and around Keta lagoon (Keta/Akatsi South districts) (Figure 4.4); predominantly with cropland and savannah grassland. Contrastingly, lower proportions occur near Volta River in South and Central Tongu, Ketu South near the Togo border, and Anloga by the river mouth, consisting of built-up, mangrove and wetland landcover. The disparity in BND between Anloga and coastal communities in Keta aligns with previous multidimensional wellbeing studies (Duku et al., 2022).

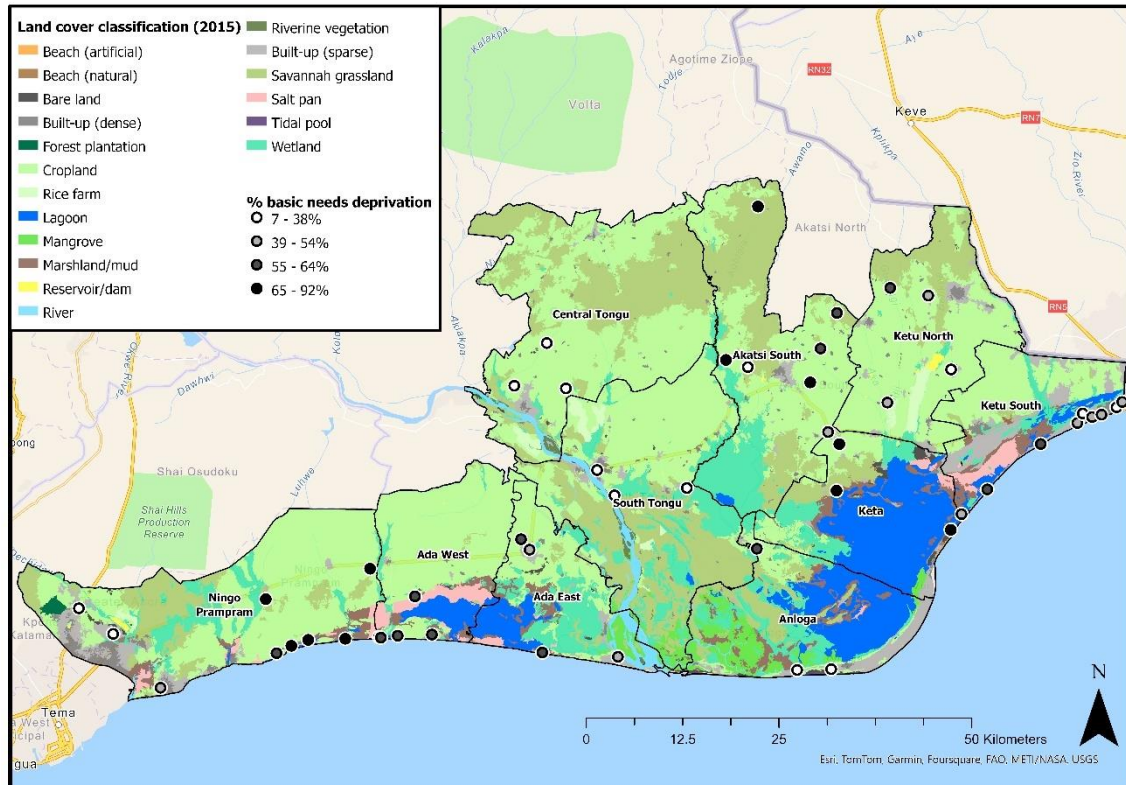


Figure 4.4 Proportion of households in each EA experiencing basic needs deprivation

Thirdly, subjective financial stress has hotspots south of Songor Lagoon in Ada West, Central Tongu (high cropland coverage), and around Keta Lagoon in Keta, Anloga and Ketu South districts (Figure 4.5). Lower proportions appear in peri-urban west Nino Prampram, also shown to possess lower expenditure poverty; supporting the association between the two measures (section 3.10.1). However, lower financial stress within agricultural/grassland areas of Akatsi South and Ketu North contrasts the higher expenditure poverty.

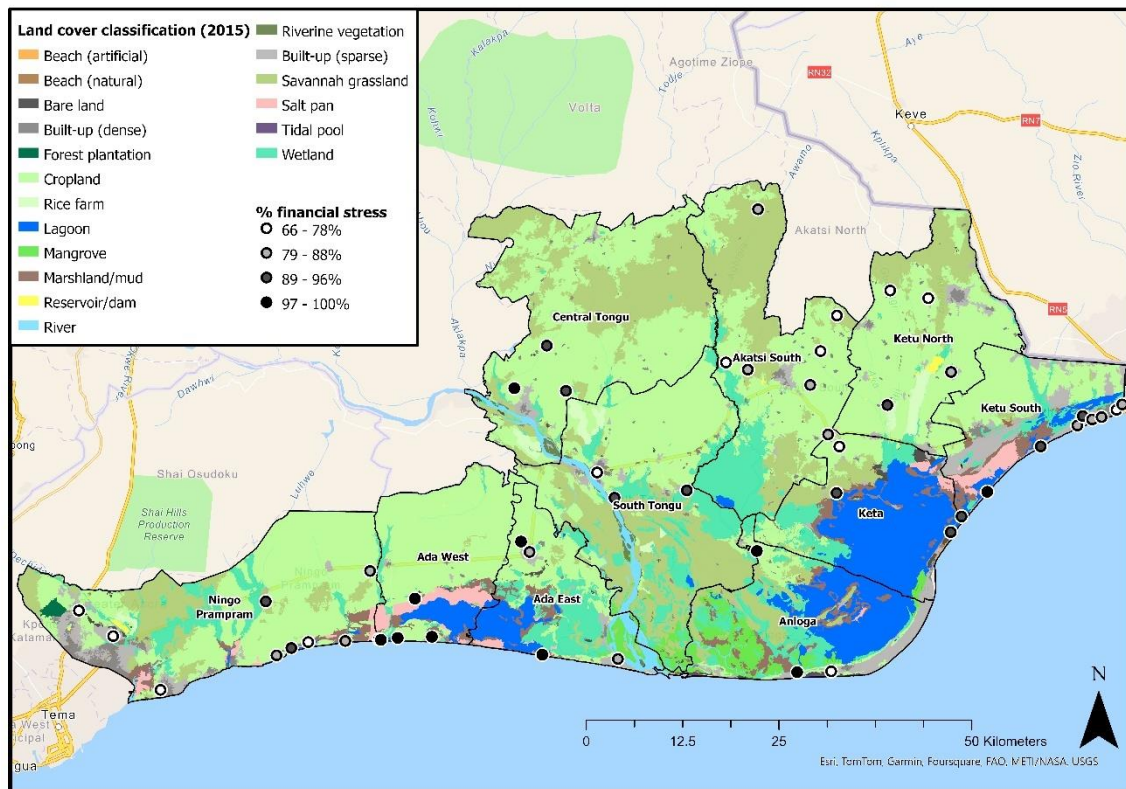


Figure 4.5 Proportion of households in each EA experiencing subjective financial stress

Fourthly, higher unhappiness is concentrated southwest of Songor Lagoon (Figure 4.6). Another hotspot exists along the coast, close to the Togo border in Ketu South, with extensive salt pans, marshland, and small inland water bodies. Furthermore, higher proportions are recorded in South Tongu, including Sogakope, contrasting the lower proportions of expenditure poverty. In contrast, lower proportions exist in Central Tongu, coastal communities near Anloga, west Ningo Prampram, and north of Keta lagoon (Ketu North/Akatsi South districts).

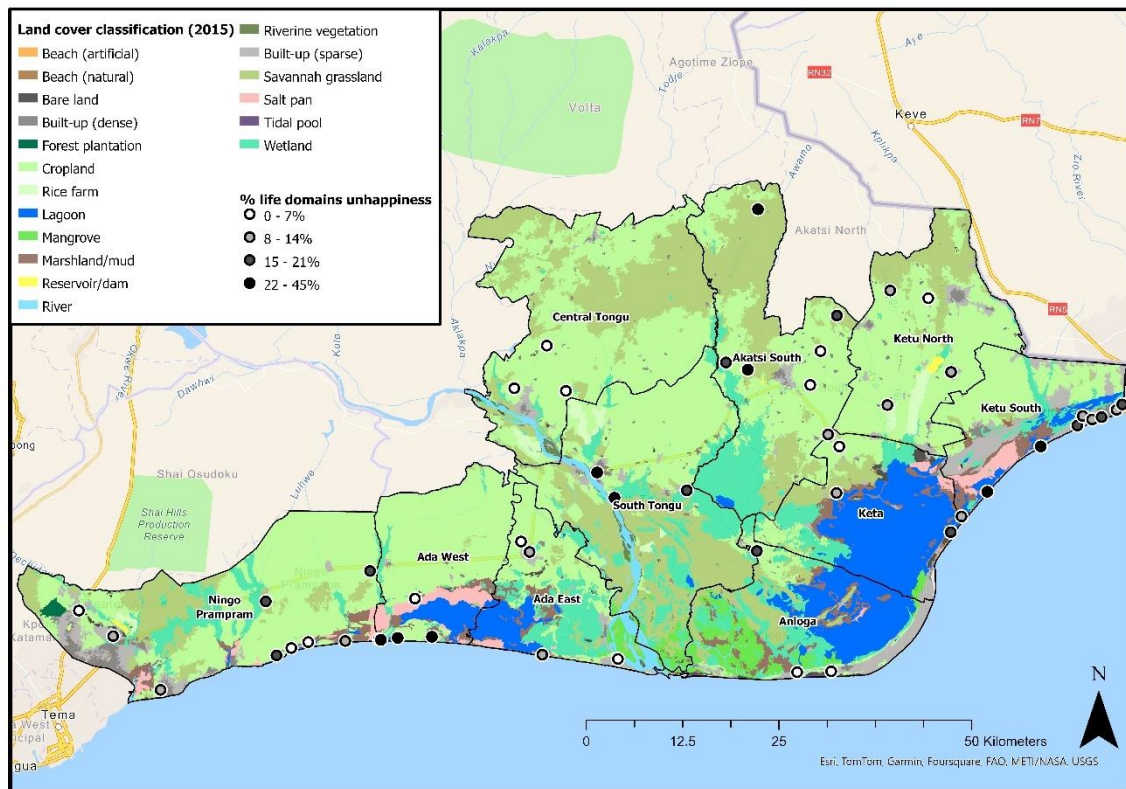


Figure 4.6 Proportion of households in each EA experiencing “life domains” unhappiness

4.4.1.2 Combined OWB-SWB outcomes

Households with aligning high OWB/SWB (“non-poor/happy”) are concentrated within coastal, built-up regions, including; west Ningo Prampram near Tema, Ketu South near Togo, Anloga and Ada East in proximity to Volta River. Whereas, the highest proportions of aligning “poor/unhappy” households occur within Akatsi South and close to Songor Lagoon (Figure 4.7).

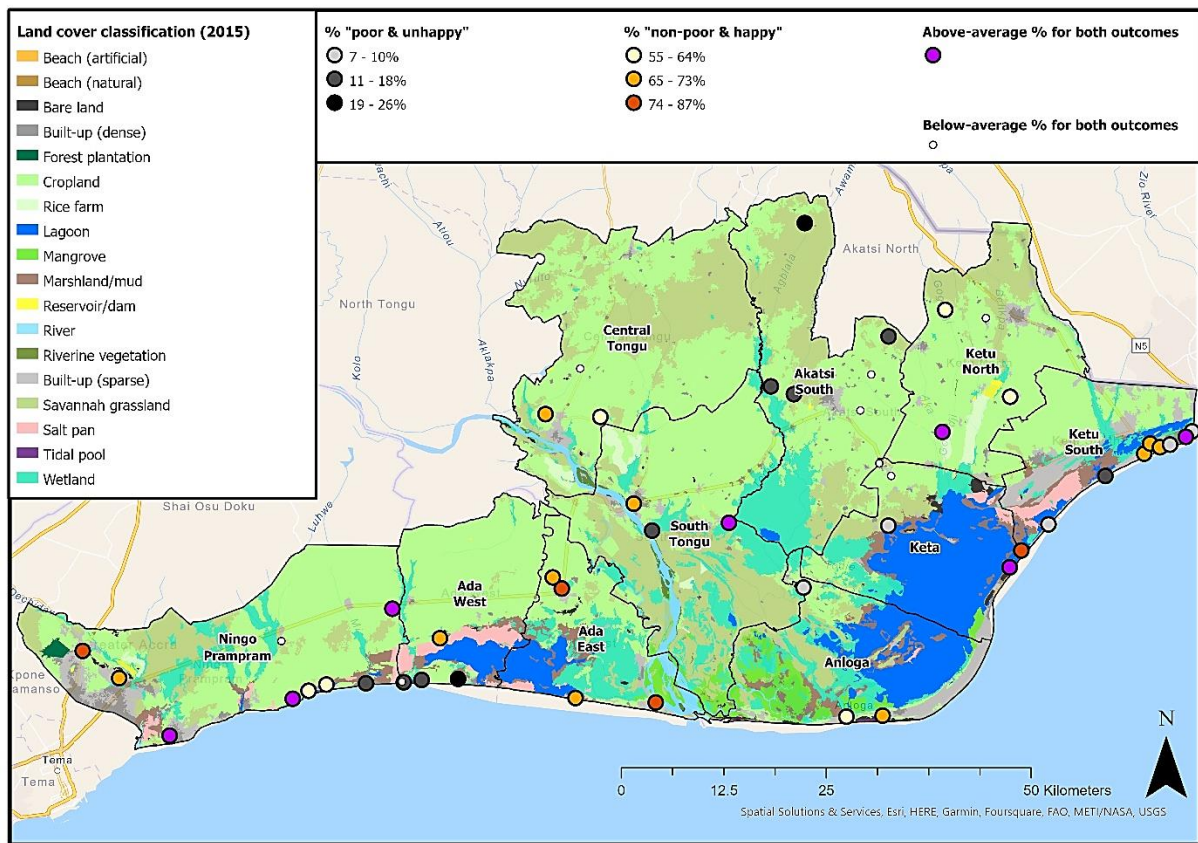


Figure 4.7 Proportion of households in each EA with aligning OWB/SWB outcomes

Note, EAs with "above-average" proportions are highlighted (red/black). EAs with "above-average" proportions for both outcomes are highlighted purple, and highlighted white if the proportion is "below-average" for both outcomes.

Households with opposing high OWB/low SWB ("non-poor/unhappy") are concentrated in three areas; around Sogakope (South Tongu), near the Togo border, and southwest of Songor Lagoon in Ada West; the latter including beach, marshland, salt pan and cropland coverage. Lastly, "poor/happy" households are primarily in inland agricultural/grassland communities in Akatsi South, Ketu North and Keta (Figure 4.8).

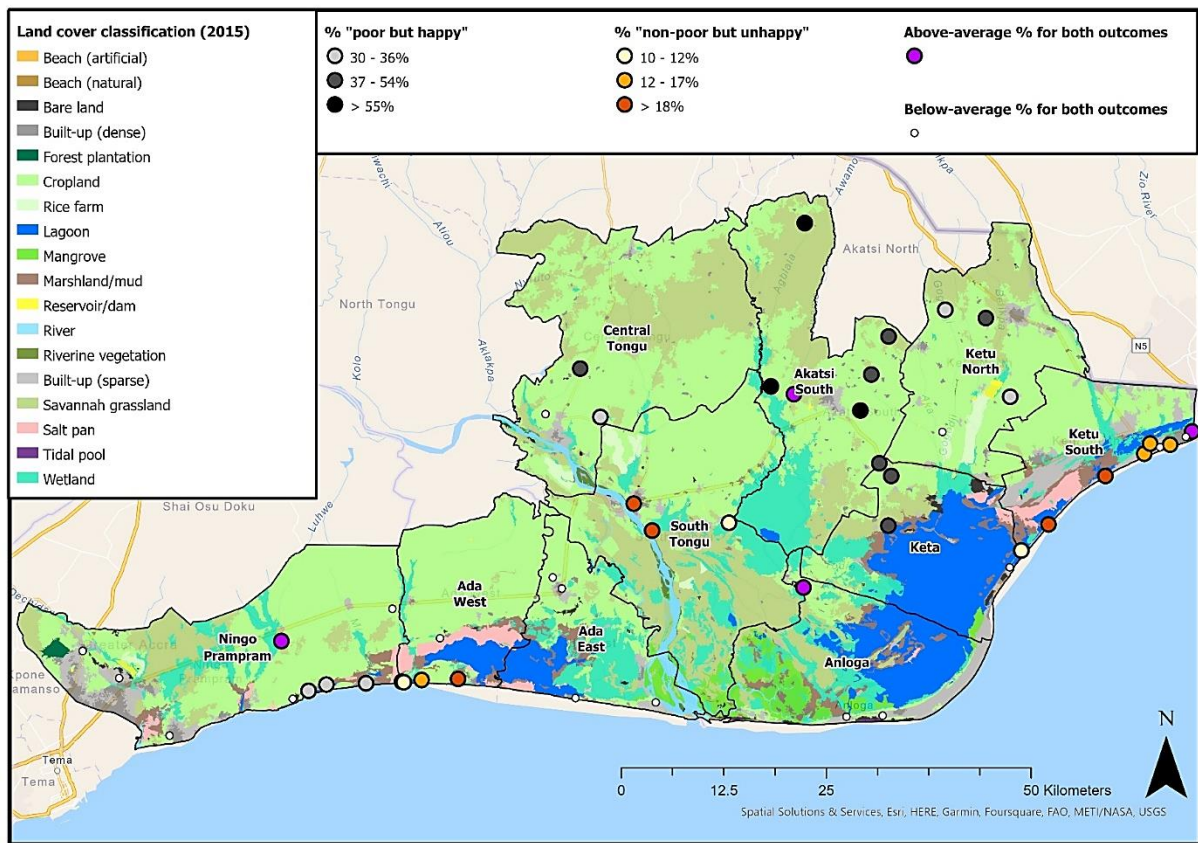


Figure 4.8 Proportion of households in each EA with opposing OWB/SWB outcomes

Note, EAs with "above-average" proportions are highlighted (red/black). EAs with "above-average" proportions for both outcomes are highlighted purple, and highlighted white if the proportion is "below-average" for both outcomes.

4.4.2 Multiple regression results

The following section outlines results from eight models (Table 4.4) examining associations between environmental and control characteristics, singular outcomes (RQ2a), and aligning/opposing OWB/SWB outcomes (RQ2b).

Table 4.4 The eight binary logistic multiple regression models and corresponding research questions

Research question	Model	Dependent variable
2a: Explore how environmental conditions and control characteristics explain the distribution of OWB and SWB, and how the drivers of OWB and SWB outcomes vary.	4.1.1	Objective: Expenditure poverty
	4.1.2	Objective: Basic needs deprivation
	4.1.3	Subjective: Financial stress
	4.1.4	Subjective: Life domains unhappiness
2b: Understand relationships between OWB and SWB within an environmental context	4.2.1	Aligning: Non-poor & Happy
	4.2.2	Aligning: Poor & Unhappy
	4.2.3	Opposing: Non-poor & Unhappy
	4.2.4	Opposing: Poor & Happy

Full model tables are presented, with interpreted results significant at the 5% level⁺. Different observation counts across the models result from missing data. All results are presented as odds ratios, whilst controlling for all other model variables. Interaction terms are visualised as predicted probabilities, holding all other variables at the mean. Appendix (4.8) presents further information on predicted probabilities/marginal effects, model equations, and goodness-of-fit diagnostics; all models demonstrate good fit (McFadden, 1977)⁴⁶.

Results focus on whether variables significantly explain variation in the outcome, therefore effect sizes are not compared between independent models. Results are structured using the conceptual framework (Figure 4.1). Interpretations focus on livelihoods, landscape (landcover & remoteness), climate hazards (shocks, stresses & seasonality), and significant interaction terms. Control variables, relating to “capitals/perceptions” and “response”, are summarised.

⁺ *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

⁴⁶ 7/8 models illustrate “excellent” fit with a pseudo R^2 value between 0.2 and 0.4 (McFadden, 1977). The lower R^2 threshold used to define good model fit is due to this research not aiming to predict human behaviour, but rather identify associated explanatory variables (Ozili, 2023).

4.4.2.1 *Singular wellbeing outcomes*

4.4.2.1.1 Objective expenditure poverty

Model 4.1.1 examines associations with objective expenditure poverty (Table 4.5). Firstly, examining the role of livelihood, “crop farmer” and “fisher/trade/transport” clusters have odds 119% and 85% higher respectively than the “salaried employee/business owner” cluster.

Chapter 4

Table 4.5 Model 4.1.1 – Binary logistic regression model results, dependent variable; objective expenditure poverty

Model 4.1.1	Variable	Odds coefficient [exp(β)] (S.E) (95% CIs)
Climatic shocks, stresses & shifts		
Environmental impact from drought (ref: No impact)		
Impacted		0.660 (0.282) (0.286-1.526)
Economic impact from flooding (ref: No impact)		
Impacted		0.664 (0.138) (0.442-0.997)**
Environmental landscape/remoteness		
Travel time to Accra (ref: 1-2 hours)		
2-3 hours		1.482 (0.345) (0.939-2.339)*
3+ hours		2.046 (0.456) (1.322-3.168)***
Distance to inland water (km)		
Distance (km)		1.090 (0.069) (0.963-1.234)
River vegetation in 2km community buffer (ref: No)		
Yes		0.236 (0.104) (0.100-0.561)***
Savannah grassland in 2km community buffer (%)		
Percentage grassland coverage		1.026 (0.007) (1.012-1.039)***
Mean 2016 EVI value for 2km community buffer (ref: Low)		
Medium EVI		0.636 (0.239) (0.305-1.327)
High EVI		5.006 (2.901) (1.608-15.586)***
Physical assets		
Drinking water source (ref: Piped or tubewell)		
Dug well or open-source		1.282 (0.367) (0.732-2.246)
Household characteristics		
Household size		
2-3 people		7.522 (2.491) (3.930-14.394)***
4-5 people		27.565 (9.314) (14.215-53.451)***
6-7 people		49.957 (18.285) (24.381-102.362)***
8+ people		108.892 (45.109) (48.349-245.250)***
% females in the household		
Percentage in household		0.992 (0.003) (0.986-0.998)***
Household livelihood cluster (ref: Salaried employee/business owner)		
Crop farmer		2.185 (0.545) (1.340-3.563)***
Fisher/trade/transport/construction		1.852 (0.417) (1.191-2.880)***
Household head characteristics		
Highest education level (ref: No schooling)		
Primary education (below-basic)		0.574 (0.112) (0.392-0.840)***
Lower secondary education (basic)		0.649 (0.129) (0.440-0.958)**
Higher secondary or higher education (above-basic)		0.264 (0.066) (0.162-0.431)***
Subjective characteristics		
Place/community attachment (ref: Low attachment)		
Medium attachment		0.394 (0.115) (0.222-0.699)***
High attachment		0.215 (0.065) (0.120-0.383)***
Adaptation		
Current migrant outside household (ref: No)		
Yes		1.453 (0.233) (1.061-1.990)**
Any form of adaptation in the last 5 years (ref: No)		
Yes		0.628 (0.171) (0.369-1.071)*
Interactions		
Drinking water source x distance to inland water (km)		
Dug well or open-source x distance (km)		1.271 (0.100) (1.089-1.484)***
Mean 2016 EVI value x Household Adaptation		
Medium EVI x Adaptation [Yes]		1.539 (0.612) (0.706-3.356)
High EVI x Adaptation [Yes]		0.152 (0.083) (0.052-0.445)***
Environmental drought impact x place/community attachment		
Impacted x Medium attachment		1.816 (0.869) (0.711-4.637)
Impacted x High attachment		3.582 (1.695) (1.417-9.054)***
Additional model information		
Intercept		0.063 (0.033) (0.023-0.175)***
No. observations		1,265
Log Likelihood		-584.742

Next, exploring landscape characteristics, three significant associations with landcover were recorded; every 1% increase in savannah grassland increased odds 3%, and the presence of river vegetation reduced odds 76%. Thirdly, landscape “greenness” (EVI) (section 4.2.2) associated with adaptation, with households undertaking livelihood/environment adaptation (Appendix 4.9) having a probability 0.53 lower than non-adapting households in high-EVI communities (Figure 4.9).

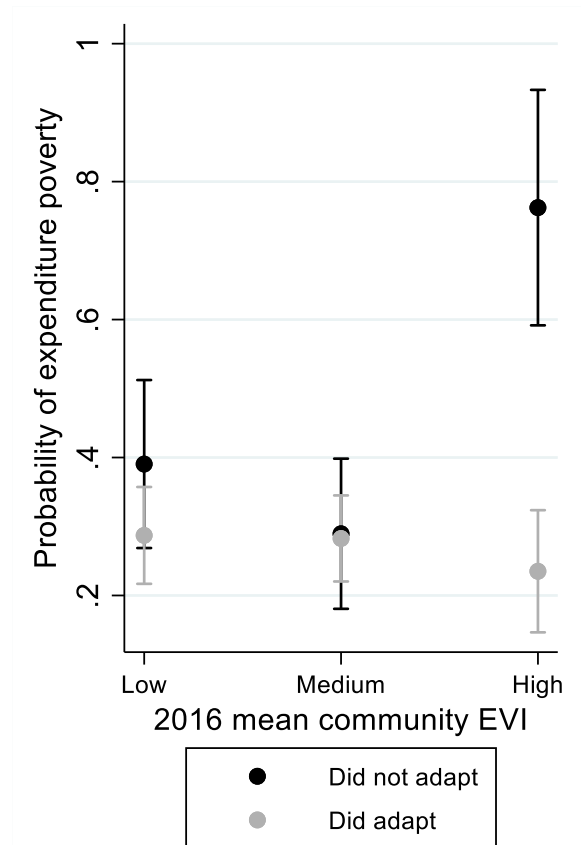


Figure 4.9 Probability of expenditure poverty by mean 2016 community EVI value, and whether the household actively adapted in the past 5 years

Landscape remoteness also associated with expenditure poverty. Firstly, each 1km increase in distance from inland water increased the probability by 0.08 for households reliant on dug well/open source water (Figure 4.10). Furthermore, households located 2-3 and 3+ hours from Accra had odds 48% and 105% higher respectively than those 1-2 hours away.

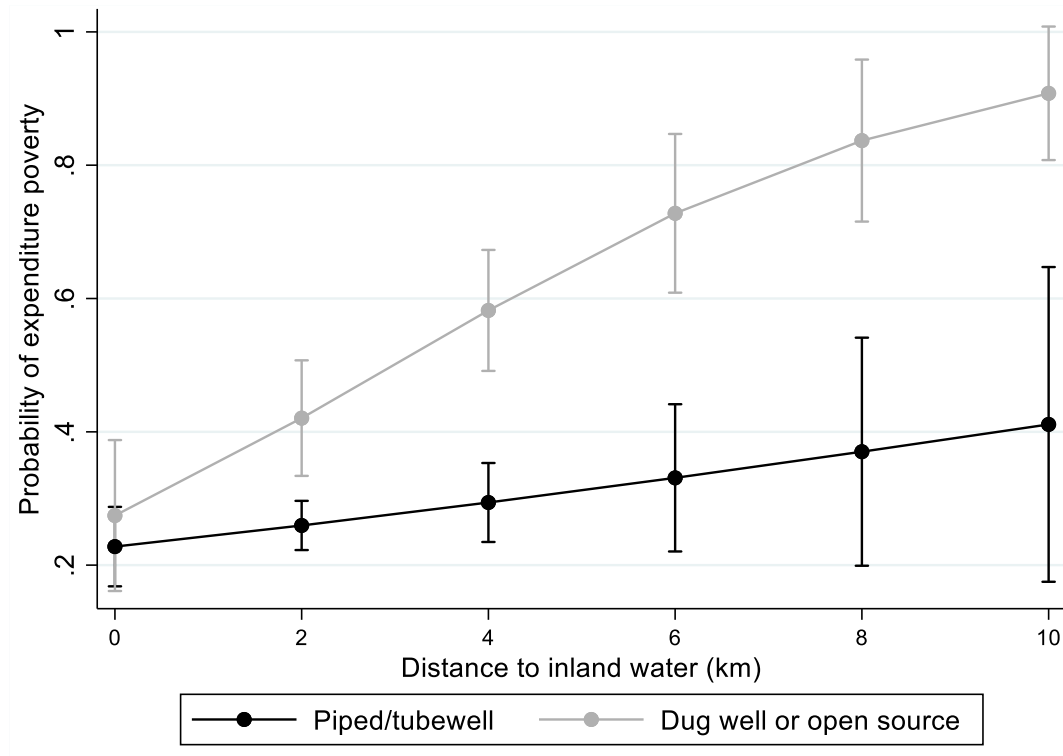


Figure 4.10 Probability of expenditure poverty by community distance from inland water and drinking water source

Climate stress, in the form of environmental drought impact⁴⁷, also significantly associated with expenditure poverty, with the probability increasing 0.17 for drought-impacted households compared to non-impacted households with high place/community attachment. Furthermore, focusing on non-impacted households, the probability was 0.22 and 0.33 lower for those with medium and high attachment compared to low attachment (Figure 4.11). Additionally, households economically impacted by flooding⁴⁸ had odds 34% lower than non-impacted households.

⁴⁷ Environmental impact from drought means drought negatively impacted at least one of housing, health, water or food.

⁴⁸ Economic impact from flooding means flooding negatively impacted economic security (inc. livelihood equipment) and/or crops and livestock.

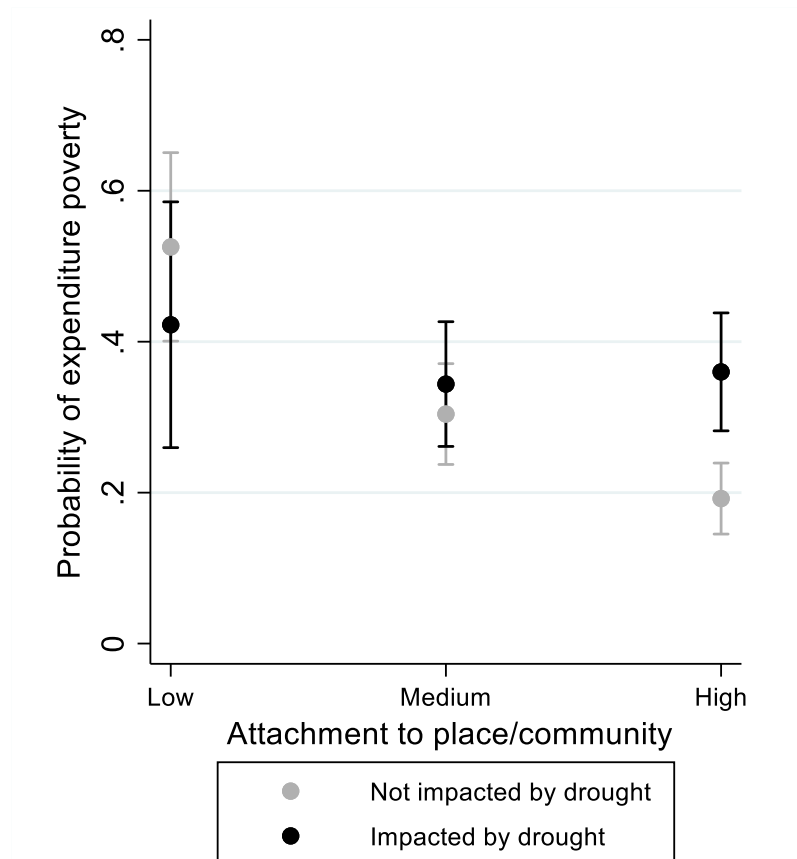


Figure 4.11 Probability of expenditure poverty by attachment to place/community (Appendix 4.2) and environmental impact from drought

Control variables also associated with expenditure poverty. Larger households⁴⁹, with current migrants, lower proportions of women, and unschooled household heads, recorded higher odds.

4.4.2.1.2 Objective BND

Model 4.1.2 examined associations with BND (Table 4.6). Firstly, “crop farmer” and “fisher/trade/transport” livelihood clusters have odds 95% and 70% higher respectively than the “salaried employee/business owner” cluster.

⁴⁹ It is acknowledged that the confidence intervals for household size (8+) in Model 4.1.1 are wide. However, categories were selected to ensure each category had at least 100 observations. In this example, 73/108 (68%) of households with 8+ members were defined as experiencing expenditure poverty.

Table 4.6 Model 4.1.2 – Binary logistic regression model results, dependent variable; objective BND

Model 4.1.2	Variable	Odds coefficient [exp(β)] (S.E) (95% CIs)
Climatic shocks, stresses & shifts		
Environmental impact from drought (ref: No impact)		
Impacted		0.443 (0.097) (0.289-0.680)***
Exposure to drought (ref: Not exposed)		
Exposed		2.659 (0.568) (1.750-4.041)***
Self-reported change in rainfall in the last 5 years (ref: Changed)		
Stayed the same		1.859 (0.555) (1.035-3.337)**
Environmental landscape/remoteness		
Distance from road intersect (ref: Closest to intersect)		
Group 2 (of 3)		0.980 (0.197) (0.661-1.454)
Group 3 (of 3, furthest from intersect)		1.631 (0.322) (1.109-2.400)**
Travel time to district capital (ref: Group 4/4 [longest travel time])		
Group 1: Shortest travel time		0.255 (0.057) (0.165-0.395)***
Group 2		0.587 (0.118) (0.396-0.871)***
Group 3		0.383 (0.081) (0.253-0.580)***
Region (ref: Greater Accra)		
Volta		0.289 (0.645) (0.186-0.447)***
Built-up land in 2km community buffer (ref: None/Low coverage)		
Medium coverage		1.204 (0.277) (0.767-1.890)
High coverage		0.538 (0.143) (0.320-0.907)**
Household characteristics		
Household religion (ref: Christian)		
Non-Christian		2.119 (0.342) (1.545-2.906)***
Household livelihood cluster (ref: Salaried employee/business owner)		
Crop farmer		1.950 (0.432) (1.264-3.009)***
Fisher/trade/transport/construction		1.700 (0.336) (1.154-2.505)***
Household head characteristics		
Sex (ref: Male)		
Female		1.660 (0.254) (1.230-2.241)***
Age quartile (ref: Youngest quartile)		
Young quartile		0.774 (0.153) (0.525-1.140)
Medium quartile		0.627 (0.131) (0.416-0.946)**
Oldest quartile		1.106 (0.246) (0.716-1.710)
Marital status (ref: Previously married – separated/widowed)		
Married/cohabitating		0.794 (0.143) (0.558-1.131)
Never married		0.410 (0.114) (0.238-0.709)***
Personality group (ref: Low personality)		
Medium personality		1.025 (0.217) (0.678-1.551)
High personality		0.625 (0.132) (0.412-0.946)**
Adaptation		
Past migrant in household (ref: No)		
Yes		0.387 (0.091) (0.244-0.614)***
Any form of adaptation in the last 5 years (ref: No)		
Yes		0.431 (0.071) (0.312-0.594)***
Interactions		
Past migrant x Region		
Past migrant in household [Yes] x Volta		2.647 (0.757) (1.512-4.637)***
Additional model information		
Intercept		5.072 (2.187) (2.179-11.810)***
No. observations		1,273
Log Likelihood		-688.812

Landscape characteristics, including landcover and remoteness, also associated with BND. Communities with higher built-up land coverage had odds 46% lower than communities with no/low coverage. Furthermore, odds were 74% lower for those closest to district capitals (0-10 mins) compared to those furthest away (30+ mins), and 63% higher for communities furthest from road intersects (6.9-12.7km), compared to those closest (1.0-3.1km). The probability was also 0.23 lower for households in Greater Accra with past migration than those without past migrants (Figure 4.12).

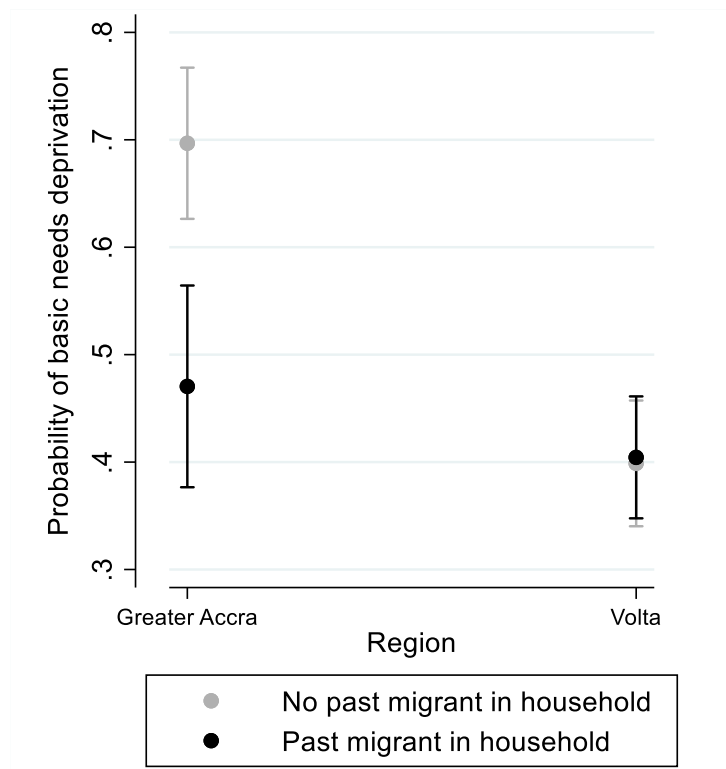


Figure 4.12 Probability of BND by past migration status and region

Climate stresses and shifts also significantly explained variation in BND. Households stating rainfall volumes had remained the same over the last five years had odds 86% higher than those stating it changed⁵⁰. Additionally, households exposed to drought⁵¹ had odds 166% higher, yet those environmentally impacted by drought had odds 56% lower.

⁵⁰ Note: “changed” incorporates households stating rainfall/temperature had increased, decreased or “changed another way”

⁵¹ Drought exposure related to self-reported annual, or more frequent, drought events (Appendix 4.3).

Different control characteristics also associated with BND. Non-Christian households headed by the youngest/oldest individuals, females or previously married individuals (separated/divorced) recorded higher odds. Contrastingly, those who actively adapted or had a high personality value recorded lower odds.

BND is decomposable, allowing relationships with specific basic needs, rather than “overall” deprivation, to be explored. Table 4.7 presents chi-square analysis between each significant model variable, and each binary deprivation indicator. Significantly overrepresented categories (5% level) for each variable are symbolised using “↑”.

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Table 4.7 Chi-square test results between significant explanatory variables in Model 4.1.2 (BND), and the individual deprivation indicators

Explanatory variable	Deprivation											
	Employment	Excess capital	Bank access	Basic education	Healthcare access	Social cooperative	Network size	Roof material	Latrine type	Drinking water	Over-crowding	Home ownership
Env. Impact from drought		↑ Not impacted	↑ Impacted		↑ Impacted			↑ Impacted	↑ Not impacted	↑ Impacted		↑ Not impacted
Drought exposure		↑ Not exposed	↑ Exposed	↑ Exposed	↑ Exposed			↑ Exposed	↑ Not exposed	↑ Exposed	↑ Not exposed	↑ Not exposed
Change in rainfall volume	↑ Stayed the same	↑ Stayed the same			↑ Stayed the same		↑ Stayed the same	↑ Stayed the same	↑ Stayed the same		↑ Stayed the same	
Distance to road intersect (closest/medium/furthest)	↑ Furthest group (7 - 13km)	↑ Furthest group (7 - 13km)	↑ Medium & Furthest groups (3.3 - 13km)		↑ Medium & Furthest groups (3.3 - 13km)	↑ Furthest group (7 - 13km)		↑ Medium distance (3.3 - 6.3km)	↑ Furthest group (7 - 13km)	↑ Medium distance (3.3 - 6.3km)	↑ Closest group (1.0 - 3.2km)	↑ Closest group (1.0 - 3.2km)
Travel time to district capital (closest/2 nd group/3 rd group/furthest)	↑ Furthest group (30+ mins)	↑ Furthest group (30+ mins)	↑ 2 nd group (11-20 mins) & furthest group (30+ mins)	↑ 2 nd group (11-20 mins) & furthest group (30+ mins)	↑ 3 rd and furthest group (20+ mins)	↑ Furthest group (30+ mins)	↑ 3 rd and furthest group (20+ mins)	↑ 2 nd group (11-20 mins) & furthest group (30+ mins)	↑ 3 rd and furthest group (20+ mins)	↑ 2 nd group (11 - 20 mins)		↑ Closest group (= < 10 mins)
Region	↑ Greater Accra	↑ Greater Accra	↑ Volta		↑ Greater Accra	↑ Greater Accra	↑ Greater Accra	↑ Volta	↑ Greater Accra	↑ Volta		
Built-up landcover in community (None & low/medium/high)			↑ None & low coverage	↑ None/low coverage	↑ None & low, and medium coverage	↑ None & low, and medium coverage	↑ None & low coverage	↑ None & low coverage	↑ None & low coverage	↑ None & low, and high coverage	↑ High coverage	↑ Medium and high coverage
Household religion			↑ Non-Christian	↑ Non-Christian	↑ Christian			↑ Non-Christian	↑ Christian	↑ Non-Christian		
Household livelihood cluster	↑ Crop farmer cluster		↑ Crop farmer cluster	↑ Crop farmer & fisher/trade clusters	↑ Crop farmer cluster			↑ Crop farmer cluster	↑ Fisher/trade cluster	↑ Crop farmer cluster		
Sex (household head)	↑ Female	↑ Female	↑ Female	↑ Female			↑ Female					
Age (household head) [quartiles]	↑ Oldest two quartiles	↑ Youngest and oldest quartiles	↑ Oldest quartile	↑ Oldest quartile	↑ Oldest quartile	↑ Oldest quartile	↑ Oldest quartile			↑ Oldest quartile	↑ 2 nd quartile (34-45 yrs.)	↑ Youngest quartile

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<i>Table 4.7 continued</i>												
Explanatory variable	Deprivation											
	Employment	Excess capital	Bank access	Basic education	Healthcare access	Social cooperative	Network size	Roof material	Latrine type	Drinking water	Over-crowding	Home ownership
Marital status (household head)	↑ Previously married	↑ Never married	↑ Previously married	↑ Previously married		↑ Previously married	↑ Previously married				↑ Married/cohabitating	↑ Never married
Household head personality (low/medium/high)			↑ “Medium” personality	↑ “Low” personality		↑ “Low” & “Medium” personality	↑ “Low” personality		↑ “Low” personality		↑ “High” personality	
Any form of adaptation (last 5 yrs.)	↑ No adaptation	↑ No adaptation	↑ No adaptation	↑ No adaptation		↑ No adaptation	↑ No adaptation			↑ Did adapt	↑ Did adapt	↑ No adaptation
Past migrant in household		↑ No past migrant			↑ Past migrant in household	↑ No past migrant	↑ No past migrant				↑ No past migrant	↑ No past migrant

Note, associations significant at the 5% level are presented. Standardised residuals are interpreted to determine which households are overrepresented (↑) amongst those experiencing each deprivation. Example: “↑ Exposed” means the proportion of households experiencing the deprivation is higher than expected when exposed to the climatic hazard.

4.4.2.1.3 Subjective financial stress

Model 4.1.3 examined associations with financial stress (Table 4.8). Firstly, “crop farmer” and “fisher/trade/transport” livelihood clusters had odds 145% and 107% higher respectively than the “salaried employee/business owner” cluster.

Table 4.8 Model 4.1.3 – Binary logistic regression model results, dependent variable; subjective financial stress

Model 4.1.3	Variable	Odds coefficient [exp(β)] (S.E) (95% CIs)
Climatic shocks, stresses & shifts		
Economic impact from storms (ref: No impact)		
Impacted		2.525 (0.906) (1.250-5.104)***
Exposed to storms (ref: Not exposed)		
Exposed		0.432 (0.140) (0.230-0.815)***
Self-reported change in rainfall in the last 5 years (ref: Changed)		
Stayed the same		0.445 (0.137) (0.243-0.815)***
Self-reported change in temperature in the last 5 years (ref: Changed)		
Stayed the same		0.363 (0.133) (0.178-0.743)***
Environmental landscape/remoteness		
Distance from road intersect (ref: Closest to intersect)		
Group 2 (of 3)		0.936 (0.681) (0.225-3.897)
Group 3 (of 3, furthest from intersect)		1.729 (1.562) (0.294-10.166)
Travel time to Accra (ref: 1-2 hours)		
2-3 hours		1.924 (0.587) (1.058-3.498)**
3+ hours		0.841 (0.216) (0.509-1.391)
Marshland in 2km community buffer (ref: No)		
Yes		2.388 (0.549) (1.522-3.747)***
Savannah grassland in 2km community buffer (ref: None)		
Low/medium coverage		0.508 (0.111) (0.331-0.778)***
High coverage		0.409 (0.131) (0.218-0.766)***
Built-up land in 2km community buffer (ref: None/Low coverage)		
Medium/high coverage		0.371 (0.107)***
Household characteristics		
Household religion (ref: Christian)		
Non-Christian		0.581 (0.128) (0.378-0.894)**
Child/adult dependency ratio		
Child/adult ratio		1.538 (0.234) (1.141-2.072)***
Household livelihood cluster (ref: Salaried employee/business owner)		
Crop farmer		2.449 (0.730) (1.366-4.392)***
Fisher/trade/transport/construction		2.068 (0.488) (1.302-3.283)***
Household head characteristics		
Highest education level (ref: No schooling)		
Primary education (below-basic)		1.051 (0.297) (0.604-1.828)
Lower secondary education (basic)		0.623 (0.176) (0.358-1.085)*
Higher secondary or higher education (above-basic)		0.550 (0.165) (0.306-0.990)**
Employment status (ref: Permanent employment)		
Non-Permanent		2.124 (0.588) (1.234-3.655)***
Dependant		1.165 (0.381) (0.613-2.212)
Age quartile (ref: Youngest quartile)		
Young quartile		2.007 (0.519) (1.209-3.331)***
Medium quartile		2.235 (0.601) (1.320-3.784)***
Oldest quartile		1.566 (0.462) (0.879-2.791)
Subjective characteristics		
Personality group (ref: Low personality)		
Medium personality		0.534 (0.252) (0.211-1.348)
High personality		0.677 (0.319) (0.269-1.703)
Adaptation		
Current migrant outside household (ref: No)		
Yes		0.499 (0.109) (0.326-0.765)***
Interactions		
Distance from road intersect x Household head personality cluster		
Medium distance x Medium personality		1.098 (0.865) (0.234-5.145)
Medium distance x High personality		0.761 (0.593) (0.165-3.504)
Furthest distance x Medium personality		1.533 (1.496) (0.226-10.381)
Furthest distance x High personality		0.293 (0.275) (0.046-1.851)
Built-up land cover x Exposure to storms		
Medium/high coverage x Exposed to storms		6.565 (3.026) (2.661-16.201)***
Additional model information		
Intercept		9.741 (6.001) (2.909-32.627)***
No. observations		1,266
Log Likelihood		-415.303

Three significant associations with landcover were recorded. Low/medium and high grassland coverage⁵² had odds 49% and 59% lower respectively compared to communities with no grassland. Communities with marshland, in proximity to lagoons, had odds 139% higher than those without. Thirdly, higher built-up land-cover increased the probability 0.08 for households exposed to storms, compared to non-exposed built-up areas (Figure 4.13). Economic impacts from storms also increased odds 155% compared to non-impacted households, whilst households recording rainfall and temperature to have remained static had odds 55% and 64% lower respectively, compared to households recording change.

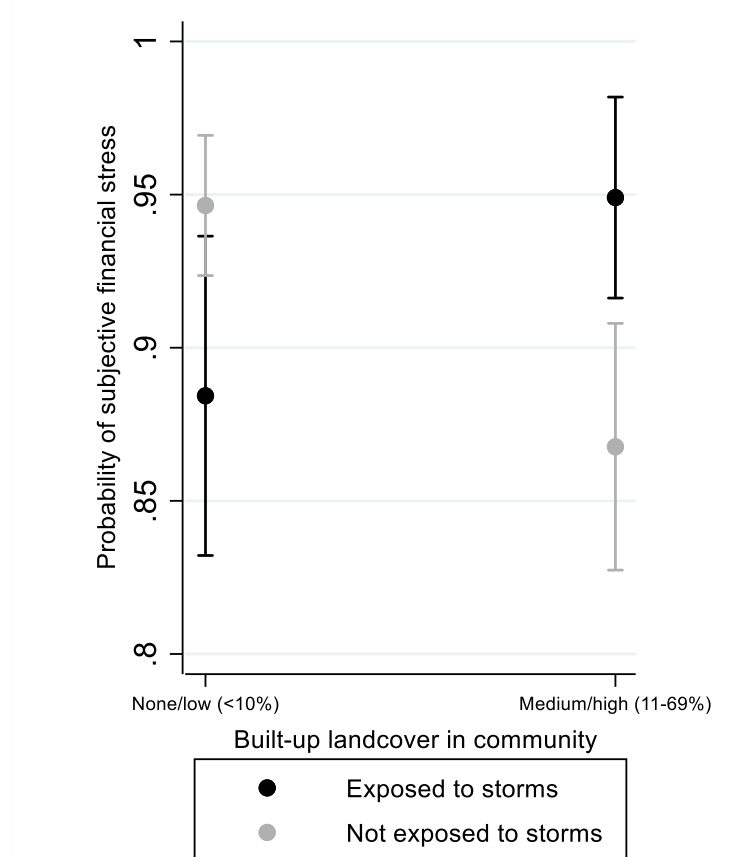


Figure 4.13 Probability of subjective financial stress by community built-up landcover and exposure to storms

Landscape remoteness also significantly associated with financial stress, with distance from road intersects interacting with household head personality. “High” personality households had probabilities 0.11 lower than “low” and “medium” personality households when furthest from road intersects (Figure 4.14). Furthermore, “high” personality households furthest from road

⁵² Note: Model 4.1.3 (subjective financial stress) categorised “savannah grassland %” due to the linearity assumption being violated, whereas Model 4.1.1 (expenditure poverty) maintained the variable in its percentage format.

intersects had probabilities 0.07 lower than those closest to intersects. Households 2-3 hours from Accra also had odds 92% and 129% higher than those 1-2 and 3+ hours away respectively.

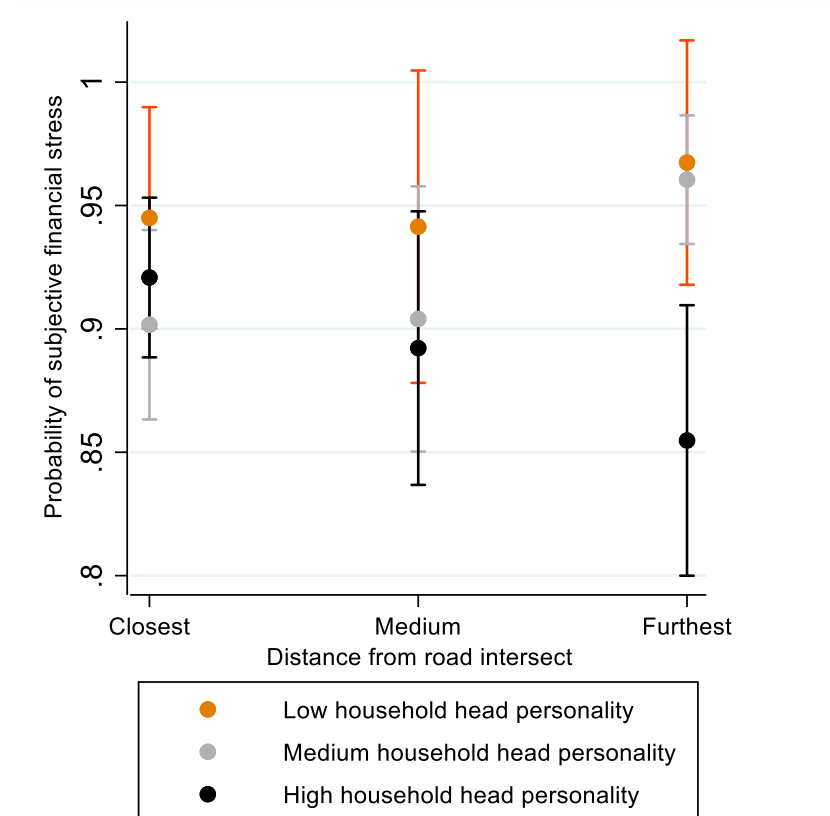


Figure 4.14 Probability of subjective financial stress by community distance from road intersects and household head personality cluster

Conclusively, interpreting control variables, Christian households, with high child/adult dependency ratios, without current migrants, and household heads with no/below-basic schooling and non-permanent employment recorded higher odds.

4.4.2.1.4 Subjective unhappiness

Model 4.1.4 examined associations with unhappiness (Table 4.9). Two significant associations with landcover were recorded; firstly, the presence of wetland increased odds 88%, whereas every 1% increase in cropland reduced the probability 0.01 for households with high place/community attachment (Figure 4.15). Remoteness from major roads also associated with unhappiness, with odds 99% higher for medium-distance (1.7-3.9km) households compared to closer locations (0.4-1.6km).

Table 4.9 Model 4.1.4 – Binary logistic regression model results, dependent variable; subjective life domains unhappiness

Model 4.1.4	Variable	Odds coefficient [exp(β)] (S.E) (95% CIs)
Climatic shocks, stresses & shifts		
Environmental impact from salinity (ref: No impact)		
Impacted		1.659 (0.341) (1.109-2.483)**
Environmental impact from storms (ref: No impact)		
Impacted		0.769 (0.309) (0.350-1.690)
Environmental landscape/remoteness		
Distance from major road (ref: Closest to major road)		
Group 2 (of 3)		1.991 (0.459) (1.268-3.127)***
Group 3 (of 3, furthest from major road)		1.008 (0.346) (0.515-1.974)
Cropland in 2km community buffer (%)		
Percentage coverage		1.009 (0.006) (0.997-1.022)
Wetland in 2km community buffer (ref: No)		
Yes		1.880 (0.439) (1.190-2.971)***
Subjective characteristics		
Place/community attachment (ref: Low attachment)		
Medium attachment		0.960 (0.344) (0.476-1.936)
High attachment		0.854 (0.312) (0.417-1.747)
Personality group (ref: Low personality)		
Medium personality		0.606 (0.181) (0.338-1.088)*
High personality		0.219 (0.074) (0.113-0.424)***
Physical assets		
Household roof material (ref: Secure, non-natural materials)		
Non-secure, natural materials		1.749 (0.332) (1.205-2.538)***
Household characteristics		
Child/adult dependency ratio group (ref: Group 1 [lowest])		
Group 2 - medium		1.415 (0.283) (0.956-2.094)*
Group 3 - highest ratio		2.277 (0.625) (1.330-3.899)***
Household head characteristics		
Employment status (ref: Permanent)		
Non-Permanent		1.539 (0.323) (1.020-2.322)**
Dependant		1.701 (0.496) (0.966-3.015)*
Adaptation		
Past migrant in household (ref: No)		
Yes		1.450 (0.257) (1.025-2.052)**
Interactions		
Cropland community coverage x Place/community attachment		
% coverage x Medium attachment		0.987 (0.007) (0.973-1.002)*
% coverage x High attachment		0.976 (0.008) (0.961-0.991)***
Environmental storm impact x Household head personality group		
Impacted by storms x Medium personality		2.071 (0.967) (0.829-5.172)
Impacted by storms x High personality		3.588 (1.845) (1.310-9.832)**
Additional model information		
Intercept		0.082 (0.039) (0.032-0.209)***
No. observations		1,231
Log Likelihood		-439.494

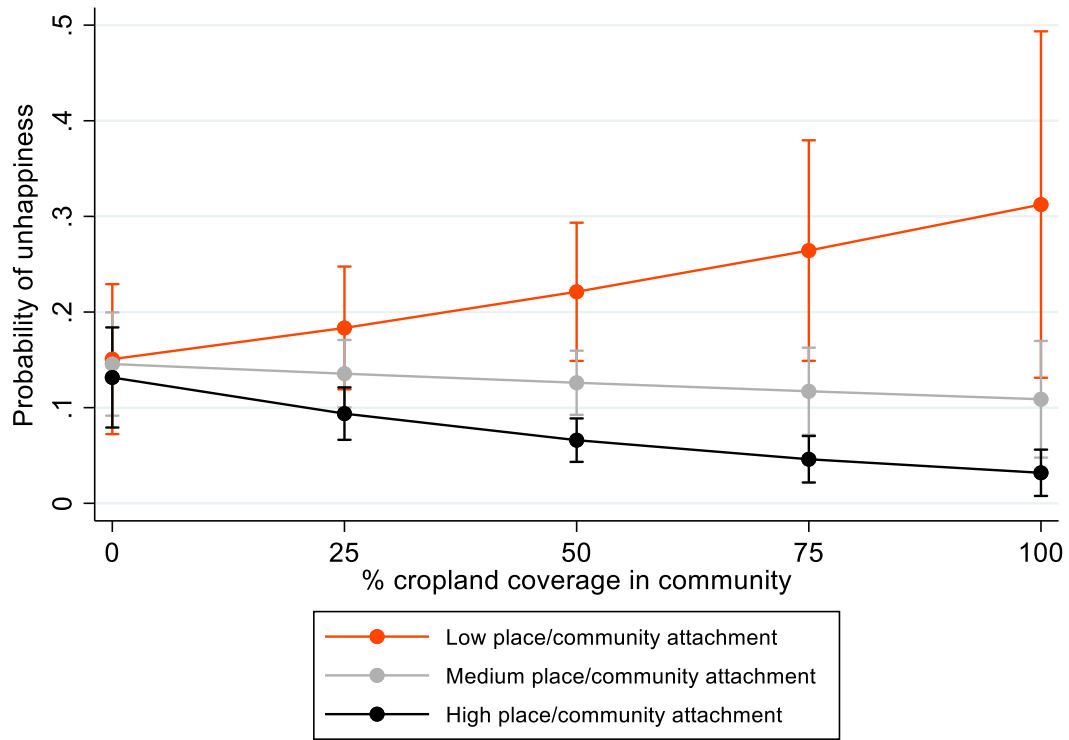


Figure 4.15 Probability of life domains unhappiness by community cropland coverage and place/community attachment

Climatic shocks and stresses also associated with unhappiness, with environmental salinity impacts increasing odds 66%, and environmental storm impacts increasing the probability 0.08 for households with “high” personality scores, compared to non-impacted households (Figure 4.16). However, amongst non-impacted households, a “high” personality lowered the probability 0.15 and 0.08 compared to “low” and “medium” personalities respectively.

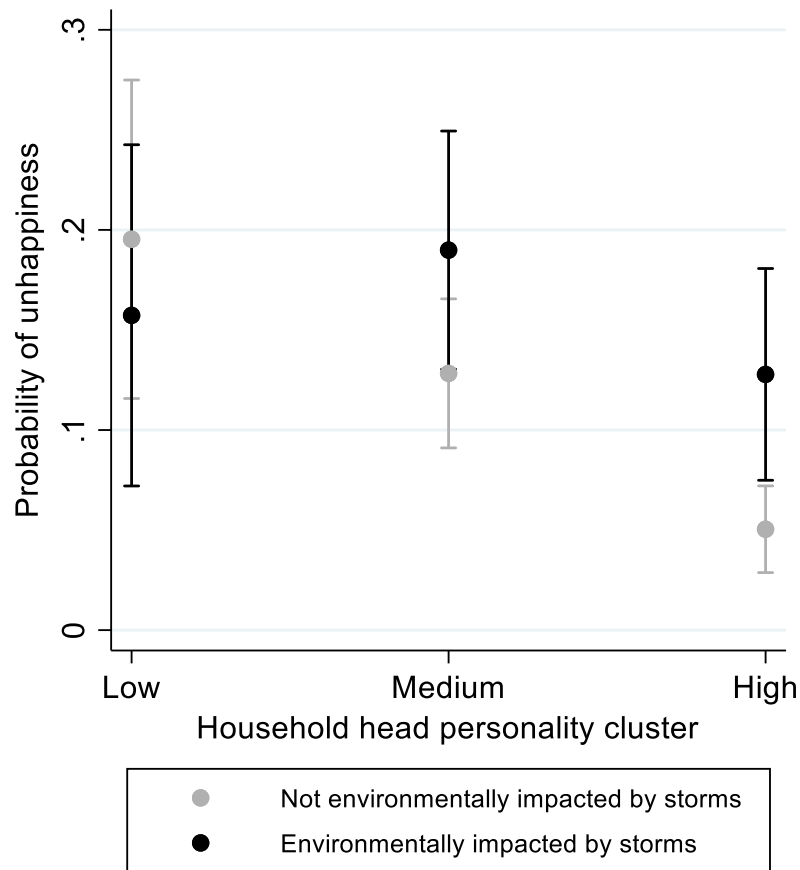


Figure 4.16 Probability of life domains unhappiness by environmental impact from storms and household head personality cluster

Control variables, representing “objective capitals” and “response” (Figure 4.1), also associated with unhappiness. Households headed by non-permanently employed individuals, with non-secure roofing, higher child/adult dependency ratios, and previous migrants recorded higher odds.

The decomposable “life domains” measure enables chi-square tests to explore associations between significant model variables and individual domains, and tailor discussions to specific challenges. The significantly over/underrepresented categories (5% level) for each variable are symbolised using “↑” and “↓” respectively (Table 4.10).

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Table 4.10 Chi-square test results between significant explanatory variables in Model 4.1.4 (life domains unhappiness), and individual domains

Explanatory variable	Unhappiness (moderate/very) with life domain...							
	Food security	Housing	Economic security	Health	Drinking water	Family interactions	Community interactions	Environment
Cropland in community (none/low/medium/high)	↑ No/low/medium coverage		↑ Medium coverage		↑ No coverage	↑ No coverage	↓ High coverage	
Environmental impact from salinity					↑ Impacted	↑ Impacted	↑ Impacted	↑ Impacted
Environmental impact from storms	↑ Impacted	↑ Impacted		↑ Impacted	↑ Impacted	↑ Impacted	↑ Impacted	↑ Impacted
Wetland landcover present in community		↑ Wetland present				↑ Wetland present	↑ Wetland present	↑ Wetland present
Distance from major road (closest/medium/furthest)	↑ Medium distance (1.6 – 3.9km)		↑ Medium distance (1.6 – 3.9km)	↑ Medium distance (1.6 – 3.9km)	↑ Medium distance (1.6 – 3.9km)			↑ Furthest distance (>3.9 – 7.4km)
Roof material	↑ Non-secure roofing	↑ Non-secure roofing	↑ Non-secure roofing					
Place/community attachment cluster (low/medium/high)	↑ “Low/medium” attachment	↑ “Low” attachment		↑ “Low” attachment		↑ “Low” attachment	↑ “Low” attachment	↑ “Low” attachment
Personality cluster (low/medium/high)	↑ “Low” personality	↑ “Low” personality	↑ “Low” personality	↑ “Low” personality		↑ “Low” personality	↑ “Low” personality	↑ “Low” personality
Child/adult dependency ratio (low/medium/high)			↑ High ratio				↑ High ratio	
Past migrant in household	↑ Past migrant household			↑ Past migrant household	↑ Past migrant household	↑ Past migrant household	↑ Past migrant household	
Household head employment status	↑ Non-permanent/dependant	↑ Non-permanent	↑ Non-permanent/dependant	↑ Non-permanent/dependant	↑ Non-permanent			

Note, associations significant at the 5% level are presented. Standardised residuals are interpreted to determine which households are over (↑) or underrepresented (↓) amongst those unhappy with each domain. Example: “↑ Impacted” means the proportion of households unhappy with the domain is higher than expected when impacted by the climatic hazard.

Note, cropland coverage is a numerical value in Model (4.1.4), but has been categorised for consistency in this analysis. Furthermore, happiness outcomes have been grouped into three categories unhappy (moderate/very), neutral, and happy (moderate/very) to simplify the analysis and interpretation.

4.4.2.2 *Combined OWB-SWB outcomes*

4.4.2.2.1 Aligning OWB/SWB

Firstly, Model 4.2.1, highlighted associations with “non-poor/happy” outcomes (Table 4.11).

Firstly, “crop farmer” and “fisher/trade/transport” livelihood clusters lowered the odds 54% and 38% respectively compared to the “salaried employee/business owner” cluster.

Table 4.11 Model 4.2.1 – Binary logistic regression model results, dependent variable; aligning “non-poor/happy” outcome

Model 4.2.1	Variable	Odds coefficient [exp(β)] (S.E) (95% CIs)
Climatic shocks, stresses & shifts		
Environmental impact from drought (ref: No impact)		
Impacted		0.564 (0.127) (0.363-0.875)**
Environmental impact from salinity (ref: No impact)		
Impacted		0.702 (0.123) (0.497-0.991)**
Environmental impact from erosion (ref: No impact)		
Impacted		0.697 (0.126) (0.489-0.994)**
Exposure to drought (ref: Not exposed)		
Exposed		1.709 (0.386) (1.098-2.660)**
Self-reported change in rainfall in the last 5 years (ref: Changed)		
Stayed the same		2.278 (0.720) (1.226-4.232)***
Environmental landscape/remoteness		
Distance from major road (ref: Closest to major road)		
Group 2 (of 3)		0.206 (0.055) (0.122-0.346)***
Group 3 (of 3, furthest from major road)		1.309 (0.306) (0.827-2.071)
Mean 2016 EVI value for 2km community buffer (ref: Lowest)		
Low EVI		1.260 (0.261) (0.840-1.890)
Medium EVI		1.298 (0.298) (0.827-2.037)
High EVI		0.477 (0.132) (0.277-0.822)***
Change in built-up landcover % (2001-15) (ref: Stayed the same)		
Decreased		1.531 (0.260) (1.098-2.134)**
Increased		2.012 (0.657) (1.061-3.815)**
Subjective characteristics		
Place/community attachment (ref: Low attachment)		
Medium attachment		1.958 (0.463) (1.232-3.113)***
High attachment		2.302 (0.547) (1.446-3.669)***
Personality group (ref: Low personality)		
Medium personality		1.308 (0.297) (0.837-2.042)
High personality		2.344 (0.542) (1.490-3.689)***
Physical assets		
Drinking water source (ref: Piped or tubewell)		
Dug well or open-source		0.462 (0.082) (0.326-0.655)***
Household characteristics		
Household religion (ref: Christian)		
Non-Christian		0.615 (0.101) (0.446-0.848)***
Household size (ref: 1-person household)		
2-3 people		0.322 (0.078) (0.200-0.519)***
4-5 people		0.109 (0.027) (0.067-0.175)***
6-7 people		0.072 (0.020) (0.042-0.124)***
8+ people		0.039 (0.013) (0.020-0.076)***
Household livelihood cluster (ref: Salaried employee/business owner)		
Crop farmer		0.458 (0.106) (0.291-0.721)***
Fisher/trade/transport/construction		0.622 (0.127) (0.417-0.928)**
Additional model information		
Intercept		4.207 (0.123) (1.957-9.046)**
No. observations		1,181
Log Likelihood		-614.158

Secondly, landscape characteristics also associated with “non-poor/happy” outcomes. The “greenest” (high-EVI) communities had odds 52% lower than low-EVI areas, whilst decreasing *and* increasing built-up landcover (2001-15) increased odds 53% and 101% respectively compared to areas with “no change”⁵³. Furthermore, households “medium” distance from major roads (1.7-3.9km) had odds 79% and 84% lower than communities closest (0.4-1.6km) and furthest (3.9km+) from major roads respectively.

Climatic hazards also significantly associated with the aligning outcome. Environmental salinity and erosion impacts reduced odds 30%, whilst households recording consistent rainfall volumes had odds 128% higher than those recording change. Exposure and environmental impact from drought had contrasting effects, the former increased odds 71%, whereas the latter reduced odds 44%.

Control variables also linked to “non-poor/happy” outcomes, with higher odds found in smaller, Christian households, with piped/infrastructure-based drinking water, high place/community attachment, and a “high” personality household head.

Next, Model 4.2.2 records associations with “poor/unhappy” households (Table 4.12). Landscape characteristics associated with the low OWB/SWB classification; “low”, “medium” and “high” cropland coverage reduced odds 79%, 65% and 77% respectively, compared to communities with no cropland. Next, examining the role of remoteness, households 21-30 and 30+ mins from district capitals had odds 218% and 111% higher respectively than households 11-20 mins away⁵⁴. Additionally, smaller households (<5 people) 1km+ from major roads had a probability 0.047 higher than those closer (<1km), yet larger household sizes significantly increased the probability 0.025 compared to smaller households when both well-connected to major roads (<1km) (Figure 4.17)⁵⁵.

⁵³ Note: built-up land cover consists of both sparse and dense built-up land; therefore, decreasing built-up land is hypothesised to be plausible through the expansion of cropland within rural villages, coastal erosion or the expansion of Keta lagoon in east Volta Delta.

⁵⁴ Table 4.12 uses a different reference category to maintain consistency with other result tables.

⁵⁵ Significant differences are based on marginal effects (Appendix 4.8), indicating the difference between the two groups. This may differ from whether the predicted probability confidence intervals overlap (Figure 4.17 & Figure 4.14).

Table 4.12 Model 4.2.2 – Binary logistic regression model results, dependent variable; aligning “poor/unhappy” outcome

Model 4.2.2	Variable	Odds coefficient [exp(β)] (S.E) (95% CIs)
Environmental landscape/remoteness		
Distance from major road (ref: Closest to major road)		
Furthest from major road		5.888 (2.595) (2.482-13.970)***
Travel time to district capital (ref: Group 4/4 [longest travel time])		
Group 1: Shortest travel time		1.011 (0.383) (0.481-2.126)
Group 2		0.474 (0.175) (0.231-0.976)**
Group 3		1.507 (0.517) (0.770-2.951)
Cropland in 2km community buffer (ref: None)		
Low coverage		0.212 (0.104) (0.081-0.553)***
Medium coverage		0.353 (0.181) (0.129-0.965)**
High coverage		0.228 (0.102) (0.095-0.548)***
Subjective characteristics		
Place/community attachment (ref: Low attachment)		
Medium attachment		0.387 (0.121) (0.210-0.714)***
High attachment		0.235 (0.081) (0.120-0.461)***
Personality group (ref: Low personality)		
Medium personality		0.723 (0.221) (0.397-1.317)
High personality		0.278 (0.102) (0.135-0.572)***
Physical assets		
Drinking water source (ref: Piped or tubewell)		
Dug well or open-source		2.835 (0.813) (1.616-4.973)***
Household roof material (ref: Secure, non-natural materials)		
Non-secure, natural materials		1.760 (0.456) (1.059-2.926)**
Household characteristics		
Household size (ref: 1-4 person household)		
5+ people		3.581 (1.561) (1.524-8.415)***
% females in the household (ref: 50% or lower)		
Over 50% females		0.561 (0.141) (0.342-0.919)**
Child/adult dependency ratio group (ref: Group 1 [lowest])		
Group 2 - medium		2.136 (0.586) (1.248-3.655)***
Group 3 - highest ratio		2.952 (1.066) (1.454-5.993)***
Household head characteristics		
Employment status (ref: Permanent)		
Non-Permanent		1.857 (0.513) (1.081-3.190)**
Dependant		3.565 (1.328) (1.718-7.400)***
Past migrant in household (ref: No)		
Yes		1.994 (0.506) (1.213-3.278)***
Interactions		
Major road distance x household size		
Furthest distance x 5+ people household size		0.354 (0.181) (0.129-0.967)**
Additional model information		
Intercept		0.068 (0.039) (0.022-0.210)***
No. observations		1,343
Log Likelihood		-259.316

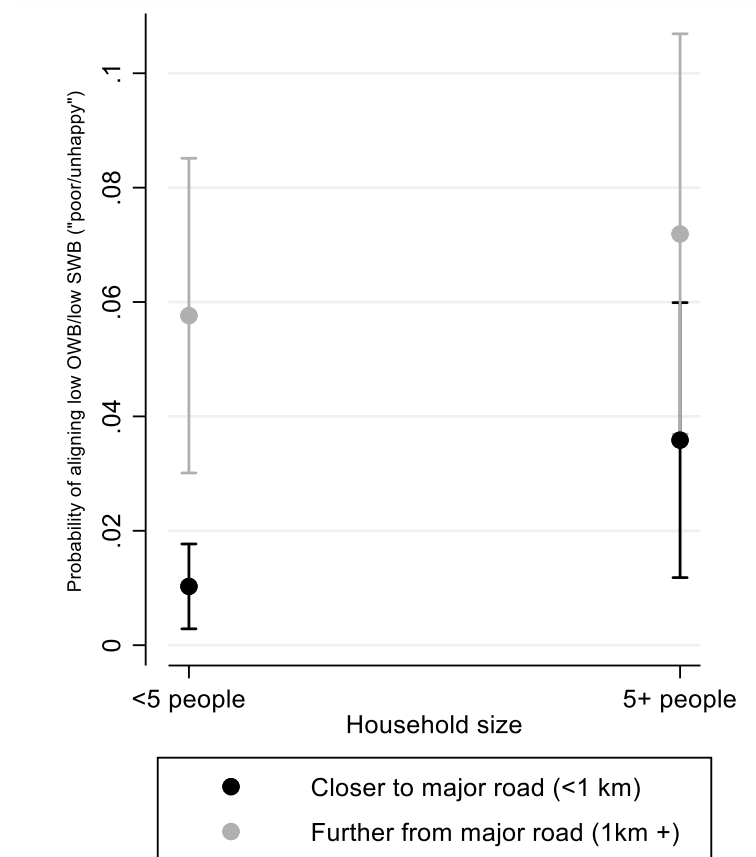


Figure 4.17 Probability of being classified as “poor/unhappy” by distance to major roads and household size

Interpreting the control variables, households with low place/community attachment, non-secure roof materials, open source drinking water, <50% female household members, past migrants, higher child/adult dependency ratios and non-permanently employed/dependant household heads with “low” personalities recorded higher odds.

4.4.2.2.2 Opposing OWB/SWB

Model 4.2.3 examined associations with households classified as “non-poor/unhappy” (Table 4.13). Firstly, three landcover variables associated with the opposing OWB/SWB association. “Low” and “high” cropland coverage reduced odds 55% compared to areas with no cropland. Furthermore, the presence of riverine vegetation, primarily around Sogakope, and wetlands, increased odds 286% and 121% respectively. Furthermore, climatic hazards, including environmental salinity impacts and flood exposure, increased odds 117% and 100% respectively. Smaller households with low place/community attachment also recorded higher odds.

Table 4.13 Model 4.2.3 – Binary logistic regression model results, dependent variable; opposing “non-poor/unhappy” outcome

Model 4.2.3	Variable	Odds coefficient [exp(B)] (S.E) (95% CIs)
Climatic shocks, stresses & shifts		
Environmental impact from salinity (ref: No impact)		
Impacted		2.167 (0.531) (1.341-3.502)***
Exposed to flooding (ref: Not exposed)		
Exposed		1.999 (0.461) (1.272-3.142)***
Environmental landscape/remoteness		
Cropland in 2km community buffer (ref: None)		
Low coverage		0.454 (0.139) (0.249-0.827)***
Medium coverage		0.866 (0.274) (0.465-1.611)
High coverage		0.446 (0.163) (0.218-0.913)**
River vegetation in 2km community buffer (ref: No)		
Yes		3.861 (1.436) (1.863-8.002)***
Wetland in 2km community buffer (ref: No)		
Yes		2.210 (0.816) (1.072-4.556)**
Subjective characteristics		
Place/community attachment (ref: Low attachment)		
Medium attachment		0.772 (0.220) (0.441-1.351)
High attachment		0.496 (0.144) (0.281-0.876)**
Household characteristics		
Household size (ref: 1-4 person household)		
5+ people		0.528 (0.132) (0.324-0.861)***
Additional model information		
Intercept		0.067 (0.033) (0.026-0.174)***
No. observations		1,275
Log Likelihood		-313.102

Next, Model 4.2.4 examined relationships with “poor/happy” outcomes (Table 4.14). Firstly, landcover characteristics explained variation in the opposing outcome. “Low”, “medium” and “high” cropland coverage increased odds 229%, 149% and 196% compared to communities with no cropland, whereas riverine vegetation reduced odds 66%. Households in Volta Region also had odds 263% higher than those in Greater Accra.

Table 4.14 Model 4.2.4 – Binary logistic regression model results, dependent variable; opposing “poor/happy” outcome

Model 4.2.4	Variable	Odds coefficient [exp(β)] (S.E) (95% CIs)
Climatic shocks, stresses & shifts		
Economic impact from drought (ref: No impact)		
Impacted		1.493 (0.261) (1.060-2.103)**
Economic impact from flooding (ref: No impact)		
Impacted		0.563 (0.116) (0.377-0.842)***
Environmental impact from erosion (ref: No impact)		
Impacted		1.540 (0.271) (1.091-2.174)**
Environmental landscape/remoteness		
Region (ref: Greater Accra)		
Volta		3.628 (0.792) (2.365-5.564)***
Cropland in 2km community buffer (ref: None)		
Low coverage		3.293 (0.866) (1.967-5.512)***
Medium coverage		2.488 (0.742) (1.387-4.462)***
High coverage		2.956 (0.724) (1.828-4.778)***
River vegetation in 2km community buffer (ref: No)		
Yes		0.339 (0.113) (0.177-0.651)***
Physical assets		
Drinking water source (ref: Piped or tubewell)		
Dug well or open-source		1.841 (0.326) (1.301-2.605)***
Latrine facility (ref: Flushing)		
Pit/Public/KVIP (ventilated pit)		2.107 (0.797) (1.004-4.421)**
No facility		3.319 (1.296) (1.545-7.133)***
Household characteristics		
Household size (ref: 1-person household)		
2-3 people		4.072 (1.268) (2.212-7.496)***
4-5 people		11.053 (3.398) (6.050-20.192)***
6-7 people		14.995 (4.926) (7.876-28.550)***
8+ people		32.438 (12.156) (15.572-67.573)***
Household head characteristics		
Highest education level (ref: No schooling)		
Primary education (below-basic)		0.775 (0.143) (0.540-1.112)
Lower secondary education (basic)		0.854 (0.166) (0.584-1.248)
Higher secondary or higher education (above-basic)		0.376 (0.094) (0.231-0.614)***
Adaptation		
Current migrant outside household (ref: No)		
Yes		1.471 (0.220) (1.096-1.973)***
Additional model information		
Intercept		0.003 (0.002) (0.001-0.011)***
No. observations		1,237
Log Likelihood		-600.313

Climatic shocks and stresses also associated with being “poor/happy”. Households economically impacted by drought and environmentally impacted by erosion had odds 49% and 54% higher respectively. Contrastingly, households economically impacted by flooding had odds 44% lower.

Control characteristics, incorporated within the “objective capitals” and “response” components of the framework, also associated with the opposing outcome. Larger households, with open-source drinking water, non-flushing latrines, current migrants and unschooled household heads recorded higher odds.

4.4.3 Results summary

The models respond to RQ2a and RQ2b by exploring environmental and control associations with singular, and combined, OWB/SWB outcomes. A hierarchical partitioning approach (Meier et al., 2010) was used to understand how much variation in each outcome was explained by environment and control characteristics. The proportion explained by environmental variables varies across singular outcome models; ranging from 57% for BND and 16% for expenditure poverty. The count of significant environmental variables, and the proportion of variation explained, also varied amongst combined OWB/SWB models; ranging from 19% to 76% for “poor/unhappy” and “non-poor/unhappy” outcomes respectively. These results illustrate the importance of understanding wellbeing within an environmental context; further information in Appendix (4.10).

This summary, and the following discussion, explore the different framework components; livelihoods, landscape, climate hazards, adaptive capacity & sensitivity (capitals/perceptions), and response. Primary livelihoods associate with lower OWB *and* SWB, whereas “business owner/salaried employee” households experience aligning high OWB/SWB. Different landscapes produce different outcomes, with remote grasslands experiencing higher poverty, yet lower financial stress, and cropland communities associating with opposing “poor/happy” outcomes. All climate hazards reduce OWB and/or SWB, yet complex relationships are recorded in response to RQ2b; for example, coastal hazards associate with opposing high OWB/low SWB.

Examining control characteristics, non-permanent employment (financial capital) associates with expenditure poverty and unhappiness, whereas education (human capital) lowers the odds of expenditure poverty and financial stress. Female presence in the household (social capital) reduces poverty, yet female-headed households experience greater BND. Physical capitals can

shape OWB *and* SWB, with poor housing quality associated with “poor/unhappy” outcomes. Conclusively, livelihood/environment adaptation (response) reduces poverty in rural areas, yet migration produces complex results; with current/past migration associating with varying SWB outcomes.

4.5 Discussion

This section uses the “ECW” framework structure to investigate modelled environment-wellbeing relationships. This discussion focuses on how livelihoods, landscape, climate, adaptive capacity & sensitivity (human, social, physical, financial⁵⁶), and response (adaptation) may influence OWB and SWB. Significant interaction effects are interpreted within the relevant subsections.

As illustrated in the framework and supporting literature, different wellbeing components interrelate (Appendix 2.3); therefore, potential relationships with other wellbeing capitals/perceptions are referenced within each section. However, interactions between control variables were not tested to maintain the environmental focus.

This discussion explores relationships with singular (RQ2a) and combined OWB/SWB (RQ2b). Despite acknowledging how wellbeing also impacts environmental conditions (Fisher et al. 2013), these feedbacks are beyond the study’s scope.

Within select subsections, summary tables showing the direction of the statistical effects are presented. The first subsection expands upon how livelihoods control environmental sensitivity, with following subsections discussing how various hazards and control characteristics may impact OWB *and* SWB within different socioecological groups.

4.5.1 Livelihoods

Wellbeing capitals and perceptions control livelihood strategies (Scoones, 1998), illustrated in the “ECW” framework (Figure 4.1). Livelihood practices, and the reliance upon natural resources and vulnerable ESs, impact households’ sensitivity to climatic hazards (Thomas,

⁵⁶ Note, there is no explicit “natural capital” section, as these discussions are presented in the “environment” section.

2019). Additionally, livelihoods implicitly incorporate information on “Exposure”, as different occupations are situated within varying spaces (Scott, 2006); for example, fishing communities reside within locations with greater flood exposure.

The exposure and sensitivity of different livelihood groups potentially influences the environmental impacts upon OWB and SWB. Responding to RQ2a, households incorporating primary livelihoods (farming/fishing) have higher odds of expenditure poverty, BND and financial stress. Additionally, in response to RQ2b, “salaried employee/business owner” households have higher odds of aligning high financial OWB/SWB (Table 4.15). However, no significant interaction effects with “livelihood cluster” were found.

Table 4.15 Direction of the statistical effects of “household livelihood cluster” on different wellbeing outcomes/combinations

Research question	Wellbeing measurement	Household livelihood cluster: direction of the statistical effect (odds ratio) (ref: salaried employee/business owner)	
		Crop farmer	Fisher/trade/transport/construction
RQ2a	Expenditure poverty (Model 4.1.1)	↑	↑
	Basic needs deprivation (Model 4.1.2)	↑	↑
	Subjective financial stress (Model 4.1.3)	↑	↑
RQ2b	“Non-poor/happy” (Model 4.2.1)	↓	↓

Firstly, lower poverty and financial stress amongst salaried employees/business owners could reflect their higher recorded incomes and lower dependency upon threatened ESs (Atiglo, 2017). In contrast, no models in Table 4.15 displayed a significant difference in the odds between “crop farmer” and “fisher/trade” households, reflecting the interconnectivity between primary and other economic sectors, such as market trading and transport (Cazcarro et al., 2018).

As introduced in section (2.5.1), multiple climate hazards threaten farmers’ and fishers’ employment options, yield/catches, objective wealth and financial self-evaluations (Derbile & Kasei, 2012; Reason et al., 2005; Tanner et al., 2014; Zakari et al., 2014). Reduced productivity and erratic food security amongst subsistence workers may also increase poverty and financial stress by heightening dependence on costly food imports (Hertel et al., 2010; Leichenko & Silva, 2014); with households in “net-importing” Volta Delta already spending 61% annual expenditure on food. Periods of reduced productivity may also contribute towards the higher odds of BND. For example, the overrepresentation of education deprivation amongst “crop farmer” households (Table 4.7) may be due to the limited access to surplus capital required to afford

school resources, or the prioritisation of subsistence over human capital investment (Dowling & Yap, 2012).

The uncertainty of future environmental and financial conditions for primary sector households may also lower OWB by disincentivizing investment in productive or domestic assets to ensure resources remain available for future shock recovery (Gollier & Pratt, 1996). Uncertainty may also heighten financial stress compared to others with more stable income streams (Ng & Diener, 2014). Furthermore, if environmental conditions deteriorate compared to more profitable past periods, primary livelihood households may perceive their current situation as relatively worse-off (Tibesigwa et al., 2016). Reports of political isolation and low “linking” social capital (Claridge, 2018b) amongst fishers in the Volta Basin, could also contribute towards greater pessimism and financial stress if households believe they are not receiving equal opportunities (Béné & Friend, 2011).

In contrast, salaried employee/business owner households possess higher odds of aligning high OWB/SWB (Table 4.15). Happiness could be a pre-requisite for financial success, allowing households to transition away from primary sectors and reduce poverty risks (Ravallion, 2015). Alternatively, less-vulnerable, non-primary employment within subsistence economies may provide higher relative status, resulting in higher happiness (Kingdon & Knight, 2006; Osei-Tutu et al., 2020).

This section illustrates vulnerable primary livelihoods to associate with lower OWB *and* SWB. However, the following section introduces complexity by examining different landscape effects. The role of livelihoods in controlling climatic sensitivity is referenced throughout.

4.5.2 Environment: Landscape characteristics

This section expands upon the livelihood effects by exploring associations with different environmental landscape characteristics. Landcover, land-use and associated ESs, defined as natural capitals (Figure 4.1), interlink with livelihoods and environmental vulnerability in Ghana (Forkuo et al., 2021), and therefore may associate with communities’ wellbeing. Firstly, relationships between cropland and OWB/SWB are discussed, drawing on ideas of place attachment and social capital.

4.5.2.1 Cropland coverage

Crop farmer livelihoods associate with lower financial OWB (Table 4.15); however, examining the relationship with cropland coverage reveals a complexity. Results suggest agricultural communities have higher odds of experiencing opposing low OWB/high SWB (RQ2b) (Table 4.16), illustrated by higher proportions of “poor/happy” households in Akatsi South (Figure 4.8).

Table 4.16 Direction of the statistical effects of increased “cropland coverage” on different wellbeing combinations

Research question	Wellbeing measurement	Increased cropland coverage: direction of the statistical effect (odds ratio)
RQ2b	“Poor/unhappy” (Model 4.2.2)	↓
	“Non-poor/unhappy” (Model 4.2.3)	↓
	“Poor/happy” (Model 4.2.4)	↑

These results support the “happy farmer” identity (Markussen et al., 2018), where poorer, vulnerable rural communities achieve higher SWB through greater collective harmony (Schutte et al., 2022), stronger place/community attachment (Ma et al., 2022; Quinn & Halfacre, 2014), and free access to local resources (Duku et al., 2022). This interconnection between natural capital (cropland) and social perceptions (collective norms) is supported by an underrepresentation of unhappiness with “community interactions” amongst high cropland communities (Table 4.10), and an interaction effect within Model (4.1.4) illustrating a lower probability of unhappiness within highly attached, cropland communities (Figure 4.15). The modelled interaction may also represent how an affiliation with the natural environment can bring happiness in itself, provide spiritual benefits and support the fulfilment of individuals’ desired livelihoods and identities (Albrecht et al., 2007); particularly pertinent amongst LMIC farmers (Brown et al., 2021). The importance of this interaction is illustrated by the large proportion of estimated variation in unhappiness it explains (Appendix 4.10).

High place attachment also increases the odds of “non-poor/happy” outcomes (Model 4.2.1), suggesting OWB benefits are also available. For example, social capital and community networks can provide cash transfers, employment opportunities, and facilitate asset sharing to overcome environmental challenges (Bandauko et al., 2022; Calo-Blanco et al., 2017; Jordan, 2015).

Nevertheless, as illustrated in Model (4.1.1), higher expenditure poverty amongst highly attached households⁵⁷ impacted by drought (Figure 4.11), suggests place/community attachment may not unanimously provide climatic resiliency or facilitate OWB benefits. Contributing towards reciprocal relationships and community safety nets may drain individuals' resources during periods of environmental pressure (Babcicky & Seebauer, 2017), removing the capital needed for productive or adaptive investments, and resulting in persistent poverty (Di Falco & Bulte, 2009).

The interaction between place/community attachment and drought may also reflect differences between coping and adaptation. Localised “bonding” social capital enables communities to cope with climatic stress, yet is insufficient for full-scale adaptation and poverty alleviation (Jordan, 2015) which requires “bridging/“linking” social capital to access resources outside the community (Antwi-Agyei et al., 2013). Additionally, the lower probability of expenditure poverty amongst highly attached households when non-impacted by drought (Figure 4.11) suggests the relationship between social capital and financial OWB is “fluid”, with positive impacts available during favourable climates. In contrast, during times of scarcity (or abundance) the benefits of reciprocity are reduced, and greater individualism may arise. Another hypothesis suggests high place attachment could lower the willingness to migrate during droughts (Atiglo & Codjoe, 2017), potentially resulting in greater food/water insecurity, health risks and financial pressures compared to households open to relocation to productive landscapes (Barrett & Bevis, 2015; Heger et al., 2018; Serdeczny et al., 2017). See section (4.5.8.1) for further discussions on migration.

This subsection highlights how place/community attachment may increase happiness within cropland communities. “Poor/happy” outcomes in agricultural landscapes suggest some households may mitigate the negative SWB impacts of financial insecurity by accessing social capital. Conversely, aligning “non-poor/happy” outcomes in highly attached households demonstrate how social capital can stimulate objective benefits; however, these benefits may be insufficient to overcome financial challenges during droughts.

⁵⁷ As Model 4.1.1 controls for landscape “greenness” (EVI), it is assumed that high “place attachment” is not simply capturing “agricultural landscapes” which are more exposed to drought.

4.5.2.2 *Proximity to water sources*

This section explores relationships between wellbeing and landcover types representing proximity to water sources (Figure 4.2); including riverine vegetation, concentrated around Sogakope and Volta River, and marshland/wetlands located around lagoons and inland water.

Firstly, responding to RQ2a, the presence of riverine vegetation reduces expenditure poverty (Model 4.1.1). This relationship may be influenced by Sogakope's economy being less dependent on primary productivity, with prominent food processing industries (Tsikata, 2006). Despite relying upon raw materials, these industries can maintain productivity by accessing external resources, rather than being tied to local conditions. Sogakope also contains river tourism businesses, offering high economic returns less directly influenced by climatic variability; despite flooding and erosion threatening coastal hospitality (Sagoe-Addy & Addo, 2013).

Furthermore, as Sogakope is the district capital, higher "linking" social capital and lower institutional isolation can facilitate greater access to private and public investment. This is exemplified by South Tongu district being one of the first assisted by state-led "Livelihood Empowerment Against Poverty (LEAP) programmes" which provided social cash transfers and health insurance to aid long-term development (Karakara & Ortsin, 2022). Furthermore, the Republic of Ghana's (2020) "1 District 1 Factory" programme, designed to reduce reliance upon imports by encouraging private investment into water management and local manufacturing, is expected to increase industrial development in Keta, Anloga and South Tongu districts.

Additionally, proximity to Volta River can improve financial OWB by supplying supporting and provisioning ESs: (i) improved agricultural yield⁵⁸: dry season agriculture, hydropower, reduced soil erosion, higher riparian soil fertility (Celentano et al., 2014; Mohammed et al., 2013; Tickner et al., 2017; Warner et al., 2012), (ii) higher value crops (i.e., fruits/vegetables): available through irrigation and higher soil moisture (Zakaria & Matsui, 2021), (iii) domestic water use (section 4.5.7.1), (iv) livelihood diversification: high-productivity seasonal fishing⁵⁹, harvesting of timber, firewood and fruits from riverine forests provide income channels during low agricultural yield (Béné & Friend, 2011; Codjoe et al., 2020a; Heubes et al., 2012), (v) low-cost transportation of

⁵⁸ ¼ households in riverine vegetation communities are headed by a crop farmer.

⁵⁹ Only 4 households in communities with riverine vegetation have an individual with "fishing" as their primary livelihood, suggesting small-scale fishing could be a supportive, rather than central, practice within these locations.

people/products: facilitating access to untapped markets inaccessible by road (Delta Alliance, 2019).

Next, addressing RQ2b, riverine vegetation associates with opposing “non-poor/unhappy” outcomes (Model 4.2.3)⁶⁰; juxtaposing the relationship with cropland. Greater financial OWB in Sogakope, due to formalised and diversified livelihood options, may in contrast lower “bonding” social capital, generate greater individualism and heighten aspirations, which if unmet, reduce SWB (Alem et al., 2014). For example, survey data shows riverine vegetation communities to be overrepresented amongst those deprived in, and unhappy with, housing quality and drinking water. This suggests households’ material assets may not align with their aspirations and relatively higher financial OWB. Qualitative fieldwork is required to further understand opposing OWB/SWB in Sogakope.

The presence of marshland and wetland also associates with different outcomes (Table 4.17). These relationships are hypothesised to be linked, to an extent, to livelihoods, with both landcover types containing higher proportions of households with at least one fisher.

Table 4.17 Direction of the statistical effects of “marshland” and “wetland” landcover on different wellbeing outcomes/combinations

Research question	Wellbeing measurement	Landcover present in the community: direction of the statistical effect (odds ratio) (ref: landcover type not present in community)	
		Marshland	Wetland
RQ2a	Subjective financial stress (Model 4.1.3)	↑	
	Life domains unhappiness (Model 4.1.4)		↑
RQ2b	“Non-poor/unhappy” (Model 4.2.3)		↑

Firstly, Models (4.1.3) & (4.1.4) highlight potential negative SWB effects from residing near water sources. Financial stress in marshland communities and unhappiness within wetlands may relate to multiple potential drivers: (i) climatic and financial uncertainty, potentially linked to the future viability of salt mining activities (Roland et al., 2019), (ii) overexploitation and climatic damage to culturally/ecologically important sites (Wiegleb, 2019), (iii) protected or privately-owned land, such as Songor Lagoon Ramsar site (section 6.3.2.3), restricting livelihoods and autonomy (Everard, 2018; Markussen et al., 2018), (iv) intergenerational disputes over natural

⁶⁰ The presence of riverine vegetation explains the most estimated variation in the “non-poor/unhappy” outcome for any single explanatory variable (Appendix 4.10).

resource management (Harvey & Langdon, 2010); supported by higher unhappiness with community and family interactions in wetland communities (Table 4.10).

However, when addressing RQ2b, wetland communities have higher odds of opposing high OWB/low SWB. Living near wetlands and inland water sources could benefit financial OWB by reducing the time/energy required for water collection (Porter, 2007), and facilitating livelihood diversification with mangrove/reed/oyster shell harvesting, salt mining, and hospitality opportunities (Codjoe et al., 2017; Everard, 2018; Tanner et al., 2014). Wetlands are also ideal locations for cultivating important subsistence resources, such as rice⁶¹ (Willoughby et al., 2001), and cash crops such as sugarcane; with previous studies in Volta Delta illustrating higher incomes and consumption amongst sugarcane farmers, potentially linked to the emergence of flood-resistant sugarcane biofuels (Ahmed et al., 2019). Therefore, opposing OWB/SWB may emerge from objective benefits raising aspirations, which if unattainable due to physical remoteness, limited infrastructure, or climatic uncertainty, can prevent households from achieving their “good life” (Dzokoto et al., 2019). This hypothesis is corroborated by Ahmed et al., (2019) describing industrial sugarcane farmers in South Tongu as “frustrated achievers” (p.26). Uncertainty regarding market access, and fears of climatic hazards, such as floods which previously contributed towards crop failure, prevented these groups from experiencing psychological benefits alongside objective, financial gains.

These modelled relationships illustrate the different mechanisms controlling OWB and SWB amongst communities near water sources; highlighting the benefit of incorporating various wellbeing measures within sustainability research. The next section expands on previous discussions of “remoteness” by examining relationships between wellbeing and accessibility to transport infrastructure and urban hubs.

4.5.2.3 *Physical remoteness and connectivity*

Connectivity relies on physical capital, such as road infrastructure, yet landscape characteristics and climatic shocks can amplify remoteness; for example, seasonal flooding making rural roads inaccessible (Afriyie et al., 2018). Higher odds of expenditure poverty (Model 4.1.1) and BND (Model 4.1.2) when further from Accra and district capitals/road infrastructure respectively (RQ2a), support studies suggesting poor accessibility negatively impacts OWB (Bird

⁶¹ Rice is also recognised as a key marketable crop, with studies in Volta Region highlighting an increasing male presence within rice farming, which was traditionally a female practice, due to increased profitability (Lambrecht, 2016).

et al., 2010; Chamberlin, 2007); particularly within Ghana where services and financial opportunities are concentrated within district capitals (Owusu, 2005).

Firstly, higher odds of expenditure poverty when distant from Accra could represent limited access to profitable markets and market information (Bird et al., 2010), with distant traders arriving later when there are lower customers (Porter, 2007), prices and bargaining power (Owusu & Lund, 2004). Contrastingly, proximate communities can provide larger quantities and higher quality produce, with less damage during transit (Chamberlin, 2007), resulting in remote households prioritising subsistence rather than cash crops. Additionally, greater land competition closer to key markets incentivises increased productivity and diversification to ensure return on investment, compared to remote areas with greater land availability (El Jarbi, 2010; Stifel et al., 2003). Remote areas may also experience greater vulnerability to environmental hazards and rising food prices, as higher transport and transactional costs amplify prices (Béné & Friend, 2011). This hypothesis is supported by remote households being overrepresented amongst those with >60% annual food expenditure (Table 4.7). However, the relationship could be bidirectional, with better-connected areas demanding higher land prices and attracting “better-off” individuals.

The lower odds of expenditure poverty in proximity to Accra and Tema⁶² may also be driven by the higher quantity and quality of migration networks. Easier movement, greater access to information on work opportunities, and a consistent flow of workers between Accra/Tema and surrounding communities, compared to more-remote areas, can create persistent networks which offer seasonal labour opportunities (i.e., construction or service industries) and enable households to maintain stable incomes (Awumbila et al., 2017).

Secondly, higher odds of BND when further from district capitals (Model 4.1.2) could result from lower social capital (Jordan, 2015; Porter, 2007) and human capital access, with health and education workers less willing to relocate to remote locations (Béné & Friend, 2011). Lower “linking/bridging/bonding” social capital is illustrated by households furthest from district capitals being overrepresented amongst those deprived in bank/healthcare access, and social cooperatives/networks (Table 4.7). For example, banks less frequently lend capital to remote communities (Ofori-Danson et al., 2013), whereas the ability to forge and maintain effective social networks is restricted when distant from major employment hubs (Awumbila et al., 2017). Remote areas, with lower political participation and historic investment (Kambala, 2023), are also less-targeted by current public and private funding (Bird & Shepherd, 2003), supported by

⁶² higher formal private employment in Tema compared to the national average [2010] (GSS, 2014).

higher proportions of education and employment deprivation when furthest from district capitals (Table 4.7).

Responding to RQ2b, Model (4.2.4) suggests households in Volta region, further from the profitable markets, services and less-vulnerable employment in Accra/Tema, have higher odds of being “poor/happy” than Greater Accra households. This result corroborates GSS (2018) reports showing Greater Accra to have the lowest regional poverty rate due to higher concentrations of human, physical, social and political capital (Bird et al., 2010). However, greater distance from Greater Accra’s higher living standards may produce “frame-of-reference” bias in Volta, where unawareness of wider inequalities reduces relative comparability and mitigates SWB impacts (Ravallion, 2014).

In contrast, an interaction between household size and major road distance (Model 4.2.2), a proxy for market/service access, illustrates higher probabilities of being “poor/unhappy” when furthest from major roads; particularly for smaller households (Figure 4.17). This result suggests remoteness may also bring aligning low OWB/SWB, where limited financial opportunities and material investment lower SWB by creating a sense of “hopelessness” (Addai et al., 2014a). Limited accessibility, especially if amplified by climatic shocks, can also reduce autonomy and mobility; impacting eudaimonic happiness and objective productivity (Markussen et al., 2018).

However, when controlling for this interaction, Model (4.2.2) displays no significant difference in the odds of being “poor/unhappy” when closest or furthest from district capitals, whereas Model (4.2.1) shows no significant difference in the odds of being “non-poor/happy” when closest or furthest from major roads. These findings indicate some communities may overcome accessibility challenges. For example, Pacillo (2016) suggests poor market access in remote communities is compensated for by reduced transaction/transport costs due to “at-the-gate” sales, and the substitution of financial capital with social capital by trading amongst family/friends rather than paying market intermediaries. The association with of remoteness is expanded upon in the next subsection.

4.5.2.4 *Savannah grassland coverage*

This subsection responds to RQ2a by interpreting associations between grassland landscapes and OWB/SWB; drawing on ES access and remoteness. Previous research suggests grasslands are used for livestock pasture in Volta Delta (Delta Alliance, 2019); however, only two household heads identified as livestock farmers. This finding could result from crop farmers undertaking livestock practices as secondary activities as insurance or to accumulate savings (Boval et al., 2017; Gray & Moseley, 2005).

Higher grassland coverage increases the odds of expenditure poverty, yet reduces subjective financial stress (Models 4.1.1 & 4.1.3); challenging the significant association in section (3.10.1). Figures 4.2 & 4.4 illustrate these results, with higher proportions of poverty and lower financial stress across northern grasslands. Higher expenditure poverty corroborates GSS (2018)⁶³ reports evidencing high and increasing (2005-2017) poverty rates within rural savannahs. Existing SSA studies indicate grasslands experience unreliable rainfall, land degradation from environmental and human-induced pressures, such as overpopulation, and therefore elevated risks of crop failure, livestock mortality, and financial insecurity within agricultural and interconnected industries (Cazcarro et al., 2018; Ebro, 2019). Isolation from peri-urban hubs and markets can also restrict trading opportunities and “linking” social capital in grassland landscapes. Nevertheless, the relationship is bidirectional, with marginal grasslands also potentially “selecting” poorer residents.

In contrast, grasslands’ remoteness is hypothesised to reduce financial stress (Model 4.1.3). Limited awareness of higher living standards could lower households’ financial aspirations and relative comparison points (Ravallion et al., 2013). Therefore, despite objective poverty, individuals may not self-evaluate as financially stressed. The “relational context” of rural areas may also mean communities focus less on financial growth (Alem et al., 2014; Mahmood et al., 2019), and prioritise the financial levels required to maintain community relationships, cultural identities and purpose (Ward & King, 2016). Greater collectivism may also lower financial stress by facilitating access to social and material support from the wider community (Borrero et al., 2013).

Additionally, financial stress is commonly defined in relation to temporal reference points (Kingdon & Knight, 2007). Therefore, due to low financial OWB within grasslands, the absolute improvements required to lower financial stress may be comparatively low (Crawford & Abdulai, 2009). OWB/SWB differences in grasslands illustrate the limitation of solely using SWB to guide policy (section 3.5.2.2), as focusing on personal evaluations could normalise poverty and restrict material change (De Schutter, 2021; Ravallion et al., 2013).

This section highlighted the varying associations with landscape characteristics. Responding to RQ2a, grasslands associated with higher expenditure poverty, yet lower financial stress, whereas physical remoteness lowered OWB. However, non-significant differences between connected and remote locations suggest certain communities may adapt to poor accessibility.

⁶³ Many studies focus on the North Ghana grassland belt (Adjasi & Osei, 2007), whereas this study examines coastal grasslands.

Addressing RQ2b, different landcover characteristics associated with opposing outcomes; for example, cropland produced low OWB/high SWB, whereas wetlands and riverine vegetation associated with high OWB/low SWB. These relationships demonstrate the “relational” effect between landscape and wellbeing.

4.5.3 Environment: Climate hazards

This section explores associations between climatic shocks, stresses and shifts, and OWB/SWB. Volta Delta is exposed to multiple threats including flooding, salinisation, drought, erosion, seasonality, and storms.

4.5.3.1 Flooding & salinisation

Results suggest coastal hazards, including flooding and salinity, associate with higher financial OWB, yet lower SWB (Table 4.18).

Table 4.18 Direction of the statistical effects of “exposure/impact from flooding/salinity” on different wellbeing outcomes/combinations

Research question	Wellbeing measurement	Climatic exposure/impact: direction of the statistical effect (odds ratio) (ref: non-exposed/non-impacted)		
		Exposed to flooding	Economic impact of flooding	Env. impact of salinity
RQ2a	Expenditure poverty (Model 4.1.1)		↓	
	Life domains unhappiness (Model 4.1.4)			↑
RQ2b	“Non-poor/unhappy” (Model 4.2.3)	↑		↑
	“Non-poor/happy” (Model 4.2.1)			↓
	“Poor/happy” (Model 4.2.4)		↓	

Due to the less-destructive nature of salinisation compared to flooding, it is underresearched within climate management literature; however, as short-term recovery is harder, it can cause longer-term impacts on SWB (Islam et al., 2020). Households exposed/impacted to flooding and/or salinity are overrepresented amongst those unhappy with all life domains, highlighting the capacity for wide-ranging SWB impacts (sections 2.5.1.3 & 2.5.1.4). For example, flooding/salinity could restrict culturally-valued livelihood identities (Brown et al., 2021),

generate fears of future damage and create an “emotional unfreedom” (Schaafsma & Gross-Camp, 2021;14), or force displacement (Addo et al., 2018b; Boateng, 2009).

Results showing flooding to reduce poverty, and salinity to increase unhappiness (RQ2a), are mirrored by Model (4.2.3) with higher odds of being “non-poor/unhappy” when exposed/impacted by both coastal hazards (RQ2b). Higher financial OWB could reflect the prominence of built-up land in coastal and riparian locations (Figure 4.3), meaning access to less-vulnerable, higher-paid livelihoods, diverse natural resources, transport infrastructure and key markets (Delta Alliance, 2019; Sagoe-Addy & Addo, 2013). Furthermore, localised riparian flooding can financially benefit certain communities by recharging groundwater and providing a water source during droughts to increase agricultural yield (Benito et al., 2010; Cardona et al., 2012). In contrast, greater individualism (Guillen-Royo & Velazco, 2012), land competition, materialism (Poku-Boansi et al., 2020), and objective inequalities (Kangmennaang et al., 2019) within built-up, coastal locations may reduce SWB by creating unmet aspirations and enhancing relative comparability.

Furthermore, climatic hazards can cause long-lasting psychological impacts (Sekulova & Van den Bergh, 2016). Therefore, certain households could continue to experience unhappiness despite financial improvements. Despite lower adaptive capacity in LMICs (Asante & Amuakwa-Mensah, 2015), households can detach their OWB from environmental challenges (i.e., piped water if aquifers are salinised), yet detaching subjective emotions is more challenging. Similarly, policies targeting objective capitals are easier to introduce than those aiming to alter subjective perceptions. For example, providing tangible agricultural support during flooding is more practical than aiming to boost individuals’ multidimensional happiness (Franzblau & Moore, 2001; White, 2010). These contrasting outcomes emphasise the importance of investigating multiple measures within sustainable development.

4.5.3.2 *Drought & erosion*

In contrast to coastal hazards, drought and erosion associate with opposing “poor/happy” outcomes (Model 4.2.4). Firstly, climate stress can lower households’ financial OWB through multiple mechanisms (section 2.5.1.1 & 2.5.1.3); for example, shortening farming seasons, increasing livestock mortality and reducing crop productivity (Aniah et al., 2013; Serdeczny et al., 2017). However, drought and erosion may also stimulate SWB through collective coping mechanisms (Bandauko et al., 2022; Calo-Blanco et al., 2017; Dussailant & Guzmán, 2014; Jordan, 2015). As drought and erosion impacts are overrepresented within agricultural grasslands (Appendix 4.11), the low OWB/high SWB outcome could also reflect the greater

emphasis on social relationships and non-material components amongst farming communities (Guillen-Royo & Velazco, 2012).

However, lower odds of being “non-poor/happy” when environmentally impacted by drought or erosion (Model 4.2.1), suggest climate stress can also lower SWB. Drought-impacted households are overrepresented within the dataset amongst those unhappy with drinking water, food security and health; reflecting how dry periods can reduce water availability and crop productivity compared to past conditions, and induce health issues (Aniah et al., 2013; Stanke et al., 2013). Similarly, erosion-impacted households are overrepresented amongst those unhappy with housing, community interactions and environment, potentially linked to: (i) damage to physical capital (housing/assets) affecting self-evaluated social status (Marcus, 2006), (ii) lower productivity restricting “bonding” social capital by fracturing reciprocal relationships and encouraging crime (Craig et al., 2022; Smith et al., 2024), (iii) different adaptive capacities amplifying inequality and relative comparability (Kangmennaang et al., 2019), (iv) damage to affiliated landscapes causing distress and restricting cultural identities (Albrecht et al., 2007; Brown et al., 2021; Milbourne, 2014).

The complexity of the drought-wellbeing relationship is further illustrated by the differing effects of “exposure” and “impact” on BND and “non-poor/happy” outcomes (Table 4.19). Each variable effect controls for other variables in the model; therefore, households exposed, but not impacted, by drought associate with aligning high OWB/SWB, yet higher BND. Due to these contrasting results, the remainder of this subsection addresses RQ2a and RQ2b.

Table 4.19 Direction of the statistical effects of “exposure/impact from drought” on basic needs deprivation and aligning “non-poor/happy” outcomes

Research question	Wellbeing classification	Drought exposure/impact: direction of the statistical effect (odds ratio) (ref: non-exposed/non-impacted)	
		Exposed to drought	Environmental impact of drought
RQ2a	Basic Needs Deprivation (Model 4.1.2)	↑	↓
RQ2b	“Non-poor/happy” (Model 4.2.1)	↑	↓

Firstly, aligning “non-poor/happy” outcomes may be achieved through successful adaptation mitigating the negative impacts of drought within exposed areas. This result highlights how hazard exposure only constitutes a “risk” for vulnerable communities with high sensitivity and/or low adaptive capacity (Cardona et al., 2012). For example, irrigation can enhance happiness by improving autonomy and environmental control (“competence”), whilst also

ensuring sufficient yield for subsistence and trade (Markussen et al., 2018). Furthermore, certain drought-exposed areas may receive greater “linking” social capital from government/NGOs in response to environmental challenges⁶⁴. These resources may improve subjective “relatedness” across scales and institutions, and mitigate negative OWB impacts by developing less-vulnerable livelihood alternatives (Craig et al., 2022; Duku et al., 2022). The association could also illustrate how financial OWB and happiness are prerequisites for successful adaptation (Gowdy, 2004; Zapata, 2021).

In contrast, higher BND within households exposed, yet not impacted, by drought suggests alternative mechanisms may influence different outcomes. Looking at individual deprivations, these households are overrepresented in excess capital, education, healthcare access, and network size deprivations (Appendix 4.12). The latter could arise from successful adaptation lessening requirements for wider social networks and collective action (Jordan, 2015). This relationship may also capture the effect of location, infrastructure and policy, rather than “drought”. Figure 4.18 highlights communities with higher proportions of exposed, non-impacted households to be located near Songor Lagoon. Higher food expenditure in this location could stem from a greater demand for food imports, with local farming potentially restricted by soil salinisation, whereas lower education and healthcare access could reflect remoteness from key services. Conversely, high proportions of household heads with fishing and trading livelihoods in these five communities, and the availability of Songor Lagoon salt mining during dry periods (Roland et al., 2019), could explain why despite drought exposure, the impacts upon financial OWB are lower than within agricultural communities.

⁶⁴ Only 42 households recorded they had received NGO or government assistance for their home, family or livelihood in the last 5 years. However, households exposed to drought were overrepresented amongst those receiving support ($\chi^2 = 16.516^{***}$).

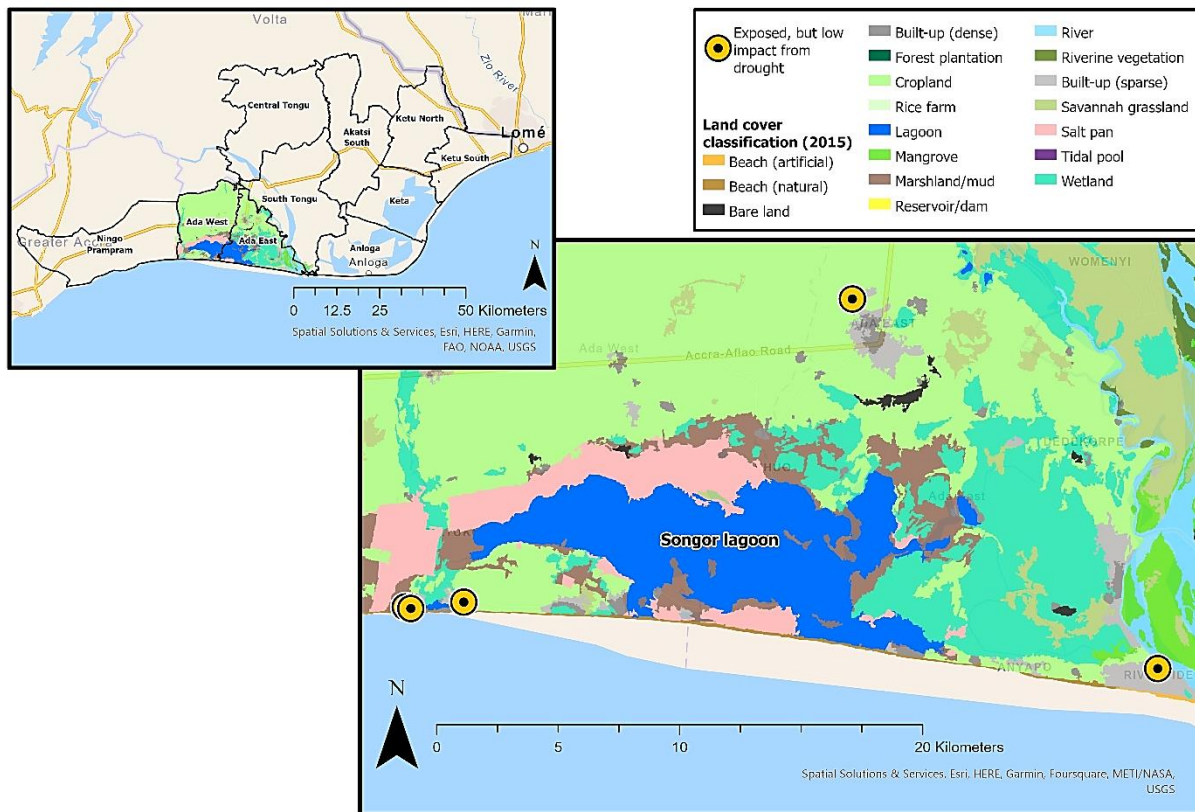


Figure 4.18 Five communities with the highest percentage of households exposed, yet not environmentally impacted, by drought (>25% households in EA)

Note, two communities overlap to the west of Songor Lagoon.

4.5.3.3 Seasonality

This section responds to RQ2a by exploring associations with seasonality. Firstly, seasonal shifts may lower SWB in agricultural communities by increasing future climatic and financial uncertainty (Alem & Colmer, 2013); supported by changes in rainfall and temperature increasing the odds of financial stress (Model 4.1.3). Additionally, changing conditions can reduce the effectiveness of past experiences and indigenous knowledges, deeply intertwined with individuals' identities (Schaafsma, 2021), when strategising seasonal cultivation, potentially reducing SWB (Adger, 2010).

In contrast, self-reported consistent rainfall volumes associated with BND (Model 4.1.2), opposing hypotheses stating fluctuating climates lower OWB by preventing long-term planning (Reason et al., 2005; Sultan et al., 2019). One possible explanation is that households are not incentivized to adapt/diversify their livelihoods without uncertain rainfall, increasing their vulnerability to other climate hazards. However, this counter-intuitive result may also capture a

location effect, with most households recording stable rainfall located in cropland communities, furthest from centralised services and basic need provision in district capitals⁶⁵.

4.5.3.4 Storms

Similar to seasonal shifts, exposure and economic impacts from storms, interpreted as oceanic and precipitation-based events (Appendix 4.4), may increase financial stress (RQ2a), particularly within built-up coastal locations (Figure 4.13), through multiple mechanisms. For example, destroying safety net resources (Idowu et al., 2011) or lowering fish yield/tradable produce⁶⁶ by preventing expeditions and/or destroying fish habitats (i.e., mangroves) (Hossain et al., 2014; Tanner et al., 2014).

Wellbeing is “relational”, meaning different environments shape individuals’ values (White, 2016); therefore, the significantly greater effect of storms upon financial stress in built-up landscapes could relate to the socioeconomic context (Figure 2.19). Built-up areas associate with higher recorded expenditures and lower BND (Model 4.1.2), likely attributable to the availability of less-vulnerable livelihoods and greater connectivity to district capitals with higher public/private investment (Béné & Friend, 2011). Therefore, built-up communities are potentially more sensitive to harm as they have “more-to-lose”, meaning if storms worsen living standards compared to before, or cause individuals’ higher aspirations to become unattainable, financial stress could increase; especially when acknowledging the greater emphasis on relative positionality when constructing SWB in urbanised areas (Duku et al., 2022).

Comparative reference points are commonly on “higher rungs” of the socioeconomic ladder, especially within individualistic urban areas with greater inequality (Guillen-Royo & Velazco, 2012) (Appendices 4.13-4.14). Therefore, if storms exacerbate inequalities due to uneven exposure or adaptive capacity, SWB could be lowered by creating “perceptions of inferiority” (Kangmennaang et al., 2019;12). Storm exposure may also enhance individualism if hazards break reciprocal relationships, reducing access to financial risk sharing and the SWB benefits available within collective communities (Craig et al., 2022). This statistical interaction illustrates

⁶⁵ 99 households recorded consistent rainfall volumes, with 64% located 30+ minutes from a district capital. Furthermore, the mean community cropland coverage for these households is 52%, higher than the average 41% across the entire sample.

⁶⁶ 52% households with at least one fisher, and 57% households with at least one trader/tailor/transport worker, reside in medium/high built-up (10-69%) communities.

an interrelationship between climate shocks (storms), and physical (urban landscape) and social (individualism) capitals (Figure 4.1).

This section showed flooding, salinity, drought, seasonality and storms to impact OWB and/or SWB. Flooding/salinity create opposing “non-poor/unhappy” identities; potentially driven by the OWB benefits available within built-up landscapes juxtaposing the psychological threats from coastal hazards. Drought/erosion are concentrated within agricultural areas; therefore, “poor/happy” outcomes could reflect how remoteness and collective wellbeing can mitigate negative SWB impacts, despite hazards reducing crop yield and trade income. However, counter-intuitive outcomes for households exposed, yet not impacted, by drought require further investigation. Lastly, seasonality and storm exposure may increase financial stress by creating uncertainty and reducing living standards compared to past reference points, particularly within built-up areas.

The next four sections explore relationships between wellbeing and financial/human/social/physical control characteristics. Discussions centre around relationships found within existing literature, and statistical interactions within the eight models. Control variables without a statistical interaction can be interpreted independently to the environmental context. However, to maintain the research focus, control characteristics are discussed through an environmental lens by exploring potential relationships with adaptive capacity and sensitivity.

4.5.4 Controls: Financial

As mentioned in section (2.5), financial capital intertwines with other wellbeing components (Figure 4.1). This section focuses on employment to avoid repeating discussions on how livelihoods and environmental conditions can influence trade incomes.

Non-permanent employment negatively impacts both SWB outcomes (Models 4.1.3 & 4.1.4, RQ2a) and increases the odds of aligning low OWB/SWB (Model 4.2.2, RQ2b). Firstly, supporting the significant association between the two SWB measures (section 3.10.5), financial stress and unhappiness amongst non-permanent workers, primarily within the agricultural sector⁶⁷, could be attributed to their lesser skills (Leichenko & Silva, 2014) lowering their autonomy to access

⁶⁷ 30% of all households are within the crop farmer cluster, yet 47% non-permanently employed households are within the crop farmer cluster ($\chi^2 = 89.358^{***}$).

alternative livelihoods during environmental stress, entrapping them within fragile and uncertain financial positions (Falco et al., 2015). In contrast, low SWB may also exist amongst skilled workers whose non-permanent employment does not align with their aspirations (Mahmood et al., 2019). However, no significant interactions were found between livelihood and environmental variables.

Non-permanent employment may also lower eudaimonic SWB as climatic uncertainty and dependency upon landowners can reduce seasonal/day labourers' financial autonomy (Karabchuk & Soboleva, 2014; Wheatley, 2017). This uncertainty is supported by LMIC studies showing non-permanent employees to often be replaced by landowners' free family labour during low productivity (Lipton, 1986; Tambo, 2016). Furthermore, periodic employment may lower SWB by restricting individuals' ability to fulfil their worker "identity" (Brown et al., 2021; Ohemeng et al., 2020; Oteng et al., 2021), and social obligations to provide for the family (Osei-Tutu et al., 2020).

The modelled relationship could also reflect how poor SWB restricts individuals' capacity to find new employment, reduces productivity, and increases household care burdens (Dasgupta & Baschieri, 2010; Knapp, 2003); particularly within remote communities without formalised health insurance (Mills et al., 2012). These financial feedbacks may further lower SWB due to a "good life" in Ghana being growth-orientated (Osei-Tutu et al., 2020). Nevertheless, SWB is temporal, therefore, as the DECCMA survey was undertaken during the growing season before peak harvest labour demand (Abenyega & Gockowski, 2003), financial stress may have been inflated amongst seasonal workers.

In contrast, permanent employment may improve both SWB outcomes by increasing financial control, future financial optimism, and allowing households to plan their expenditure to avoid financial stress during environmental challenges (Heintz, 2004). Furthermore, Alem et al. (2014) suggest employment, regardless of objective wealth, reduces individuals' perception of themselves as poor, whilst Person et al. (2016) claim the sense of achievement and ability to support the community boosts SWB, particularly amongst women.

Next, in response to RQ2b, non-permanent employment associates with aligned low financial OWB/SWB (Model 4.2.2). Firstly, higher poverty amongst seasonal/day labourers is likely attributed to the vulnerability of labour demand to environmental factors. Furthermore, excess agricultural labour during low productivity reduces workers' bargaining power, driving wages below market value (Leavy & White, 1999). Lower labour demands also often coincide with

increasing food prices, applying additional financial pressures⁶⁸ (Kaminski et al., 2016). Low financial OWB may also contribute towards low SWB; supported by an overrepresentation of economic unhappiness amongst non-permanent households (Table 4.10). For example, from a freedom perspective (van Parijs, 1992), lower and volatile financial resources can prevent households from doing “things of intrinsic worth” (Kingdon & Knight, 2006), reduce respect among peers (Reyes-García et al., 2016), and restrict access to social support (Dzokoto et al., 2019) which can provide OWB *and* SWB benefits (section 2.5.4.2). This section highlighted how non-permanent employment, which can increase during climatic uncertainty, may lower OWB *and* SWB.

4.5.5 Controls: Human

This section examines associations between human capital/perceptions and OWB/SWB, focusing on education and personality traits.

4.5.5.1 Education

Access to above-basic education can improve OWB and SWB (RQ2a), indicated by the lower odds of expenditure poverty (Model 4.1.1) and financial stress (Model 4.1.3). Despite capturing household heads’ education, it is assumed the effect transmits throughout the household due to low social mobility (Azomahou & Yitbarek, 2016).

Education is a vulnerable wellbeing component within an environmental context, and a means to further wellbeing and improved adaptive capacity (section 2.5.2.2). Firstly, education is threatened by climatic hazards (section 2.5.2.2); for example, flooding destroying school infrastructure (Munsaka & Mutasa, 2020).

Education is also a conduit to broader OWB, adaptation and reduced sensitivity. For example, above-basic schooling could lower poverty by enabling access to less-vulnerable livelihoods, thus facilitating greater capital accumulation to fund productive/adaptive investments (Morton, 2014). However, the relationship could be bidirectional, with financial capital a pre-requisite for education (i.e., affording uniforms) (Palmer, 2005). Education can also improve health

⁶⁸ Supported by higher proportions of non-permanent household heads stating living costs recently increased within the dataset (98%).

management, which can prevent ill-health from draining objective resources (Böhnke & Kohler, 2010; Siri, 2014), and facilitate long-term financial planning (Muttarak & Lutz, 2014).

Regarding SWB, studies suggest education can reduce financial stress by generating current success, future optimism (Anyidoho et al., 2012), autonomy (Peters et al., 2010), and a sense of personal achievement (Schueller & Seligman, 2010;54). For example, increased autonomy due to greater access to alternative occupations during unfavourable climates (Assan et al., 2018; Fagariba et al., 2018; Owusu, 2017; Partey et al., 2020). Nevertheless, statistical interactions between education and environmental conditions were not found. Yet, within a society where most have “below-basic” education, higher education can generate respect (Morley et al., 2009) and give individuals a “clear status advantage” (Striessnig, 2015;10).

These results support the association between expenditure poverty and financial stress (section 3.10.1), and suggest education in Volta Delta brings objective benefits which align with individuals’ expectations (Djimesah et al., 2018).

4.5.5.2 *Household head personality*

Next, household heads’ personalities are interpreted in an environmental context. Responding to RQ2a, positive personalities reduce BND (Model 4.1.2), financial stress (when distant from road intersects) (Model 4.1.3), and increase unhappiness (when impacted by storms) (Model 4.1.4). “High” personality scores also increase the odds of aligning high OWB/SWB (RQ2b, Model 4.2.1).

Firstly, remoteness has a complex relationship with wellbeing (section 4.5.2.3). Figure 4.14 shows positive personalities in remote areas to further lower the probability of financial stress. “Positive” individuals are more willing to take risks and explore new opportunities (Appendix 4.15), which if successful, can reduce environmental vulnerability and financial uncertainties (Cooper et al., 2008; Ward et al., 2007). Furthermore, “outgoing” individuals are often optimistic, potentially creating subjective resiliencies to objective disadvantages (Clare et al., 2017; Rishworth et al., 2020; Seccombe, 2002; Sharpe et al., 2011).

Associations between positive personalities, lower BND (Model 4.1.2) and aligning high OWB/SWB (Model 4.2.1) support studies showing conscientiousness/reliability⁶⁹ to improve OWB by increasing entrepreneurship and productivity during environmental challenges.

⁶⁹ These elements are included within the “personality” cluster variable (Appendix 4.2).

Friendlier personalities also heighten social capital access (Rashid et al., 2020), improving OWB and SWB through community safety nets and emotional support (De Silva et al., 2006).

However, despite personality being an underlying driver of happiness (Dowling & Yap, 2012), a complexity is introduced within an environmental context. Figure 4.16 shows positive personalities associate with greater unhappiness when impacted by storms (Model 4.1.4). This finding is initially counter-intuitive. However, positive individuals may possess higher aspirations, which if unattainable due to disruptive hazards, can lower SWB (Hudson et al., 2019).

The interaction suggests storms nullify the benefits of positive personalities, with storm-impacted, high-personality households overrepresented amongst those unhappy with housing, drinking water, health, family/community interactions and environment. Storms may override individuals' positivity by negatively influencing; (i) housing; asset damage (Addo et al., 2018a), (ii) drinking water; salinized coastal aquifers (Namara et al., 2010), (iii) health; disease and psychological harm (Amoako, 2012; Brecht et al., 2012; Sekulova & Van den Bergh, 2016), (iv) family/community interactions; weakened social ties (Dolan & Walker, 2006), (v) environment; affiliated land being degraded (Albrecht et al., 2007). This result highlights how innate characteristics can produce differing outcomes depending on the environmental and “relational” context.

This section highlighted the OWB and SWB benefits of education and positive personalities. However, unhappiness amongst positive, storm-impacted households suggests climatic shocks may surmount psychological resiliencies.

4.5.6 Controls: Social

The association between social capital/perceptions and OWB/SWB in different landscapes was explored in section (4.5.2). To avoid replication, this section focuses on gender within an environmental context. Religious participation is also a key channel for social capital in Ghana (Ababio et al., 2021); however, it is not discussed as the dataset only contains “religious affiliation”, rather than “participation”.

4.5.6.1 Gender

Responding to RQ2a, gender associates with OWB measures differently. Firstly, higher female presence in households reduces expenditure poverty (Model 4.1.1), supporting studies

highlighting shifting gendered roles in Ghana with women focused on cash generation (Vercillo, 2020). Furthermore, female dominance in market spaces potentially improves financial OWB by reducing the immediate dependency upon primary productivity, and enabling access to other wellbeing capitals. For example, markets act as social hubs, expanding networks and facilitating access to new ideas/business opportunities (Antwi-Agyei et al., 2013; Porter, 2007). Lower poverty in predominantly female households may also result from male emigration⁷⁰ (Atiglo, 2017), and access to monetary and knowledge remittances (Castaldo et al., 2012; Ionesco & Chazalnoel, 2015).

In contrast, female-headed households associate with BND (Model 4.1.2); potentially reflecting continued inequalities within a patrilineal society. Female-headed households are overrepresented amongst those deprived in employment, bank access and education (Table 4.7); displaying imbalances within the interconnected job market, financial institutions and educational system. The autonomy of female household heads to invest in human capital may be restricted if emigrant males maintain decision-making power (Fuseini et al., 2019). These overarching challenges may be exacerbated for separated/widowed women; supported by higher odds of BND (Model 4.1.2). An overrepresentation of social cooperatives/networks deprivation amongst previously married household heads (Table 4.7) suggests these individuals may lose access to the social capital and financial support required to adapt and remain productive during uncertain climates (Afriyie et al., 2018; Berchoux & Hutton, 2019; Codjoe et al., 2020a; Khazaeian et al., 2017).

However, despite multiple examples of gendered environmental risks in the literature, no significant interactions were found. The household-level survey data, and the missing SWB data from the female-only dataset, limited the capacity to explore gendered differences. Therefore, gendered focus groups (Chapters 5-6) were used to examine intrahousehold differences.

4.5.7 Controls: Physical

This section explores how material assets⁷¹, including water sources and housing, may relate to climatic sensitivity and wellbeing.

⁷⁰ 48% households with 50% + females had a current migrant outside the household, significantly higher than the 41% within households with <50% females ($\chi^2 = 6.562^{***}$).

⁷¹ Note: “road infrastructure” is acknowledged as a form of physical capital; however, it is discussed as a “landscape” characteristic (section 4.5.2.3) to maintain the environmental focus.

4.5.7.1 *Drinking water source*

The relationship between physical capital and sensitivity is illustrated in Figure 4.10, with piped water access lowering the probability of expenditure poverty when distant from inland water sources (Model 4.1.1). The relationship may be multidirectional, with better-off households capable of affording higher-quality assets with lower sensitivity (Stoler, 2012). In contrast, relying on open sources can lower financial OWB by inducing health risks and limiting economic productivity (Hallegatte, 2016; Stanke et al., 2013); see section (2.5.3.2). Women/children may also spend more time/energy on domestic water collection, reducing their capacity to undertake productive activities and enhance human capital (i.e., education); potentially contributing towards intergenerational poverty (Limbu, 1999; Muttarak & Lutz, 2014). This example illustrates the interrelationship between the five wellbeing capitals (Figure 4.1); clean water (natural), pipe/tubewell infrastructure (physical), health/education (human), female obligations (social), and economic productivity (financial).

4.5.7.2 *Housing quality*

Next, responding to RQ2b, low-quality housing, captured through roof material, associates with aligning low OWB/SWB (Model 4.2.2). Lower financial OWB could be capturing poorer rural communities, unable to invest in material improvements and reliant upon self-constructed dwellings made from natural materials (Danso, 2013). However, lower financial OWB could also reflect how poor-quality housing can increase environmental sensitivity and impact other wellbeing components. For example, greater susceptibility to flood/storm damage can exacerbate health risks and curtail financial wellbeing by generating unplanned repair costs (Adjei & Kyei, 2013; Atiglo & Codjoe, 2017; Diop et al., 2011; Obeng-Odoom & Amedzro, 2011; Weeks et al., 2012).

The association between non-secure housing and aligning low OWB/SWB supports Ghanaian studies illustrating lower SWB and “hopelessness” to coexist with financial and/or material deprivation (Addai et al., 2014a). Marcus (2006) defines housing as a “mirror of self”, reflecting how one wants to be perceived (Saunders, 2021). Therefore, low-quality housing, sensitive to climatic damage, may produce unhappiness by creating discrepancies between how individuals want to be, and how they are, viewed in the community. Climate damage to dwellings can also lower SWB by disrupting place attachment (Carroll et al., 2009), preventing homes from being spaces of comfort and security, and challenging individuals’ social obligations to protect their family (Zakari et al., 2014). Differing levels of physical capital sensitivity, highlighted by 47/50 surveyed communities having a mixture of secure/non-secure dwellings, may also exacerbate

inequalities and reduce SWB during hazards (Addai et al., 2014a). However, despite multiple hypothesised associations, no significant interactions between housing quality and environmental variables were found.

This section illustrated relationships between physical capital and wellbeing within an environmental context. Water infrastructure is suggested to lower climatic sensitivity, whereas low-quality housing may contribute towards lower OWB *and* SWB.

4.5.8 Response: Adaptation

This final section explores associations between “response”, including livelihood/environmental adaptation and migration, and wellbeing; illustrated by the framework’s feedback arrow (Figure 4.1).

Responding to RQ2a, results suggest adaptation improves both OWB measures (Models 4.1.1 & 4.1.2). Vulnerable rural livelihoods require adaptation to remain viable; supported by Figure 4.9 illustrating adaptation to reduce the probability of expenditure poverty to a greater extent within high-EVI, agricultural communities⁷². Lower odds of poverty in high-EVI communities supports studies highlighting adaptation to contribute more to poverty reduction than increasing average incomes in SSA (Heger et al., 2018).

Agricultural adaptation can benefit financial OWB by reducing crop failure, and improving yields for consumption and trade (Antwi-Agyei et al., 2018; Ndamani & Watanabe, 2015). Past studies in Volta Delta record multiple strategies (p.102); however, adaptation requires upfront financial and human capital (Antwi-Agyei & Stringer, 2021). Yet, most surveyed households adapted in some form (78%). Therefore, the modelled association with expenditure poverty may have been driven by non-adapters, who likely reflect the poorest households without the necessary resources. Nevertheless, vulnerable agricultural households still demonstrated their agency to adapt to changing conditions, with households in high-EVI communities overrepresented amongst those using hired labour, moving house, house modifications, community protection and cooperatives.

Surplus financial capital is required to hire labour to increase yield within land areas too large for family labour (Chowdhury, 2016); supporting ideas that adaptive agricultural households have pre-existing capital access. However, within rural communities with insufficient means to

⁷² Supported by higher cropland/grassland coverage in high-EVI communities (Appendix 4.16).

undertake their favoured practices, strategies which pool resources can be more effective in combatting collective poverty (Ndamani & Watanabe, 2015); supporting the overrepresentation of community protection and cooperative strategies. These practices support the narrative that agricultural communities value collectivism and reciprocity when conceptualising wellbeing.

In contrast, non-adapting, high-EVI households have higher probabilities of expenditure poverty, potentially driven by the greater vulnerability to climate-induced productivity reductions.

Furthermore, communities in productive “green” landscapes could be disincentivised from diversifying, keeping them “trapped” within low-paid, fragile agricultural occupations (Wantchekon & Stanig, 2015).

Active adaptation also independently lowers BND (Model 4.1.2). Adaptive households are underrepresented amongst those deprived in employment, education, homeownership and social cooperatives/networks (Table 4.7). These associations could reflect how adaptation can ensure consistent job opportunities within sectors dependent on erratic ESs (Castaldo et al., 2012; Owusu & Lund, 2004), facilitate investment in human and physical capital (Agyarko et al., 2012), and create foundations for structural social capital through the sharing of new practices and technologies (Chaudhury et al., 2017; Claridge, 2018b).

4.5.8.1 *Migration*

Seasonal and long-term migration is a crucial adaptive strategy undertaken within LMICs to achieve livelihood diversification, increase financial security, and reduce climatic exposure (Falco et al., 2018). However, results are inconsistent, with current migrant households having higher odds of expenditure poverty, yet lower financial stress, whereas past migrant households associate with low BND (in Greater Accra), yet higher unhappiness (Table 4.20). The varying OWB/SWB outcomes are further reflected in models addressing RQ2b, with “poor/happy” and “poor/unhappy” outcomes associated with current and past migration respectively.

Table 4.20 Direction of the statistical effects of “current and past migration” on different wellbeing outcomes/combinations

Research question	Wellbeing classification	Household migration status: direction of the statistical effect (odds ratio) (ref: no current/past migrant)	
		Current migrant outside household	Past migrant in household
RQ2a	Expenditure poverty (Model 4.1.1)	↑	
	Basic needs deprivation (Model 4.1.2)		↓ (in Greater Accra region)
	Subjective financial stress (Model 4.1.3)	↓	
	Life domains unhappiness (Model 4.1.4)		↑
RQ2b	“Poor/unhappy” (Model 4.2.2)		↑
	“Poor/happy” (Model 4.2.4)	↑	

Responding to RQ2a, the association between current migration and expenditure poverty suggests migration is a reactive, survival tactic, not a long-term strategy to improve financial OWB (Mortreux & Adams, 2015). For example, SSA communities often migrate short distances to escape climate hazards (Flahaux & De Haas, 2016; Kubik & Maurel, 2016). Migration can also contribute towards poverty (section 2.5.6.2); for example, by causing labour shortages (Walsham, 2020). Overreliance upon remittances may also disincentivize sustainable investments, resulting in long-term vulnerability and prolonged poverty risks (Adger et al., 2002).

In contrast, current migration also associates with low financial stress. This opposing result suggests, despite current poverty, access to remittances or new ideas/practices may increase households’ perceived financial security and future financial optimism (Apatinga et al., 2022; Cai & Wang, 2018; Gyimah-Brempong & Asiedu, 2015; Knight & Gunatilaka, 2010a). Furthermore, as migration requires financial/social resources (Falco et al., 2018), low financial stress may represent the higher perceived status relative to non-migrant households (Nieswand, 2014).

The opposing OWB/SWB outcomes are mirrored by the association between current migration and “poor/happy” outcomes (Model 4.2.4). Exploring SWB, current migrant households are overrepresented amongst those happy with environment and community interactions; potentially reflecting the capacity for remittances to fund sustainable activities (Musah-Surugu et al., 2017), and for migration to extend the size/diversity of social networks (Kloosterman et al., 2016). The hypothesised detachment of SWB from financial challenges in migrant households emphasises the importance of evaluating OWB and SWB within sustainable development (Adger, 2010).

Next, Model (4.1.2) suggests past migrant households in Greater Accra experience lower odds of BND, whereas there is no significant effect in Volta (Figure 4.12). Volta migration is hypothesised to be less tailored towards improving long-term OWB, supported by an overrepresentation in the DECCMA dataset of “family obligations” and “health care” migration reasons, compared to “employment opportunities” in Greater Accra. Previous studies indicate the intention for economic migration in Greater Accra is shaped by the “relational context”, with greater proximity to industrial/administrative hubs, access to information on employment opportunities, and established networks forged from constant labour flows (Awumbila et al., 2017). Greater connectivity to major urban hubs within Greater Accra may also stimulate productive improvements and lower BND by improving access to public services, and raising communities’ expectations for higher living standards (Clemens, 2013; Gyimah-Brempong & Asiedu, 2015). Nevertheless, these associations could be bidirectional, as credit access (Codjoe et al., 2017), education (Amuakwa-Mensah et al., 2016), and expansive social networks are potential pre-requisites for migration (Awumbila et al., 2017).

However, past migration also associates with unhappiness (Model 4.1.4) and aligning low OWB/SWB (Model 4.2.2). Low SWB may be generated by a failure to meet the new material aspirations generated by migrants’ experiences of higher living standards (Knight & Gunatilaka, 2010a). In particular, past migrant households are overrepresented amongst those unhappy with drinking water, food security, health, and family/community interactions (Table 4.10). Poverty and unhappiness with family/community interactions could emerge if relationships breakdown following unfulfilled remittance obligations, or if migrants “abandoned” their origin during periods of hardship (Craig et al., 2022). Unhappiness with health, and the interrelated financial impacts, could relate to domestic care deficiencies, particularly when acknowledging the “feminisation of mobility” (Awumbila, 2015). Unhappiness with food security could be attributed to emigration of young adults causing labour shortages and lower subsistence yields, particularly during climate pressures (Van Der Geest, 2010). The association between migration and aligning low OWB/SWB emphasises how effective adaptation and migration policy must account for material, “psychological, symbolic and emotional aspects” (Adger, 2010;282).

This section highlighted the objective benefits of adaptation in rural communities, and the complex relationship between wellbeing and migration. Current migrant households experience low financial OWB/high SWB, whereas past migrant households associate with low financial OWB/SWB. Low financial OWB across both groups suggests migration is a reactionary response to poverty, whereas differing SWB outcomes suggest happiness is dependent on migratory success and future optimism.

4.6 Conclusion

This chapter explored associations between environmental and control variables with OWB, SWB, and aligning/opposing OWB/SWB. This conclusion summarises how models supported, and challenged, different components of the “ECW” framework (Figure 4.1); further evaluated in Chapter 7 using quantitative and qualitative results.

Firstly, addressing RQ2a, all outcomes significantly associated with at least one climatic hazard or landscape characteristic; supporting the interconnection between **“Environment”** and **“Wellbeing”**. However, not all environment-wellbeing relationships were expected, for example households exposed to, but not impacted by, drought experiencing higher odds of BND (Model 4.1.2). The framework also illustrated how environmental conditions impact various wellbeing measures differently, supported by grassland coverage associating with expenditure poverty (Model 4.1.1), yet lower financial stress (Model 4.1.3). These opposing relationships emphasise the importance of incorporating OWB *and* SWB, and using mixed methods, to further the understanding of community wellbeing.

Select models also illustrated how environment-wellbeing relationships may differ depending on supporting characteristics; including **“Exposure”**, **“Adaptive capacity”** and **“Sensitivity”**. Firstly, climatic hazards possess spatial characteristics, capturing differences in **“Exposure”**. For example, flooding and salinisation hazards are associated with built-up coastal locations, whereas drought and soil erosion are concentrated inland. The impact of **“Livelihoods”** in influencing **“Sensitivity”** was captured in all singular outcome models, except Model (4.1.4). Households with primary, or interconnected (Cazcarro et al., 2018), livelihoods possess higher odds of expenditure poverty, BND, and financial stress. These models suggest primary sectors are more sensitive to environmental challenges, and consequent wellbeing reductions, due to their greater integration with threatened ESs. However, the models do not explicitly capture this relationship through interactions between “livelihood cluster” and environmental variables.

Nevertheless, significant interactions between environmental and control characteristics potentially reflected how capitals can act as means to further wellbeing by controlling **“Adaptive capacity”** and/or **“Sensitivity”**. For example, Model (4.1.4) illustrates lower odds of unhappiness amongst agricultural households with high place attachment (social perception). This result suggests rural communities may use strong community bonds to increase psychological resiliency, and reduce the **“Sensitivity”** of SWB to environmental challenges and material deprivation (Milbourne, 2014). Additionally, this relationship may reflect how climatic pressures can reinforce reciprocal relationships and enhance collective **“Adaptive capacity”**. Results also suggest water infrastructure (physical capital) minimises **“Sensitivity”** to

expenditure poverty during periods of water insecurity amongst households furthest from inland water (Model 4.1.1).

Yet, other expected interactions from the literature did not emerge; for example, education increasing **“Adaptive capacity”**. The absence of a significant interaction does not necessarily mean the relationship does not exist. The effect may have been accounted for by other model variables, as the influence of education was mentioned several times during qualitative fieldwork (Chapters 5-6). However, control variables without a significant interaction were still interpreted through an environmental lens to maintain the research focus, and due to environmental variables being estimated to explain substantial proportions of variation in wellbeing (Appendix 4.10).

However, not all significant interaction terms, representing **“Adaptive capacity”** and/or **“Sensitivity”**, aligned with the literature-based framework. For example, higher expenditure poverty in drought-impacted households with high place attachment (Model 4.1.1) suggests community togetherness is insufficient to achieve poverty alleviation, yet may contribute towards static “coping”. Similarly, higher odds of financial stress in built-up locations exposed to storms (Model 4.1.3) suggests the lower **“Sensitivity”** of peri-urban livelihoods does not negate the negative SWB impacts.

When exploring **“Response”**, the models illustrated how **“Relational Context”** shapes wellbeing. For example, adaptation only significantly reduced the odds of expenditure poverty within rural areas (Model 4.1.1). Contextual differences were also illustrated with migration, with past migrant households associating with lower odds of BND in Greater Accra, but not Volta Region (Model 4.1.2). This example emphasises the importance of acknowledging **“Global Drivers”** and “relational” processes when interpreting small-scale results, as despite macroscale OWB improvements being recorded in Ghana after the implementation of structural readjustment programmes (Konadu-Agyemang, 2000), postcolonial influences and investment patterns potentially uncover why regional and community-level differences in wellbeing and vulnerability exist today.

By creating outcome variables which combined expenditure poverty and unhappiness, the relationship between OWB/SWB within an environmental context could be explored (RQ2b). For example, the odds of aligning low OWB/SWB, illustrated through the positive (“+”) association in the framework (Figure 4.1), were higher amongst remote households (Model 4.2.2); potentially attributable to the financial impacts and sense of hopelessness generated from being isolated from markets, services and investment.

In contrast, Models (4.2.3 & 4.2.4) highlight the capacity for opposing OWB/SWB; supporting the framework's negative (“-“) association between capitals and perceptions. For example, higher odds of “poor/happy” outcomes within cropland communities, exposed to drought and erosion, could have been influenced by the **“Relational Context”**. Rural communities may experience greater SWB due to their limited awareness of higher living standards, the lower value attached to financial accumulation, or climate hazards forging stronger relationships. This outcome juxtaposed “non-poor/unhappy” households within built-up, coastal/riverine locations exposed to flooding and salinisation; reflecting how climate hazards and landscape characteristics can have varying impacts depending upon the contextual setting. These contrasting relationships are explored further in Chapter 6.

The influence of wellbeing upon environmental conditions is acknowledged; however, these feedbacks are beyond the project's scope. Furthermore, **“Global Drivers”** and elements of **“Relational Context”**, such as governance structures, were not captured within statistical modelling. These elements are included to contextualise the research, and are discussed using qualitative methods (Chapters 5-6).

The key associations between wellbeing, landscape characteristics and climatic hazards uncovered in this chapter were used to guide the qualitative fieldwork design; outlined in the following chapter. Study site selection targeted certain landscapes (i.e., grasslands with low OWB/high SWB), whereas interview questions were formulated to further understand, or challenge, modelled relationships. This mixed method approach comprehensively evaluates wellbeing in Volta Delta, and explores how environmental conditions can associate with OWB, SWB, and their relationship.

Chapter 5 Capturing wellbeing priorities across socioecological subgroups

5.1 Introduction

Wellbeing is multidimensional; therefore, sustainable development research and policy should capture its various facets to comprehensively understand communities' challenges. When measuring multidimensional wellbeing, assigning weights to different components to reflect their assumed importance to a "good life" is an "inescapable step" (Decancq & Lugo, 2013). Even if weighting is not incorporated, all components are assumed equal, which may not reflect lived realities (Esposito & Chiappero-Martinetti, 2008). As recommended by Booysen (2002), this study experiments with different weighting techniques and engages with methodological literature when calculating wellbeing. Using the objective, decomposable BND measure (section 3.8.3), this chapter introduces an exercise to capture how communities and local decision-makers prioritise different "basic needs" when conceptualising a "good life". By collecting and comparing different subgroups' weightings, this chapter addresses the RQ:

3. How do different socioecological groups conceptualise and weight components of wellbeing?

- a. Compare weights given to basic needs deprivation components across livelihood groups, genders and community/district planning officers.
- b. Assess if the different weightings alter the overall deprivation rate, or spatial distribution of basic needs deprivation across Volta Delta.

Wellbeing measures and policy are sensitive to weighting methodology (section 3.8.3), justifying the collection of community and expert-preference weights to mitigate the influence of researchers' assumptions, or arbitrary statistical relationships, and ensure measures align with targeted communities' conceptualisations (Decancq & Lugo, 2013). This chapter illustrates the impact of weighting choice upon multidimensional wellbeing classification by comparing communities' weighted deprivation rates to the "nested" baseline rate.

Community-preference weighting is relatively absent from economic studies, yet prevalent within social and health studies (Lawson et al., 2013; Pyne et al., 2008). However, many studies apply these weights homogenously, or across large subgroups such as gender (De Kruijk & Rutten, 2007) or country (Schaafsma & Gross-Camp, 2021). Analysis incorporating local

perceptions can improve policy buy-in (Kay & Jost, 2003) and restore the “person” within research, which could otherwise be lost if viewing individuals’ emotions through detached quantitative surveys (White, 2016). Applying subjective community-preference weights to the objective BND measure alters how “wellbeing” is understood (Folwell, 1995), and illustrates the capacity for mixed methods, and both objective and subjective elements, to be incorporated within sustainable development research to achieve a locally-grounded understanding of wellbeing.

However, “no weighting system is above criticism” (Booyesen, 2002;127) (section 3.3.4.2). For example, during community-preference weighting respondents may emphasise short-term requirements, rather than broadly interpreting a “good life” across time, if they assume external researchers can provide immediate monetary support (Dosu, 2021).

Nevertheless, this method supports the “comprehensive wellbeing” approach (White, 2016), at the heart of the newly-constructed “ECW” framework, by collecting qualitative information from various communities and district planning officers (DPOs)⁷³. This approach ensures local priorities guide wellbeing measures, and acknowledges how priorities differ between livelihood groups and geographic locations (Fabricant, 2013); potentially supporting heterogenous small-scale wellbeing initiatives rather than blanket approaches. Furthermore, collecting community and DPO information can produce a powerful policy tool by identifying differences between district-level agendas and communities’ needs (Kim et al., 2015).

This chapter outlines, and justifies, the selected study sites and the participatory rural appraisal (PRA) methods (Schreckenberget al., 2016) undertaken to capture actors’ priorities and experiences. Note, focused discussions on environment-wellbeing associations are presented in Chapter 6 (RQ4), whereas this chapter focuses on the weighting exercises undertaken during community focus groups (FGs) and DPO interviews. Nevertheless, environmental themes and verbatim quotes⁷⁴ are drawn upon in this chapter when discussing weighting differences across space and livelihoods. Following the description of the weighting methodology, the weights are statistically compared across socioecological subgroups to identify key differences (RQ3a), then applied to all surveyed communities to explore the sensitivity of wellbeing outcomes to weighting selection (RQ3b).

⁷³ See Appendix (5.1) for a description of the DPOs’ responsibilities.

⁷⁴ Verbatim quotes are classified by the site number (Figure 5.1), and community focus group/community interview/district planner interview (FG/CI/DPO). Community focus groups/interviews will also be defined by gender (M/F). For example, a female focus group in Afienea (S1) would be denoted by (1,FG,F).

5.2 Methodology

This section outlines the selection of eight study sites across Volta Delta, and describes the PRA methods; transect walks, FGs and semi-structured interviews. Next, the methods used to collect, compare, calculate and apply weights are summarised.

5.2.1 Study sites

Eight communities from the DECCMA sample were selected based on key themes identified in quantitative results; including areas with distinct wellbeing outcomes, livelihoods or environmental conditions. For example, Nyitawuta (S4)⁷⁵ was selected due to higher proportions of “poor/happy” households and grassland coverage; associated with higher expenditure poverty (Model 4.1.1), yet lower financial stress (Model 4.1.3). Similarly, peri-urban Sogakope (S3) was selected due to the presence of river vegetation; associated with “non-poor/unhappy” outcomes (Model 4.2.3). See Appendix (5.2) for further information on site selection. All communities were located in different districts⁷⁶ (Figure 5.1). Sites from Volta *and* Greater Accra regions were selected to incorporate different wellbeing priorities, landscapes, livelihoods and environmental challenges; shaped by (post)colonial investment patterns (Kambala, 2023).

⁷⁵ References to study sites are followed by the corresponding site number displayed in Figure 5.1.

⁷⁶ Site 4 (Nytawuta) is illustrated to belong to the Akatsi South district; however, I was informed upon arrival that it falls under the jurisdiction of Akatsi North district, located to the east of Site 4 in Figure 5.1. The difference is likely attributable to the offset GPS coordinates available in the dataset.

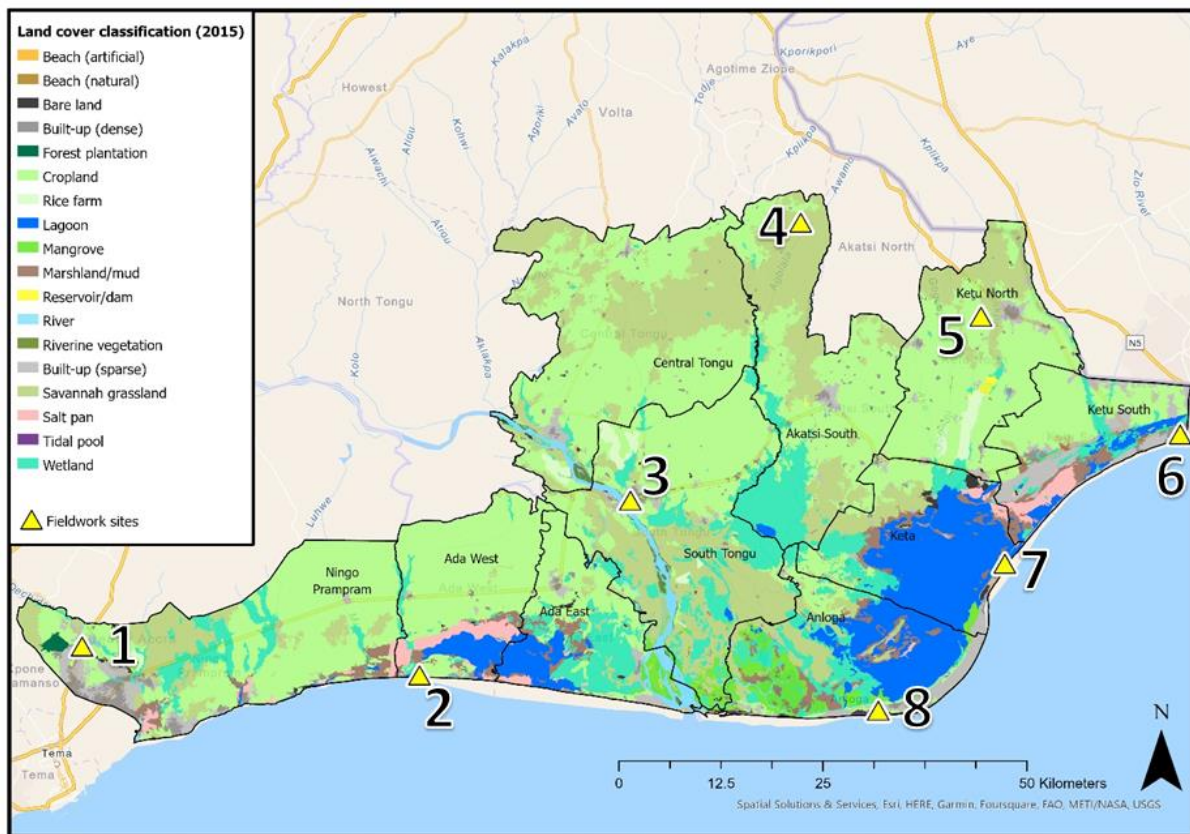


Figure 5.1 Eight selected study sites across eight districts in Volta Delta

5.2.2 Accessing respondents

Permission to enter communities was received from the Chief Executive, Chief Planning Officer or DPO from all eight districts. Participant information sheets and approval letters from University of Ghana's (UoG) Regional Institute for Population Studies (Appendix 5.3) were provided. Liaising with local leaders was necessary to follow cultural norms and ensure acceptance within communities (Maunganidze, 2019). Assemblymen and committee members granted permission to undertake fieldwork activities. These individuals acted as "gatekeepers" by assisting in recruiting participants and organising FGs (Mfoafo-M'Carthy & Grischow, 2022).

Framing the project as an extension of DECCMA, collaborating with UoG, and introducing myself as a doctoral student (Adu-Ampong & Adams, 2020) increased the project's legitimacy and ensured successful entry into all communities (Morley et al., 2009). However, these actions potentially created a power dynamic. Despite attempting to minimise this dichotomy by having informal conversations with community members, my position of power was continually apparent as it legitimised my right to certain places and types of information, for instance my ability to ask personal, emotive questions (Funder, 2005).

5.2.3 Transect walks

Transect walks are categorised as; (i) social: observing cultural behaviours, economic activities, and occupations, (ii) land-use: observing environmental features such as land-use and crop types (Dongre et al., 2009). Transect walks were undertaken at every site with an assemblyman or committee member to get a “bird’s eye view of the locality” (Barton, 1997;1093), record social and land-use observations, and identify potential participants. However, as transect walks were led by community leaders, and not “random” journeys through the village, their representativeness may have been affected (ParCITYpatory, 2017). Furthermore, my perceived legitimacy and “white” identity facilitated access to spaces unavailable to others, such as the chief fisherman’s house in Kedzi (S7).

Nevertheless, transect walks provided contextual information to tailor FG questions to individual communities. Observations of environmental challenges and livelihood practices aided the interpretation of qualitative transcripts, and validated/challenged communities’ statements (Eelderink, 2019; JLIFLC, 2012). For example, discrepancies existed between committee members’ claims and observed realities regarding open-defecation; illustrating potential social desirability bias if participants attempted to protect their community’s image (Vercillo et al., 2022).

5.2.4 Focus groups

Two FGs were carried out at each site; one female and one male. Each FG targeted 6-10 participants (Table 5.1). Due to the traditional social structure in Ghana (Codjoe et al., 2020a), FGs were split by gender to reduce social desirability bias (Yager et al., 2013). For example, women feeling unable to speak about negative impacts of male actions (Tseklevs et al., 2020). Furthermore, unlike household-level quantitative analysis, gendered FGs provided opportunities to discuss intrahousehold differences in wellbeing and environmental experiences. However, power dynamics along other social lines, such as political influence or age, could still have generated bias (Farr, 2018). See Appendix (5.4) for additional FG information; including duration, age range and language.

Table 5.1 Number of participants within each focus group

Location	No. male participants	No. female participants
1) Afienya	7	6
2) Anyamam	8	8
3) Sogakope	6	10
4) Nyitawuta	8	8
5) Awlikope	8	8
6) Aflao	7	8
7) Kedzi	9	7
8) Anloga	10	8

All FG participants provided written consent; research assistants (RAs) translated and relayed the information to those unable to read English. All FGs were undertaken in Ewe or Dangbe, except the male FG in Afienya (S1) conducted in English. FGs were audio recorded and transcribed following the fieldwork. The voice recorder may have induced bias; however, it was necessary to capture detailed data and verbatim comments (Rutakumwa et al., 2020). All participants were provided with refreshments.

Semi-structured FGs bridge scientific research and local knowledge (Cornwall & Jewkes, 1995) by efficiently gathering information (Henningsen et al., 2020) on different groups' experiences and priorities (Flowerdew & Martin, 2013). The FG guide (Appendix 5.5) contained general questions and site-specific topics based on quantitative results and environmental conditions. Discussions were centred around the weighting exercise (section 5.2.7). Questions aimed to understand how environmental challenges impact, and are impacted by, objective capitals, adaptation, and SWB.

FGs create relaxed environments where researchers become “moderators” rather than “investigators” (Nyumba et al., 2018). This approach can stimulate greater idea generation due to the “synergy and spontaneity” of discussions (Coenen et al., 2012;367), increase participant disclosure (Guest et al., 2017), and empower marginalised groups (Peek & Fothergill, 2009) by ensuring “priority is given to [respondents’]...frameworks [and languages] for understanding the world” (Wilkinson, 1998;117).

However, FGs possess several limitations. For example, dominant individuals preventing wider views from being collected (Barrett & Twycross, 2018), or social desirability restricting certain

topics from being discussed collectively (Kitzinger, 1995). Studies also suggest certain viewpoints could be withheld if participants feel the researchers do not possess similar experiences or understand their perspective (Peek & Fothergill, 2009).

Assemblymen/committee members selected FG respondents. Despite discussions with gatekeepers regarding the importance of accessing participants with the diverse characteristics observed during transect walks, access to certain voices may have been restricted. This was observed in remote Nyitawuta (S4), where transect walks unveiled more deprived individuals compared to the educated male FG participants with experiences of travelling to Accra. However, to ensure community access and relationships were maintained, control over participant selection was partly surrendered (Dosu, 2021).

However, diverse FGs could hinder discussions, where individuals with lower social status may be silenced or conform to more “powerful” members (Tsekleves et al., 2020). For example, younger community members, often omitted from FGs (Appendix 5.4), may be unable to challenge elders’ views; illustrated in Sogakope (S3) where a younger woman was asked to leave after discussing the benefits of living within a district capital. My positionality may have influenced this dynamic, as respondents may have downplayed positives in fear of discouraging “white outsiders” from providing support (Funder, 2005). See section (6.4) for my reflexive account.

5.2.5 Semi-structured interviews

Two semi-structured interviews were conducted at each site. Participants were purposively selected from FGs and/or transect walks based on the interest in their FG inputs or their livelihood, particularly if similar livelihoods were absent during FGs. One female and one male participant were chosen to capture gendered differences in environment-wellbeing experiences⁷⁷. All interviewees provided written consent, with RAs translating the information if required. All interviews were recorded and transcribed.

Semi-structured interviews, incorporating pre-determined discussion topics, yet permitting “participants to bring their own personality and perspective to the discussion” (Barrett & Twycross, 2018;63) were essential in allowing participants to define their own “wellbeing”,

⁷⁷ However, due to availability, two males were interviewed in Site 7 (Kedzi) and only one male interview was undertaken in Site 1 (Afiénya) due to time restraints and two potential participants dropping out early in the interview process.

rather than be restricted by researchers' assumptions. Undertaking interviews after FGs allowed for additional detail to be collected regarding groups' reported environmental-wellbeing associations (Guest et al., 2017), particularly regarding personal SWB information which is more accessible in one-to-one settings (Kvale & Brinkmann, 2009). Using FGs *and* interviews also provided an opportunity to detect differences in individualistic/collective wellbeing conceptualisations, a key theme identified during quantitative analysis, and evaluate any potential biases within FG responses (Groves et al., 2011).

An overarching interview guide was used across all sites (Appendix 5.5), alongside site-specific questions arising from FGs. The questions focused on individuals' environmental challenges, their perspective on OWB/SWB relationships, and their comparative reference points; the latter an important SWB control (section 2.2.3). Interviews were led by the same gendered RA, or myself if the participant was comfortable conversing in English (Appendix 5.4). Nevertheless, a RA was present in all English-spoken interviews to support translations or interpretations.

Eight DPOs were also interviewed face-to-face or via telephone; written or spoken consent was gained. DPO interviews enabled broader discussions on district-level challenges and policy decisions. These interviews were structured around the capitals included in the weighting exercise (section 5.2.7), yet were flexible to facilitate the inclusion of communities' key themes/priorities.

5.2.6 Broader limitations

Fieldwork was conducted February-March 2023, seven years after DECCMA. Therefore, research exploring communities' challenges and priorities must acknowledge the contextual changes. The Ghanaian economic landscape has deteriorated, illustrated by a sharp upturn in inflation rates in 2022 (IMF, 2023), the highest food prices and worst-performing currency in SSA (World Bank, 2022), and the debt-to-GDP ratio rising >80% (Bob-Milliar & Sigman, 2022). The socioeconomic implications of COVID-19 also likely influenced communities' wellbeing over time. Therefore, qualitative findings offer plausible hypotheses regarding modelled environment-wellbeing relationships, rather than directly explaining quantitative results formed within a different context.

Another limitation was the short timeframe, with a maximum of 2 days within each community. This restricted my ability to build rapport, potentially limited data richness, and prevented certain voices from being captured. However, this limitation was accepted due to time and

funding restraints, and the project being mixed methods, rather than in-depth ethnographic research.

Ensuring privacy during FGs and interviews was challenging as they were organised ad-hoc upon arrival, and were commonly held outdoors where others could potentially overhear. During several FGs, non-participating community members gathered to listen/respond. The RAs paused the recording where possible and asked non-participants to leave. This was important when men attempted to attend female FGs, otherwise their presence could have prevented women from freely discussing their experiences (Thummapol et al., 2019).

As most discussions were not in English, the RAs or respondents may have misinterpreted certain questions and responses during translation. One example is the term “wellbeing”, which was rephrased to “good life” (Dzokoto et al., 2019) as the former was suggested to specifically relate to good “health” or “character” (Osei-Tutu et al., 2020). Nevertheless, terms I understood to be universal, such as “happiness”, may have also been interpreted differently, as illustrated by a study of Ghanaian college students, where “happy mood” was interpreted in multiple ways (Table 5.2). This limitation was accepted as an inevitable challenge of overseas research.

Table 5.2 “The many names of happiness” from a sample of Ghanaian college students (Dzokoto, 2012)

Description of happy mood	Frequency
Very happy	17
Good/Positive/Heavenly/Wonderful	15
Elated/Energetic/Positive energy/Delighted/Jubilant	9
Excitement	7
Fulfilled/Satisfied/Content	7
Beaming/Smiling/Glowing	6
Comfortable/Calm/Serene/Enjoyment/Pleased	5
Carefree/Free/No worry	4
Light/Lighten up	4
Warm inner glow/Bliss	2
High spirited	1
Love	1

5.2.7 Weighting exercise

This section outlines the methodologies for collecting, comparing, calculating and applying weights to the BND measure.

5.2.7.1 Collection

The weighting exercise was undertaken at each community FG and DPO interview. The BND measure was selected for the exercise as it contains decomposable components which could be individually scored (Alkire & Foster, 2011).

A direct weighting approach was used, where participants distributed ten sticks across the different components depending on the importance to their “good life” (Shaffer, 2013) (Figure 5.2). DPOs weighted the components based on their perception of the communities’ priorities.

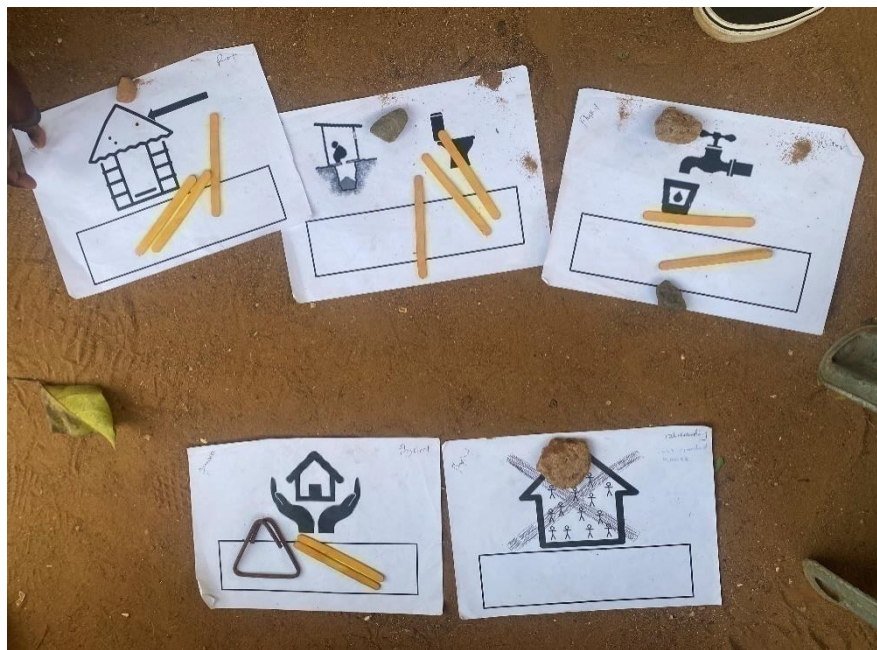


Figure 5.2 Photograph of the weighting scores distributed across the physical capital components during a community focus group

Pictograms eased interpretation and facilitated participation from illiterate individuals (Schaafsma & Gross-Camp, 2021) (Appendix 5.6). To minimise the cognitive load associated with comparing unrelated components (i.e., roof quality & education), participants distributed weights within one capital group at a time, then across the four overarching groups (Table 5.3). Nevertheless, my positionality could have influenced the exercise (Bryman, 2016), especially as participants knew I was contacting DPOs. Larger weights may have been applied to current

desires, rather than broadly interpreting the question to incorporate basic needs already accessed, or required across time.

Table 5.3 The different rounds of weighting undertaken during community focus groups and DPO interviews

Round 1: Financial capital ->	Employment/ livelihood	Excess capital (beyond food expenditure)	Bank access (formal or informal)	x	x
Round 2: Human capital ->	Education	Health	x	x	x
Round 3: Social capital ->	Cooperatives	Family/ friends network	x	x	x
Round 4: Physical capital ->	Roof quality	Safe drinking water	Safe latrine facilities	No crowding in the home	Home ownership
Round 5: overall capitals ->	Financial capital	Human capital	Social capital	Physical capital	

A “ranking” approach was not used as it assumes equal differences in importance between each component, and fails to reflect the “hierarchy of needs” (Sulemana, 2016). In contrast, a weighting approach allows participants to weight components equally, and disregard components perceived as unnecessary for a “good life”. It is recognised how the equal distribution of the ten sticks was not possible in Rounds 1 & 5 (Table 5.3). However, viewing results from Round 5 as an example, 64% of community respondents gave a weight of 0 or 1 to at least one capital, suggesting most respondents did not aim to distribute weights equally across the four groups.

Each participant distributed their sticks in turn, rather than deciding upon a score collectively, to avoid certain individuals projecting their views upon others (Flowerdew & Martin, 2013). Local leaders were excluded from FGs to minimise their influence on community members’ responses⁷⁸. Due to time and space restraints each individual distributed their weights in front

⁷⁸ One exception includes Awlikope (S5) where the local chief requested he be involved in the focus group. However, he was relatively reserved and did not dominate the discussion.

of the group. Future research should allow for individual, anonymous scoring to minimise social desirability and score mimicking. Nevertheless, score mimicking was not a major issue. Of the 126 community FG participants, 110 did not allocate their sticks first. These individuals completed 550 rounds of weighting (110 participants x 5 rounds). Only 15% of these rounds matched the scores of the corresponding first respondent.

5.2.7.2 *Comparison*

Mann-Whitney and Kruskal-Wallis⁷⁹ non-parametric tests were undertaken to determine whether mean ranked scores for different wellbeing components differed by community subgroup; livelihood, gender and decision-making level (community/DPO). For the purpose of comparative analysis, individuals' scores were adjusted by "overall capital" scores⁸⁰ (Round 5, Table 5.3). Following significant Kruskal-Wallis results, stochastic dominance tests detected which groups' scores significantly differed.

These tests are commonly used in participatory studies comparing community scores/ranks (Ahmad Yahaya et al., 2022; Ahmed & Jena, 2023; Bassachs et al., 2020; Dicker et al., 2019; Jones et al., 2019; Koko et al., 2020; Nthiwa et al., 2019; Schaafsma & Gross-Camp, 2021) as they do not require normal distributions, and perform well with small samples and unequal subgroups⁸¹ (Lomuscio, 2021). Due to the purposive study site selection, significant differences are not generalizable to the population. Future research could collect weights at the household level and across more socioecological subgroups.

Exploring differences between livelihoods (Table 5.4) is key as groups experience different climatic hazards, landscape characteristics and relative reference points across time and space (Adger et al., 2002). Livelihoods can also associate with sensitivity, adaptation and how wellbeing is conceptualised, as illustrated in the framework (Figure 4.1). Similarly, examining

⁷⁹ Both tests compared summed ranked scores, the difference is that Mann-Whitney tests compare two independent samples, whereas Kruskal-Wallis can incorporate 3+ samples. Therefore, Mann-Whitney tests are used to compare genders and community/DPO scores, whereas Kruskal-Wallis tests compare the three livelihood groups.

⁸⁰ For example, if "employment" was given 5/10 points in Round 1, and financial capital was given 5/10 points in Round 5, the individual would be assigned a score of 2.5 ($5 \times (5/10)$).

⁸¹ Large differences in subgroup size, for example community members (n=126) and DPOs (n=8), could lower the statistical power of the Mann-Whitney test. However, the test can account for such differences and provide valid results.

gendered priorities was crucial as previous household-level survey analysis limited the capacity to explore intrahousehold differences. With shifting gendered roles for women *and* men in Ghana (Vercillo, 2020), understanding differing wellbeing priorities in Volta Delta could shed light on current gendered processes within the relational context. Furthermore, analysing differences between communities and DPOs can also provide a powerful policy tool (Kim et al., 2015). Examining subgroup differences illustrates the importance of collecting different groups' priorities, as aggregating community or expert weightings across space may not capture the heterogeneity of required interventions and desired outcomes.

Table 5.4 Livelihood group classification for the eight study sites

Location	Livelihood group
1) Afienya	Peri-urban
2) Anyamam	Fishing
3) Sogakope	Peri-urban
4) Nyitawuta	Farming
5) Awlikope	Farming
6) Aflao	Fishing
7) Kedzi	Fishing
8) Anloga	Farming

Note, most communities practiced multiple livelihood types; however, these categorisations are based on observations during transect walks and discussions with the communities. Peri-urban livelihoods include non-primary occupations such as construction and transport.

Many communities possessed multiple livelihood types. For this analysis, the dominant type was defined by transect walk observations. For example, Anloga's (S8) respondents mentioned farming *and* fishing; however, irrigated farmland was most visible in the immediate community. Classifying communities as homogenous is a limitation; yet, limited resources and control over participant selection restricted the ability to capture multifaceted intracommunity differences. This limitation was accepted when applying and comparing community-preference weightings.

5.2.7.3 Weight calculation

Next, individuals' scores were converted to BND weights using Equation (5.1). Scores for individual basic need components (Rounds 1-4) and overall capitals (Round 5, Table 5.3) were summed by community, livelihood, gender and decision-making level⁸². All components' weights sum to 12, ensuring comparability with the baseline "nested" approach. Radar charts visually compare different subgroups' weightings to one another, and baseline values.

Equation 5.1. Methodology for transforming community-preference scores into basic needs deprivation weights

$$\text{Basic needs subgroup weighting} = \left(\left(x_i / \sum x_i \right) \times \left(y_j / \sum y_j \right) \right) \times 12$$

All weights sum to 12. Where x_i represents the individual component (i) within the capital group (x) (Rounds 1-4, Table 5.3), and y_j represents the corresponding capital weighting (j) as a proportion of the four capitals (y) (Round 5, Table 5.3)

5.2.7.4 Applying weights

The calculated weights were applied to the 12 binary BND indicators (Table 5.5). The BND measure uses the Alkire-Foster (2011) "dual cut-off" count method (section 3.7.2). To ensure consistency with the baseline "nested" measure, households experiencing 50%+ weighted deprivations were defined as deprived "overall" (section 3.8.3).

⁸² The summed subgroup weights for each basic need (Rounds 1-4, Table 5.3) are adjusted for by the summed subgroup weight for the corresponding overall capital (Round 5, Table 5.3). This method differs to the approach used for comparative analysis (section 5.2.7.2), which adjusts individual-level, rather than subgroup, scores to maintain a sufficient sample size for non-parametric comparative tests.

Table 5.5 Individual deprivation indicators incorporated within the objective BND measure

Capital	Indicator	Deprived household count (%)	“Nested” baseline weight
Financial	One or more household members are unemployed	328 (24%)	1
	Monthly expenditure on food >60% total expenditure	776 (57%)	1
	No access to bank or loan service	823 (60%)	1
Human	All household members aged 15+ without basic education	453 (33%)	1.5
	>5km from nearest hospital	1,120 (82%)	1.5
Social	Not a member of a community cooperative	1,167 (86%)	1.5
	Under 3 family/friends outside household with migration experience	471 (35%)	1.5
Physical	Low-quality roof material	738 (54%)	0.6
	Unsafe latrine facility	557 (41%)	0.6
	Unsafe drinking water source	304 (22%)	0.6
	Overcrowded household	222 (16%)	0.6
	Home is not owned	195 (14%)	0.6

Two alternative “overall” deprivation rates were calculated by applying subgroup weights to all 50 DECCMA communities: (i) “DPO rate”; summed weights from 8 DPOs, (ii) “community rate”; summed weights from the community’s most relevant livelihood group (farming/fishing/peri-urban).

Each community’s livelihood type was determined by the proportion of households with at least one crop farmer, fisher, and salaried employee/business owner (peri-urban). If this approach was inconclusive, landscape characteristics were used. The proportion of crop/grassland (farmer) and built-up landcover (peri-urban) within the community buffer, and the proximity to coast/inland water (fisher) were used to allocate the most appropriate category for each EA. By applying different subgroups’ weightings within a single measure, this analysis could support the identification of target areas where the prevalence, and perceived importance, of certain deprivations is highest.

However, this method has limitations. Firstly, communities’ livelihoods may have altered since the 2016 DECCMA survey. Secondly, many communities contained mixed livelihoods, so applying a single set of weights may not have been relevant to all households. Therefore, future fieldwork should revisit all 50 sampled locations to accurately classify livelihood typologies.

Furthermore, applying community-preference to a pre-determined list of basic needs limited the method's subjectivity (Adato & Meinzen-Dick, 2002); mirroring criticisms of paternalistic, "objective-list" methods (Dolan & White, 2007). However, this limitation was accepted due to the reliance upon secondary survey data. Future studies should incorporate preliminary work to capture communities' self-defined priorities, before collecting weights (Schaafsma & Gross-Camp, 2021).

Maps are also produced to illustrate the difference in the proportion of households defined as "deprived" within each EA when applying community weights, compared to DPO and "nested" weights. Examining spatial differences in BND when applying different weights can support policy by detecting deprived areas that may have been overlooked if alternative weights were used.

5.3 Weighting exercise results

5.3.1 Wellbeing component scores

This section outlines the weighting results from the 16 community FGs and 8 DPO interviews. Scores are statistically compared across livelihoods, genders and decision-making subgroups (Table 5.6). Appendix (5.7) presents individual and community-level scores.

Table 5.6 Socioecological subgroup sample sizes

Subgroup	No. participants
Gender	
Male	63
Female	63
Livelihood	
Farming	50
Fishing	47
Peri-urban	29
Decision-making level	
Community	126
District Planning Officer (DPO)	8

5.3.1.1 Livelihood group

This subsection examines weighted scores across farming, fishing and peri-urban livelihood groups (Figure 5.3). Kruskal-Wallis and stochastic dominance tests show “employment”, “bank access” and “cooperatives” to be scored significantly higher amongst farming and fishing communities than peri-urban groups. In contrast, peri-urban communities valued “healthcare access” significantly higher. Additionally, farming communities scored “family/friends networks” significantly higher than fishing communities (Table 5.7).

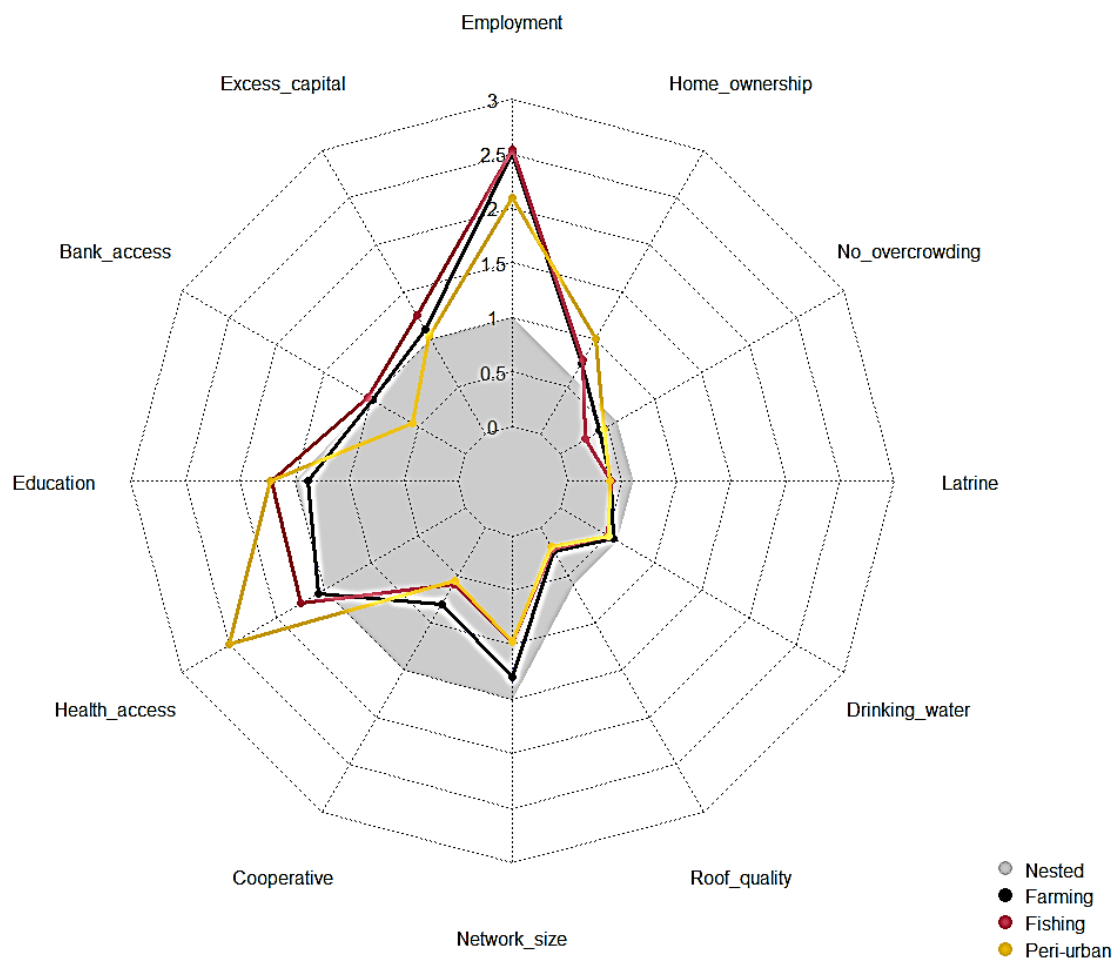


Figure 5.3 Comparison of individual basic need weightings by livelihood group. “Nested” weights displayed as a comparative baseline

Table 5.7 Tests for stochastic dominance between livelihood groups' basic needs scores⁺

Deprivation component	Livelihood group	Livelihood group		Kruskal-Wallis test statistic
		Farming	Fishing	
Employment	Fishing	0.143		7.456**
	Peri-urban	2.589***	2.437***	
Bank access	Fishing	-0.334		13.307***
	Peri-urban	3.317***	3.566***	
Healthcare access	Fishing	-1.479*		15.520***
	Peri-urban	-4.165***	-2.844***	
Cooperative membership	Fishing	1.628*		14.605***
	Peri-urban	4.033***	2.586***	
Network size	Fishing	2.679***		6.980**
	Peri-urban	1.416*	-0.905	

Note, only the deprivation components shown to significantly differ (Kruskal-Wallis) are tested. For each pairwise comparison the z-test statistic and p-value significance are presented. A positive z-test statistic corresponds to a larger mean ranked score within the column group compared to the row group.

To compare communities' perceptions to objective circumstances, and to help uncover potential mechanisms behind why livelihood groups prioritised certain basic needs, similar analysis was undertaken to compare objective basic needs prevalence within the eight visited communities. Using Kruskal-Wallis and stochastic dominance tests, "bank access", "healthcare access" and "drinking water" deprivations were significantly more prominent in farming/fishing communities than peri-urban groups (Table 5.8). The proportion of households with "latrine" deprivation was significantly higher amongst visited fishing communities, whereas "roof quality" deprivation was lower. Additionally, "homeownership" deprivation was significantly higher amongst visited peri-urban communities than farming/fishing groups.

⁺ *** p < 0.01, ** p < 0.05, * p < 0.1

Table 5.8 Tests for stochastic dominance between livelihood groups' prevalence of objective basic needs deprivations

Deprivation component	Livelihood group	Livelihood group		Kruskal-Wallis test statistic
		Farming	Fishing	
Bank access	Fishing	1.674**		13.016***
	Peri-urban	3.705***	2.262**	
Healthcare access	Fishing	5.587***		49.710***
	Peri-urban	7.588***	2.784***	
Roof quality	Fishing	5.627***		30.533***
	Peri-urban	0.669	-4.153***	
Drinking water	Fishing	5.745***		47.359***
	Peri-urban	7.184***	2.246**	
Safe latrine	Fishing	-4.904***		36.241***
	Peri-urban	1.875**	6.073***	
Homeownership	Fishing	-1.663**		19.961***
	Peri-urban	-4.658***	-3.222***	

Note, only the deprivation components shown to significantly differ (Kruskal-Wallis) are tested. For each pairwise comparison the z-test statistic and p-value significance are presented. A positive z-test statistic corresponds to a larger mean ranked score (higher deprivation proportion) within the column group compared to the row group.

5.3.1.2 Gender

Overall, there was relatively consistent weights between genders (Figure 5.4); however, “education” was valued significantly higher by females than males (Mann-Whitney test statistic (W)= 1433.0***). In contrast, males applied a greater weight to “employment” (+0.42); however, the mean ranked difference was non-significant at the 5% level (W =2337.0*).

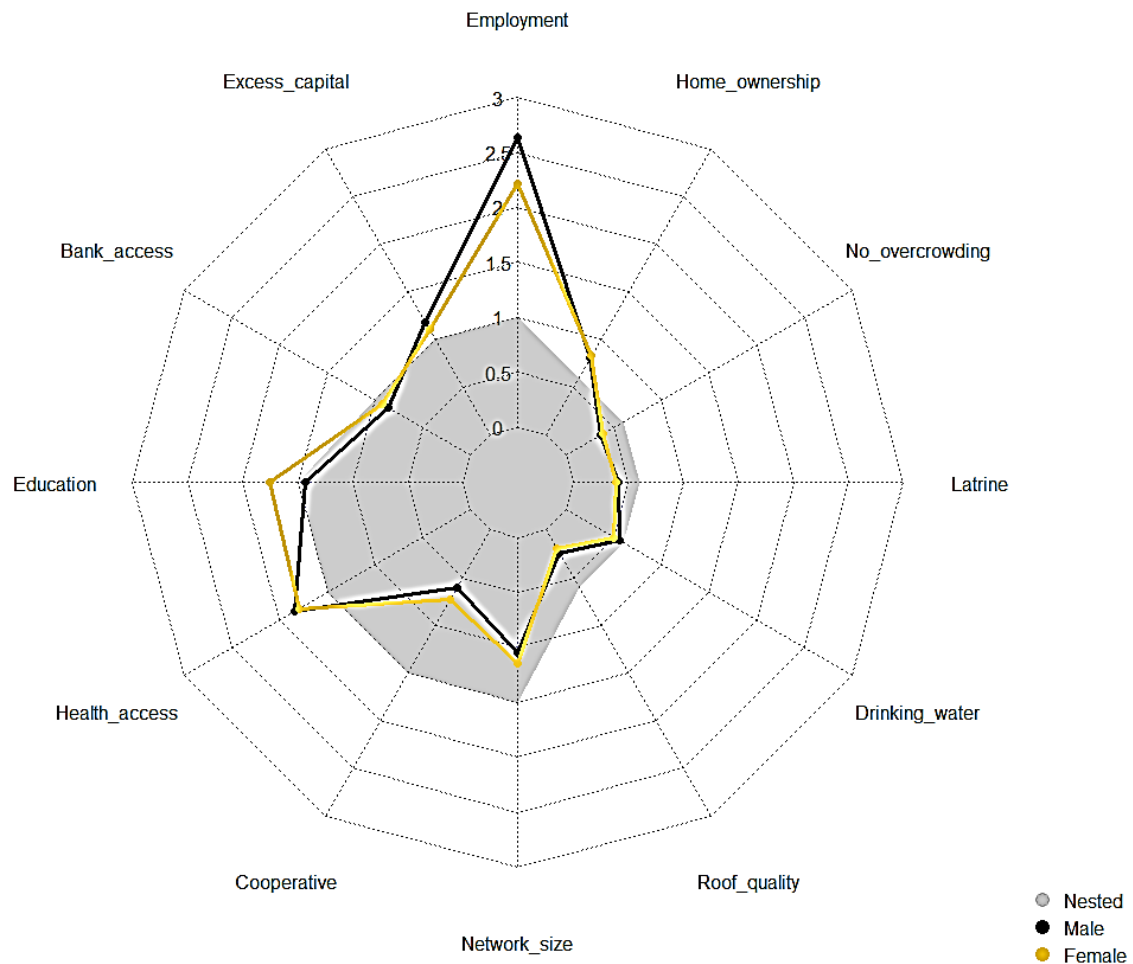


Figure 5.4 Comparison of individual basic need weightings by gender. “Nested” weights displayed as a comparative baseline

5.3.1.3 Decision-making level

This section compares community-level and DPO scores across the 12 basic needs (Figure 5.5). Community members weighted two financial capital components significantly higher; “employment” ($W=737.5^{**}$) and “bank access” ($W=727.0^{**}$). Social capital displayed substantial variation, with “cooperatives” weighted significantly higher by DPOs ($W=247.5^{**}$), whereas “network size” was weighted consistently. DPOs also scored 3/5 physical capital components significantly higher than communities; “roof material” ($W=300.0^{**}$), “drinking water” ($W=133.0^{***}$), and “safe latrines” ($W=283.0^{**}$).

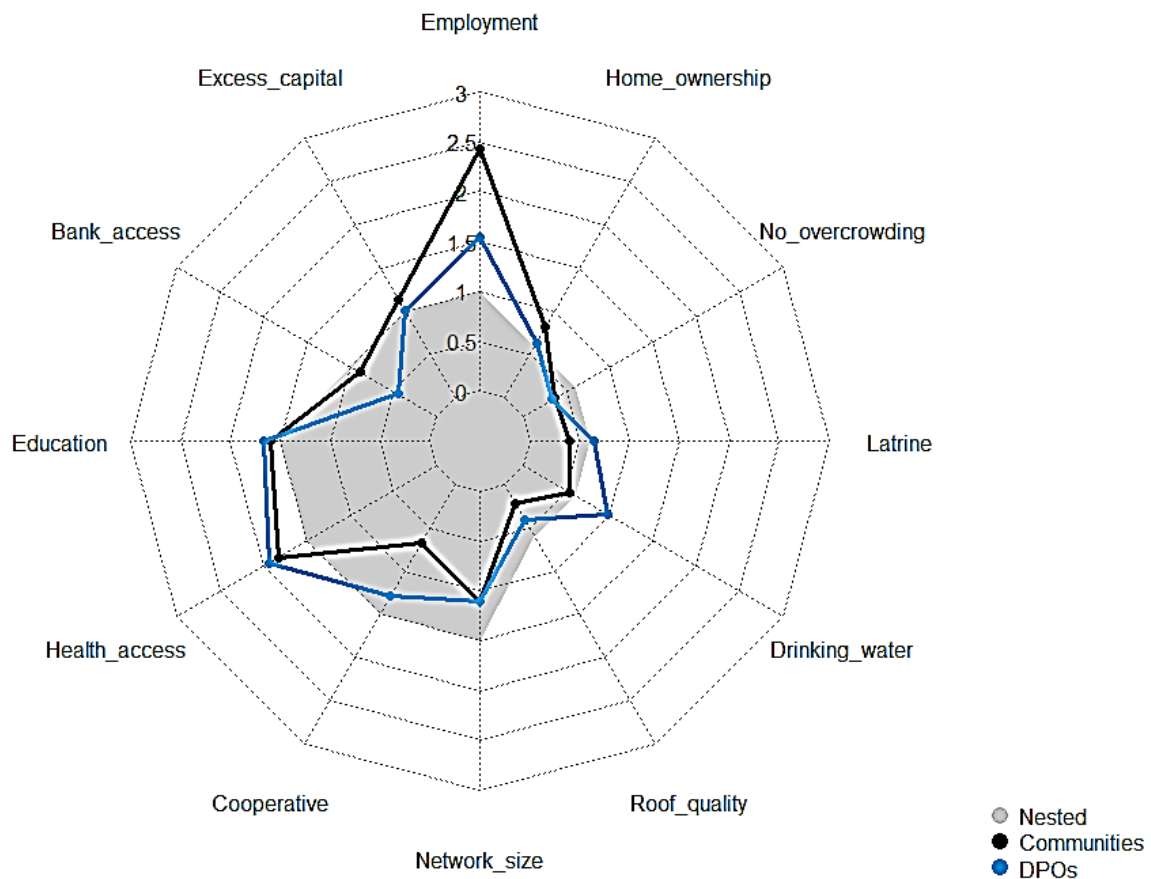


Figure 5.5 Comparison of individual basic need weightings by decision-making level. “Nested” weights displayed as a comparative baseline

5.3.2 Weighted BND outcomes

5.3.2.1 Deprivation rates

Applying different weights alters the overall deprivation rate (Figure 5.6). The community-weighted rate is 12.7 percentage points lower than the “nested” baseline rate, whereas the DPO-weighted rate is 5.0 percentage points lower. Examining individual livelihood groups’ rates, the difference to the “nested” weight is smaller in peri-urban communities than farming/fishing locations (Table 5.9).

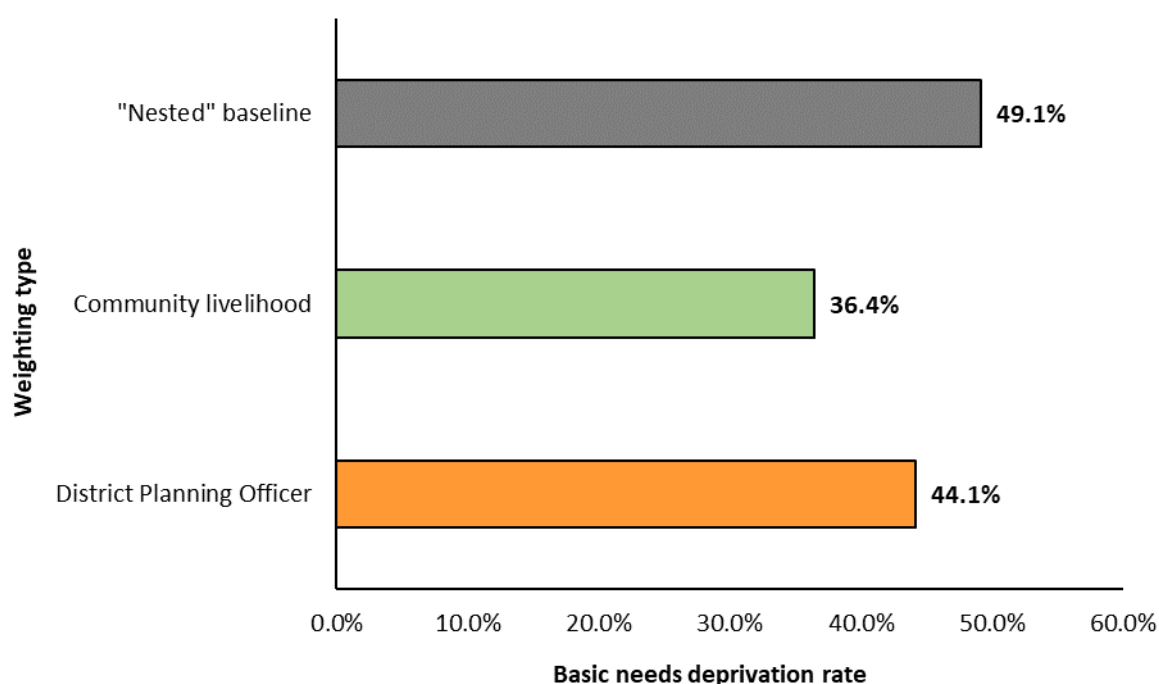


Figure 5.6 Overall basic needs deprivation rates by weighting type; “nested” baseline, community livelihood and District Planning Officer weights

Table 5.9 Basic needs deprivation rates by livelihood group classification across the 50 sampled communities in Volta Delta. Absolute/relative differences between the baseline “nested” rate and community livelihood rates also presented

Livelihood group	“Nested” rate	Community livelihood rate	Absolute difference	Relative difference	No. communities
Farming	52%	38%	-14%	-27%	22
Fishing	58%	43%	-15%	-26%	16
Peri-urban	32%	25%	-7%	-22%	12

The community livelihood rate is also 7.7 percentage points lower than the DPO rate (Figure 5.6); driven by the higher weight applied to “cooperatives” by DPOs (Figure 5.5), which is the most common deprivation (Table 5.5). Examining differences across livelihood groups, there is a greater alignment between peri-urban community and DPO-weighted deprivation rates (Table 5.10).

Table 5.10 Basic needs deprivation rates by livelihood group classification across the 50 sampled communities in Volta Delta. Absolute/relative differences between the DPO rate and community livelihood rates also presented

Livelihood group	DPO rate	Community livelihood rate	Absolute difference	Relative difference	No. communities
Farming	48%	38%	-10%	21%	22
Fishing	51%	43%	-8%	16%	16
Peri-urban	26%	25%	-1%	4%	12

5.3.2.2 Spatial distribution

This section evaluates the impact upon the spatial distribution of BND when applying community livelihood weights compared to baseline “nested” and DPO weights.

44/50 locations have a lower deprivation rate when applying community livelihood weights compared to baseline “nested” weights; on average the community-level rate is 14 percentage points lower. In contrast, one location has a lower rate when using “nested” weights⁸³, and five communities show no difference (Figure 5.7). However, examining individual communities illustrates greater sensitivity to weighting selection. For example, three communities have deprivation rates >30% lower when applying community weights compared to “nested” weights. These differences are driven by the greater “nested” weight applied to “cooperatives” (Figure 5.3), and the large proportion of households not accessing cooperative groups (Table 5.5).

⁸³ The one community with a higher community-level rate, compared to the “nested” baseline rate, is included within the peri-urban group. Two additional households are classified as deprived when using the community weight. The difference for both households is attributed to the higher peri-urban weighting applied to the “unemployment”, “homeownership”, and “healthcare access” deprivations, compared to the “nested” weight.

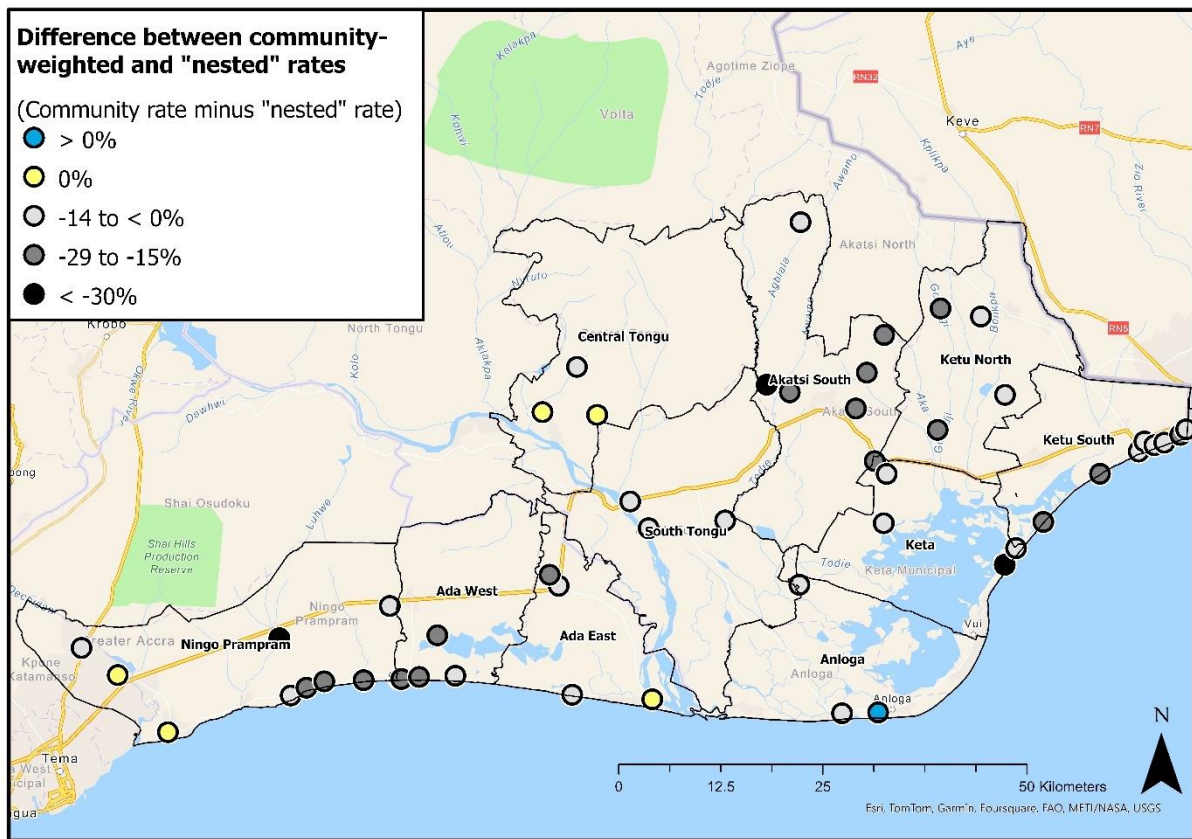


Figure 5.7 Spatial distribution of community-level differences between “nested” baseline and community livelihood deprivation rates. Values are calculated by subtracting the “nested” rates from community rates

A clear spatial pattern does not appear when comparing baseline and community livelihood rates (Figure 5.7). For example, the largest differences (>30%) are located in three separate districts; Ningo Prampram, Akatsi South and Keta. However, similar community-weighted and “nested” rates are located in peri-urban locations and areas closer to built-up settings; such as west Ningo Prampram near Tema, and South Tongu district. This is supported by the average community-level deprivation difference being lower within peri-urban communities than farming/fishing groups (Table 5.10).

Examining differences between community livelihood and DPO rates, 37/50 EAs have a lower community-weighted deprivation rate; on average the community-level rate is 11 percentage points lower. In contrast, five locations have a lower rate when using “DPO” weights, and eight communities show no difference (Figure 5.8). Again, individual communities illustrate greater sensitivity, with five communities possessing rates >20% lower when applying community livelihood weights. These differences are driven by the greater weight applied by DPOs to “cooperatives” and “drinking water” deprivations (Figure 5.5). See Appendix (5.8) for further

maps illustrating differences in community and DPO-weighted counts⁸⁴ of “employment”, “cooperatives” and “drinking water” deprivations; the three components with the largest community/DPO difference.

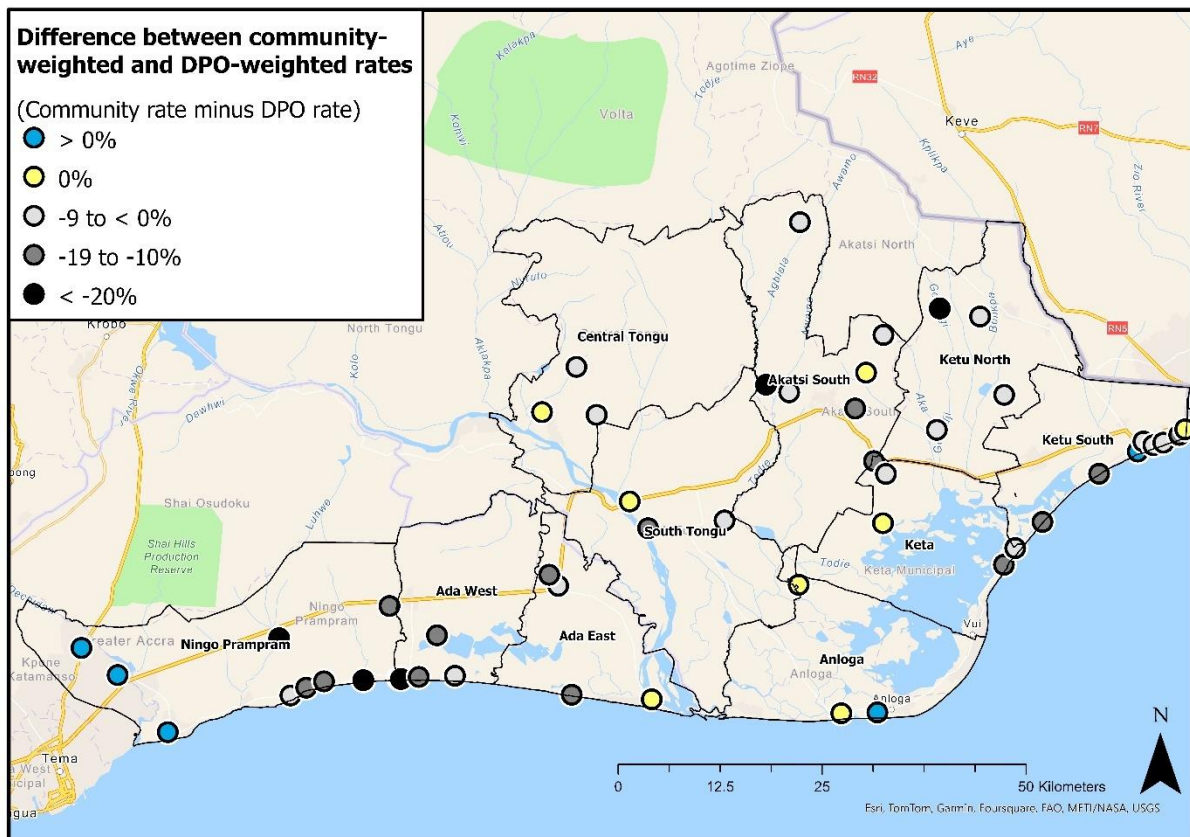


Figure 5.8 Spatial distribution of community-level differences between DPO-weighted and community livelihood deprivation rates. Values are calculated by subtracting the DPO rates from community rates

Similarly, the communities with the largest differences (>20%) between DPO and community-weighted rates do not show a distinct spatial pattern (Figure 5.8). These five communities are located across four districts; Ningo Prampram, Ada West, Akatsi South and Ketu North. However, a cluster of communities with lower DPO-weighted rates is found in Ningo Prampram. All three communities belong to the peri-urban livelihood group, with the higher community-weighted rate potentially attributable to higher-than-average proportions of “employment”, “health access” and “homeownership” deprivations; all weighted higher by peri-urban respondents than DPOs (Appendix 5.9). In contrast, no households within these three communities experienced “drinking water” deprivation, dampening the influence of the higher weight applied by DPOs (Figure 5.5).

⁸⁴ To compare the influence of different weightings upon specific indicators across communities, the deprivation “count” refers to the *community livelihood weight multiplied by the number of households in the community (EA) experiencing the deprivation*.

5.4 Qualitative results & Discussion

Structured using the framework's wellbeing capitals (Figure 4.1), and drawing on community FGs and DPO interviews, this section explores potential mechanisms behind weighting differences across livelihoods, genders and decision-making levels within an environmental context. The influence of weighting on the overall deprivation rate and spatial distribution is also explored.

5.4.1 Financial capital

Comparing livelihood groups, “employment” was weighted higher by farming/fishing communities (Table 5.7). This result reflects the importance of fulfilling intergenerational obligations and identities in primary sector communities (Béné & Friend, 2011; Markussen et al., 2018), and the interconnectivity between employment and food security in vulnerable subsistence locations (Asare-Nuamah, 2021).

“Farmers hold the world together”...“I am proud to be a farmer because our work brings food to the community...Farming is the only source of our happiness, we are content” (5,FG,M)

“Employment is more important...if I’m not working, I don’t eat” (2,FG,M)

The greater weight applied to all financial components within farming/fishing communities contrasts theories suggesting that primary-based communities place less emphasis on financial OWB when defining their “good life” than money-orientated peri-urban locations (Guillen-Royo & Velazco, 2012). However, this result could reflect the lower financial OWB of these areas (Appendix 5.10), and the more immediate requirement for employment to provide their families with basic needs such as food security (Kansanga et al., 2022; Moseley, 2001). More-affluent, peri-urban communities may have less short-term insecurities, and therefore focus on long-term wellbeing challenges, such as improved healthcare access (Figure 5.3). This hypothesis is supported by studies illustrating that greater individual wealth often results in higher health expenditure to increase life expectancy and life satisfaction (Hall & Jones, 2007). Additionally, my positionality and known contact with DPOs may have inflated participants' financial scores.

Farming/fishing communities also weighted “bank access” significantly higher than peri-urban communities (Table 5.7) and DPOs (Figure 5.5). This result potentially reflects the lower availability of formal services (Ofori-Danson et al., 2013) and the greater requirement for credit access to overcome seasonal income fluctuations within primary sectors (Afful et al., 2015). This is supported by higher proportions of “bank access” deprivation within farming/fishing communities (Table 5.8), suggesting in this situation, individuals weighted basic needs higher if they were wanted, but not currently accessed. This possible disconnect between longer-term financial aspirations, and the skills and infrastructure needed to achieve these goals, was illustrated in Nyitawuta (S4).

“We do not have electrical power so it is not conducive for a bank to be established here, but we have some small susu associations where at the end of the year we count and distribute it”

(4,FG,M)

Landscape characteristics within rural communities, including poor road networks, may also limit access to financial services, as banks are reluctant to lend to remote households due to difficulties in collecting repayments (Porter, 2007). Limited credit access is a potential determinant of poverty entrapment (Banerjee & Jackson, 2017), with remoteness from key markets also lowering trade profits (Owusu & Lund, 2004) and restricting access to the excess capital required to start saving.

“We usually spend all our money on taking care of the home...we do hand to mouth with the income we get. The [capacity]...is not there to save money” **(4,FG,M)**

In contrast, peri-urban communities potentially viewed banking services as “normality”, and therefore weighted it lower; supported by the lower proportion of “bank access” deprivation within visited peri-urban communities (Table 5.8)⁸⁵.

⁸⁵ 35% and 40% surveyed households in Afienya (S1) and Sogakope (S3) did not have access to a banking service. Both are comparatively lower than the sample average (65%).

“When you make money, you can pay for your light bill, water bill and take care of your home and the little you have you can save in the bank” (1,FG,F)

Next, examining gendered differences, “employment” was not weighted significantly higher by males (Figure 5.4); adding to the discussion of changing gendered responsibilities in Ghana (Vercillo, 2020). Despite a non-significant difference, a higher male score supports traditional male “breadwinner” identities (Tolhurst et al., 2008), where greater resource access and involvement in community decision-making (Lambrecht, 2016; Ramón-Hidalgo & Harris, 2018) are crucial in ensuring households’ needs are achieved. Fulfilling these “masculine” obligations through employment is important for male SWB, with Central Region studies highlighting the shame caused if female members contribute equally, or more, towards household finances (Carr, 2008).

“The inability to take care of your wife/children causes heartache to the man of the house. Employment plays a key role in been able to take care of your home” (5,M,FG)

However, the non-significant difference alludes to changing gendered dynamics, with Northern Region studies illustrating male labour to increasingly focus on subsistence, whereas females target income generation (Vercillo, 2020). Female employment is progressively important in dampening financial fluctuations, with “male” seasonal agriculture/fishing accompanied by diverse, year-round “female” activities (Tolhurst et al., 2008).

“We can do petty jobs but men are not able to. They want to get money at once but as for us we search for the little ones and when it’s...needed we can fall on them...to make money” (4,Ci,F)

Furthermore, DPOs recorded a significantly lower “employment” score than communities (Figure 5.5). This disparity in the value attached to “employment” is exemplified in Anyamam (S2), where despite traditional small-scale salt mining livelihoods being removed following the private sale of Songor Lagoon (Harvey & Langdon, 2010; Roland et al., 2019; Yeboah et al., 2013), the district government created no alternative livelihoods. See section (6.3.2.3) for further information.

“The restriction has affected their livelihood, it was a quick source of money, they depended highly on it...now that way of making money has been stopped and the disadvantage was that we did not put any alternative livelihood measures in place” (2,DPO)

The difference between the decision-making levels is pronounced within primary sector communities, with fishing/farming communities weighting “employment” significantly higher (Figure 5.3). Therefore, using DPO weights could reduce the policy focus upon farming/fishing communities with high unemployment, such as north Keta Lagoon and coastal Ningo Prampram (Appendix 5.8a).

Nevertheless, despite the disparity in scores, DPOs did emphasise the importance of employment for a “good life”. The lower score could be attributed to the different responsibilities of communities and DPOs. For example, as DPOs coordinate and monitor development plans within health, education and employment (Appendix 5.1), they could interpret BND from a broader perspective to community members with narrower, more-immediate challenges. This theory is supported by the smaller range of scores given to the overarching capitals by DPOs compared to communities (Appendix 5.11a), and the stronger alignment between DPO and baseline “nested” weights (Figure 5.5) which assume equal importance across the capitals (Appendix 5.11b).

The greater emphasis placed upon “employment” across communities, compared to DPOs (Figure 5.5), could also reflect their more-direct awareness of how livelihoods facilitate access to broader wellbeing resources and support SWB by fulfilling cultural identities (Brown et al., 2021). Many respondents noted how before they could consider accessing other basic needs, employment and a source of income, is required; this is expanded upon in section (6.3.3) when discussing responses to “does money equal happiness?”. Therefore, community members may view employment as encompassing other needs, whereas DPOs may interpret different components independently as separate government institutions address them.

5.4.2 Human capital

Peri-urban communities scored “healthcare access” significantly higher than farming/fishing communities (Figure 5.3); primarily driven by Sogakope respondents (S3). This result appears counter-intuitive, with both visited peri-urban sites having nearby hospitals; reflected by the lower prevalence of “healthcare access” deprivation (Table 5.8).

“We are lucky, we have clinics around here...we are close to Tema general hospital, so when someone from Afienya is referred...it is easy to get there” (1,FG,M)

This result emphasises how wellbeing perceptions form within the “relational context”, with peri-urban areas potentially exposed to particular health challenges at the time. For example, all female FG respondents in Sogakope (S3) initially claimed “good health” was the only characteristic of a “good life”. Additionally, living close to health services could raise expectations, yet if the service is low-quality, or if there are non-physical barriers such as high fees (Imoro, 2015), frustrations could have increased the perceived importance during the weighting exercise. This finding potentially juxtaposes studies illustrating urban dwellers in Ghana to be less willing to pay higher taxes for healthcare than rural dwellers with less access to high-quality facilities (Adisah-Atta, 2017).

“Health insurance, you cannot use it when you do not have money”...“I have to go for check-up, but...I do not have money to go and my medicine has finished” (3,FG,F)

In contrast, the lowest community-level “healthcare access” scores (Appendix 5.7) were given by; (i) rural Nyitawuta (S4), where the soon-to-open NGO clinic potentially lowered the prioritisation of “healthcare access” due to it providing a relative improvement and increasing future optimism (Duku et al., 2022), (ii) Anyamam (S2), where limited health care, beyond “*two health centres, one clinic and five Community Health Planning Services for whole district [Ada West]*” (2,DPO) could have created an acceptance, where households become accustomed to the limited services to the extent it limits their ability to “recognise...weaknesses in the system” (Amoah et al., 2021;12).

Next, examining gendered differences, female respondents scored “education” significantly higher (Figure 5.4), supporting their “child caregiver” role within traditional Ghanaian communities (Quaye et al., 2016). For example, studies suggest female household heads spend more remittances on children’s education than males (Guzmán et al., 2008; Teye et al., 2022).

5.4.3 Social capital

Farming communities scored social capital components, “cooperatives” and “family/friend networks”, significantly higher (Figure 5.3). This finding supports modelled results (section 4.5.2.1) and literature (Leviston et al., 2018; Schutte et al., 2022), which suggest reciprocal relationships, place attachment, and collectivism are more important to a “good life” in rural communities.

“A good life is someone who respects others...the person is of help to other people when the need arise. Secondly...a good life is when the person has a good attitude towards people”

(4,CI,M)

The importance of social capital within farming communities may be amplified by its capacity to lower environmental vulnerability (Garrity et al., 2010; Heger et al., 2018), and mitigate the negative impacts on financial security and SWB caused by climatic hazards (Jordan, 2015). This hypothesis is supported by responses to, “do community relationships strengthen or weaken during climatic shocks?”

“We support each other in such situations...people begin to bring up ideas that will help the affected person...we are very sympathetic when our neighbours are in distress” **(4,FG,M)**

However, social capital can fluctuate in response to climate hazards (section 6.3.1.2); challenging the assumption of persistent togetherness and happiness in vulnerable locations (Kay & Jost, 2003). Furthermore, lower social capital scores amongst peri-urban communities could reflect greater individualism and inequality (Appendix 4.14), potentially driven by differences in access to less-vulnerable employment and varying adaptive capacities. Inequality can increase relative comparability; lowering SWB (Kangmennaang et al., 2019) and the perceived importance of social capital for a “good life”.

“This town we are one people but things are getting difficult, now we don’t have love among us anymore, we will gather, talk and laugh, but when someone is going far, others are envious”

(1,CI,M)

Differences also exist between communities and DPOs, with “cooperatives” scored significantly higher by DPOs (Figure 5.5). This disparity is particularly pronounced within coastal peri-urban and fishing livelihood groups (Appendix 5.8b) which weighted “cooperatives” significantly lower than farming communities (Table 5.7). This disconnect between decision-making levels could lead to ineffective policies and poorly identified locations for intervention. The difference could be attributed to DPOs being unaware of the challenges faced within community cooperatives, such as corruption and distrust (Dary & Grashuis, 2021).

“Cooperative is...not like a family, something can happen to you now and the cooperative won’t come to your aid” (7,FG,M)

Additionally, several DPOs mentioned the limited funding available to districts, therefore cooperatives may be viewed as a low-cost strategy to address local challenges. Previous studies allude to how local governments, and international organisations, can be overly dependent upon cooperatives to address social issues and stimulate growth; despite community groups having to function within wider structural systems in which they have little influence (Afranaa Kwapong & Hanisch, 2013; Simmons & Birchall, 2008). The expectation that communities should address their own issues, such as sanitation, was exemplified by one DPO.

“Sanitation is a personal responsibility, but they are not getting it, they feel government should be responsible for sanitation” (2,DPO)

One DPO also noted how cooperatives act as channels for governmental and NGO support (Duku et al., 2022; Porter & Lyon, 2006), facilitating better access to investments than when acting individually.

“If you are in a group then the government can give you the equipment for planting, harvesting, all these things. So individuals suffer, but the cooperative groups do not suffer to that level” (5,DPO)

The ability for cooperatives to access public funding, alongside potential differences in the expectations and perceived efficiency of community groups, potentially clarifies the disparity in “cooperative” weighting between communities and DPOs.

5.4.4 Physical capital

Communities and DPOs recorded significant differences in physical capital scores (section 5.3.1.3), yet no component significantly differed across livelihood or gender subgroups. Therefore, this subsection draws upon key community-level differences to explore potential relationships between physical capital and wellbeing priorities within different environments.

Firstly, “drinking water” was weighted lowest in rural Nyitawuta (S4) (Appendix 5.7). The lower score could be attributed to the current satisfaction with improved access to a newly-constructed dam, compared to the previously low reference point (Ravallion et al., 2013).

*“We walked 10-11 kilometres before we get water to drink even that we share with cattle...A dam was created [2020] [which]...now serves as a source of drinking water for the community...**What distance?** 4 kilometres...we got the dam so that infection [guinea worm] has reduced” (4,FG,M)*

However, many respondents discussed the continued challenges of accessing safe water; supported by significantly higher proportions of “drinking water” deprivation in farming communities (Table 5.8). This result suggests individuals’ perceived “good life” and “desires...[can be] constrained by what seems possible” (Laderchi et al., 2003;253); illustrated by the visible joy of community members when receiving the low-quality water delivery.

“It is not safe for drinking, but because we do not have any other option that is what we drink” (4,FG,F)

In contrast, Awlikope (S5) weighted “drinking water” highest. The assemblyman noted a divide between local leaders and government officials, stemming from government-supplied piped water not functioning for years. The perceived injustice, and acknowledgement of DPO

involvement in the project, potentially resulted in “drinking water” being prioritised during the weighting exercise.

“[Water is a] long-term issue, even the pipe the government provided, the available water is very few and far between...politicians, they want to line their pocket to the detriment of society”

(5,CI,M)

This perceived “political abandonment” was partnered by increasing salinisation of borehole water, meaning the community was increasingly dependent upon fresher, yet uncertain, rainwater (Ebro, 2019). This example highlights the interconnectivity between physical (water pipe & storage infrastructure) and social (governance) capitals, and how environmental conditions can shape wellbeing priorities.

However, despite this potential disconnect, DPOs weighted “drinking water” significantly higher than community members (Figure 5.5). The impact of this difference upon communities’ deprivation classification is pronounced in Akatsi South, Ketu North and Ketu South, with higher levels of “drinking water” deprivation⁸⁶ (Appendix 5.8c). One potential reason for the different weightings between decision-making levels relates to how many communities recently received improvements in drinking water access. For example in Kedzi (S7), a piped supply was installed in 2020 to reduce pressure upon increasingly saline boreholes (Figure 5.9). Furthermore, many communities had access to some form of drinking water, whether piped, borehole, sachet or open-source. Therefore, the weighting exercise may have reflected what communities wanted in that moment, rather than what is generally needed for a “good life”. This interpretation may have been influenced by my positionality and the perception I could provide immediate support through collaboration with government agencies (Dosu, 2021).

⁸⁶ “Drinking water” deprivation refers to households with dug wells, springs, rainwater or surface water as their primary source of drinking water (Appendix 3.3).



Figure 5.9 Piped water supply in Kedzi (S7), funded by the community assemblyman and their committee in 2020

Additionally, previous studies suggest Ghanaians possess a greater acceptance of challenges, such as accessing water, due to “the social reality of little environmental control and slow socioeconomic and infrastructural development” (Dzokoto, 2012;318). Consequently, temporary solutions to ongoing issues are often readily deployed, such as driving around potholes or collecting alternative water sources (Box 5.1). Therefore, certain deprivations could have been accepted as the “norm” and weighted lower, whereas other basic needs, without alternative access channels, were prioritised. Nevertheless, it is recognised how the differences in weighting scores between the various socioecological subgroups may simply reflect differences in their values and conceptualisations of a “good life”.

Box 5.1. A hypothetical conversation created by Dzokoto (2012, p.319) to illustrate the acceptance of social and environmental challenges in Ghana.

New to Ghana: I turned on the tap, and there was no water!

Ghanaian: Yes, the water isn't running.

New to Ghana: What do you mean the water isn't running?

Ghanaian: Like I said, the water isn't running.

New to Ghana: Well, why isn't the water running? Is there a water main break?

Ghanaian: No.

New to Ghana: Well, is there a drought or something?

Ghanaian: No.

New to Ghana: So then why isn't the water running?

Ghanaian: My friend, this is Ghana. Sometimes, the water runs, sometimes, it doesn't. That is how it is...Here, take this bucket. There is water in the tank around the corner.

This cultural perspective could also support communities' significantly lower score for “roof quality” compared to DPOs (Figure 5.5). For example, respondents in Nyitawuta (S4) reported how even when unable to afford metal sheeting, free access to timber and natural materials provided alternative solutions.

“I am not able to change my roofing sheets because my business did not flourish ...[but] this is our hometown and we have natural resources like timber, which we consider as our timber. We cannot sell, we only use it for roofing” (4,FG,M)

Next, “safe latrines” were weighted similarly across livelihood groups, illustrating the universal importance of sanitation for wellbeing (Duku et al., 2022; Simiyu et al., 2022). However, community-level weights show coastal Anyamam (S2) and Anloga (S8) to have two of the three lowest scores (Appendix 5.7), despite being located in flood-prone areas where poor sanitation can exacerbate health issues (Stanke et al., 2013). One hypothesis for this counter-intuitive result is the cultural acceptance and perceived spiritual benefits of open-defecation (Osumanu

et al., 2019); supported by 83% surveyed households in Anyamam (S2) not having access to latrine facilities. Differences in traditional beliefs and the understanding of health risks between communities and local government could also clarify why DPOs weighted “safe latrines” significantly higher (section 5.3.1.3).

“Along the coast they have that belief that you go to the toilet in fresh air...I think it is cultural, I do not understand why someone goes to the toilet on the shore” (2,DPO)

Furthermore, the significantly higher weight applied to 3/5 physical capital components by DPOs compared to communities (Figure 5.5), potentially illustrates their different perspective when conceptualising wellbeing. DPOs emphasise infrastructure developments to a greater extent than communities who prioritise employment as a conduit for wider wellbeing; highlighting the need for greater capacity within local government to engage with local communities, ensure aligned policy priorities and mitigate conflicts.

This overarching section discussed significant differences between subgroups’ weightings. The next section explores the influence of these weights on the overall BND rate and spatial distribution.

5.4.5 Deprivation rates

Different weighting approaches produce varying overall deprivation rates (Figure 5.6). Both community and DPO weights produce rates lower than the baseline, suggesting “nested” weighting overestimates BND within Volta Delta. High sensitivity to weighting selection could impact the effectiveness of policies with limited resources. For example, if a wellbeing initiative selected the ten most-deprived communities using “nested” or DPO weighting, two communities within the ten most-deprived when using community weighting would be excluded (Appendix 5.12). These two farming communities are overrepresented with “employment” and “excess capital” deprivations; therefore, “nested” or DPO weighting could result in financially insecure communities being omitted from policy intervention. This scenario emphasises the need to examine different weighting approaches to ensure the most-vulnerable communities are targeted (Booyesen, 2002).

Community-weighted livelihood rates are lower than “nested” rates across most communities; however, the spatial pattern is not well-defined, with nearby communities experiencing varying

levels of sensitivity to weighting selection (Figure 5.7). These small-scale differences emphasise how wellbeing measurement is situated within the relational context. However, a lower average difference in overall deprivation between “nested” and peri-urban livelihood rates (Table 5.9), suggests in certain contexts assuming equal weighting may not substantially overestimate BND.

Similarly, most communities record higher deprivation rates when applying DPO, rather than community livelihood, weights (Figure 5.8); driven by the greater scores applied to “cooperatives” and “drinking water” by DPOs (Figure 5.5). These differences are pronounced in different locations, with higher “cooperatives” deprivation within coastal communities (Appendix 5.8b), and greater “drinking water” deprivation within inland farming districts such as Akatsi South and Ketu North Districts (Appendix 5.8c).

Viewing these differences across livelihood groups, there is a greater alignment between DPO and peri-urban community-weighted rates than with farming/fishing communities (Table 5.10). Farming/fishing communities possess comparatively higher levels of objective BND; therefore, DPOs’ perceptions of communities’ needs, particularly regarding financial capital (Appendix 5.9), could be most disconnected from communities facing the greatest challenges. However, similar overall deprivation rates do not mean DPOs and peri-urban communities share similar priorities. For example, the larger weight applied to “employment” by peri-urban communities could offset the higher DPO weight given to “cooperatives” (Appendix 5.9).

This chapter not only assesses how sensitive wellbeing measures are to weighting selection, but also underscores the ability for decomposable measures and weighting exercises to evaluate the alignment between government and community priorities, and support targeted interventions to address local needs. Community-preference weights vary across socioecological subgroups; therefore, wellbeing research should collect various groups’ priorities to address context-specific challenges. Future research should revisit all communities to ensure up-to-date livelihood classifications.

5.5 Conclusion

This chapter illustrated how basic need priorities differ between socioecological groups within select communities of Volta Delta. Significant differences in the scores given to “employment”, “bank access”, “healthcare access”, “cooperatives” and “network size” were recorded between livelihood groups. All, except “healthcare access”, were weighted higher by farming communities, illustrating different mechanisms behind communities’ wellbeing conceptualisations. The higher “employment” and social capital weights support the

significance of agricultural employment in fulfilling social obligations, and the importance of collective wellbeing within rural environments. The higher “bank access” weight could reflect how communities scored components higher if they were desired, yet not currently accessible. In contrast, greater weights applied to “healthcare access” amongst peri-urban communities could have captured frustrations with non-physical barriers.

Decision-making level comparisons uncovered significant differences, with DPOs weighting “employment” lower, and “cooperatives” significantly higher than the community average. These differences suggest a potential disconnect between communities’ and governments’ perceived local priorities, particularly in farming/fishing communities. The weighting exercise could therefore be an effective policy tool, highlighting to local decision-makers the discrepancies between their perceptions and communities’ lived priorities.

By applying various community and expert-preference weights, this chapter highlighted the sensitivity of BND classification to weighting selection. In particular, all three livelihood groups’ deprivation rates were lower when using “community” rather than “nested” weights, illustrating the potential weakness of externally applying arbitrary weights within multidimensional wellbeing measurement. However, applying subjective weights to an “objective-list” of basic needs may have misrepresented communities’ main challenges. Therefore, future research should capture communities’ prioritised basic needs before the weighting exercise. Furthermore, this chapter shows *“where and whom you collect weightings from matters”*; therefore, future research should collect and apply household-level weightings to avoid assuming a single livelihood homogeneously represents each community.

Certain results suggested individuals weighted components based upon their current desires, and what they did not have alternatives for, rather than what was needed broadly for a “good life”. Future research could address these internal biases by amending the methodology. Reframing the weighting exercise to capture respondents’ thoughts around what is needed for a “good life” within a hypothetical village, rather than their own, or asking respondents to sketch their “ideal” community (Schreckenberget al., 2016), could encourage participants to think more generally.

This chapter aligns with the overarching study aim by exploring subjective perceptions alongside an OWB measure. The following chapter also draws on FGs and interviews to challenge/validate quantitative model findings (Chapter 4), and explore how environmental conditions contribute towards opposing OWB/SWB.

Chapter 6 Local perceptions of opposing objective and subjective wellbeing within an environmental context

6.1 Introduction

Chapter 5 illustrated local wellbeing perceptions to vary between subgroups, whereas section (3.10) showed OWB and SWB measures to be related, yet not interchangeable. This chapter explores communities' and DPOs' experienced environment-wellbeing associations to further understand mechanisms behind opposing OWB/SWB within an environmental context; corresponding to the negative ("–") relationship in the "ECW" framework (Figure 4.1).

Researching opposing OWB/SWB can support decisions to include various wellbeing measures when implementing and monitoring policy. This approach may illustrate to policymakers the importance of SWB in achieving policy buy-in (Coulthard, 2011) and the limitations of prioritising specific outcomes at the expense of other wellbeing components (Copestake, 2008). For example, exclusively "objective" research may omit information on how collective community norms could promote sustainable activities (Bouma et al., 2008), whereas "subjective" approaches may overlook requirements for more-immediate material support (Davis, 2014).

Despite most households experiencing aligning "non-poor/happy" outcomes (Table 4.2), it remains important to investigate opposing outcomes within specific locations and livelihood groups to avoid results being generalized on a wider scale. Furthermore, wellbeing, and the relationship to the environment, is relational to the specific time and place (Gough & McGregor, 2007). Therefore, the prominence of aligning high OWB/SWB may not be a permanent feature, especially when acknowledging the objective and subjective challenges associated with increasing environmental pressures. Consequently, understanding why OWB/SWB oppose one another can help uncover potential interventions to ensure communities experience "comprehensive" wellbeing under current, and future, conditions.

Quantitative analysis illustrated multiple significant associations between environmental variables and opposing "poor/happy" (Model 4.2.4) and "non-poor/unhappy" (Model 4.2.3) outcomes. The rigidity of statistical models within fluid social spaces underscores the importance of incorporating qualitative information to help understand the underlying processes (Shaffer, 2013). PRA methods also validate/challenge survey-based results, an important requirement when acknowledging the different socioeconomic, political and

environmental context the original survey took place (section 5.2.6). This chapter draws upon FGs and interviews to address RQ4:

4. What drives the divergence between OWB and SWB within an environmental context?

- a. Investigate communities' perceptions of the mechanisms underlying opposing outcomes in expenditure poverty (OWB) and unhappiness (SWB).
- b. Determine if experiences of communities, local governments and other actors support quantitative evidence.

Quantitative findings from Chapter 4 are presented first to contextualise the discussion of qualitative results. Drawing on exploratory spatial (Figure 6.1) and model analysis (Figures 6.2-6.3) a distinction between the environmental conditions associated with “poor/happy” and “non-poor/unhappy” outcomes is unveiled. “Poor/happy” households are prominent within inland, agricultural/grassland locations impacted by drought and erosion; including north Keta and Akatsi South. In contrast, “non-poor/unhappy” households are primarily in non-agricultural areas, including built-up coastal areas exposed to salinity and flooding in Ketu South and Ada West, and Sogakope near Volta River.

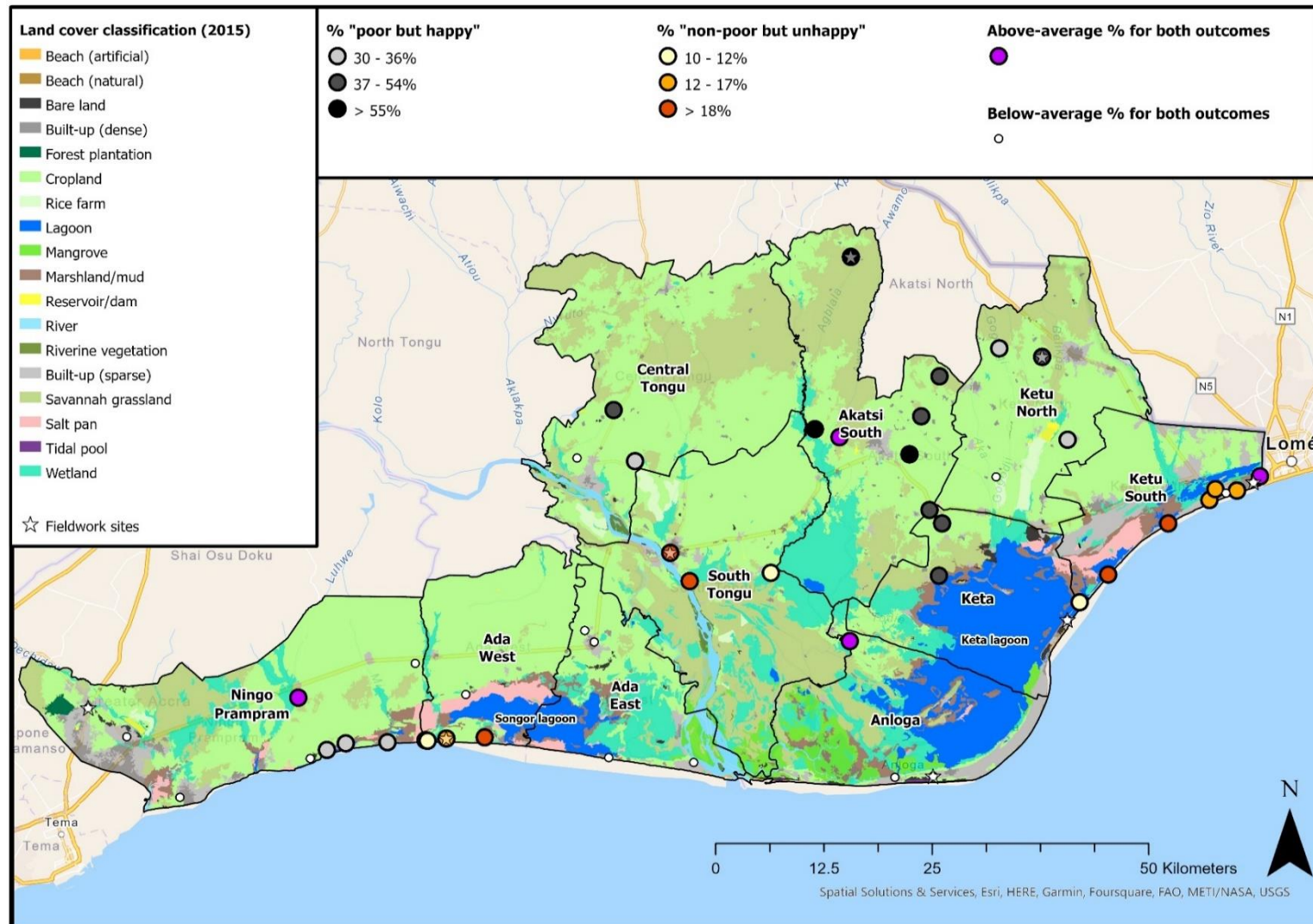


Figure 6.1 Proportion of households in each EA with opposing OWB/SWB outcomes

Note, EAs with "above-average" proportions are highlighted (red/black). EAs with "above-average" proportions for both outcomes are highlighted purple, and highlighted white if the proportion is "below-average" for both outcomes. Landcover data and visited study sites are also presented.

Chapter 6

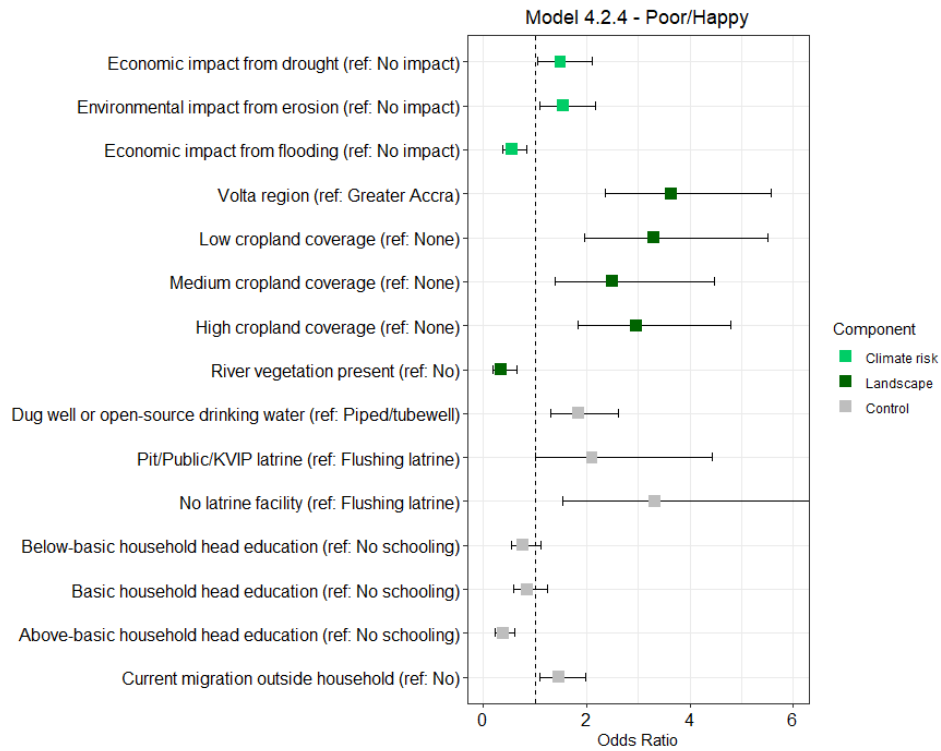


Figure 6.2 Odds ratios (with 95% confidence intervals) for variables significantly associated with being “poor & happy” (Model 4.2.4)

Note, certain variables' confidence intervals extend beyond the x-axis' limit. “Household size” variable excluded from figure due to large odds ratio values; see Table 4.14 for results.

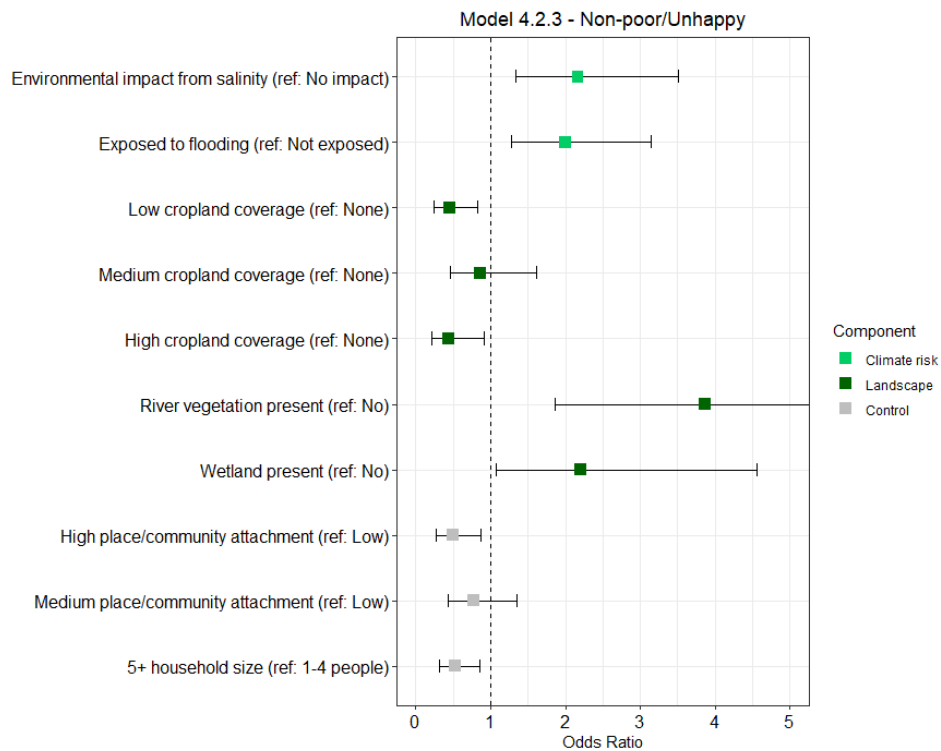


Figure 6.3 Odds ratios (with 95% confidence intervals) for variables significantly associated with being “non-poor & unhappy” (Model 4.2.3)

Note, certain variables' confidence intervals extend beyond the x-axis' limit.

The relationship between “poor/happy” outcomes and agricultural communities is based upon statistical results, and not a simple perpetuation of the stereotype which interprets “poor” from a Western capitalist perspective; commonly portrayed in LMIC research and mass media (Kay & Jost, 2003). Happiness within objectively poor locations should not be considered a substitute for financial OWB (section 3.5.2.2).

This chapter explores why OWB/SWB may oppose one another, and highlights the benefit of incorporating both concepts within sustainable development research. PRA methods are used to support and/or challenge quantitative relationships between environmental conditions and opposing OWB/SWB. Qualitative fieldwork incorporated 8/50 sampled EAs, therefore the findings and comparisons are not inferable to the Volta Delta population. However, results can contribute towards formulating hypotheses regarding on-the-ground mechanisms behind modelled environment-wellbeing relationships.

6.2 Methods

PRA methods, including semi-structured FGs and interviews were undertaken with communities and DPOs across 8 sites. 16 FGs (8 male, 8 female), 15 community interviews (9 male, 6 female), and 8 DPO interviews were completed. See section (5.2) for more information.

Following transcription, thematic analysis was undertaken. This multidisciplinary method (Clarke et al., 2015) was selected as this study draws upon concepts and frameworks from different schools of thought. Thematic analysis specifically addressed the RQs (Vaismoradi et al., 2013) by detecting key “environment-wellbeing” themes and local interpretations of a “good life”. The aim was not to quantify codes, but to extract common or varying perceptions across communities.

However, responses to “does money equal happiness, and why?”, which was asked at the conclusion of each community FG and interview, were coded, quantified and compared across select communities. This approach was used to explore differences in how financial capital associates with happiness across landscapes, and to better understand the potential mechanisms behind opposing wellbeing outcomes (section 6.3.3). To maintain the chapter’s narrative on opposing OWB/SWB, two communities containing higher-than-average proportions of “poor/happy” households (Nytawuta [S4] & Awlikope [S5]), and two containing higher proportions of “non-poor/unhappy” households (Anyamam [S2] & Sogakope [S3]) were selected for this specific analysis (Appendix 6.1).

Across all communities, thematic codes were created inductively and deductively using NVivo (Fereday & Muir-Cochrane, 2006). Key themes, established from the literature and quantitative modelling, were complimented by codes organically developed from participants' responses. Responses were categorised into themes based on existing theories, recurring responses, and disagreements. This approach's flexibility (Javadi & Zarea, 2016) supported the investigation of dynamic processes behind "static" statistical results (Shaffer, 2013). Codes were developed solely by the researcher. Future research should incorporate collaborative coding with researchers from the local context.

Following the explanatory sequential mixed method approach, this chapter presents qualitative verbatim quotes to illustrate key themes (Eldh et al., 2020), support/challenge model findings and uncover concepts absent from regression analysis. However, the voices captured may reflect certain subgroups, as access to seldom-heard individuals may have been restricted by constraints on time and participant selection (section 5.2.4).

6.3 Results & Discussion

This section explores the potential relationships between climatic hazards, landscape characteristics and opposing OWB/SWB, and discusses whether "money equals happiness". Based on quantitative results⁸⁷, this section investigates two broad examples: (i) "poor/happy" outcomes within inland, agricultural communities impacted by drought and/or erosion, (ii) "non-poor/unhappy" outcomes within peri-urban, coastal/riverine communities exposed to flooding and/or salinity⁸⁸. The discussion is informed by key concepts developed during thematic analysis:

- Climatic damage & fears
- Remoteness/accessibility
- Social norms, security and status
- Place attachment
- Social capital (collective/individualistic)
- Aspirations & relative/past comparisons

⁸⁷ Note, results from Models 4.2.3 & 4.2.4 are complimented by other model results to support discussions on the environment-wellbeing relationships referenced by communities and/or DPOs.

⁸⁸ Note, these outcomes are not unanimous across the described landscapes.

6.3.1 “Poor but happy”

Households with greater odds of experiencing “poor/happy” outcomes associate with cropland landscapes exposed to drought and/or soil erosion (Figure 6.2). This section draws upon qualitative results to explore why these locations may experience lower OWB, yet higher SWB, and how OWB/SWB associate with each other.

6.3.1.1 Landscape: Cropland

Despite happiness in rural LMICs often romantically assumed to offset low financial OWB (Kay & Jost, 2003), Model (4.2.4) does support the “happy farmer” identity by presenting an association between cropland coverage and “poor/happy” outcomes. Therefore, despite financial and climatic pressures, vulnerable households may maintain SWB through alternative channels such as place attachment and reciprocal relationships (Quinn & Halfacre, 2014; Schutte et al., 2022).

Visited agricultural communities also noted how opposing low OWB/high SWB may arise from rural individuals placing less emphasis on financial OWB when self-evaluating happiness compared to peri-urban dwellers. For example, communities may strive for the financial security required to fulfil non-material needs, such as safety and cultural identity (Ward & King, 2016), rather than accumulate capital for increased market activity.

“For urban dwellers their focus is on making the most money...meanwhile in rural areas, money is not their goal, their goal is having the social network, the communal feeling” (3,DPO)

“Even though I am not rich I am happy...I do not want to overburden myself thinking about my lack of money” (4,FG,M)

Fulfilling social expectations brings “peace of mind”, a core component of a Ghanaian “good life” (Dzokoto et al., 2019). Many agricultural respondents noted how working in society maintained SWB, despite environmental challenges, by creating a sense of pride and fulfilling intergenerational identities (Markussen et al., 2018). The importance of preserving traditional family livelihoods was exemplified by a young man in Nyitawuta (S4), who wanted to return home to undertake their farming duties, even if they fulfilled their aspirations of attending university. The relationship between “work” and “identity” is potentially most pronounced

amongst male farmers, where providing food/financial security to the household is a crucial obligation within the “breadwinner” role (Lambrecht, 2016). Multiple respondents supported these ideas by claiming that unemployed or “lazy” individuals fail to uphold the social norms associated with working diligently to improve one’s business (Grischow, 2008), with “discrepancies between reality and culturally-sanctioned values [a] source of societal concern” and lower SWB in Ghana (Dzokoto, 2012;319). Rural respondents also noted how being perceived as “lazy” can cause a loss of respect, break relationships and limit marriage opportunities; further impacting social status and SWB.

“We are farmers that is our identity...Sometimes the farming occupation does not go as planned but we never give up” (4,FG,M)

However, many rural respondents were not transfixed on fulfilling social obligations solely through farming, with others noting a desire to transition away from agriculture through increased education and mobility. This challenges time-preference theory (Moseley, 2001), where subsistence communities are assumed to have short-term goals, without aspirations for long-term development. Self-improvement was frequently mentioned as a component of SWB across all communities (Appiah et al., 2022; Sulemana & Agyapong, 2019), with education increasing future optimism, and contributing towards lower unhappiness (Model 4.1.4) and financial stress (Model 4.1.3), regardless of persistent financial and material challenges.

“When the child refuses to go to school...we will continue being in the same place...[otherwise] we will always be farmers...education can change our lives” (4,FG,F)

Place/community attachment, commonly passed down generations in rural Ghana (Addo et al., 2018a), was also expected to improve subjective happiness within agricultural communities (Gross-Camp et al., 2019; Heerwagen, 2009) by providing spiritual benefits and a sense of security (Osei-Tutu et al., 2020); supported by lower odds of unhappiness within cropland communities with high place attachment (Figure 4.15). Respondents also reported how agricultural landscapes can be SWB “constituents” (Schleicher et al., 2018a), with fresh air and the vibrant colours of crops inherently representing happiness. Furthermore, eudaimonic “relatedness” is pronounced within spaces of ESs, such as cropland, which provide platforms

for knowledge-sharing (Schaafsma & Gross-Camp, 2021) and friendships (Fagerholm et al., 2016).

“I am very proud to be associated with this community because this is the land of my youth, I have lived here and have my possessions here and it is just natural...it becomes some sort of pride in you” (5,FG,M)

6.3.1.2 Climate hazards: Drought & erosion

This subsection uses the term “hazard”, rather than “risk”, as the IPCC (2024) defines the latter as having the “potential for adverse consequences for human/ecological systems”. By exploring mechanisms behind opposing OWB/SWB, this discussion acknowledges how hazards may have negative, positive or neutral impacts upon varying outcomes.

Lower financial OWB within cropland communities could be attributable to the vulnerability of agricultural livelihoods; illustrated by drought and erosion increasing the odds of being “poor/happy” (Model 4.2.4). Communities also referenced uncertain rainfall and drought to exacerbate financial issues by limiting the utility of traditional knowledges (Sarku et al., 2020), increasing food import costs, reducing tradable yield, and undermining investments (Davis, 2014).

“Drought affected me badly...last year I cultivated two acres of cassava and it rained generously so I had...about 15-20 sacks of cassava/maize, with this I invest about 2000 cedi. But I cultivated the same acres this year and got just 3 bags...the money invested is totally lost” (4,CI,M)

Droughts within inland, agricultural locations reliant on open-source or rainwater, can also increase water insecurity and health issues. These challenges can constrain economic productivity (Buor, 2004b; Graham et al., 2016), increase water collection demands, and limit the time available for women and children to improve their human capital or contribute towards household finances (Vercillo, 2020). This relationship is supported by higher odds of expenditure poverty when further from inland water and reliant on open-source water (Figure 4.10).

“Children walk to fetch water from the dam and it affects their ability to go to school” (4,FG,M)

However, some communities “accepted” unfavourable climates, potentially mitigating negative SWB impacts compared to communities without prior experience (Brody et al., 2008; Navarro, 2017). Persistent threats could become the “norm”, creating resilience to future hazards, rather than additively increasing fears (Baruah & Hussain, 2021). As temporal and relative comparisons can influence SWB, if the starting reference point in vulnerable agricultural communities is low, or if individuals become accustomed to environmental challenges, smaller increases in living standards may be required for comparatively larger increases in SWB (Ravallion, 2014). This theory was illustrated by the scenes of celebration witnessed when water was delivered to the isolated village of Nyitawuta (S4), despite its low-quality (p.276). Furthermore, overcoming, or surviving, climatic or financial challenges was seen as an “achievement”, which could further improve SWB.

“Drought has become part of their lives, whether it rains or not, they stay in the same position” (5,CI,M)

“Good life means at first you faced hardship, but after a while there have been some changes and you are no longer facing hardships” (4,CI,F)

Respondents also noted how religion created resiliency, enabling agricultural communities to remain “content” despite facing multifaceted challenges. For example, unfavourable rainfall patterns were often interpreted as God’s plan (Quayesi-Amakye, 2017). Therefore, individuals’ worries, self-blame, and the subsequent negative SWB impacts, were mitigated. However, accepting environmental challenges as “God’s will” (2,FG,M) could discourage tangible adaptation, and conversely contribute towards lower financial OWB (Evadzi et al., 2018; Ndamani & Watanabe, 2015).

“Climatic happenings will always be with us...God created it like that so we just have to thrive through it to achieve what we want” (3,FG,M)

Additionally, climatic hazards may stimulate social cohesion as a coping mechanism (Dussaillant & Guzmán, 2014), where frustrations with surrounding vulnerability or injustice trigger collective action (Cattell, 2001). Increased community attachment and trust, often associated with agricultural landscapes, can enhance SWB by giving individuals facing similar challenges a shared purpose (Lawrance et al., 2021) and by providing emotional support channels (Lent, 2004). These mechanisms can produce positive feedback effects, with happier communities associated with lower environmental vulnerability (Addai et al., 2014a).

“Even if there is drought, people are still happy, the relationships are still there despite the hard times” (5,CI,M)

“If someone is affected by rain, erosion, drought, the community really assists the person...we do this because of unity, love, peace...for each other” (4,FG,M)

Nevertheless, community-wide responses to hazards could reinforce “poor/happy” outcomes, as persistent sharing could limit the surplus capital available for individual households to make productive or adaptive investments, and escape poverty (Di Falco & Bulte, 2009).

“[Flooding] mostly disturbs people who have farms closer to [the water body]...but it becomes a burden on us all because the affected person borrows money to survive” (8,FG,M)

However, model results are not generalisable, with certain associations challenged by select agricultural communities. For example, continuous access to romanticised social capital and togetherness in rural locations is contested by communities noting inconsistent cohesiveness within an environmental context (Adler, 2015; Craig et al., 2022). For instance, financial insecurity during climatic hazards could weaken relationships if individuals fear helping others could remove the resources required to overcome their own challenges (Di Falco & Bulte, 2009). This exemplifies the benefit of mixed methods research, with qualitative fieldwork uncovering the temporal variability of social capital, uncaptured by cross-sectional survey analysis (Shaffer, 2013).

“Even though the disaster may not have affected everyone, the people who were not affected will feel hesitant in supporting...because they do not know when they may also be affected”

(5,FG,M)

6.3.1.3 *Landscape: Remoteness*

Across Volta Delta agricultural communities may also experience lower OWB due to isolation from road networks, district capitals, and the industrial hubs of Accra and Tema. Supported by higher odds of being “poor/happy” in Volta, compared to Greater Accra (Model 4.2.4), and higher odds of expenditure poverty when further from Accra (Model 4.1.1). Remoteness from large markets can lower financial OWB by increasing transport costs, weakening bargaining power (Owusu & Lund, 2004; Porter, 2007), and encouraging communities to prioritise subsistence rather than cash crops due to the relative market advantage of better-connected peri-urban towns.

“There is no road to get to the market. When we pack our goods and we miss one market day then all things get rotten and we will not make any money” **(4,FG,F)**

Remoteness from district capitals, which are hubs of human, physical and political capitals (Bird et al., 2010), could also indirectly lower financial OWB by limiting access to health and education services. Despite national decentralisation aiming to reduce rural/urban inequalities, rural locations often do not access the same levels of public investment (Awuah et al., 2009; Owusu, 2005).

“There are a lot of inequalities...the district capital is expected to have basic facilities...the capital is developing and ideally it should be duplicating in other communities, but [it is not] because the assembly is [financially] handicapped” **(2,DPO)**

Additionally, poor accessibility and limited infrastructure discourages teachers and health professionals from relocating to remote areas (Béné & Friend, 2011). Lower education associates with higher odds of expenditure poverty (Model 4.1.1), with limited schooling potentially restricting individuals’ adaptive capacity and non-primary employment opportunities

(Morton, 2014), while poor health increases household burdens and curbs productivity (Okorosobo et al., 2018).

“Our main challenge...is the presence of teachers...because of the bad roads and the absence of electricity, the teachers refuse to stay” (4,FG,M)

Remoteness from key locations may also contribute towards opposing OWB/SWB. SWB is often associated with perceived inequalities, and relative comparisons to other households and social expectations (Kangmennaang et al., 2019; Ravallion, 2014). Therefore, rural areas with poor access to information systems and infrequent engagement with peri-urban towns may experience higher SWB due to their lower awareness of external living standards. For example, a Nyitawuta (S4) resident, the only one to travel outside the village for secondary education, spoke of their confusion when first encountering electronic equipment at school. Greater equality within rural communities (Appendix 4.13) may also improve SWB by reducing relative comparability, despite lower absolute financial OWB.

“They only compare themselves to others in the community, they cannot compare to others because they are all subsistence farming” (5,DPO)

“If I am privileged to have food at home, I wish the same applies to others in the community...but if I am the only happy person and others are in pain it doesn’t feel right...it is good for us all to be at the same level” (4,CI,M)

This “inward” focus when comparing oneself to the community is highlighted by one respondent in rural Nyitawuta (S4) relatively positioning their “good life” (1-10 scale) based on agricultural performance, rather than monetary accumulation.

“Because if you see the crops I have on my farm you will testify...that this woman’s crops are different. I am close to the ten” (4,CI,F)

Landscape remoteness could also shape adaptive practices, and therefore OWB. For example, *successful* migration could be hindered by restricted access to information about the destination location, weak “linking” social capital, and inadequate transport infrastructure (Flahaux & De Haas, 2016; Henry et al., 2003). Limited awareness of higher urban living costs, coupled with migration being used as a reactionary solution to seasonal poverty, could contribute towards the lower financial OWB amongst current migrant households with higher odds of being “poor/happy” (Model 4.2.4).

“[Emigrants] struggle because life in Accra is not easy, they end up engaging in hand to mouth because the standard of living is very high, so...things do not really work out” (4,C1,M)

Rural-urban migration could also contribute towards lower financial OWB in origin locations by generating labour shortages, and therefore food and financial insecurity (Szaboova et al., 2021; Walsham, 2020). Many respondents noted that younger generations are predominantly migrating away from primary livelihoods; however, statistical models did not capture interactions between age, livelihood and landscape.

“Our youths are moving to the industrial sector and abandoning agriculture...migration is disadvantaging us...instead of producing to feed Accra, we go to Accra to buy foodstuffs” (2,DPO)

In contrast, better-connected locations with more-frequent migration networks and greater information access can experience improved OWB; supported by Model (4.1.2) illustrating migration to lower the odds of BND within Greater Accra Region, yet not within the more-remote, historically overlooked Volta Region (section 2.2.4.2).

“Because of the closeness [to Accra/Tema] they get job opportunities...in metal factory, construction industry, there are a lot of industries moving closer to us” (2,DPO)

Nevertheless, the association between current migration and “poor/happy” outcomes could have emerged from migration increasing future optimism, and therefore SWB (Cai & Wang,

2018; Knight & Gunatilaka, 2010a), despite the lower objective conditions within remote, rural areas. Lower odds of financial stress amongst current migrant households (Model 4.1.3) supports this hypothesis, with multiple respondents viewing migration as a conduit for a brighter future.

“Some youth want to move away from agriculture and seek greener pastures in other areas”
(4,DPO)

However, the assumption of rural communities being completely isolated was challenged by Nyitawuta’s (S4) respondents. Certain individuals were aware of higher living standards in Accra, despite the village not having functioning roads or electricity. Upon reflection, experiences of Accra were potentially only mentioned by more-privileged residents; nevertheless, it illustrates how “remoteness” does not homogenously influence communities.

“I compare myself to the people living in cities. If I were in the city I will have a better life...they have good roads, water, good jobs, they can put up good buildings” **(4,FG,M)**

This finding potentially changes the interpretation of the “poor/happy” outcome. Even if individuals are aware of higher living standards, accepting that such standards are not realistically attainable due to remoteness or limited mobility, could mitigate the impact of relative comparability upon SWB. Despite recognising broader inequalities, many were content with their lives and generated SWB through alternative channels. For example, autonomy to freely access land and resources, compared to urban areas where payment is required (Duku et al., 2022), and greater tenure security within self-constructed dwellings provided “peace of mind” (Osei-Tutu et al., 2020).

“Over here the land is free, we have built our small houses...they are for us and no one else...We are content because no one is chasing us for rent”.....“even though sachet water is a good thing, over here all you have to do is get 1-2 cups of water to drink, you do not pay for it, we are happy” **(4,FG,F)**

Discussions with community members and DPOs supported the prominence of “poor/happy” outcomes within inland, agricultural locations exposed to drought and/or erosion. Communities recorded multiple financial OWB challenges, including uncertain seasonality, yet noted how fulfilling social roles and community relationships could improve SWB. However, modelled relationships were not generalisable across the selected communities. Certain “romanticised” assumptions, such as persistent community cohesiveness, were challenged. “Poor/happy” agricultural landscapes are contrasted in the next section by “non-poor/unhappy” coastal/riverine peri-urban locations.

6.3.2 “Non-poor but unhappy”

“Non-poor/unhappy” outcomes associate with non-rural⁸⁹, coastal/riverine locations (including wetlands) impacted by flooding and/or salinisation (Figure 6.3). This section draws upon FGs and interviews to explore why these communities may experience high OWB and low SWB, and how OWB/SWB could interact to create opposing outcomes.

6.3.2.1 *Landscape: Built-up, peri-urban*

Higher financial OWB within “non-poor/unhappy” households in areas with no cropland (Figure 6.3) could represent greater availability of higher-paid, non-primary livelihoods, such as tourism (Sagoe-Addy & Addo, 2013), within peri-urban landscapes. This is supported by lower odds of expenditure poverty amongst the business owner/salaried employee livelihood cluster (Model 4.1.1). The lower vulnerability of non-primary sectors can mitigate financial losses, and provide the confidence required to undertake productive investments (Davis, 2014).

“It is a sustainable job for them [hospitality]...but those in the hinterlands only have the livelihoods of farming and fishing, so when rain comes to destroy their farms they are handicapped” (3,DPO)

⁸⁹ Built-up land is overrepresented in areas closer to the coast (Appendix 6.2).

However, a greater drive for individual, financial success within peri-urban areas (Guillen-Royo & Velazco, 2012) could conversely lower SWB by enhancing financial inequality (Appendix 4.14) and creating higher, yet unattainable, aspirations; particularly in areas with unequal access to non-primary livelihoods (Schaafsma, 2021). For example, Sogakope (S3) respondents noted migrant workers were favoured over local residents within the emerging hospitality sector, potentially reducing SWB within a broader context of financial success (Sarracino, 2010). These negative effects may be compounded by the absence of the SWB benefits related to cohesive communities with reciprocal networks and respect; often associated with agricultural landscapes.

“the moment your [business] move forward...the “so-called” rich people will invest some to sell it at a low price so that ends your business” (3,CI,M)

“when I was sick, none of the rich people supported...now I don’t regard rich people at all” (1,CI,M)

Additionally, drawing on Easterlin’s (1974) Paradox and Figure 2.19, improved financial wellbeing could alter actors’ expectations, meaning the value attached to certain levels of financial capital when conceptualising SWB reduces over time; resulting in opposing OWB/SWB.

“First salary came and I was so happy, now you feel OK but the money does not mean as much. When I had nothing it was ok, but the more you earn the more responsibilities” (7,CI,M)

However, “individualism” is not generalisable across peri-urban communities, with examples of reciprocity, harmony and place attachment also recorded; *“We are each other’s keeper so we ensure that the affected persons [flooding] are well taken care of...I love the community, no matter how long I stay away I still come back” (8,FG,M)*

Many respondents also noted “money is blood”, meaning money is essential in “sustaining the physical, emotional, and social vitality of Ghanaian life” (Hasty, 2005;276). Therefore, higher

financial OWB may encourage stronger relationships (Meyer, 1998)⁹⁰; *“without money the love disappears”* (4,CI,M). However, acknowledging these social ties to be solely attributed to one’s financial success evoked conflicting emotions of unhappiness among some peri-urban respondents.

“When I was fully employed I usually get calls...from family because people know at the end of the month I will give them something, now I will go a whole year without a single call” (1,FG,M)

Nevertheless, similar to agricultural respondents (section 6.3.1.2), coastal, peri-urban respondents’ noted how social capital is fluid within an environmental context, and capable of influencing OWB and SWB differently across time. Access to diverse non-primary livelihoods in peri-urban locations could increase individuals’ “bridging” social capital (Claridge, 2018b), and their financial capacity to support others during hazards. For example, many respondents recalled how community-wide support was provided when repairing flood-damaged dwellings. However, examples from Anyamam (S2) suggest despite short-term shocks stimulating collective action, individualism prevails within everyday income-generating activities.

“If there is an accident we all come together and help...if we all have to contribute one cedi we will do it”...[yet, also stated]...“when we go to the market together and they buy mine but they do not buy hers then that is it, the relationship has been destroyed...instead of being happy for her you...carry hatred in your heart” (2,FG,F)

Yet, even when coastal peri-urban communities exhibited collective attitudes, underlying individualistic motives could still prevail; *“If everyone is doing well, how does that make you feel?”...“You will feel good because nobody will be a burden on you...If everyone is progressing then you will also be progressing”* (8,CI,F).

Greater individualism within peri-urban locations could also stimulate growth and increase financial OWB by generating a money-orientated culture and heightening individuals’ material aspirations.

⁹⁰ Taken from the Akan proverb; “once a person has made money, poorer relatives suddenly will visit and be full of devotion” (p.35)

“We say someone has money when the person has cars in excess, mansion, other valuable properties...a poor man with his bread money is not money” (3,FG,M)

“When it comes to money no one will ever be content...you always crave more” (7, CI,M)

However, opposing low SWB could arise across the community if a desire for “quick money” disturbs social norms, a core component of a “good life” in Ghana (Dzokoto et al., 2019), or threatens others’ security, another key SWB determinant (Vladislavjević & Mentus, 2019). This concept was exemplified in Sogakope (S3) where the status attached to financial wealth encouraged crime.

“[More money] is their target, they will do whatever they can to get there. We do not care if you are a thief, the moment you are rich everyone bows to you” (3,CI,M)

Landscape characteristics may also associate with social norms and SWB. For example, increased land prices in Ningo Prampram, due to the urban expansion of Accra/Tema, encouraged individual self-gain amongst landlords at the expense of community wellbeing. This shift contests the traditional “Ubuntu” worldview (Bangura, 2005) and opposes collective cultural values, potentially reducing community-wide SWB (Dzokoto, 2012).

“The landlords gave the land for free, whoever wants to farm...but now selling land became lucrative...now they sell outright so...there is no land for you”..... “everyone has moved for Accra and Tema, in Volta region...rooms rent for 30-40 cedi, but here...rent is 100 cedi” (1,FG,M)

The goal of accumulating capital, particularly pertinent amongst peri-urban youth within the “relational context”, could also produce opposing “non-poor/unhappy” outcomes by disincentivizing productive, long-term human capital investments such as education (Brown et al., 2021; Markussen et al., 2018). Such investments are crucial for enhancing SWB, as self-improvement is a fundamental component of happiness.

“With [salt] mining you...go to the shores, day ends you get something, they are valuing money over going to school, so they do not have employable skills” (2,DPO)

Opposing OWB/SWB may also exist due to individuals with higher financial OWB, and accumulated assets, being more sensitive to SWB impacts due to them having “more-to-lose” (Adams et al., 2020). This is hypothesised to be pertinent in coastal landscapes where oceanic hazards can damage land and property; supported by higher odds of subjective financial stress amongst built-up locations exposed to storms (Figure 4.13). Furthermore, material damage following flooding in Kedzi (S7) was said to lower social status and cause “thinking”, which can disrupt individuals’ peace and happiness; “[if] you are not thinking about anything, you are comfortable” (Osei-Tutu et al., 2020;7).

“when hazards destroy [your assets] you lose recognition and prestige” (7,FG,M)

“They worked hard and accumulated all those things and the rain just washes it all away...If you are not careful the person will overthink things and die. They will be wondering where they will get the money back” (7,FG,F)

6.3.2.2 Landscape: Remoteness

In contrast to the limitations of physical remoteness (section 6.3.1.3), greater connectivity between non-rural communities and district capitals (Appendix 6.3) can improve OWB. This hypothesis is supported by lower odds of BND, when closer to district capitals (Model 4.1.2), and expenditure poverty, when near riverine vegetation (Model 4.1.1) in the district capital of Sogakope (Figure 6.1).

“The benefit we derive [from being a district capital]...we have access to education office...judiciary court...Senior High Schools and other schools...We have all the institutions” (3,FG,M)

Accessibility to road networks and urban hubs can improve financial OWB through multiple mechanisms; for example, stimulating business investment, as roadside trading is prominent

throughout Volta Delta, and allowing individuals to trade within different markets depending on where is most profitable (Chamberlin, 2007; Owusu & Lund, 2004).

“We compare prices in Aflao market to Togo market and see which is cheaper then we go and buy it” (6,FG,M)

Communities with good connectivity to peri-urban towns may also experience lower expenditure poverty due to the greater private and public investment into businesses and basic services (Karakara & Ortsin, 2022). For example, availability of high-quality healthcare in hospitals (Dotse-Gborgbortsi et al., 2023) can improve financial OWB by reducing the productivity losses associated with ill-health (Serdeczny et al., 2017).

“When you are all healthy in the household, the woman can travel to the market to trade. But if you are sick then her business stops” (8,CI,F)

Similarly, access to “above-basic” education within Senior High Schools or Universities in built-up towns may improve financial OWB by increasing adaptive capacity or facilitating access to higher-paid, less sensitive livelihoods (Morton, 2004; Muttarak & Lutz, 2014). However, despite multiple respondents noting the importance of education in adapting to environmental challenges, no significant model interactions were found.

“Where the world is going if you don’t have education you’re lost”...”Without education you’ll be hooked on the manual way of farming”...”due to education we just fix machine and direct the water [irrigation]...we are encouraging...education so in the future some of these problems can be controlled” (7,FG,M)

In contrast, higher education may enhance individuals’ aspirations (Anyidoho et al., 2012), particularly amongst rural-urban migrants, which if unmet due to wider structural restraints can cause frustration and lower SWB (Knight & Gunatilaka, 2010b; Szaboova et al., 2021). For example, one DPO mentioned the systemic divide between Ghana's education system and job

market, resulting in high graduate unemployment and lower community SWB due to the perceived “laziness” of unemployed youths disrupting social expectations (Grischow, 2008).

“Now everyone wants to go to school...but if you...complete school what do you get, you come back to where you were sitting” (1,FG,M)

These feelings towards the youth could reflect different generational experiences and SWB determinants (Botha & Vera-Toscano, 2022). For example, self-improvement and education may be valued higher among youths due to its greater availability (Palmer et al., 2007). These differences are supported by younger people being less attached to, and migrating away from, primary livelihoods (Rodríguez-Díaz et al., 2022; Sumberg et al., 2017), compared to “older” generations prioritising traditional, often environmentally vulnerable, livelihoods (Wireko-Gyebi et al., 2023; Wuni et al., 2017). However, no models incorporated significant age interaction effects.

Residing closer to major towns, such as Accra and Tema, may also improve access to migratory networks, lubricate the transfer of information and labour, and lower transport costs (Awumbila et al., 2017). These benefits may improve households’ financial OWB by providing opportunities for year-round, non-primary labour, rather than seasonal farming/fishing (Flahaux & De Haas, 2016; Mortreux & Adams, 2015). However, ever-present migration networks can lower SWB by increasing the visibility of higher living standards in urban hubs, creating “tangible” comparative reference points, and inducing emotions of jealousy (Box 6.1); supporting the “non-poor/unhappy” outcome.

“Those who go to Tema and Accra...have more money than us here...because of where they are and the things they have their bodies are looking nice but us over here we are not looking nice” (7,FG,F)

Box 6.1 – Lyrics from Sogakope’s (S3) own Wolfman, in their song “Dem Sell out”

“Mi na reach yet dema envy” – meaning they have not reached their own goals yet, but they are envious of those who have.

“Wey dey mek money anywhere anyhow” – relating to the previously mentioned “quick money”, and how social rules, expectations and relationships are often sacrificed for personal financial gain.

Visibility of unequal investment within local areas can also lower SWB within marginalised sections of the broader community (Owusu, 2005). For example, better-off individuals in Ada West undertake their fishing business in Anyamam (S2), yet invest in properties and assets outside the community in the nearby district capital (Sege) due to fears of flooding. This example illustrates the interconnectivity between climate hazards and SWB, with flood events exacerbating proximate inequalities and relative comparability.

“most of the big houses in Sege are owned by people in Anyamam. They use Anyamam as a business point and do their fishing...but in terms of assets they...do it [in Sege]...they know that anytime the floods can take over...They are not spending money on [Anyamam]” (2,DPO)

However, these broad ideas surrounding inequality and SWB are not constant across coastal, peri-urban locations. For example, respondents in Anyamam (S2) and Aflao (S6) claimed *“all hands are not equal, so someone will definitely do better than others”* and *“all fingers are not equal”*. These sayings suggest an acceptance of inequality within everyday life, potentially minimising the SWB impacts of relative comparability for certain individuals (Li et al., 2019).

6.3.2.3 Landscape: Proximity to water

Quantitative models, and community responses, also highlighted the potential for opposing high OWB/low SWB within areas near water sources. Figure 6.3 illustrates “non-poor/unhappy” outcomes to associate with river vegetation, wetlands (located near rivers and lagoons [Figure 4.2]), and coastal areas (inferred from flooding/salinisation).

Firstly, exploring potential benefits to financial OWB, access to aquifers or open-source water could mitigate domestic water insecurity; reducing health risks and time poverty associated with water collection (Atiglo, 2017). Coastal farmers also noted the capacity for non-saline shallow boreholes (Nielsen et al., 2007) to facilitate irrigation and improve tradable yield by buffering against drought, and permitting year-round seasonal crop growth.

“We can do irrigation, the farmers are waiting for rains, so there is not as much...supply, so when they hear we have okra they come rushing” (7,CI,M)

The above quote also demonstrates the interconnectedness between social capital and adaptation, as the participant recounted how neighbouring villages provided guidance on irrigation and land management for okra farming. Respondents also recorded how access to water sources increased their capacity to diversify income channels and reduce financial insecurity during shocks and uncertain seasonality (Antwi-Agyei et al., 2014; Burney & Naylor, 2012; Mahama & Nkegbe, 2021). For example, communities with access to saline (ocean) and freshwater (lagoon/river) environments, and mangroves (Tanner et al., 2014), could strategically exploit different resources across the year depending on where the greatest harvest/catch and profits were available.

“If the farm does not do well you will definitely get something small from the lagoon for sale which will sustain you for the day. Other communities do not have these options” (8,FG,M)

“They plant [mangroves] and leave it when doing their other activities like farming and fishing. When mangrove develops they harvest it and sell, but it is not their primary economic activity, it is a top-up” (8,DPO)

The capacity to diversify is also suggested to be influenced by gender, with Model (4.1.1) illustrating a higher percentage of females in the household to reduce expenditure poverty. This result aligns with findings that women often access less-vulnerable jobs to “top-up” and dampen seasonal fluctuations in household finances (p.271).

However, despite potential financial opportunities within coastal/riverine landscapes, statistical models suggest communities may experience low SWB; exemplified by the association between wetland locations and higher odds of being “non-poor/unhappy” (Figure

6.3). Firstly, wetlands are ideal for cultivating subsistence crops, including rice (Willoughby et al., 2001), and profitable cash crops such as sugarcane. However, previous studies in Volta Delta define sugarcane farmers in South Tongu as “frustrated achievers” (Ahmed et al., 2019), where their increased financial OWB does not correspond to improved SWB due to fears of climate hazards and crop failure (p.220). Similarly, multiple coastal respondents mentioned how changing environmental conditions contributed to dwindling fish stocks, uncertain fishing seasons, and species extinction in oceans and lagoons (Koomson et al., 2020; Nieto & Mélin, 2017). Therefore, even though fieldwork observations suggested fishing incomes were sufficient to prevent financial poverty in select communities⁹¹, reduced catches and profits compared to past reference points could still result in unhappiness (Tibesigwa et al., 2016); producing opposing OWB/SWB (Model 4.2.3).

“In the past...we collected the harvest from the sea with so many basins but nowadays that is difficult” (6,FG,F)

Reductions in primary productivity can also impact the relative positionality and temporal comparisons of individuals working within integrated non-primary sectors, such as market trading (Cazcarro et al., 2018); *“They do not buy from me as much as I would like. When it’s fishing season that is when they patronize my business, but nowadays the fishing season is not like it was in the past” (2,CI,F).*

Changing access to natural resources, and lower SWB, were also notable in Anyamam (S2); shown to contain a comparatively higher proportion of “non-poor/unhappy” households (Figure 6.1). Originally communities accessed year-round resources; fishing in the wet season and salt mining in Songor lagoon during droughts (Roland et al., 2019). However, government’s demand for salt⁹², linked to its use within the emerging petroleum industry (Mensah & Botchway, 2013), resulted in the entire 41,000-acre lagoon being sold to private industry (Harvey & Langdon, 2010; Yeboah et al., 2013); continuing Ghana’s (post)colonial development pathway centred around

⁹¹ For example, the chief fisherman in Kedzi (S7) showed us his multiple, expensive fishing boats paid for by his fishing business. However, others mentioned how the number of fishing boats had reduced in recent years due to dwindling fish stocks; therefore, the chief fisherman’s success may not have been representative of the fishing business in Kedzi as a whole.

⁹² The declaration of salt as a “mineral” in the 2006 Minerals and Mining Act (Parliament of the Republic of Ghana, 2006) gave Parliament control over salt resources, meaning exploitation could only be undertaken with a licence. This prohibited local artisanal salt miners, and paved the way for industrial-scale operations (Atta-Quayson, 2023).

extracting raw materials (Atta-Quayson, 2023). Respondents were unhappy about their income source and identity being removed without the provision of state compensation or alternative livelihoods (p.272), and how “individual” ownership disrupted collective norms. Violent conflicts between resistant communities and private police (Agbove, 2022) also reduced respondents’ perceived safety (Vladislavljević & Mentus, 2019). This injustice mirrors past instances where dam construction disrupted fishing livelihoods in Volta Basin, yet alternative irrigation projects promised by government were scrapped (Ofori et al., 2016). This example emphasises the importance of examining environment-wellbeing associations within the “relational context” (Figure 4.1). Despite proximity to diverse natural resources having the capacity to provide OWB/SWB benefits, the governance and power structures reversed this relationship by restricting local communities’ capabilities (Sen, 2005) and autonomy to pursue their desired livelihoods.

“The salt has been their livelihood for years. So when they compare themselves to other communities, they feel they are nothing” (2,DPO)

“You don’t have the right to take any salt out the lagoon...this has brought war between town people and the individual...affecting our peace in the community” (2,FG,M)

The Songor Lagoon example, alongside the significant difference between communities’ and DPOs’ weighting of “employment” when interpreting a “good life” (section 5.3.1.3), highlights the need for greater capacity within local government to engage with communities. These platforms for cross-scale dialogue can mitigate conflicts and minimise the disconnect between decision-makers and locals’ lived priorities.

6.3.2.4 *Climate hazards: Flooding & salinisation*

Despite the financial OWB benefits associated with residing in less-rural coastal communities, climatic hazards, including flooding and salinisation (Figure 6.3), may conversely lower OWB and/or SWB. This section focuses on negative SWB impacts to explore the association between coastal hazards and “non-poor/unhappy” outcomes (Model 4.2.3).

Firstly, flooding and salinisation can bring health issues. Respondents noted increased cholera in areas with insufficient latrine facilities (Mireku-Gyimah et al., 2018), and hypertension from consuming saline water (Nahian et al., 2018). Health risks can lower economic productivity,

however even if they do not result in poverty, unhappiness can still arise. A Ghanaian “good life” incorporates inevitable “ups and downs”, however “good health” is a minimum requirement (Dzokoto, 2012) and a crucial SWB determinant across LMICs (Van Praag et al., 2003).

“As long as I am alive, and I am healthy, I am happy” (7,CI,M)

Coastal hazards can also trigger long-term psychological damage, where fears of future risks, guilt relating to being unprepared for previous hazards, and feelings of anxiety (Sekulova & Van den Bergh, 2016) can disrupt individuals’ SWB and “peace of mind” (Osei-Tutu et al., 2020). Many participants noted how floodwaters had entered their homes, invaded their safe havens (Carroll et al., 2009), and caused “thinking” by forcing people out of their dwellings before alternative living arrangements could be made. Furthermore, respondents stated how climatic fears discouraged investment in assets and livelihood inputs, resulting in unfulfilled aspirations and unhappiness. These potential long-term impacts may result in households continuing to experience low SWB, even if financial OWB improves; supporting the “non-poor/unhappy” outcome.

“If you are unfortunate to work...at the shores of the sea, you’ll always be in fear” (2,FG,M)

“We are in fear of amassing assets then later the disaster strikes again...even though people will like to do things to beautify the community, due to the fear of disaster they don’t” (7,FG,M)

Additionally, the sense of powerlessness to combat or control repeat hazards can lower individuals’ autonomy and capacity to care for nature; core components of eudaimonic SWB (Deci & Ryan, 2012; Jax et al, 2018). These negative impacts may be exacerbated amongst communities perceived to be politically isolated (Sarracino, 2010), with multiple respondents noting national-level coastal defence projects to have been abandoned and/or delayed. This example emphasises the need for cross-scale dialogue between government departments and community members, and the importance of exploring governance structures within the “relational context” of wellbeing.

“Last year over 1,000 houses were affected [by flooding]...the communities created a roadblock to make the government fix the coastal defences. National government started, and then stopped” (6,DPO)

Autonomy may also be restricted when coastal inundation and/or intense rainfall lowers mobility, as roads, paths and rivers can become impassable (Amankwaa & Gough, 2023; Porter, 2007). The relative effect upon SWB is hypothesised to be greater for communities accustomed to good connectivity and reliant on travelling for work.

“We are in the middle of...water bodies, so when there is a flood, how do you go out to work?...some of us will lose our job” (1,FG,M)

Flooding may further inhibit autonomy by causing displacement, and removing individuals’ freedom to choose their livelihood and where they live. Personal accounts of coastal inundation displacing communities from traditional lands were recorded in Anyamam (S2), Kedzi (S7) and Anloga (S8).

“If your source of income is through fishing and because of...tidal waves you have been moved out of your land...you have to start all over again, how would you be able to take care of your wives and children?” (8,DPO)

The impact of community displacement may also be influenced by households’ place/community attachment. Model (4.2.3) illustrates low attachment to associate with being “non-poor/unhappy”, suggesting an individualistic culture could improve financial OWB by lessening obligations for resource redistribution and ensuring greater financial control (Di Falco & Bulte, 2009).

“When people think individually they know the consequences of every decision...they are very analytical in making economic decisions...But a group is for nobody...if it fails it will affect all of us, so that attachment...is not the same” (3,DPO)

In contrast, low attachment could amplify unhappiness by restricting access to the benefits available within collective communities (section 2.5.4.2). However, qualitative discussions unveiled how high community attachment could conversely exacerbate environmental sensitivity, and lower SWB, if floods involuntarily displace groups from intergenerational lands or impact “relatedness” by dividing family/friend networks. Displacement could further reduce SWB by; (i) causing “disorganisation”, meaning daily routines and obligations are disrupted, (ii) threatening “peace of mind” and perceived security (Dzokoto et al., 2019), (iii) creating “emotional conflict” within households if displaced relatives relocate with other family members and perceive themselves as burdensome. However, quantitative modelling did not uncover this interaction between high attachment, hazards and SWB.

“People are displaced from their homes, you will not know where your neighbour is and you become disorganized. We do not know what to eat because the people selling the food are also trying to sort out their lives”... “when the sea becomes violent [and] you are in somebody’s house, you will not have peace” (2,FG,F)

Additionally, coastal hazards can lower SWB through the concept of “solastalgia” (p.85) if individuals’ social identities are emotionally linked to environmental landscapes (Adams et al., 2020; Schleicher et al., 2018a) (Figure 6.4). For example, coastal erosion and community displacement can reduce SWB by damaging individuals’ self-esteem (Du et al., 2017) and disrupting social relationships forged within traditional “spaces” (Schaafsma & Gross-Camp, 2021). This relationship exemplifies how subjective components may also control environmental “sensitivity” (Figure 4.1), as individuals with greater affiliation to nature or their landscape may experience more subjective harm from hazards and degradation.

“The attachment...this is where I’m born...our fathers suffered in building a house only to have it destroyed by the sea...this brings a lot of thinking and depression...some of us held strong and that’s why we are still here protecting the little left for the future” (7,FG,M)



Figure 6.4 Damage to dwellings from flooding and erosion in Anyamam (S2). Damage resulted in the displacement of some households; however, despite some dwellings being partly submerged in sand, many continued to reside in their homes due to “place attachment”

However, place/community attachment was not homogenous along the coast, with communities stating how constant flooding and loss of provisioning ESs (i.e., fish stocks), which form the basis of social norms/practices (Kankam et al., 2021), have challenged collective relationships, weakened individuals’ emotional attachment (Carroll et al., 2009), and reduced community-wide SWB.

“As the sea keeps on removing us, people have still not relocated back. They don’t even visit here...because the sea always disturbs us” (7,FG,M)

This section highlighted potential mechanisms behind opposing “non-poor/unhappy” outcomes within peri-urban, coastal/riverine communities. Access to diverse livelihoods may improve financial OWB, yet fears of coastal hazards, greater relative comparability, and reduced success compared to past reference points may bring unhappiness. However, these relationships are not generalisable; for example, collective responses to flooding challenged the assumed “individualism” in built-up landscapes. The next section focuses on the question “does money equal happiness?” to further investigate how financial OWB interrelates with happiness.

6.3.3 Money = happiness?

This chapter highlights how environmental conditions can relate to OWB and SWB differently, and produce opposing outcomes. However, when asked directly, most participants proclaimed “money does equal happiness”; contrasting the message within an Akatsi hotel (Figure 6.5). Yet, some acknowledged exceptions, noting interpersonal relationships cannot be purchased, and too much money can cause “overthinking”. My positionality could have influenced responses if participants believed I could provide financial support (Bryman, 2016); exemplified during Sogakope FGs (S3) with requests for money, assets and rent payments. Nevertheless, the consistency of responses across communities with different environmental and economic characteristics suggests the common sentiment was legitimate.



Figure 6.5 A poster from a hotel in Akatsi South district

Responses may have also been influenced by the economic context in Ghana, with my visit coinciding with rising food prices and the depreciation of the Cedi (World Bank, 2022).

Therefore, “money” may have been an immediate priority for many communities. However,

despite the consistency of responses to the initial question, the reasons as to *why* “money equals happiness” varied across communities (Figure 6.6)⁹³.

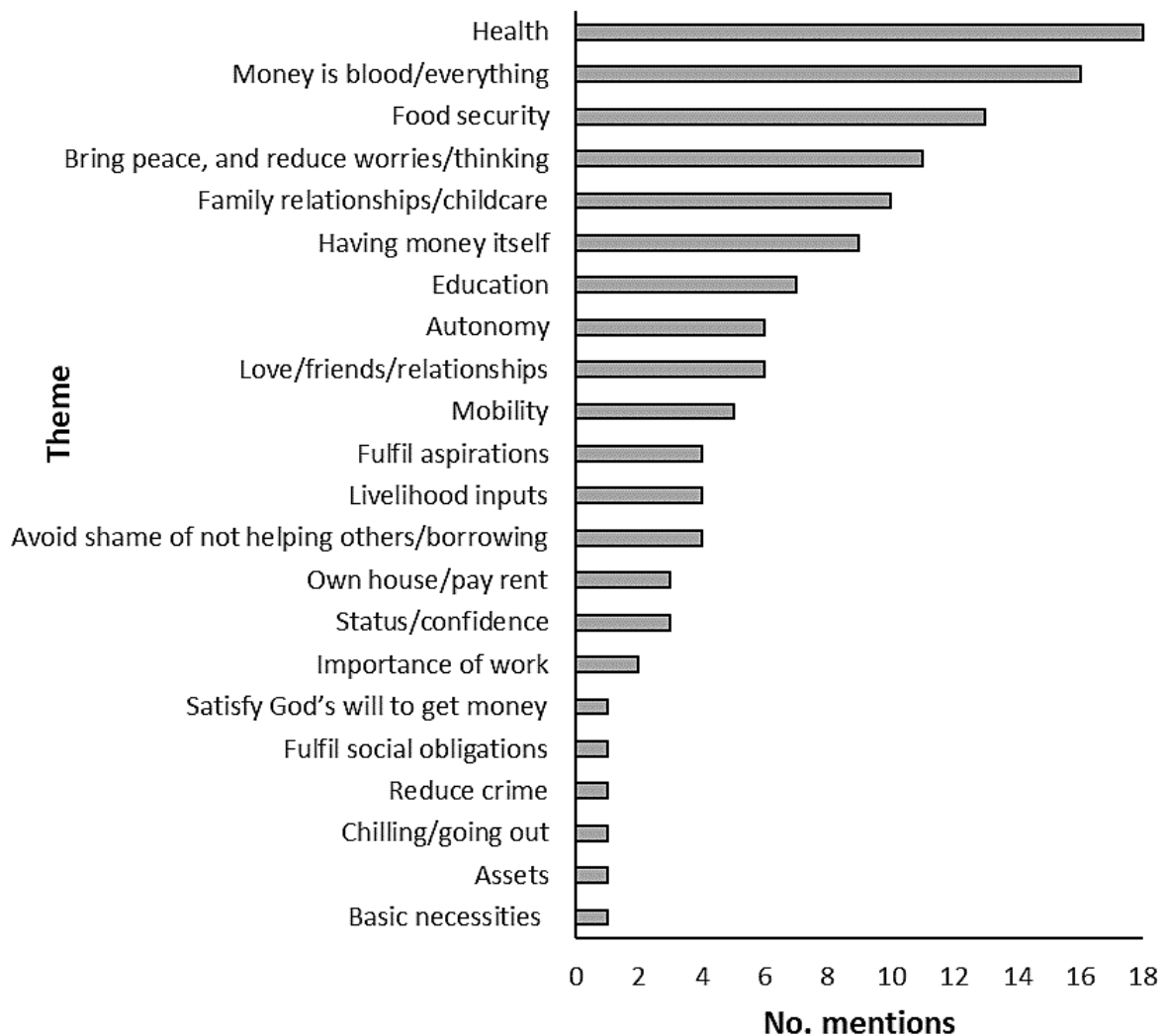


Figure 6.6 Number of themes mentioned across community FGs and interviews as to why money equals happiness. Responses which opposed this notion are not incorporated

When comparing reasons why money *does* equal happiness from the four communities with higher-than-average proportions of opposing OWB/SWB (section 6.2), similarities and differences were identified (Table 6.1). Firstly, both groups mention “money is blood” (Box 6.2), meaning money is essential in maintaining the fabric of Ghanaian culture and social relationships (Hasty, 2005). Similarly, the capacity for money to generate happiness through

⁹³ Note, this analysis is solely based on the single question asked at the conclusion of FGs and interviews. The count relates to the number of times a theme was mentioned.

food security (“a hungry man is an angry man” [1,FG,M]) and healthcare were consistent across the two groups. This finding aligns with Fadji et al., (2021) who found financial capital in Ghana was often geared towards avoiding “ill-being”, rather than maximising “wellbeing”. This theory may capture the “relational context”, where slow socioeconomic growth and inadequate publicly-funded social safety nets necessitate greater reliance on personal finances to fulfil basic needs.

Table 6.1 Number (and %) of mentions as to why money does equal happiness from respondents in the four selected communities

Theme	Percentage of mentions	
	“Poor/happy” (Nytawuta & Awlikope)	“Non-poor/unhappy” (Anyamam & Sogakope)
Overall no. themes mentioned	20	41
Health	10%	17%
Food security	15%	17%
Money is blood/everything	10%	10%
Bring peace, and reduce worries/thinking	10%	10%
Family relationships/childcare	20%	10%
Having money in itself	0%	7%
Love/friends/relationships	5%	5%
Mobility	0%	5%
Status/confidence	0%	5%
Education	5%	2%
Autonomy	5%	2%
Avoid shame of not helping others/borrowing	5%	2%
Own house/pay rent	0%	2%
Assets	0%	2%
Chilling/going out	0%	2%
Livelihood inputs	5%	0%
Importance of work	5%	0%
Basic necessities	5%	0%

Note, the most mentioned theme for each group is highlighted blue.

Box 6.2 – Lyrics from Pat Thomas’ popular 1980s song “Sika Ye Mogya” (translated to “Money Is Blood”), now used within Ghanaian lottery advertisements:

*“Not knowing, money is blood, money truly is blood.
Look, money makes marriages work; money makes families united.
Money gives happiness; money gives love; money gives everything.
Why then do they call money an animal? Money is not an animal.
Everyday I continue to say that money is blood.”*

However, the role of money in maintaining the family home and preventing intrahousehold conflicts was more frequently mentioned by agricultural, “poor/happy” communities. This finding aligns with the importance of family/community relationships in rural communities (Tsai & Dzorgbo, 2012), and how employment can generate happiness, not only through wealth accumulation, but also through communal involvement in livelihood activities (Arku & Arku, 2009). The lower absolute financial capital required for these “less-tangible” priorities may explain the higher prevalence among the “poor/happy” households (Ward & King, 2016).

In contrast, certain themes were only mentioned by “non-poor/unhappy” coastal/riverine, peri-urban respondents; including, “having money in itself”, “mobility” and “status” (Table 6.1). “Having money in itself” reflects the individualistic, money-orientated cultures in some peri-urban towns (Guillen-Royo & Velazco, 2012); illustrated in Sogakope (S3) where a committee member flaunted his multiple cars, properties and businesses during the transect walk. Likewise, “mobility” could reflect the greater emphasis on migration in well-connected areas with access to non-primary employment in industrial hubs, compared to isolated rural locations. Therefore, lower SWB in these built-up landscapes may result from greater inequality and relative comparability to others and previous periods of success. Lastly, despite “status” only being mentioned by the “non-poor/unhappy” group when directly asked “why does money equal happiness?”, all communities mentioned how money improves one’s image and authority during general FG discussions. However, SWB is relative, so the value of “status” may vary between individuals and communities.

“Because you have money...they will be greeting you and telling you are welcome but...because I do not have money they will not even acknowledge my presence” (2,FG,F)

My positionality and perceived ability to provide financial support may have influenced the consistency of the response “money *does* equal happiness”. For example, respondents in Nyitawuta (S4) strongly agreed with the sentiment; however, when asked why previous survey results suggested their community maintained higher SWB, despite low financial OWB, many mechanisms were documented:

- Avoiding the burden of thinking about money
- Optimism for improved future
- Improved access to education compared to past
- Religious obligation to remain happy
- Free access to resources
- Good character and supporting each other

6.4 Reflexive account

Throughout the fieldwork my positionality as an “outsider” (Mfoafo-M’Carthy & Grischow, 2022) was made explicitly clear by frequent shouts of “yevu” or “obũroní”⁹⁴. This “otherness” likely stemmed from a “colonial consciousness” (Nabbali, 2016;95), which was evident when the British colonial past was used to justify why I should purchase products or financially support communities. These challenges were pertinent in Sogakope (S3), where female FG respondents aggressively demanded money and work. However, this community had previously been visited by DECCMA and other research teams; therefore, if no tangible changes had been experienced, frustration with external organisations could have been high (Sultana, 2007).

“Three months ago they came to write down our names...they said the project was from World Bank. After we do these things we do not get anything from it, is that right?” (3,FG,F)

My position as a “British outsider” brought perceptions of guilt, most notably when drinking bottled water within communities without potable sources. These obstacles were overcome through daily discussions with RAs about their past experiences of European research projects, and communicating with supervisors to get difficult feelings “off my chest” (Thummapol et al., 2019).

⁹⁴ Meaning “white man” or “foreigner” in Ewe and Twi respectively.

During some FGs, my position as an “outsider” was literal, as I sat outside the circle of respondents and whispered prompts to the RAs. Upon reflection this likely exacerbated the power dynamic and could have influenced responses. For example, as respondents were aware of my involvement with DPOs, responses may have focused on areas they perceived to require greater public investment (Bryman, 2016). I attempted to sit within the circle where possible to mitigate this imbalance.

Furthermore, the language barrier created an inevitable divide, with the translation between English and Ewe/Dangbe potentially influencing the interpretation of questions and answers (Tseklevs et al., 2020). Particular challenges emerged when discussing non-tangible concepts relating to SWB, with initial responses often centred around financial/material challenges. This may have been influenced by my perceived positionality as someone who could provide tangible support. Additionally, my privileged position allowed me to look beyond material wellbeing into the “bonus” psychological needs incorporated within SWB. These needs may have appeared irrelevant to communities prioritising more immediate requirements when conceptualising their “good life” (Chumo et al., 2023). The fieldwork also challenged some of my Western, romanticized presumptions of rural Ghana; for example, agricultural communities unanimously favouring social capital over financial capital.

I attempted to minimise my study being interpreted as “extractive science” by working alongside local researchers and capturing communities’ voices (Steinert et al., 2021). However, despite hopes that NGOs with sufficient resources to address communities’ long-term challenges will engage with my published research, my fieldwork could not provide any immediate capacity building (Walsh et al., 2016). I was persistently honest with participants regarding my inability to address their concerns. Despite visible disappointment amongst some communities, many respondents stated their appreciation, as other researchers/agencies had given false promises.

6.5 Conclusion

Qualitative discussions supported *and* challenged modelled relationships between environmental conditions and opposing OWB/SWB. A broad dichotomy was illustrated between agricultural “poor/happy” and peri-urban coastal/riverine “non-poor/unhappy” communities. Agricultural communities experience financial OWB challenges, associated with vulnerable livelihoods and remoteness, yet maintain SWB by normalising environmental challenges and prioritising community relations. Conversely, peri-urban coastal/riverine locations experience

less expenditure poverty, attributable to less-vulnerable, diverse livelihoods and greater public/private investment, yet lower SWB related to greater inequality, unreachable money-orientated aspirations, and restricted autonomy following coastal hazards. However, as this study captures a snapshot of environment-wellbeing associations, future climatic and landscape changes may reshape these existing relationships.

Nevertheless, these broad ideas are not generalisable across all visited communities. For example, the collective/individualistic divide between rural/peri-urban areas was challenged by the reported fluidity of social capital. Agricultural communities recorded strong unity, yet reciprocal relationships were strained during climatic hazards, whereas peri-urban communities illustrated collective responses to flooding within a broader context of self-maintaining inequalities and individualism. Furthermore, existing literature and model results suggested rural communities have limited awareness of external living standards and lower comparative reference points; however, this was challenged in the field. Nonetheless, rural communities made less-direct comparisons to external locations, potentially due to their less-frequent engagement with key urban hubs, or because other channels, such as free access to resources or place attachment, were valued higher than material comparisons when conceptualising SWB. Yet, the consistent sentiment of “money equals happiness” across various communities challenged this hypothesised non-material focus.

By exploring environmental associations with opposing OWB/SWB, this chapter advocates for including objective *and* subjective measures within sustainable development to target long-term “comprehensive” wellbeing. This chapter also highlights the benefits of mixed methods by providing information on the processes behind static model results, and ensuring communities’ voices are heard. The next chapter synthesises the results from the previous four chapters, and evaluates the “ECW” framework in light of these findings.

Chapter 7 Synthesis

7.1 Results summary

This mixed methods study explored comprehensive wellbeing within Volta Delta. Environment and wellbeing interconnect within LMICs; however, research on OWB/SWB associations within an environmental context is limited (Schleicher et al., 2018a). This chapter summarises the results chapters (3-6) to address the RQs:

1. How are OWB and SWB measured within an environmental context?
2. What are the spatial environmental associations with OWB and SWB measures?
3. How do different socioecological groups conceptualise and weight components of wellbeing?
4. What drives the divergence between OWB and SWB within an environmental context?

Empirical, methodological and theoretical contributions to the literature are outlined, before the policy relevance is summarised. Next, the various components of the new “ECW” framework (Figure 7.1) are evaluated using quantitative and qualitative examples. The chapter concludes by reviewing limitations and potential future work.

*Landscape characteristics incorporate objective natural capitals and subjective natural perceptions. However, to maintain the focus upon environment-wellbeing associations, landscape variables are included as explanatory variables.

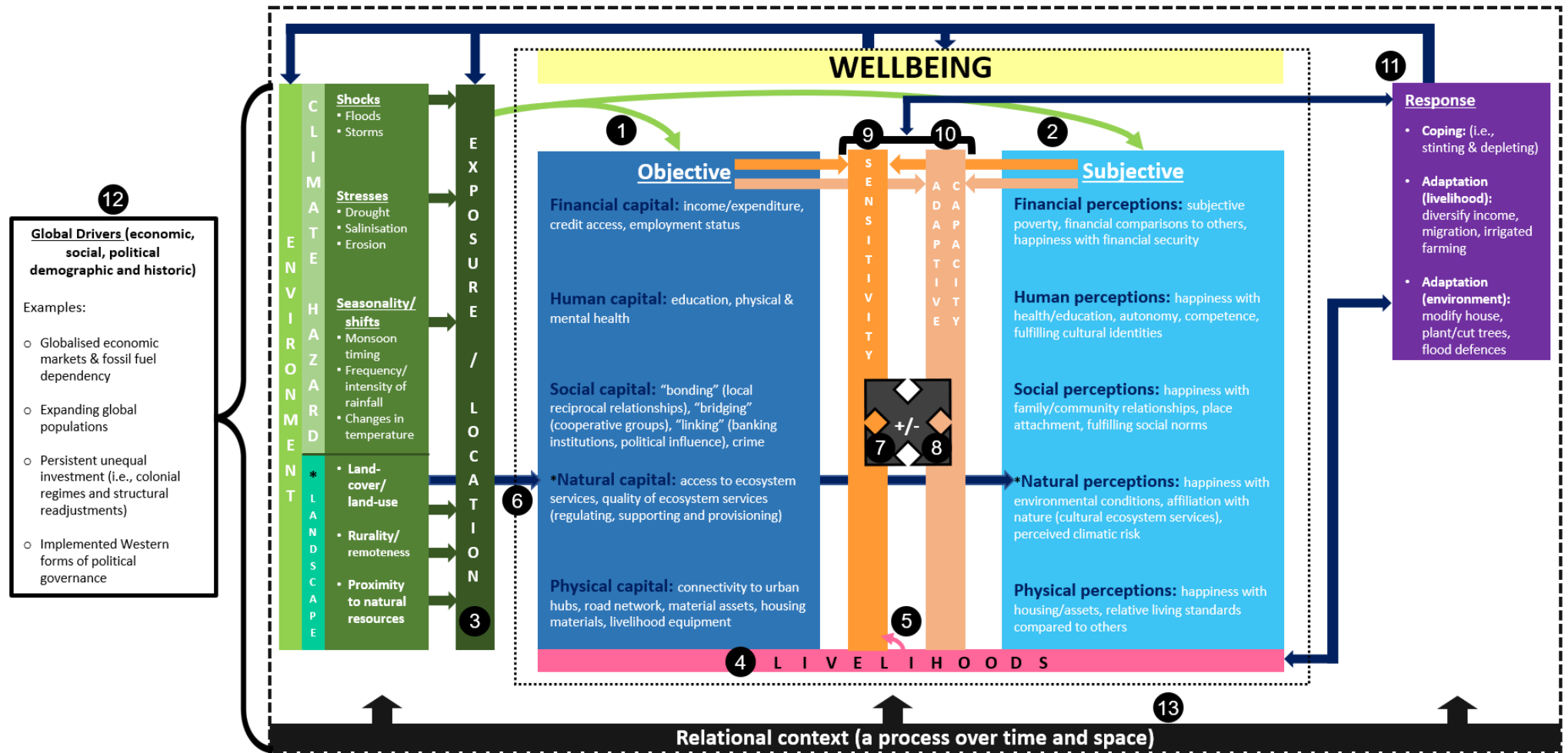


Figure 7.1 The Environment and Comprehensive Wellbeing (ECW) framework. The numbered components are discussed in section (7.3)

7.1.1 Measuring OWB/SWB (Chapter 3)

Chapter 3 illustrated the sensitivity of wellbeing measurement to methodological and conceptual decisions, emphasising the importance of methodological transparency within research. OWB and SWB measures possess strengths *and* weaknesses; therefore, measures should be selected based on research relevancy and contextual suitability. For example, expenditure is favoured over income poverty within subsistence and/or seasonal economies due to its greater stability (Atkinson, 2019).

Association tests illustrated significant interrelations between most multidisciplinary wellbeing measures; however, objective BND did not significantly associate with any other measure. This new finding challenges utility theory (White, 2016), and assumptions that fulfilling basic needs constitutes the foundation of SWB in LMICs (Bull et al., 2010; Guillen-Royo et al., 2013; Nanor et al., 2021). Potential reasons for the non-significant associations include: (i) expenditure poverty; basic needs are ends in themselves, and can be achieved through non-market channels such as informal exchange, (ii) subjective financial stress; SWB impacted more by relative comparisons than absolute basic needs, (iii) unhappiness; less-tangible needs, such as community relations, prioritised over material needs within certain communities. Opposing outcomes across households illustrated that different measures are not interchangeable, supporting claims of Edwards et al. (2016), yet challenging studies implicitly assuming single measures capture wellbeing in its entirety (Hallegatte & Rozenberg, 2017).

This chapter highlighted the importance of incorporating different wellbeing measures within sustainability research to avoid excluding crucial information (Copestake, 2008). Even within the same broad philosophical approach wellbeing rates varied; for example, cultural traits potentially contributed towards the lower unhappiness rate compared to financial stress (Dzokoto, 2012). This result accentuates the value of exploring wellbeing within the “relational context” (Figure 7.1).

7.1.2 Environmental associations with OWB/SWB (Chapter 4)

Chapter 4 explored environmental associations with singular and combined wellbeing measures. All climate hazard variables negatively impacted at least one outcome, while primary sector livelihoods significantly associated with greater odds of expenditure poverty, BND and financial stress. However, landscape characteristics associated with OWB and SWB differently. For example, high grassland coverage increased expenditure poverty, yet reduced financial stress; potentially linked to remote landscapes restricting market opportunities, yet reducing

visibility of comparatively higher living standards (Ravallion et al., 2013). Interaction terms within select models and key statistical relationships also illustrated wellbeing components, such as education (Muttarak & Lutz, 2014), to be “means” to further wellbeing by influencing “sensitivity” (section 7.3.9) and/or “adaptive capacity”.

A broad distinction was uncovered between “poor/happy” outcomes within agricultural communities exposed to drought and/or erosion, and “non-poor/unhappy” households within coastal/riverine, peri-urban locations impacted by flooding and/or salinisation. These results suggest hazards associate with wellbeing differently within varying contexts, supporting Gough & McGregor’s (2007) claim that wellbeing is constructed within a specific time and space.

This chapter highlighted multiple environment-wellbeing relationships. The analysis focused on environmental variables, one of many broad contextual factors influencing wellbeing. Other factors were controlled for by the breadth of independent variables within the models.

7.1.3 Communities’ wellbeing weightings (Chapter 5)

Chapter 5 evaluated differences in wellbeing priorities between key socioecological subgroups using the decomposable BND measure. For example, farming and fishing livelihood groups weighted “employment” significantly higher than peri-urban groups; potentially linked to its importance in fulfilling cultural obligations and food security (Brown et al., 2021).

Significant differences were also recorded between community members and DPOs. For example, “cooperatives” received higher scores from DPOs, possibly because local governments were unaware of the associated challenges, such as corruption, and viewed community groups as low-cost solutions to social issues (Afranaa Kwabong & Hanisch, 2013). By highlighting areas of disconnect, this exercise advocates for greater cross-scale dialogue to minimise government/community conflicts.

The sensitivity of wellbeing measurement to weighting selection was illustrated by the overall BND rate being lower when using “community livelihood”, rather than “nested” or “DPO” weights. Certain communities recorded deprivation rates >20% lower when using community, rather than DPO, weights. However, differences were not homogenous, with greater alignment between peri-urban community and DPO-weighted rates. Nevertheless, even if similar rates were produced, individual priorities still varied.

Due to the sensitivity of wellbeing measurement to weighting selection, and its implications for policy focus, sustainability research should incorporate multiple weighting approaches and local priorities to ensure the most vulnerable communities are targeted (Booyesen, 2002).

7.1.4 Drivers of opposing OWB/SWB (Chapter 6)

Chapter 6 analysed semi-structured FGs and interviews to explore environmental relationships with opposing OWB/SWB. This chapter expanded upon the distinction between rural “poor/happy” and peri-urban “non-poor/unhappy” households identified during quantitative modelling.

Fieldwork discussions supported certain model results. For instance, low financial OWB in agricultural areas was linked to uncertain seasonality and limited adaptive resources, whilst SWB was maintained through a contentment with life, often grounded in religion, and community togetherness. In contrast, higher financial OWB in non-rural locations was associated with less-vulnerable livelihoods and greater public investment, whereas lower SWB was potentially related to greater inequality, unreachable aspirations, and fears of coastal hazards. The urban/rural disparity aligns with existing LMIC studies (Guillen-Royo & Velazco, 2012; Knight & Gunatilaka, 2010a; Markussen et al., 2018).

However, qualitative fieldwork also uncovered concepts uncaptured by quantitative models. For example, social capital and place/community attachment were not a constant source of SWB within rural communities, with fluctuations in togetherness recorded during climate hazards. Similarly, despite no significant interactions between environmental variables and education, multiple respondents supported Muttarak & Lutz (2014) by noting the importance of schooling in boosting adaptive capacity.

Responses to “does money equal happiness?” were also examined. Despite the majority claiming “money *does* equal happiness”, differences in how financial OWB contributes towards SWB were recorded. For example, the role of money in maintaining family relationships was mentioned more within rural communities, whereas its capacity to create “status” was more-frequently noted in peri-urban sites. Yet, overall, financial OWB most commonly represented “potential”, rather than “realised”, wellbeing (Gasper, 2007), with money bringing happiness through access to other prioritised needs.

7.2 Wider significance

This section reviews the thesis' methodological/empirical, theoretical and policy contributions. See Appendix (7.1) for more detail. The three overarching insights are:

- OWB/SWB are associated, yet not interchangeable. However, the association varies across environmental conditions.
- Wellbeing measures should incorporate weights from different groups to capture diverse priorities across space.
- Sustainable development targets should incorporate SWB goals to achieve comprehensive improvements.

7.2.1 Methodological/Empirical contribution

7.2.1.1 *Measuring wellbeing*

This research contributes towards understanding wellbeing measurement within sustainability research. Evaluating different OWB/SWB methodologies highlighted pros/cons within an LMIC context. For example, measuring financial stress with an “adequacy” approach minimises errors associated with subsistence communities quantifying their needs. The review emphasised the importance of methodological transparency, as decisions can impact households' classifications and policy focus. Additionally, calculating multiple wellbeing measures using the DECCMA survey illustrated the capacity to comprehensively explore wellbeing with secondary data.

As policy interest in “wellbeing” grows (Osei-Tutu et al., 2020), research should further evaluate how different concepts interrelate. Association tests showing OWB/SWB to be related, yet not interchangeable (Chapter 3), support the need to incorporate and compare multiple wellbeing measures within sustainability research, and avoid using singular, unidimensional measures. These various measures and policy interventions should be monitored on multiple scales, as macroscale, easy-to-collect OWB outcomes may not align with the greater responsiveness of individual-level SWB.

Furthermore, this study combined OWB/SWB within binary measures (Chapter 4) to better understand how environmental and control factors shape the relationship between different conceptualisations. From a methodological perspective, the use of binary rather than multinomial modelling improved model parsimony and interpretability, and allowed for

outcomes of interest to be compared to the rest of the sample, rather than arbitrary reference groups.

7.2.1.2 *Wellbeing & Environment*

This thesis adds to the limited empirical evidence supporting environment-wellbeing interconnections (Schleicher et al., 2018a). Chapter 4 illustrated the value of incorporating self-reported *and* remote sensing environmental variables within wellbeing research. Self-reported variables are important as climatic perceptions influence people's behaviour (Alam & Mallick, 202), whereas the large proportion of variation in outcomes explained by landscape variables (Appendix 4.10) supports the inclusion of remote sensing variables. Understanding relationships with readily-available remote sensing variables can support local planning decisions, and improve the timeliness of wellbeing evaluations and policy response (Berchoux & Hutton, 2019).

Constructing multiple environment-wellbeing models, including several singular and combined outcomes, was an important methodological process when exploring “comprehensive” wellbeing. Incorporating environment-control interaction effects was also key in reflecting how wellbeing components can be “means” to further wellbeing by influencing “Adaptive capacity” and/or “Sensitivity”. Furthermore, climate-landscape interactions were also required to statistically acknowledge the “relational context”, as hazards potentially impact wellbeing differently in varying environments. Supporting models with qualitative fieldwork was also essential in capturing “relational” processes; for example, restrictive natural resource governance in Anyamam (S2) potentially contributed towards lower SWB, despite proximity to diverse natural capital.

7.2.1.3 *Community involvement*

This project exemplified the benefit of an explanatory sequential mixed method approach within wellbeing research. Qualitative fieldwork aided the understanding of counter-intuitive statistical results which can emerge when modelling complex human behaviour. For example, higher financial OWB within flood-impacted communities (Model 4.1.1) potentially reflected the positive effect of diverse livelihoods and connectivity, rather than the impact of climate shocks. PRA methods also enriched the wellbeing data, and ensured non-tangible concepts such as SWB, which are difficult to capture through detached quantifiable surveys, were discussed.

Chapter 5 highlighted the importance of capturing local weightings when measuring wellbeing, as results and policy focus can substantially differ to when using external assumptions. This novel method can be an effective policy tool in encouraging cross-scale dialogue. The varying BND rates across livelihoods, genders and decision-making groups also emphasised it is not only important to capture communities' priorities, but *where* and *whom* you collect weightings from matters.

7.2.2 Theoretical contribution

7.2.2.1 *Conceptual framework*

The new “ECW” framework (Figure 7.1) theoretically contributes to sustainability research by providing a novel approach to exploring environment-wellbeing systems. The framework integrates concepts from “comprehensive” wellbeing (White, 2016), and multiple existing frameworks, to ensure accessibility for broad audiences. The structure supports research on the environmental factors affecting OWB, SWB, and OWB/SWB associations. Furthermore, incorporating quantifiable capitals and subjective perceptions within a “relational context”, offers flexibility regarding data sources, supports mixed method participatory research, and encourages the inclusion of interdisciplinary theories.

Evaluating small-scale studies alongside the framework can help detect context-specific “relational” processes which differ from general understanding in the literature (section 7.3). Additionally, the “comprehensive” approach ensures the framework incorporates elements from Nunan’s (2015) “livelihood” and “wellbeing” approaches, providing flexibility to explore quantifiable trends over time and space, alongside in-depth understandings of individuals’ values and emotions.

7.2.2.2 *Wellbeing & Environment*

This thesis contributes towards understanding how environmental conditions associate with different wellbeing conceptualisations in Volta Delta. For example, the dichotomy between “poor/happy” agricultural households impacted by drought and/or erosion, and “non-poor/unhappy” peri-urban households within flood-impacted coastal/riverine locations, highlights the capacity for hazards to influence wellbeing differently depending on the environmental and social context. These differences draw on existing comparisons in the

literature; rural/urban (Theodoropoulos, 1999), collectivism/individualism (Guillen-Roya & Velazco, 2012) and connected/remote (Fafchamps & Shilpi, 2008).

By including multiple, decomposable OWB and SWB measures, this study highlighted the broad range of potential environmental impacts upon wellbeing. For example, mixed method results suggest flooding has material, social, emotional and financial impacts. These results advocate for further research into how environmental conditions impact different strands of wellbeing in LMICs, particularly SWB which is often overlooked (Sulemana et al., 2016), yet plays a pivotal role in communities' behaviours and responses.

Qualitative findings further contributed by challenging assumptions and creating future research avenues. For example, the expectation that social capital is an ever-present substitute for financial capital in rural areas (Kay & Jost, 2003) was disputed by respondents claiming “money equals happiness” and that droughts occasionally weaken relationships to facilitate individual survival. Furthermore, some respondents challenged assumptions that remote communities have limited awareness of external living standards; therefore, future research should explore the scope of comparative reference points within communities with varying levels of connectivity.

7.2.3 Policy relevance

This study emphasises the importance of incorporating OWB and SWB within policy to target “comprehensive” wellbeing improvements (White, 2016). In contrast, many Ghanaian development agendas monitor success through OWB measures, including the “Ghana Poverty Reduction Strategy” (Government of Ghana, 2012) and SDGs. Crawford & Abdulai (2009) also note the influence of World Bank policies upon Ghanaian strategies, with expanding privatisation and economic reforms monitored through unidimensional OWB goals.

The importance of incorporating SWB within development policy is reinforced by studies showing that psychological impacts of climatic hazards often outweigh physical effects (Hayes et al., 2018). Furthermore, individuals' emotions and perceptions govern behaviour, thereby influencing community buy-in and policy success. Therefore, sustainability research should assist policymakers by improving their understanding of SWB, and exploring relationships with various social, political, and environmental challenges to alleviate the hidden costs of unhappiness and build resiliency within vulnerable socioecological systems. This shift in focus could broaden the scope of success for Ghanaian development projects (Domfeh & Bawole, 2009).

Chapters (4-6) highlight how environment-wellbeing associations vary across space. Therefore, wellbeing policy should not apply “blanket approaches”, rather decentralised initiatives addressing communities’ specific needs are recommended. Ideally, the measures used to monitor policy should be decomposable, allowing multidimensional challenges to be addressed through bespoke, rather than homogenous, interventions.

Results highlighting opposing OWB/SWB further justify the inclusion of different wellbeing conceptualisations to prevent one being interpreted as an effective substitute for the other. In contrast, policy solely using an “objective” framework could omit information on how collective norms, a foundation of higher SWB, could be used to harness knowledge sharing and collaboration to support environmental policies (Bouma et al., 2008). Similarly, an exclusively “subjective” framework may discourage essential material investments if happiness is high.

7.2.3.1 *Recommendations*

This subsection lists policy recommendations based on the study’s findings:

- **Improve domestic and irrigation water access/affordability;** boost financial OWB by facilitating year-round employment and trade, and reducing collection demands.
- **Use community togetherness to stimulate growth in rural *and* urban communities;** explored by Akatsi North DPO (S4), where social welfare programmes promoted the “need” to develop common goals and collaborative projects, which local government then supported.
- **Improve rural connectivity;** roads generate growth in business and populations, and improve market access.
- **Construct and maintain flood defences;** grey or green infrastructure (i.e., mangroves) to mitigate health risks and displacement. Need to function at a suitable scale to prevent issues being shifted to other communities.
- **Minimise rural/peri-urban divide;** previous decentralisation has not reduced inequalities. Increased funding in public services (i.e., education & health) and access to private credit in rural areas. Many stated “money equals happiness” because it satisfies basic needs. Investing in accessible services could therefore also maximise SWB.
- **Introduce agricultural standards/set prices;** ensure farmers receive a fair price, with many examples of buyers from Accra underpaying when buying directly within other communities.
- **Tackle systemic divide between education system & job market;** further integration, with opportunities for work placements during studies. Create alternative education channels tailored towards emerging industries.

- **Capacity building within national/local governments for more-frequent community engagement;** create spaces for cross-scale dialogue to minimise disconnect between government and communities. For example, communities being neglected by state-driven privatisation in Songor Lagoon. Cross-scale platforms should be inclusive, empowering marginalised groups to make decisions over agricultural practices and trade.
- **Climate resilient agriculture;** improve access to tolerant crop varieties and seed bank technology to minimise crop failures and food/financial insecurity.
- **Local employment quotas for incoming industries;** ensure local communities benefit from non-primary sectors. For example, few locals are employed in Accra-funded Sogakope hotels and Songor Lagoon salt operations.
- **Increase mental health service access;** climate hazards often associate with poorer mental health and SWB, yet current service provision in Ghana is inadequate (WHO, 2023).

7.3 Evaluating the conceptual framework

This section draws on mixed method results to evaluate each numbered component of the “ECW” framework (Figure 7.1), and discusses findings challenging the framework (RQ1a). Two causal loop case studies from Kedzi (S7) and Anyamam (S2) (Appendix 7.2) illustrate the complex interconnections. This section includes segments of these diagrams to demonstrate key relationships. Verbatim quotes are also included, with previously referenced quotes cited using the site number (Table 5.1) and corresponding page number.

Overall, the literature-based “ECW” framework was robustly supported in Volta Delta. Although local and individual-level nuances can create differences, the framework’s flexibility to accommodate these variations can facilitate meaningful contextual comparisons.

7.3.1 Environment-OWB

Quantitative model results (Chapter 4) illustrated climate hazards, landscape connectivity and landcover characteristics to significantly associate with expenditure poverty and BND; supporting the overarching interpretation of “environment” as a wellbeing determinant. For example, grassland landscapes associated with higher odds of expenditure poverty (Model 4.1.1), while poor connectivity to district capitals increased BND (Model 4.1.2). These relationships were supported during fieldwork, with grassland communities discussing the loss of investments during drought (S4,p.291), while others supported Owusu (2005) by noting how

decentralisation has resulted in public investment being channelled into district capitals rather than surrounding areas (S2,p.294). Certain model results also illustrated positive or neutral relationships with climate events. For example, Model (4.2.1) presented higher odds of aligning high OWB/SWB when a household was exposed to, yet not impacted by, drought; potentially due to successful adaptation.

7.3.2 Environment-SWB

Environmental conditions were also illustrated to be SWB determinants. Changing rainfall and temperature increased odds of financial stress (Model 4.1.3), whereas salinisation increased unhappiness (Model 4.1.4). Fieldwork respondents also noted how coastal hazards disturb peace, generate fear (Hudson et al., 2019) and force displacement (S2,p.311), whereas changing rainfall patterns bring emotional challenges; *“lack of rains...lead to poor yield which brings heartache” (5,FG,M)*.

Climate hazards also related to SWB by increasing inequality and relative comparability (Adger et al., 2002). Figure 7.2 illustrates this process in Anyamam, where due to persistent flooding (hazard), community members' investment in property and assets (physical capital) was alternatively undertaken in the district capital Sege, which possesses greater political influence (linking social capital). The financial capital used to invest in the district capital was accumulated from fishing operations (natural capital) and extracted outside the community. These processes created proximate and visible inequalities (financial/physical perceptions) (S2,p.305).

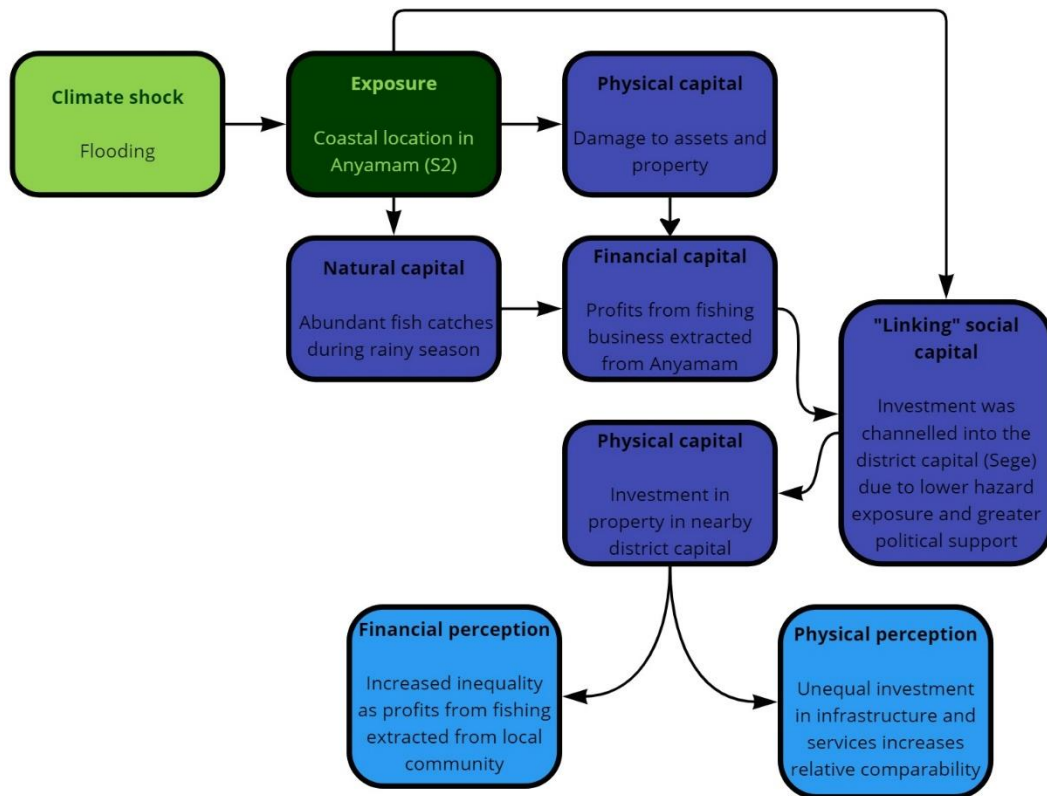


Figure 7.2 Section of the Anyamam (S2) causal loop diagram presented in Appendix (7.2a), incorporating various elements of the “ECW” framework

7.3.3 Exposure/Location

“Exposure” is a component, not a determinant, of “risk” (IPCC, 2024). Regardless of “sensitivity” and “adaptive capacity”, certain communities are located in areas more exposed to hazards. For example, livelihood type may implicitly capture “Exposure”, with one respondent noting how residing in coastal fishing communities brings persistent danger (S2,p.309). Furthermore, crop farmers primarily live in cropland and grassland landscapes exposed to drought and erosion. Rural respondents also noted how their inland location influences drought exposure and water shortages; *“unlike our counterparts closer to the sea, they easily access water unlike us who depend on God-given rain”* (5,FG,M).

7.3.4 Livelihood-Wellbeing

The “ECW” framework appends “Livelihood” to OWB and SWB to illustrate how different groups can conceptualise and prioritise wellbeing differently (Nanor et al., 2021); supported by the significantly different weights given to basic needs (Chapter 5). Different wellbeing priorities, shaped by communities’ “relational” processes, were also found across varying landscapes.

For instance, an interviewee in Afienya (S1), with access to industrial occupations in Tema, stated those doing the best *“are people who have a lot of money”* (1,CI,M), whereas a respondent in rural Nyitawuta claimed crop quality was a key indicator of a “good life” (S4,p.295).

7.3.5 Livelihood-Sensitivity

“Livelihood” can affect “Sensitivity”, supported by quantitative models reporting higher odds of expenditure poverty, BND and financial stress amongst “crop farmers” and “fishers/traders”. Despite no significant interaction effects, these results suggest primary livelihoods are more sensitive to environmental and wellbeing challenges (Saha et al., 2024). Fieldwork discussions supported these findings, with residents near Tema and Accra transitioning from farming to factory and construction jobs to minimise financial uncertainty (S2,p.296). In contrast, within communities with fewer migration opportunities, the sensitivity of farming livelihoods resulted in financial challenges; *“the rainfall patterns are not helping our yields which reduces the income we get from selling produce”* (5,FG,M).

7.3.6 Landscape (wellbeing determinant and constituent)

The “ECW” framework is primarily designed to interpret “environment” as a wellbeing determinant; however, the arrow connecting “landscape” to natural capitals/perceptions flexibly allows for the inclusion of environmental “constituents” also (Schleicher et al., 2018b). Quantitative models captured determinants, whereas qualitative methods could identify determinants *and* constituents; justifying the mixed method approach. For example, respondents noted how landscape characteristics contribute towards different wellbeing outcomes; with wetlands providing ideal conditions for flood-resistant cash crops, and poor road infrastructure restricting market opportunities (S4,p.294). However, communities also viewed “environment” as a wellbeing constituent (Mawere, 2012; Shoko, 2016); *“this is the land our forefathers reserved for us...we are excited about where we have”* (4,FG,F) and *“good life and happiness exists through the fresh air we get here”* (6,FG,M).

7.3.7 Aligning wellbeing (+)

Chapter 3 supported the depiction of OWB and SWB as separate, yet interconnected, components. Significant chi-square associations were found between certain measures, yet the measures contained different information and were not interchangeable.

The framework depicts OWB and SWB to positively and/or negatively associate with one another (“+/-“). Firstly, exploring reinforcing mechanisms, aligning “non-poor/happy” outcomes were associated with stable environments, including consistent rainfall and limited erosion (Model 4.2.1). Greater certainty in current and future conditions can increase actors’ confidence to invest in objective living standards (Cooper et al., 2008), and reduce subjective feelings of powerlessness (Kidner, 2007).

This study also provided multiple examples of positive associations between capitals/perceptions. For example, permanent employment (financial capital) lowered the odds of financial stress (financial perception) (Model 4.1.3), as a “good job” contributes towards personal growth, status and reduced perceptions of oneself as poor (Alem et al., 2014). Additionally, accessible road infrastructure (physical capital) improved healthcare access (human capital) in Afienya (S1,p.273). Respondents also illustrated a positive relationship between free access to land (natural/physical capital), autonomy (human perception) and happiness (S4,p.297); supporting Dawson et al. (2016), and Davy (2017) who notes accessing land, and its resources, is crucial for maintaining human dignity.

Multiple respondents also suggested financial capital can boost social capital (Meyer, 1998), with monetary resources creating extrafamilial bonds and trusting relationships (social perception); key SWB elements. Viewing this reinforcing mechanism in the other direction, respondents also noted limited employment opportunities may break reciprocal family relationships (S1,p.300); highly valued within a Ghanaian “good life” (Tsai & Dzorgbo, 2012).

7.3.8 Opposing wellbeing (-)

Quantitative and qualitative findings also illustrated potential negative relationships between capitals/perceptions. For example, Model (4.2.4) highlighted opposing “poor/happy” outcomes to associate with inland, agricultural communities impacted by drought and/or erosion. This opposing outcome was hypothesised to be related to physical remoteness limiting relative comparability to higher living standards, and a greater emphasis on non-material components when conceptualising SWB (Ward & King, 2016). In contrast, “non-poor/unhappy” outcomes (Model 4.2.3) associated with peri-urban, coastal/riverine communities exposed to flooding

and/or salinisation. The higher OWB was interpreted to be driven by less-vulnerable employment options and greater public investment, whereas SWB could have been reduced by psychological impacts from coastal hazards (Sekulova & Van den Bergh, 2016), unreachable money-orientated reference points and higher inequality (Guillen-Royo & Velazco, 2012).

Similar themes were also discussed in the field. For example, one DPO disputed the findings of Fafchamps & Shilpi (2008) by noting how limited road accessibility and electricity (physical capital) restricted rural communities' aspirations, reduced comparability to outsiders (financial/physical perceptions) and mitigated negative SWB impacts (S5,p.295). Others noted increased financial capital could conversely lower mental health (human capital) and disturb one's peace (human perception) (S4,p.289) by generating fear of losing accumulated assets (S7,p.302). However, as illustrated by existing LMIC studies (Jordan, 2015; Rotberg, 2010), negative associations between capitals/perceptions also produce positive outcomes. For example, Anloga respondents noted community togetherness (social capital) increased following flood damage to dwellings (physical capital) (S8,p.299).

7.3.9 Wellbeing-Sensitivity

The framework depicts OWB and SWB as “outcomes” *and* “means” to further wellbeing (Atkinson, 2013) by influencing “Sensitivity”. Model results supported this interpretation; for example, an interaction between households' water infrastructure (physical capital) and “distance to water source” (landscape) (Model 4.1.1) suggested access to piped water minimised sensitivity to expenditure poverty during periods of water insecurity amongst households furthest from inland water. This relationship between physical and financial capital could reflect how improved accessibility can minimise “time poverty”, particularly prominent amongst women with domestic obligations (Fisher & Carr, 2005); *“I go to do business, I will gain more, but if I have to do chores; sweeping, fetching water, washing...which take up a lot of time, it will not be possible” (2,C1,F).*

The framework also demonstrates SWB to influence “Sensitivity”, supporting claims that happiness can create a “resiliency culture” and mitigate harm from environmental and social shocks (Addai et al., 2014a). For example, Model (4.1.4) showed lower odds of unhappiness amongst agricultural households with high place attachment, suggesting communities may use their landscape affiliation and community bonds (natural/social perception) as compensatory factors to reduce the sensitivity of SWB to environmental uncertainty and material deprivation (Milbourne, 2014). However, this mechanism may also function in the opposite direction, with

high place attachment potentially exacerbating subjective harm if hazards damage culturally important landscapes (S7,p.311).

7.3.10 Wellbeing-Adaptive capacity

The framework also interprets OWB and SWB to potentially control “Adaptive capacity”; contrasting other studies which view it exclusively through an objective lens (Nyamwanza, 2012). Despite no quantitative models explicitly capturing “adaptive capacity” through interaction effects, multiple qualitative examples were provided. Several respondents noted the importance of education (human capital) and credit (financial capital) in accessing adaptive and sustainable farming practices; *“education has taught us...buy a pumping machine for irrigation and manage your farm without struggling...you can read the instructions [for fertilizers] and how to administer the chemical” (3,FG,M)*. Education was also pivotal in encouraging adaptive construction techniques to mitigate tangible damage, unplanned financial pressures, and negative SWB impacts associated with being unable to look after one’s home; *“because of education we now use slate roofing. The sea breeze cannot destroy it...We are no longer embarrassed by not been knowledgeable in the past” (8,FG,F)*. These statements find support when interpreting model results through an environmental lens; for example, Model (4.1.1) reports lower odds of expenditure poverty amongst households with “above-basic” education.

Family and friend networks (social capital) also increase “Adaptive capacity” by providing soft loans (6,DPO), and sharing knowledge and skills to support adaptive farming practices. “Linking” social capital also boosted “Adaptive capacity” within Anloga (S8), where a dedicated agricultural district office, and extension workers located within communities, improved rural workers’ access to technical advice. The capacity for SWB elements to alter “Adaptive capacity” (Weis et al., 2016) was also demonstrated by Kedzi residents, who claimed place attachment (natural/social perception) stimulated action to combat coastal erosion (S7,p.311).

7.3.11 Response

The importance of “Response” to agricultural communities was highlighted by Model (4.1.1), with lower odds of expenditure poverty among rural (high-EVI) communities when undertaking adaptive practice(s). This relationship emphasises how adaptation often contributes more to poverty reduction than increasing average incomes (Heger et al., 2018). The feedback from “Response” to “Wellbeing” is further supported by a Kedzi farmer whose irrigation reduced

“Sensitivity” to drought, and improved financial OWB by providing a market advantage over rain-fed farmers (S7,p.306). Figure 7.3 illustrates this process; firstly, the farmer responded to uncertain rainfall and salinisation (climate hazards) through irrigation. They possessed sufficient “adaptive capacity”, with savings (financial capital) used to buy pumping machines (physical capital), and guidance from friends (social capital) increasing their knowledge/skills (human capital). Introducing irrigation altered their livelihood and increased access to cash crops (natural capital). Access to sought after crops resulted in buyers travelling to their farm, increasing their financial capital and limiting the financial “sensitivity” associated with remoteness from key markets (physical capital). By fulfilling culturally-valued traits associated with working diligently to progress one’s business (social perception) (Grishchow, 2008), they achieved higher social status and SWB.

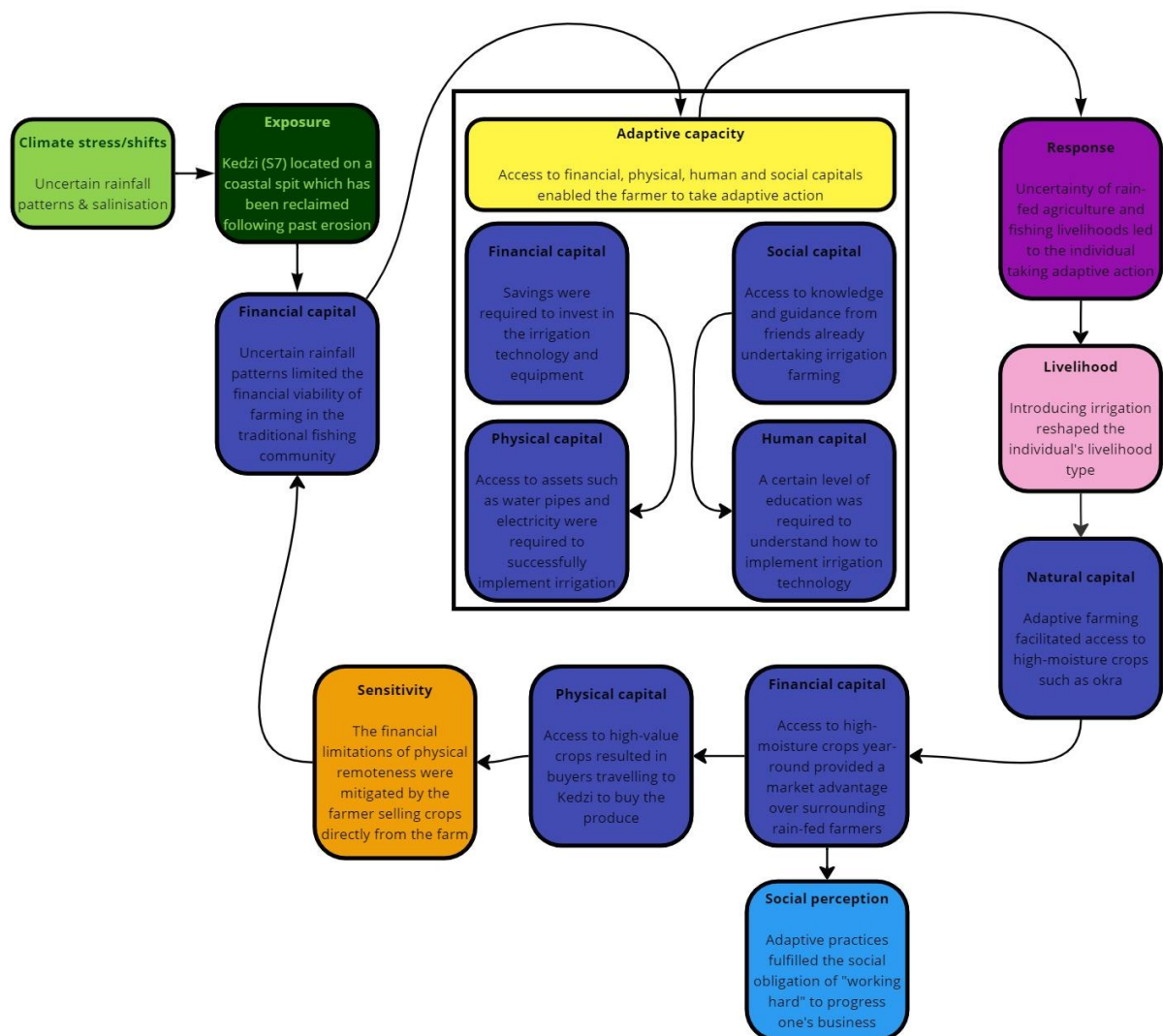


Figure 7.3 Section of the Kedzi (S7) causal loop diagram presented in Appendix (7.2b), incorporating various elements of the “ECW” framework

However, similar to the positive *and* negative relationships recorded between wellbeing capitals/perceptions, results also illustrated inconsistent adaptation outcomes. Households in Greater Accra with past migrant experience associated with lower odds of BND (Model 4.1.2), potentially due to their greater access to financial, knowledge and social remittances from Tema and Accra (Awumbila et al., 2017; Codjoe et al., 2017). However, past migrant households also associated with aligning low OWB/SWB (Model 4.2.2), suggesting migration could result in maladaptation. For example, low SWB may arise from an increased visibility of “unobtainable” living standard reference points (S7,p.304). Similarly, higher odds of expenditure poverty amongst current migrant households (Model 4.1.1) were supported by claims that emigration increases pressures upon the origin’s labour and food productivity (S2,p.296). These results highlight how effective migration policy must account for material *and* subjective requirements (Adger, 2010).

7.3.12 Global drivers

The ability to capture and conceptualise “Global Drivers” within quantitative methods was limited; justifying why the “ECW” framework advocates for participatory mixed method research. Nevertheless, certain model results could be interpreted from a “global” perspective. For example, lower odds of BND in Greater Accra compared to Volta (Model 4.1.2), could be linked to uneven (post)colonial investment causing regional disparity in human capital, infrastructure and livelihood vulnerability (Kambala, 2023). The prominence of vulnerable agricultural livelihoods in Volta Delta can also be connected to macroscale drivers, with structural readjustment programmes generating development pathways centred around unsustainably extracting raw materials for export (Atta-Quayson, 2023). These examples emphasise the importance of acknowledging “Global Drivers” within local-level research to avoid interpreting environmental and wellbeing challenges as internally created and experienced.

7.3.13 Relational context

Similar to “Global drivers”, the “Relational Context” was difficult to capture within quantitative analysis; however, results can be interpreted through a “relational” lens and supported by qualitative findings. For example, “relational” processes can help explain differences between collective agricultural communities and individualistic peri-urban towns (S3,p.289), and subsequently, why different OWB/SWB combinations were observed across varying

environmental contexts. Long-term differences in private and public investment may have resulted in personal financial success being prioritised in built-up areas, compared to collective practices within rural areas with historically slow socioeconomic development (Pokimica et al., 2012).

The greater emphasis upon financial wellbeing and relative comparisons in peri-urban areas (Duku et al., 2022) is potentially reflected by the higher odds of financial stress in built-up areas exposed to storms (Model 4.1.3). Individuals may perceive themselves as having “more-to-lose”, and therefore experience greater SWB impacts from climate hazards. This finding contrasts how collectivism in rural areas may create psychological resilience to hazards, and allow actors to maintain higher SWB. These results suggest the “relational” mediates communities’ priorities, the value attached to financial capital, and the extent to which it impacts SWB (Figure 2.19).

The “relational context” is broadly interpreted to include power and natural resource governance. The influence of these social structures upon environment-wellbeing relationships is exemplified around Songor Lagoon (S2), where despite proximity to profitable salt resources, enforced restrictions upon actors’ capabilities reversed the potential financial benefits (section 6.3.2.3).

The “relational context” is also hypothesised to influence individuals’ wellbeing conceptualisations. For example, the deteriorating economic landscape in Ghana (IMF, 2023; World Bank, 2022), compared to previous periods of growth, potentially encouraged respondents to prioritise financial capital during the weighting exercise (Chapter 5) and near unanimously state “money equals happiness”. Including the “relational context” ensures researchers challenge their assumptions and explore how broader processes interact with local wellbeing.

7.3.14 Challenges

This subsection summarises findings challenging the “ECW” framework. Firstly, despite the terminology “wellbeing” providing an optimistic and holistic outlook, the positive tone could result in certain challenges being overlooked. This framework uses “wellbeing” when referring to positive *and* negative impacts, whereas other authors distinguish between “well/ill-being” (White, 2010).

Furthermore, using the IPCC risk model as the foundation for the framework implicitly suggests environmental challenges cause adverse effects (Reisinger et al., 2020); however, some

respondents noted minimal or positive impacts. For example, increased community togetherness (social capital) was recorded during flood events, whereas a religious acceptance of drought minimised negative SWB impacts (S3,p.292). Nevertheless, by framing “Wellbeing” to have the capacity to improve “Adaptive capacity” and reduce “Sensitivity”, rather than defining the terms as elements of “risk”, the “ECW” framework is flexible in allowing negative, neutral and positive impacts to be explored.

Next, by listing wellbeing capitals/perceptions under the “OWB” and “SWB” umbrella titles, the framework could suggest similar mechanisms influence each component. However, substantially different subjective financial stress and unhappiness rates (section 3.10.5), and the different variables associated with varying outcomes (Chapter 4), illustrate how wellbeing measures within the same broad OWB/SWB classification can be affected in distinct ways.

Despite the “livelihood cluster” variable featuring in multiple models, no significant interactions with environmental variables were found. This finding suggests the variable did not effectively capture how “Livelihood” potentially impacts “Sensitivity”. However, qualitative discussions supported the framework. For example, fishing communities (S2,S7) recorded how storms disturbed their catches, destroyed equipment and lowered financial OWB, whereas the dependence upon agriculture for income and food security increased the harm caused by drought and uncertain seasonality for crop farmers.

Certain findings also challenged the assumption that wellbeing components consistently contribute towards further wellbeing by improving “Adaptive capacity”. For example, high place attachment (natural/social perception) did not significantly reduce the odds of expenditure poverty when impacted by drought (Model 4.1.1). Similarly, positive personalities did not lower the odds of unhappiness when impacted by storms (Model 4.1.4). Select respondents also stated education (human capital) raises aspirations, which if unmet due to the systemic disconnect between education and job markets, can lower SWB. Therefore, the framework should be interpreted flexibly to acknowledge how capitals/perceptions do not universally enhance “Adaptive capacity”.

Conclusively, the concept “money is blood” was mentioned by multiple respondents, referring to how financial capital maintains the fabric of Ghanaian culture (Hasty, 2005). Therefore, depicting wellbeing as consisting of decomposable, yet interrelated, elements may not align with local views, where financial capital is seen as inseparable from other wellbeing elements, such as social capital. However, encompassing different capitals/perceptions under the term “Wellbeing” illustrates the capacity for different elements to simultaneously coexist.

Furthermore, a framework should provide practical research and policy support; therefore, having distinct categories can improve results’ simplicity and interpretability (Nunan, 2015).

7.4 Limitations

This section summarises the study's broad limitations. Firstly, Volta Delta is a case study, therefore the environment-wellbeing relationships uncovered are potentially not scalable to larger global deltas. However, the various methodologies can be replicated, and new findings can be compared to Volta Delta, and the "ECW" framework, to detect context-specific effects.

Quantitative analysis incorporated environmental variables as wellbeing determinants, yet the "ECW" framework and qualitative discussions also depicted "environment" as a wellbeing "constituent". Therefore, incorporating environmental independent variables within regression models potentially omits important components of communities' wellbeing. However, viewing environment as a wellbeing "constituent" may prevent policies from addressing urgent challenges if it does not align with broader socioeconomic or environmental goals (Schleicher et al., 2018b).

Feedback effects from "Wellbeing" to "Environment" were beyond the study's scope. Quantitative modelling introduced an "artificial" linearity to the environment-wellbeing system, yet cyclical relationships were illustrated in the "ECW" framework and causal loop examples (Appendix 7.2).

Using the DECCMA survey also had limitations. Firstly, proxy measures were calculated because the survey was designed for alternative RQs (Tripathy, 2013). Furthermore, certain wellbeing components, considered important in the literature, were unavailable or contained high missing data (i.e., land ownership, livestock assets, female-specific SWB, and natural resource governance⁹⁵). Additionally, to ensure comparability across measures, a "household" unit of analysis was used, which alongside the assumption that household heads' SWB applied to the entire household, prevented quantitative analysis from exploring intrahousehold differences. Measuring wellbeing through binary measures also potentially reduced the amount of information captured (Laderchi et al., 2003), limited the capacity to examine different environmental relationships across the wellbeing spectrum and identify households close to "low wellbeing" thresholds.

As the DECCMA survey was cross-sectional, SWB could have represented an individual's momentary mood, rather than general wellbeing (Ravallion, 2014). The severity of this limitation depends on the theory subscribed to; for example, set point theorists assume framing SWB questions within broad timeframes captures actors' baseline SWB rather than temporary

⁹⁵ See Appendix (2.4) for examples of variables which would have been used to explore the relationships within the conceptual framework if available in the dataset.

fluctuations (Lent, 2004). Nevertheless, although the “ECW” framework acknowledges environment-wellbeing relationships to be negotiated through the “relational context” in time and space, cross-sectional survey data limited the capacity to view “wellbeing” and “environment” as dynamic processes.

Resource and time restraints potentially limited the richness of qualitative data. Limited control over participant selection also affected which voices were accessible, potentially reducing the sample’s representativeness. Moreover, wellbeing weights (Chapter 5) were collected from eight communities, yet broadly applied to all 50 EAs. Future research should collect weights from all sites to robustly capture local priorities across various socioecological subgroups.

The explanatory sequential mixed methods approach meant quantitative findings guided qualitative fieldwork, potentially resulting in preconceived ideas being brought into the field. For example, pre-selected basic needs, rather than community-defined priorities, were scored during the weighting exercise. This limitation was accepted due to the reliance on secondary data, yet future research should capture communities’ prioritised basic needs before weightings.

7.5 Future work

This section summarises suggestions for future research. Firstly, the remainder of the non-linear environment-wellbeing system could be explored by modelling the association between “wellbeing” and environmental dependent variables. Furthermore, collecting longitudinal data would overcome the limitation of viewing environment-wellbeing associations as a snapshot, and facilitate analysis on the impacts of hazards, land-use change and seasonality over time. For example, investigating whether flooding causes permanent SWB damage, or whether fears dissipate over time (Sekulova & Van den Bergh, 2016).

Future work could also explore OWB and SWB as continuous, rather than binary, measures. For example, absolute expenditure or the happiness index, rather than clustered groupings, could be used for more-granular analysis. Yet, challenges would arise when comparing measures with different scales (Laderchi et al., 2003).

From a policy perspective, incorporating multiple wellbeing measures could be confusing, and potentially delay action if outcomes oppose one another. Therefore, future work could combine OWB and SWB into a single “comprehensive wellbeing” measure (White, 2016), similar to Bhutan’s Gross National Happiness index (Ura et al., 2012). The measure should be

decomposable to facilitate targeted action, and contain community-preference weights to minimise the effect of researchers' assumptions. With greater monetary and time resources, household-level rather than livelihood type weightings should also be collected to prevent priorities being generalised. However, combining OWB and SWB brings challenges (section 3.5.2.1).

Extended fieldwork is required to achieve an in-depth understanding of key environment-wellbeing mechanisms, for example analysis on whether “money equals happiness” only “scratches the surface” in this thesis. Community workshops could use vignettes to elicit the emotions experienced during climatic hazards or in specific landscapes, and uncover how OWB/SWB relationships change in time and space (Gould et al., 2015).

The fluidity of social capital unveiled in this study could be explored further. Particular focus could be given to agricultural communities, where social relationships are often a source of climatic and financial resiliency (Kay & Jost, 2003). For example, seasonal calendars could be used to explore how seasonal patterns, and unforeseen climatic hazards, influence cohesiveness and reciprocity over time (Craig et al., 2023).

7.6 Concluding remarks

This study, structured using the new “ECW” framework, explored OWB, SWB, and their association within an environmental context using mixed method, multidisciplinary approaches.

Interpreting wellbeing through objective capitals and subjective perceptions highlighted how OWB/SWB are related, yet not interchangeable, and how environmental conditions can associate with varying wellbeing conceptualisations differently. These findings advocate for sustainability research and policy to incorporate OWB *and* SWB to address individual methodological limitations, improve community buy-in, and target “comprehensive” wellbeing (White, 2016). Incorporating local priorities and voices from diverse communities and socioecological groups is also pivotal in capturing context-specific needs, and preventing external assumptions from overly influencing wellbeing classifications and policy focus.

Quantitative modelling addressed the research aim by illustrating significant environmental associations with various wellbeing outcomes. However, relationships were complex, with certain characteristics impacting OWB and SWB differently. Further analysis of opposing OWB/SWB uncovered a broad distinction between “poor/happy” agricultural communities and

“non-poor/unhappy” coastal/riverine peri-urban towns. However, SWB should not be interpreted as a substitute for financial security, with initiatives targeting OWB *and* SWB recommended.

This study highlighted how OWB and SWB can be impacted by, and interact differently within, various environmental contexts. These relationships sit alongside other “Global Drivers” within the broader, cyclical environment-wellbeing nexus. Overall, sustainability research and policy should be transparent when measuring wellbeing, and incorporate OWB *and* SWB to prevent negative trade-offs and the omission of crucial information regarding communities’ wellbeing.

Appendix

Appendix – Chapter 2

Appendix 2.1 The different metrics incorporated within the multidimensional deprivation index produced by the GSS (2020)

Dimension	Indicator	Deprivation cut-off	Weight
Living standards	Cooking fuel	Deprived if household uses solid fuels and cooking is not done outside the house or in the open, or cooking is undertaken in enclosed spaces	1/21
	Water	Deprived if a household's drinking water is from an unclean source (tanker supply/vendor provided; unprotected well; unprotected spring; river/stream; dugout/pond/lake/dam/canal; other) or a round trip distance to collect water takes 30 minutes or more	1/21
	Assets	Deprived if household does not have more than one small asset (radio, TV, telephone, bike, motorbike, refrigerator, or computer) and does not own a car	1/21
	Housing	Deprived if household uses inadequate flooring (earth/mud, other) or walls (earth/mud, palm leaves/thatch [grass/raffia], other)	1/21
	Overcrowding	Deprived if household has more than 3 people per sleeping room, on average	1/21
	Electricity	Deprived if household does not have electric power	1/21
	Sanitation	Deprived if household has no toilet facilities, uses bucket/pan, public toilet, shared toilet outside the house, other	1/21
Education	School attendance	Deprived if any school-age child (4-15 years) in the household is not attending school	1/9
	School attainment	Deprived if no household member has received an educational qualification	1/9
	School lag	Deprived if household has any member who is 2 or more years behind in school	1/9
Health	Nutrition	Deprived if household has any child under 5 who is undernourished (underweight or stunted)	1/6
	Health insurance	Deprived if anyone in the household is not covered by the national health insurance scheme	1/6

Appendix 2.2. Selection of development indicators across the 10 regions of Ghana. Data from the 2010 Population and Housing Census (GSS, 2013), sourced from Awanyo & Attua (2018)

	Region									
Indicator	G. Accra	Ashanti	Eastern	Central	West	Volta	Brong-Ahafo	North	Upper East	Upper West
% regional population 12+ years with mobile phone 2010	73.5	56.1	44.5	44.9	46.4	37.3	40.2	22.3	24.2	21.7
Population 12+ years using the internet (% national total) 2010	42.3	22.5	6.8	7.9	7.9	3.9	4.0	2.4	1.2	1.1
Dwelling units with access to pipe-borne water (% regional total) 2010	64.3	51	34	53.4	46.3	45.3	37	28	18	21.1
% urban, 2010	90.5	60.6	43.4	47.1	42.4	33.7	44.5	30.3	21.0	16.3
Net migration rate (per 1,000) 2010	324.8	0.6	-127.2	-110.1	120.2	-258.6	51.5	-135.5	-257.2	-302.5
% households with electricity 2010	87.1	73.6	58.5	66.1	65.0	49.6	53.8	36.1	24.1	30.9
Population per doctor (public/private) 2012	3,540	9,715	19,748	22,505	27,775	24,728	15,705	19,163	39,697	40,502
% regional trunk roads classified as good 2007	83.0	70.8	53.7	69.6	62.5	47.5	54.0	59.0	46.9	23.0
Illiteracy rates (% regional population 11+ years) 2010	10.7	17.4	19	21.8	23.6	26.5	30.2	62.8	52.5	53.8
% regional population 6+ years with education beyond basic education levels 2010	32.3	19.7	14.1	16.0	16.5	13.5	13.4	8.5	9.1	9.9

Appendix 2.3. Examples of the interrelationships between the five objective capitals and five subjective perceptions outlined in the conceptual framework. Positive and negative associations are presented

Wellbeing component (1)		Wellbeing component (2)	Examples of association	References
Objective financial	↔	Objective human	- Financial capital facilitates access to higher-quality education and health services. - Education enables higher-paid, less-vulnerable livelihoods. - Good health increases productivity, and reduces household burdens and unplanned costs.	(Hallegatte, 2016; Korboe et al., 2011; Limbu, 1999; Morton, 2014; Muttarak & Lutz, 2014; OECD/WHO, 2003; Okorosobo et al., 2018; Palmer, 2005; Schnittker, 2004; Serdeczny et al., 2017)
Objective financial	↔	Objective social	- A community's financial wellbeing may influence individualistic/collective relationships and wellbeing conceptualisations. - Money is a "social glue". - Community networks/cooperatives may provide financial safety nets during shocks, and incentivize risk/investment. - Sharing of knowledges and skills can stimulate financial innovation. - Social capital can be used as a coping strategy during periods of low income.	(Alguezaui & Filieri, 2010; Bandauko et al., 2022; Calo-Blanco et al., 2017; Craig et al., 2022; Di Falco & Bulte, 2009; Dlamini et al., 2020; Dowling & Yap, 2012; Dzokoto et al., 2019; Jensen & Tiwari, 2021; Jordan, 2015; Kangmennaang et al., 2019; Landry et al., 2002; Poortinga, 2012; Prakash, 1997; Woolcock & Narayan, 2000)
Objective financial	↔	Objective natural	- Provisional ecosystem services, such as crop production, important for trade income and regional food costs. - Access to regulated, clean water will influence collection times, and the subsequent burden on financial productivity. - Low financial capital may increase exploitation/degradation, as economic growth may be prioritised over environmental protection.	(Angelsen & Wunder, 2003; Barbier, 2000; Cheng et al., 2018; Fisher et al., 2013; Jehan & Umana, 2003; Joly & Voldoire, 2009; Lufumpa, 2005; Reardon & Vosti, 1995; Sedda et al., 2015)
Objective financial	↔	Objective physical	- Financial capital is a prerequisite for improved assets/housing. - Accessibility/proximity to roads is key in accessing markets and financial services. - Assets, such as tools, may boost financial productivity, whereas other assets, such as land, can be sold to recover from financial/climatic shocks.	(Ackah, 2013; Atiglo & Codjoe, 2015; Béné & Friend, 2011; Bird et al., 2010; Bird et al., 2002; Chamberlin, 2007; Diop et al., 2011; Moseley, 2001; Owusu & Lund, 2004; Pacillo, 2016; Porter, 2007)

Appendix

Wellbeing component (1)		Wellbeing component (2)	Examples of association	References
Objective human	↔	Objective social	- Education improves equality in society and reduces household dependency ratios. - Patrilineal social structure can limit female access to education. - Social networks can facilitate improved health through informal care and access to health facilities.	(Crentsil et al., 2019; Heintz, 2004; Leach et al., 1999; Morton, 2014; Refaeli & Achdut, 2022; Senadza, 2012; Wolf et al., 2016)
Objective human	↔	Objective natural	- Education can improve sustainable practices and facilitate access to the climatic information required for the long-term maintenance of provisional ecosystem services. - Regulatory ecosystem services, such as water quality purification, are key in maintaining health. - Access to provisional water services will influence the time/money available to invest in human capital. For example, if having to travel long distances for water then there may not be the time/energy available for schooling.	(Amoako, 2012; Asante & Amuakwa-Mensah, 2015; Atiglo, 2017; Brecht et al., 2012; Buor, 2004b; Butler & Oluoch-Kosura, 2006; Cheng et al., 2018; Graham et al., 2016; Korboe et al., 2011; Limbu, 1999; Muttarak & Lutz, 2014; Pickering & Davis, 2012; Porter, 2007; WHO, 2011)
Objective human	↔	Objective physical	- Physical infrastructure required to access schools and health clinics. - Higher quality assets, such as housing and piped water, can improve household health. - Less frequent repairs on high-quality assets will free-up excess capital for human development.	(Anyidoho et al., 2012; Atiglo, 2017; Bashir, 2002; Béné & Friend, 2011; Cattaneo et al., 2009; Porter, 2007; Riverson et al., 1991; Sulemana & Dinye, 2014; Wales & Wild, 2012)
Objective social	↔	Objective natural	- Collective communities may act together to protect common natural resources and ecosystem services. - Areas of ecosystem services, such as agricultural land, can be key in generating social interaction and networks. - Scarcity of natural resources may result in conflict or a shift to more individualistic wellbeing approaches. - Community governance structures could influence natural resource access.	(Ellis, 2000; Fagerholm et al., 2016; Leviston et al., 2018; McCusker & Carr, 2006; Reuveny, 2007; Schueler et al., 2011)
Objective social	↔	Objective physical	- Transport infrastructure required to access “linking social capital” from broader communities and institutions. - Patrilineal society may restrict female access to assets such as land; particularly following divorce or the death of a spouse. - Individualistic communities may place greater emphasis on material wealth, whereas collective communities may prioritise “post-material” capitals.	(Afriyie et al., 2018; Atiglo & Codjoe, 2017; Codjoe et al., 2020a; Jordan, 2015; Kangmennaang et al., 2019; Ofori-Danson et al., 2013; Panday et al., 2021; Porter, 2007)

Appendix

Wellbeing component (1)		Wellbeing component (2)	Examples of association	References
Objective natural	↔	Objective physical	- Available natural resources may control which material assets are desired. For example, access to local timber may generate a preference for self-constructed housing. - Remoteness may influence which ecosystem services are obtainable (i.e., access to open-source water). - Physical assets (i.e., farming/fishing tools) will influence the scale of provisional ecosystem services accessible, including crop yield and fish catches.	(Asomani-Boateng et al., 2015; Atta-Mills et al., 2004; Badu et al., 2013; Danso, 2013; Idowu et al., 2011)
Subjective financial	↔	Subjective human	- Self-reported health, and perceived health fees, may influence future financial aspirations/goals. - Perceived financial poverty can cause physical and psychological health issues. - Mastery of skills ("competence") may influence perceived financial success, and relative comparisons to others.	(Ababio et al., 2021; Burney & Naylor, 2012; Chang et al., 2020; Codjoe et al., 2020b; Deci & Ryan, 2012; Elo, 2009; Kim et al., 2019; Leviston et al., 2018; Lewchuk et al., 2008; Lynch et al., 2000; Markussen et al., 2018; Okorosobo et al., 2018; Serdeczny et al., 2017; Sharma & Prakash, 2021; Shifa & Leibbrandt, 2018; Sommet et al., 2018)
Subjective financial	↔	Subjective social	- Perceived financial inequality may result in community distrust, whereas equality may increase cohesiveness. - Attachment to place may lessen the weight placed on subjective financial comparisons when comparing oneself to the community. - Trust and reciprocal bonds may create optimism for future financial success, or greater financial security due to the knowledge of community safety nets.	(Addai & Adjei, 2014; Akay & Martinsson, 2011; Alem et al., 2014; Blankson & Nukpezah, 2019; Di Falco & Bulte, 2009; Gough & McGregor, 2007; Kangmennaang et al., 2019; Kingdon & Knight, 2006, 2007; Mathbor, 2007; Ravallion, 2015; Reyes-García et al., 2016; Tibesigwa et al., 2016)
Subjective financial	↔	Subjective natural	- Perceived environmental deterioration may induce pessimistic outlooks of future financial viability. - Connection to place/nature may mitigate the emphasis on subjective financial comparisons when self-reporting subjective wellbeing. - The perception that financial needs are not, or will not, be met can reduce environmental awareness.	(Boyce, 1994; Glenk et al., 2006; Kangmennaang et al., 2019; Navarro, 2017; Posel & Rogan, 2016; Veenhoven, 2007; Watts et al., 2019)

Appendix

Wellbeing component (1)		Wellbeing component (2)	Examples of association	References
Subjective financial	↔	Subjective physical	- Perceived quality of assets, relative to others, can influence subjective poverty. - Relative financial deprivation can translate into perceived material deprivation. - Perceived financial inequalities may result from perceived political/physical isolation. For example, rural areas receiving less construction and infrastructure investment.	(Badu et al., 2013; Béné & Friend, 2011; Huang et al., 2016; Kangmennaang & Elliott, 2019; Kangmennaang et al., 2019; Marcus, 2006; Marks, 2007; Posel & Rogan, 2016)
Subjective human	↔	Subjective social	“Relatedness”, an innate component of human wellbeing, influenced by community connections. - Attachment to place/community can improve autonomy, or limit it if restricted by community obligations. - Self-reported health may influence household dynamics. For example, poor health instigating emotional conflict.	(Albrecht et al., 2007; Atiglo, 2017; Ayerakwa et al., 2015; Brown et al., 2021; Deci & Ryan, 2012; Hossain et al., 2016; Markussen et al., 2018; Read et al., 2009; Rollero & De Piccoli, 2010)
Subjective human	↔	Subjective natural	- Attachment to place can boost perceived health, yet environmental deterioration may lower self-reported health. - Satisfaction with education may influence the level of environmental awareness. - Human “competence” incorporates mastery over the environment. This could result in higher environmental awareness and sustainable activities, or exploitation/degradation to achieve short-term gains.	(Albrecht et al., 2007; Brown et al., 2021; Cheng et al., 2018; Deci & Ryan, 2012; Grün & Grunewald, 2010; Hossain et al., 2016; Markussen et al., 2018; Mkrtchyan et al., 2018; Navarro, 2017; Sekulova & Van den Bergh, 2016; Sulemana, 2016; Sulemana et al., 2016)
Subjective human	↔	Subjective physical	- Subjective perceptions of material inequality may lower self-reported health. - Relative comparisons to materially “better-off” households can produce positive impacts if one is pleased for the success of others, or by improving future aspirations. - Perceived material inequalities may result in lessened “autonomy”. - Perceived low-quality housing can reduce subjective wellbeing. For example, feelings of shame if housing does not reflect one’s desired identity.	(Atsebi & Ferrer-i-Carbonell, 2022; Elo, 2009; Kondo et al., 2008; Lynch et al., 2000; Marcus, 2006; Markussen et al., 2018; Shifa & Leibbrandt, 2018; Smith et al., 2019)
Subjective social	↔	Subjective natural	- Attachment to place can increase community trust/togetherness and environmental awareness to protect common resources. - Inherent attachment to nature/place can increase societal collectivism and encourage permanent residence (lessen migration intentions). - Perception of high quality environment and ecosystem services can increase attachment to place, restrict social disputes and encourage reciprocal relationships.	(Albrecht et al., 2007; Kangmennaang et al., 2019; Lyon, 2000; Mesch & Manor, 1998; Reuveny, 2007; Rollero & De Piccoli, 2010)

Appendix

Wellbeing component (1)		Wellbeing component (2)	Examples of association	References
Subjective social	↔	Subjective physical	- Individualistic communities may generate greater awareness of material inequalities. - In the other direction, perceived inequality may promote individualism in an attempt to achieve the higher reference points. - Trust in institutions (“linking” social capital) can be influenced by perceived inequalities in opportunity and material investment, or feelings of political isolation. - Higher social trust/capital may result in greater asset sharing and reduced perceived material inequalities.	(Agyapong et al., 2017; Asitik, 2015; Di Falco & Bulte, 2009; Guillen-Royo & Velazco, 2012; Kingdon & Knight, 2007; Lynch et al., 2000; Theodoropoulos, 1999; Veenhoven, 1993)
Subjective natural	↔	Subjective physical	- Attachment to nature may reduce the desire to improve material living standards. - Perceived material inequality may reduce emphasis on environmental protection. - Satisfaction with environment may incorporate “built environment”, which relates to the individuals’ perceived relative access to assets and services.	(Ekins et al., 2003; Kangmennaang et al., 2019; Milbourne, 2014; Navarro, 2017; Perrings, 1989)
Objective financial	↔	Subjective financial	- Objective financial capital will influence one’s perceived financial status. - Perceived inequality/deprivation may result in changes to financial/livelihood practices. - Subjective poverty may differ to objective poverty due to different mechanisms (i.e., different comparative reference points across the financial spectrum).	(Bradshaw & Finch, 2003; Graham & Felton, 2006; Guillen-Royo, 2011; Haughton & Khandker, 2009; Knight et al., 2009; Mahmood et al., 2019; Posel & Rogan, 2016; Sacks et al., 2010; Smith et al., 2019; Wang et al., 2020)
Objective financial	↔	Subjective human	- Unemployment will influence autonomy, competence and relatedness. - Self-reported poor health can result in objective financial losses, or vice versa. - Objective financial capital can improve access to education, improving one’s perceived status relative to others. - Access to money can improve autonomy from a freedom perspective. - Personality traits can influence financial risk-taking and investment behaviour.	(Brown et al., 2021; Buor, 2004a; Chang et al., 2020; Deci & Ryan, 2012; Kabote, 2017; Layard & Layard, 2011; Markussen et al., 2018; Novignon, 2010; Palmer, 2005; Torssander & Erikson, 2010; van Parijs, 1992; Van Praag et al., 2003)
Objective financial	↔	Subjective social	- Employment and livelihood type may influence social relationships and trust. - Agricultural employment spaces are hubs of interaction and knowledge sharing. - Low productivity periods can strain reciprocal relationships. - Trust lubricates co-operation and reduces transaction costs. - Trusting social relationships can stimulate greater investment/risk taking. - Increased wealth, and individualistic “money-orientated” cultures, could disrupt the cultural values associated with “collectivism”.	(Ababio et al., 2021; Agyapong et al., 2017; Atiglo & Codjoe, 2017; Bandauko et al., 2022; Deci & Ryan, 2012; Di Falco & Bulte, 2009; Fagerholm et al., 2016; Lyon, 2000; Markussen et al., 2018; Owusu & Lund, 2004; Pacillo, 2016; Pretty, 2003; Rishworth et al., 2020)

Appendix

Wellbeing component (1)		Wellbeing component (2)	Examples of association	References
Objective financial	↔	Subjective natural	- Financial improvements may arise from lower environmental awareness and the exploitation of natural resources. - Poverty can result in greater land degradation and lower environmental awareness. - Satisfaction with environment may be linked to how it supports objective wealth. - Attachment to place/environment could reduce objective wealth if conservation/protected areas are favoured.	(Atta-Mills et al., 2004; Barbier, 2000; Dewu & Røskaft, 2018; Fisher et al., 2014; Fisher et al., 2013; Ives et al., 2018; Jehan & Umana, 2003; Lawson et al., 2012; OXFAM, 2021; Reardon & Vosti, 1995; Sims, 2010; Yeboah et al., 2013)
Objective financial	↔	Subjective physical	- Objective expenditure on productive assets will influence the perceived living standards compared to others. - Low financial capital could result in lower aspirations/awareness of the potential material wealth available. - Reference groups used when creating subjective comparisons of physical living standards will depend on objective finances.	(Addai et al., 2014a; Akay & Martinsson, 2011; Alem et al., 2014; Guillen-Royo, 2011; Hirons et al., 2018; Kangmennaang et al., 2019; Kingdon & Knight, 2006, 2007; Lentz, 2017; Ravallion, 2015; Ravallion et al., 2013; Tibesigwa et al., 2016; Wang et al., 2020)
Objective human	↔	Subjective human	- Objective health and education will influence subjective evaluations. - Access to education and healthcare can provide autonomy/competence. - Poor health may increase labour burdens, restrict access to basic services, and lower satisfaction with education and one's own health.	(Abraham & Martin, 2016; Akintola, 2006; Amoako et al., 2021b; Muttarak & Lutz, 2014; Ngamaba et al., 2017; Porter, 2007; Rominski et al., 2014; Togoe, 2012)
Objective human	↔	Subjective financial	- Objective health and education can influence financial aspirations and comparative reference points, which if unmet can cause unhappiness. - Subjective financial stress may cause objective health issues, which may feedback to cause further financial stress. - Perceived deprivation may lower investment in human capital to ensure sufficient capital available for shock recovery/adaptation.	(Aref, 2011; Cattell, 2001; Dalton et al., 2016; Filandri et al., 2020; Kangmennaang, 2019; Kuruvilla & Jacob, 2007; Nortey et al., 2017; Swinnerton, 2006; Van der Berg, 2008; Wang et al., 2020)
Objective human	↔	Subjective social	- Place attachment and social expectations can control whether human capital (i.e., education) is prioritised over obligated family labour. - Perceived trust and reciprocity can improve objective health. - Poor health and increased burdens can strain family relationships. - Education can support the formation of reciprocal relationships amongst peers.	(Anyanwu, 2014; Cullen & Whiteford, 2001; Hamenoo et al., 2018; Kangmennaang et al., 2019; Kawachi, 1999; Markussen et al., 2018; Miller et al., 2006; Read et al., 2009; Rojas & Carlson, 2006; Rose, 2000; Swapam & Sadeque, 2021; Yip et al., 2007)

Appendix

Wellbeing component (1)		Wellbeing component (2)	Examples of association	References
Objective human	↔	Subjective natural	- Attachment and satisfaction with environment can improve physical/mental health. - Concerns regarding environmental change can negatively impact health. - Access to education will alter perceptions of the environment (i.e., greater awareness of sustainable and adaptive activities).	(Albrecht et al., 2007; Braimah & Tweneboah-Koduah, 2011; Debrah et al., 2021; Galway et al., 2019; Grinde & Patil, 2009; Hartley et al., 2015; Heerwagen, 2009; Ingulli & Lindbloom, 2013; Schleicher et al., 2018b; White & Hunter, 2009; Wolsko & Lindberg, 2013)
Objective human	↔	Subjective physical	- Perceived lack of opportunity or living standard inequalities can result in negative health issues. - Education can influence the skills available to alter one's relative material wealth. - Education can improve optimism for future material wealth. - Higher education may raise the material aspirations of a household, which can result in unhappiness if the goals are unmet.	(Achore & Bisung, 2022; Agyei et al., 2016; Anyidoho et al., 2012; Cattell, 2001; Fallon, 1999; Kangmennaang, 2019; Kangmennaang et al., 2020; Kangmennaang & Elliott, 2019; Kangmennaang et al., 2019; Kondo et al., 2008; Muttarak & Lutz, 2014; Sahn & Stifel, 2003; Saunders, 2021; White, 2016; Wilkinson & Pickett, 2011; Zhang & Churchill, 2020)
Objective social	↔	Subjective social	- Trust (cognitive/relational capital) is required as the foundation for structural social capital (i.e., cooperatives and reciprocal relationships). - Place attachment can influence the likelihood of participating in collective action. - Gendered societal rules may influence who one trusts and reciprocates with. - Conflict or crime can disturb social norms, and break reciprocal relationships. - Governance structures which create unequal resource access can result in greater individualism and intra-community conflict.	(Amoako et al., 2021a; Bayor, 2010; Bott et al., 2019; Bouma et al., 2008; Bukari et al., 2018; Cattell, 2001; Claridge, 2018b; Jönsson, 2009; Kelly et al., 2017; Khazaeian et al., 2017; Langer et al., 2009; Langer & Ukiwo, 2008; Lyon, 2000, 2003; Ma et al., 2022; Mihaylov & Perkins, 2014; Mohapatra & Mohamed, 2013; Porter & Lyon, 2006; Yiran, 2016)
Objective social	↔	Subjective financial	- Community cooperatives can redistribute capital to reduce perceived inequalities. - Perceptions of inequality may motivate collective action as a response. - Household make-up will influence current and future perceptions of financial viability (i.e., high dependency ratio creates financial stress [more mouths to feed]). - Obligations to financially support others in the community could increase concerns over one's future financial security.	(Addae, 2020; Bisung et al., 2018; Cattell, 2001; Cook, 2014; Guagnano et al., 2016; Herrera et al., 2006; Lin, 2000; Mahmood et al., 2019; Nelson, 1988; Ram, 2006; Refaeli & Achdut, 2022; Sarracino, 2008)

Appendix

Wellbeing component (1)		Wellbeing component (2)	Examples of association	References
Objective social	↔	Subjective human	- Community networks can provide care and improve self-reported health. - Autonomy is controlled by social expectations (i.e., patrilineal societies obligating domestic female roles). - Cooperative group obligations could limit individuals' "autonomy" over financial decisions. - Dissatisfaction with education opportunities may result in social disengagement. "Relatedness" (social connections) is a key component of eudaimonic human wellbeing.	(Addai & Adjei, 2014; Adger et al., 2002; Amegbor et al., 2020; Araujo, 2003; Avogo, 2013; Ayentimi et al., 2021; Bisung et al., 2018; Calvo-Armengol & Jackson, 2004; Codjoe et al., 2020b; Cullen & Whiteford, 2001; Di Falco & Bulte, 2009; Dwumah et al., 2018; Kawachi, 1999; Khazaeian et al., 2017; Korboe et al., 2011; Kwarteng, 2012; Lloyd & Gage-Brandon, 1993; Miller et al., 2006; Poortinga, 2006; Porter, 2007; Refaeli & Achdut, 2022; Rojas & Carlson, 2006; Rose, 2000; Sulemana, 2015; Torssander & Erikson, 2010; Udry & Conley, 2004; Van der Geest, 2011; Wong, 2006; Yeboah, 2017; Yip et al., 2007)
Objective social	↔	Subjective natural	- Community rights/laws regarding land ownership may influence environmental awareness and attachment (i.e., tragedy of the commons). - Community support may increase psychological resiliency to climate hazards, and buffer against the negative environmental impacts upon happiness. - Social structure may influence how natural resources are evaluated (i.e., proximity to water sources may be a priority for female household members who are expected to collect water resources).	(Amoako et al., 2021a; Asante & Amuakwa-Mensah, 2015; Babicky & Seebauer, 2017; Barbier, 2000; Cazcarro et al., 2018; Dewu & Røskaft, 2018; Fisher et al., 2013; Hudson et al., 2019; Korboe et al., 2011; Mathbor, 2007; Osei, 2016; Prakash, 1997; Reardon & Vosti, 1995; Selman, 2001; Sims, 2010; Su et al., 2019; Tompkins et al., 2020)
Objective social	↔	Subjective physical	- Access to services and community support may result in greater equality in living standards, and less relative comparisons. - Perceived material inequalities may result in social conflicts/disputes. - Access to institutional "linking" social capital can result in greater investment and improved assets, consequently lowering perceived relative deprivation.	(Adger et al., 2020; Allan, 1997; Badu et al., 2013; Bisung et al., 2018; Chang & Chuang, 2011; Di Falco & Bulte, 2009; Landry et al., 2002; Lin, 1999; Ofori-Danson et al., 2013; Porter, 2007; Prakash, 1997; Ram, 2006; Sarracino, 2008)
Objective natural	↔	Subjective natural	- Access/quality of ecosystem services will influence subjective satisfaction with natural resources. - Objective ecosystem services could also be interpreted subjectively as cultural services. - Attachment to nature may result in tangible sustainable practices.	(Breuste et al., 2013; Cheng et al., 2018; Cumming et al., 2014; Hiron et al., 2016; Kankam et al., 2021; Osman et al., 2022)

Appendix

Wellbeing component (1)		Wellbeing component (2)	Examples of association	References
Objective natural	↔	Subjective financial	- Ecosystem services can improve one's relative financial position (i.e., increased provisional crop production boosting tradable profits). - Perceived income inequality may arise following land degradation and unsustainable behaviours. - Payments for ecosystem services (PES) could increase perceived inequalities if there is elitist capture. - Fears of future financial insecurity if the community is frequently impacted by climatic hazards or uncertain seasonality.	(Agarwala et al., 2014; Anarfi et al., 2020; Anarfi et al., 2022; Badu et al., 2013; Bhattacharya & Innes, 2013; Boyce, 1994; Cobbinah & Niminga-Beka, 2017; Fisher et al., 2013; Gyasi et al., 2014; Huxham et al., 2023; Khan et al., 2022; MEA, 2005; Pata et al., 2022; Perrings, 1989; Schleicher et al., 2018a; Spangenberg & Settele, 2010; To et al., 2012; Wang et al., 2021; Wu & Xie, 2020; Zhang et al., 2019)
Objective natural	↔	Subjective human	- Various ecosystem services are key in maintaining self-reported health. - Control over natural resources may result in greater preservation/innovation, which can increase perceived autonomy over financial security. - Access to natural capital can control livelihood "competence". For example, increasingly uncertain seasonality and climatic hazards can prevent individuals from controlling/mastering their environment.	(Agarwala et al., 2014; Anarfi et al., 2022; Anthonj et al., 2018; Bandauko et al., 2022; Borrero et al., 2013; Butler & Oluoch-Kosura, 2006; Chan et al., 2019; Chhatre & Agrawal, 2009; Ciftcioglu, 2017; Cundill et al., 2017; Darnier, 2012; Fagerholm et al., 2016; Fortnam et al., 2019; Gómez-Baggethun et al., 2013; Gough & McGregor, 2007; Herrera et al., 2006; Jackson et al., 2013; Jarvis et al., 2020; Johnson et al., 2013; Jones et al., 2020; Korboe et al., 2011; Kretsch & Keune, 2016; Markussen et al., 2018; Paudyal et al., 2017; Porter, 2007; Pröbstl-Haider, 2015; Rishworth et al., 2020; Salmond et al., 2016)
Objective natural	↔	Subjective social	- Attachment to place/community can result in sustainable and equitable use of natural capital/resources. - High-quality environments can increase an individual's subjective attachment to place. - Type of natural capital may influence individualistic/collective societies (i.e., differences between urban and rural landcover, and associated livelihoods/ecosystem services). - Access to land/ecosystem services contributes to subjective positionality in the social hierarchy.	(Adams & Adger, 2013; Afriyie et al., 2018; Atiglo & Codjoe, 2017; Bhandari, 2004; Cheung & Hui, 2018; Codjoe et al., 2020a; Cundill et al., 2017; Cuni-Sanchez et al., 2019; Devine-Wright, 2009; Freeman, 1997; Gyampoh et al., 2009; Kangmennaang & Elliott, 2019; Kangmennaang et al., 2019; Kingdon & Knight, 2007; Marshall et al., 2007; Pretty & Ward, 2001; Rollero & De Piccoli, 2010; Rooks et al., 2016; Scannell & Gifford, 2010; Selfa et al., 2021; Sinha et al., 2001; Theodoropoulos, 1999; Tonge et al., 2015; Veenhoven, 1993; Vorkinn & Riese, 2001)

Appendix

Wellbeing component (1)		Wellbeing component (2)	Examples of association	References
Objective natural	↔	Subjective physical	- Objective natural capital may influence perceived living standards (i.e., a greater relative importance placed upon piped water infrastructure if remote from open sources). - Ecosystem deterioration can lower living standards compared to past. - Perceived inequalities in material wealth may result in environmental degradation in an attempt to reach higher reference points.	(Bhandari, 2004; Danso, 2013; Dika, 2017; Kangmennaang et al., 2019; Kendie, 1996; Laterra et al., 2019; Leviston et al., 2018; Parby et al., 2015)
Objective physical	↔	Subjective physical	- Objective asset quality influences subjective evaluations of physical capital. - Remoteness and lack of transport infrastructure may influence comparative reference points (i.e., isolated from higher living standards). - Perceptions and value attached to certain assets, such as clothes and durable products, will depend on current levels of objective consumption. - Current assets will control what level of material wealth is strived for.	(Ackah, 2013; Alem et al., 2014; Appadurai, 2004; Graham & Felton, 2006; Guillen-Royo, 2011; Jørgensen, 2008; Kangmennaang et al., 2019; Kingdon & Knight, 2007; Knight et al., 2009; Milbourne, 2014; Ravallion et al., 2013; Ward et al., 2016)
Objective physical	↔	Subjective financial	- Access to markets/roads will influence perceived financial opportunities, the effort required to fulfil them (travel time) and profitability. - The ownership of specific assets, such as high-quality housing, can influence perceived financial stress. - Perceived poverty may alter the adaptive practices/technologies used, and curtail investment into improving objective assets. - Poor road connectivity could limit mobility and visibility of higher living standards, reducing the financial stress caused by relative comparisons.	(Andersson, 2012; Bigsten & Shimeles, 2011; Bird et al., 2002; Chamberlin, 2007; Crettaz & Suter, 2013; Devereux & Teshome, 2005; Gollier & Pratt, 1996; Haughton & Khandker, 2009; Kingdon & Knight, 2006; Mahmood et al., 2019; Marks, 2007; Moseley, 2001; Owusu & Lund, 2004; Porter, 2007; Posel & Casale, 2011; Schelzig, 2005; Wang et al., 2020; Yeboah, 2010)
Objective physical	↔	Subjective human	- Physical access to health care/school facilities will influence satisfaction with health/education. - Transport infrastructure can increase autonomy and mobility, yet may reduce air quality and health. - Physical assets, such as safe latrines and piped water, can improve perceived health.	(Adamkiewicz et al., 2014; Adjei & Kyei, 2013; Afful-Mensah et al., 2014; Ansah et al., 2016; Anyidoho et al., 2012; Armah et al., 2015; Cau et al., 2016; Clasen et al., 2014; Corburn & Hildebrand, 2015; Dushie et al., 2017; Ference, 2018; Hart, 2016; Hubbard et al., 2020; Jepson et al., 2021; Kailembo et al., 2018; Mattah et al., 2018; McGrail & Humphreys, 2009; Nketiah-Amponsah & Hiemenz, 2009; Opare-Addo et al., 2020; Richterman et al., 2019; Sam et al., 2015; Saunders, 2021; Slekiene & Mosler, 2019; Stanke et al., 2013; Stoler et al., 2012; Vuong et al., 2022; Yaya et al., 2017)

Wellbeing component (1)		Wellbeing component (2)	Examples of association	References
Objective physical	↔	Subjective social	- Physical transport infrastructure may influence the scale of social capital (i.e., “linking” social capital requires access to areas outside the immediate community/district). - Place attachment may stimulate greater investment into improving the material assets in one’s own location (rather than migrating). - Physical remoteness may result in greater collective action due to isolation from wider institutional support, and increase place attachment due to restricted mobility.	(Adger et al., 2013; Adjargo, 2012; Agyapong et al., 2017; Alguezaui & Filieri, 2010; Behnke et al., 2017; Gómez-Limón et al., 2014; Hollard & Sene, 2016; Kansanga, 2017; Kelly et al., 2017; Landry et al., 2002; Lazega & Pattison, 2017; Leahy & Lyons, 2021; Lyon, 2000; Nieman, 2006; Owusu, 2005; Owusu & Agyei-Mensah, 2011; Panday et al., 2021; Porter & Lyon, 2006; Pretty & Ward, 2001; Schoo et al., 2016; Theodoropoulos, 1999; Veenhoven, 1993; Wiesinger, 2007)
Objective physical	↔	Subjective natural	- Physical remoteness may create higher attachment to local environmental resources. - Less environmental awareness if suffering from material deprivations. - Physical infrastructure (i.e., coastal defences) could influence the magnitude of perceived climatic hazards. - Higher material wealth/assets may cause greater environmental sensitivity and psychological fears due to households having “more-to-lose”.	(Barbier, 2000; Bradley, 2012; Codjoe & Afuduo, 2015; Danso, 2013; Darko et al., 2022; Fisher et al., 2013; Nanor et al., 2021; Reardon & Vosti, 1995; Theodoropoulos, 1999; Veenhoven, 1993)

Appendix 2.4. Examples of the “ideal” wellbeing measures (assuming no data access limitations) which could be used when studying relationships in the conceptual “ECW” framework. Bolded metrics are available in the DECCMA survey dataset (with minimal missing data)

Framework component	Objective	Subjective
Financial	• Income • Expenditure • Employment • Bank access • Employment permanency (i.e., seasonal) and diversity • Job security • Debt amount/repayment history/schedule (enable “income:debt ratio” calculation) • Change in income, trade, expenditure • Financial inequality (Betti et al., 2007; DHS Programme, 2023)	• Subjective evaluation of poverty status/financial stress • Satisfaction with economic security • Relative ranking of financial position • Evaluation of job security/working conditions (Akay & Martinsson, 2011; Clark et al., 2008; Kingdon & Knight, 2007; Layard & Layard, 2011; Reyes-García et al., 2016; Sulemana et al., 2020; Tibesigwa et al., 2016).
Human	• Distance/travel time to health clinic • Health assessment (i.e., BMI, stunting, wasting, life expectancy) • Calorie intake • Infant mortality • Maternal mortality • Health insurance • Hand washing facilities • Mosquito nets (Artha & Dartanto, 2018; Boachie & Ramu, 2016; Clarke & Erreygers, 2020; Debrah, 2013; GSS, 2020; Reinhard & Wijeratne, 2000) • Education level achieved • School attainment (i.e., reading age, school lag) • School enrolment • Child/Adult literacy • Early years education programme enrolment (Alkire & Fang, 2019; GSS, 2020; UNICEF MICS 2019; World Bank, 2021b)	• Satisfaction with education (entire household, not just children’s) • Satisfaction with health • Evaluation of autonomy/freedom • Evaluation of competence (mastery of skill/environment) • Evaluation of future opportunities • Self-reported food insecurity • Self-reported optimism for the future • Personality traits (i.e., willingness to adapt or take risks) (Anyidoho et al., 2012; Deci & Ryan, 2012; Heintz, 2004; Markussen et al., 2018; UNICEF MICS 2019)
Social	• Social rules/laws/precedents (i.e., patrilineal arrangements) • Membership in social cooperatives/groups • Size of social network • Number of violent conflicts • Crime • Gender relations (inc. domestic violence) • Female decision-making autonomy • Household security measures	• Satisfaction with family /community interactions • Perceived trust in different communities/decision-making levels • Perceived inequalities (i.e., class, gender) • Understanding of political processes

Appendix

Framework component	Objective	Subjective
Social (continued)	• Number of community gatherings attended • Political participation (i.e., voting, signing petitions, boycotts) • Intergenerational duties • Access to banking institutions • Financial gifts received • Governance/ownership of land/resources • Religious participation • Governmental/NGO support • Access to information (i.e., internet access) (DHS Programme, 2023; Fraser, 2021; Gannon & Roberts, 2020; Huckle & Silva, 2020; Straub et al., 2020)	• Self-assessed status/reputation (Claridge, 2018b; Harpham et al., 2002; Jean-Paul & Martine, 2018; Kangmennaang & Elliott, 2019; Kangmennaang et al., 2019)
Natural	• Drinking water source • Ecosystem quality measures (i.e., soil quality – proxy variables, such as NDVI, included in “environmental” explanatory variables). • Amount of crops/fish produced/caught [high missing data in DECCMA] • Number of livestock [high missing data in DECCMA] • Land ownership/size [high missing data in DECCMA] (Betley et al., 2022; Schleicher et al., 2018; Smith et al., 2013)	• Satisfaction with food security • Satisfaction with environmental quality • Environmental awareness, risk, concern, attitude towards climate/environmental change • Attachment to nature • Contribution of nature to cultural identities (Adams et al., 2020; Albrecht et al., 2007; Anarfi et al., 2022; Brown et al., 2021; Dewu & Røskoft, 2018; Jehan & Umana, 2003; Khan et al., 2022; Milbourne, 2014; Navarro, 2017; Pata et al., 2022; Sims, 2010)
Physical	• Drinking water source • Homeownership • Latrine type • Housing information: roof material, number of rooms, floor material • Dwelling tenure • Overcrowding • Mode of transport • Electricity (access & source) • Household assets (i.e., television, radio) • Cooking fuel • Livelihood assets (i.e., irrigation, fertiliser) (Alkire & Santos, 2010; GSS, 2020; Santos & Ura, 2008; Santos & Villatoro, 2018)	• Satisfaction with housing • Satisfaction with water security • Evaluation/ranking of relative material wealth/assets • Satisfaction with accessibility to key services/hubs • Satisfaction with energy availability (Dzokoto et al., 2019; Hudson, 2013; Kaiser et al., 2017; Schultz, 2019)

Appendix – Chapter 3

Appendix 3.1. Recommended wellbeing measures, and their components, located within the five objective capitals and five subjective perceptions outlined in the conceptual framework. Components which appear in multiple capitals/perceptions are italicised

Capital/ perception	Objective	Subjective
Financial	• Expenditure poverty • Basic needs deprivation: ○ Excess capital (food expenditure) ○ Bank access ○ Employment ○ <i>Community cooperative membership (social financial support)</i>	• <i>Financial stress</i> • Life domains unhappiness: ○ Unhappiness with economic security
Human	• Basic needs deprivation: ○ Basic education ○ <i>Healthcare access</i> ○ <i>Drinking water source (influences health)</i> ○ <i>Roof material quality (influences health)</i> ○ <i>Latrine facility (influences health)</i> ○ <i>Overcrowding (influences health/education)</i> ○ <i>Network size (controls information/skills access)</i>	• Life domains unhappiness: ○ <i>Unhappiness with health</i> ○ <i>Unhappiness with food security</i> ○ <i>Unhappiness with drinking water</i> • <i>Financial stress (financial evaluations based on future opportunities, influenced by subjective health/education)</i>
Social	• Basic needs deprivation: ○ <i>Community cooperative membership</i> ○ <i>Network size</i> ○ <i>Bank access (institutional social capital)</i>	• Life domains unhappiness: ○ Unhappiness with family interactions ○ Unhappiness with community interactions • <i>Financial stress (financial evaluations based on relative comparisons, influenced by perceived inequalities and trust)</i>
Natural	• Basic needs deprivation: ○ <i>Healthcare access (influenced by landscape characteristics)</i>	• Life domains unhappiness: ○ <i>Unhappiness with food security</i> ○ Unhappiness with environment • <i>Financial stress (financial evaluations based on future opportunities, influenced by perceived climate risk)</i>
Physical	• Basic needs deprivation: ○ <i>Healthcare access (transport infrastructure)</i> ○ <i>Drinking water source</i> ○ <i>Roof material quality</i> ○ <i>Latrine facility</i> ○ Homeownership ○ <i>Overcrowding</i>	• Life domains unhappiness: ○ Unhappiness with housing ○ <i>Unhappiness with drinking water</i> • <i>Financial stress (financial evaluations based on relative comparisons, influenced by remoteness and perceived material inequalities)</i>

Appendix 3.2. Regional cost of living indices, produced by GSS

Indices are produced over the 12-month period of the Ghanaian Living Standards Survey No. 7 (2017) (produced with Greater Accra January 2017 as the reference point). Note, the indices for a region are calculated as the monthly average over a 12-month period. Therefore the index for Greater Accra is not 1.0, despite being the reference location (GSS, 2018).

Region	Overall price index	Food index	Non-Food index
Western	1.02	1.00	1.04
Central	0.98	0.94	1.03
Greater Accra	1.03	1.02	1.03
Volta	0.99	0.93	1.07
Eastern	0.95	0.94	0.96
Ashanti	0.96	0.90	1.03
Brong Ahafo	0.93	0.91	0.97
Northern	0.97	0.98	0.97
Upper East	0.86	0.80	0.93
Upper West	0.92	0.90	0.96

Appendix 3.3. Definitions and deprivation thresholds for the indicators incorporated within the objective BND measure

Financial (employment, excess capital & bank access)

Employment deprivation was categorised by whether a household had an unemployed member. Unemployment is defined as those who are not employed, yet have actively sought after paid employment. The DECCMA dataset did not provide information on whether individuals were actively seeking work, therefore certain assumptions had to be made. In Ghana, the working population is defined as those aged 15 (Baah-Boateng, 2013) to a retirement age of 60 (Tawiah, 2011). However, occupation data was only collected for those aged 18+. Also, data showed that a large proportion of over 60s still work. Therefore to avoid overestimating unemployment by assuming all those aged 60+ were not working, unemployment was looked at across all ages 18+. An individual was defined as unemployed if they reported themselves as unemployed and were aged 18+ years old, not a student, retired or an unpaid carer. A household was seen to be deprived if there was at least one unemployed individual. If no one in the household was of working age or economically active (retired, student or carer) then the household was deemed to be deprived also as there would be no incoming income channel. 48 households had all working age members unemployed, however this potential deprivation cut-off was deemed too constrictive and would ignore the financial effort and burden that having an unemployed household member can have on the household as a whole (Kassa, 2012).

The second financial capital indicator captures households' proportion of expenditure on food (excess capital indicator); reflecting sensitivity to food price changes. This study uses a cut-off of 60% total expenditure to define households as financially and nutritionally insecure; as defined by the World Food Programme and other food security and welfare studies (Junaedi, 2021; Lele et al., 2016; Rose et al., 2013). Other studies suggested a threshold of 65-75% for high levels of insecurity and 50-65% for medium levels (Hjelm, et al., 2016; World Food Programme, 2017). Nevertheless, 60% is selected in this study as the mean % expenditure on food in the sample is approximately 60%; therefore a 60% threshold was deemed appropriate to identify those who spend a higher-than-average amount relative to the rest of Volta Delta, and are also classified as "insecure" by international guidelines.

Thirdly, Peachey & Roe (2004) state that access to financial services should be viewed as much of a basic need in LMICs as access to water, education and health services. Availability and access to financial institutions is also interpreted as a freedom, essential for poor communities to protect themselves and achieve socio-economic development (Bayulgen, 2013; Pogge, 2005). Without financial services, it is "harder to build up reserves, let alone use credit, insurance and other complex formal financial tools," which can aid access to wider basic needs and services (World Bank, 2012). A household is defined as deprived if they have no access to banking services or loans. Therefore, if they stated that they had access to any of the following, they were not deprived; micro finance organisations (including rural banks), informal money lenders, kinship loans or large formal banks.

Human (education & health)

Basic education in Ghana is a combination of primary school and lower secondary school, with the latter starting at age 12 and concluding after 3 years (UNESCO, 2012). Upper secondary school and higher education are deemed “additional education”; upper secondary starts at age 15 for 4 years, with higher education commonly starting at age 19. Each individual within each household, aged 15 or over, was deemed deprived of education if they had not completed lower secondary school (basic education). A household is deemed deprived of education if every household member aged 15 and over has not completed a basic education.

The second human capital indicator is “healthcare access”. Due to the common absence of objective health data within social surveys, this proxy measure was calculated as a contextual variable for each of the 50 enumeration areas, with the distance to a hospital taken from the central point of each enumeration area. Locations of hospitals were obtained directly from the Ghana Health Service (GHS). Using Google API, distances, based on car travel across the road network, from the community centroids to the nearest hospital were produced. The World Health Organisation (WHO) recommends that households should be within 5km of a health facility (Ashiagbor et al., 2020); therefore, a 5km cut-off was used to define households as having poor access to health facilities. Hospitals, rather than all primary/secondary health facilities, were selected due to greater data completeness, and an acknowledgment that hospitals provide a wider range of crucial health services, and are commonly provided with higher quality (Dotse-Gborgbortsi et al., 2023). Hospitals were also selected, over other health clinics and facilities, due to findings from qualitative fieldwork, where both communities and DPOs primarily discussed hospitals when questioned on health service access.

Social (cooperative membership & network size)

The first social metric is based on whether households had joined a community cooperative group in the last 5 years. If the respondent responded “no” then they are defined as deprived in objective social capital (Francesconi & Wouterse, 2011). The limitation of some households existing within a cooperative network prior to the 5-year timeframe is acknowledged. However, restricting the question to the last 5 years increases the probability that the cooperative networks are still being accessed.

The second social metric captures households’ network size. This proxy sums the number of family members from outside the household (i.e., number of uncles/aunts, cousins, nieces/nephews, brothers/sisters in-laws), and the number of friends with migration experience. Many studies reflect the role of network size in positively influencing innovation, exposure to diverse information/knowledge, reducing transaction costs, increasing new opportunities, mobilizing greater communication and broadening worldviews (Abbasi et al., 2014; Rojas et al., 2011; Zheng, 2010). It is acknowledged that the network size does not necessarily reflect the density, quality or quantity of information/resources available; however, these limitations are accepted due to data availability restraints (Knight & Yueh, 2008; Peng et al., 2021). It is assumed that as the network has migration experience, the probability of them being “redundant” relationships is mitigated. An absence of guidance regarding a network size “threshold” resulted in the threshold being constructed relatively. The mean number of

family/friends outside the household is 5, the median is 4 and the mode is 3. Based on these summary statistics, a household is said to be deprived in social networks if the total number is below 3, which is also below the sample median. Access to training or NGO/governmental support, defined as a social capital measure by Gannon & Roberts (2020), could not be included due to high missing data.

Physical (roof material, latrine type, drinking water, overcrowding, housing tenure)

Inadequate roofing is defined as one made of natural materials (Gordon, 2005) or one that lacks cement, slabs or tiling (Catalan, 2017). Within the DECCMA survey, a household was not deprived if the roof material was stone/brick/slate or cement/tiles/asbestos, whereas the household was recorded as deprived if the roof was constructed from tin/corrugate, hay/leaves/branches or “other”.

WHO (2022a) defines improved latrine sanitation as private facilities that “separate human excreta from human contact”. Respondents who recorded having either a flushing latrine, a pit latrine or a ventilated pit (KVIP) were deemed to have improved facilities, whereas those without a facility or primarily using a public toilet were recorded as deprived.

WHO (2022b) defines an improved drinking water source as “piped water, public tap, borehole or pump, protected well or protected spring”. Based on the categories available in the DECCMA survey, households with piped water, standpipe or tubewell/borehole were defined as having an improved source. Contrastingly, those relying on dug wells, springs, rainwater or surface water were deemed to be deprived. 199 households stated they used an “other” drinking water source that was not listed. 84% of these households stated that they were either moderately or very happy with their drinking water; therefore, it was assumed those that stated “other” were not deprived. For reference, a comparative 83% households with piped/standpipe/borehole water were moderately/very happy with their drinking water.

Overcrowding was incorporated within the GSS multiple deprivation study, defined as having 3+ people per room in a dwelling (GSS, 2020). However, the DECCMA dataset did not possess information on the number of rooms in the household. Therefore, to evaluate overcrowding house size (m^2) was divided by the number of people in the household, to give a result of people per m^2 house space. A UN study in 2000 of 9 African countries stated the average floor space per person was 5-9 m^2 (Ramalhete et al., 2018). A threshold for overcrowding was taken at 5 m^2 and 9 m^2 to test the measure's sensitivity. If using a 5 m^2 threshold then only 2.7% sample would be deemed “overcrowded”; this is too restrictive and could be criticised for its lack of “specificity” (Rose et al., 2013). Contrastingly, when using a threshold of 9 m^2 , 16% households were recorded as overcrowded. Selecting the 9 m^2 threshold ensures that those defined as overcrowded have less floor space than the average household in the sampled African countries (Ramalhete et al., 2018).

The final physical capital indicator reflects home ownership and tenure security. Many multidimensional wellbeing measures emphasise the importance of secure tenure and ownership as a strategy to increase productivity, safety, remove poverty, “free-up” capital for productive investments (Adarkwa, 2010), reduce health issues emerging from the uncertainty of having an “exclusive” place to call home (Luginaah et al., 2010), and ensure universally

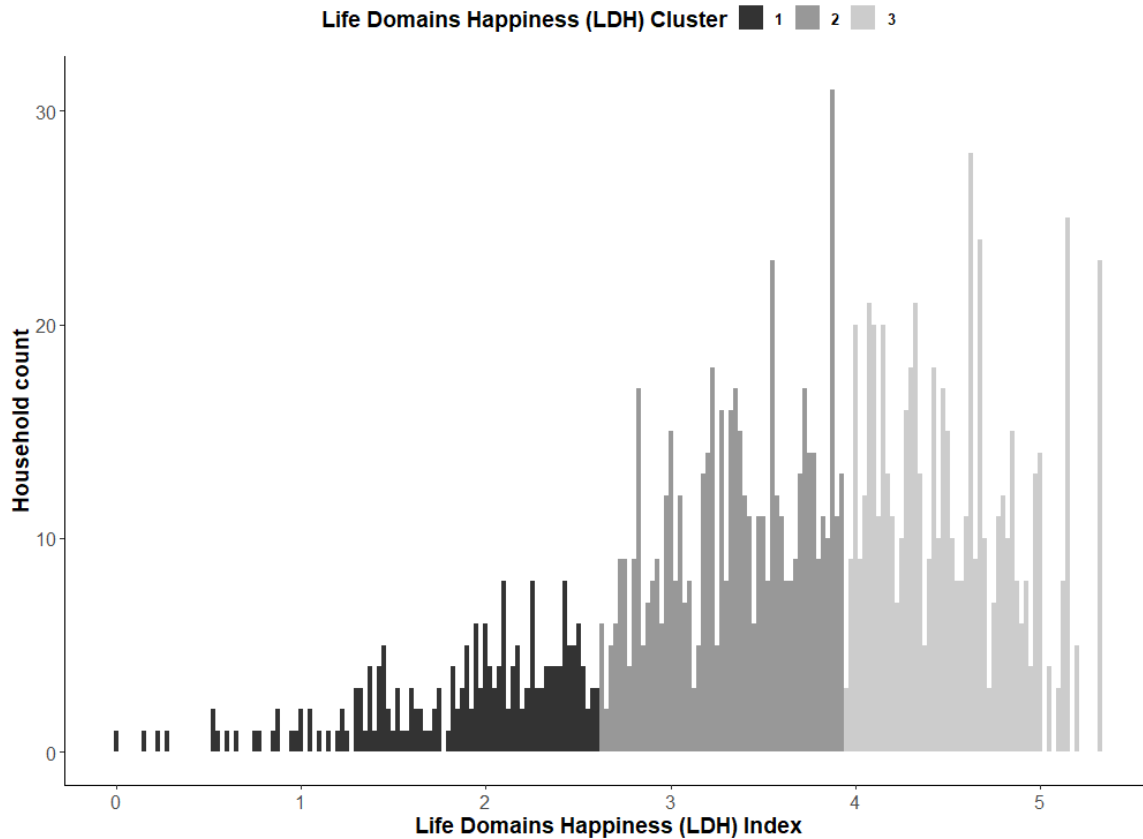
recognised basic living standards are met (Alkire & Santos, 2010; El-hadj et al., 2018; Lemanski, 2011; Santos & Villatoro, 2018). Households that outright owned their property were defined as non-deprived, whereas households that either rented, mortgaged or squatted in their property were deemed to be deprived. Due to high rent/mortgage costs in urban areas, and preference for self-construction in poorer, rural areas (Cobbinah & Niminga-Beka, 2017; Decardi-Nelson et al., 2012; Parby et al., 2015), it is hypothesised that housing tenure is less prevalent in more-affluent, peri-urban areas. However, “housing tenure” is not incorporated to reflect monetary wealth, it is an “end” of deprivation in itself.

Appendix 3.4. First component loading weights for each life domain

Loadings represent the strength of the correlation with the first component (happiness index).

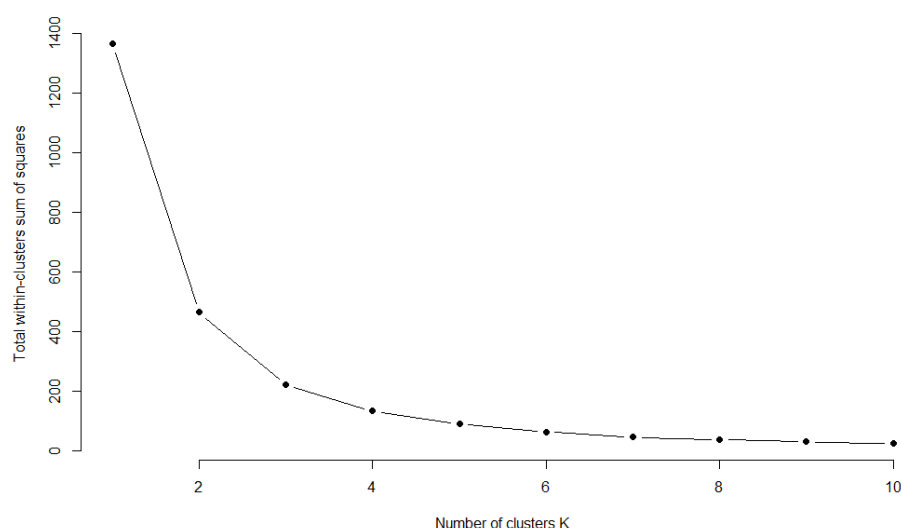
Life Domain	First Principal Component loading
Happiness with food security	+0.6577
Happiness with housing	+0.6535
Happiness with economic security	+0.6397
Happiness with family interactions	+0.6367
Happiness with environment	+0.6310
Happiness with community interactions	+0.6207
Happiness with health	+0.5756
Happiness with drinking water	+0.4231

Appendix 3.5. Histogram of the distribution of life domains happiness PCA index scores. As the distribution is not approximately normal, equal groupings were not deemed appropriate when categorising the index. Minimum = 0, Maximum = 5.32, Median = 3.78, Mean = 3.65. Index categorisation; low (0 to 2.60), medium (2.61 to 3.94), high happiness (3.95 to 5.32)



Appendix 3.6. Visualisation of the “elbow method” between number of clusters and total within-clusters sum of squares

The “bend” reflects the optimum number of clusters for analysis. 3 clusters were chosen.



Appendix 3.7. Chi-square association tests between objective expenditure poverty and each individual deprivation indicator included in the objective BND measure

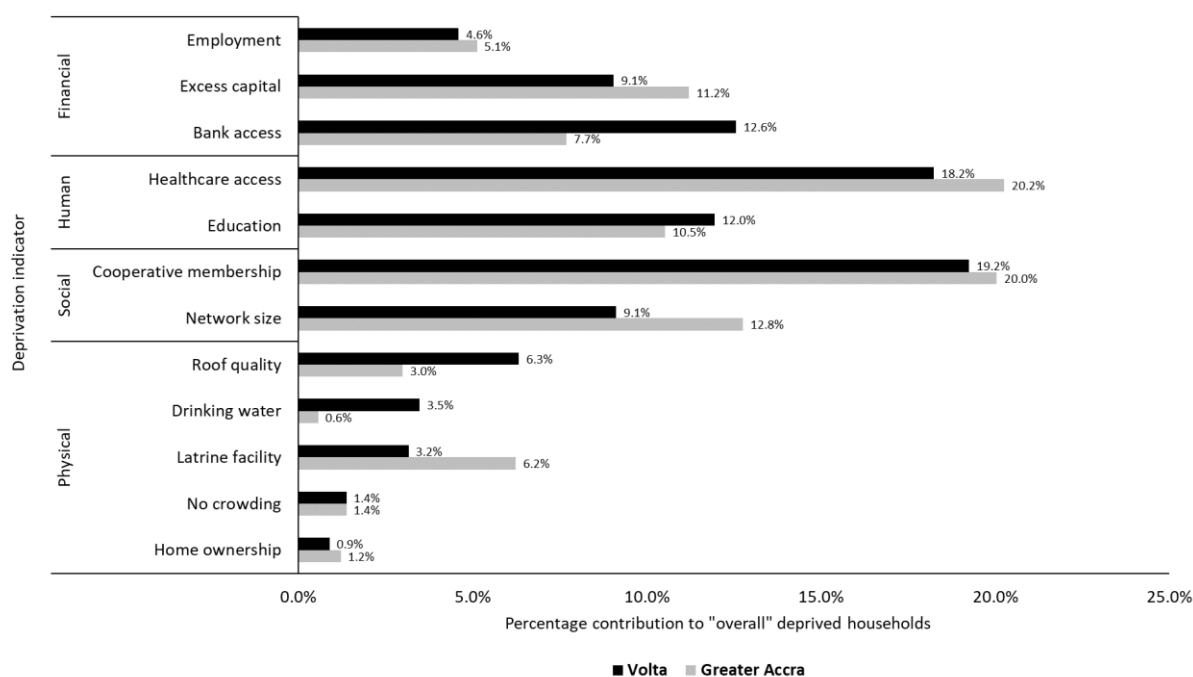
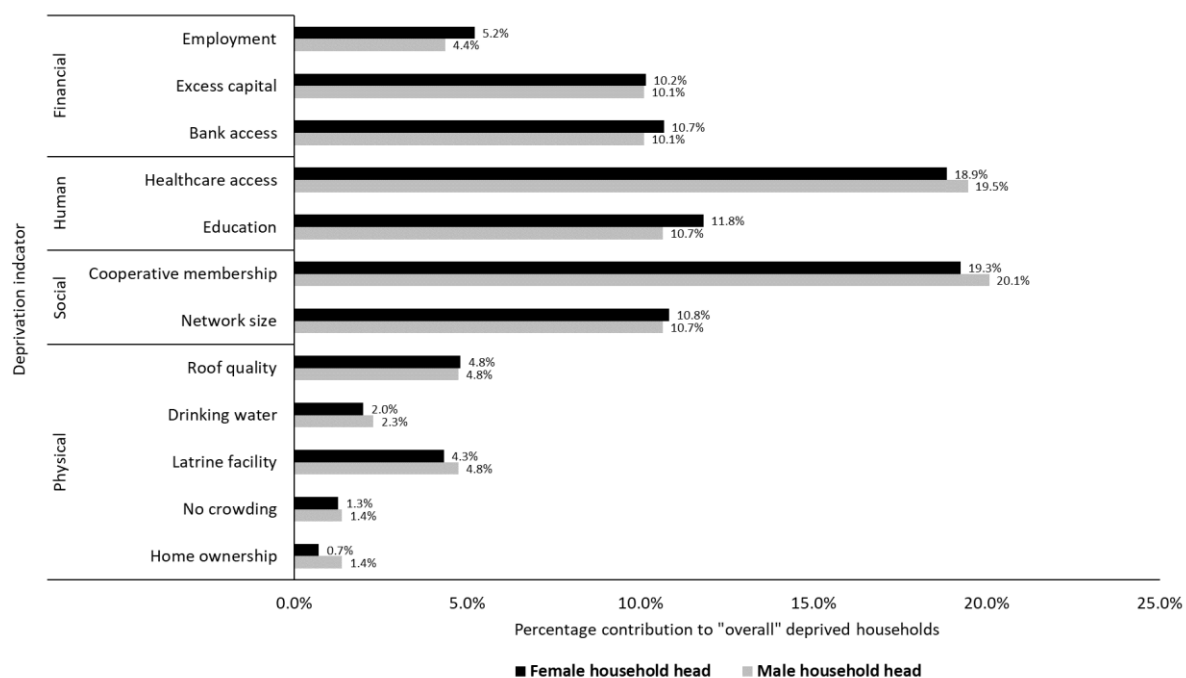
Financial wellbeing	BND deprivation indicator	Chi ² test statistic	Description
Objective expenditure poverty	Employment	0.192	
	Excess capital (food expenditure)	26.847***	More-than-expected households expend >60% on food when not in poverty .
	Bank access	23.805***	More-than-expected households without banking access when in poverty .
	Basic education	1.467	
	Healthcare access	12.091***	More-than-expected households >5km from hospital when in poverty .
	Cooperative	0.043	
	Network size	3.972**	More-than-expected households with smaller network size when in poverty .
	Roof material	16.003***	More-than-expected households with low-quality roofing when in poverty .
	Latrine type	2.983*	
	Drinking source	41.594***	More-than-expected households with unprotected drinking water when in poverty .
	Overcrowding	22.722***	More-than-expected overcrowded households when in poverty .
	Homeownership	11.948***	More-than-expected non-homeowner households when not in poverty .

Appendix 3.8. Phi binary correlation coefficients for each combination of the 12 chosen deprivation measures

Only 5 combinations (8%) have a strong association according to Akoglu's (2018) thresholds; >0 none/very weak, >0.05 weak, >0.10 moderate, >0.15 strong, >0.25 very strong. None of the "strong" associations occur within the same basic need capital category.

		Financial			Human		Social		Physical				
Deprivation		Employment	Excess capital	Bank access	Education	Healthcare access	Cooperative membership	Network size	Roof material	Safe latrine	Drinking source	Overcrowding	Home ownership
Financial	Employment		0.12	0.05	0.00	0.10	0.04	0.01	0.00	0.08	0.05	0.02	0.03
	Excess capital			0.05	0.12	0.02	0.05	0.01	0.01	0.08	0.01	0.01	0.01
	Bank access				0.19	0.05	0.10	0.02	0.17	0.04	0.11	0.00	0.10
Human	Education					0.04	0.07	0.13	0.03	0.16	0.05	0.11	0.05
	Healthcare access						0.10	0.10	0.09	0.28	0.01	0.04	0.13
Social	Cooperative membership							0.08	0.02	0.10	0.07	0.01	0.02
	Network size								0.07	0.16	0.00	0.11	0.05
Physical	Roof quality									0.08	0.11	0.03	0.07
	Safe latrine										0.05	0.03	0.11
	Drinking source											0.05	0.07
	Overcrowding												0.02
	Homeownership												

Appendix 3.9 Contribution of each deprivation indicator towards households defined as deprived “overall” by household head gender (top) and region (bottom)



Appendix 3.10. **a)** Crosstabulation and chi-square association test between general (global) happiness and happiness with community interactions and economic security. The 5-point Likert scale was aggregated into a 3-point scale, with moderately/very (un)happy combined. **b)** PCA loading plot showing the distinction between “tangible” and “less-tangible” happiness domains. The second principal component primarily captures information on “less-tangible” happiness with family and community interactions (circled)

3.10a Happiness in general	Happiness with community interactions			Total
	Happy	Neutral	Unhappy	
Happy	830 (90%)	50 (5%)	43 (5%)	923
Neutral	94 (78%)	21 (17%)	6 (5%)	121
Unhappy	251 (78%)	27 (8%)	42 (13%)	320
Total	1,175 (86%)	98 (7%)	91 (7%)	1,364

Chi-square test statistic

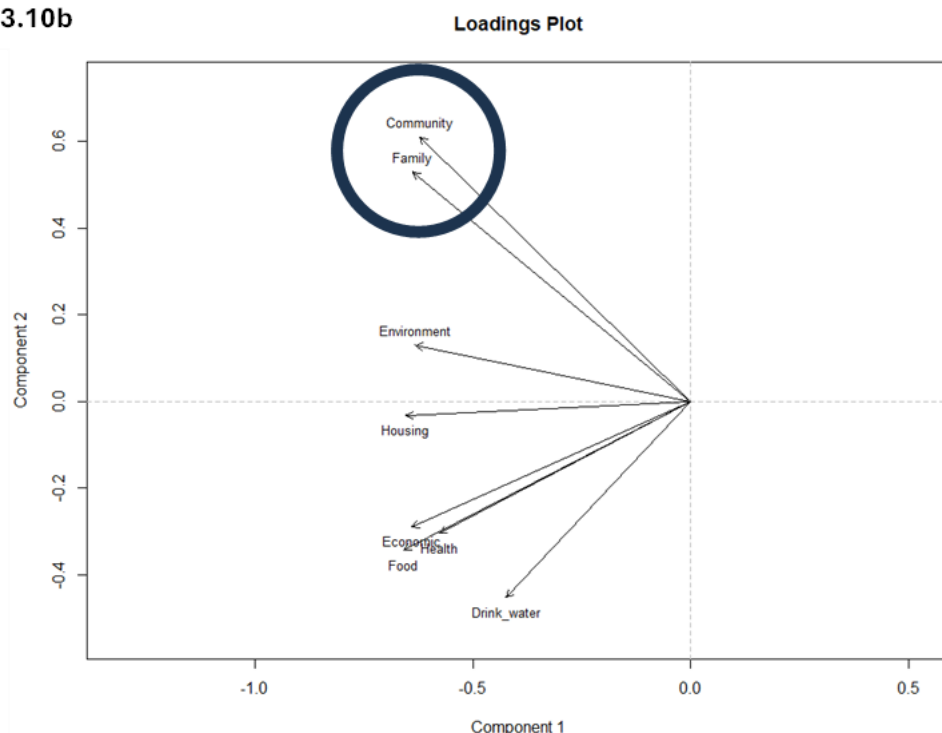
52.989***

Happiness in general	Happiness with economic security			Total
	Happy	Neutral	Unhappy	
Happy	471 (51%)	132 (14%)	320 (35%)	923
Neutral	30 (25%)	23 (19%)	68 (56%)	121
Unhappy	36 (11%)	18 (6%)	266 (83%)	320
Total	537 (39%)	173 (13%)	654 (48%)	1,364

Chi-square test statistic

239.208***

3.10b



Appendix – Chapter 4

Appendix 4.1. Methodological information regarding the construction of the “livelihood cluster” variable. Livelihood is linked to environmental sensitivity, and may also implicitly contain information on community location and exposure

Using Le Phan & Tortora’s (2019) methodology, each household was assigned eight binary values (0/1) based on whether the household had at least one:

- Current migrant outside the household
- Crop/livestock farmer
- Fisher/shrimp farmer
- Construction/factory worker
- Salaried employee/business owner
- Trader/tailor/transport worker
- Other livelihood (inc. hawkers)
- Unemployed/unpaid carer/student/retiree

Multiple Correspondence Analysis (MCA) created uncorrelated, linear components explaining variability in livelihoods. The first four components were grouped into 3 groups using k-means clustering. The Hopkins statistic result (>0.5) suggested the data was suitable for clustering. The first four dimensions of the MCA explained over 50% variation (61%); therefore, the first four dimensions were incorporated within cluster analysis. Three groups were selected to minimise the overlap between the clusters’ distribution of households, and to ensure sufficient livelihood variability (>2 clusters) was captured (Figure A4.1).

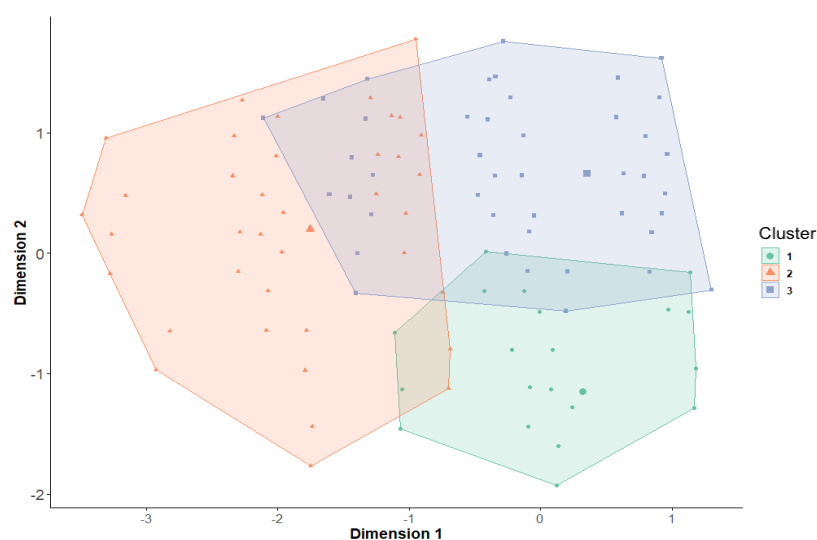


Figure A4.1. Distribution of households within the three clusters against the first two dimensions of the MCA results.

Using the proportion of households with each livelihood as a guide (Table A4.1), clusters are entitled “crop farmer”, “fisher/trade/transport/construction” and “salaried employee/business owner”. Economically inactive members are distributed across the clusters, yet this study focuses on active livelihoods and how they shape environment-wellbeing relationships. The incorporation of primary fishing livelihoods and non-primary trade/transport/construction livelihoods within a single cluster is hypothesised to be attributed to location, with peri-urban locations, with non-primary livelihood options, often located in coastal or riverine landscapes where fishing is also present. The combination also reflects the interconnectivity of primary and non-primary sectors within Volta Delta (Cazcarro et al., 2018).

Households and communities contain mixed livelihoods, therefore a statistical clustering approach was favoured over “manually” grouping households to avoid arbitrarily assuming a household contains a single livelihood type. Further analysis (Chapter 5) examining the effect of community-preference weightings upon basic needs deprivation manually categorised communities into farming/fishing/peri-urban livelihood groups. Manual classification was done to separate “fishing” livelihoods from non-primary livelihoods at the community-level; however, a similar method would have been more challenging if using household-level secondary data.

Table A4.1. Proportion of households with at least one livelihood type by livelihood cluster classification

Livelihood	Count (%) households with at least one member with the livelihood type as their primary occupation			Total
	Crop farmer cluster	Fisher/trade/transport /construction cluster	Business owner/salaried employee cluster	
Crop/livestock farmer	352 (82%)	47 (11%)	30 (7%)	429
Fisher/shrimp farmer	5 (3%)	166 (87%)	20 (10%)	191
Construction worker/factory worker	21 (14%)	101 (74%)	14 (10%)	136
Business owner/salaried employee	0 (0%)	0 (0%)	224 (100%)	224
Trader/tailor/transport worker	73 (11%)	532 (78%)	80 (12%)	685
Other (inc. domestic employee, hawker, money lender)	10 (10%)	79 (77%)	13 (13%)	102
Unemployed/unpaid carer/student/retired	213 (36%)	287 (49%)	85 (15%)	585

Appendix 4.2. Methodology for calculating the “place/community attachment” and “household head personality” independent variables

Both the “place/community attachment” and “household head personality” variables were constructed using ordinal Principal Components Analysis (PCA) (*princals R-function*) and cluster analysis. The ordinal components within both variables were measured on 5-point Likert scales (Table A4.2). The first dimension of the PCA analysis was extracted as the index value. Using k-means clustering, three clusters were constructed to ensure sufficient sample size (>100) within each group, and provide low/medium/high values.

Table A4.2. Ordinal variables (measured on 5-point Likert scales) incorporated within the “place/community attachment” and “household head personality” independent variables.

Place/community attachment	Household head personality
How well do the following statements describe you?: Disagree strongly → Agree strongly	
The village is part of my life	I am cheerful and outgoing
I want my family and friends to live here in future	I am easy to get along with
I feel like an outsider in this place (scale reversed)	I am reliable
I live here because it is practical	I am relaxed and handle stress well
I miss the place when I am not here	I am open to new experiences
My friends and family are a good support for me	I like looking for better ways of doing things
I enjoy being involved in village activities	I feel comfortable making big decisions (such as changing livelihood or migrating)

Appendix 4.3. Variables tested within the regression models, categorised by environmental and control characteristics. Note that some variables have different categorisations to maintain a minimum cell size (>10) across varying models. Also, numerical values were categorised if the numerical variable violated the assumption of linearity with the log odds of the dependent variable, explaining why some variables have a numerical and categorical version. Information on how categorisations were defined is also presented

Variable	Coding	Data source
Environmental variables		
Climate		
Climate shocks		
Exposure to storms/flooding (annual or more-frequent)	0: Not exposed to storms/flooding 1: Exposed to storms/flooding	DECCMA
Environmental impact from storms/flooding (negative impact on housing, health, water and/or food)	0: Not environmentally impacted by storms/flooding 1: Environmentally impacted by storms/flooding	DECCMA
Economic impact from storms/flooding (negative impact on economic security and/or crops and livestock)	0: Not economically impacted by storms/flooding 1: Economically impacted by storms/flooding	DECCMA
Climate stresses		
Exposure to drought/salinity/erosion (annual or more-frequent)	0: Not exposed to drought/salinity/erosion 1: Exposed to drought/salinity/erosion	DECCMA
Environmental impact from drought/salinity/erosion (negative impact on housing, health, water and/or food)	0: Not environmentally impacted by drought/salinity/erosion 1: Environmentally impacted by drought/salinity/erosion	DECCMA
Economic impact from drought/salinity/erosion (negative impact on economic security and/or crops and livestock)	0: Not economically impacted by drought/salinity/erosion 1: Economically impacted by drought/salinity/erosion	DECCMA
Climate shifts/seasonality		
Change in rainfall over the last 5 years	0: Stayed the same 1: Changed (increased/decreased/changed another way)	DECCMA
Change in rainfall timing over the last 5 years	0: Stayed the same 1: Earlier rainy season 2: Later rainy season	DECCMA
Change in temperature over the last 5 years	0: Stayed the same 1: Changed (increased/decreased/changed another way)	DECCMA
Landscape		
Remoteness		
Distance to coast	0: 0-<10km 1: 10-20km 2: 20km+ (10km increments)	WorldPop (US NASA Shuttle Radar Topography Mission (SRTM))
Distance to inland water (km)	Numeric (km)	WorldPop (European Space Agency CCI)
Travel time to Accra	0: 1-2 hours 1: 2-3 hours 2: 3+ hours (1 hour increments)	Produced using Google API data
Travel time to district capital	0: 0-10 mins 1: 11-20mins 2: 21-30 mins 3: 30+ mins (10-min increments)	Produced using Google API data

Appendix

Variable	Coding	Data source
Distance to major road	<i>3-group categorisation (natural breaks)</i> 0: 0.4-1.6km 1: 1.7-3.9km 2: 3.9km+ <i>2-group categorisation (natural breaks)</i> 0: 0 - 0.99km 1: 1km+	WorldPop (OpenStreetMap)
Distance to road intersect	0: 1-3.15km 1: 3.16-6.3km 2: 6.3km+ <i>(natural breaks)</i>	WorldPop (OpenStreetMap)
Region	0: Volta 1: Greater Accra	x
Topography		
Elevation	0: 0-10.5masl 1: 10.6-27masl 2: 27masl + <i>(natural breaks)</i>	WorldPop (US NASA Shuttle Radar Topography Mission (SRTM))
Slope	0: Under 1° 1: 1° or more <i>(logical threshold)</i>	WorldPop (US NASA Shuttle Radar Topography Mission (SRTM))
Landcover		
EVI vegetation index (2016)	<i>3-group categorisation (natural breaks)</i> 0: 0.113-0.198 1: 0.199-0.269 2: 0.270+ <i>4-group categorisation (natural breaks)</i> 0: 0.113-0.171 1: 0.172-0.233 2: 0.234-0.298 3: 0.299+	NASA (MODIS)
EVI % change (2006-16)	0: High decrease (-50% to -15%) 1: Low decrease (-14% to <0%) 2: Low increase (>0% to 17%) 3: High increase (18% to 52%) <i>(two natural breaks above/below 0%)</i>	NASA (MODIS)
EVI % change (2011-16)	0: High decrease (-55% to -19%) 1: Low decrease (-18% to <0%) 2: Low increase (>0% to 25%) 3: High increase (26% to 63%) <i>(two natural breaks above/below 0%)</i>	NASA (MODIS)
EVI % change (2015-16)	0: High decrease: (-57% to -36%) 1: Medium decrease: (-35% to -19%) 2: Low increase: (-18% to 0%) 3: Increase: (Over +0%) <i>(natural breaks below 0%)</i>	NASA (MODIS)
Cropland	<i>Numeric value</i> % within 2km community buffer <i>4-group categorisation (natural breaks)</i> 0: 0% 1: 0-25% 2: 26-55% 3: 55%+	LANDSAT-7, FAO Classifications (Jayson-Quashigah, 2016)
Change in cropland (2001-15)	<i>Numeric value</i> % change <i>3-group categorisation (logical groups)</i> 0: No change (-1% > +1%) 1: Decrease (<-1%) 2: Increase (>+1%)	LANDSAT-7, FAO Classifications

Appendix

Variable	Coding	Data source
Savannah grassland	<i>Numeric value</i> % within 2km community buffer <i>3-group categorisation (0% group, and natural breaks)</i> 0: 0% 1: 0-20% 2: 20+%	LANDSAT-7, FAO Classifications
Riverine vegetation	0: Riverine vegetation not present in community buffer 1: Riverine vegetation present in community buffer	LANDSAT-7, FAO Classifications
Mangrove	0: Mangrove not present in community buffer 1: Mangrove present in community buffer	LANDSAT-7, FAO Classifications
Wetland	0: Wetland not present in community buffer 1: Wetland present in community buffer	LANDSAT-7, FAO Classifications
Bare land	0: Bare land not present in community buffer 1: Bare land present in community buffer	LANDSAT-7, FAO Classifications
Marshland	0: Marshland not present in community buffer 1: Marshland present in community buffer	LANDSAT-7, FAO Classifications
Lagoon	0: Lagoon not present in community buffer 1: Lagoon present in community buffer	LANDSAT-7, FAO Classifications
Beach	0: Beach not present in community buffer 1: Beach present in community buffer	LANDSAT-7, FAO Classifications
Salt pan	0: Salt pan not present in community buffer 1: Salt pan present in community buffer	LANDSAT-7, FAO Classifications
Built-up land	<i>2-group categorisation (grouped at median)</i> 0: 0% - 9% 1: 10+% <i>3-group classification (natural breaks)</i> 0: 0% - 16% 1: 17% - 38% 2: 39+%	LANDSAT-7, FAO Classifications
% change in built-up land (2001-15)	0: No change 1: Decrease 2: Increase (logical groups)	LANDSAT-7, FAO Classifications
Control variables		
Household characteristics		
Household size	<i>5-group categorisation (logical groups)</i> 1: 1 person 2: 2-3 people 3: 4-5 people 4: 6-7 people 5: 8+ people <i>2-group categorisation (above/below median)</i> 1: 1-4 people 2: 5+ people	DECCMA
Dependants in household	0: 0 1: 1 to 2 2: 3 to 4 3: 5+ (logical groups)	DECCMA
Child:adult dependency ratio	<i>Numeric value</i> Child/adult ratio <i>3-group classification (logical groups)</i> 0: 0 - 0.667 1: 0.668 - 2 2: >2	DECCMA
% females	<i>Numeric value</i> % females in household <i>2-group classification (logical groups)</i> 0: <50% 1: >50%	DECCMA

Appendix

Variable	Coding	Data source
Religion	0: Christian 1: Non-Christian (Islam, Buddhism, Hinduism, Traditional)	DECCMA
Livelihood cluster (Appendix 4.1)	0: Salaried employee/business owner 1: Fishing/trade/transport/construction 2: Crop farmer	DECCMA
Household head characteristics		
Highest education level	0: No Schooling 1: Below-basic education 2: Basic education 3: Above-basic education	DECCMA
How long lived in the village?	0: Entire life 1: Migrated more than 10 years ago 2: Migrated less than 10 years ago	DECCMA
Marital status	0: Married or cohabitating 1: Never married 2: Previously married	DECCMA
Employment status	0: Permanent 1: Non-permanent 2: Dependent (unemployed, student or retired)	DECCMA
Sex	0: Male 1: Female	DECCMA
Age	0: 18-33 years 1: 34-45 years 2: 46-60 years 3: 60+ years (<i>quartiles</i>)	DECCMA
Adaptation		
Any form of adaptation (last 5 years) (Appendix 4.9)	0: No adaptation in the last 5 years 1: At least one form of adaptation in the last 5 years	DECCMA
Current migrant outside household	0: No migrant currently outside household 1: Migrant currently outside household	DECCMA
Past migrant in household	0: No migrant previously outside household 1: Migrant previously outside household	DECCMA
Intention to migrate?	0: No intention 1: Intention to migrate	DECCMA
Migration evaluation	0: Not helpful/neither helpful nor unhelpful 1: Helpful	DECCMA
Assets		
Latrine type	0: Flushing latrine 1: Pit latrine, Public latrine or KVIP 2: No facility	DECCMA
Drinking water source	0: Piped/tubewell/standpipe 1: Dug well/open source	DECCMA
Roof material	0: Non-secure 1: Secure	DECCMA
Homeownership	0: Not owned (mortgaged, renting, squatting) 1: Owned	DECCMA
Subjective evaluations		
Place/community attachment (Appendix 4.2)	0: Low 1: Medium 2: High	DECCMA
Personality (Appendix 4.2)	0: Low 1: Medium 2: High	DECCMA
Community characteristics		
Population density (2016)	0: Low (74 - 369 people/km ²) 1: Medium (370 - 877 people/km ²) 2: High (878 – 2,702 people/km ²) (<i>natural breaks</i>)	WorldPop

Appendix 4.4 Exploratory analysis on respondents' interpretation of “storm surges” in the DECCMA survey

The wide spatial distribution of storm exposure (Figure A4.4) and overrepresentation amongst communities furthest from the coast (Table A4.4a), contrasts the definition, “*an abnormal rise in seawater level during a storm*” (National Ocean Service, 2022). This analysis, alongside studies showing storm surges to correlate with intensified precipitation (Lai et al., 2021), and a significant association between storm exposure and increased rainfall (Table A4.4b), resulted in “storms” being broadly interpreted as oceanic *and* precipitation-based events.

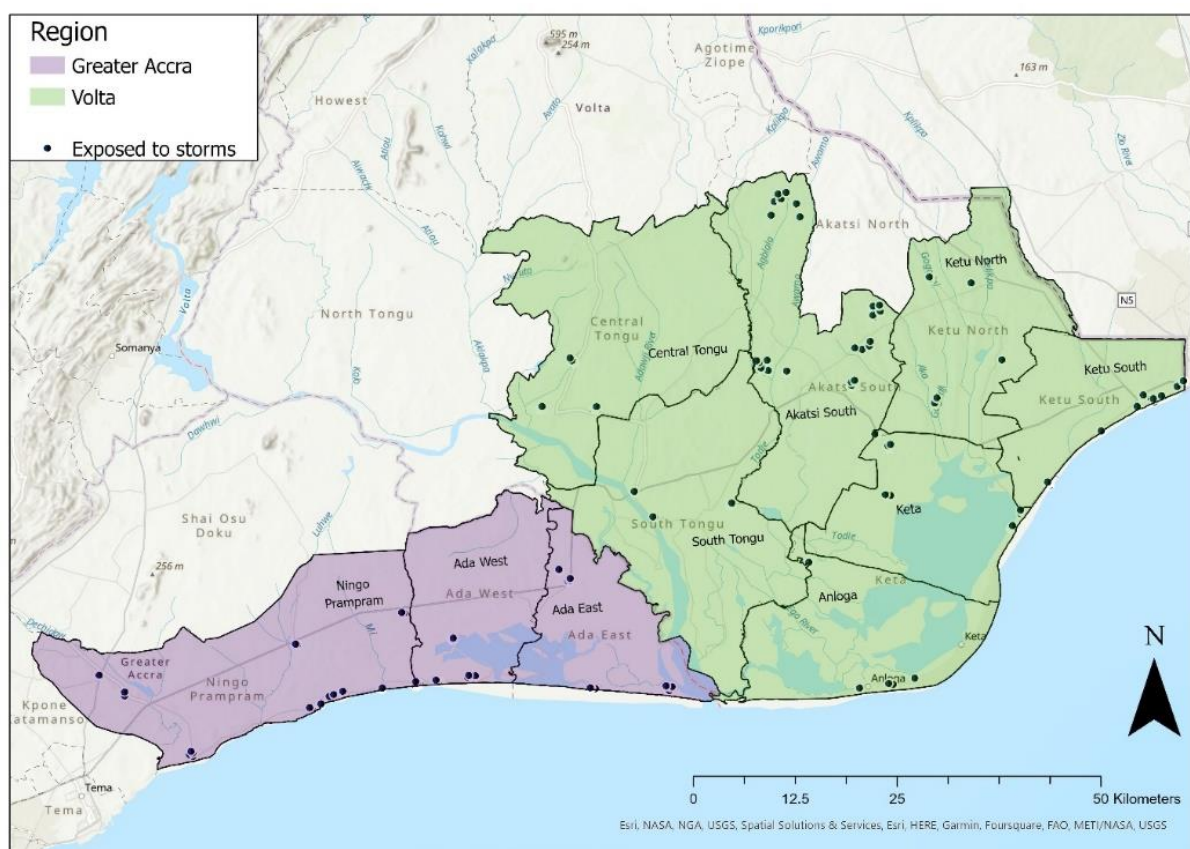


Figure A4.4. Map illustrating households self-defining as “exposed to storm surges”, meaning the household experiences a storm surge on an annual, or more-frequent, basis

Appendix

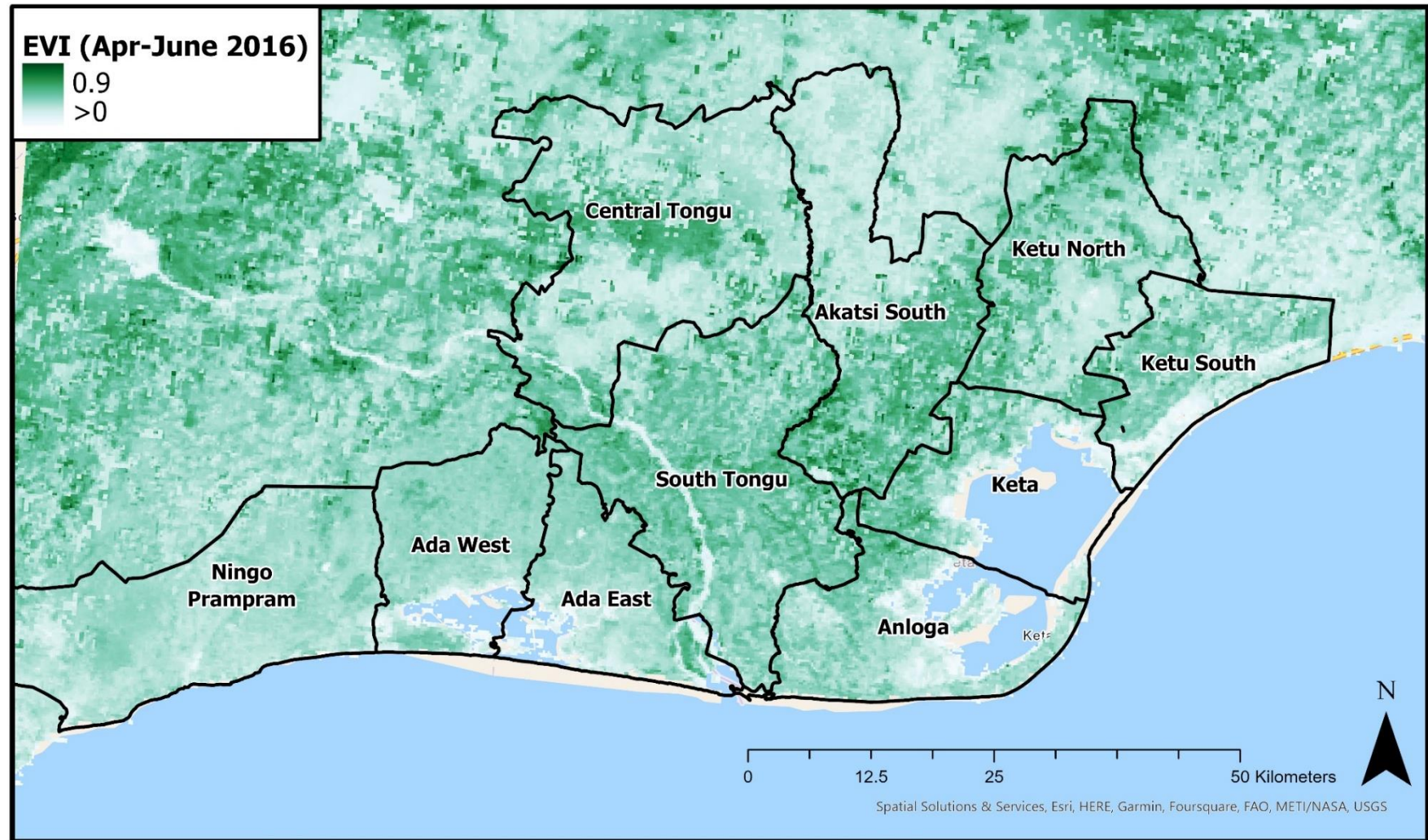
Table A4.4a. Chi-square analysis shows a significant overrepresentation of households exposed to storms when furthest from the coastline

	Exposure to storms (annual or more frequent)		
Distance from coast	Not exposed	Exposed	Total
Low (0 – 8.75km)	589 (67%)	291 (33%)	880
Medium (8.76 – 21.1km)	204 (70%)	88 (30%)	292
High (21.2 – 36.6km)	59 (46%)	70 (54%)	129
Total	852 (65%)	449 (35%)	1,301
Chi-square test statistic	25.552***		

Table A4.4b. Chi-square analysis shows a significant overrepresentation of households exposed to storms when also recording increased rainfall volume over the last 5 years

	Exposure to storms (annual or more frequent)		
Self-reported change in rainfall in the last 5 years	Not exposed	Exposed	Total
Increased	102 (56%)	81 (44%)	183
Decreased	634 (66%)	333 (34%)	967
Stayed the same	75 (81%)	18 (19%)	93
Changed another way	34 (68%)	16 (32%)	50
Total	845 (65%)	448 (35%)	1,293
Chi-square test statistic	17.250***		

Appendix 4.5. EVI values for Volta Delta (April – June 2016). Data sourced from NASA Earth Data. Higher values represent “greener” landcover



Appendix 4.6. Landcover descriptions and percentage coverage across the Volta Delta study area. Percentage coverage is calculated from the proportion of 30x30m pixels in the study area. Note, the overall number of pixels reduced in 2015 compared to 2001 due to coastal erosion

Landcover classification	Description	2001 Volta Delta coverage %	2015 Volta Delta coverage %	% change 2001-15
Built-up land	Built-up areas including associated vegetation such as gardens, trees, parks.	10.8%	10.0%	-0.8%
<i>Sparse built-up</i>	<i>Smaller towns, potentially temporary settlements.</i>	7.0%	5.2%	-1.8%
<i>Dense built-up</i>	<i>Large, urbanised areas with permanent populations.</i>	3.8%	4.8%	+1.0%
Cropland or rice farm	Areas mostly cropped either throughout the year or seasonally. Also, savannah grassland areas which are cropped during the rainy season. Rice farms include herbaceous crops mostly in floodplains or wetlands, allowing for irrigation through water channels.	33.4%	34.5%	+1.1%
Savannah grassland	Grassland areas with scattered trees and thickets. Tree density can reach 25 trees/ha.	20.9%	20.3%	-0.6%
Wetland	Areas covered with fresh/saline water with vegetation covering portions of the water. In Volta Delta the vegetation includes sparse mangroves and <i>Typha</i> grasses.	13.4%	12.8%	-0.6%
Bare land	Areas with little natural vegetative landcover, primarily manmade.	0.4%	1.1%	+0.7%
Riverine vegetation	Vegetation growing along or in rivers/streams, including trees and grasses.	0.4%	0.6%	+0.2%
Marsh/mud	Areas with wet sand (mud) around lagoons and mangroves.	6.4%	5.3%	-1.1%
Lagoon/river	Lagoons are defined as a body of saline, shallow water. Depths are on average 2m.	7.7%	8.4%	+0.7%
Beach (artificial and natural)	Artificial beaches are bare loose sand along the sea with hard sea defence structures constructed to protect against erosion. Natural beaches are the same as artificial beaches, yet without the presence of hard coastal defence structures.	0.8%	0.9%	+0.1%
Mangroves	Forest-type vegetation found along the coast and lagoons. The two main species are <i>Avicennia</i> and <i>Rhizophora</i> .	2.9%	2.5%	-0.4%
Salt pan	Areas of saline water in well-defined pans and inorganic deposits of salt.	2.3%	2.9%	+0.6%
Forest plantation	Planted forest vegetation from afforestation strategies. <i>Only 8 pixels (out of approximately 7,800)</i>	0.1%	0.1%	+/-0.0%
Other	Includes land covers with very low proportions in the study area. Reservoir or dammed waterbodies and tidal pools, which are small waterbodies along the coast with water levels controlled by tidal processes.	0.6%	0.6%	+/-0.0%

Appendix 4.7. VPC results for bivariate multilevel binary logistic models to show which variables, of those included in the final models, explain the most between-cluster variance. Contextual variables at the EA-level are shaded blue for reference. VPC values lower than the “Null” model suggest the variable explains some between-cluster difference

Expenditure Poverty		Basic Needs Deprivation		Subjective Financial Stress		Life domains unhappiness	
Independent variable	VPC	Independent variable	VPC	Independent variable	VPC	Independent variable	VPC
Inland water distance (km)	0.080	Travel time to district capital	0.093	Mud in community	0.149	Major road distance (grouped)	0.059
Grassland landcover %	0.087	Built-up landcover in community (grouped)	0.159	Grassland landcover (grouped)	0.149	Cropland landcover %	0.072
Livelihood cluster	0.101	Region	0.183	Travel time to Accra	0.152	Environmental impact from salinity	0.075
Environmental impact from drought	0.107	Road intersect distance (grouped)	0.186	Household head education	0.152	Wetland in community	0.076
Drinking water source	0.119	Self-reported change in rainfall volume	0.207	Built-up landcover in community	0.155	Household head personality cluster	0.081
Current migrant outside household	0.126	Household head personality cluster	0.219	Exposure to storms	0.157	Environmental impact from storm	0.088
Community mean EVI value (grouped)	0.129	Livelihood cluster	0.220	Self-reported change in rainfall volume	0.158	Household head employment status	0.088
Household head education	0.131	Exposure to drought	0.221	Economic impact from storms	0.160	Past migrant in household	0.089
Travel time to Accra	0.132	Household head age	0.221	Livelihood cluster	0.161	Null	0.090
River vegetation in community	0.136	Null	0.224	Household head age	0.162	Place attachment cluster	0.094
Null	0.141	Environmental impact from drought	0.226	Household religion	0.164	Roof material	0.095
Household adaptation	0.141	Household head sex	0.227	Road intersect distance (grouped)	0.166		
% females in household	0.141	Household head marital status	0.228	Null	0.168		
Economic impact from flooding	0.143	Household adaptation	0.229	Child/adult dependency ratio (grouped)	0.168		
Place attachment cluster	0.144	Past migrant in household	0.231	Current migrant outside household	0.169		
Household size	0.216	Household religion	0.232	Self-reported change in temperature	0.169		
				Household head personality cluster	0.177		
				Household head employment status	0.180		

Appendix 4.8. Model equations and goodness-of-fit diagnostics for all eight binary logistic regression models. Predicted probabilities/marginal effects of significant categorical interaction terms are also presented. Models 4.1.1 – 4.1.4 respond to RQ2a, and Models 4.2.1 – 4.2.4 respond to RQ2b

Model 4.1.1) Objective expenditure poverty. Model 4.1.2) Objective basic needs deprivation. Model 4.1.3) Subjective financial stress. Model 4.1.4) Subjective life domains unhappiness. Model 4.2.1) Aligning “non-poor/happy”. Model 4.2.2) Aligning “poor/unhappy”. Model 4.2.3) Opposing “non-poor/unhappy”. Model 4.2.4) Opposing “poor/happy”.

Model 4.1.1: Objective expenditure poverty

Objective expenditure poverty (OR)

$$= 0.063 + 0.660(\text{Environmentally impacted by drought})$$

$$+ 0.664(\text{Economically impacted by flooding}) + 1.482(2 - 3 \text{ hour Accra travel time})$$

$$+ 2.046(3 + \text{hour Accra travel time}) + 1.090(\text{Distance to inland water [km]})$$

$$+ 0.236(\text{River vegetation in community}) + 1.026(\text{Savannah grassland in community [\%]})$$

$$+ 0.636(\text{Medium EVI}) + 5.006(\text{High EVI}) + 1.282(\text{Dug well or open source drinking water})$$

$$+ 7.522(2 - 3 \text{ person household}) + 27.565(4 - 5 \text{ person household})$$

$$+ 49.957(6 - 7 \text{ person household}) + 108.892(8 + \text{person household})$$

$$+ 0.992(\% \text{ females in household}) + 2.185(\text{Crop farmer livelihood})$$

$$+ 1.852(\text{Fisher trade transport construction livelihood})$$

$$+ 0.574(\text{Below} - \text{basic household head education}) + 0.649(\text{Basic household head education})$$

$$+ 0.264(\text{Above} - \text{basic household head education}) + 0.394(\text{Medium place attachment})$$

$$+ 0.215(\text{High place attachment}) + 1.453(\text{Current migrant outside household})$$

$$+ 0.628(\text{Adapted in the last 5 years})$$

$$+ 1.271(\text{Dug well or open source drinking water} * \text{Distance to inland water [km]})$$

$$+ 1.539(\text{Medium EVI} * \text{Adapted in the last 5 years})$$

$$+ 0.152(\text{High EVI} * \text{Adapted in the last 5 years})$$

$$+ 1.816(\text{Environmentally impacted by drought} * \text{Medium place attachment})$$

$$+ 3.582(\text{Environmentally impacted by drought} * \text{High place attachment})$$

Model goodness-of-fit diagnostic	Result
Nagelkerke pseudo-R ²	0.452 ⁽⁹⁶⁾
Model AIC	1229.483

Community EVI and household adaptation interaction

Interaction	p(Expenditure Poverty)	Marginal effect	p-value
Low mean EVI x No adaptation	0.391		
Low mean EVI x Active adaptation	0.287	-0.104	0.099*
Medium mean EVI x No adaptation	0.289		
Medium mean EVI x Active adaptation	0.283	-0.006	0.911
High mean EVI x No adaptation	0.762		
High mean EVI x Active adaptation	0.235	-0.527	0.000***

⁽⁹⁶⁾ Nagelkerke pseudo-R² compares full model to the null model. Missing values are excluded so the null and full models have the same number of observations.

Appendix

Community/place attachment and environmental impact from drought interaction

Interaction	p(Expenditure Poverty)	Marginal effect (ref: no drought impact)	Marginal effect (ref: low place attachment)
Low place attachment x Not impacted by drought	0.526		
Low place attachment x Impacted by drought	0.422	-0.104	
Medium place attachment x Not impacted by drought	0.304		-0.222***
Medium place attachment x Impacted by drought	0.344	+0.040	-0.078
High place attachment x Not impacted by drought	0.192		-0.334***
High place attachment x Impacted by drought	0.360	+0.168***	-0.062

Model 4.1.2: Objective basic needs deprivation

Basic needs deprivation (OR)

= 5.072 + 0.443(*Environmentally impacted by drought*) + 2.659(*Exposed to drought*)
 + 0.980(*Medium distance from road intersect*) + 1.631(*Furthest from road intersect*)
 + 0.255(*Shortest travel time to district capital*)
 + 0.587(*2nd group travel time to district capital*)
 + 0.383(*3rd group travel time to district capital*) + 0.289(*Volta region*)
 + 1.204(*Medium built – up landcover*) + 0.538 (*High built – up landcover*)
 + 2.119(*Non – Christian religion*) + 1.950(*Crop farmer livelihood*)
 + 1.700(*Fisher trade transport construction livelihood*) + 1.660(*Female household head*)
 + 0.774(*2nd household head age quartile*) + 0.627(*3rd age quartile*)
 + 1.106(*Oldest age quartile*) + 0.794(*Household head married or cohabitating*)
 + 0.410(*Household head never married*) + 1.025(*Household head medium personality*)
 + 0.538 (*Household head high personality*) + 0.387(*Past migrant in household*)
 + 0.431(*Adapted in the last 5 years*) + 2.647(*Past migrant in household * Volta region*)

Model goodness-of-fit diagnostic	Result
Nagelkerke pseudo-R ²	0.348
Model AIC	1429.624

Region and past migrant in household interaction

Interaction	p(Basic needs deprivation)	Marginal effect	p-value
Volta x No past migrant	0.422		
Volta x Past migrant	0.427	+0.005	0.887
Greater Accra x No past migrant	0.653		
Greater Accra x Past migrant	0.477	-0.226	0.000***

Model 4.1.3: Subjective financial stress**Subjective financial stress (OR)**

$$\begin{aligned}
&= 9.741 + 2.553(\text{Economically impacted by storms}) + 0.432(\text{Exposed to storms}) \\
&+ 0.445(\text{Rainfall volume remained the same}) + 0.363(\text{Temperature remained the same}) \\
&+ 0.936(\text{Medium distance from road intersect}) \\
&+ 1.729(\text{Furthest distance from road intersect}) + 1.924(2 - 3 \text{ hour Accra travel time}) \\
&+ 0.841(3 + \text{hour Accra travel time}) + 2.388(\text{Marshland in community}) \\
&+ 0.508(\text{Low/medium savannah grassland coverage}) \\
&+ 0.409(\text{High savannah grassland coverage}) + 0.371(\text{Medium/high builtup landcover}) \\
&+ 0.936(\text{Medium household head personality}) + 0.677(\text{High household head personality}) \\
&+ 0.581(\text{Non - Christian religion}) + 1.538(\text{Child/adult dependency ratio [numeric]}) \\
&+ 2.449(\text{Crop farmer livelihood}) + 2.068(\text{Fisher trade transport construction livelihood}) \\
&+ 1.051(\text{Below - basic household head education}) + 0.623(\text{Basic household head education}) \\
&+ 0.550(\text{Above - basic household head education}) \\
&+ 2.124(\text{Non - permanent household head employment}) + 1.165(\text{Dependant household head}) \\
&+ 2.007(2\text{nd household head age quartile}) + 2.235(3\text{rd age quartile}) \\
&+ 1.566(\text{Oldest age quartile}) + 0.499(\text{Current migrant outside household}) \\
&+ 1.098(\text{Medium distance from road intersect} * \text{Medium household head personality}) \\
&+ 0.761(\text{Medium distance from road intersect} * \text{High household head personality}) \\
&+ 1.533(\text{Furthest distance from road intersect} * \text{Medium household head personality}) \\
&+ 0.293(\text{Furthest distance from road intersect} * \text{High household head personality}) \\
&+ 6.565(\text{Medium/high builtup landcover in community} * \text{Exposed to storms})
\end{aligned}$$

Model goodness-of-fit diagnostic	Result
Nagelkerke pseudo-R ²	0.248
Model AIC	896.605

Distance to road intersect and household head personality interaction

Interaction	p(subjective financial stress)	Marginal effect (ref: closest to road intersect)	Marginal effect (ref: low personality)
Closest to road intersect x Low personality	0.945		
Closest to road intersect x Medium personality	0.902		-0.043
Closest to road intersect x High personality	0.921		-0.024
Medium distance to road intersect x Low personality	0.941	-0.004	
Medium distance to road intersect x Medium personality	0.904	+0.002	-0.037
Medium distance to road intersect x High personality	0.892	-0.029	-0.049
Furthest from road intersect x Low personality	0.967	+0.022	
Furthest from road intersect x Medium personality	0.960	+0.058***	-0.007
Furthest from road intersect x High personality	0.855	-0.066**	-0.112***

Appendix

Built-up land in community and storm exposure interaction

Interaction	p(subjective financial stress)	Marginal effect	p-value
No/low built-up land x Not exposed to storms	0.946		
No/low built-up land x Exposed to storms	0.884	-0.062	0.024**
Medium/high built-up land x Not exposed to storms	0.868		
Medium/high built-up land x Exposed to storms	0.949	+0.081	0.001***

Model 4.1.4: Subjective life domains unhappiness

Low life domains happiness (OR)

= 0.082 + 1.659(*Environmentally impacted by salinity*)
 + 0.769(*Environmentally impacted by storms*) + 1.991(*Medium distance from major road*)
 + 1.008(*Furthest distance from major road*) + 1.009(*Cropland coverage in community [%]*)
 + 1.880(*Wetland landcover in community*) + 0.960(*Medium place attachment*)
 + 0.854(*High place attachment*) + 0.606(*Medium household head personality*)
 + 0.219(*High household head personality*) + 1.749(*Non – secure roof material*)
 + 1.415(*Medium child/adult dependency ratio*) + 2.277(*High child/adult dependency ratio*)
 + 1.539(*Non – permanent household head employment*)
 + 1.701(*Dependant household head*) + 1.450(*Past migrant in household*)
 + 0.987(*Cropland coverage in community [%] * Medium place attachment*)
 + 0.976(*Cropland coverage in community [%] * High place attachment*)
 + 2.071(*Environmentally impacted by storms * Medium household head personality*)
 + 3.588(*Environmentally impacted by storms * High household head personality*)

Model goodness-of-fit diagnostic	Result
Nagelkerke pseudo-R ²	0.205
Model AIC	920.988

Household head personality and environmental impact from storms interaction

Interaction	p(unhappiness)	Marginal effect (ref: not impacted)	Marginal effect (ref: low personality)
Low personality x Not impacted by storms	0.195		
Low personality x Impacted by storms	0.157	-0.038	
Medium personality x Not impacted by storms	0.128		-0.067
Medium personality x Impacted by storms	0.190	+0.062*	+0.033
High personality x Not impacted by storms	0.050		-0.145***
High personality x Impacted by storms	0.128	+0.078***	-0.029

Model 4.2.1: Aligning “non-poor/happy” outcome**Non – poor & Happy classification (OR)**

$$\begin{aligned}
&= 4.207 + 0.564(\text{Environmentally impacted by drought}) \\
&+ 0.702(\text{Environmentally impacted by salinity}) \\
&+ 0.697(\text{Environmentally impacted by erosion}) + 1.709(\text{Exposed to drought}) \\
&+ 2.278(\text{Rainfall volume remained the same}) + 0.206(\text{Medium distance from major road}) \\
&+ 1.309(\text{Furthest distance from major road}) + 1.260(\text{Low EVI}) + 1.298(\text{Medium EVI}) \\
&+ 0.477(\text{High EVI}) + 1.531(\text{Decrease in builtup landcover}) \\
&+ 2.012(\text{Increase in builtup landcover}) + 1.958(\text{Medium place attachment}) \\
&+ 2.302(\text{High place attachment}) + 1.308(\text{Medium household head personality}) \\
&+ 2.344(\text{High household head personality}) \\
&+ 0.462(\text{Dug well or open source drinking water}) + 0.615(\text{Non – Christian religion}) \\
&+ 0.322(2 – 3 \text{ person household}) + 0.109(4 – 5 \text{ person household}) + 0.072(6 \\
&- 7 \text{ person household}) + 0.039(8 + \text{ person household}) + 0.458(\text{Crop farmer livelihood}) \\
&+ 0.622(\text{Fisher trade transport construction livelihood})
\end{aligned}$$

Model goodness-of-fit diagnostic	Result
Nagelkerke pseudo-R ²	0.386
Model AIC	1278.315

Model 4.2.2: Aligning “poor/unhappy” outcome**Poor & Unhappy classification (OR)**

$$\begin{aligned}
&= 0.068 + 5.888(\text{Furthest distance from major road}) \\
&+ 1.011(\text{Shortest travel time to district capital}) \\
&+ 0.474(2\text{nd group travel time to district capital}) \\
&+ 1.507(3\text{rd group travel time to district capital}) + 0.212(\text{Low cropland coverage}) \\
&+ 0.353(\text{Medium cropland coverage}) + 0.228(\text{High cropland coverage}) \\
&+ 0.387(\text{Medium place attachment}) + 0.235(\text{High place attachment}) \\
&+ 0.723(\text{Medium household head personality}) + 0.278(\text{High household head personality}) \\
&+ 2.835(\text{Dug well or open source drinking water}) + 1.760(\text{Non – secure roof material}) \\
&+ 3.581(5 + \text{ person household}) + 0.561(\text{Over 50\% females in household}) \\
&+ 2.136(\text{Medium child/adult dependency ratio}) + 2.952(\text{High child/adult dependency ratio}) \\
&+ 1.857(\text{Non – permanent household head employment}) + 3.565(\text{Dependant household head}) \\
&+ 1.994(\text{Past migrant in household}) \\
&+ 0.354(\text{Furthest distance from major road} * 5 + \text{ person household})
\end{aligned}$$

Model goodness-of-fit diagnostic	Result
Nagelkerke pseudo-R ²	0.258
Model AIC	562.632

Distance to major road and household size interaction

Interaction	p(Poor/Unhappy)	Marginal effect (ref: <5 household size)	Marginal effect (ref: <1km major road)
<1km to major road x <5 household size	0.010		
<1km to major road x 5+ household size	0.036	+0.026**	
>1km to major road x <5 household size	0.058		0.048***
>1km to major road x 5+ household size	0.072	0.014	0.036*

Model 4.2.3: Opposing “non-poor/unhappy” outcome**Non – poor & Unhappy classification (OR)**

$$\begin{aligned}
&= 0.067 + 2.167(\text{Environmentally impacted by salinity}) + 1.999(\text{Exposed to flooding}) \\
&+ 0.454(\text{Low cropland coverage}) + 0.866(\text{Medium cropland coverage}) \\
&+ 0.446(\text{High cropland coverage}) + 3.861(\text{River vegetation in community}) \\
&+ 2.210(\text{Wetland landcover in community}) + 0.772(\text{Medium place attachment}) \\
&+ 0.496(\text{High place attachment}) + 0.528(5 + \text{person household})
\end{aligned}$$

Model goodness-of-fit diagnostic	Result
Nagelkerke pseudo-R ²	0.143
Model AIC	648.203

Model 4.2.4: Opposing “poor/happy” outcome**Poor & Happy classification (OR)**

$$\begin{aligned}
&= 0.003 + 1.493(\text{Economically impacted by drought}) \\
&+ 0.563(\text{Economically impacted by flooding}) + 1.540(\text{Environmentally impacted by erosion}) \\
&+ 3.628(\text{Volta region}) + 3.293(\text{Low cropland coverage}) + 2.488(\text{Medium cropland coverage}) \\
&+ 2.956(\text{High cropland coverage}) + 0.339(\text{River vegetation in community}) \\
&+ 1.841(\text{Dug well or open source drinking water}) + 2.107(\text{Pit public or KVIP latrine}) \\
&+ 3.319(\text{No latrine facility}) + 4.072(2 - 3 \text{ person household}) \\
&+ 11.053(4 - 5 \text{ person household}) + 14.995(6 - 7 \text{ person household}) \\
&+ 32.438(8 + \text{person household}) + 0.775(\text{Below – basic household head education}) \\
&+ 0.854(\text{Basic household head education}) + 0.376(\text{Above – basic household head education}) \\
&+ 1.471(\text{Current migrant outside household})
\end{aligned}$$

Model goodness-of-fit diagnostic	Result
Nagelkerke pseudo-R ²	0.330
Model AIC	1240.626

Appendix 4.9 Types of adaptation incorporated within the “livelihood/environmental adaptation” variable

In the last five years have you...

- taken out a loan to purchase things for the household, or to improve livelihood?
- taken out, or cancelled insurance for your main livelihood?
- modified, or improved your house (walls, roof, floor)?
- started to cut down trees around your home, or stopped?
- planted trees around your home, or stopped planting trees around your home?
- started using hired labour to support you in generating income?
- allowed women in your household to start working outside of the house?
- moved to a new house (within the same village)?
- sent a household member to work outside the village?
- seen a member of the household who has worked outside the village come back to the household permanently?
- diversified crops or reduced the variety of crops grown?
- planted climate tolerant crops?
- increased or reduced the use of fertiliser?
- put in irrigation?
- changed land use to mixed farming/fishing production?
- bought, or sold farming or fishing tools/equipment?
- received training on new fishing or farming skills/methods?
- fished new breeds/used new breeds in ponds, or reverted to traditional breeds?
- received government or NGO assistance to help with your home, family or livelihood?
- organised your own protection or used a community shelter during a storm or flood?

Appendix 4.10. Information on the methodology used to calculate the partitioned pseudo-R² values for each model. The partitioned scores estimate the proportion of variation in the model outcomes explained by environment and non-environment (control) variables. A breakdown of the contribution of each variable within all eight models is provided

The estimated contribution of the environment and non-environment (control) explanatory variable groups towards the wellbeing outcome was calculated by subtracting the Nagelkerke R² of the opposite set from the *FULL* model:

$$R^2_{Environment} = R^2_{Full} - R^2_{Non-environment (control)}$$

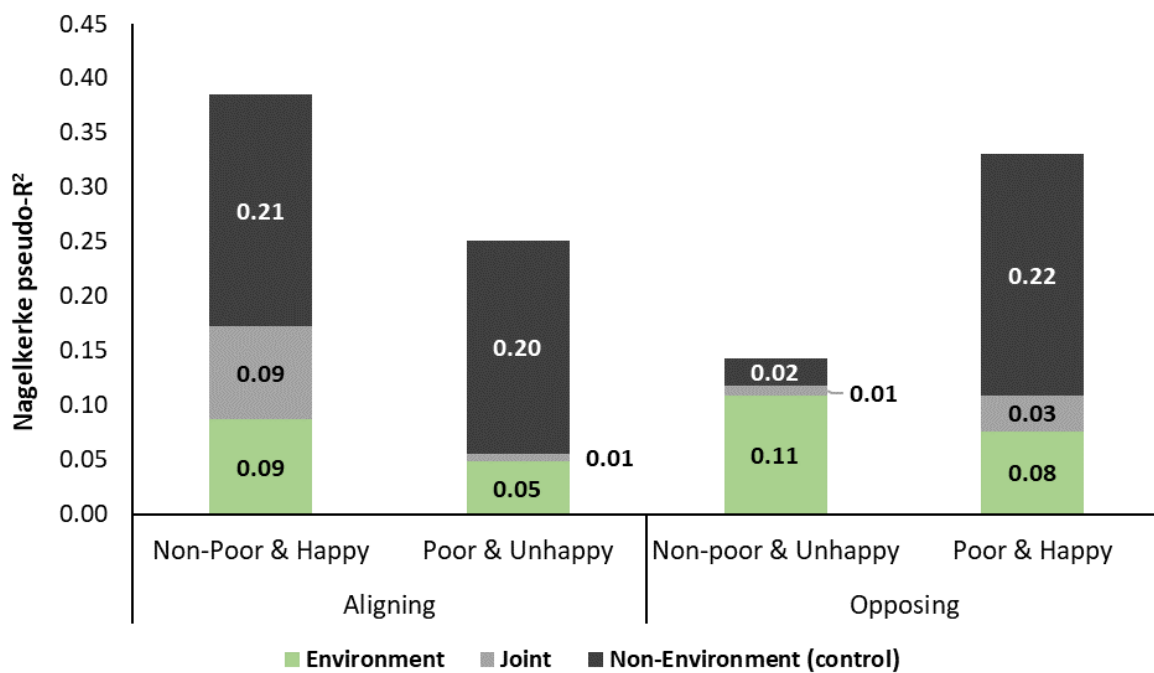
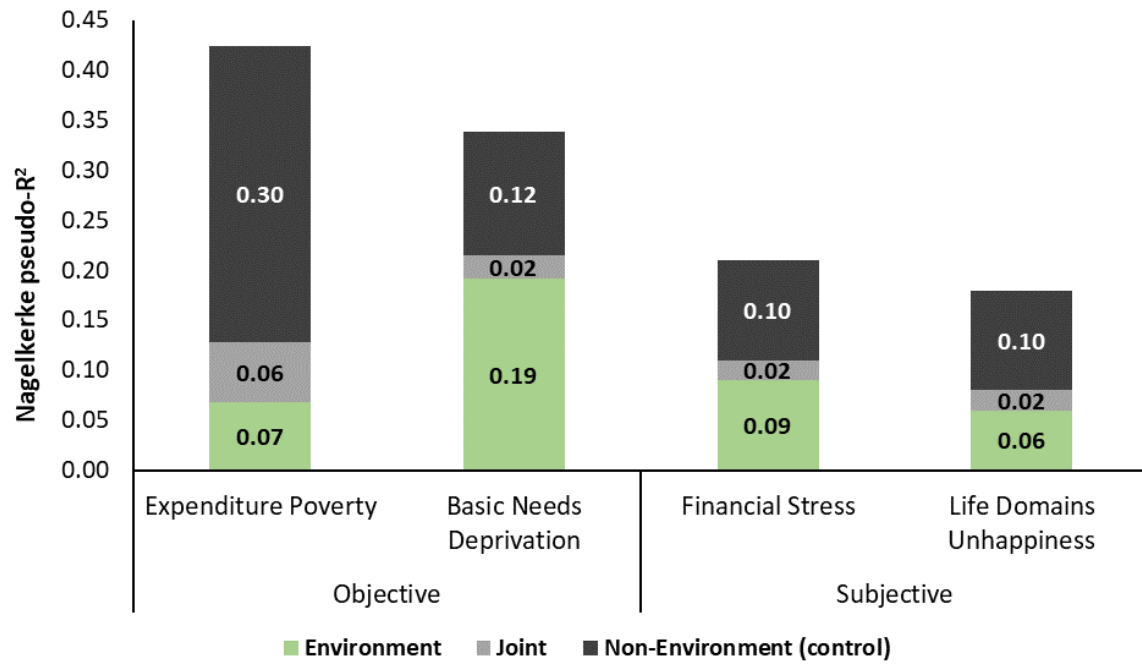
$$R^2_{Non-environment (control)} = R^2_{Full} - R^2_{Environment}$$

The joint contribution of the two groups was calculated by subtracting the estimated environment and non-environment contributions from the Nagelkerke R² value for the *FULL* model:

$$R^2_{Joint} = R^2_{Full} - (R^2_{Environment} + R^2_{Non-environment (control)})$$

The Nagelkerke R² contribution of the environment, control, and joint effects are illustrated below. The first figure contains the four single outcome models (top), and the second (bottom) shows the four combined OWB/SWB outcome models.

Appendix



A similar process was undertaken by removing individual variables from each model to provide more detailed information on which specific variables explained the highest proportions of variance in the outcome. The estimated contribution of each variable to the Nagelkerke R^2 for each of the eight models is presented below. The first table contains the four single outcome models, and the second table contains the four combined OWB/SWB models. Environmental variables are **bolded**.

Appendix

Expenditure poverty			Basic Needs Deprivation			Financial Stress			Life Domains Unhappiness		
Variable	R ² Contribution	%	Variable	R ² Contribution	%	Variable	R ² Contribution	%	Variable	R ² Contribution	%
Household size	0.219	48%	Joint	0.152	44%	Joint	0.039	16%	Joint	0.057	28%
Joint	0.080	18%	Travel time to district capital	0.037	11%	Built-up land cover x Exposure to storms	0.029	12%	Environmental storm impact x Household head personality cluster	0.045	22%
Drinking water source x distance to inland water	0.034	8%	Past migrant in household x Region	0.030	9%	Distance from road intersect x Household head personality	0.026	10%	Cropland community coverage x Place/community attachment	0.038	18%
Environmental drought impact x place/community attachment	0.027	6%	Household adaptation	0.021	6%	Marshland in community	0.019	7%	Child/adult dependency ratio group	0.012	6%
Household head education	0.022	5%	Exposure to drought	0.017	5%	Savannah grassland in community	0.016	7%	Distance from major road	0.011	6%
Mean 2016 EVI value x Household Adaptation	0.022	5%	Household religion	0.017	5%	Age quartile	0.014	6%	Household roof material	0.011	5%
Savannah grassland in community	0.011	2%	Environmental impact from drought	0.011	3%	Household livelihood cluster	0.014	6%	Wetland in community	0.010	5%
River vegetation in community	0.008	2%	Household head personality cluster	0.010	3%	Travel time to Accra	0.013	5%	Environmental impact from salinity	0.008	4%
Travel time to Accra	0.008	2%	Household head sex	0.009	2%	Current migrant outside HH	0.013	5%	Household head employ. status	0.008	4%
Household livelihood cluster	0.008	2%	Household head marital status	0.008	2%	Child/adult dependency ratio	0.011	4%	Past migrant in HH	0.006	3%
% females in household	0.006	1%	Household head age	0.008	2%	Household head employ. status	0.010	4%			
Current migrant outside HH	0.004	1%	Built-up landcover in community	0.008	2%	Household head education	0.010	4%			
Economic impact from flooding	0.003	1%	Livelihood cluster	0.008	2%	Self-reported change in temperature	0.009	4%			
			Distance to road intersect	0.007	2%	Economic impact from storms	0.009	4%			
			Self-reported change in rainfall	0.003	1%	Self-reported change in rainfall	0.008	3%			
						Household religion	0.007	3%			

Appendix

Non-poor & Happy			Poor & Unhappy			Non-poor & Unhappy			Poor & Unhappy		
Variable	R ² Contribution	%	Variable	R ² Contribution	%	Variable	R ² Contribution	%	Variable	R ² Contribution	%
Household size	0.157	41%	Joint	0.051	20%	Joint	0.040	28%	Household size	0.152	46%
Joint	0.091	24%	Place/community attachment cluster	0.031	12%	River vegetation in community	0.019	14%	Joint	0.052	16%
Distance from major road	0.036	9%	Household head personality cluster	0.026	10%	Cropland in community	0.018	13%	Region	0.033	10%
Household head personality cluster	0.017	4%	Cropland in community	0.023	9%	Environmental impact from salinity	0.017	12%	Cropland in community	0.022	7%
Drinking water source	0.016	4%	Drinking water source	0.022	9%	Exposure to flooding	0.016	11%	Household head education	0.015	5%
Mean 2016 EVI	0.013	3%	Household head employ. status	0.022	9%	Household size	0.012	9%	Latrine facility	0.012	4%
Place/community attachment cluster	0.010	3%	Child/adult dependency ratio	0.021	8%	Place/community attachment cluster	0.011	8%	Drinking water source	0.010	3%
Household livelihood cluster	0.009	2%	Travel time to district capital	0.015	6%	Wetland in community	0.009	6%	River vegetation in community	0.010	3%
Religion	0.007	2%	Distance from major road * Household size	0.015	6%				Economic impact from flooding	0.007	2%
Change in built-up landcover (2001-15)	0.007	2%	Past migrant in HH	0.013	5%				Current migrant outside HH	0.006	2%
Self-reported change in rainfall	0.006	2%	% females in household	0.009	4%				Environmental impact from erosion	0.005	2%
Environmental impact from drought	0.005	1%	Household roof material	0.008	3%				Environmental impact from drought	0.005	1%
Exposure to drought	0.005	1%									
Environmental impact from salinity	0.003	1%									
Environmental impact from erosion	0.003	1%									

Appendix 4.11. Chi-square analysis shows an overrepresentation of high community grassland coverage when households are either economically impacted by drought or environmentally impacted by erosion

Community grassland coverage	Environmental drought impact			Environmental erosion impact		
	Not impacted	Impacted	Total	Not impacted	Impacted	Total
None (0%)	376 (66%)	196 (34%)	572	445 (79%)	120 (21%)	565
Low/Medium (1% - 19%)	337 (63%)	195 (37%)	532	426 (81%)	101 (19%)	527
High (20% - 87%)	70 (37%)	120 (63%)	190	138 (72%)	54 (28%)	192
Total	783 (61%)	511 (39%)	1,294	1,009 (79%)	275 (21%)	1,284
Chi-square test statistic	52.865***			6.732**		

Appendix 4.12. Chi-square analysis shows an overrepresentation of select objective basic needs deprivations amongst households exposed, yet not environmentally impacted, by drought

Basic needs deprivation	Exposed, yet not environmentally impacted, by drought			Chi-square test statistic
	No	Yes	Total	
Excess capital (food expenditure)	623 (86%)	99 (14%)	722	8.779***
Education	355 (84%)	67 (16%)	422	12.184***
Healthcare access	919 (87%)	138 (13%)	1,057	14.923***
Network size	367 (83%)	73 (17%)	440	17.481***
Total	1,146 (89%)	148 (11%)	1,294	

Appendix 4.13. Chi-square analysis shows a significant overrepresentation of high community inequality in highly built-up communities, and an overrepresentation of low inequality within rural communities

EA Gini coefficient (equivalised, adjusted expenditure)	Built-up landcover in community buffer				Total
	None/low coverage (0% - 8%)	Low-medium coverage (9% - 19%)	Medium-high coverage (20% - 44%)	High coverage (45% - 70%)	
Low inequality (0.226 – 0.320)	233 (54%)	87 (13%)	57 (13%)	51 (12%)	428
Medium inequality (0.321 – 0.405)	227 (43%)	162 (31%)	84 (16%)	53 (10%)	526
High inequality (0.406 – 0.536)	192 (47%)	79 (19%)	53 (13%)	86 (21%)	410
Total	652 (48%)	328 (24%)	194 (14%)	190 (14%)	1,364
Chi-square test statistic	46.053***				

Appendix 4.14. Supporting analysis highlights greater individualism, and a smaller focus on place/community attachment when defining happiness, in more-affluent built-up areas

- an overrepresentation of low place/community attachment in highly built-up communities.
 - 50% households exist within medium/high built-up areas (10-69% coverage); however, 59% households with low place/community attachment are located in medium/high built-up communities ($\chi^2 = 17.740^{***}$).
- a significant association between place/community attachment and happiness clusters at each household expenditure decile, excluding the highest 20% (see below).
- a significant positive correlation between place/community attachment and happiness indices at every cropland coverage group, except communities with no cropland (urban) (see below).

Household expenditure (GSS-equivalised, adjusted) decile	Chi-square test statistic (place/community attachment & happiness clusters)
Bottom 10%	16.795***
20%	15.014***
30%	16.364***
40%	12.637**
50%	12.889**
60%	9.978**
70%	20.338***
80%	16.981***
90%	7.264
Top 10%	3.069

% cropland coverage in community	Correlation value (place/community index & happiness index)
None (0%)	0.115
Low (2 – 26%)	0.212***
Medium (27 – 54%)	0.257***
High (55 – 98%)	0.295***

Appendix 4.15. Chi-square analysis shows a significant overrepresentation of households undertaking an adaptive practice when the household head has a highly positive/outgoing personality

	Household undertaken any form of adaptation in the last 5 years		
Household head personality cluster	No	Yes	Total
Low	60 (33%)	122 (67%)	182
Medium	136 (24%)	424 (76%)	560
High	107 (17%)	515 (83%)	622
Total	303 (22%)	1,061 (78%)	1,364
Chi-square test statistic	22.610***		

Appendix 4.16. Chi-square analysis shows an overrepresentation of higher mean 2016 EVI values within communities with high cropland and grassland coverage

	Mean community (2km buffer) EVI value			
Community landcover	Low (0.113 – 0.198)	Medium (0.199 – 0.269)	High (0.270 – 0.367)	Total
Cropland				
None (0%)	227 (100%)	0 (0%)	0 (0%)	227
Low (1% – 25%)	228 (63%)	108 (30%)	28 (8%)	364
Medium (26% - 54%)	56 (23%)	134 (55%)	54 (22%)	244
High (55% +)	79 (15%)	259 (49%)	191 (36%)	529
Total	590 (43%)	501 (37%)	273 (20%)	1,364
Chi-square test statistic	595.810***			
Grassland				
None (0%)	451 (73%)	117 (19%)	51 (8%)	619
Low/medium (1 – 19%)	113 (21%)	300 (54%)	138 (25%)	551
High (20% +)	26 (13%)	84 (43%)	84 (43%)	194
Total	590 (43%)	501 (37%)	273 (20%)	1,364
Chi-square test statistic	436.636***			

Appendix – Chapter 5

Appendix 5.1 Responsibilities of the District Planning Officers (DPOs) in Ghana, described by Dr. Mumuni Abu from University of Ghana’s Regional Institute for Population Studies

“The district planning officers are responsible for coordinating planning activities at the district levels in consultation with other state institutions, NGOs, and opinion leaders in the district. So, even though the planner will not be responsible for education, health etc., the tracking of the performance of the district in these areas are the responsibility of the planner. The planner therefore liaise with other heads of institutions in the district in the implementation of the plans. The planner reports on the progress of all sectors of the district to the National Development Planning Commission”

Appendix 5.2 Defining characteristics (wellbeing, climate, landscape, livelihoods) and justifications for selecting the eight study sites. Models with relevant results, which can be interpreted within the study site, are also presented

Site	Key characteristics used to justify site selection				Relevant models
	Wellbeing outcomes	Climatic hazards	Landscape	Livelihoods	
1) Afiencya	- Lower expenditure poverty - Lower basic needs deprivation	Erosion	- Proximity to Tema/Accra - Inland	Non-primary (i.e., mechanics)	4.1.1 4.1.2 4.1.3 4.2.4
2) Anyamam	- Higher basic needs deprivation, financial stress and unhappiness. - Higher odds of opposing “non-poor/unhappy”	Exposed, yet not impacted by drought	- Proximate marshland (associated with financial stress) - Near lagoon & coast	- Fishing - Salt mining	4.1.1 4.1.2 4.1.3 4.1.4 4.2.1 4.2.3 4.2.4
3) Sogakope	- Higher proportion “non-poor/unhappy” - Higher financial stress	- Limited self-reported exposure to climate hazards - Changing rainfall and temperature	- Within district capital - Proximity to river - Wetland and river vegetation coverage (associated with “non-poor/unhappy”)	Non-primary (i.e., tourism & construction)	4.1.1 4.1.2 4.1.3 4.1.4 4.2.3 4.2.4
4) Nyitawuta	- Higher expenditure poverty - Lower financial stress and unhappiness (“poor/happy”)	Drought & erosion (associated with “poor/happy”)	- Inland, remote village - High grassland coverage (associated with high poverty, yet low financial stress)	Agricultural	4.1.1 4.1.2 4.1.3 4.2.1 4.2.4
5) Awlikope	“Poor/happy” outcomes	Erosion (associated with “poor/happy”)	High cropland coverage	- Agricultural - NGO support	All eight models
6) Aflao	Lower basic needs deprivation	Lower exposure to flooding/storms despite coastal location	- High built-up coverage - Close to Togo border - High accessibility to roads - Near coast	- Fishing - Nearby non-primary factory opportunities	All eight models
7) Kedzi	Higher “non-poor/happy”	Flooding, coastal erosion & salinity	- Near lagoon & coast - Located on reclaimed spit following loss of old town to the ocean.	Fishing	4.1.1 4.1.2 4.1.4 4.2.1 4.2.3 4.2.4
8) Anloga	- Higher “non-poor/happy” - Low financial stress, contrasting nearby village with 100%	Lower exposure to flooding/erosion despite coastal location	- Near coast, river & lagoon - Wetland coverage (associated with “non-poor/unhappy”)	- Fishing - Farming	4.1.1 4.1.2 4.1.3 4.1.4 4.2.1 4.2.3

Appendix 5.3. Copy of the letter provided to the District Chief Executives, District Planning Officers and Chiefs/Assemblymen describing the research and the collaboration with the University of Ghana



February 16, 2023

To whom it may concern

Dear Madam/Sir,

INTRODUCTION OF ENVIRONMENT AND WELLBEING ASSOCIATION STUDY

The Regional Institute for Population Studies (RIPS), University of Ghana in collaboration with the University of Southampton, United Kingdom is doing a follow-up study on the Deltas, Vulnerability and Climate Change: Migration and Adaptation (DECCMA) project which took place in the Volta Delta between the period 2014 and 2018. In the current collaboration, we have PHD students who are following up on some of the findings of the project.

Mr. Laurence Cannings who is a PHD candidate at the University of Southampton is investigating environment and wellbeing associations in the Volta Delta as a follow-up to the DECCMA project. He is being supported in the field by two research assistants (Mr. Winfred Korsi and Ms. Belinda Ofori). Laurence and his team will conduct qualitative interviews at both the community and district administrative levels. Specifically, they will conduct focus group discussions with selected community members, and interview district development planners. The study involves direct interaction with human participants and therefore will uphold core ethical principles of autonomy, beneficence, non-maleficence, confidentiality and integrity. The research will contribute to the global literature on environment and wellbeing association. There is no physical, social and emotional risk associated with the study.

We are officially introducing the research team to you with this letter and requesting permission to speak with the district development planner at her/his convenience. The interview will last for a maximum of 40 minutes.

Please, if you have any concerns related to this study, kindly contact Dr. Mumuni Abu (Work Package 3 Lead, DECCMA) at 0277385249 and the staff of the Regional Institute for Population Studies, University of Ghana, Legon.

Yours faithfully,

Mumuni Abu (Ph.D.)
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Appendix 5.4. Details of focus group and interview participants from all eight study sites. Age profiles of all community interviews, focus group members, and DPOs also presented. Note, some individuals did not disclose their age, also some individuals who consented left during FGs. However, as it is not possible to know which individuals departed, their ages are included in the figure

1) Afienny	Male FG	Female FG	Community interviews	DPO interview
No. participants	7	6	1 (M)	1 (F)
Duration	01:45	01:38	00:33	00:55
Ages	32 - 49	21 - 55	32 – 41	42 - 51
Language	English	Dangbe	Dangbe	English
Consent	Written	Written	Written	Written

2) Anyamam	Male FG	Female FG	Community interviews	DPO interview
No. participants	8	8	1 (M), 1 (F)	1 (F)
Duration	01:47	02:09	00:42 (M), 00:49 (F)	00:59
Ages	28 - 48	25 - 62	32 – 41 (M & F)	32 - 41
Language	Dangbe	Dangbe	Dangbe (M & F)	English
Consent	Written	Written	Written	Written

3) Sogakope	Male FG	Female FG*	Community interviews	DPO interview
No. participants	6	10	1 (M), 1 (F)	1 (M)
Duration	01:32	01:49	00:32 (M), 00:32 (F)	00:46
Ages	30 - 57	34 - 55	26 – 31 (M), 18 – 25 (F)	32 - 41
Language	Ewe	Ewe	English (M & F)	English
Consent	Written	Written	Written	Written

* Female FG respondents became quite aggressive, demanding money, or telling others to stop sharing their opinions.

4) Nyitawuta	Male FG	Female FG	Community interviews	DPO interview
No. participants	8	8	1 (M), 1 (F)	1 (M)
Duration	02:08	01:42	00:46 (M), 00:47 (F)	00:36
Ages	20 - 80	36 - 63	x (M), 42 – 51 (F)	x
Language	Ewe	Ewe	Ewe	English
Consent	Written	Written	Written	Spoken

5) Awlikope	Male FG	Female FG	Community interviews	DPO interview
No. participants	8	8	1 (M), 1 (F)	1 (M)
Duration	01:51	01:52	00:58 (M), 01:03 (F)	00:41
Ages	35 - 50	26 - 62	62 – 71 (M), 32 – 41 (F)	42 - 51
Language	Ewe	Ewe	English (M), Ewe (F)	English
Consent	Written	Written	Written	Written

Appendix

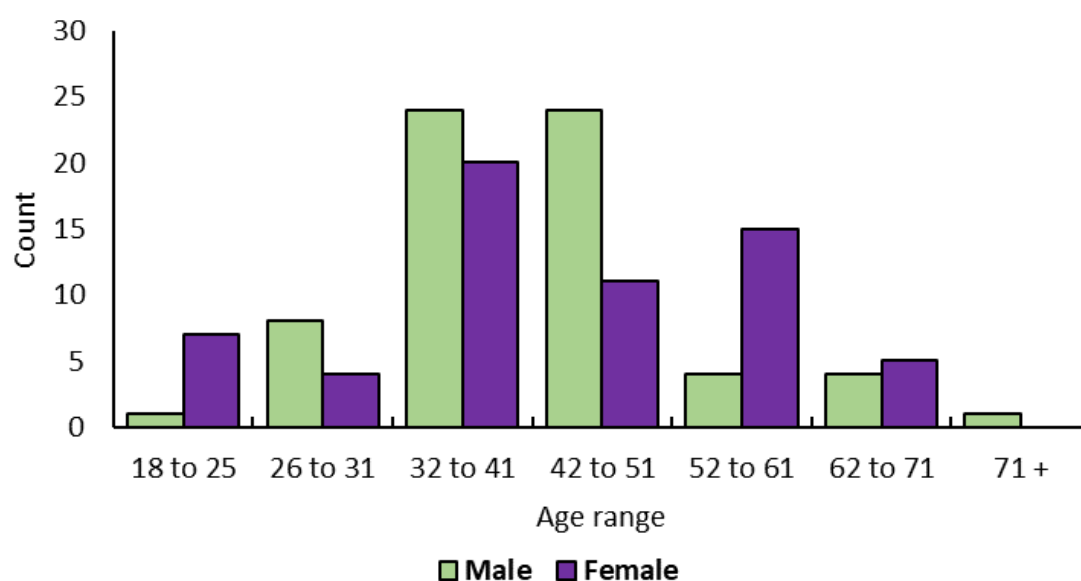
6) Aflao	Male FG*	Female FG	Community interviews	DPO interview
No. participants	7	8	1 (M), 1 (F)	1 (M)
Duration	01:04	01:27	00:37 (M), 00:39 (F)	00:47
Ages	26 - 60	19 - 63	32 – 41 (M), 62 – 71 (F)	x
Language	Ewe	Ewe	Ewe (M) Ewe/Dangbe (F)	English
Consent	Written	Written	Written	Spoken

* Male FG respondents were reluctant to stay and not very responsive.

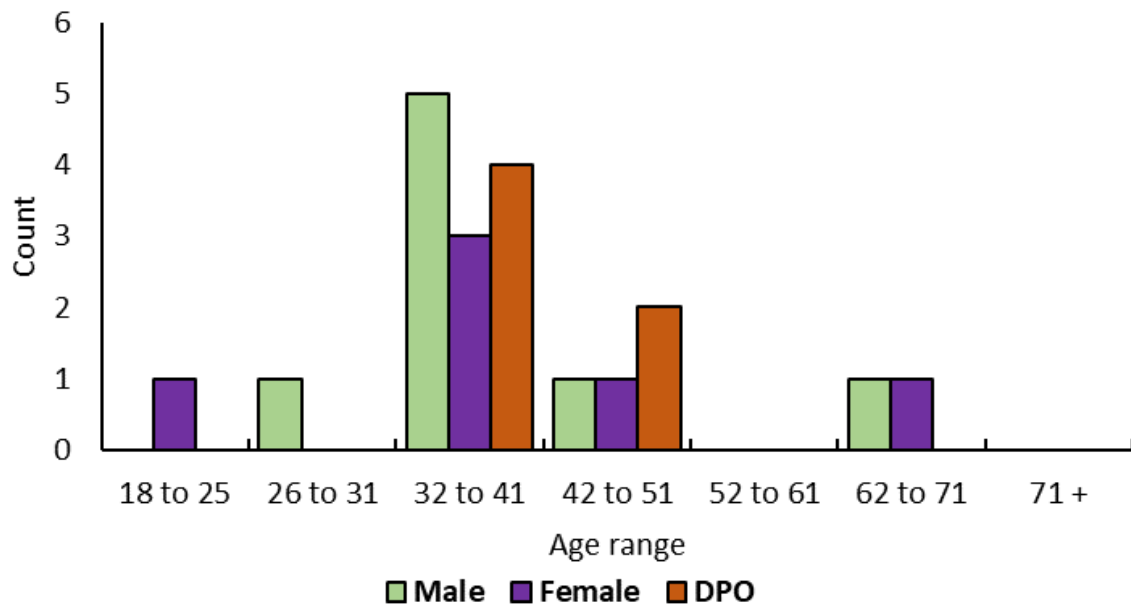
7) Kedzi	Male FG	Female FG	Community interviews	DPO interview
No. participants	9	7	2 (M)	1 (M)
Duration	01:51	01:45	00:45, 01:02 (M)	00:38
Ages	32 - 66	38 - 58	32 – 41, 42 – 51 (M)	52 - 61
Language	Ewe	Ewe	English (M x2)	English
Consent	Written	Written	Written	Written

8) Anloga	Male FG	Female FG	Community interviews	DPO interview
No. participants	10	8	1 (M), 1 (F)	1 (M)
Duration	01:30	01:40	00:48 (M), 00:37 (F)	00:46
Ages	28 - 63	18 - 59	32 – 41 (M & F)	32 – 41
Language	Ewe	Ewe	English (M), Ewe (F)	English
Consent	Written	Written	Written	Written

Community focus groups: age profile



Community and DPO interviews: age profile



Appendix 5.5 General and site-specific focus group and interview question guides

Site-specific focus group question guides. Not all questions were asked, many were used as prompts if respondents needed encouragement to discuss their thoughts. Environmental characteristics were based on remote sensing data, and where self-reported climatic hazards exceeded the DECCMA sample average. Two columns of FG questions are presented for each study site. Interview guides are presented after FG guides.

Community: Afiénya (1)Focus group questions

• Opening questions

- How would you define “a good life”? (not “wellbeing”)
- How would you describe your environment?
- Have you faced any hazards/pressures (use prompts above)

Environmental characteristics

- Near to Accra
- Urban
- Erosion
- Further from coast
- Further from inland water

• Introduce ranking exercise

- Give each participants 5 bundles of 10 sticks
- Each individual should have 5x packs of the same colour

• Ask each participant to distribute their 10 sticks across the 3 components of **FINANCIAL CAPITAL**. They are allowed to distribute them however they want – based on how important the component is for their good life/wellbeing.

- Ask why, as a group, *** was selected as the most important?
- Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of financial capital.
- Follow-up/prompt questions:
 - Employed in Accra/Tema?
 - Is your employment impacted by environmental pressures/risks?
 - Does this mean you are able to access permanent employment? Does this give you confidence in future financial security? Allow you to invest with confidence? Increase your status? Bring security in providing for family?
 - What benefits of being close to the capital?
 - Has anyone you know migrated to Accra/Tema? Why? What benefits are transferred home?

• Ask each participant to distribute their 10 sticks across the 2 components of **HUMAN CAPITAL**.

- Ask why, as a group, *** was selected as the most important?
- Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of human capital.
- Follow-up/prompt questions:
 - Past results show access to higher education, how do you access this?
 - What benefits does education provide? Ability to adapt to different conditions? Less vulnerable livelihoods? Optimism for the future? Greater status in the community?
 - Past results show good health – despite increasing climate-related health risks are you able to maintain good health in the community? How?

• Ask each participant to distribute their 10 sticks across the 2 components of **SOCIAL CAPITAL**.

- Ask why, as a group, *** was selected as the most important?
- Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of social capital.
- Follow-up/prompt questions:
 - Past results suggest unhappiness with community relationships, why could this be?

- Do you focus on your own wellbeing, or the wellbeing of the wider community? If you did the opposite, how would it impact your good life (both material/financial and happiness/peace)?
- Do you feel your view on the importance of community differs to that in rural areas? Why or why not?
- What role does religion play in your life? Networks? Peace during climate stress?

• Ask each participant to distribute their 10 sticks across the 5 components of **PHYSICAL CAPITAL**.

- Ask why, as a group, *** was selected as the most important?
- Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of physical capital.
- Follow-up/prompt questions:
 - Past studies suggest poorer quality housing – why is this despite higher incomes/assets in the area?
 - Would you prefer to own your home? Does renting cause any issues regarding tenure security?
 - Would you say the housing you live within meets the aspirations you have for your living standards?

• Ask each participant to distribute their 10 sticks across the 4 overarching groups.

- Depending on time, can discuss why the group chose *** as the most important, and *** as the least important.

• Subjective themes

- Do you have the ability to travel where you want, and do the work you want to do? Are there any restraints (any environmental restraints)?
- When thinking about your own wellbeing, who do you compare to?
- Do you think different communities will compare to different areas? Why?
- What are your aims for the future? Do you think you can achieve these? Do you feel the changing environment could impact your goals?

• Concluding questions

- Does money lead to happiness? Why? Why not? (status, dignity, being able to buy services/goods)? probe for responses that say yes and no
- How does the community's wellbeing impact you? If everyone is doing well, how does that make you feel? If others are doing better than you, how do you feel?
- How have, or do you want to, adapt to changing environment? How could it improve, or worsen, your “good life”? (adaptation such as changing crops, but also migration)
- Any questions for me?

Community: Anyaman (2)

Focus group questions

Environmental characteristics

- Near Songor lagoon/coast
- Marshland cover

- Flooding
- Erosion
- Salinity
- Storms

• Opening questions

- How would you define “a good life”? (not “wellbeing”)
- How would you describe your environment?
- Have you faced any hazards/pressures (use prompts above)

• Introduce ranking exercise

- Give each participants 5 bundles of 10 sticks
- Each individual should have 5x packs of the same colour

• Ask each participant to distribute their 10 sticks across the 3 components of FINANCIAL CAPITAL. They are allowed to distribute them however they want – based on how important the component is for their good life/wellbeing.

- Ask why, as a group, *** was selected as the most important?
- Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of financial capital.
- Follow-up/prompt questions:
 - What financial benefits do you receive from being close to the lagoon?
 - What financial benefits do you receive from marshland around the lagoon?
 - What financial benefits do you receive from being close to the coast?
 - Are there any restrictions on what you can use, or benefit from, from the lagoon/coast?
 - Have environmental pressures impacted fishing communities here? How?
 - Do you work or travel to Accra/Tema? Why? How are those places different to this community?

• Ask each participant to distribute their 10 sticks across the 2 components of HUMAN CAPITAL.

- Ask why, as a group, *** was selected as the most important?
- Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of human capital.
- Follow-up/prompt questions:
 - Any barriers to accessing education?
 - Does education help you adapt to changing conditions?
 - Key result: this community is shown to be exposed, but not impacted by drought – what are they doing that prevents drought from having a negative impact?
 - Health issues following flooding? Is this made worse by latrine availability? Do people use the beach to go to the toilet? Why?

• Ask each participant to distribute their 10 sticks across the 2 components of SOCIAL CAPITAL.

- Ask why, as a group, *** was selected as the most important?
- Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of social capital.
- Follow-up/prompt questions:
 - Do you focus on your own wellbeing, or the wellbeing of the wider community? If you did the opposite, how would it impact your good life (both material/financial and happiness/peace)?

- Past results show the community to be less happy with family/community interactions – why do you think this could be?
- If there is a hazard (social, climatic) do community relationships grow, or do people focus on themselves? Why?
- Have you received NGO support? What benefits were received? Were you happy that they came?
- What role does religion play in your life? Networks? Peace during climate stress?

• Ask each participant to distribute their 10 sticks across the 5 components of PHYSICAL CAPITAL.

- Ask why, as a group, *** was selected as the most important?
- Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of physical capital.
- Follow-up/prompt questions:
 - Have climate hazards caused damage to your material assets?
 - If your physical assets are damaged, does it impact your status, or your appearance?

• Ask each participant to distribute their 10 sticks across the 4 overarching groups.

- Depending on time, can discuss why the group chose *** as the most important, and *** as the least important.

• Subjective themes

- When you are self-evaluating your own life, who do you compare to? Is it within the community, or do you compare to others in Ghana, in Accra/Tema, or others?
- Are you meeting your aspirations and goals?
- Do you think you can meet your aspirations in this community? Why/why not? Would you consider migrating somewhere else to achieve these aspirations?
- Past studies showed many to be permanently employed, what benefits does this bring? (probe for ideas on how it can be beneficial in an increasingly uncertain environment – such as changes in seasonality)
- Past studies suggest unhappiness with the environment – why is this? What could be done to improve satisfaction with your environment?
- Do you fear the potential damage of floods/erosion in the future? Does this impact your optimism/hopes for the future?
- Based on these discussions, why do you feel past results show people in this community to be unhappy, despite having more money than other communities in the area?

• Concluding questions

- Does money lead to happiness? Why? Why not? (status, dignity, being able to buy services/goods)?
- How does the community's wellbeing impact you? If everyone is doing well, how does that make you feel? If others are doing better than you, how do you feel?
- How have, or do you want to, adapt to changing environment? How could it improve, or worsen, your “good life”? (adaptation such as changing crops, but also migration)
- Any questions for me?

Community: Sogakope (3)

Focus group questions

Environmental characteristics	
- Near river - Urban district capital - River vegetation	- Flooding - Erosion - Changing rainfall and temperature

• Opening questions

- How would you define “a good life”? (not “wellbeing”)
- How would you describe your environment?
- Have you faced any hazards/pressures (use prompts above)

• Introduce ranking exercise

- Give each participants 5 bundles of 10 sticks
- Each individual should have 5x packs of the same colour

• Ask each participant to distribute their 10 sticks across the 3 components of FINANCIAL CAPITAL. They are allowed to distribute them however they want – based on how important the component is for their good life/wellbeing.

- Ask why, as a group, *** was selected as the most important?
- Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of financial capital.
- Follow-up/prompt questions:
 - What non-primary livelihoods can you access in Sogakope (not reliant on ecosystem services such as rainfall)?
 - Financial, or non-financial, benefits from being next to the river? Including river vegetation/resources?
 - Did damming the river impact your good life? How?
 - Financial, or non-financial, benefits from being next to wetland resources?
 - Benefits from being within a district capital (investment, government support)?
 - Has drought/flooding impacted your ability to farm/fish?
 - Difficulties in planning future activities if conditions change?

• Ask each participant to distribute their 10 sticks across the 2 components of HUMAN CAPITAL.

- Ask why, as a group, *** was selected as the most important?
- Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of human capital.
- Follow-up/prompt questions:
 - Results suggest better access to education, what are the benefits? Help adapt to changing conditions? Do your aspirations for the future increase because of access to education?
 - Access to hospital, any restrictions to your access? Do health issues increase when there are environmental pressures (temperature, rain, floods)?

• Ask each participant to distribute their 10 sticks across the 2 components of SOCIAL CAPITAL.

- Ask why, as a group, *** was selected as the most important?
- Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of social capital.
- Follow-up/prompt questions:
 - Do you focus on your own wellbeing, or the wellbeing of the wider community? If you did the opposite, how would it impact your good life? (both material/financial and happiness/peace)?
 - Do you receive support from the wider community? If so, what support?

- If you have migrated to the area, or know someone who has – do they receive the same amount of support from the community?
- Does the government provide support? (mention the LEAP programme, and 1 district 1 factory programme, if needing to probe)
- What role does religion play in your life? Networks? Peace during climate stress?

• Ask each participant to distribute their 10 sticks across the 5 components of PHYSICAL CAPITAL.

- Ask why, as a group, *** was selected as the most important?
- Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of physical capital.
- Follow-up/prompt questions:
 - How important is home ownership? Ask about the differences between ownership/self-construction in rural areas, and renting in urban areas? Do you feel owning your own home is important for your good life? Why?
 - Does the quality of housing you live in match your aspirations? Why? Why not?

• Ask each participant to distribute their 10 sticks across the 4 overarching groups.

- Depending on time, can discuss why the group chose *** as the most important, and *** as the least important.

• Subjective themes

- Are there any restrictions, or environmental pressures, which prevent you from doing what livelihood you want? (probe for any restrictions on access, such as wetland resources)
- How important is your livelihood to your identity/to who you are? Would you like to do a different job if possible? What/why?
- If you have above basic education, do you feel it provides a level of “status” or authority within the community?
- Who do you compare yourself to when you evaluate how well you are doing?
- Why do you compare yourself to them?
- Is there inequality in the community? How do you feel if others are doing better?
- If impacted by a hazard (i.e. flooding) does it cause unhappiness? How? Why?
- Are you attached to your environment? Are you happy with the environment you live within?
- Past results suggest Sogakope communities have more money than other areas in the region – but are unhappier, why do you think this could be?

• Concluding questions

- Does money lead to happiness? Why? Why not? (status, dignity, being able to buy services/goods)?
- How does the community’s wellbeing impact you? If everyone is doing well, how does that make you feel? If others are doing better than you, how do you feel?
- How have, or do you want to, adapt to changing environment? How could it improve, or worsen, your “good life”? (adaptation such as changing crops, but also migration)
- Any questions for me?

Community: Nyitawuta (4)Focus group questions

Environmental characteristics	
- Remote from towns - Remote from water sources	- Drought - Erosion - Grasslands

- Opening questions
 - How would you define “a good life”? (not “wellbeing”)
 - How would you describe your environment?
 - Have you faced any hazards/pressures (use prompts above)
-
- Introduce ranking exercise
 - Give each participants 5 bundles of 10 sticks
 - Each individual should have 5x packs of the same colour
 - Ask each participant to distribute their 10 sticks across the 3 components of **FINANCIAL CAPITAL**. They are allowed to distribute them however they want – based on how important the component is for their good life/wellbeing.
 - Ask why, as a group, *** was selected as the most important?
 - Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of financial capital.
 - Follow-up/prompt questions:
 - Drought/erosion impacts on yield?
 - Periods of unemployment? Impact health? Food security? Social/family obligations?
 - What markets do you access? Any restraints to where you can trade?
 - Do you prioritise trading within the community?
 - Past results suggest limited banking (community banking), why is this? Would it help your livelihood if this was available? Your ability to adapt? New crops/technology?
 - Ask each participant to distribute their 10 sticks across the 2 components of **HUMAN CAPITAL**.
 - Ask why, as a group, *** was selected as the most important?
 - Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of human capital.
 - Follow-up/prompt questions:
 - What restrictions are there to you accessing health or education services?
 - Would you prioritise working on the land over accessing further education?
 - Is subsistence your priority? Does this prevent people in the community undertaking different livelihoods, going to school (especially girls who do domestic work)?
 - Would education improve your farming? Ability to adapt to changing conditions?
 - Ask each participant to distribute their 10 sticks across the 2 components of **SOCIAL CAPITAL**.
 - Ask why, as a group, *** was selected as the most important?
 - Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of social capital.
 - Follow-up/prompt questions:
 - Do you focus on your own wellbeing, or the wellbeing of the wider community? If you did the opposite, how would it impact your good life? (both material/financial and happiness/peace)?
 - Why are relationships within the community important for your good life?
 - Do these relationships grow or weaken during environmental pressure? Why?
 - What role does religion play in your life? Does it impact your aspirations in life? Networks? Peace during climate stress?

- Does being further way from district capitals limit your opportunities? How?
 - Ask each participant to distribute their 10 sticks across the 5 components of **PHYSICAL CAPITAL**.
 - Ask why, as a group, *** was selected as the most important?
 - Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of physical capital.
 - Follow-up/prompt questions:
 - Do you want to improve your assets (housing, latrine, drinking water)? What restraints prevent you?
 - Do you have access to water? Does this change during drought?
 - If you have to travel further for water, what impact does this have? Less time for other activities? Health issues? Less productivity?
 - Ask each participant to distribute their 10 sticks across the 4 overarching groups.
 - Depending on time, can discuss why the group chose *** as the most important, and *** as the least important.
-
- Subjective themes
 - What are your priorities in life? (probe for differences between objective material wealth, and peace/community relationships/fulfilling obligations)
 - Does money lead to happiness? If so, how?
 - Past results suggest people are happy, despite being poorer – why do you think this could be?
 - Past results suggest this community is not as stressed about their financial position – why do you think this could be? (community sharing, money is not a priority, equal communities)
 - If you compare your life to someone else, who do you compare to?
 - Do you think people in the community are equal? How is this achieved?
 - Are you aware of the different living standards in urban towns/cities? Why do you not compare yourselves to them (if they say they do not compare outside the community)?
 - Are you able to grow/work where you want?
 - Are you able to provide for yourself and the family? Is this threatened by environmental pressure?
 - Is farming intergenerational? How important is it to carry on the tradition? Is farming part of your identity?
 - Is it important to be good at your job? Does environmental pressure prevent this?
 - Are you connected to nature? How?
 - What impacts on your peace/happiness if surrounding nature is damaged?
 - Are there community events that are based on nature? Seasonal celebrations? Are these important?
 - Would you prefer to live in an urban town? Why?
-
- Concluding questions
 - How does the community’s wellbeing impact you? If everyone is doing well, how does that make you feel? If others are doing better than you, how do you feel?
 - How have, or do you want to, adapt to changing environment? How could it improve, or worsen, your “good life”? (adaptation such as changing crops, but also migration)
 - Any questions for me?

Community: Awlikope (5)

Focus group questions

- Opening questions
 - How would you define “a good life”? (not “wellbeing”)
 - How would you describe your environment?
 - Have you faced any hazards/pressures (use prompts above)

Environmental characteristics

- Drought
- Erosion
- Changing rainfall/seasons
- Cropland coverage
- Inland location

- Introduce ranking exercise
 - Give each participants 5 bundles of 10 sticks
 - Each individual should have 5x packs of the same colour
- Ask each participant to distribute their 10 sticks across the 3 components of **FINANCIAL CAPITAL**. They are allowed to distribute them however they want – based on how important the component is for their good life/wellbeing.
 - Ask why, as a group, *** was selected as the most important?
 - Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of financial capital.
 - Follow-up/prompt questions:
 - How do environmental pressures impact your crop yield and employment?
 - Does unemployment impact your health?
 - Does the uncertainty of rainfall disincentivize investment, or impact your livelihood?
 - Can you access outside towns to trade your produce?
- Ask each participant to distribute their 10 sticks across the 2 components of **HUMAN CAPITAL**.
 - Ask why, as a group, *** was selected as the most important?
 - Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of human capital.
 - Follow-up/prompt questions:
 - Have education services been available to you?
 - Would you prioritise a job over access to education? Why?
 - How could education improve, or worsen, your ability for a “good life”?
 - Any climate induced illnesses? How do these impact your family/community?
- Ask each participant to distribute their 10 sticks across the 2 components of **SOCIAL CAPITAL**.
 - Ask why, as a group, *** was selected as the most important?
 - Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of social capital.
 - Follow-up/prompt questions:
 - What support is given to you by the wider community, during environmental pressures?
 - Do you have access to networks outside the community?
 - If there is environmental pressure, do community relationships grow or weaken? How? Why?

- Past results suggested NGO activity, how did they help? If they leave/have left, how would that impact the community?
- How did you feel about NGO support, were you in favour of them coming to the community?
- Do you focus on your own wellbeing, or the wellbeing of the wider community? If you did the opposite, how would it impact your good life “ (both material/financial and happiness/peace)?
- What role does religion play in your life? Networks? Peace during climate stress?

- Ask each participant to distribute their 10 sticks across the 5 components of **PHYSICAL CAPITAL**.
 - Ask why, as a group, *** was selected as the most important?
 - Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of physical capital.
 - Follow-up/prompt questions:
 - What negative impacts arise if unable to collect water? Time? Energy used?
 - Do you aspire to have better quality housing, latrines? Why is that important?
- Ask each participant to distribute their 10 sticks across the 4 overarching groups.
 - Depending on time, can discuss why the group chose *** as the most important, and *** as the least important.

- Subjective themes
 - Are you able to grow the crops you want to? Why? Why not?
 - Are you able to provide for yourself and family? Environmental pressure?
 - Are you able to choose what job/occupation you have? Why? Why not?
 - How important is it to your identity to be a farmer? Status?
 - Is it important to be good at your job? Does environmental pressure prevent this?
 - How would you feel if you could no longer be a farmer, or your current livelihood? Why?
 - Are you connected to your environment/nature? What does this mean to you?
 - How would you feel if your natural environment was damaged?
 - Past results suggest people are happy, despite being poorer – why do you think this could be?
 - Importance of family/community for your happiness? Why?
 - Who do you compare yourself to when you are evaluating your “good life” or living standards?

- Concluding questions
 - Does money lead to happiness? Why? Why not? (status, dignity, being able to buy services/goods)?
 - How does the community’s wellbeing impact you? If everyone is doing well, how does that make you feel? If others are doing better than you, how do you feel?
 - How have, or do you want to, adapt to changing environment? How could it improve, or worsen, your “good life”? (adaptation such as changing crops, but also migration)
 - Any questions for me?

Community: Aflao (6)

Environmental characteristics	
- Urban - Access to roads - Near Lomé - Far from Accra	- Near lagoon - Near coast - Floods/storms - Changing seasons/rainfall

Focus group questions

• Opening questions

- How would you define “a good life”? (not “wellbeing”)
- How would you describe your environment?
- Have you faced any hazards/pressures (use prompts above)

• Introduce ranking exercise

- Give each participants 5 bundles of 10 sticks
- Each individual should have 5x packs of the same colour

• Ask each participant to distribute their 10 sticks across the 3 components of **FINANCIAL CAPITAL**. They are allowed to distribute them however they want – based on how important the component is for their good life/wellbeing.

- Ask why, as a group, *** was selected as the most important?
- Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of financial capital.
- Follow-up/prompt questions:
 - Are non-vulnerable livelihoods available? Cement industry? Are these commercial livelihoods impacted by environmental change/damage, such as floods and storms?
 - Benefits from being able to access towns/markets/Lomé? (as well as financial improvements, talk about government funding, better infrastructure, government interaction?)
 - Road transport? What benefits does being able to travel to different communities bring? (talk about financial, access to services, but also if it provides people with new ideas/networks?)
 - What financial benefits are there from living on the coast?

• Ask each participant to distribute their 10 sticks across the 2 components of **HUMAN CAPITAL**.

- Ask why, as a group, *** was selected as the most important?
- Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of human capital.
- Follow-up/prompt questions:
 - Does education help your ability to adapt to changes (social, economic, environmental)?
 - Any health implications from the hazards? Does this impact other components of your good life (education, productivity, family/community)?

• Ask each participant to distribute their 10 sticks across the 2 components of **SOCIAL CAPITAL**.

- Ask why, as a group, *** was selected as the most important?
- Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of social capital.
- Follow-up/prompt questions:

- Do you focus on your own wellbeing, or the wellbeing of the wider community? If you did the opposite, how would it impact your good life? (both material/financial and happiness/peace)?
- Do you provide support to others if they have less?
- Do you think focusing on yourself is crucial to achieving financial improvements?
- What role does religion play in your life? Networks? Peace during climate stress?

• Ask each participant to distribute their 10 sticks across the 5 components of **PHYSICAL CAPITAL**.

- Ask why, as a group, *** was selected as the most important?
- Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of physical capital.
- Follow-up/prompt questions:
 - How do you access improved housing, drinking water or safe latrines (self-funded, or government)?
 - Does having a better house than others improve how you feel about yourself?

- Ask each participant to distribute their 10 sticks across the 4 overarching groups.
 - Depending on time, can discuss why the group chose *** as the most important, and *** as the least important.

• Subjective themes

- Are you able to provide for yourself and family? Environmental pressure?
- Are you able to choose what job/occupation you have? Why? Why not?
- Are you able to travel where you want, access the markets you want? Why not?
- Past results suggest this community is happier with all components of their life, compared to the wider region, why could this be?
- Does living near the coast improve your happiness/peace?
- Do you have fears of coastal hazards (health/livelihood/assets)? Do you still remember past impacts?
- Do you think you have more to lose from a flood for example, compared to poorer areas?
- Do hazards impact your current/future aspirations?
- When you are evaluating your living standards, who do you compare yourself to? Do you compare yourself to others in the town, or to people in rural areas?
- If there is inequality (someone has more money, a better house) how does it make you feel (are you happy for them, or does it represent injustice?)
- If you have a stable job – does it allow you to plan for the future? Are you more confident in making investments for the future?

• Concluding questions

- Does money lead to happiness? Why? Why not? (status, dignity, being able to buy services/goods)?
- How does the community's wellbeing impact you? If everyone is doing well, how does that make you feel? If others are doing better than you, how do you feel?
- How have, or do you want to, adapt to changing environment? How could it improve, or worsen, your “good life”? (adaptation such as changing crops, but also migration)
- Any questions for me?

Community: Kedzi (7)

Focus group questions

- Opening questions
 - How would you define “a good life”? (*not “wellbeing”*)
 - How would you describe your environment?
 - Have you faced any hazards/pressures (*use prompts above*)
- Introduce ranking exercise
 - Give each participants 5 bundles of 10 sticks
 - Each individual should have 5x packs of the same colour
- Ask each participant to distribute their 10 sticks across the 3 components of **FINANCIAL CAPITAL**. They are allowed to distribute them however they want – based on how important the component is for their good life/wellbeing.
 - Ask why, as a group, *** was selected as the most important?
 - Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of financial capital.
 - Follow-up/prompt questions:
 - Do hazards impede your livelihood (*mention any long-term impacts of salinity*)?
 - Opportunities for non-primary livelihoods (i.e. tourism)?
 - What benefits does being close to the coast and lagoon bring? Have there been any changes to these benefits due to environmental change?
 - Are you able to maintain employment during periods of environmental pressure? How?
 - Do you have food security issues (rising prices, reduced productivity)?
- Ask each participant to distribute their 10 sticks across the 2 components of **HUMAN CAPITAL**.
 - Ask why, as a group, *** was selected as the most important?
 - Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of human capital.
 - Follow-up/prompt questions:
 - Does education help your ability to adapt to changes (social, economic, environmental)?
 - Any health implications from the hazards? Does this impact other components of your good life (education, productivity, family/community)?
 - Impact ability to sleep, and live in peace?
 - Have floods ever prevented you from accessing key services such as health and education? How?
- Ask each participant to distribute their 10 sticks across the 2 components of **SOCIAL CAPITAL**.
 - Ask why, as a group, *** was selected as the most important?
 - Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of social capital.
 - Follow-up/prompt questions:
 - Do you focus on your own wellbeing, or the wellbeing of the wider community? If you did the opposite, how would it impact your good life (both material/financial and happiness/peace)?

Environmental characteristics

- Flooding
- Erosion
- Salinity
- Close to water source/lagoon
- Coastal

- If there is a flood (hazard) do you focus more on yourself, or the wider community?
- How important are relationships in the community to your happiness/peace?
- What role does religion play in your life? Networks? Peace during climate stress?

- Ask each participant to distribute their 10 sticks across the 5 components of **PHYSICAL CAPITAL**.
 - Ask why, as a group, *** was selected as the most important?
 - Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of physical capital.
 - Follow-up/prompt questions:
 - Past data suggested limited latrines? Why is there limited access?
 - Past data suggested limited piped water? Why is there limited access?
 - Do you have health issues if using open source water, or no latrines, during climate events such as floods?
- Ask each participant to distribute their 10 sticks across the 4 overarching groups.
 - Depending on time, can discuss why the group chose *** as the most important, and *** as the least important.

- Subjective themes
 - How important are your assets to your appearance/status? What happens if they are damaged during floods/erosion?
 - Benefits of coast versus coastal hazards? How is it balanced?
 - Past results suggest communities are concerned about their future and current finances – does the environment play a role in this (floods, erosion)?
 - Does the flooding/erosion impact happiness, or cause fear?
 - If flooding/erosion damages the land, does this cause unhappiness? Are you connected to the place you live?
 - Are you able to work and live how you want to? What blockades, such an environment hazards?

- Concluding questions
 - Does money lead to happiness? Why? Why not? (*status, dignity, being able to buy services/goods*)?
 - How does the community’s wellbeing impact you? If everyone is doing well, how does that make you feel? If others are doing better than you, how do you feel?
 - How have, or do you want to, adapt to changing environment? How could it improve, or worsen, your “good life”? (*adaptation such as changing crops, but also migration*)
 - Any questions for me?

Community: Anloga (8)

Focus group questions

Environmental characteristics	
- Near river - Near coast - Salinity	- Close to district capital - Built-up - Mangroves

- Opening questions
 - How would you define “a good life”? (not “wellbeing”)
 - How would you describe your environment?
 - Have you faced any hazards/pressures (use prompts above)
-
- Introduce ranking exercise
 - Give each participants 5 bundles of 10 sticks
 - Each individual should have 5x packs of the same colour
 - Ask each participant to distribute their 10 sticks across the 3 components of **FINANCIAL CAPITAL**. They are allowed to distribute them however they want – based on how important the component is for their good life/wellbeing.
 - Ask why, as a group, *** was selected as the most important?
 - Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of financial capital.
 - Follow-up/prompt questions:
 - Past results suggest this community is financially better-off than other communities, why?
 - What livelihood options/benefits are available from the coast and river (tourism, water access, irrigation)?
 - Mangroves nearby – are these used for financial gain, what opportunities?
 - Are you aware of the negative effects of harvesting mangroves?
 - Has salinity negatively impacted your livelihoods? How have you adapted?
 - Access to urban towns, how does this impact your trading or market opportunities?
 - Ask each participant to distribute their 10 sticks across the 2 components of **HUMAN CAPITAL**.
 - Ask why, as a group, *** was selected as the most important?
 - Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of human capital.
 - Follow-up/prompt questions:
 - What benefits do you receive from receiving education? Does education impact your optimism for the future (inc. children’s education)?
 - Does education help changing/adapting to new environmental conditions?
 - Have there been any health issues following any coastal hazards?
 - Ask each participant to distribute their 10 sticks across the 2 components of **SOCIAL CAPITAL**.
 - Ask why, as a group, *** was selected as the most important?
 - Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of social capital.
 - Follow-up/prompt questions:
 - Do you focus on your own wellbeing, or the wellbeing of the wider community? If you did the opposite, how would it impact your good life “ (both material/financial and happiness/peace)?

- Do you access areas outside the community? What for? Have you accessed new ideas, people, communities? If so, what benefits were achieved?
- If you are impacted by a hazard, do community relationships get stronger, or do people look after themselves firstly?
- What role does religion play in your life? Networks? Peace during climate stress?

- Ask each participant to distribute their 10 sticks across the 5 components of **PHYSICAL CAPITAL**.
 - Ask why, as a group, *** was selected as the most important?
 - Using what was said earlier, and the prompts above, ask how the environment impacts their ability to achieve the different parts of physical capital.
 - Follow-up/prompt questions:
 - Do you primarily use your money to improve material assets (i.e. housing)?
 - Do climate hazards ever damage your physical assets? Does this impact your happiness? Status? Public image?
- Ask each participant to distribute their 10 sticks across the 4 overarching groups.
 - Depending on time, can discuss why the group chose *** as the most important, and *** as the least important.

-
- Subjective themes
 - Is money good for your happiness? Why? (freedom, status?)
 - Is it important to have material wealth, to have good housing, piped water etc.? Why?
 - What are your aspirations for the future? (see if they revolve around money and assets, prompt to see if there are any aspirations for more “subjective” components)
 - Permanent employment – does it improve your certainty in future security, your ability to plan for the future?
 - Do you have a choice over which livelihood you undertake?
 - Has salinity or flooding ever prevented you from acting the way you want to?
 - Do you have any fears of future environmental damage? How does this make you feel?
 - Are you attached to your place/landscape? Does being on the coast, in a natural environment bring happiness?
 - What do you do to protect this?
 - Past results show high financial stress in one community (Whuti) and low in another (Agove) – what are the potential reasons for this difference? (when I say financial stress I am referring to people self-evaluating as experiencing financial pressure – this could include fears for future financial issues, or low optimism for the future)
-

- Concluding questions
 - Does money lead to happiness? Why? Why not? (status, dignity, being able to buy services/goods)?
 - How does the community’s wellbeing impact you? If everyone is doing well, how does that make you feel? If others are doing better than you, how do you feel?
 - How have, or do you want to, adapt to changing environment? How could it improve, or worsen, your “good life”? (adaptation such as changing crops, but also migration)
 - Any questions for me?

Interview guide, with female-specific questions:

Interview questions for all communities

- What is included in a “good life” for you? *(Give them the opportunity to say anything that was not said in the focus group)*
- What is your livelihood/role in the community?
- Ask for a personal account regarding environmental pressures they have faced?
- I will create some questions based off the focus group to discuss with an individual
- Who do you know that is doing the best, 10/10 – and why?
- Who do you know who is doing the worst, 0/10 – and why?
- Where would you put yourself on that scale – and why?
- During environmental pressures do you move on this scale?
- What makes you happy? Are you happy?
- Have there been times when you had more money but were unhappier?
- Have there been times when you had less money but were happier?
- Does money lead to happiness? How? Status/dignity? Or through the capacity to buy services/assets?
- How does your environment help or worsen your access to money?
- How does the community’s wellbeing impact you? If everyone is doing well, how does that make you feel? If others are doing better than you, how do you feel?
- During environmental pressure, do you think community relationships strengthen/weaken? Why?
- Do you adapt to environmental change? How? Why? Outcomes? *(when talking about outcomes, talk about yield/income, but also talk about what it meant for them to have to change their practice, were they happy to make a change, or did it cause negative outcomes?)*
- Experience of migration? What is needed for someone to successfully migrate? Why would you migrate? Outcomes?
- Any elements of a “good life” not mentioned?
- Questions for me...

Female interview questions

These questions can be used as a guide within the female interviews. I have grouped within the capitals, but please raise when most relevant.

Financial

- How do women contribute towards financial wellbeing of the household?
- Are women present in jobs less dependent on the environment? Market workers?
- Do domestic requirements prevent time/energy for productive activities which can improve financial wellbeing?
- If husband migrates, what opportunities arise from remittances?

Human

- Do women provide domestic health support to the household/community?
- Access to education?
- What other inequalities are faced by women? How do these impact your vulnerability to environmental stress?

Social

- Do you play a role in expanding social networks? If so, what benefits do these bring?
- Any further pressures, or difficulties, if unmarried? (especially around accessing funds/land to adapt to changing conditions)
- Intention to migrate? Any barriers?

Physical

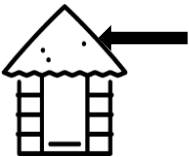
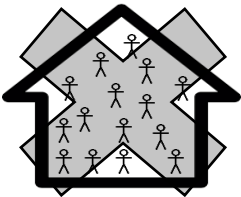
- Do you have access to land, money or assets to help you be productive, or adapt, within difficult environments/climates?

Subjective

- Do domestic requirements prevent time/energy for doing what you want to do?
- Dependency on males? Does dependency limit your freedom to choose what you do?
- What do they prevent you from doing what you want to do?
- How do inequalities make you feel?
- If males migrate, do women have the authority to make household decisions?
- Do you feel different to others in the household? Is your happiness different to others?

Appendix 5.6 Supporting pictograms for the 12 basic needs indicators weighted by community focus groups and district planning officers

Capital	Indicator	Pictogram
Financial	One or more household members are unemployed	
	Monthly expenditure on food >60% total expenditure	
	No access to bank or loan service	
Human	All household members aged 15+ without basic education	
	>5km from nearest hospital	
Social	Not a member of a community cooperative	
	Under 3 family/friends outside household with migration experience	

Capital	Indicator	Pictogram
Physical	Low-quality roof material	
	Unsafe latrine facility	
	Unsafe drinking water source	
	Overcrowded household	
	Home is not owned	

Appendix 5.7 Individual and community-level weight scores provided during the community focus groups and DPO interviews. Summed community-level weights are presented after the raw individual-level scores for each community.

Individual scores:

			Male respondents											Female respondents										
Location	Weighting round	Indicator	1	2	3	4	5	6	7	8	9	10	DPO	1	2	3	4	5	6	7	8	9	10	DPO
1 - Afienea	1	Employment	4	3	6	5	5	3	6	x	x	x	x	4	5	5	5	5	5	x	x	x	x	5
		Excess capital	4	7	3	3	5	5	3	x	x	x	x	3	2	3	0	2	3	x	x	x	x	3
		Bank access	2	0	1	2	0	2	1	x	x	x	x	3	3	2	5	3	2	x	x	x	x	2
	2	Education	5	4	4	4	5	6	5	x	x	x	x	3	4	3	5	4	3	x	x	x	x	5
		Healthcare access	5	6	6	6	5	4	5	x	x	x	x	7	6	7	5	6	7	x	x	x	x	5
	3	Cooperative	4	2	3	3	5	2	4	x	x	x	x	10	8	10	8	8	0	x	x	x	x	5
		Network size	6	8	7	7	5	8	6	x	x	x	x	0	2	0	2	2	10	x	x	x	x	5
	4	Roof	3	0	2	2	1	0	1	x	x	x	x	0	0	0	0	0	0	x	x	x	x	0
		Drinking water	3	2	1	4	3	2	2	x	x	x	x	2	2	2	1	2	2	x	x	x	x	3
		Toilet	1	0	0	2	1	3	1	x	x	x	x	2	2	2	2	1	2	x	x	x	x	3
		No crowding	0	3	5	0	0	2	3	x	x	x	x	4	4	4	5	5	4	x	x	x	x	0
		Home ownership	3	5	2	2	5	3	3	x	x	x	x	2	2	2	2	2	2	x	x	x	x	4
	5	Financial	4	7	4	4	5	4	4	x	x	x	x	4	4	3	3	3	4	x	x	x	x	2
		Human	3	0	3	3	2	2	3	x	x	x	x	3	3	4	5	4	2	x	x	x	x	3
		Social	0	0	2	0	1	2	2	x	x	x	x	0	1	0	0	0	0	x	x	x	x	2
		Physical	3	3	1	3	2	2	1	x	x	x	x	3	2	3	2	3	4	x	x	x	x	3

Appendix

			Male respondents											Female respondents										
Location	Weighting round	Indicator	1	2	3	4	5	6	7	8	9	10	DPO	1	2	3	4	5	6	7	8	9	10	DPO
2- Anyamam	1	Employment	5	6	4	5	6	6	7	6	x	x	x	7	6	5	6	6	5	5	5	x	x	7
		Excess capital	2	1	3	2	2	1	1	1	x	x	x	2	2	3	2	2	2	2	3	x	x	2
		Bank access	3	3	3	3	2	3	2	3	x	x	x	1	2	2	2	2	3	3	2	x	x	1
	2	Education	4	4	8	5	5	8	7	6	x	x	x	5	7	6	5	4	7	5	5	x	x	6
		Healthcare access	6	6	2	5	5	2	3	4	x	x	x	5	3	4	5	6	3	5	5	x	x	4
	3	Cooperative	4	2	4	4	4	3	4	3	x	x	x	4	9	6	5	8	5	5	7	x	x	7
		Network size	6	8	6	6	6	7	6	7	x	x	x	6	1	4	5	2	5	5	3	x	x	3
	4	Roof	2	2	2	2	2	1	1	2	x	x	x	2	1	1	1	1	1	1	1	x	x	1
		Drinking water	3	3	1	2	2	3	3	3	x	x	x	2	1	2	1	2	2	1	2	x	x	3
		Toilet	1	2	1	2	1	2	1	2	x	x	x	1	1	1	3	1	1	3	1	x	x	1
		No crowding	0	0	1	1	1	0	1	1	x	x	x	1	2	2	1	1	1	3	1	x	x	1
		Home ownership	4	3	5	3	4	4	4	2	x	x	x	4	5	4	4	5	5	2	5	x	x	4
	5	Financial	4	4	8	4	4	7	9	4	x	x	x	4	5	4	4	2	2	6	4	x	x	4
		Human	2	3	1	2	2	3	1	4	x	x	x	3	2	2	3	3	3	0	2	x	x	3
		Social	1	0	0	2	2	0	0	1	x	x	x	1	1	2	1	2	2	4	1	x	x	1
		Physical	3	3	1	2	2	0	0	1	x	x	x	2	2	2	2	3	3	0	3	x	x	2

Appendix

			Male respondents											Female respondents										
Location	Weighting round	Indicator	1	2	3	4	5	6	7	8	9	10	DPO	1	2	3	4	5	6	7	8	9	10	DPO
3 - Sogakope	1	Employment	6	9	7	10	7	9	x	x	x	x	5	3	6	5	5	5	5	7	8	7	5	x
		Excess capital	4	1	3	0	2	1	x	x	x	x	3	4	3	3	4	3	3	2	1	1	3	x
		Bank access	0	0	0	0	1	0	x	x	x	x	2	3	1	2	1	2	2	1	1	2	2	x
	2	Education	3	2	2	2	3	5	x	x	x	x	4	7	6	6	2	5	5	5	3	3	4	x
		Healthcare access	7	8	8	8	7	5	x	x	x	x	6	3	4	4	8	5	5	5	7	7	6	x
	3	Cooperative	3	6	2	5	7	4	x	x	x	x	3	0	3	0	2	0	0	2	2	0	4	x
		Network size	7	4	8	5	3	6	x	x	x	x	7	10	7	10	8	10	10	8	8	10	6	x
	4	Roof	0	0	3	0	2	0	x	x	x	x	2	2	2	0	0	0	0	2	2	0	0	x
		Drinking water	0	2	2	2	2	2	x	x	x	x	3	2	2	2	2	2	2	2	4	2	0	x
		Toilet	0	1	3	2	2	1	x	x	x	x	1	2	2	2	0	2	2	2	0	2	2	x
		No crowding	0	2	0	0	1	2	x	x	x	x	1	0	0	2	0	0	0	2	2	0	2	x
		Home ownership	10	5	2	6	3	5	x	x	x	x	3	4	4	4	8	6	6	2	2	6	6	x
	5	Financial	7	2	4	0	1	2	x	x	x	x	3	2	2	2	2	2	2	2	1	3	2	x
		Human	3	2	2	7	7	6	x	x	x	x	2	2	3	4	5	3	3	4	6	4	4	x
		Social	0	3	2	0	1	0	x	x	x	x	2	2	2	3	2	3	3	2	2	2	2	x
		Physical	0	3	2	3	1	2	x	x	x	x	3	4	3	1	1	2	2	2	1	1	2	x

Appendix

			Male respondents											Female respondents										
Location	Weighting round	Indicator	1	2	3	4	5	6	7	8	9	10	DPO	1	2	3	4	5	6	7	8	9	10	DPO
4 - Nyitawuta	1	Employment	6	5	5	5	5	6	7	6	x	x	5	6	4	4	5	6	5	6	5	x	x	x
		Excess capital	2	0	1	2	2	1	1	0	x	x	3	2	3	3	3	2	2	2	3	x	x	x
		Bank access	2	5	4	3	3	3	2	4	x	x	2	2	3	3	2	2	3	2	2	x	x	x
	2	Education	4	5	6	5	6	6	4	4	x	x	4	4	5	6	5	6	5	5	6	x	x	x
		Healthcare access	6	5	4	5	4	4	6	6	x	x	6	6	5	4	5	4	5	5	4	x	x	x
	3	Cooperative	4	5	4	4	2	5	6	2	x	x	6	6	5	5	5	4	5	4	6	x	x	x
		Network size	6	5	6	6	8	5	4	8	x	x	4	4	5	5	5	6	5	6	4	x	x	x
	4	Roof	2	1	1	1	1	1	0	0	x	x	2	1	3	2	2	3	2	2	2	x	x	x
		Drinking water	2	2	2	2	1	1	2	1	x	x	4	2	1	2	2	2	4	2	2	x	x	x
		Toilet	1	1	2	1	1	1	1	1	x	x	2	2	1	2	2	1	1	2	2	x	x	x
		No crowding	4	2	4	4	4	5	3	4	x	x	1	3	3	3	2	3	1	1	2	x	x	x
		Home ownership	1	4	1	2	3	2	4	4	x	x	1	2	2	1	2	1	2	3	2	x	x	x
	5	Financial	4	5	5	4	5	6	4	7	x	x	3	4	4	4	4	3	4	3	3	x	x	x
		Human	2	3	2	4	2	2	2	1	x	x	4	2	3	1	4	4	2	3	2	x	x	x
		Social	2	0	2	0	2	1	1	1	x	x	1	2	1	2	1	2	2	2	3	x	x	x
		Physical	2	2	1	2	1	1	3	1	x	x	2	2	2	3	1	1	2	2	2	x	x	x

Appendix

			Male respondents											Female respondents										
Location	Weighting round	Indicator	1	2	3	4	5	6	7	8	9	10	DPO	1	2	3	4	5	6	7	8	9	10	DPO
5 - Awlikope	1	Employment	6	7	5	6	4	6	4	4	x	x	5	6	6	5	2	5	4	5	3	x	x	x
		Excess capital	2	2	4	2	3	3	4	4	x	x	4	2	2	2	2	2	3	2	2	x	x	x
		Bank access	2	1	1	2	3	1	2	2	x	x	1	2	2	3	6	3	3	3	5	x	x	x
	2	Education	7	3	5	5	5	2	4	4	x	x	4	4	6	4	7	7	5	5	7	x	x	x
		Healthcare access	3	7	5	5	5	8	6	6	x	x	6	6	4	6	3	3	5	5	3	x	x	x
	3	Cooperative	6	4	4	5	5	4	6	5	x	x	8	3	4	4	4	6	3	0	7	x	x	x
		Network size	4	6	6	5	5	6	4	5	x	x	2	7	6	6	6	4	7	10	3	x	x	x
	4	Roof	0	2	2	1	0	2	0	2	x	x	1	0	0	0	0	0	1	0	1	x	x	x
		Drinking water	4	2	2	2	3	2	3	2	x	x	4	3	2	2	4	2	3	2	3	x	x	x
		Toilet	4	1	2	2	3	2	3	2	x	x	3	1	2	1	3	2	2	2	3	x	x	x
		No crowding	0	0	0	0	0	0	0	0	x	x	0	3	1	1	1	2	1	2	1	x	x	x
		Home ownership	2	5	4	5	4	4	4	4	x	x	2	3	5	6	2	4	3	4	2	x	x	x
	5	Financial	4	3	4	4	4	3	3	4	x	x	1	1	4	2	2	4	2	2	3	x	x	x
		Human	3	4	3	3	2	3	3	3	x	x	4	3	2	2	3	3	2	2	3	x	x	x
		Social	1	2	1	1	2	2	2	1	x	x	3	3	2	2	3	1	3	4	1	x	x	x
		Physical	2	1	2	2	2	2	2	2	x	x	2	3	2	4	2	2	3	2	3	x	x	x

Appendix

			Male respondents											Female respondents										
Location	Weighting round	Indicator	1	2	3	4	5	6	7	8	9	10	DPO	1	2	3	4	5	6	7	8	9	10	DPO
6 - Aflao	1	Employment	4	4	2	6	6	6	8	x	x	x	4	5	5	4	4	6	4	4	5	x	x	x
		Excess capital	4	3	4	2	1	2	2	x	x	x	4	3	3	4	4	3	3	3	3	x	x	x
		Bank access	2	3	4	2	3	2	0	x	x	x	2	2	2	2	2	1	3	3	2	x	x	x
	2	Education	5	5	6	4	5	6	4	x	x	x	5	4	4	4	8	9	4	6	6	x	x	x
		Healthcare access	5	5	4	6	5	4	6	x	x	x	5	6	6	6	2	1	6	4	4	x	x	x
	3	Cooperative	2	4	7	2	1	4	2	x	x	x	3	3	6	4	4	0	3	3	2	x	x	x
		Network size	8	6	3	8	9	6	8	x	x	x	7	7	4	6	6	10	7	7	8	x	x	x
	4	Roof	1	0	2	0	2	0	0	x	x	x	1	1	2	2	1	0	2	0	0	x	x	x
		Drinking water	2	1	1	2	2	3	2	x	x	x	3	2	2	3	4	1	2	2	0	x	x	x
		Toilet	2	2	2	2	2	1	2	x	x	x	2	3	3	2	2	2	2	1	0	x	x	x
		No crowding	2	1	2	3	2	2	4	x	x	x	3	0	0	0	0	0	0	0	0	x	x	x
		Home ownership	3	6	3	3	2	4	2	x	x	x	1	4	3	3	3	7	4	7	10	x	x	x
	5	Financial	4	5	2	5	5	2	3	x	x	x	3	4	2	5	3	5	3	6	4	x	x	x
		Human	3	1	2	1	2	4	4	x	x	x	3	3	4	2	3	5	4	4	4	x	x	x
		Social	0	1	3	1	2	2	0	x	x	x	1	2	2	1	0	0	2	0	1	x	x	x
		Physical	3	3	3	3	1	2	3	x	x	x	3	1	2	2	4	0	1	0	1	x	x	x

Appendix

			Male respondents											Female respondents										
Location	Weighting round	Indicator	1	2	3	4	5	6	7	8	9	10	DPO	1	2	3	4	5	6	7	8	9	10	DPO
7 - Kedzi	1	Employment	5	7	5	4	4	6	4	4	6	x	5	5	7	5	5	5	6	6	x	x	x	x
		Excess capital	3	2	2	4	3	2	3	3	2	x	3	3	2	4	5	4	2	3	x	x	x	x
		Bank access	2	1	3	2	3	2	3	3	2	x	2	2	1	1	0	1	2	1	x	x	x	x
	2	Education	3	2	3	4	2	4	5	5	3	x	5	3	5	4	4	5	6	4	x	x	x	x
		Healthcare access	7	8	7	6	8	6	5	5	7	x	5	7	5	6	6	5	4	6	x	x	x	x
	3	Cooperative	4	4	2	4	4	6	4	5	3	x	6	2	3	2	3	1	2	4	x	x	x	x
		Network size	6	6	8	6	6	4	6	5	7	x	4	8	7	8	7	9	8	6	x	x	x	x
	4	Roof	0	0	0	0	0	0	0	0	0	x	3	1	2	2	1	2	2	1	x	x	x	x
		Drinking water	3	7	2	3	4	5	2	3	3	x	3	1	2	2	3	2	3	2	x	x	x	x
		Toilet	2	1	3	2	3	5	2	3	2	x	2	1	2	2	2	2	2	1	x	x	x	x
		No crowding	1	1	1	2	3	0	2	0	1	x	1	1	2	2	3	2	1	4	x	x	x	x
		Home ownership	4	1	4	3	0	0	4	4	4	x	1	6	2	2	1	2	2	2	x	x	x	x
	5	Financial	2	1	2	3	3	2	3	3	2	x	2	5	5	5	5	6	4	5	x	x	x	x
		Human	4	7	2	3	2	3	4	3	4	x	2	3	2	2	3	4	4	3	x	x	x	x
		Social	3	1	2	2	2	3	1	2	2	x	4	1	1	1	1	0	1	1	x	x	x	x
		Physical	1	1	4	2	3	2	2	2	2	x	2	1	2	2	1	0	1	1	x	x	x	x

Appendix

			Male respondents											Female respondents										
Location	Weighting round	Indicator	1	2	3	4	5	6	7	8	9	10	DPO	1	2	3	4	5	6	7	8	9	10	DPO
8 - Anloga	1	Employment	10	5	8	5	5	7	8	10	0	5	5	6	5	6	6	6	7	6	5	x	x	x
		Excess capital	0	3	2	2	2	3	2	0	10	3	5	2	3	2	3	2	2	2	4	x	x	x
		Bank access	0	2	0	3	3	0	0	0	0	2	0	2	2	2	1	2	1	2	1	x	x	x
	2	Education	4	3	3	4	4	3	3	4	5	4	4	5	5	4	7	4	4	4	4	x	x	x
		Healthcare access	6	7	7	6	6	7	7	6	5	6	6	5	5	6	3	6	6	6	6	x	x	x
	3	Cooperative	2	1	1	3	2	3	1	2	4	2	5	3	2	8	3	2	3	3	2	x	x	x
		Network size	8	9	9	7	8	7	9	8	6	8	5	7	8	2	7	8	7	7	8	x	x	x
	4	Roof	2	1	2	1	2	2	1	1	2	1	1	0	0	1	0	0	0	0	0	x	x	x
		Drinking water	2	3	1	3	2	3	3	1	2	3	3	3	4	1	2	3	6	2	2	x	x	x
		Toilet	2	2	1	1	1	1	1	2	2	1	3	1	0	1	2	2	0	2	3	x	x	x
		No crowding	1	1	2	1	2	1	1	2	2	1	2	2	3	1	1	2	1	4	1	x	x	x
		Home ownership	3	3	4	4	3	3	4	4	2	4	1	4	3	6	5	3	3	2	4	x	x	x
	5	Financial	4	4	5	4	4	4	4	5	2	4	2	4	2	7	1	5	6	5	5	x	x	x
		Human	2	2	1	2	2	2	2	2	3	2	3	2	4	1	4	2	1	2	3	x	x	x
		Social	2	2	2	2	2	2	2	1	2	2	2	2	2	1	3	1	1	2	1	x	x	x
		Physical	2	2	2	2	2	2	2	2	3	2	3	2	2	1	2	2	2	1	1	x	x	x

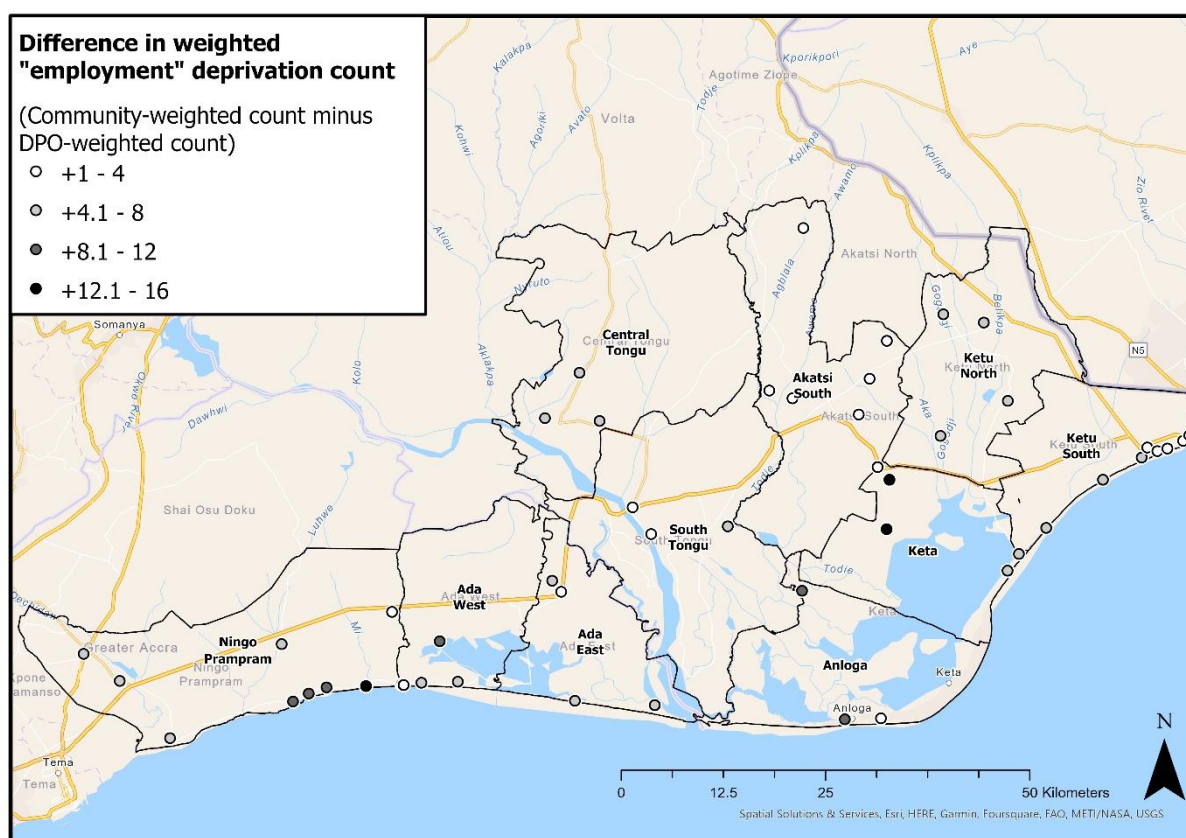
Summed community-level basic needs weights (Equation 5.1, rounded to 1.d.p) – highest weight for each indicator highlighted:

Capital	Indicator	Nested baseline	Community							
			1 – Afiencya	2 – Anyamam	3 – Sogakope	4 – Nyitawuta	5 – Awlikope	6 – Aflao	7 – Kedzi	8 – Anloga
Financial	Employment	1.0	2.3	3.2	1.8	2.8	1.8	2.3	2.2	2.9
	Excess capital	1.0	1.6	1.1	0.6	0.9	0.9	1.4	1.2	1.3
	Bank access	1.0	1.0	1.4	0.3	1.5	0.9	1.0	0.8	0.6
Human	Education	1.5	1.4	1.5	1.9	1.5	1.7	2.0	1.5	1.1
	Healthcare access	1.5	2.0	1.2	3.0	1.4	1.7	1.7	2.4	1.6
Social	Cooperative	1.5	0.4	0.7	0.5	0.8	1.0	0.4	0.6	0.6
	Network size	1.5	0.4	0.8	1.6	1.0	1.3	0.9	1.2	1.6
Physical	Roof quality	0.6	0.2	0.3	0.2	0.3	0.2	0.2	0.1	0.2
	Drinking water	0.6	0.6	0.4	0.4	0.4	0.7	0.4	0.6	0.6
	Latrine	0.6	0.4	0.3	0.4	0.3	0.6	0.4	0.4	0.3
	No crowding	0.6	0.9	0.2	0.2	0.6	0.2	0.2	0.3	0.4
	Homeownership	0.6	0.8	0.9	1.1	0.5	1.0	1.0	0.5	0.8

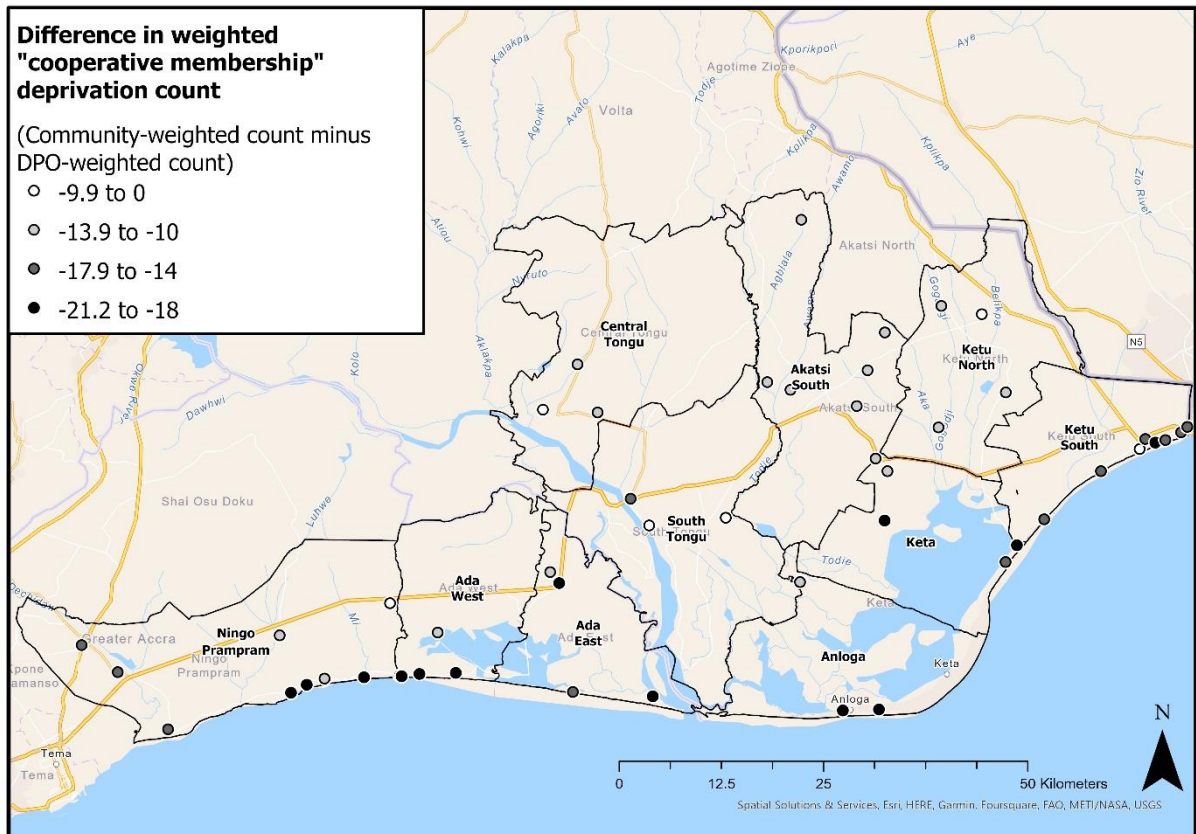
Appendix 5.8 Maps illustrating the difference in the weighted count of **a)** “employment” deprivation **b)** “cooperative” deprivation **c)** “drinking water” deprivation, when applying corresponding community livelihood and DPO weights. See section (5.2.7.4) for information on how the livelihood type of each community was defined

Household counts are calculated by multiplying each households’ binary deprivation indicator (0/1) by the corresponding weight. For example, if a household experiences “employment” deprivation, within a farming livelihood community, the weighted count would be (1 x 2.51). These values are summed within each community, to give an overall weighted count for each location. The DPO-weighted count is subtracted from the community-weighted count. A positive value suggests the community livelihood group weighted the indicator higher, whereas a negative value suggests DPOs placed greater value on the basic need component than the community.

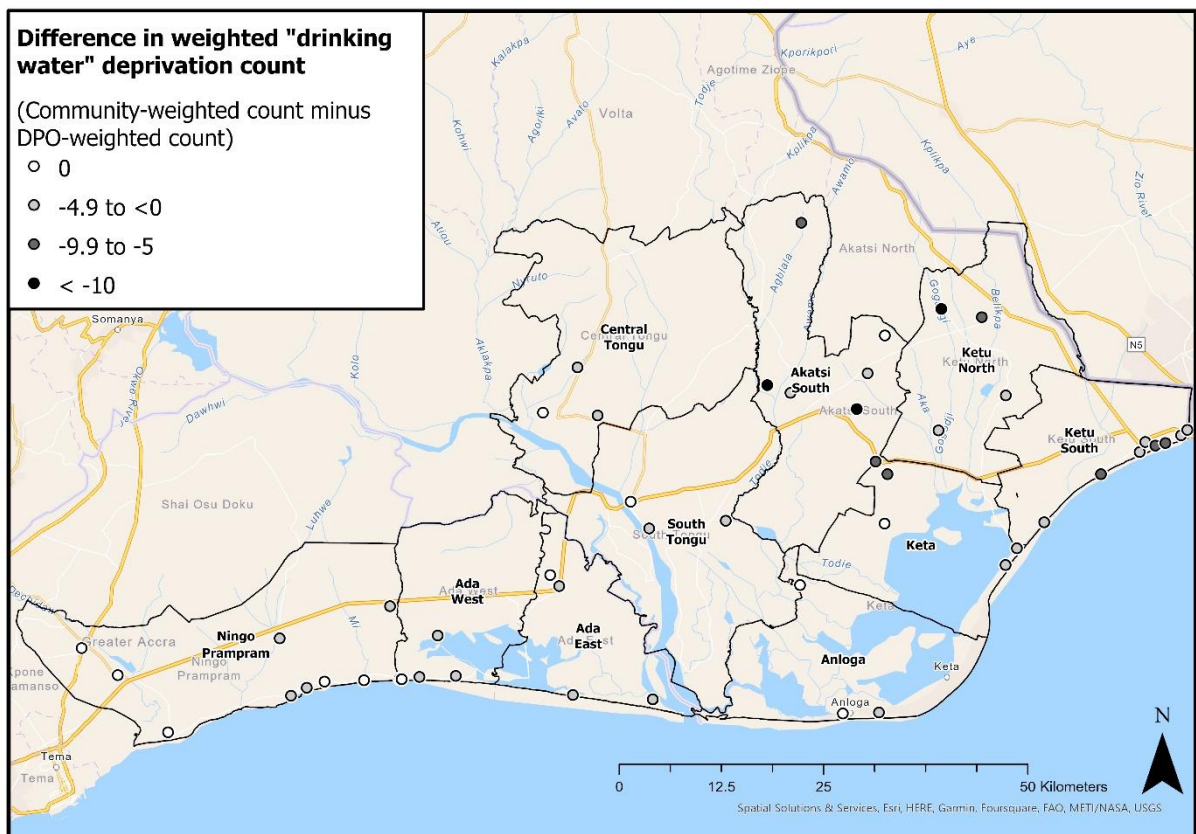
a) Employment (Weights – DPO; 1.54, Farming; 2.51, Fishing; 2.54, Peri-urban; 2.10)



b) Cooperative membership (Weights – DPO; 1.29, Farming; 0.80, Fishing; 0.59, Peri-urban; 0.56)



c) Drinking water (Weights – DPO; 0.98, Farming; 0.56, Fishing; 0.50, Peri-urban; 0.51)



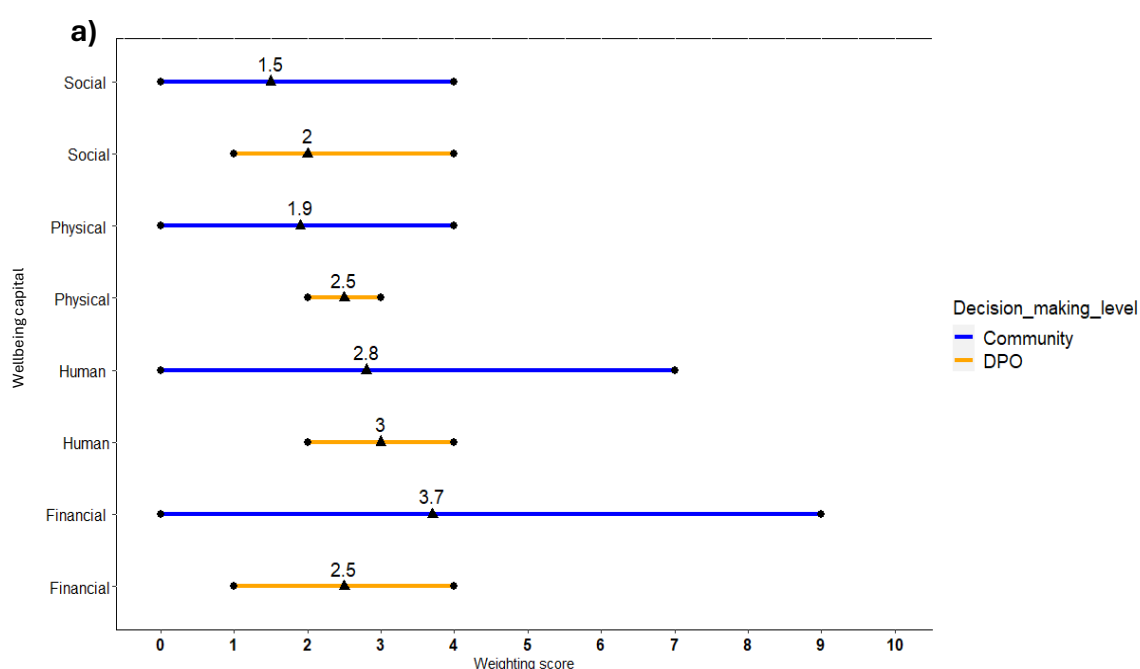
Appendix 5.9 Differences between livelihood group weights and summed DPO weights for all basic needs deprivation components. Highlighted cells referenced in text

Capital group	Deprivation indicator	DPO weight	Weight applied			Difference to DPO weight		
			Farming weight	Fishing weight	Peri-urban weight	Farming	Fishing	Peri-urban
Financial	Employment	1.54	2.51	2.54	2.10	+0.97	+1.00	+0.56
	Excess capital	1.01	1.10	1.25	1.03	+0.09	+0.24	+0.02
	Bank access	0.45	0.98	1.04	0.56	+0.53	+0.59	+0.11
Human	Education	1.67	1.38	1.71	1.72	-0.29	+0.04	+0.05
	Health access	1.94	1.56	1.74	2.50	-0.38	-0.20	+0.56
Social	Cooperative	1.29	0.80	0.59	0.56	-0.49	-0.70	-0.73
	Network size	1.11	1.30	0.97	0.97	+0.19	-0.14	-0.14
Physical	Roof quality	0.41	0.24	0.22	0.19	-0.17	-0.19	-0.22
	Drinking water	0.98	0.56	0.50	0.51	-0.42	-0.48	-0.47
	Latrine	0.64	0.40	0.40	0.39	-0.24	-0.24	-0.25
	No crowding	0.34	0.42	0.27	0.46	+0.08	-0.07	+0.12
	Home ownership	0.64	0.75	0.78	1.01	+0.11	+0.14	+0.37

Appendix 5.10 Mean equivalised, adjusted annual household expenditure by percentage built-up landcover in the community

Percentage built-up landcover in the community	Mean household expenditure (cedi)	No. households
None/lowest (0 – 8%)	2678.1	650
Low (9 - 20%)	2986.6	327
Medium (21 – 44%)	4392.3	194
High (45 – 69%)	3528.5	189

Appendix 5.11 **a)** Range of individual community member and DPO scores for each overarching capital group (Round 5, Table 5.3). Mean score for each capital marked by “▲”. Note, these values correspond to the raw scores, and have not been converted to weights. **b)** The difference between baseline “nested” weights, and DPO and community livelihood weights. Note, the “absolute average difference” does not account for whether the difference is positive/negative



b)			Difference to “nested” baseline weight				
Capital group	Deprivation indicator	“Nested” weight	DPO weight	Farming weight	Fishing weight	Peri-urban weight	Summed average community weight
Financial	Employment	1.00	+0.54	+1.51	+1.54	+1.10	+1.43
	Excess capital	1.00	+0.01	+0.10	+0.25	+0.03	+0.14
	Bank access	1.00	-0.55	-0.02	+0.04	-0.44	-0.11
Human	Education	1.50	+0.17	-0.12	+0.21	+0.22	+0.09
	Health care	1.50	+0.44	+0.06	+0.24	+1.00	+0.33
Social	Cooperative	1.50	-0.21	-0.70	-0.91	-0.94	-0.83
	Network size	1.50	-0.39	-0.20	-0.53	-0.53	-0.40
Physical	Roof	0.60	-0.19	-0.36	-0.38	-0.41	-0.38
	Drinking water	0.60	+0.38	-0.04	-0.10	-0.09	-0.07
	Toilet	0.60	+0.04	-0.20	-0.20	-0.21	-0.20
	No crowding	0.60	-0.26	-0.18	-0.33	-0.14	-0.23
	Homeownership	0.60	+0.04	+0.15	+0.18	+0.41	+0.22
Average absolute difference to “nested” weight			0.27	0.30	0.41	0.46	0.37

Appendix 5.12. Community-level deprivation rates using “nested”, community livelihood and DPO weights. Table illustrates how the ten-most deprived communities (highlighted grey for each weighting approach), using “nested” or DPO weights, excludes two communities (highlighted blue) which are defined within the ten-most deprived when using community livelihood weighting

DECCMA Enumeration area code	Community basic needs deprivation rate (%)		
	"Nested" weight	Community livelihood weight	DPO weight
309100068	92	69	92
315100055	90	69	79
309100072	85	48	78
405100162 (S4 – Nyitawuta)	81	78	81
315100071	79	71	86
402200218	79	71	71
405100096	71	54	69
405100053	71	39	64
309100006	69	69	65
402200215	69	66	72
315100060	68	52	64
402200178 (S7 – Kedzi)	65	31	42
402200147	64	57	57
403100024	64	46	64
310100085	63	40	57
309100053	62	50	58
310100014 (S2 - Anyamam)	62	45	55
403100011	60	40	53
404100161	59	38	62
310100009	57	30	50
310100165	57	30	47
405100131	56	41	45
310100024	55	48	52
310100033	55	41	55
404100028	54	36	43
402200179	52	38	45
310100145	50	40	47
405100055	50	35	42
402200210	50	30	41
309100008	48	48	42
315100086 (S1 – Afiencya)	48	43	35
402200028	48	37	37
310100005	47	43	47
310100055	41	41	41
404100159 (S5 – Awlikope)	41	33	41
404100051	38	25	29
401100057	36	25	36
406100094	29	29	36
401100049	24	14	17
402200033 (S8 - Anloga)	21	24	17
403100034	21	18	7
406100157	19	15	19
405100123	19	4	4
403100076 (S6 – Aflao)	19	0	11
403100045	18	7	11
403100058	17	7	14
403100087	14	0	0
406100105	10	10	10
403100051	10	3	7
401100139 (S3 – Sogakope)	8	4	4

Appendix – Chapter 6

Appendix 6.1. Percentage of households in each visited site experiencing opposing “poor/happy” and “non-poor/unhappy” outcomes. Highlighted cells represent values greater than the average percentage across all 50 sampled enumeration areas

Location	Opposing wellbeing outcome	
	“Poor/happy”	“Non-poor/unhappy”
Overall sample average	30.5%	8.1%
1) Afiencya	8.7%	4.4%
2) Anyamam	17.2%	17.2%
3) Sogakope	4.0%	28.0%
4) Nyitawuta	63.0%	0.0%
5) Awlikope	44.4%	3.7%
6) Aflao	25.9%	3.7%
7) Kedzi	15.3%	0.0%
8) Anloga	20.7%	6.9%

Appendix 6.2. Chi-square analysis shows a significant overrepresentation of households closer to the coast when the community contains a larger proportion of built-up landcover

Built-up landcover in community	Distance to coast (km)			Total
	0 – 10km	11 – 20km	>20km	
None/low coverage (0 – 16%)	544 (59%)	137 (15%)	241 (26%)	922
Medium coverage (17 – 38%)	199 (89%)	25 (11%)	0 (0%)	224
High coverage (>38%)	195 (89%)	23 (11%)	0 (0%)	218
Total	938 (69%)	185 (14%)	241 (18%)	1,364
Chi-square test statistic	158.556***			

Appendix 6.3. Chi-square analysis shows a significant overrepresentation of households with shorter travel times to district capitals when the community contains a larger proportion of built-up landcover

Built-up landcover in community	Travel time to district capital				Total
	0 - 10 mins	11 – 20 mins	21 – 30 mins	30+ mins	
None/low coverage (0 – 16%)	129 (14%)	254 (28%)	200 (22%)	339 (37%)	922
Medium coverage (17 – 38%)	110 (49%)	54 (24%)	60 (27%)	0 (0%)	224
High coverage (>38%)	167 (77%)	28 (13%)	0 (0%)	23 (11%)	218
Total	406 (30%)	336 (25%)	260 (19%)	362 (27%)	1,364
Chi-square test statistic	450.126***				

Appendix – Chapter 7

Appendix 7.1. Summary of this study's methodological/empirical, theoretical and policy-based contributions

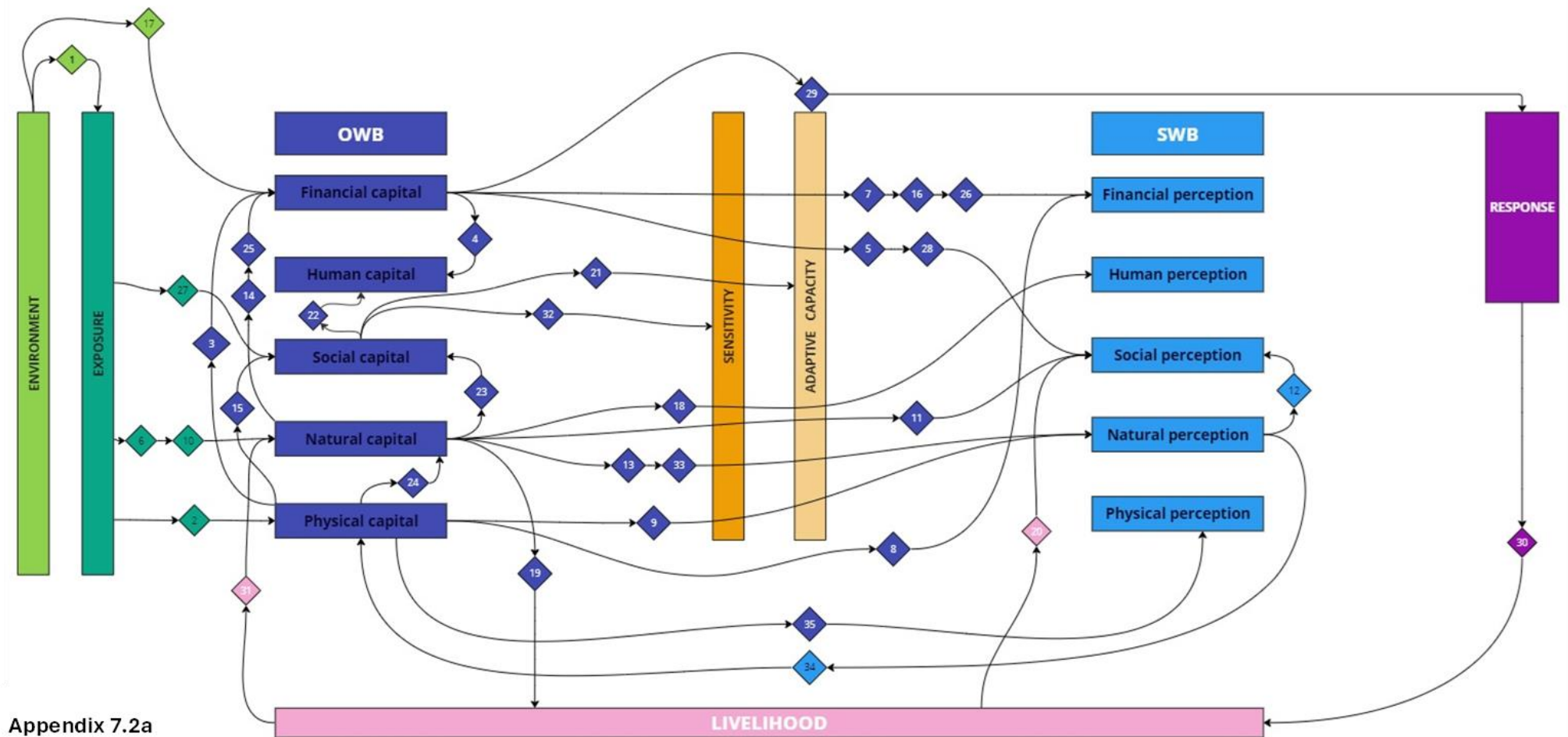
Chapter	Methodological/Empirical	Theoretical	Policy
2	➤ Incorporation of quantifiable objective capitals within the framework, alongside subjective perceptions and the “relative context”, advocates for mixed method approaches within sustainability research.	➤ Framework aids research by incorporating different components of OWB and SWB. ➤ OWB and SWB are both ends and means to further wellbeing in an environmental context. ➤ Framework supports the interpretation of OWB & SWB as channels of “adaptive capacity” and “sensitivity”.	➤ “Relational context” within the framework means policymakers should not look at community wellbeing as an isolated phenomenon, but acknowledge the wider effects in time and space (i.e., natural resource governance).
3	➤ Expenditure data potentially more-accurately captures financial OWB within subsistence locations. ➤ Proxy variables exploring wellbeing can be developed from secondary data with alternative RQs. ➤ Sensitivity of weighting selection, when calculating basic needs deprivation, justifies the preference for community weighting. ➤ Prioritise measures which do not require quantification within subsistence or low-income locations (i.e., adequacy approach to subjective financial stress). ➤ Life domains happiness can capture less-tangible components of happiness which can be omitted within global evaluations. ➤ Importance of being transparent when recording wellbeing measurement methodologies.	➤ Incorporate OWB and SWB measures to avoid missing crucial information. ➤ OWB and SWB are related, yet not interchangeable. ➤ Within broad philosophical approaches, different biases and cultural effects can result in large outcome differences (i.e., subjective financial stress > unhappiness).	➤ Incorporate both OWB and SWB measures within policy to ensure the most-vulnerable communities are targeted. ➤ SWB should not be considered a substitute for OWB. ➤ SWB should be used as a conduit for communities’ voices. ➤ By acknowledging OWB and SWB to interact, both conceptualisations should be targeted in policy to avoid sacrificing one for the other. ➤ Calculating decomposable measures (i.e., life domains happiness & basic needs deprivation) can allow for targeted policy action.
4	➤ Creating combined wellbeing measures (i.e., expenditure poverty & unhappiness) can facilitate the exploration of a certain combined outcome against the rest of the sample, and avoid the complexities associated with multinomial modelling. ➤ Importance of examining wellbeing on smaller scales to identify potential contributing factors.	➤ Climate hazards are primarily associated with lower wellbeing; however, the effect can differ depending on the landscape. ➤ OWB and SWB can associate with one another differently depending on the landscape and climate hazards.	➤ Environment-wellbeing associations vary spatially, therefore policy should acknowledge the different needs. ➤ Utilise community togetherness in rural areas to stimulate growth, and improve resiliency to climate hazards. ➤ Greater connectivity of remote areas should be paired with initiatives to minimise inequality and relative comparability.

Chapter	Methodological/Empirical	Theoretical	Policy
4 (cont.)	➤ Combination of survey and remote sensing data to examine environment-wellbeing associations. ➤ Environmental conditions explain large proportions of variation in wellbeing outcomes (Appendix 4.10), yet wider structural factors and control characteristics are also important. ➤ Livelihood type is assumed to influence wellbeing outcomes by controlling “sensitivity”, yet does not interact with any climatic or landscape variable.	➤ Remoteness from road networks and district capitals appears to negatively impact OWB, yet positively effect SWB (i.e., relative comparability). ➤ Attachment to place is potentially an important control of SWB within agricultural communities. ➤ Individuals’ personality traits play a role in wellbeing outcomes, yet can be superseded by climate shocks (i.e., storm events).	➤ Effective adaptation and migration policy should also account for the psychological and symbolic impacts which can influence communities’ SWB. ➤ Improve efficiency and access to piped water to minimise multidimensional effects upon OWB and SWB. ➤ Improved flood defences to minimise physical and emotional damage.
5	➤ Basic needs deprivation outcomes are sensitive to weighting selection. ➤ Not only important to collect local weights, but also important to collect from different locations and socioecological subgroups. ➤ Disparity in weighting between communities and DPOs justifies the inclusion of weights from different decision-makers. ➤ Anonymous weighting could minimise issues of social desirability bias and score mimicking. ➤ Weighting exercises are effective in incorporating subjective perceptions within tangible OWB measures. ➤ A larger sample of community weights needs to be collected to ensure robust application to the sampled population.	➤ Where, and who, weights are collected from matters, with different livelihood groups presenting different scores for basic needs components. ➤ Weights collected from the visited communities produced lower overall deprivation rates than when using “nested” or DPO weighting. ➤ Social capital components were weighted higher by farming communities, supporting literature illustrating the importance of relationships within a rural “good life”. ➤ Weighting is thought to be impacted by the positionality of the interviewer, and by what communities do not have, yet wish they did. ➤ Some communities weighted components lower if recent improvements had been experienced. ➤ DPOs potentially have an idealistic view of “cooperatives, ” which not all community members share.	➤ Collection of community & DPO weights can provide a powerful policy tool to identify areas where priorities differ, opening channels for dialogue/negotiation. ➤ More-frequent communication between communities and local government to avoid differences in opinion (i.e., benefit of cooperatives & responsibility for sanitation). ➤ Avoid “blanket approaches” as different communities have different priorities. ➤ Include multiple weighting methods within policy monitoring to ensure the most-vulnerable areas are targeted. ➤ Subjective weightings, within a OWB measure, can ensure communities’ issues are captured, whilst ensuring the metric remains quantifiable and easy to interpret by policymakers. ➤ Target improved agricultural support in rural areas to ensure year-round employment options, and minimise the seasonality of wellbeing. ➤ Improve equality of access to healthcare within peri-urban hubs (i.e., access to health insurance).
6	➤ Benefit of mixed method approach in enriching model results. ➤ Mixed methods capable of providing explanations on the ground, which differ from static model results. ➤ The mixed method approach can guide future research in other localities, as results from the sample only apply to visited areas in Volta Delta.	➤ Collectivism is part of Ghanaian culture, yet levels of collectivism differ across landscapes and time (i.e., seasonality & climate hazards). ➤ Community togetherness can maintain SWB in poor areas, yet can fluctuate within an environmental context.	➤ Address systematic divide between education system and job market. ➤ Outreach from major urban hubs to construct effective migration channels in rural areas; reduce “return of failure” (Cerese, 1974). ➤ Improve access/affordability of irrigation to mitigate seasonal wellbeing fluctuations.

Appendix

Chapter	Methodological/Empirical	Theoretical	Policy
6 (cont.)	➤ Need to acknowledge interview positionality (i.e., nearly all stated money was needed for happiness). ➤ Need to reflect on my challenges as a white researcher in Africa; power dynamic, my identity, and how it influenced whom I accessed and how they responded.	➤ The assumption that remoteness means no awareness of external living standards is challenged. ➤ Importance of education in “good life”, with self-improvement and betterment seen as crucial for SWB. ➤ Coastal hazards can negatively impact physical/psychological health, community relationships and identities. ➤ Disruptions to social/group norms can lower community SWB. ➤ Attachment to place can bring SWB benefits, yet also exacerbate damage from displacement. ➤ Across all communities, money is needed for happiness, yet differences exist in how it is used.	➤ Ensure incoming industries have a quota of local employment to avoid exacerbating inequalities (i.e., Sogakope tourism). ➤ Improve communication between government and communities to avoid conflicts (i.e., Songor Lagoon). If privatisation is introduced, ensure alternative livelihoods are in place beforehand. ➤ Reduce fragmentation of adaptation policies across scales. Many examples of how local governments & communities are unaware when national coastal defence support will be provided. ➤ More cross-scale dialogue platforms required. ➤ Minimise peri-urban/rural divide in basic need provision to improve happiness within poorer location (as many stated money equals happiness due to its ability to satisfy households’ basic need requirements).

Appendix 7.2 Causal loop diagrams illustrating the complex interconnections of the “ECW” framework, with supporting mixed method findings in tables. **Appendix 7.2a** presents the Anyamam (S2) example. **Appendix 7.2b** presents the Kedzi (S7) example, with specific focus on a male interview respondent, alongside statements from other members of the community.



Appendix

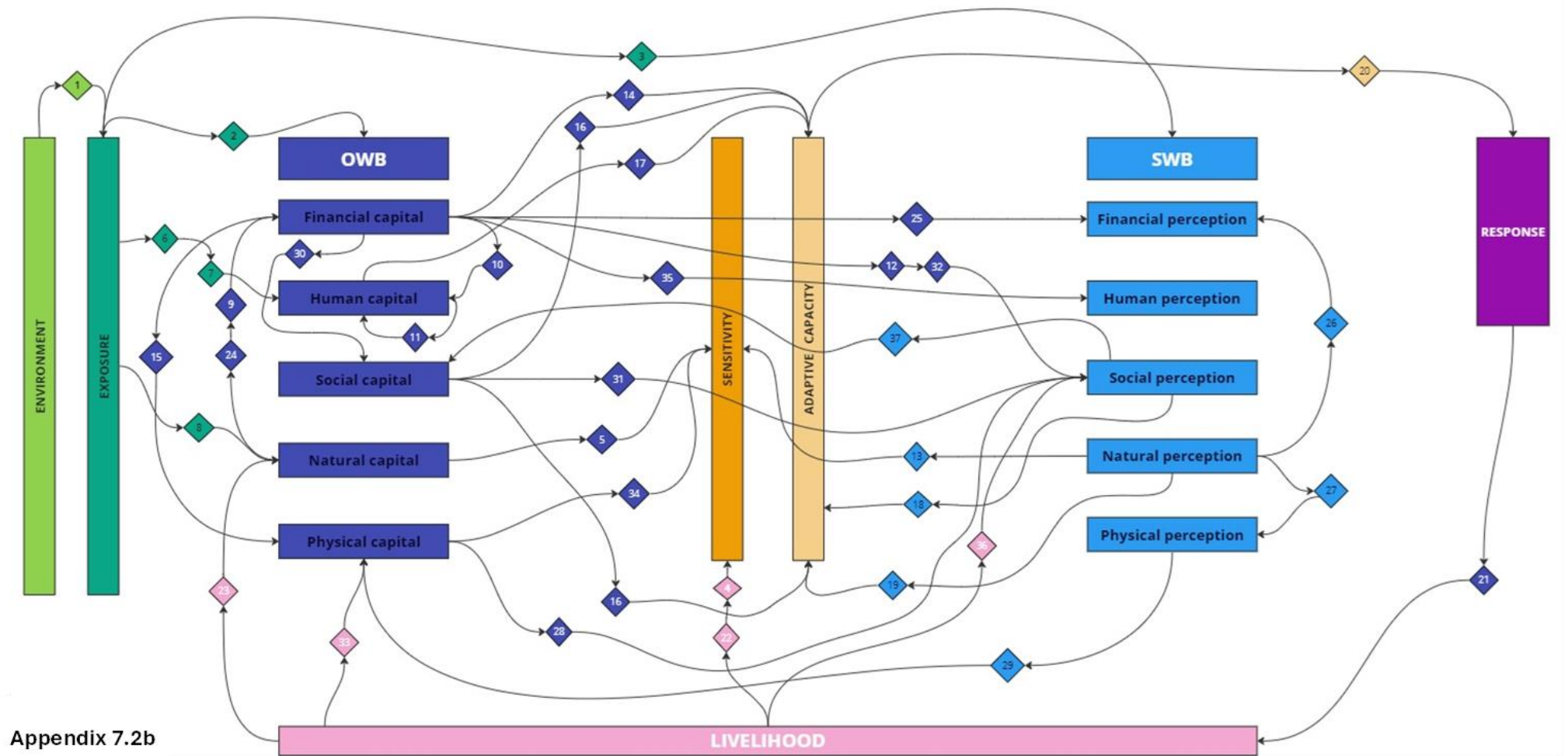
Appendix 7.2a: Anyamam (S2) causal loop supporting findings	
No.	Description
1	The coastal location of Anyamam creates exposure to hazards such as flooding, salinisation and erosion; which are shown across various quantitative models (Chapter 4) to potentially cause negative OWB and SWB impacts; <i>“We have the sea here and there are times when the sea level rises and floods the community. This is another problem that we face”</i> (FG,F)
2	Hazards have destroyed housing and livelihood assets; <i>“when the sea is not happy, it flows into the town to pull down houses and as we speak, the sea has swallowed a lot of houses”</i> (FG,M)
3	Destruction/damage to livelihood assets, such as fishing boats, can restrict access to the financial capital received from trading natural resources; <i>“since the sea is our main source of fishing, so when the disaster occur like that we unable to go fishing because it destroys most of our boats which affects where we can get money...”</i> (FG,M)
4	Limited financial capital can restrict access to human capital, in the form of health services and education; <i>“... destroys most of our boats which affects where we can get money to take care the children education, feeding at home and even save some for future emergency”... “I am here I have 6 children my only plan is to go fishing to take care of them but since the season didn’t favour me only one of my children is going to school. The rest of the 5 children are home and this is the problem we are going through in the coastal area”</i> (FG,M)
5	Limited financial capital may impact SWB by preventing individuals from undertaking social and cultural obligations to look after the family and the home; <i>“if my boat was not destroyed then I can take it fishing and get some catch to feed my family”</i> (FG,M)
6	Lower fish catches compared to before due to changing environmental conditions; <i>“nowadays the fishing season is not like it was in the past”</i> (CI,F)
7	Lower incomes compared to before, due to lower fish trading, can lower one’s perceived financial status; <i>“they do not buy from me as much as I would like. When it’s fishing season that is when they patronize my business [yet the fishing season is not as profitable as it once was]”</i> (CI,F)
8	Nevertheless, the town does have physical capital assets, including road networks and services in the town and nearby district capital; <i>“as we speak we are fortunate to have two banks in the town now which shows that this place is becoming a big town”</i> (FG,M) Yet, this may cause negative impacts on SWB, including financial stress, if they perceive themselves to have “more-to-lose”; supported by the interaction between built-up landcover, storm exposure and financial stress (Model 4.1.3).
9	Damage to physical capital, including housing, can increase actors’ fears of climate hazards (natural perception), especially if past events have disturbed their peace or brought distress; <i>“So people who are relocating to the other side are not getting land so we are just living in fear because it can happen in the night”</i> (FG,M)
10	Coastal erosion has resulted in the community losing land over the years; <i>“the sea has taken over 60% of our land and still taking because the size of Town A is still reducing”</i> (FG,M)
11	Loss of land due to coastal erosion, and the need to relocate, can apply pressure upon reciprocal family/community relationships, with some respondents noting how they feel a burden if having to relocate with family members; <i>“I have five or six children and my sibling comes to live with me with their children too during this time [flooding], what will I do, how will I take care of all of us? So, when this happens then it becomes a burden”</i> (FG,F)
12	Past events and current worries can damage relationships and reduce actor’s attachment to place, linked to the fears of displacement and relocation; <i>“People are displaced from their homes, you will not know where your neighbour is and you become disorganized. We do not know what to eat because the people who are selling the food are also trying to sort out their lives...[also] when the sea becomes violent [and] you are in somebody’s house you will not have peace”</i> (FG,F)
13	Loss of land due to coastal erosion can lower SWB. Drawing on the concept of “solastalgia”, individuals may experience distress if landscapes in which they are emotionally and culturally attached to are damaged or destroyed; <i>“as we speak the water bodies are taking the 30% [land] we have. We are in fear that in some years to we won’t have a place to settle”</i> (FG,M)
14	Loss of land to coastal erosion can increase the cost of the remaining land; <i>“back then when we had enough lands the cost of land isn’t that expensive and most of us could afford it”</i> (FG,M)
15	The eastern expansion of Accra and Tema, in terms of built infrastructure and employment opportunities, into Ningo Prampram has increased the local population, land costs, conflicts and competition for services; <i>“the industrial areas are moving towards our district, they are expanding... they have a very huge population, the are the second biggest town in the district”</i> (DPO)
16	Increased land costs can generate perceived financial stress; <i>“due to the recent happenings the small lands are very scarce and expensive and all this makes us unhappy”</i> (FG,M)

Appendix

No.	Description
17	Landscape characteristics, and the associated natural capital, are key sources for financial capital; however, these relationships are governed by relational processes associated with power and governance, and the “money-orientated” culture. For example, the sale of Songor Lagoon; <i>“government has taken a decision to give it to a private investor, and the investor pays back some revenue to national, to district assembly, whereby everybody benefits. So that is what the community is battling with now”</i> (DPO) Larger fishing vessels from other countries limiting the fish catches available to local artisanal fisherfolk; <i>“So the big boats are the ones spoiling our harvest because they also use certain types of chemicals which are not good for the sea”</i> (FG,M) Chiefs selling fishing rights to outsiders; <i>“in the past you could also take your tools and go and fish in the Paga, sell and buy things for yourself but now the chiefs are selling it so, we do not get anything”</i> (FG,F)
18	The autonomy to undertake desired livelihoods is restricted through the prevention of artisanal salt mining in Songor Lagoon; <i>“this was for us, it was for everyone in Ada. It was free, when you get there could mine salt for free there and no one will take it from you or question you but that one is [now] for someone”... “In the past, you can go there with your basin collect the salt sell and use it to purchase things or pay off your debts but now it is no longer so”... “We are no longer happy so even if you are working you are disorganized”</i> (FG,F)
19	Traditional, intergenerational livelihood identities are prohibited by the sale of the Lagoon and the private police deployed to prevent access; <i>“You don’t have the right to take any salt out of the lagoon and this has brought about war between the town people and the individual the whole concession has been handed over to”</i> (FG,M)
20	The pride associated with fulfilling traditional identities may be limited if unable to continue salt mining, resulting in community-wide reductions in SWB; <i>“because the salt has been their livelihood for years. So when they compare themselves to the other communities, they feel they are nothing”</i> (DPO)
21	Linking social capital, in the form of governmental support, is required to aid individuals who have had their traditional livelihood removed adapt and diversify their income streams. However, this was not provided in the case of Ada West; <i>“So now that way of making money has been stopped and the disadvantage was that we did not put any alternative livelihood measures in place before the new arrangements, so that is what they are battling with”</i> (DPO)
22	Limited political influence in areas outside the district capital links to how decentralisation has resulted in district capital investment, yet the benefits and services, such as education and health (human capital), are not replicated in surrounding areas; <i>“There are a lot of inequalities...the district capital, is expected to have some basic facilities...the capital is developing and ideally it should be duplicating in other communities, but [it is not] because the assembly is [financially] handicapped”</i> (DPO)
23	Access to natural capital, which is influenced by the relational processes of governance, can result in conflict and the disruption of community relationships, as seen with the violence surrounding Songor Lagoon; <i>“The war [over the salt concession] is intense that we are fighting with guns and other weapons and this is affecting our peace in the community”</i> (FG,M)
24	Inequalities in physical capital may also influence how natural capital is accessed and used; for example, locals are unable to access salt during the wet season, yet outsiders with access to technology can maintain year-round access; <i>“We know of companies who mine nicely without having to carry it on your head but rather having some push trucks that helps bring it out. We town people uses manual way such that even after parking it outside and it rains it will wash it back into the lagoon”</i> (FG,M)
25	The inequality in natural capital access can result in inequalities in financial capital due to certain groups having access to more resources for trade during particular seasons; <i>“It is only the dry season you can get it so we can’t maintain it... gone were the days you can go and mine if you have the strength but now that they put it in the hand of Electrochem Company you can’t just go and mine unless you are an employee of the company”</i> (FG,M)
26	The restrictions on accessing Songor Lagoon have financial impacts, which can translate into subjective financial stress, with trade incomes lower than before, and also potentially more volatile due to limited livelihood options during the dry season where fish catches are lower; <i>“Like how we had money before now we don’t. Gone were the days when the school needs something, they go mining the salt to buy that”</i> (FG,M)

Appendix

No.	Description
27	Climate hazards may influence social capital differently over time. Firstly, reciprocal relationships may strengthen during shocks and crises in order to overcome collective challenges; <i>“If there is an accident we all come together and help...if we all have to contribute one cedi we will do it”</i> (FG,F)
28	However, in other contexts, the unity and reciprocity between individuals is not as strong. For example, due to increasing competition and rising costs, there are weaker relationships when it comes to everyday trading and income generation; <i>“when we go to the market together and they buy mine but they do not buy hers then that is it, the relationship has been destroyed...instead of being happy for her you...carry hatred in your heart”</i> (FG,F)
29	Due to the threats of flooding, and the reduction in available fish catches, individuals (with sufficient adaptive capacity) are responding by adapting their livelihood practices; <i>“due to the disaster occurring the sea people have gone into salt mining”</i> (FG,M)
30	For example, individuals are altering their livelihood type by converting their farmland into salt mining sites; <i>“[the flood disaster is] making people turn their farmlands into mining sites”</i> (FG,M)
31	This land-use and livelihood shift has exacerbated soil salinity issues within the community; <i>“people just gather salt near farmland anyhow...through knowledge we got to know that the salt going through the grounds destroying things which makes crops flourish”</i> (FG,M)
32	The sensitivity of individuals’ farmland to salinity issues has been exacerbated by increasing populations, and the increased proximity of land used for salt mining/storage and crop production; <i>“Gone were the days the salt in the land doesn’t disturb the crops because people were not many but now due to the increment in population and the urge [to collect salt resources near others’ land]”</i> (FG,M)
33	The conversion of agricultural land to salt mining sites may also damage SWB by removing green spaces, and their associated aesthetic and health values; <i>“We are very happy about our environment because we are able to get fresh air and it’s natural”... “before when they plant crops here it was a beautiful sight”</i> (FG,M)
34	Fears of continued flood damage have resulted in investment taking place outside Anyamam in the district capital (Sege). Therefore, despite fishing businesses being located in the town, the financial capital received, and the consequent investment in infrastructure and dwellings, is extracted; <i>“they are using Anyamam as a business point and do their fishing and their everything, but in terms of assets they come and do it [in Sege]... they have their assets outside. He does not see that place as his permanent home”</i> (DPO)
35	The difference in investment creates proximate inequalities in infrastructure and services, which can enhance relative comparability and lower SWB; <i>“They do not renovate their house, not spend more money on it. So they would rather invest it in the capital... if you ask him [with the investment resources] to construct toilets and stuff [in Anyamam] then he is not ready to do, because the floods can come and they will take it away”</i> (DPO)



Appendix

Appendix 7.2b: Kedzi (S7) causal loop supporting findings	
No.	Description
1	The community of Kedzi is exposed to multiple climate hazards, including; coastal erosion due to its location upon a thin spit between the ocean and Keta lagoon (Figure 6.1), uncertain rainfall and aquifer salinisation; <i>“if the dry season persists for a long time then it becomes salty...his borehole there is always salt in it”</i> (CI,M)
2	Across Volta Delta climate hazards can negatively impact OWB, illustrated by Models (4.1.1 & 4.2.4) showing drought to increase the odds of expenditure poverty.
3	Across the study area, climate hazards such as salinisation, are associated with higher odds of unhappiness (Model 4.1.4); particularly regarding the domains of drinking water, environment and family/community interactions.
4	The livelihoods available in Kedzi influence environmental “sensitivity”; for example, households reliant upon fishing are sensitive to storm and flood hazards, <i>“the sea throw the fishing boats out of the sea leading to its destruction and some of the fishing boats were carried away and never found”</i> (FG,M). Similarly, farming livelihoods are sensitive to climate hazards in Kedzi; <i>“do your crops suffer during dry periods?.....It affects me if the drought is for a while, so the groundwater goes down and sometimes my pipes are not able to get enough water”</i> (CI,M)
5	The natural capital, and landscape in Kedzi may also increase the sensitivity of certain livelihoods to unfavourable environmental conditions; <i>“you see how sandy the place is, it is difficult as the crop will not survive”</i> (CI,M)
6	Hazards such as floods are also shown to negatively impact health, with increases in malaria and cholera during flood events; <i>“Most of them are used to open defecation...then it floods and it affects them...cholera increases during floods”</i> & <i>“Malaria is also very common during those times. During the rainy season, there is stagnant waters around your house and in other areas and you see mosquitos”</i> (CI,M)
7	Flooding can also disrupt schooling, limit children’s education, and restrict the transmission of knowledge to parents; <i>“during the rainy season, their homes, the whole compound is flooded...Some of the children just stay at home, and parents not give them pressure to come to school”</i> & <i>“educate the children so when they go home at least some of their parents, who did not have the opportunity to attend school, learn some of the basic things needed for good health”</i> (CI,M)
8	Climate hazards impact crop yields and fish catches (natural capital), <i>“storms affect the catch because if you capsize, all the fish is gone”</i> (CI,M)
9	Limited yield and catches inevitably impact the income available from trading produce; <i>“when the sea becomes rough, you cannot go fishing so you have to stay offshore [which limits how much you can] offload and sell”</i> (CI,M)
10	Limited income can feedback to restrict access to education; <i>“I was able to save a small amount, and I am doing my first degree at university”</i> (CI,M)
11	Limited education can feedback to further lower human capital in the form of health; <i>“I see no reason why I would allow my kids to sleep outside a net, when I know they will definitely get malaria...but [those without education] do not see that way, so I say education is lacking”</i> (CI,M)
12	Limited income may also threaten SWB by restricting individuals’ capacity to fulfil social obligations to provide for the family, particularly amongst male “breadwinners”; <i>“I am with people around me, my family, with nothing in my pocket how will I support my family and the community. Someone from the community comes to you and asks for something and you have no money....how will you do, it is embarrassing”</i> (CI,M)
13	Past experiences of climate hazards may increase individuals’ sensitivity to further negative SWB impacts; <i>“if nothing is done [with coastal defences] there’s the fear that in the next 2-5 years what we experience in the past will repeat again”</i> (FG,M)
14	Financial insecurity is a motivating factor behind adaptation, but initial financial capital is required to ensure sufficient adaptive capacity; <i>“[irrigation] requires money, because you can not use your hands to water”</i> & <i>“if you try farming, the land is not fertile enough, you have to invest beforehand”</i> (CI,M)
15	Financial capital is required to invest in the necessary physical capital to successfully adapt farming practices; <i>“first you pay electricity bills, and here the bills are a bit high, also have to buy the pipes to lay, the pumping machine, it can be a small amount of investment to be made”</i> (CI,M)
16	Social networks are used to access information and increase one’s capacity to adapt agricultural practices, including the installation of irrigation; <i>“What do we gain from neighbouring communities, I have a friend in the next town...I admire the work they are doing there. So I come to him and said I also want to do some [irrigation] here. [He tells me to] buy this cow dung, this poultry waste and you spread it on the ground and then plant it. So they encourage me and gave me guidance”</i> (CI,M)

Appendix

No.	Description
17	A certain level of education is also required to ensure an individual has the adaptive capacity to implement new livelihood strategies; <i>“we are doing small farming here, there are things that are coming and without education you’ll still be hooked on the manual way of farming...there are things you need to use in your farm but because you have no idea, pest are worrying your crops and you don’t know what to do unless someone who is educated comes to see and tell you how to resolve the problem”</i> (FG,M)
18	Long-standing traditions and social perceptions regarding livelihood identity may also influence adaptive capacity. This idea is also linked to human/financial capital, as if the community has historically focused on fishing, then the skills required to adapt and undertake farming may not exist; <i>“the people in this community are not farmers, they are fisherfolk. You will be surprised the investment in farming, 100s cedis, the guy abandoned the work and left, so that money is down the drain”</i> (CI,M)
19	Attachment to land may increase one’s desire to protect the landscape and community, and therefore their adaptive capacity; <i>“The attachment or belonging that this is where I’m born and what I can do to make here a better place is the main reason why some of us are here...why we are still here protecting the little left for the future”</i> (FG,M)
20	The case study interviewee had sufficient OWB capitals to implement a “response” through irrigation; <i>“I farm as well did you see the garden the opposite the clinic with irrigation, that is mine”</i> (CI,M)
21	The response subsequently altered the individual’s livelihood. They were previously just a teacher, but now they possess a mixed livelihood as an irrigation farmer.
22	The change in livelihood and the installation of irrigation technology reduced the sensitivity to drought and uncertain seasonality; <i>“So as we are able to do irrigation [and grow okra year-round], and other farmers are waiting for rains”</i> (CI,M)
23	The adapted livelihood strategy increased access to more diverse natural capital, including cash crops; <i>“Onions and then currently Okra. It is a type of fruit that requires a lot of water”</i> (CI,M)
24	The importance of adaptation in improving financial wellbeing is illustrated by Model (4.1.1) with significantly lower odds of expenditure poverty in rural (high-EVI) areas when undertaking adaptive practice(s). The capacity for adaptive irrigation and higher-quality natural capital to improve financial OWB was illustrated by the individual’s market advantage over rain-fed farmers in the surrounding areas; <i>“the farmers are waiting for rains, so there is not as much of a supply, so when they hear we have okra here [due to irrigation] then they come rushing, and it is one of the fruits that people like using”</i> (CI,M)
25	Increased financial capital may result in less subjective financial stress, with the respondent noting how his increased salary has reduced financial worries as they can afford food and overcome basic challenges; <i>“now I am OK, because in life is simple. Once you have something to eat, you feed yourself and feed your family it is OK. If there are times when you do not have anything, when you get money mostly what worries is when you have nothing to eat, that is the biggest challenge”</i> (CI,M) However, this relationship is a “relational” process, as the amount of financial capital required to fulfil an individual’s aspirations may shift over time; <i>“First salary came and I was so happy, now you feel OK but now the money does not mean as much. When I had nothing it was ok, but the more you earn the more responsibilities increase”</i> (CI,M)
26	The “relational context” in Kedzi where approximately 80% of land had been lost to the ocean, including people’s dwellings and school infrastructure, may generate fears (natural perception), which could increase financial stress as residents are worried about losing any accumulated wealth; <i>“They worked hard and accumulated all those things and the rain just falls and washes it all away...If you are not careful the person will overthink things and die. They will be wondering where they will get the money...back after accumulating for a long time”</i> (FG,F)
27	Similarly, fears of future flooding due to repeated past hazards may have a cumulative effect and generate a sense of hopelessness regarding the material living standards available to them in Kedzi; <i>“you see as the sea keeps on removing us, people have still not relocated back. They don’t even visit here, they’ve migrated and are gone because the sea always disturb us a lot it just happen unexpectedly. You’ll just be there and it will flow into your room destroying your properties even it pulls down houses”</i> (FG,M)
28	Damage to assets can also lower one’s status in the community, which can negatively impact their self-evaluated SWB; <i>“when all your assets get destroyed through those hazards it reduces the recognition and prestige you might have in the community”</i> (FG,M)

Appendix

No.	Description
29	Fears of future hazards and destruction may ultimately feedback to disincentivize investment in improving the physical capital of the town; <i>“we are currently in fear of amassing assets then later these disaster strikes again. So most of us conscientise our mind on amassing assets which may be destroyed in the future. Even though people would like to do things to beautify the community but due to the fear of disaster they don’t engage in it”</i> (FG,M)
30	The ability to increase financial capital through adaptive irrigation may strengthen social capital, with additional funds able to reinforce reciprocal family relationships; <i>“I have my mum at home, she’s 60 something and I have to support her to survive”</i> (CI,M)
31	Fulfilling reciprocal family relationships can also be assumed to improve SWB, with Ghanaian studies highlighting the importance of fulfilling traditional obligations in achieving a “good life”; <i>“I always say family is the most important one. Also when something happen to me now my families are the first people to come and help before the society will even hear it”</i> (FG,M)
32	Improved financial wellbeing may also improve one’s social status, resulting in increased happiness. This relationship was illustrated by the assemblyman noting his admiration for a community member who had accumulated financial capital and assets; <i>“No... money if not in your pocket you are nobody....[when describing the person who is “doing the best”] He has a private car for himself, three boats working for him, he deserved to be applauded. He is serious with his business”</i> (CI,M) This effect of financial capital upon social status is “relational”, with respondents noting how the value attached to financial capital has shifted over time, and is especially prominent amongst the youth of today; <i>“the attitude of the youth about work, all they need right now is money in their pocket”</i> (CI,M)
33	The change in livelihood, and the subsequent market advantage, reduced the importance of having high quality physical capital in the form of road networks as people visited the individual to buy their produce, rather than having to commute to markets; <i>“Yes people come to buy, people in the community and people from other sites if they need it then they come. I do not travel to the market”</i> (CI,M)
34	Due to buyers visiting the farm itself due to the limited supply of high-moisture crops during dry periods, the individual’s financial sensitivity to physical remoteness from key markets was reduced.
35	Access to increased trade incomes also improved the individual’s autonomy (human perception), as the higher wage meant that they were no longer dependent upon others; <i>“I have the opportunity to attend school, I have not reached [where I want to yet], but at least I do not depend on anyone to survive”</i> (CI,M)
36	Overall, the adaptive process and the change in livelihood fulfilled the social expectation of “working hard” in the community. Working diligently to progress one’s business and support the family is a desired trait, which if fulfilled can boost individuals’ pride and SWB; <i>“what I am doing, I am going to work, I wake up at 3am, then 6am take a shower before work, then come back and do it again”</i> (CI,M)
37	However, this social perception may weaken tangible social relationships, as the interviewee noted his frustrations with others who were given similar opportunities to undertake irrigation farming, but did not put the required effort in; <i>“two guys who were with us yesterday. Someone invested, laid the pipes, it is quite expensive... these two guys cannot wake up to weed, they do not go to work, they are in the house, maybe they go fishing and then they come back... the way they took care of grasses, weeds took over crops, the man [gave up] because they are making loss”</i> (CI,M) & <i>“what he’s doing [the person doing the worst (0/10)] is not yielding any profit, what he is doing there is nothing to show”</i> (CI,M)

List of References

- Ababio, A. G., Osei-Fosu, A., & Buabeng, E. (2021). Religious orientation and poverty in Ghana: associations and explanations. *Journal of Social and Economic Development*, 23(2), 377-396.
- Abbasi, A., Wigand, R. T., & Hossain, L. (2014). Measuring social capital through network analysis and its influence on individual performance. *Library & Information Science Research*, 36(1), 66-73.
- Abenyega, O., & Gockowski, J. (2003). Labor practices in the cocoa sector of Ghana with a special focus on the role of children. Findings from a 2001 survey of cocoa producing households, with KNUST, IITA and ILO. https://www.hubrural.org/IMG/pdf/stcp_ghana_labor_practices.pdf, last accessed 25th July 2024.
- Abraham, E., & Martin, A. (2016). Understanding households' livelihood choices, wealth, and poverty in Accra, Ghana. *Development in practice*, 26(3), 387-402.
- Abu, M., & Codjoe, N. (2018). Do Deltas Remain Attractive? Testing the Migration to Coast Hypothesis. Proceedings from the Collaborative Adaptation Research Initiative in Africa and Asia (CARIAA) 3rd Annual Learning Review.
- Abubakari, M., Owoob, N. S., & Nketiah-Amponsah, E. (2019). Socio-economic determinants of life expectancy in Sub-Saharan Africa. *Ghanaian Journal of Economics*, 7(1), 156-177.
- Achore, M., & Bisung, E. (2022). Experiences of inequalities in access to safe water and psycho-emotional distress in Ghana. *Social Science & Medicine*, 114970.
- Ackah, C. (2013). Nonfarm employment and incomes in rural Ghana. *Journal of International Development*, 25(3), 325-339.
- Adamkiewicz, G., Spengler, J. D., Harley, A. E., Stoddard, A., Yang, M., Alvarez-Reeves, M., & Sorensen, G. (2014). Environmental conditions in low-income urban housing: clustering and associations with self-reported health. *American journal of public health*, 104(9), 1650-1656.
- Adams, H. (2016). Why populations persist: mobility, place attachment and climate change. *Population and Environment*, 37(4), 429-448.
- Adams, H., Adger, W. N., Ahmad, S., Ahmed, A., Begum, D., Matthews, Z., Rahman, M. M., Nilsen, K., Gurney, G. G., & Streatfield, P. K. (2020). Multi-dimensional well-being associated with economic dependence on ecosystem services in deltaic social-ecological systems of Bangladesh. *Regional Environmental Change*, 20(2), 1-16.
- Adarkwa, K. K. (2010). *Housing as a strategy for poverty reduction in Ghana*. UN-Habitat report, available at <https://unhabitat.org/sites/default/files/download-manager-files/Housing%20as%20a%20Strategy%20for%20Poverty%20Reduction%20in%20Ghana.pdf>; last accessed 8th August 2023.
- Adato, M., & Meinzen-Dick, R. S. (2002). *Assessing the impact of agricultural research on poverty using the sustainable livelihoods framework*. International Food Policy Research Institute Discussion paper, available at <https://www.ifpri.org/publication/assessing-impact-agricultural-research-poverty-using-sustainable-livelihoods-framework>; last accessed 23rd July 2023.
- Addae, E. A. (2020). The mediating role of social capital in the relationship between socioeconomic status and adolescent wellbeing: evidence from Ghana. *BMC public health*, 20(1), 1-11.
- Addai, I., Opoku-Agyeman, C., & Amanfu, S. K. (2014a). Exploring predictors of subjective well-being in Ghana: A micro-level study. *Journal of Happiness Studies*, 15(4), 869-890.
- Addai, I., & Adjei, J. (2014b). Predictors of self-appraised health status in sub-Saharan Africa: The case of Ghana. *Applied Research in Quality of Life*, 9(2), 233-253.
- Addai, I., Opoku-Agyeman, C., & Amanfu, S. K. (2015). Marriage and subjective well-being in Ghana. *African Review of Economics and Finance*, 7(1), 53-79.
- Addison, T., Hulme, D., & Kanbur, R. (2008). *Poverty dynamics: measurement and understanding from an interdisciplinary perspective*. Brooks World Poverty Institute Working Paper No.19.

- Addo, K. (2015). Assessment of the Volta delta shoreline change. *J Coast Zone Manag*, 18(3), 1-6.
- Addo, K. A., & Addo, I. A. (2016). Coastal erosion management in Accra: Combining local knowledge and empirical research. *Jàmbá: Journal of Disaster Risk Studies*, 8(1), 1-10.
- Addo, K. A. (2018). *Ghana's coastline, swallowed by the sea*. <https://en.unesco.org/courier/2021-1/ghanas-coastline-swallowed-sea>, last accessed 25th July 2024.
- Addo, K. A., Nicholls, R. J., Codjoe, S. N. A., & Abu, M. (2018a). A biophysical and socioeconomic review of the Volta delta, Ghana. *Journal of Coastal Research*, 34(5), 1216-1226.
- Addo, K. A., Jayson-Quashigah, P.-N., Codjoe, S. N. A., & Martey, F. (2018b). Drone as a tool for coastal flood monitoring in the Volta Delta, Ghana. *Geoenvironmental Disasters*, 5(1), 1-13.
- Adelekan, I. O. (2000). A survey of rainstorms as weather hazards in southern Nigeria. *Environmentalist*, 20, 33-39.
- Adger, W. N. (2010). Climate change, human well-being and insecurity. *New Political Economy*, 15(2), 275-292.
- Adger, W. N., Barnett, J., Brown, K., Marshall, N., & O'Brien, K. (2013). Cultural dimensions of climate change impacts and adaptation. *Nature climate change*, 3(2), 112-117.
- Adger, W. N., Kelly, P. M., Winkels, A., Huy, L. Q., & Locke, C. (2002). Migration, remittances, livelihood trajectories, and social resilience. *AMBIO: A Journal of the Human Environment*, 31(4), 358-366.
- Adger, W. N., Safra de Campos, R., Siddiqui, T., & Szaboova, L. (2020). Commentary: Inequality, precarity and sustainable ecosystems as elements of urban resilience. *Urban Studies*, 57(7), 1588-1595.
- Adisah-Atta, I. (2017). Financing health care in Ghana: are Ghanaians willing to pay higher taxes for better health care? Findings from Afrobarometer. *Social Sciences*, 6(3), 90.
- Adjargo, G. (2012). Social capital: an indispensable resource in Ghana. *Journal of sustainable development in Africa*, 14(3), 219-227.
- Adjasi, C. K., & Osei, K. A. (2007). Poverty profile and correlates of poverty in Ghana. *International Journal of Social Economics*, 34(7), 449-471.
- Adjei, P. O.-W., & Kyei, P. O. (2013). Linkages between income, housing quality and disease occurrence in rural Ghana. *Journal of housing and the built environment*, 28(1), 35-49.
- Adjei, P. O.-W., Ofori-Danson, P., Asenso, J. K., Asmoah, E., & Amponsah, S. K. (2018). *Climate change and livelihood sustainability threats in the Volta Delta of Ghana*. <https://generic.wordpress.soton.ac.uk/deccma/wp-content/uploads/sites/181/2017/07/Prince-poster-Climate-Change-and-Livelihood-Sustainability.pdf>, last accessed 25th July 2024.
- Adler, A., & Seligman, M. E. (2016). Using wellbeing for public policy: Theory, measurement, and recommendations. *International journal of wellbeing*, 6(1).
- Adler, K. F. (2015). *Natural disasters as a catalyst for social capital: A study of the 500-year flood in Cedar Rapids, Iowa*. Rowman & Littlefield.
- Adu-Ampong, E. A., & Adams, E. A. (2020). "But you are also Ghanaian, you should know": Negotiating the insider-outsider research positionality in the fieldwork encounter. *Qualitative Inquiry*, 26(6), 583-592.
- Afful, C. F., Hejkrlik, J., & Doucha, T. (2015). Rural banking in Ghana and its impact on rural farmers. Case study of the Birim South District, Ghana. *Asian Social Science*, 11(25), 101.
- Afful-Mensah, G., Nketiah-Amponsah, E., & Boakye-Yiadom, L. (2014). Rural-urban differences in the utilization of maternal healthcare in Ghana: the case of antenatal and delivery services. *African social science review*, 6(1), 4.
- Afranaa Kwapong, N., & Hanisch, M. (2013). Cooperatives and poverty reduction: A literature review. *Journal of rural cooperation*, 41(886-2016-64714), 114-146.
- Afriyie, K., Ganle, J. K., & Santos, E. (2018). 'The floods came and we lost everything': weather extremes and households' asset vulnerability and adaptation in rural Ghana. *Climate and Development*, 10(3), 259-274.

- Agarwala, M., Atkinson, G., Fry, B. P., Homewood, K., Mourato, S., Rowcliffe, J. M., Wallace, G., & Milner-Gulland, E. (2014). Assessing the relationship between human well-being and ecosystem services: a review of frameworks. *Conservation and Society*, 12(4), 437-449.
- Agbove, P. (2022). *Four bloodied as gunshots add salt to injury in controversial Ada salt mining project*. <https://thefourthstategh.com/2022/09/15/four-bloodied-as-gunshots-add-salt-to-injury-in-controversial-ada-salt-mining-project/>, last accessed 2nd August 2023.
- Ager, A., Bancroft, C., Berger, E., & Stark, L. (2018). Local constructions of gender-based violence amongst IDPs in northern Uganda: analysis of archival data collected using a gender-and age-segmented participatory ranking methodology. *Conflict and health*, 12, 1-10.
- Agresti, A., & Finlay, B. (2009). *Statistical methods for the social sciences*. Pearson.
- Aguilar, G. R., & Sumner, A. (2020). Who are the world's poor? A new profile of global multidimensional poverty. *World Development*, 126, 104716.
- Agyapong, F. O., Agyapong, A., & Poku, K. (2017). Nexus between social capital and performance of micro and small firms in an emerging economy: The mediating role of innovation. *Cogent Business & Management*, 4(1), 1309784.
- Agyarko, K., Adu, J., Gyasi, D., Kumi, S., & Mensah, L. (2012). Soil Erosion around Foundations of Houses in Four Communities in Ghana. *Open Journal of Soil Science*, 2(01), 28.
- Agyei, Y. A., Kumi, E., & Yeboah, T. (2016). Is better to be a kayayei than to be unemployed: reflecting on the role of head portering in Ghana's informal economy. *GeoJournal*, 81(2), 293-318.
- Ahadzie, D. K., & Proverbs, D. G. (2011). Emerging issues in the management of floods in Ghana. *International Journal of Safety and Security Engineering*, 1(2), 182-192.
- Ahmad Yahaya, M., Shimelis, H., Nebie, B., Ojiewo, C. O., & Danso-Abbeam, G. (2022). Sorghum production in Nigeria: Opportunities, constraints, and recommendations. *Acta Agriculturae Scandinavica, Section B—Soil & Plant Science*, 72(1), 660-672.
- Ahmed, A., Nahian, M. A., Hutton, C. W., & Lázár, A. N. (2018). Hypertension and malnutrition as health outcomes related to ecosystem services. In Nicholls, R., Hutton, C., Adger, N., Hanson, S., Rahman, M. & Salehin, M. (eds) *Ecosystem Services for Well-Being in Deltas* (pp. 505-521). Palgrave Macmillan, Cham.
- Ahmed, A., Dompheh, E., & Gasparatos, A. (2019). Human wellbeing outcomes of involvement in industrial crop production: Evidence from sugarcane, oil palm and jatropha sites in Ghana. *Plos one*, 14(4), e0215433.
- Ahmed, B. N. (2013). *Poor but Happy? Understanding Happiness in Bangladesh*. A research paper produced for the International Institute of Social Studies.
- Ahmed, I., & Jena, A. K. (2023). Using Non-Parametric Kruskal-Wallis H Test for Assessing Mean Differences in the Opinion of Environmental Sustainability. *Online Submission*, 5(1), 74-80.
- Akay, A., & Martinsson, P. (2011). Does relative income matter for the very poor? Evidence from rural Ethiopia. *Economics Letters*, 110(3), 213-215.
- Akintola, O. (2006). Gendered home-based care in South Africa: more trouble for the troubled. *African journal of AIDS research*, 5(3), 237-247.
- Akoglu, H. (2018). User's guide to correlation coefficients. *Turkish journal of emergency medicine*, 18(3), 91-93.
- Alam, E., & Mallick, B. (2022). Climate change perceptions, impacts and adaptation practices of fishers in southeast Bangladesh coast. *International Journal of Climate Change Strategies and Management*, 14(2), 191-211.
- Albrecht, G., Sartore, G.-M., Connor, L., Higginbotham, N., Freeman, S., Kelly, B., Stain, H., Tonna, A., & Pollard, G. (2007). Solastalgia: the distress caused by environmental change. *Australasian psychiatry*, 15(sup1), S95-S98.
- Alcamo, J. (2003). *Ecosystems and Human Well-being: A Framework for Assessment*. Island Press, Washington DC.

- Alem, Y., & Colmer, J. (2013). *Optimal expectations and the welfare cost of climate variability: A subjective well-being approach*. Centre for Climate Change Economics and Policy Working Paper No. 138.
- Alem, Y., Köhlin, G., & Stage, J. (2014). The persistence of subjective poverty in urban Ethiopia. *World Development*, 56, 51-61.
- Alesina, A., Di Tella, R., & MacCulloch, R. (2004). Inequality and happiness: are Europeans and Americans different? *Journal of public economics*, 88(9-10), 2009-2042.
- Alguezaui, S., & Filieri, R. (2010). Investigating the role of social capital in innovation: sparse versus dense network. *Journal of knowledge management*, 14(6), 891-909.
- Al-Hassan, R. M., & Diao, X. (2007). Regional disparities in Ghana: Policy options and public investment implications. International Food Policy Research Institute (IFPRI) discussion Paper No. 00693
- Alkire, S. & Santos, M. E. (2010). Acute multidimensional poverty: A new index for developing countries, Oxford Poverty & Human Development Initiative (OPHI) Working Paper No.38, University of Oxford.
- Alkire, S., & Fang, Y. (2019). Dynamics of multidimensional poverty and uni-dimensional income poverty: An evidence of stability analysis from China. *Social indicators research*, 142(1), 25-64.
- Alkire, S., & Foster, J. (2011). Counting and multidimensional poverty measurement. *Journal of public economics*, 95(7-8), 476-487.
- Alkire, S., Roche, J. M., Ballon, P., Foster, J., Santos, M. E., & Seth, S. (2015). *Multidimensional poverty measurement and analysis*. Oxford University Press.
- Allan, J. (1997). Household demand for improved sanitation. A paper produced from the 23rd Water Engineering and Development Centre (WEDC) Conference, Durban, South Africa.
- Almar, R., Kestenare, E., Reyns, J., Jouanno, J., Anthony, E., Laibi, R., Hemer, M., Du Penhoat, Y., & Ranasinghe, R. (2015). Response of the Bight of Benin (Gulf of Guinea, West Africa) coastline to anthropogenic and natural forcing, Part1: Wave climate variability and impacts on the longshore sediment transport. *Continental Shelf Research*, 110, 48-59.
- Althor, G., Watson, J. E., & Fuller, R. A. (2016). Global mismatch between greenhouse gas emissions and the burden of climate change. *Scientific reports*, 6(1), 20281.
- Althor, G., & Witt, B. (2020). A quantitative systematic review of distributive environmental justice literature: a rich history and the need for an enterprising future. *Journal of Environmental Studies and Sciences*, 10(1), 91-103.
- Amankwaa, E. F., & Gough, K. V. (2023). 'We are at the mercy of the floods!': Extreme weather events, disrupted mobilities, and everyday navigation in urban Ghana. *Singapore Journal of Tropical Geography*, 44(2), 235-254.
- Amegbor, P. M., Braimah, J. A., Adjaye-Gbewonyo, D., Rosenberg, M. W., & Sabel, C. E. (2020). Effect of cognitive and structural social capital on depression among older adults in Ghana: A multilevel cross-sectional analysis. *Archives of Gerontology and Geriatrics*, 89, 104045.
- Amoah, A. S., Forson, A. G., & Boakye, D. A. (2012). A review of epidemiological studies of asthma in Ghana. *Ghana medical journal*, 46(2), 23-28.
- Amoah, P. A., Nyamekye, K. A., & Owusu-Addo, E. (2021). A multidimensional study of public satisfaction with the healthcare system: a mixed-method inquiry in Ghana. *BMC Health Services Research*, 21(1), 1320.
- Amoako, C. (2012). Emerging issues in urban flooding in African cities-The Case of Accra, Ghana. Proceedings from the 35th African Studies Association of Australasia and the Pacific (AFSAAP) annual conference.
- Amoako, C., Doe, B., & Adamtey, R. (2021a). Flood Responses and Attachment to Place Within Low-Income Neighbourhoods in Kumasi, Ghana. *African Geographical Review*, 1-13.
- Amoako, Y. A., Ackam, N., Omuojine, J.-P., Oppong, M. N., Owusu-Ansah, A. G., Abass, M. K., Amofa, G., Ofori, E., Frimpong, M., & Bailey, F. (2021b). *Caregiver burden in Buruli ulcer disease: Evidence from Ghana*. *PLoS neglected tropical diseases*, 15(6), e0009454.

- Ampim, P. A., Ogbe, M., Obeng, E., Akley, E. K., & MacCarthy, D. S. (2021). Land Cover Changes in Ghana over the Past 24 Years. *Sustainability*, 13(9), 4951.
- Amuakwa-Mensah, F., Boakye-Yiadom, L., & Baah-Boateng, W. (2016). Effect of education on migration decisions in Ghana: A rural-urban perspective. *Journal of Economic Studies*, 43(2), 336-356.
- Anarfi, K., Hill, R. A., & Shiel, C. (2020). Highlighting the sustainability implications of urbanisation: A comparative analysis of two urban areas in Ghana. *Land*, 9(9), 300.
- Anarfi, K., Shiel, C., & Hill, R. A. (2022). The public's perspectives of urban sustainability: A comparative analysis of two urban areas in Ghana. *Habitat International*, 121, 102496.
- Andah, W. E., van de Giesen, N., & Biney, C. A. (2003). Water, climate, food, and environment in the Volta Basin. *Contribution to the project ADAPT. Adaptation strategies to changing environments*. <https://www.weap21.org/downloads/ADAPTVolta.pdf>, last accessed 25th July 2024.
- Andersson, L. (2012). Migration, remittances and household welfare in Ethiopia. *Migration*, 4, 1-40.
- Angelsen, A., & Wunder, S. (2003). Exploring the forest-poverty link. *CIFOR occasional paper*, 40, 1-20.
- Angnuureng, B., Appeaning Addo, K., & Wiawe, G. (2013). Impact of sea defense structures on downdrift coasts: The case of Keta in Ghana. *Academia Journal of Environmental Sciences*, 1(6), 104-121.
- Angulo, R., Díaz, Y., & Pardo, R. (2016). The Colombian multidimensional poverty index: Measuring poverty in a public policy context. *Social indicators research*, 127(1), 1-38.
- Aniah, P., Wedam, E., Pukunyiem, M., & Yinimi, G. (2013). Erosion and livelihood change in North East Ghana: A look into the bowl. *International journal of sciences: Basic and applied research*, 7(1), 28-35.
- Anim, D. O., Nkrumah, P. N., & David, N. M. (2013). A rapid overview of coastal erosion in Ghana. *International Journal of Scientific & Engineering Research*, 4(2), 1-7.
- Ansah, E. K., Gyapong, M., Narh-Bana, S., Bart-Plange, C., & Whitty, C. J. (2016). Factors influencing choice of care-seeking for acute fever comparing private chemical shops with health centres and hospitals in Ghana: a study using case-control methodology. *Malaria journal*, 15(1), 1-9.
- Anthonj, C., Rechenburg, A., & Kistemann, T. (2018). The impact of water on health and ill-health in a sub-Saharan wetland: Exploring both sides of a coin, 624, 1411-1420.
- Antwi-Agyei, P., Dougill, A. J., Fraser, E. D., & Stringer, L. C. (2013). Characterising the nature of household vulnerability to climate variability: empirical evidence from two regions of Ghana. *Environment, development and sustainability*, 15(4), 903-926.
- Antwi-Agyei, P., Stringer, L. C., & Dougill, A. J. (2014). Livelihood adaptations to climate variability: insights from farming households in Ghana. *Regional Environmental Change*, 14(4), 1615-1626.
- Antwi-Agyei, P., Dougill, A. J., Stringer, L. C., & Codjoe, S. N. A. (2018). Adaptation opportunities and maladaptive outcomes in climate vulnerability hotspots of northern Ghana. *Climate Risk Management*, 19, 83-93.
- Antwi-Agyei, P., & Stringer, L. C. (2021). Improving the effectiveness of agricultural extension services in supporting farmers to adapt to climate change: Insights from northeastern Ghana. *Climate Risk Management*, 32, 100304.
- Anyanwu, J. C. (2014). Marital status, household size and poverty in Nigeria: evidence from the 2009/2010 survey data. *African Development Review*, 26(1), 118-137.
- Anyidoho, N. A., Leavy, J., & Asenso-Okyere, K. (2012). Perceptions and aspirations: a case study of young people in Ghana's cocoa sector. *Ids Bulletin*, 43(6), 20-32.
- Anyidoho, N. A., Leavy, J., & Asenso-Okyere, K. (2012). Young People's Aspirations in Agriculture: A Case Study of Ghana's Cocoa Sector. A paper produced for the "Young People, Farming and Food": International Conference on the Future of the Agrifood Sector, University of Ghana, Legon, 19-20th March 2012.
- Apatinga, G. A., Kyeremeh, E. K., & Arku, G. (2022). 'Feminization of migration': the implications for 'left-behind' families in Ghana. *Migration and Development*, 11(1), 83-100.

- Appadurai, A. (2004). The capacity to aspire: Culture and the terms of recognition. *Culture and public action*, 59, 62-63.
- Appiah, R., Wilson Fadji, A., Wissing, M. P., & Schutte, L. (2022). The inspired life program: development of a multicomponent positive psychology intervention for rural adults in Ghana. *Journal of Community Psychology*, 50(1), 302-328.
- Araujo, C. (2003). Participation in off-farm employment in rural Mexico: The role of individual attributes, the local context, and social networks. Paper produced by the Department of Agricultural and Resource Economics University of California, Berkeley.
- Aref, A. (2011). Perceived impact of education on poverty reduction in rural areas of Iran. *Life Science Journal*, 8(2), 498-501.
- Arias-Arévalo, P., Gómez-Baggethun, E., Martín-López, B., & Pérez-Rincón, M. (2018). Widening the evaluative space for ecosystem services: A taxonomy of plural values and valuation methods. *Environmental values*, 27(1), 29-53.
- Arku, C., & Arku, F. S. (2009). More money, new household cultural dynamics: Women in micro-finance in Ghana. *Development in practice*, 19(2), 200-213.
- Armah, F. A., Yawson, D. O., & Pappoe, A. A. (2010). A systems dynamics approach to explore traffic congestion and air pollution link in the city of Accra, Ghana. *Sustainability*, 2(1), 252-265.
- Armah, F. A., Odoi, J. O., & Luginaah, I. (2015). Indoor air pollution and health in Ghana: Self-reported exposure to unprocessed solid fuel smoke. *EcoHealth*, 12(2), 227-243.
- Arnáez, J., Lana-Renault, N., Lasanta, T., Ruiz-Flaño, P., & Castroviejo, J. (2015). Effects of farming terraces on hydrological and geomorphological processes. A review. *Catena*, 128, 122-134.
- Arndt, C., & Tarp, F. (2016). *Measuring poverty and wellbeing in developing countries*. Oxford University Press.
- Arndt, C., Mahrt, K., & Tarp, F. (2016). Absolute poverty lines. In Arndt, C & Tarp, F. (eds) *Measuring Poverty and Wellbeing in Developing Countries* (pp.10-23), Oxford University Press.
- Artha, D. R. P., & Dartanto, T. (2018). The multidimensional approach to poverty measurement in Indonesia: Measurements, determinants and its policy implications. *Journal of Economic Cooperation & Development*, 39(3), 1-38.
- Arthur, G. A., & Turkson, D. (2021). The Welfare Impact of Household Loans: An Analysis for Ghana. *Grace Araba Arthur, and Danny Turkson, "The Welfare Impact of Household Loans: An Analysis for Ghana."* *Journal of Finance and Economics*, 9(2), 83-92.
- Arto, I., Cazcarro, I., Markandya, A., Hazra, S., Bhattacharya, R. N. & Adjei, P. O.-W. (2020). Delta economics and sustainability. In: Nicholls, R., Adger, N., Hutton, C. & Hanson, S. (eds) *Deltas in the Anthropocene* (pp. 179-200), Palgrave Macmillan, Cham.
- Asante, F. A., & Amuakwa-Mensah, F. (2015). Climate change and variability in Ghana: Stocktaking. *Climate*, 3(1), 78-99.
- Asare, E. O., & Amekudzi, L. K. (2017). Assessing climate driven malaria variability in Ghana using a regional scale dynamical model. *Climate*, 5(1), 20.
- Asare-Nuamah, P. (2021). Climate variability, subsistence agriculture and household food security in rural Ghana. *Heliyon*, 7(4), e06928.
- Asare-Nuamah, P., Dick-Sagoe, C., & Ayivor, R. (2021). Farmers' maladaptation: Eroding sustainable development, rebounding and shifting vulnerability in smallholder agriculture system. *Environmental Development*, 40, 100680.
- Ashiagbor, G., Ofori-Asenso, R., Forkuo, E. K., & Agyei-Frimpong, S. (2020). Measures of geographic accessibility to health care in the Ashanti Region of Ghana. *Scientific African*, 9, e00453.
- Asiedu, E., & Chimbar, N. (2020). Impact of remittances on male and female labor force participation patterns in Africa: Quasi-experimental evidence from Ghana. *Review of Development Economics*, 24(3), 1009-1026.

- Asitik, A. J. (2015). Culture and rural entrepreneurship in northern Ghana. *Humanities and Social Sciences Review*, 4(2), 239-252.
- Asomani-Boateng, R., Fricano, R. J., & Adarkwa, F. (2015). Assessing the socio-economic impacts of rural road improvements in Ghana: A case study of transport sector program support (II). *Case Studies on Transport Policy*, 3(4), 355-366.
- Assan, E., Suvedi, M., Schmitt Olabisi, L., & Allen, A. (2018). Coping with and adapting to climate change: A gender perspective from smallholder farming in Ghana. *Environments*, 5(8), 86.
- Atiglo, D. Y., & Codjoe, N. (2015). *Migration in the Volta Delta: A Review of Relevant Literature*. A DECCMA Working Paper IDRC Project Number 107642. https://www.researchgate.net/profile/D-Yaw-Atiglo/publication/325426162_Migration_in_the_Volta_Delta_a_review_of_the_literature/links/5b0d762aa6fdcc8c253aa71c/Migration-in-the-Volta-Delta-a-review-of-the-literature.pdf, last accessed 25th July 2024.
- Atiglo, D. (2017). Gender, Vulnerability to Environmental Change and Migration in the Volta Delta, Ghana, a PhD thesis submitted to the University of Ghana.
- Atiglo, D. Y., & Codjoe, S. N. A. (2017). Place attachment: a critical link between vulnerability to environmental change and (im)mobility in the Volta Delta of Ghana. A paper produced for the 2017 International Population Conference.
- Atiglo, D. Y., Abu, M., Jayson-Quashigah, P.-N., Addo, K. A., & Codjoe, S. N. A. (2022). Sociodemographic and geophysical determinants of household vulnerability to coastal hazards in the Volta Delta, Ghana. *International Journal of Disaster Risk Reduction*, 78, 103146.
- Atkinson, A. B. (2019). *Measuring poverty around the world*. Princeton University Press.
- Atkinson, S. (2013). Beyond components of wellbeing: The effects of relational and situated assemblage. *Topoi*, 32(2), 137-144.
- Atsebi, J.-M. B., & Ferrer-i-Carbonell, A. (2022). Relative deprivation in Tanzania: Relative concerns and empathy. *Journal of Economic Behavior & Organization*, 198, 389-408.
- Atta-Mills, J., Alder, J., & Rashid Sumaila, U. (2004). The decline of a regional fishing nation: the case of Ghana and West Africa. *Natural Resources Forum*, 28, 13-21.
- Atta-Quayson, A. (2023). New Extractivism in Ghana's Salt Sector. *Cosmopolitan Civil Societies: An Interdisciplinary Journal*, 15(1), 19-32.
- Avogo, W. A. (2013). Social capital, civic engagement, and self-rated health in Ghana. *African Population Studies*, 27(2), 188-202.
- Awadzi, T., Ahiabor, E., & Breuning-Madsen, H. (2008). The soil-land use system in a sand spit area in the semi-arid coastal savanna region of Ghana—development, sustainability and threats. *West African journal of applied ecology*, 13(1), 132-143.
- Awanyo, L., & Attua, E. M. (2018). A paradox of three decades of neoliberal economic reforms in Ghana: A tale of economic growth and uneven regional development. *African Geographical Review*, 37(3), 173-191.
- Awuah, E., Nyarko, K., & Owusu, P. (2009). Water and sanitation in Ghana. *Desalination*, 248(1-3), 460-467.
- Awumbila, M. (2015). Women moving within borders: Gender and internal migration dynamics in Ghana. *Ghana Journal of Geography*, 7(2), 132-145.
- Awumbila, M., Teye, J. K., & Yaro, J. A. (2017). Social networks, migration trajectories and livelihood strategies of migrant domestic and construction workers in Accra, Ghana. *Journal of Asian and African Studies*, 52(7), 982-996.
- Awuse, N., Offi, P. T., & Acakpovi, A. (2020). Internal migration and poverty reduction in Ghana. *International Journal of Technology and Management Research*, 5(1), 72-90.
- Ayanoore, I., & Hickey, S. (2022). Reframing the politics of natural resource governance in Africa: Insights from the local content legislation process in Ghana. *Politics & Policy*, 50(1), 119-136.

- Ayentimi, D. T., Hinson, R. E., & Burgess, J. (2021). Cultivating social capital: an exploratory analysis of business postgraduates in Ghana. *Education+ Training*, 63(9), 1225-1241.
- Ayerakwa, H. M., Osei, R. D., & Osei-Akoto, I. (2015). *Poverty and happiness: An examination of the factors influencing happiness among the extreme poor in rural Ghana*. United Nations University (UNU), World Institute for Development Economics Research (WIDER) Working Paper, No. 2015/034
- Azomahou, T. T., & Yitbarek, E. A. (2016). Intergenerational education mobility in Africa: Has progress been inclusive? World Bank Policy Research Working Paper No. 7843.
- Azongo, D. K., Awine, T., Wak, G., Binka, F. N., & Rexford Oduro, A. (2012). A time series analysis of weather variables and all-cause mortality in the Kasena-Nankana Districts of Northern Ghana, 1995–2010. *Global health action*, 5(1), 19073.
- Baah-Boateng, W. (2013). Determinants of unemployment in Ghana. *African Development Review*, 25(4), 385-399.
- Babcicky, P., & Seebauer, S. (2017). The two faces of social capital in private flood mitigation: Opposing effects on risk perception, self-efficacy and coping capacity. *Journal of Risk Research*, 20(8), 1017-1037.
- Backlund, E., Sorlie, P. D., & Johnson, N. J. (1999). A comparison of the relationships of education and income with mortality: the National Longitudinal Mortality Study. *Social Science & Medicine*, 49(10), 1373-1384.
- Badu, E., Owusu-Manu, D. G., Edwards, D. J., Adesi, M., & Lichtenstein, S. (2013). Rural infrastructure development in the Volta region of Ghana: barriers and interventions. *Journal of financial management of Property and Construction*, 18(2), 142-159.
- Baffour-Ata, F., Antwi-Agyei, P., & Nkiaka, E. (2021). Climate Variability, Land Cover Changes and Livelihoods of Communities on the Fringes of Bobiri Forest Reserve, Ghana. *Forests*, 12(3), 278.
- Ballas, D., Dorling, D., & Shaw, M. (2007). Societal inequality, health and well-being. In Haworth, J and Hart, G (eds) *Well-Being: individual, community, and social perspective* (pp. 163-186). Springer.
- Balzan, M. V., Zulian, G., Maes, J., & Borg, M. (2021). Assessing urban ecosystem services to prioritise nature-based solutions in a high-density urban area. *Nature-Based Solutions*, 1, 100007.
- Bandauko, E., Kutor, S. K., & Arku, G. (2022). To leave or not to leave? An analysis of individual and neighbourhood characteristics shaping place attachment in Harare's selected informal settlements. *The Canadian Geographer/Le Géographe canadien*, 66(3), 524-541.
- Banerjee, S. B., & Jackson, L. (2017). Microfinance and the business of poverty reduction: Critical perspectives from rural Bangladesh. *Human relations*, 70(1), 63-91.
- Bangura, A. K. (2005). Ubuntu pedagogy: An African educational paradigm that transcends pedagogy, andragogy, ergonagy and heutagogy. *Journal of third world studies*, 22(2), 13-53.
- Barbier, E. B. (2000). The economic linkages between rural poverty and land degradation: some evidence from Africa. *Agriculture, ecosystems & environment*, 82(1-3), 355-370.
- Barbier, E. B., & Hochard, J. P. (2016). Does land degradation increase poverty in developing countries? *Plos one*, 11(5), e0152973.
- Barbier, E. B., & Hochard, J. P. (2018). Land degradation and poverty. *Nature Sustainability*, 1(11), 623-631.
- Barrett, C. B., & Bevis, L. E. (2015). The self-reinforcing feedback between low soil fertility and chronic poverty. *Nature Geoscience*, 8(12), 907-912.
- Barrett, D., & Twycross, A. (2018). Data collection in qualitative research. *Evidenced Based Nursing*, 3, 63-64.
- Barton, T. G. (1997). *Our people, our resources: Supporting rural communities in participatory action research on population dynamics and the local environment*. IUCN Publishing.
- Baruah, C., & Hussain, D. (2021). The Dynamics of Subjective Well-Being Among Recurrent Flood Victims: Development and Testing of an Integrated Model. *The European Journal of Counselling Psychology*, 9(1), 51-65.

- Bashir, S. A. (2002). Home is where the harm is: inadequate housing as a public health crisis. *American journal of public health*, 92(5), 733-738.
- Bassachs, M., Cañabate, D., Serra, T., & Colomer, J. (2020). Interdisciplinary cooperative educational approaches to foster knowledge and competences for sustainable development. *Sustainability*, 12(20), 8624.
- Batana, Y. M. & Cockburn, J. (2018). Do demographics matter for African child poverty? World Bank Policy Research Working Paper no. 8426.
- Bayor, I. (2010). *Community Participation in Poverty Reduction Interventions: Examining the Factors that impact on the Community-Based Organisation (CBO) Empowerment Project in Ghana*. A paper produced within the School of Government, Faculty of Economics and Management Science, University of the Western Cape, Bellville – Cape Town, South Africa, https://etd.uwc.ac.za/bitstream/handle/11394/2637/Bayor%20_MPA_2010.pdf?sequence=1&isAllowed=y, last accessed 25th July 2024.
- Bayulgen, O. (2013). Giving credit where credit is due: can access to credit be justified as a new economic right? *Journal of Human Rights*, 12(4), 491-510.
- Beery, T., Jönsson, K. I., & Elmberg, J. (2015). From environmental connectedness to sustainable futures: Topophilia and human affiliation with nature. *Sustainability*, 7(7), 8837-8854.
- Behnke, N. L., Klug, T., Cronk, R., Shields, K. F., Lee, K., Kelly, E. R., Allgood, G., & Bartram, J. (2017). Resource mobilization for community-managed rural water systems: Evidence from Ghana, Kenya, and Zambia. *Journal of Cleaner Production*, 156, 437-444.
- Belton, B. (2016). Shrimp, prawn and the political economy of social wellbeing in rural Bangladesh. *Journal of Rural Studies*, 45, 230-242.
- Bempah, S. A., & Øyhus, A. O. (2017). The role of social perception in disaster risk reduction: Beliefs, perception, and attitudes regarding flood disasters in communities along the Volta River, Ghana. *International Journal of Disaster Risk Reduction*, 23, 104-108.
- Béné, C., & Friend, R. M. (2011). Poverty in small-scale fisheries: old issue, new analysis. *Progress in Development Studies*, 11(2), 119-144.
- Benito, G., Rohde, R., Seely, M., Külls, C., Dahan, O., Enzel, Y., Todd, S., Botero, B., Morin, E., Grodek, T., & Roberts, C. (2010). Management of Alluvial Aquifers in Two Southern African Ephemeral Rivers: Implications for IWRM. *Water Resources Management*, 24(4), 641-667.
- Benjamin, D. (2023). Adjusting for Scale-Use Heterogeneity in Self-Reported Well-Being. National Bureau of Economic Research Working Paper 31728.
- Berchoux, T., & Hutton, C. W. (2019). Spatial associations between household and community livelihood capitals in rural territories: An example from the Mahanadi Delta, India. *Applied Geography*, 103, 98-111.
- Berg, M., & Veenhoven, R. (2010). Income inequality and happiness in 119 nations: In search for an optimum that does not appear to exist. In Greve, B., (ed.) *Social Policy and Happiness in Europe* (pp.174-194). Edward Elgar Publishing, Cheltenham.
- Betley, E. C., Sigouin, A., Pascua, P. a., Cheng, S. H., MacDonald, K. I., Arengo, F., Aumeeruddy-Thomas, Y., Caillon, S., Isaac, M. E., & Jupiter, S. D. (2022). Assessing human well-being constructs with environmental and equity aspects: A review of the landscape. *People and Nature*, 5(6), 1756-1773.
- Betti, G., Dourmashkin, N., Rossi, M., & Yin, Y. P. (2007). Consumer over-indebtedness in the EU: measurement and characteristics. *Journal of Economic Studies*, 34(2), 136-156.
- Bhandari, P. (2004). Relative deprivation and migration in an agricultural setting of Nepal. *Population and Environment*, 25(5), 475-499.
- Bhattacharya, H., & Innes, R. (2013). Income and the environment in rural India: Is there a poverty trap? *American Journal of Agricultural Economics*, 95(1), 42-69.
- Bhuiyan, M. F., & Ivlevs, A. (2019). Micro-entrepreneurship and subjective well-being: Evidence from rural Bangladesh. *Journal of Business Venturing*, 34(4), 625-645.

- Bibi, S. (2005). Measuring poverty in a multidimensional perspective: A review of literature. PMMA Working Paper 2005-07. <https://idl-bnc-idrc.dspacedirect.org/server/api/core/bitstreams/071bcc81-959a-479a-a3be-1c75b7c6cf56/content>, last accessed 25th July 2024.
- Biewen, M. (2009). Measuring state dependence in individual poverty histories when there is feedback to employment status and household composition. *Journal of Applied Econometrics*, 24(7), 1095-1116.
- Bigsten, A., & Shimeles, A. (2011). The persistence of urban poverty in Ethiopia: A tale of two measurements. *Applied Economics Letters*, 18(9), 835-839.
- Bimrah, K., Dasgupta, R., & Saizen, I. (2022). Cultural ecosystem services of mangroves: a review of models and methods. In: Dasgupta, R., Hashimoto, S. & Saito, O. (eds) *Assessing, Mapping and Modelling of Mangrove Ecosystem Services in the Asia-Pacific Region* (pp. 239-250), Springer Singapore.
- Bird, K., Hulme, D., Shepherd, A., & Moore, K. (2002). Chronic poverty and remote rural areas. Chronic Poverty Research Centre Working Paper No. 13.
- Bird, K., & Shepherd, A. (2003). Livelihoods and chronic poverty in semi-arid Zimbabwe. *World Development*, 31(3), 591-610.
- Bird, K., Higgins, K. & Harris, D. (2010). Spatial poverty traps: An overview, an Overseas Development Institute (ODI) Working Paper 321, Chronic Poverty Research Centre (CPRC Working) Paper 161.
- Bisung, E., Kangmennaang, J., & Luginaah, I. (2018). Neighborhood structural differences and women's mental health: an empirical study in Accra, Ghana. *Quality of Life Research*, 27(3), 661-671.
- Bjørnsen, H.-M. (2005). Living conditions and subjective well-being of farmers-An ordered response analysis of regional differences and changes over time. A paper produced from the 45th Congress of the European Regional Science Association: "Land Use and Water Management in a Sustainable Network Society", 23-27 August 2005, Amsterdam, The Netherlands.
- Blackden, C. M., & Wodon, Q. (2006). *Gender, time use, and poverty in sub-Saharan Africa*. World Bank working paper; no. 73 Washington, D.C.
- Blanchflower, D. G. (2021). Is happiness U-shaped everywhere? Age and subjective well-being in 145 countries. *Journal of Population Economics*, 34(2), 575-624.
- Blankespoor, B., Dasgupta, S., & Lange, G.-M. (2017). Mangroves as a protection from storm surges in a changing climate. *Ambio*, 46(4), 478-491.
- Blankson, C., & Nukpezah, J. A. (2019). Market orientation and poverty reduction: A study of rural microentrepreneurs in Ghana. *Africa Journal of Management*, 5(4), 332-357.
- Boachie, M. K., & Ramu, K. (2016). Effect of public health expenditure on health status in Ghana. *International Journal of Health*, 4(1), 6-11.
- Boateng, I. (2009). Development of integrated shoreline management planning: A case study of Keta, Ghana. Proceedings of the Federation of International Surveyors Working Week 2009: Surveyors Key Role in Accelerated Development, TS 4E, Eilat, Israel, 3-8 May.
- Boateng, I. (2012). An application of GIS and coastal geomorphology for large scale assessment of coastal erosion and management: a case study of Ghana. *Journal of Coastal Conservation*, 16(3), 383-397.
- Boateng, P. K. (2017). Land access, agricultural land use changes and narratives about land degradation in the savannahs of northeast Ghana during the pre-colonial and colonial periods. *Social Sciences*, 6(1), 35.
- Bob-Milliar, G., & Sigman, R. (2022). *How Ghana's economic crisis is reshaping its democracy*. <https://www.washingtonpost.com/politics/2022/12/01/how-ghanas-economic-crisis-is-reshaping-its-democracy/>, last accessed 25th July 2024.
- Böhnke, P., & Kohler, U. (2010). Well-being and inequality. In Immerfall, S. & Therborn, G. (eds) *Handbook of European societies* (pp. 629-666). Springer.

- Bookwalter, J. T., & Dalenberg, D. (2004). Subjective well-being and household factors in South Africa. *Social indicators research*, 65(3), 333-353.
- Booyesen, F. (2002). An overview and evaluation of composite indices of development. *Social indicators research*, 59(2), 115-151.
- Borrero, S., Escobar, A. B., Cortés, A. M., & Maya, L. C. (2013). Poor and distressed, but happy: situational and cultural moderators of the relationship between wealth and happiness. *Estudios Gerenciales*, 29(126), 2-11.
- Boscoe, F. P., Henry, K. A., & Zdeb, M. S. (2012). A nationwide comparison of driving distance versus straight-line distance to hospitals. *The Professional Geographer*, 64(2), 188-196.
- Botha, F., & Vera-Toscano, E. (2022). Generational Differences in Subjective Well-Being in Australia. *Applied Research in Quality of Life*, 17(5), 2903-2932.
- Bott, L.-M., Ankel, L., & Braun, B. (2019). Adaptive neighborhoods: The interrelation of urban form, social capital, and responses to coastal hazards in Jakarta. *Geoforum*, 106, 202-213.
- Bouma, J., Bulte, E., & Van Soest, D. (2008). Trust and cooperation: Social capital and community resource management. *Journal of environmental economics and management*, 56(2), 155-166.
- Boval, M., Angeon, V., & Rudel, T. (2017). Tropical grasslands: A pivotal place for a more multi-functional agriculture. *Ambio*, 46(1), 48-56.
- Boyce, J. K. (1994). Inequality as a cause of environmental degradation. *Ecological economics*, 11(3), 169-178.
- Boyce, W., Raja, S., Patranabish, R. G., Bekoe, T., Deme-der, D., & Gallupe, O. (2009). Occupation, poverty and mental health improvement in Ghana. *Alter*, 3(3), 233-244.
- Bradley, R. H. (2012). Rural versus urban environments. In Meyes, L. & Lewis, M (eds) *The Cambridge Handbook of Environment in Human Development* (pp. 330-346), Cambridge University Press.
- Bradshaw, J., & Finch, N. (2003). Overlaps in dimensions of poverty. *Journal of social policy*, 32(4), 513-525.
- Braimah, F. R., & Lawson, E. T. (2014). Does it matter where I live? Comparing the impact of housing quality on child development in slum and non-slum areas in Ghana. *International Journal of Child, Youth and Family Studies*, 5(3), 375-393.
- Braimah, I., & Oduro-Ofori, E. (2005). Basic school dropout in Ghana: a case study of the Amansie West district. *Journal of Science and Technology (Ghana)*, 25(1), 67-76.
- Braimah, M., & Tweneboah-Koduah, E. Y. (2011). An exploratory study of the impact of green brand awareness on consumer purchase decisions in Ghana. *Journal of Marketing Development and Competitiveness*, 5(7), 11-18.
- Brandolini, A. (2009). On applying synthetic indices of multidimensional well-being: health and income inequalities in France, Germany, Italy, and the United Kingdom. In: Gotoh, R. & Dumouchel, P. (eds) *Against injustice: The new economics of Amartya Sen* (pp. 221-251). Cambridge University Press, Cambridge.
- Brecht, H., Dasgupta, S., Laplante, B., Murray, S., & Wheeler, D. (2012). Sea-level rise and storm surges: High stakes for a small number of developing countries. *The Journal of Environment & Development*, 21(1), 120-138.
- Breuste, J., Haase, D., & Elmqvist, T. (2013). Urban landscapes and ecosystem services. *Ecosystem services in agricultural and urban landscapes*, 83-104.
- Brobbe, L. K., Hansen, C. P., Kyereh, B., & Pouliot, M. (2019). The economic importance of charcoal to rural livelihoods: Evidence from a key charcoal-producing area in Ghana. *Forest Policy and Economics*, 101, 19-31.
- Brody, S. D., Zahran, S., Vedlitz, A., & Grover, H. (2008). Examining the relationship between physical vulnerability and public perceptions of global climate change in the United States. *Environment and behavior*, 40(1), 72-95.

- Brown, K. W., & Kasser, T. (2005). Are psychological and ecological well-being compatible? The role of values, mindfulness, and lifestyle. *Social indicators research*, 74, 349-368.
- Brown, K., Schirmer, J., & Upton, P. (2021). Regenerative farming and human wellbeing: Are subjective wellbeing measures useful indicators for sustainable farming systems? *Environmental and Sustainability Indicators*, 11, 100132.
- Brown, O., Hammill, A., & McLeman, R. (2007). Climate change as the 'new' security threat: implications for Africa. *International affairs*, 83(6), 1141-1154.
- Bryman, A. (2006). Integrating quantitative and qualitative research: how is it done? *Qualitative research*, 6(1), 97-113.
- Bryman, A. (2016). *Social research methods*. Oxford University Press.
- Buchel, S., & Frantzeskaki, N. (2015). Citizens' voice: A case study about perceived ecosystem services by urban park users in Rotterdam, the Netherlands. *Ecosystem Services*, 12, 169-177.
- Bugri, J. T. (2008). The dynamics of tenure security, agricultural production and environmental degradation in Africa: Evidence from stakeholders in north-east Ghana. *Land use policy*, 25(2), 271-285.
- Bukari, K. N., Sow, P., & Scheffran, J. (2018). Cooperation and co-existence between farmers and herders in the midst of violent farmer-herder conflicts in Ghana. *African Studies Review*, 61(2), 78-102.
- Bull, T., Duah-Owusu, M., & Autry Andvik, C. (2010). 'My happiest moment is when I have food in stock': Poor women in northern Ghana talking about their happiness. *International Journal of Mental Health Promotion*, 12(2), 24-31.
- Buor, D. (2004a). Determinants of utilisation of health services by women in rural and urban areas in Ghana. *GeoJournal*, 61(1), 89-102.
- Buor, D. (2004b). Water needs and women's health in the Kumasi metropolitan area, Ghana. *Health & place*, 10(1), 85-103.
- Burney, J. A., & Naylor, R. L. (2012). Smallholder irrigation as a poverty alleviation tool in sub-Saharan Africa. *World Development*, 40(1), 110-123.
- Butler, C. D., & Oluoch-Kosura, W. (2006). Linking future ecosystem services and future human well-being. *Ecology and Society*, 11(1).
- Cadag, J. R. D., Petal, M., Luna, E., Gaillard, J., Pambid, L., & Santos, G. V. (2017). Hidden disasters: Recurrent flooding impacts on educational continuity in the Philippines. *International Journal of Disaster Risk Reduction*, 25, 72-81.
- Cai, S., & Wang, J. (2018). Less advantaged, more optimistic? Subjective well-being among rural, migrant and urban populations in contemporary China. *China economic review*, 52, 95-110.
- Calo-Blanco, A., Kovářík, J., Mengel, F., & Romero, J. G. (2017). Natural disasters and indicators of social cohesion. *Plos one*, 12(6), e0176885.
- Calvo-Armengol, A., & Jackson, M. O. (2004). The effects of social networks on employment and inequality. *American Economic Review*, 94(3), 426-454.
- Cardona, O. D., Van Aalst, M. K., Birkmann, J., Fordham, M., Mc Gregor, G., Rosa, P., Pulwarty, R. S., Schipper, E. L. F., Sinh, B. T., & Décamps, H. (2012). Determinants of risk: exposure and vulnerability. In Field, C.B.; Barros, V; Stcoker, T.F; Qin, D; Dokken, D.J; Ebi, K.L; Mastrandrea, M.D; Mach, K.J; Plattner, G-K; Allen, S.K; Tignor, M; Midgley, P.M (eds) *Managing the risks of extreme events and disasters to advance climate change adaptation: special report of the intergovernmental panel on climate change* (pp. 65-108). Cambridge University Press, Cambridge
- Carr, E. R. (2008). Men's crops and women's crops: The importance of gender to the understanding of agricultural and development outcomes in Ghana's central region. *World Development*, 36(5), 900-915.
- Carroll, B., Morbey, H., Balogh, R., & Araoz, G. (2009). Flooded homes, broken bonds, the meaning of home, psychological processes and their impact on psychological health in a disaster. *Health & place*, 15(2), 540-547.

- Castaing, P. (2021). Joint liability and adaptation to climate change: evidence from Burkinabe cooperatives. *European Review of Agricultural Economics*, 48(3), 502-537.
- Castaldo, A., Deshingkar, P., & McKay, A. (2012). Internal migration, remittances and poverty: evidence from Ghana and India. Migrating out of Poverty Research Programme Consortium Working Paper 7.
- Catalan, H. E. N. (2017). Multiple deprivation, severity and latent sub-groups: advantages of factor mixture modelling for analysing material deprivation. *Social indicators research*, 131(2), 681-700.
- Cattaneo, M. D., Galiani, S., Gertler, P. J., Martinez, S., & Titiunik, R. (2009). Housing, health, and happiness. *American Economic Journal: Economic Policy*, 1(1), 75-105.
- Cattell, V. (2001). Poor people, poor places, and poor health: the mediating role of social networks and social capital. *Social Science & Medicine*, 52(10), 1501-1516.
- Cau, B. M., Falcão, J., & Arnaldo, C. (2016). Determinants of poor self-rated health among adults in urban Mozambique. *BMC public health*, 16(1), 1-10.
- Cazcarro, I., Arto, I., Hazra, S., Bhattacharya, R. N., Osei-Wusu Adjei, P., Ofori-Danson, P. K., Asenso, J. K., Amponsah, S. K., Khondker, B., & Raihan, S. (2018). Biophysical and socioeconomic state and links of deltaic areas vulnerable to climate change: Volta (Ghana), Mahanadi (India) and Ganges-Brahmaputra-Meghna (India and Bangladesh). *Sustainability*, 10(3), 893.
- Celentano, D., Rousseau, G. X., Engel, V. L., Façanha, C. L., de Oliveira, E. M., & de Moura, E. G. (2014). Perceptions of environmental change and use of traditional knowledge to plan riparian forest restoration with relocated communities in Alcântara, Eastern Amazon. *Journal of ethnobiology and ethnomedicine*, 10(1), 1-14.
- Cerase, F. P. (1974). Expectations and reality: a case study of return migration from the United States to Southern Italy. *International Migration Review*, 8(2), 245-262.
- Chalise, D., Kumar, L., & Kristiansen, P. (2019). Land degradation by soil erosion in Nepal: a review. *Soil Systems*, 3(1), 12.
- Chamberlin, J. (2007). Defining Smallholders Agriculture in Ghana: Who are smallholders, what do they do and how are they linked with markets? Ghana Strategy Support Program (GSSP) Background Paper No. GSSP 0006.
- Chambers, R., & Conway, G. (1992). Sustainable rural livelihoods: practical concepts for the 21st century. Institute of Development Studies (IDS) Discussion Paper 296. <https://www.ids.ac.uk/download.php?file=files/Dp296.pdf>, last accessed 25th July 2024.
- Chamboko, R., Re, A., & Guvuriro, S. (2017). Mapping patterns of multiple deprivation in Namibia. *International Journal of Social Economics*, 44(12), 2486-2499.
- Chan, C., Armitage, D., Alexander, S. M., & Campbell, D. (2019). Examining linkages between ecosystem services and social wellbeing to improve governance for coastal conservation in Jamaica. *Ecosystem Services*, 39, 100997.
- Chang, H. H., & Chuang, S.-S. (2011). Social capital and individual motivations on knowledge sharing: Participant involvement as a moderator. *Information & management*, 48(1), 9-18.
- Chang, M. S., Khatoon, Z. S., & Shah, S. (2013). Flood disasters and its impacts on child education in Sindh: a case study of 2010 flood. *Int. J. Adv. Res*, 1(3), 329-344.
- Chang, Q., Peng, C., G., Y., C., Z., & Yip, P. S. (2020). Mechanisms connecting objective and subjective poverty to mental health: Serial mediation roles of negative life events and social support. *Social Science & Medicine*, 265(113308).
- Chaudhury, A. S., Thornton, T. F., Helfgott, A., Ventresca, M. J., & Sova, C. (2017). Ties that bind: Local networks, communities and adaptive capacity in rural Ghana. *Journal of Rural Studies*, 53, 214-228.
- Chen, J., Yang, S., Li, H., Zhang, B., & Lv, J. (2013). Research on geographical environment unit division based on the method of natural breaks (Jenks). *Int. Arch. Photogramm. Remote Sens. Spat. Inf. Sci*, 3, 47-50.

- Chen, Y., & Ye, Y. (2014). Effects of salinity and nutrient addition on mangrove *Excoecaria agallocha*. *Plos one*, 9(4), e93337.
- Cheng, X., Shuai, C., Liu, J., Wang, J., Liu, Y., Li, W., & Shuai, J. (2018). Topic modelling of ecology, environment and poverty nexus: An integrated framework. *Agriculture, ecosystems & environment*, 267, 1-14.
- Cheung, L. T., & Hui, D. L. (2018). Influence of residents' place attachment on heritage forest conservation awareness in a peri-urban area of Guangzhou, China. *Urban forestry & urban greening*, 33, 37-45.
- Chhatre, A., & Agrawal, A. (2009). Trade-offs and synergies between carbon storage and livelihood benefits from forest commons. *Proceedings of the National Academy of Sciences*, 106(42), 17667-17670.
- Chiappero-Martinetti, E., & Sabadash, A. (2014). Integrating human capital and human capabilities in understanding the value of education. In Ibrahim, S. & Tiwari, M (eds) *The Capability Approach* (pp. 206-230). Springer.
- Chibvongodze, D. T. (2016). Ubuntu is not only about the human! An analysis of the role of African philosophy and ethics in environment management. *Journal of Human ecology*, 53(2), 157-166.
- Chowdhury, N. T. (2016). The relative efficiency of hired and family labour in Bangladesh agriculture. *Journal of International Development*, 28(7), 1075-1091.
- Christiaensen, L., Demery, L., & Paternostro, S. (2003). Reforms, remoteness and risk in Africa: Understanding inequality and poverty during the 1990s. World Institute for Development Economics Research Discussion Paper No. 2003/70.
- Chumo, I., Kabaria, C., Shankland, A., & Mberu, B. (2023). Unmet Needs and Resilience: The Case of Vulnerable and Marginalized Populations in Nairobi's Informal Settlements. *Sustainability*, 15(1), 37.
- Cianconi, P., Betrò, S., & Janiri, L. (2020). The impact of climate change on mental health: a systematic descriptive review. *Frontiers in psychiatry*, 11, 490206.
- Ciftcioglu, G. C. (2017). Assessment of the resilience of socio-ecological production landscapes and seascapes: A case study from Lefke Region of North Cyprus. *Ecological indicators*, 73, 128-138.
- Clare, A., Graber, R., Jones, L., & Conway, D. (2017). Subjective measures of climate resilience: what is the added value for policy and programming? *Global environmental change*, 46, 17-22.
- Claridge, T. (2018a). Dimensions of Social Capital-structural, cognitive, and relational. *Social Capital Research*, 1, 1-4.
- Claridge, T. (2018b). Functions of social capital-bonding, bridging, linking. *Social Capital Research*, 20(1), 1-7.
- Clark, A. E., Frijters, P., & Shields, M. A. (2008). Relative income, happiness, and utility: An explanation for the Easterlin paradox and other puzzles. *Journal of Economic literature*, 46(1), 95-144.
- Clarke, P., & Erreygers, G. (2020). Defining and measuring health poverty. *Social Science & Medicine*, 244, 112633.
- Clarke, V., Braun, V., & Hayfield, N. (2015). Thematic analysis. In Smith, J (ed.) *Qualitative psychology: A practical guide to research methods* (pp.222-248), Sage, London.
- Clasen, T., Pruss-Ustun, A., Mathers, C. D., Cumming, O., Cairncross, S., & Colford Jr, J. M. (2014). Estimating the impact of unsafe water, sanitation and hygiene on the global burden of disease: evolving and alternative methods. *Tropical Medicine & International Health*, 19(8), 884-893.
- Clemens, M. A. (2013). What do we know about skilled migration and development. Migration Policy Institute Policy Brief No. 3.
- Cobbinah, P. B., & Niminga-Beka, R. (2017). Urbanisation in Ghana: Residential land use under siege in Kumasi central. *Cities*, 60, 388-401.
- Codjoe, S. N. A., & Afuduo, S. (2015). Geophysical, socio-demographic characteristics and perception of flood vulnerability in Accra, Ghana. *Natural Hazards*, 77(2), 787-804.

- Codjoe, S. N. A., Nyamedor, F. H., Sward, J., & Dovie, D. B. (2017). Environmental hazard and migration intentions in a coastal area in Ghana: a case of sea flooding. *Population and Environment*, 39(2), 128-146.
- Codjoe, S. N. A., Addo, K. A., Tagoe, C. A., Nyarko, B. K., Martey, F., Nelson, W. A., Jayson-Quashigah, P.-N., Atiglo, D. Y., Adjei, P. O.-W., & Anderson, K. (2020a). The Volta Delta, Ghana: Challenges in an African Setting. In Nicholls, R; Hutton, C; Adger, N; Hanson, S (eds) *Deltas in the Anthropocene* (pp. 79-102). Palgrave Macmillan, Cham.
- Codjoe, S. N., Gough, K. V., Wilby, R. L., Kasei, R., Yankson, P. W., Amankwaa, E. F., Abarike, M. A., Atiglo, D. Y., Kayaga, S., & Mensah, P. (2020b). Impact of extreme weather conditions on healthcare provision in urban Ghana. *Social Science & Medicine*, 258, 113072.
- Coenen, M., Stamm, T. A., Stucki, G., & Cieza, A. (2012). Individual interviews and focus groups in patients with rheumatoid arthritis: A comparison of two qualitative methods. *Quality of Life Research*, 21(2), 359-370.
- Coirolo, C., & Rahman, A. (2014). Power and differential climate change vulnerability among extremely poor people in Northwest Bangladesh: lessons for mainstreaming. *Climate and Development*, 6(4), 336-344.
- Conti, G., & Pudney, S. (2011). Survey design and the analysis of satisfaction. *Review of Economics and Statistics*, 93(3), 1087-1093.
- Cook, K. S. (2014). Social capital and inequality: the significance of social connections. In McLeod, J., Lawler, E. & Schwalbe, M. (eds) *Handbook of the Social Psychology of Inequality* (pp. 207-227), Springer.
- Cooke, P. J., Melchert, T. P., & Connor, K. (2016). Measuring well-being: A review of instruments. *The Counseling Psychologist*, 44(5), 730-757.
- Cooper, P., Dimes, J., Rao, K., Shapiro, B., Shiferaw, B., & Twomlow, S. (2008). Coping better with current climatic variability in the rain-fed farming systems of sub-Saharan Africa: An essential first step in adapting to future climate change? *Agriculture, ecosystems & environment*, 126(1-2), 24-35.
- Cooper, P. (2013). Socio-ecological accounting: DPSWR, a modified DPSIR framework, and its application to marine ecosystems. *Ecological economics*, 94, 106-115.
- Copestake, J. (2008). Wellbeing in international development: What's new? *Journal of International Development: The Journal of the Development Studies Association*, 20(5), 577-597.
- Corazzini, L., Esposito, L., & Majorano, F. (2011). Exploring the absolutist vs relativist perception of poverty using a cross-country questionnaire survey. *Journal of Economic Psychology*, 32(2), 273-283.
- Corburn, J., & Hildebrand, C. (2015). Slum sanitation and the social determinants of women's health in Nairobi, Kenya. *Journal of environmental and public health*, 1, 209505.
- Corcoran, E., Ravilious, C., & Skuja, M. (2007). *Mangroves of western and central Africa*. Report produced for UNEP-DEPI under the UNEP Biodiversity Related Projects in Africa.
- Cordes, D. L., Wongthongtham, P. & Morrison, G. (2021). Transforming Urban Slums: Pathway to Functionally Intelligent Cities in Developing Countries. In: Mahmood, Z. (ed.) *Developing and Monitoring Smart Environments for Intelligent Cities*, Hershey, IGI Global.
- Cornwall, A., & Jewkes, R. (1995). What is participatory research? *Social Science & Medicine*, 41(12), 1667-1676.
- Cornwall, A. (2002). *Beneficiary consumer citizen: perspectives on participation for poverty reduction* (Vol. 2). Swedish International Development Cooperation Agency.
- Costa, M. (2003). A comparison between unidimensional and multidimensional approaches to the measurement of poverty. A IRISS Working Paper, No. 2003-02.
- Coulthard, S. (2008). Adapting to environmental change in artisanal fisheries—Insights from a South Indian Lagoon. *Global environmental change*, 18(3), 479-489.
- Coulthard, S. (2011). More than just access to fish: the pros and cons of fisher participation in a customary marine tenure (Padu) system under pressure. *Marine Policy*, 35(3), 405-412.

- Craggs, R. (2014). Development in a global-historical context. In Desai, V. & Potter, R. (eds) *The Companion to Development Studies* (pp. 27-31). Routledge, London.
- Craig, A., Hutton, C. W., & Sheffield, J. (2022). Social Capital Typologies and Sustainable Development: Spatial Patterns in the Central and Southern Regions of Malawi. *Sustainability*, 14(15), 9374.
- Craig, A., Hutton, C., Musa, F. B., & Sheffield, J. (2023). Bonding, bridging and linking social capital combinations for food access; A gendered case study exploring temporal differences in southern Malawi. *Journal of Rural Studies*, 101, 103039.
- Crawford, G. & Abdulai, A-G. (2009). The World Bank and Ghana's poverty reduction strategies: strengthening the State or consolidating neoliberalism? *Labour, Capital and Society/Travail, capital et société*, 42(1/2), 82–115.
- Crentsil, A. O., Asuman, D., & Fenny, A. P. (2019). Assessing the determinants and drivers of multidimensional energy poverty in Ghana. *Energy Policy*, 133, 110884.
- Creswell, J. W. (2015). Revisiting mixed methods and advancing scientific practices. In Hesse-Biber, S. & Johnson, B. (eds) *The Oxford Handbook of Multimethod and Mixed Methods Research Inquiry* (pp. 57-71), Oxford University Press.
- Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.
- Crettaz, E., & Suter, C. (2013). The impact of adaptive preferences on subjective indicators: An analysis of poverty indicators. *Social indicators research*, 114(1), 139-152.
- Crossley, É. (2012). Poor but happy: Volunteer tourists' encounters with poverty. *Tourism Geographies*, 14(2), 235-253.
- Crowley, M. S. (1998). Men's Self-Perceived Adequacy as the Family Breadwinner: Implications for Their Psychological, Marital, and Work-Family Well-Being. *Journal of Family and Economic Issues*, 19(1), 7-23.
- Cullen, M., & Whiteford, H. (2001). The interrelations of social capital with health and mental health. Discussion Paper. 2001, The Commonwealth of Australia.
- Cumming, G. S., Buerkert, A., Hoffmann, E. M., Schlecht, E., von Cramon-Taubadel, S., & Tschardtke, T. (2014). Implications of agricultural transitions and urbanization for ecosystem services. *Nature*, 515(7525), 50-57.
- Cummins, R. A. (2000). Personal income and subjective well-being: A review. *Journal of Happiness Studies*, 1(2), 133-158.
- Cummins, R. A., Eckersley, R., Pallant, J., Van Vugt, J., & Misajon, R. (2003). Developing a national index of subjective wellbeing: The Australian Unity Wellbeing Index. *Social indicators research*, 64(2), 159-190.
- Cundill, G., Bezerra, J. C., De Vos, A., & Ntingana, N. (2017). Beyond benefit sharing: Place attachment and the importance of access to protected areas for surrounding communities. *Ecosystem Services*, 28, 140-148.
- Cuni-Sanchez, A., Ngute, A. S. K., Sonké, B., Sainge, M. N., Burgess, N. D., Klein, J. A., & Marchant, R. (2019). The importance of livelihood strategy and ethnicity in forest ecosystem services' perceptions by local communities in north-western Cameroon. *Ecosystem Services*, 40, 101000.
- Daily, G. (1997). *Nature's Services: Societal Dependence on Natural Ecosystems*. Island Press.
- Dalton, P. S., Ghosal, S., & Mani, A. (2016). Poverty and aspirations failure. *The Economic Journal*, 126(590), 165-188.
- Dankwa, H. R., & Gordon, C. (2002). The fish and fisheries of the lower Volta mangrove swamps in Ghana. *African Journal of Science and technology*, 3(1), 25-32.
- Danso, H. (2013). Building houses with locally available materials in Ghana: benefits and problems. *International Journal of Science and Technology*, 2(2), 225-231.

- DARA. (2012). *Methodological Documentation for the Climate Vulnerability Monitor*. https://daraint.org/wp-content/uploads/2012/09/CVM2_Methodology.pdf, last accessed 7th March 2024.
- Darko, G., Bi, S., Sarfo, I., Amankwah, S. O. Y., Azeez, F. E., Yeboah, E., Oduro, C., Kedjanyi, E. A. G., Archer, B., & Awuah, A. (2022). Impacts of climate hazards on coastal livelihoods in Ghana: the case of Ningo-Prampram in the Greater Accra region. *Environment, development and sustainability*, 24(1), 1445-1474.
- Darner, R. (2012). An empirical test of self-determination theory as a guide to fostering environmental motivation. *Environmental Education Research*, 18(4), 463-472.
- Dary, S. K., & Grashuis, J. (2021). Characterization of farmer-based cooperative societies in the upper west region of Ghana. *Annals of Public and Cooperative Economics*, 92(4), 669-687.
- Das, N., Yasmin, R., Ara, J., Kamruzzaman, M., Davis, P., Behrman, J., Roy, S., & Quisumbing, A. R. (2013). How do intrahousehold dynamics change when assets are transferred to women? Evidence from BRAC's Challenging the Frontiers of Poverty Reduction—Targeting the Ultra Poor Program in Bangladesh. An International Food Policy Research Institute Discussion Paper No. 01317.
- Dasgupta, A., & Baschieri, A. (2010). Vulnerability to climate change in rural Ghana: Mainstreaming climate change in poverty-reduction strategies. *Journal of International Development*, 22(6), 803-820.
- Dasgupta, P. (2022). The Demography of Sustainable Human Wellbeing, proceedings from the Population-Environment Research Network Cyberseminar, 21st March 2022.
- Datt, G. (2002). Philippines: enhanced poverty monitoring—studies component, an implementation completion report produced by the Government of Philippines with the World Bank.
- Datt, G. (2019). Multidimensional poverty in the Philippines, 2004–2013: How much do choices for weighting, identification and aggregation matter? *Empirical Economics*, 57, 1103-1128.
- Datt, G., & Ravallion, M. (2011). Has India's economic growth become more pro-poor in the wake of economic reforms? *The world bank economic review*, 25(2), 157-189.
- Davidson, G. R., & Carr, S. C. (2010). Forced migration, social exclusion and poverty: Introduction. *Journal of Pacific Rim Psychology*, 4(1), 1-6.
- Davis, E. P. (2014). A review of the economic theories of poverty. National Institute of Economic and Social Research Discussion Paper No. 435.
- Davis, J., Moulton, A. A., Van Sant, L., & Williams, B. (2019). Anthropocene, capitalocene,... plantationocene?: A manifesto for ecological justice in an age of global crises. *Geography Compass*, 13(5), e12438.
- Davy, B. (2017). Human Dignity and Property in Land—A Human Rights Approach. In Pellissery, S., Davy, B. & Jacobs, M (eds), *Land Policies in India: Promises, Practices and Challenges* (pp. 1-33). Springer Singapore.
- Daw, T., Brown, K., Rosendo, S., & Pomeroy, R. (2011). Applying the ecosystem services concept to poverty alleviation: the need to disaggregate human well-being. *Environmental Conservation*, 38(4), 370-379.
- Dawson, N., Martin, A., & Sikor, T. (2016). Green Revolution in Sub-Saharan Africa: Implications of Imposed Innovation for the Wellbeing of Rural Smallholders. *World Development*, 78, 204-218.
- De Haan, L. J. (2012). The livelihood approach: A critical exploration. *Erdkunde*, 66(4), 345-357.
- De Kruijk, H., & Rutten, M. (2007). *Weighting dimensions of poverty based on peoples' priorities: Constructing a composite poverty index for the Maldives*. Institute for International and Development Economics Discussion paper 200708-01.
- De Neve, J.-E., & Sachs, J. D. (2020). The SDGs and human well-being: a global analysis of synergies, trade-offs, and regional differences. *Scientific reports*, 10(1), 1-12.
- De Schutter, O. (2021). A human rights-based approach to measuring poverty. In Davis, M., Kjaerum, M. & Lyons, A. (eds) *Research Handbook on Human Rights and Poverty* (pp. 2-20). Edward Elgar Publishing.

- De Silva, M. J., Harpham, T., Tuan, T., Bartolini, R., Penny, M. E., & Huttly, S. R. (2006). Psychometric and cognitive validation of a social capital measurement tool in Peru and Vietnam. *Social Science & Medicine*, 62(4), 941-953.
- Debela, N., Mohammed, C., Bridle, K., Corkrey, R., & McNeil, D. (2015). Perception of climate change and its impact by smallholders in pastoral/agropastoral systems of Borana, South Ethiopia. *SpringerPlus*, 4(1), 1-12.
- Debrah, E. (2013). Alleviating poverty in Ghana: the case of livelihood empowerment against poverty (LEAP). *Africa Today*, 59(4), 41-67.
- Debrah, J. K., Vidal, D. G., & Dinis, M. A. P. (2021). Innovative use of plastic for a clean and sustainable environmental management: Learning cases from Ghana, Africa. *Urban Science*, 5(1), 12.
- Decancq, K., & Lugo, M. A. (2013). Weights in multidimensional indices of wellbeing: An overview. *Econometric Reviews*, 32(1), 7-34.
- Decardi-Nelson, I., Asamoah, O., Solomon-Ayeh, B., & Ndure, K. (2012). The informal sector and mortgage financing in Ghana. *Ghana Journal of Development Studies*, 9(2), 136-152.
- DECCMA. (2014). *Climate Change Impact in the Volta Delta*. <https://www.youtube.com/watch?v=dznVX4Ju70E>, last accessed 25th July 2025.
- Deci, E. L., & Ryan, R. M. (2012). Self-determination theory. In Lange, P; Kruglanski, A and Higgins, E (eds) *Handbook of Theories of Social Psychology* (pp. 416-437). Sage, London.
- Dědeček, R., & Dudzich, V. (2022). Exploring the limitations of GDP per capita as an indicator of economic development: a cross-country perspective. *Review of Economic Perspectives*, 22(3), 193-217.
- Delta Alliance. (2019). *Report of the Volta Delta Status and Trends*. <http://www.delta-alliance.org/media/default.aspx/emma/org/10901545/Report+of+the+Volta+Delta+Status+and+trends.pdf>, last accessed 13th July 2023.
- Derbile, E. K., & Kasei, R. A. (2012). Vulnerability of crop production to heavy precipitation in north-eastern Ghana. *International Journal of Climate Change Strategies and Management*, 4(1), 36-53.
- Deressa, A., Gamachu, M., Birhanu, A., Mamo Ayana, G., Raru, T. B., Negash, B., Merga, B. T., Regassa, L. D., & Ababulgu, F. A. (2023). Malaria Risk Perception and Preventive Behaviors Among Elementary School Students, Southwest Ethiopia. Generalized Structural Equation Model. *Infect Drug Resist*, 16, 4579-4592.
- Desai, M., & Begg, M. D. (2008). A comparison of regression approaches for analyzing clustered data. *American journal of public health*, 98(8), 1425-1429.
- Devereux, S., & Teshome, A. (2005). Too much inequality or too little? Inequality and stagnation in Ethiopian agriculture. *IDS Bulletin*, 36(2), 121-126.
- Devine-Wright, P. (2009). Rethinking NIMBYism: The Role of Place Attachment and Place Identity in Explaining Place-protective Action, *J. Community. Appl. Soc. Psychol.*, 19, 426-441.
- Dewu, S., & Røskaft, E. (2018). Community attitudes towards protected areas: insights from Ghana. *Oryx*, 52(3), 489-496.
- DHS Programme. (2023). Ghana: Standard DHS, 2022. <https://dhsprogram.com/methodology/survey/survey-display-598.cfm>, last accessed 26th July 2014.
- Di Falco, S., & Bulte, E. (2009). *Social capital and weather shocks in Ethiopia: Climate change and culturally-induced poverty traps*. London School of Economics, Working Paper.
- Dicker, R., Garcia, M., Kelly, A., & Mulrooney, H. (2019). What does 'quality' in higher education mean? Perceptions of staff, students and employers. *Studies in Higher Education*, 44(8), 1425-1441.
- Dickson, K. B. (1968). Background to the problem of economic development in Northern Ghana. *Annals of the Association of American Geographers*, 58(4), 686-696.
- Didan, K., Munoz, A. B., Solano, R., & Huete, A. (2015). MODIS vegetation index user's guide. https://lpdaac.usgs.gov/documents/621/MOD13_User_Guide_V61.pdf, last accessed 25th July 2024.

- Diener, E., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The satisfaction with life scale. *Journal of personality assessment*, 49(1), 71-75.
- Diener, E., & Suh, E. (1997). Measuring quality of life: Economic, social, and subjective indicators. *Social indicators research*, 40(1), 189-216.
- Diener, E., Suh, E. M., Lucas, R. E., & Smith, H. L. (1999). Subjective well-being: Three decades of progress. *Psychological bulletin*, 125(2), 276.
- Diener, E., Napa-Scollon, C. K., Oishi, S., Dzokoto, V., & Suh, E. M. (2000). Positivity and the construction of life satisfaction judgments: Global happiness is not the sum of its parts. *Journal of Happiness Studies*, 1(2), 159-176.
- Diener, E., & Biswas-Diener, R. (2002). Will money increase subjective well-being? *Social indicators research*, 57(2), 119-169.
- Diener, E., Diener, M., & Diener, C. (2009). Factors predicting the subjective well-being of nations. In Diener, E. (ed.) *Culture and well-being* (pp. 43-70). Springer.
- Diener, E., Wirtz, D., Biswas-Diener, R., Tov, W., Kim-Prieto, C., Choi, D.-w., & Oishi, S. (2009). New measures of well-being. *Assessing well-being: The collected works of Ed Diener*, 247-266.
- Dika, J. L. (2017). *Effects of pollution on coastal environment and socio-economic life of the people of Elmina*. PhD thesis submitted to University of Ghana.
- Diop, S., Stapelberg, F., Tegegn, K., Ngubelanga, S., & Heath, L. (2011). A review on problem soils in South Africa. Council for Geoscience Report No. 2011-0062.
- Djimesah, I. E., Okine, A. N. D., & Mireku, K. K. (2018). Influential factors in creating warning systems towards flood disaster management in Ghana: An analysis of 2007 Northern flood. *International Journal of Disaster Risk Reduction*, 28, 318-326.
- Dlamini, S., Tesfamichael, S. G., Shiferaw, Y. A., & Mokhele, T. (2020). Socio-demographic determinants of place attachment in Gauteng, South Africa, using partial proportional odds models. *GeoJournal*, 87, 35-51.
- Doherty, T. J., & Clayton, S. (2011). The psychological impacts of global climate change. *American Psychologist*, 66(4), 265.
- Dolan, A. H., & Walker, I. J. (2006). Understanding vulnerability of coastal communities to climate change related risks. *Journal of Coastal Research*, SI 39, 1316-1323.
- Dolan, P., & White, M. P. (2007). How can measures of subjective well-being be used to inform public policy? *Perspectives on psychological science*, 2(1), 71-85.
- Dolan, P., Layard, R. & Metcalfe, R. (2011). Measuring subjective well-being for public policy, a Centre for Economic Performance Special Paper No. 23, report to the ONS, September 2010.
- Domfeh, K., & Nyigmah Bawole, J. (2009). Localising and sustaining poverty reduction: experiences, from Ghana. *Management of Environmental Quality: An International Journal*, 20(5), 490-505.
- Donaldson, J. A., Loh, J., Mudaliar, S., Md Kadir, M., Wu, B., & Yeoh, L. K. (2013). Measuring poverty in Singapore: frameworks for consideration. *Social Space*, 58-66.
- Dongre, A. R., Deshmukh, P. R., & Garg, B. S. (2009). Using the 'transect walk' as a public health teaching and learning tool. *Medical education*, 43(11), 1093-1094.
- Donnellan, M. B., Conger, K. J., McAdams, K. K., & Neppl, T. K. (2009). Personal characteristics and resilience to economic hardship and its consequences: Conceptual issues and empirical illustrations. *Journal of personality*, 77(6), 1645-1676.
- Dosu, B. (2021). Doing fieldwork the Ghanaian way: The dilemma of conducting research in rural Ghana. *The Canadian Geographer/Le Géographe canadien*, 65(4), 487-498.
- Dotse-Gborgbortsi, W., Tatem, A. J., Matthews, Z., Alegana, V. A., Ofosu, A., & Wright, J. A. (2023). Quality of maternal healthcare and travel time influence birthing service utilisation in Ghanaian health facilities: a geographical analysis of routine health data. *BMJ open*, 13(1), e066792.

- Douxchamps, S., Ayantunde, A., Panyan, E., Ouattara, K., Kaboré, A., Karbo, N., & Sawadogo, B. (2015). Agricultural water management and livelihoods in the crop–livestock systems of the Volta Basin. *Water Resources and Rural Development*, 6, 92-104.
- Dovie, D. B. (2017). A communication framework for climatic risk and enhanced green growth in the eastern coast of Ghana. *Land use policy*, 62, 326-336.
- Dowling, J. M., & Yap, C. F. (2012). *Happiness and poverty in developing countries: A global perspective*. Springer.
- Doyle, L., Brady, A.-M., & Byrne, G. (2016). An overview of mixed methods research–revisited. *Journal of research in nursing*, 21(8), 623-635.
- Drakopoulos, S. A. (2008). The paradox of happiness: towards an alternative explanation. *Journal of Happiness Studies*, 9(2), 303-315.
- Du, H., King, R. B., & Chi, P. (2017). Self-esteem and subjective well-being revisited: The roles of personal, relational, and collective self-esteem. *Plos one*, 12(8), e0183958.
- Duku, E., Mattah, P. A. D., Angnuureng, D. B., & Adotey, J. (2022). Understanding the complexities of human well-being in the context of ecosystem services within coastal Ghana. *Sustainability*, 14(16), 10111.
- Dunn, E. W., Gilbert, D. T., & Wilson, T. D. (2011). If money doesn't make you happy, then you probably aren't spending it right. *Journal of Consumer Psychology*, 21(2), 115-125.
- Dunn, F. E. (2017). Multidecadal fluvial sediment fluxes to major deltas under environmental change scenarios: projections and their implications. *Environmental Research Letters*, 14, 084034.
- Durayappah, A. (2011). The 3P Model: A general theory of subjective well-being. *Journal of Happiness Studies*, 12(4), 681-716.
- Dushie, D., Fenny, A. P., & Crentsil, A. O. (2017). Vehicular Emissions and Its Implications on the Health of Traders: A Case Study of Traders in La Nkwantanang Municipality in Ghana. *Journal of Sustainable Development*, 10(6).
- Dussaillant, F., & Guzmán, E. (2014). Trust via disasters: the case of Chile's 2010 earthquake. *Disasters*, 38(4), 808-832.
- Dwomoh, D., Amuasi, S., Agyabeng, K., Incoom, G., Alhassan, Y., & Yawson, A. E. (2019). Understanding the determinants of infant and under-five mortality rates: a multivariate decomposition analysis of demographic and health surveys in Ghana, 2003, 2008 and 2014. *BMJ global health*, 4(4), e001658.
- Dwumah, P., Akuoko, K. O., & Yeboah, E. H. (2018). Family Networks' Support to Employment Paths of Rural Youth in a Ghanaian Community. *Int'l J. Soc. Sci. Stud.*, 6, 32.
- Dziątek, J., Biernacki, W., & Bokwa, A. (2013). Challenges to social capacity building in flood-affected areas of southern Poland. *Natural Hazards and Earth System Sciences*, 13(10), 2555-2566.
- Dzokoto, V. A. A. (2012). Ghanaian happiness: global, cultural, and phenomenological perspectives. In Selin, H and Davey, G (eds) *Happiness across cultures* (pp. 311-327), Springer.
- Dzokoto, V. A., Osei-Tutu, A., Kyei, J. J., Twum-Asante, M., Attah, D. A., & Ahorsu, D. K. (2018). Emotion norms, display rules, and regulation in the Akan society of Ghana: an exploration using proverbs. *Frontiers in psychology*, 9, 1916.
- Dzokoto, V. A., Osei-Tutu, A., Scollon, C. N., Wallace, D., & Peters-Chitwood, L. (2019). Meaning and perceptions of the good life in Ghana. *Psychological Studies*, 64(1), 11-20.
- Easdale, M. H., Bruzzone, O., Mapfumo, P., & Tittonell, P. (2018). Phases or regimes? Revisiting NDVI trends as proxies for land degradation. *Land Degradation & Development*, 29(3), 433-445.
- Easterlin, R. A. (1974). Does economic growth improve the human lot? Some empirical evidence. In David, P and Reder, M (eds) *Nations and households in economic growth* (pp. 89-125). Elsevier.
- Ebro, A. (2019). *Changing Grassland Scenario in Developing Countries--Economical and Social Perspective*. Proceedings of 23rd International Grassland Congress 2015-Keynote Lectures,

available at <https://uknowledge.uky.edu/cgi/viewcontent.cgi?article=1037&context=igc>; last accessed 27th May 2023.

- Edmonds, D. A., Caldwell, R. L., Brondizio, E. S., & Siani, S. M. (2020). Coastal flooding will disproportionately impact people on river deltas. *Nature communications*, 11(1), 1-8.
- Edwards, G. A., Reid, L., & Hunter, C. (2016). Environmental justice, capabilities, and the theorization of well-being. *Progress in Human Geography*, 40(6), 754-769.
- Eelderink, M. S. (2019). *Transect Walk method for Participatory Action Research*. <https://www.youtube.com/watch?v=do7Nz1GOMqk>, last accessed 25th July 2024.
- Ehrhardt, J. J., Saris, W. E., & Veenhoven, R. (2000). Stability of life-satisfaction over time. *Journal of Happiness Studies*, 1(2), 177-205.
- Eid, M., & Larsen, R. J. (2008). *The science of subjective well-being*. Guilford Press.
- Ekins, P., Simon, S., Deutsch, L., Folke, C., & De Groot, R. (2003). A framework for the practical application of the concepts of critical natural capital and strong sustainability. *Ecological economics*, 44(2-3), 165-185.
- El Jarbi, C. (2010). *Income diversification and household welfare: empirical evidence for Ghana*. PhD thesis from Christian-Albrechts-Universität zu Kiel. https://macau.uni-kiel.de/servlets/MCRFileNodeServlet/dissertation_derivate_00003232/phdthesis_eljarbi_2010.pdf, last accessed 25th July 2024.
- Eldh, A. C., Årestedt, L., & Berterö, C. (2020). Quotations in qualitative studies: Reflections on constituents, custom, and purpose. *International Journal of Qualitative Methods*, 19, 1-6.
- El-hadj, M. B., Faye, I. & Geh, Z. F. (2018). The housing sector in Africa: setting the scene. In: Bah, E-H.M., Faye, I. & Geh, Z.F. (eds) *Housing Market Dynamics in Africa* (pp.1-21). Palgrave Macmillan, London.
- Ellis, F. (2000). *Rural livelihoods and diversity in developing countries*. Oxford University Press.
- Elo, I. T. (2009). Social class differentials in health and mortality: Patterns and explanations in comparative perspective. *Annual review of sociology*, 35, 553-572.
- Éltető, Ö., & Havasi, É. (2002). Impact of choice of equivalence scale on income inequality and on poverty measures. *Review of sociology*, 8(2), 137-148.
- Engstrom, R., Hersh, J., & Newhouse, D. (2016). Poverty in HD: What does high resolution satellite imagery reveal about economic welfare. Public document produced by the World Bank. <https://thedocs.worldbank.org/en/doc/60741466181743796-0050022016/original/PovertyinHDdraftv2.75.pdf>, last accessed 26th July 2024.
- Ericksen, P., de Leeuw, J., Thornton, P., Said, M., Herrero, M., & Notenbaert, A. (2013). Climate change in sub-Saharan Africa. In Catley, A., Lind, J. & Scoones, I (eds). *Pastoralism and development in Africa: Dynamic change at the margins* (pp.71-82), Routledge, London.
- Ericson, J. P., Vörösmarty, C. J., Dingman, S. L., Ward, L. G., & Meybeck, M. (2006). Effective sea-level rise and deltas: Causes of change and human dimension implications. *Global and Planetary Change*, 50(1-2), 63-82.
- Eriksen, S. H., Brown, K., & Kelly, P. M. (2005). The dynamics of vulnerability: locating coping strategies in Kenya and Tanzania. *Geographical Journal*, 171(4), 287-305.
- Ervin, P. A., Gayoso de Ervin, L., Molinas Vega, J. R., & Sacco, F. G. (2018). Multidimensional poverty in Paraguay: Trends from 2000 to 2015. *Social indicators research*, 140(3), 1035-1076.
- Esposito, L. & Chiappero-Martinetti, E. (2008). Multidimensional Poverty Measurement: Restricted and Unrestricted Hierarchy of Weights Among Poverty Dimensions, an Oxford Poverty & Human Development Initiative (OPHI) Working paper No. 22.
- Evadzi, P. I., Scheffran, J., Zorita, E., & Hünicke, B. (2018). Awareness of sea-level response under climate change on the coast of Ghana. *Journal of Coastal Conservation*, 22, 183-197.

- Evans, H. E. (1992). A virtuous circle model of rural-urban development: Evidence from a Kenyan small town and its Hinterland. *The Journal of Development Studies*, 28(4), 640-667.
- Everard, M. (2018). National Wetland Policy: Ghana. In Finlayson, C. M., Everard, M., Irvine, K., McInnes, R. J., Middleton, B.A., van Dam, A.A. & Davidson, N. C. (eds), *The Wetland Book: I: Structure and Function, Management, and Methods* (pp. 785-788). Springer Netherlands.
- Fabricant, N. (2013). Good living for whom? Bolivia's climate justice movement and the limitations of indigenous cosmovisions. *Latin American and Caribbean Ethnic Studies*, 8(2), 159-178.
- Fadiji, A., Meiring, L., & Wissing, M. P. (2021). Understanding Well-Being in the Ghanaian Context: Linkages between Lay Conceptions of Well-Being and Measures of Hedonic and Eudaimonic Well-Being. *Applied Research in Quality of Life*, 16(2), 649-677.
- Fafchamps, M., & Shilpi, F. (2008). Subjective welfare, isolation, and relative consumption. *Journal of Development Economics*, 86(1), 43-60.
- Fafchamps, M., & Shilpi, F. (2021). The evolution of built-up areas in Ghana since 1975. *Plos one*, 16(5), e0250847.
- Fagariba, C. J., Song, S., & Soule Baoro, S. K. G. (2018). Climate change adaptation strategies and constraints in Northern Ghana: Evidence of farmers in Sissala West District. *Sustainability*, 10(5), 1484.
- Fagerholm, N., Oteros-Rozas, E., Raymond, C. M., Torralba, M., Moreno, G., & Plieninger, T. (2016). Assessing linkages between ecosystem services, land-use and well-being in an agroforestry landscape using public participation GIS. *Applied Geography*, 74, 30-46.
- Faisal, M., Abbas, A., Cai, Y., Ali, A., Shahzad, M. A., Akhtar, S., Haseeb Raza, M., Ajmal, M. A., Xia, C., & Sattar, S. A. (2021). Perceptions, Vulnerability and Adaptation Strategies for Mitigating Climate Change Effects among Small Livestock Herders in Punjab, Pakistan. *International Journal of Environmental Research and Public Health*, 18(20), 10771.
- Falco, C., Donzelli, F., & Olper, A. (2018). Climate change, agriculture and migration: A survey. *Sustainability*, 10(5), 1405.
- Falco, P., Maloney, W. F., Rijkers, B., & Sarrias, M. (2015). Heterogeneity in subjective wellbeing: An application to occupational allocation in Africa. *Journal of Economic Behavior & Organization*, 111, 137-153.
- Falkingham, J., & Namazie, C. (2002). Measuring health and poverty: a review of approaches to identifying the poor. DFID Health Systems Resource Centre Issue Paper. <https://assets.publishing.service.gov.uk/media/57a08d46ed915d622c0018bd/Measuring-health-and-poverty.pdf>, last accessed 26th July 2024.
- Fallon, K. M. (1999). Education and perceptions of social status and power among women in Larteh, Ghana. *Africa Today*, 46(2), 67-91.
- FAO. (2019). *The State of food security and nutrition in the world*. A publication which is part of THE "State of the World" series of the Food and Agriculture Organization of the United Nations.
- Farr, M. (2018). Power dynamics and collaborative mechanisms in co-production and co-design processes. *Critical Social Policy*, 38(4), 623-644.
- Farrar, T., Nicholson, S., & Lare, A. (1994). The influence of soil type on the relationships between NDVI, rainfall, and soil moisture in semiarid Botswana. II. NDVI response to soil moisture. *Remote sensing of Environment*, 50(2), 121-133.
- Feeny, S., McDonald, L., & Posso, A. (2014). Are poor people less happy? Findings from Melanesia. *World Development*, 64, 448-459.
- Ferdman, A. (2021). Well-being and mobility: A new perspective. *Transportation research part A: policy and practice*, 146, 44-55.
- Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International Journal of Qualitative Methods*, 5(1), 80-92.

- Ference, M. E. (2018). Life at the crossroads: Transportation Infrastructure in African Cities. *African Studies Review*, 61(1), 248-254.
- Ferreira, F. H., Chen, S., Dabalen, A., Dikhanov, Y., Hamadeh, N., Jolliffe, D., Narayan, A., Prydz, E. B., Revenga, A., & Sangraula, P. (2016). A global count of the extreme poor in 2012: data issues, methodology and initial results. *The Journal of Economic Inequality*, 14(2), 141-172.
- Filandri, M., Pasqua, S., & Struffolino, E. (2020). Being working poor or feeling working poor? The role of work intensity and job stability for subjective poverty. *Social indicators research*, 147(3), 781-803.
- Fisher, J. A., Patenaude, G., Meir, P., Nightingale, A. J., Rounsevell, M. D., Williams, M., & Woodhouse, I. H. (2013). Strengthening conceptual foundations: analysing frameworks for ecosystem services and poverty alleviation research. *Global environmental change*, 23(5), 1098-1111.
- Fisher, J. A., Patenaude, G., Giri, K., Lewis, K., Meir, P., Pinho, P., Rounsevell, M. D., & Williams, M. (2014). Understanding the relationships between ecosystem services and poverty alleviation: a conceptual framework. *Ecosystem Services*, 7, 34-45.
- Fisher, M., & Carr, E. R. (2015). The influence of gendered roles and responsibilities on the adoption of technologies that mitigate drought risk: The case of drought-tolerant maize seed in eastern Uganda. *Global environmental change*, 35, 82-92.
- FitzRoy, F., Franz-Vasdeki, J., & Papyrakis, E. (2012). Climate change policy and subjective well-being. *Environmental Policy and Governance*, 22(3), 205-216.
- Flahaux, M.-L., & De Haas, H. (2016). African migration: trends, patterns, drivers. *Comparative Migration Studies*, 4(1), 1-25.
- Fleuret, S., & Atkinson, S. (2007). Wellbeing, health and geography: A critical review and research agenda. *New Zealand Geographer*, 63(2), 106-118.
- Flik, R. J., & Van Praag, B. M. (1991). Subjective poverty line definitions. *De Economist*, 139(3), 311-330.
- Flowerdew, R., & Martin, D. (2013). *Methods in human geography: a guide for students doing a research project*. Pearson Education.
- Folwell, K. (1995). Single measures of deprivation. *Journal of Epidemiology & Community Health*, 49(Suppl 2), S51-S56.
- Forkuo, E. K., Biney, E., Harris, E., & Quaye-Ballard, J. A. (2021). The impact of land use and land cover changes on socioeconomic factors and livelihood in the Atwima Nwabiagya district of the Ashanti region, Ghana. *Environmental Challenges*, 5, 100226.
- Fortnam, M., Brown, K., Chaigneau, T., Crona, B., Daw, T. M., Gonçalves, D., Hicks, C., Revmatas, M., Sandbrook, C., & Schulte-Herbruggen, B. (2019). The gendered nature of ecosystem services. *Ecological economics*, 159, 312-325.
- Foster, J., Greer, J., & Thorbecke, E. (1984). A class of decomposable poverty measures. *Econometrica: journal of the econometric society*, 52(3), 761-766.
- Foster, J., Greer, J., & Thorbecke, E. (2010). The Foster–Greer–Thorbecke (FGT) poverty measures: 25 years later. *The Journal of Economic Inequality*, 8(4), 491-524.
- Foufoula-Georgiou, E., Overeem, I., Saito, Y., Dech, S., Künzer, C., Goodbred, S., Harrison, I., Anthony, E., Brondizio, E., & Hutton, J. (2013). A vision for a coordinated international effort on delta sustainability. *Deltas: Landforms, Ecosystems and Human Activities*, 358, 3-11.
- Francesconi, G. N. & Wouterse, F. (2011). The renewed case for farmers' cooperatives: Diagnostics and implications from Ghana. An International Food Policy Research Institute Discussion Paper No. 01129.
- Franzblau, S. H., & Moore, M. (2001). Socializing efficacy: A reconstruction of self-efficacy theory within the context of inequality. *Journal of Community & Applied Social Psychology*, 11(2), 83-96.
- Fraser, T. (2021). Does social capital boost or block renewable energy siting? South African solar politics in comparison. *Energy Research & Social Science*, 71, 101845.

- Frazer, G. (2006). Learning the master's trade: apprenticeship and human capital in Ghana. *Journal of Development Economics*, 81(2), 259-298.
- Fredrickson, B. L., & Joiner, T. (2002). Positive emotions trigger upward spirals toward emotional well-being. *Psychological science*, 13(2), 172-175.
- Freeman, M. A. (1997). Demographic correlates of individualism and collectivism: A study of social values in Sri Lanka. *Journal of Cross-Cultural Psychology*, 28(3), 321-341.
- Frey, B. S., & Stutzer, A. (2010). *Happiness and economics*. Princeton University Press.
- Frey, B. S., & Gallus, J. (2013). Subjective well-being and policy. *Topoi*, 32(2), 207-212.
- Funder, M. (2005). Bias, intimacy and power in qualitative fieldwork strategies. *The Journal of Transdisciplinary Environmental Studies*, 4(1), 1-9.
- Funk, C., Sathyan, A. R., Winker, P., & Breuer, L. (2020). Changing climate-Changing livelihood: smallholder's perceptions and adaption strategies. *Journal of Environmental Management*, 259, 109702.
- Fuseini, K., Kalule-Sabiti, I., & Lwanga, C. (2019). Dynamics of women's autonomy in household decision-making in Ghana. *Journal of Comparative Family Studies*, 50(4), 293-312.
- Gaillard, J.-C., Maceda, E. A., Stasiak, E., Le Berre, I., & Espaldon, M. V. O. (2009). Sustainable livelihoods and people's vulnerability in the face of coastal hazards. *Journal of Coastal Conservation*, 13, 119-129.
- Gallup. (2014). *State of Global Well-being report*. Available at: <https://wellbeingindex.sharecare.com/wp-content/uploads/2017/12/Country-Well-Being-Rankings-2015.pdf>, last accessed 21st March 2024.
- Galway, L. P., Beery, T., Jones-Casey, K., & Tasala, K. (2019). Mapping the solastalgia literature: A scoping review study. *International Journal of Environmental Research and Public Health*, 16(15), 2662.
- Gannon, B., & Roberts, J. (2020). Social capital: exploring the theory and empirical divide. *Empirical Economics*, 58(3), 899-919.
- García-Quero, F., & Guardiola, J. (2018). Economic poverty and happiness in rural Ecuador: The importance of Buen Vivir (living well). *Applied Research in Quality of Life*, 13(4), 909-926.
- Garcia Rodrigues, J., Villasante, S. & Sousa Pinto, I. Non-material nature's contributions to people from a marine protected area support multiple dimensions of human well-being. *Sustainability Science*, 17, 793–808.
- Gari, S. R., Newton, A., & Icely, J. D. (2015). A review of the application and evolution of the DPSIR framework with an emphasis on coastal social-ecological systems. *Ocean & Coastal Management*, 103, 63-77.
- Garner, T. I., & de Vos, K. (1995). Income sufficiency v. poverty Results from the United States and The Netherlands. *Journal of Population Economics*, 8(2), 117-134.
- Garrity, D. P., Akinnifesi, F. K., Ajayi, O. C., Weldesemayat, S. G., Mowo, J. G., Kalinganire, A., Larwanou, M., & Bayala, J. (2010). Evergreen Agriculture: a robust approach to sustainable food security in Africa. *Food security*, 2(3), 197-214.
- Garroway, C., & de Laiglesia, J. (2012). *On the Relevance of Relative Poverty for Developing Countries*. OECD Development Centre Working Paper No. 314.
- Gaspar, D. (2007). What is the capability approach?: Its core, rationale, partners and dangers. *The Journal of Socio-Economics*, 36(3), 335-359.
- Gennetian, L. A., Castells, N., & Morris, P. A. (2010). Meeting the basic needs of children: Does income matter? *Children and Youth Services Review*, 32(9), 1138-1148.
- Ghai, D. (1978). Basic needs and its critics. *The IDS Bulletin*, 9(4), 16-18.
- Githeko, A. K. (2009). Malaria and climate change: special feature. *Commonwealth health ministers' update 2009*. <https://assets.publishing.service.gov.uk/media/57a08b8440fb64974000bd6/CommonwealthHealthMinistersUpdate2009Githeko.pdf>, last accessed 26th July 2024.

- Glenk, K., Barkmann, J., Schwarze, S., Zeller, M., & Marggraf, R. (2006). Differential influence of relative poverty on preferences for ecosystem services: Evidence from rural Indonesia. Contributed paper prepared for presentation at the International Association of Agricultural Economists Conference, Gold Coast, Australia, August 12-18, 2006
- Glozah, F. N. (2015). Exploring Ghanaian adolescents' meaning of health and wellbeing: A psychosocial perspective. *International Journal of Qualitative Studies on Health and Well-being*, 10(1), 26370.
- Goldsmith, E. (2002). Development as colonialism. *World Affairs: The Journal of International Issues*, 6(2), 18-36.
- Gollier, C., & Pratt, J. W. (1996). Risk vulnerability and the tempering effect of background risk. *Econometrica: journal of the econometric society*, 64(5), 1109-1123.
- Gómez-Baggethun, E., Gren, Å., Barton, D. N., Langemeyer, J., McPhearson, T., O'Farrell, P., Andersson, E., Hamstead, Z., & Kremer, P. (2013). Urban ecosystem services. In Elmqvist, T., Fragkias, M., Goodness, J., Güneralp, B., Marcotullio, P., McDonald, R., Parnell, S., Schewenius, M., Senstad, M., Seto, K. & Wilkinson, C (eds). *Urbanization, biodiversity and ecosystem services: Challenges and opportunities* (pp. 175-251). Springer, Dordrecht.
- Gómez-Limón, J. A., Vera-Toscano, E., & Garrido-Fernández, F. E. (2014). Farmers' Contribution to Agricultural Social Capital: Evidence from Southern Spain. *Rural Sociology*, 79(3), 380-410.
- González, P., Sehnbruch, K., Apablaza, M., Méndez Pineda, R., & Arriagada, V. (2021). A multidimensional approach to measuring quality of employment (QoE) deprivation in six central American countries. *Social indicators research*, 158(1), 107-141.
- Gordon, D. (2005). *Indicators of Poverty & Hunger*. Expert Group Meeting on Youth Development Indicators United Nations Headquarters, New York, available at https://www.un.org/esa/socdev/unyin/documents/ydiDavidGordon_poverty.pdf; last accessed 28th July 2023.
- Gough, I., & McGregor, J. A. (2007). *Wellbeing in developing countries: from theory to research*. Cambridge University Press.
- Gould, R. K., Klain, S. C., Ardoin, N. M., Satterfield, T., Woodside, U., Hannahs, N., Daily, G. C., & Chan, K. M. (2015). A protocol for eliciting nonmaterial values through a cultural ecosystem services frame. *Conservation Biology*, 29(2), 575-586.
- Gove, W. R., Hughes, M., & Galle, O. R. (1979). Overcrowding in the home: An empirical investigation of its possible pathological consequences. *American sociological review*, 44(1), 59-80.
- Government of Ghana. (2012). Ghana: Poverty Reduction Strategy Paper. <https://www.imf.org/en/Publications/CR/Issues/2016/12/31/Ghana-Poverty-Reduction-Strategy-Paper-26126>, last accessed 25th July 2024.
- Gowdy, J. (2004). Toward a new welfare foundation for sustainability. *Ecological Economics*, 53(2), 211-222.
- Graham, C., & Felton, A. (2006). Inequality and happiness: insights from Latin America. *The Journal of Economic Inequality*, 4(1), 107-122.
- Graham, C., & Pettinato, S. (2006). Frustrated achievers: winners, losers, and subjective well-being in Peru's emerging economy. *The Annals of the American Academy of Political and Social Science*, 606(1), 128-153.
- Graham, C. (2010). The challenges of incorporating empowerment into the HDI: Some lessons from happiness economics and quality of life research. United National Human Development Research Paper 2010/13.
- Graham, J. P., Hirai, M., & Kim, S.-S. (2016). An analysis of water collection labor among women and children in 24 sub-Saharan African countries. *Plos one*, 11(6), e0155981.
- Gray, L. C., & Moseley, W. G. (2005). A geographical perspective on poverty–environment interactions. *Geographical Journal*, 171(1), 9-23.

- Greiner, C., & Sakdapolrak, P. (2016). Migration, environment and inequality: Perspectives of a political ecology of translocal relations. In McLeman, R; Schade, J and Faist, T (eds) *Environmental migration and social inequality* (pp. 151-163). Springer.
- Grinde, B., & Patil, G. G. (2009). Biophilia: does visual contact with nature impact on health and well-being? *International Journal of Environmental Research and Public Health*, 6(9), 2332-2343.
- Grischow, J. D. (2008). Rural 'community', chiefs and social capital: the case of southern Ghana. *Journal of Agrarian Change*, 8(1), 64-93.
- Gross-Camp, N. (2017). Tanzania's community forests: their impact on human well-being and persistence in spite of the lack of benefit. *Ecology and Society*, 22(1).
- Gross-Camp, N., Rodriguez, I., Martin, A., Inturias, M., & Massao, G. (2019). The type of land we want: Exploring the limits of community forestry in Tanzania and Bolivia. *Sustainability*, 11(6), 1643.
- Groves, R. M., Fowler Jr, F. J., Couper, M. P., Lepkowski, J. M., Singer, E., & Tourangeau, R. (2011). *Survey methodology* (Vol. 561). John Wiley & Sons.
- Grün, C., & Grunewald, N. (2010). Subjective Well Being and the Impact of Climate Change. Proceedings of the German Development Economics Conference, Hannover 2010, No. 61.
- GSS. (2013). 2010 Population and Housing Census. https://statsghana.gov.gh/gssmain/fileUpload/pressrelease/2010_PHC_National_Analytical_Report.pdf; last accessed 7th August 2023.
- GSS. (2014). District Analytical Report: Tema Metropolitan. Report produced from 2010 Population & Housing Census. https://www2.statsghana.gov.gh/docfiles/2010_District_Report/Greater%20Accra/Tema%20Metro.pdf, last accessed 26th July 2024.
- GSS. (2018). Poverty trends in Ghana 2005-2017, a report produced from the Ghana Living Standards Survey Round 7 (GLSS7).
- GSS. (2020). *Multidimensional Poverty - Ghana*. https://ophi.org.uk/wp-content/uploads/Ghana_MPI_report_2020.pdf; last accessed 5th August 2023.
- Guagnano, G., Santarelli, E., & Santini, I. (2016). Can social capital affect subjective poverty in Europe? An empirical analysis based on a generalized ordered logit model. *Social indicators research*, 128(2), 881-907.
- Guardiola, J., González-Gómez, F., & Grajales, Á. L. (2013). The influence of water access in subjective well-being: Some evidence in Yucatan, Mexico. *Social indicators research*, 110(1), 207-218.
- Guest, G., Namey, E., Taylor, J., Eley, N., & McKenna, K. (2017). Comparing focus groups and individual interviews: findings from a randomized study. *International Journal of Social Research Methodology*, 20(6), 693-708.
- Guillen-Royo, M. (2011). Reference group consumption and the subjective wellbeing of the poor in Peru. *Journal of Economic Psychology*, 32(2), 259-272.
- Guillen-Royo, M., Velazco, J. (2012). Happy Villages and Unhappy Slums? Understanding Happiness Determinants in Peru. In: Selin, H., Davey, G. (eds) *Happiness Across Cultures. Science Across Cultures: the History of Non-Western Science*, vol 6 (pp. 253-270). Springer, Dordrecht.
- Guillen-Royo, M., Velazco, J., & Camfield, L. (2013). Basic needs and wealth as independent determinants of happiness: An illustration from Thailand. *Social indicators research*, 110(2), 517-536.
- Gunu, I. M. (2022). The Nexus Between Education and Life Expectancy in Ghana: Critical Analysis on the Impact of Educational Policies. *International Journal of Advanced Research in Education and Society*, 4(3), 63-70.
- Guzmán, J. C., Morrison, A. R., & Sjöblom, M. (2008). The impact of remittances and gender on household expenditure patterns: evidence from Ghana. In Morrison, A., Schiff, M. & Sjöblom, M (eds). *The International Migration of Women* (pp.125-152), Palgrave Macmillan and World Bank, New York and Washington DC.
- Gyampoh, B. A., Amisah, S., Iidinoba, M., & Nkem, J. (2009). Using traditional knowledge to cope with climate change in rural Ghana. *Unasylva*, 60(281/232), 70-74.

- Gyasi, E. A., Kranjac-Berisavljevic, G., Fosu, M., Mensah, A. M., Yiran, G., & Fuseini, I. (2014). Managing threats and opportunities of urbanisation for urban and peri-urban agriculture in Tamale, Ghana. In Maheshwari, B., Purohit, R., Malano, H., Singh, V. & Amerasinghe, P (eds). *The Security of Water, Food, Energy and Liveability of Cities* (pp. 87-97). Springer.
- Gyimah-Brempong, K., & Asiedu, E. (2015). Remittances and investment in education: Evidence from Ghana. *The journal of international trade & economic development*, 24(2), 173-200.
- Hall, R. E., & Jones, C. I. (2007). The value of life and the rise in health spending. *The Quarterly Journal of Economics*, 122(1), 39-72.
- Hallegatte, S. (2016). *Shock waves: managing the impacts of climate change on poverty*. World Bank Publications.
- Hallegatte, S., & Rozenberg, J. (2017). Climate change through a poverty lens. *Nature climate change*, 7(4), 250-256.
- Hamenoo, E. S., Dwomoh, E. A., & Dako-Gyeke, M. (2018). Child labour in Ghana: Implications for children's education and health. *Children and Youth Services Review*, 93, 248-254.
- Hampel-Milagrosa, A. (2011). The role of regulation, tradition and gender in doing business: case study and survey report on a two-year research project in Ghana. Paper produced from the DIE research project "Improving the Investment Climate in Developing Countries". https://www.idos-research.de/fileadmin/migratedNewsAssets/Files/Studies_60.pdf, last accessed 26th July 2024.
- Hansen, C. P., Pouliot, M., Marfo, E., Obiri, B. D., & Treue, T. (2015). Forests, timber and rural livelihoods: Implications for social safeguards in the Ghana-EU voluntary partnership agreement. *Small-scale forestry*, 14(4), 401-422.
- Happy Planet Index. (2019). Happy Planet Index. <https://happyplanetindex.org/>, last accessed 26th July 2024.
- Haq, R. (2015). Shocks as a source of vulnerability: An empirical investigation from Pakistan. *The Pakistan Development Review*, 54(3), 245-272.
- Harpham, T., Grant, E., & Thomas, E. (2002). Measuring social capital within health surveys: key issues. *Health policy and planning*, 17(1), 106-111.
- Harrold, M., Agrawala, S., Steele, P., Sharma, A., Hirsch, D., Liptow, H., Sharma, M., Abeygunawardena, P., Foy, T., & Debois, M. (2002). Poverty and climate change: reducing the vulnerability of the poor through adaptation. UN FAO Working Paper. <https://agris.fao.org/search/en/providers/122582/records/6473662753aa8c89630cbc8c>, last accessed 26th July 2024.
- Hart, J. (2016). *Ghana on the go: African mobility in the age of motor transportation*. Indiana University Press.
- Hartley, B. L., Thompson, R. C., & Pahl, S. (2015). Marine litter education boosts children's understanding and self-reported actions. *Marine pollution bulletin*, 90(1-2), 209-217.
- Harvey, B., & Langdon, J. (2010). Re-imagining Capacity and Collective Change: Experiences from Senegal and Ghana. *Ids Bulletin*, 41(3), 79-86.
- Hasty, J. (2005). The pleasures of corruption: Desire and discipline in Ghanaian political culture. *Cultural Anthropology*, 20(2), 271-301.
- Hatcher, A. M., Page, S., Eck, L. A. v., Pearson, I., Fielding-Miller, R., Mazars, C., & Stöckl, H. (2022). Systematic review of food insecurity and violence against women and girls: Mixed methods findings from low-and middle-income settings. *PLOS Global Public Health*, 2(9), e0000479.
- Haughton, J., & Khandker, S. R. (2009). *Handbook on poverty+ inequality*. World Bank Publications.
- Hayes, K., Blashki, G., Wiseman, J., Burke, S., & Reifels, L. (2018). Climate change and mental health: risks, impacts and priority actions. *International Journal of Mental Health Systems*, 12(1), 28.
- Headey, B., & Wearing, A. (1991). Subjective well-being: A stocks and flows framework. *Subjective well-being: An interdisciplinary perspective*, 21, 49-73.

- Heerwagen, J. (2009). Biophilia, health, and well-being. In Campbell, L. & Wiesen, A. (eds) *Restorative commons: creating health and well-being through urban landscapes* (pp. 38-57), USDA Forest Services, Washington DC.
- Heger, M., Zens, G., & Bangalor, M. (2018). *Does the environment matter for poverty reduction? The role of soil fertility and vegetation vigor in poverty reduction*. Environment and Natural Resources Global Practice, Policy Research Working Paper 8537.
- Heintz, J. (2004). Elements of an employment framework for poverty reduction in Ghana. Political Economy Research Institute (PERI) report of a joint ILO/UNDP mission.
- Helliwell, J. F. (2008). Life satisfaction and quality of development, a National Bureau of Economic Research working paper no. 14507.
- Helliwell, J. (2019). *How To Open Doors To Happiness*. In the Global Happiness and Wellbeing Policy Report 2019.
- Helliwell, J. F., Layard, R., Sachs, J., De Neve, J-E, Aknin, L. & Wang, S. (2024). *World Happiness Report 2024*. University of Oxford: Wellbeing Research Centre.
- Helne, T., & Hirvilammi, T. (2015). Wellbeing and sustainability: A relational approach. *Sustainable Development*, 23(3), 167-175.
- Henaku, E. A. (2022). Experiences of children living in overcrowded homes: A case of Ghana. *Journal of Social Development Studies*, 4(1), 64-73.
- Henningsen, S., Pauli, N., & Chhom, C. (2020). Seasonal livelihoods and adaptation strategies for an uncertain environmental future: Results from participatory research in Kratie province, Cambodia. In Neef, A & Pauli, N (eds) *Climate-induced disasters in the Asia-Pacific region: Response, recovery, adaptation* (pp. 135-165), Emerald Publishing Limited.
- Henry, S., Boyle, P., & Lambin, E. F. (2003). Modelling inter-provincial migration in Burkina Faso, West Africa: the role of socio-demographic and environmental factors. *Applied Geography*, 23(2-3), 115-136.
- Herrera, J., Razafindrakoto, M., & Roubaud, F. (2006). The determinants of subjective poverty: A comparative analysis in Madagascar and Peru. DIAL Working Paper, DT/2006/0.
- Hertel, T. W., Burke, M. B., & Lobell, D. B. (2010). The poverty implications of climate-induced crop yield changes by 2030. *Global environmental change*, 20(4), 577-585.
- Heubes, J., Heubach, K., Schmidt, M., Wittig, R., Zizka, G., Nuppenau, E.-A., & Hahn, K. (2012). Impact of future climate and land use change on non-timber forest product provision in Benin, West Africa: linking niche-based modeling with ecosystem service values. *Economic botany*, 66(4), 383-397.
- Hillel, D., & Hatfield, J. L. (2005). *Encyclopedia of Soils in the Environment* (Vol. 3). Elsevier Amsterdam.
- Hillesland, M. (2019). Investigating the gender wealth gap in Ghana. *Oxford development studies*, 47(1), 63-78.
- Hirata, J. (2001). Happiness and economics. Thesis to obtain the Master's degree in International Economic Studies from Maastricht University. <https://www.johannes-hirata.de/files/Hirata%202001%20-%20ThesisPrintUS.pdf>, last accessed 26th July 2024.
- Hirons, M., Comberti, C., & Dunford, R. (2016). Valuing cultural ecosystem services. *Annual Review of Environment and Resources*, 41, 545-574.
- Hirons, M., Robinson, E., McDermott, C., Morel, A., Asare, R., Boyd, E., Gonfa, T., Gole, T., Malhi, Y., & Mason, J. (2018). Understanding poverty in cash-crop agro-forestry systems: evidence from Ghana and Ethiopia. *Ecological economics*, 154, 31-41.
- Hirschman, A. O., & Rothschild, M. (1973). The changing tolerance for income inequality in the course of economic development: With a mathematical appendix. *The Quarterly Journal of Economics*, 87(4), 544-566.
- Hjelm, L., Ferrone, L., Handa, S., & Chzhen, Y. (2016a). *Comparing approaches to the measurement of multidimensional child poverty*. UNICEF Office of Research – Innocenti Working Paper WP-2016-29.

- Hjelm, L., Mathiassen, A., & Wadhwa, A. (2016b). Measuring poverty for food security analysis: consumption-versus asset-based approaches. *Food and nutrition bulletin*, 37(3), 275-289.
- Hollard, G., & Sene, O. (2016). Social capital and access to primary health care in developing countries: Evidence from Sub-Saharan Africa. *Journal of health economics*, 45, 1-11.
- Hossain, M. S., Johnson, F. A., Dearing, J. A., & Eigenbrod, F. (2016). Recent trends of human wellbeing in the Bangladesh delta. *Environmental Development*, 17, 21-32.
- Howe, L. D., Hargreaves, J. R., & Huttly, S. R. (2008). Issues in the construction of wealth indices for the measurement of socio-economic position in low-income countries. *Emerging themes in epidemiology*, 5(1), 1-14.
- Howe, L. D., Galobardes, B., Matijasevich, A., Gordon, D., Johnston, D., Onwujekwe, O., Patel, R., Webb, E. A., Lawlor, D. A., & Hargreaves, J. R. (2012). Measuring socio-economic position for epidemiological studies in low-and middle-income countries: a methods of measurement in epidemiology paper. *International journal of epidemiology*, 41(3), 871-886.
- Huang, J., Wu, S., & Deng, S. (2016). Relative income, relative assets, and happiness in urban China. *Social indicators research*, 126(3), 971-985.
- Hubbard, S. C., Meltzer, M. I., Kim, S., Malambo, W., Thornton, A. T., Shankar, M. B., Adhikari, B. B., Jeon, S., Bampoe, V. D., & Cunningham, L. C. (2020). Household illness and associated water and sanitation factors in peri-urban Lusaka, Zambia, 2016–2017. *NPJ Clean Water*, 3(1), 1-7.
- Huckle, K., & Silva, A. (2020). People of color, people of faith: The effect of social capital and religion on the political participation of marginalized communities. *Religions*, 11(5), 249.
- Hudson, E. (2013). Does relative material wealth matter for child and adolescent life satisfaction? *The Journal of Socio-Economics*, 46, 38-47.
- Hudson, P., Botzen, W., Poussin, J., & Aerts, J. C. (2019). Impacts of flooding and flood preparedness on subjective well-being: A monetisation of the tangible and intangible impacts. *Journal of Happiness Studies*, 20(2), 665-682.
- Huxham, M., Kairu, A., Lang'At, J. K., Kivugo, R., Mwafrica, M., Huff, A., & Shilland, R. (2023). Rawls in the mangrove: Perceptions of justice in nature-based solutions projects. *People and Nature*, 5(5), 1497-1511.
- Idowu, A. A., Ayoola, S. O., Opele, A., & Ikenweiwe, N. (2011). Impact of climate change in Nigeria. *Iranica Journal of Energy & Environment*, 2(2), 145-152.
- IHME. (2017) *Country Profiles: Ghana*. <http://www.healthdata.org/ghana>, last accessed 25th July 2024.
- ILO. (2020) Beyond the goal of eradicating absolute poverty in China: relative poverty indicators and social security policies. Research Brief 1, <https://www.ilo.org/resource/brief/research-brief-1-beyond-goal-eradicating-absolute-poverty-china-relative>, last accessed 25th July 2025.
- IMF. (2023). *Ghana - Country Data*. <https://www.imf.org/en/Countries/GHA#countrydata>, last accessed 5th August 2023.
- Imoro, H. (2015). Improving access of the physically disabled to health services in Tamale Metropolis, Ghana. *Research on Humanities and Social Sciences*, 5(9), 81-95.
- Inglehart, R. (1990). *Culture shift in advanced industrial society*. Princeton University Press.
- Ingulli, K., & Lindbloom, G. (2013). Connection to nature and psychological resilience. *Ecopsychology*, 5(1), 52-55.
- Ionesco, D., & Chazalnoel, M. (2015). Migration as an Adaptation Strategy to Climate Change. Blogpost from UN International Organization for Migration. <https://weblog.iom.int/migration-adaptation-strategy-climate-change>, last accessed 26th July 2024.
- IPCC. (2024). *IPCC Glossary*. <https://apps.ipcc.ch/glossary/>, last accessed 7th March 2024.
- Islam, M. A., Warwick, N., Koech, R., Amin, M. N., & de Bruyn, L. L. (2020). The importance of farmers' perceptions of salinity and adaptation strategies for ensuring food security: Evidence from the coastal rice growing areas of Bangladesh. *Science of the Total Environment*, 727, 138674.

- Ives, C. D., Abson, D. J., Von Wehrden, H., Dorninger, C., Klaniecki, K., & Fischer, J. (2018). Reconnecting with nature for sustainability. *Sustainability science*, 13(5), 1389-1397.
- Jackson, L. E., Daniel, J., McCorkle, B., Sears, A., & Bush, K. F. (2013). Linking ecosystem services and human health: the Eco-Health Relationship Browser. *International journal of public health*, 58(5), 747-755.
- Jarvis, I., Koehoorn, M., Gergel, S. E., & van den Bosch, M. (2020). Different types of urban natural environments influence various dimensions of self-reported health. *Environmental Research*, 186, 109614.
- Javadi, M., & Zarea, K. (2016). Understanding thematic analysis and its pitfall. *Journal of client care*, 1(1), 33-39.
- Jax, K., Calestani, M., Chan, K. M., Eser, U., Keune, H., Muraca, B., O'Brien, L., Potthast, T., Voget-Kleschin, L., & Wittmer, H. (2018). Caring for nature matters: a relational approach for understanding nature's contributions to human well-being. *Current Opinion in Environmental Sustainability*, 35, 22-29.
- Jayson-Quashigah, P.-N. (2016). *2001-15 Volta Land Cover Classification*. <https://www.delta-portal.net/geonetwork/srv/eng/catalog.search?sessionId=17A16671A3C85ABEA1519F9C670B57E4#/metadata/86b279b8-3cc9-4584-a8bd-9d4300a028df>, last accessed 5th August 2023.
- Jean-Paul, F., & Martine, D. (2018). *For Good Measure Advancing Research on Well-being Metrics Beyond GDP: Advancing Research on Well-being Metrics Beyond GDP*. OECD Publishing.
- Jehan, S., & Umana, A. (2003). The environment-poverty nexus. *Development Policy Journal*, 3(20), 53-70.
- Jennings, S., & Magrath, J. (2009). What happened to the seasons. Conference on Seasonality, Future Agricultures Consortium International. IDS Sussex, UK.
- Jensen, O., & Tiwari, C. (2021). Subjective Well-Being Impacts of Natural Hazards: A Review. *Economic Effects of Natural Disasters*, 583-599.
- Jepson, W. E., Stoler, J., Baek, J., Martínez, J. M., Salas, F. J. U., & Carrillo, G. (2021). Cross-sectional study to measure household water insecurity and its health outcomes in urban Mexico. *BMJ open*, 11(3), e040825.
- Jerven, M. (2013). Comparability of GDP estimates in Sub-Saharan Africa: The effect of Revisions in Sources and Methods Since Structural Adjustment. *Review of Income and Wealth*, 59, S16-S36.
- Johnson, K. B., Jacob, A., & Brown, M. E. (2013). Forest cover associated with improved child health and nutrition: evidence from the Malawi Demographic and Health Survey and satellite data. *Global Health: Science and Practice*, 1(2), 237-248.
- Joint Learning Initiative on Faith & Local Communities (JLIFLC). (2012). *Transect Walk*. <https://jliflc.com/wp-content/uploads/2019/06/Transect-Walk.pdf>, last accessed 25th July 2024.
- Jolliffe, D. (2014). *A measured approach to ending poverty and boosting shared prosperity: concepts, data, and the twin goals*. World Bank Publications.
- Joly, M., & Voldoire, A. (2009). Influence of ENSO on the West African monsoon: temporal aspects and atmospheric processes. *Journal of Climate*, 22(12), 3193-3210.
- Jones, N., Bouzid, M., Few, R., Hunter, P., & Lake, I. (2020). Water, sanitation and hygiene risk factors for the transmission of cholera in a changing climate: using a systematic review to develop a causal process diagram. *Journal of water and health*, 18(2), 145-158.
- Jones, S. K., Boundaogo, M., DeClerck, F. A., Estrada-Carmona, N., Mirumachi, N., & Mulligan, M. (2019). Insights into the importance of ecosystem services to human well-being in reservoir landscapes. *Ecosystem Services*, 39, 100987.
- Jönsson, J. (2009). The overwhelming minority: Inter-ethnic conflict in Ghana's Northern Region. *Journal of International Development*, 21(4), 507-519.
- Jordan, J. C. (2015). Swimming alone? The role of social capital in enhancing local resilience to climate stress: a case study from Bangladesh. *Climate and Development*, 7(2), 110-123.

- Jørgensen, S. H. (2008). Some perspectives on the geographies of poverty and health: A Ghanaian context. *Norsk Geografisk Tidsskrift-Norwegian Journal of Geography*, 62(3), 241-250.
- Junaedi, J. (2021). The dynamics of rural household expenditure in Indonesia. *Journal Inovasi Ekonomi*, 6(02), 59-66.
- Kabote, S. J. (2017). Revisiting subjective wellbeing to stimulate empirical research in Sub-Saharan Africa. *Social Sciences*, 6(1), 28-34.
- Kahneman, D. (1999). Objective happiness. In Kahneman, D., Diener, E. & Schwarz, N. (eds) *Well-being: The foundations of hedonic psychology* (pp. 3–25). Russell Sage Foundation.
- Kahneman, D., & Deaton, A. (2010). High income improves evaluation of life but not emotional well-being. *Proceedings of the National Academy of Sciences*, 107(38), 16489-16493.
- Kailembo, A., Preet, R., & Williams, J. S. (2018). Socioeconomic inequality in self-reported unmet need for oral health services in adults aged 50 years and over in China, Ghana, and India. *International journal for equity in health*, 17(1), 1-14.
- Kaiser, B. N., Hruschka, D., & Hadley, C. (2017). Measuring material wealth in low-income settings: A conceptual and how-to guide. *American Journal of Human Biology*, 29(4), e22987.
- Kallah-Dagadu, G., Donkor, F., Duah, M., Yeboah, H., Arku, D., & Lotsi, A. (2024). Investigation of Factors Influencing Infant Mortality at Greater Accra Regional Hospital, Ghana. *BioMed Research International*, 2024(1), 6610617.
- Kamanda, M., & Sankoh, O. (2015). A systematic review of the status of children's school access in low- and middle-income countries between 1998 and 2013: using the INDEPTH Network platform to fill the research gaps. *Global health action*, 8(1), 28430.
- Kambala, M. I. (2023). Colonial Origins of Comparative Development in Ghana. *The Journal of Development Studies*, 59(2), 188-208.
- Kaminski, J., Christiaensen, L., & Gilbert, C. L. (2016). Seasonality in local food markets and consumption: Evidence from Tanzania. *Oxford Economic Papers*, 68(3), 736-757.
- Kangmennaang, J., & Elliott, S. J. (2019). 'Wellbeing is shown in our appearance, the food we eat, what we wear, and what we buy': Embodying wellbeing in Ghana. *Health & place*, 55, 177-187.
- Kangmennaang, J., Smale, B., & Elliott, S. J. (2019). 'When you think your neighbour's cooking pot is better than yours': A mixed-methods exploration of inequality and wellbeing in Ghana. *Social Science & Medicine*, 242, 112577.
- Kankam, S., Inkoom, J. N., Koo, H., & Fürst, C. (2021). Envisioning alternative futures of cultural ecosystem services supply in the coastal landscapes of Southwestern Ghana, West Africa. *Socio-Ecological Practice Research*, 3(3), 309-328.
- Kansanga, M. M. (2017). Who you know and when you plough? Social capital and agricultural mechanization under the new green revolution in Ghana. *International Journal of Agricultural Sustainability*, 15(6), 708-723.
- Kansanga, M. M., Konkor, I., Kpienbaareh, D., Mohammed, K., Batung, E., Nyantakyi-Frimpong, H., Kuuire, V., & Luginaah, I. (2022). Time matters: A survival analysis of timing to seasonal food insecurity in semi-arid Ghana. *Regional Environmental Change*, 22(2), 41.
- Karabchuk, T., & Soboleva, N. (2014). Informal employment and subjective well-being in Europe: evidence from the European social survey data. *Comparative Southeast European Studies*, 62(4), 397-420.
- Karakara, A. A.-W., & Ortsin, E. A. (2022). Assessing the Livelihood Empowerment Against Poverty (LEAP) program as a conditional income transfer: a search for a conceptual framework. *International Journal of Social Economics*, 49(4), 546-561.
- Kassa, A. F. (2012). Unemployment in Urban Ethiopia: Determinants and Impact on household welfare. *Ethiopian Journal of Economics*, 21(2), 127-157.
- Kawachi, I. (1999). Social capital and community effects on population and individual health. *Annals of the New York Academy of Sciences*, 896(1), 120-130.

- Kay, A. C., & Jost, J. T. (2003). Complementary justice: effects of "poor but happy" and "poor but honest" stereotype exemplars on system justification and implicit activation of the justice motive. *Journal of personality and social psychology*, 85(5), 823.
- Kelble, C. R., Loomis, D. K., Lovelace, S., Nuttle, W. K., Ortner, P. B., Fletcher, P., Cook, G. S., Lorenz, J. J., & Boyer, J. N. (2013). The EBM-DPSER conceptual model: integrating ecosystem services into the DPSIR framework. *Plos one*, 8(8), e70766.
- Keller, S. (2020). What does mental health have to do with well-being? *Bioethics*, 34(3), 228-234.
- Kelly, E., Lee, K., Shields, K. F., Cronk, R., Behnke, N., Klug, T., & Bartram, J. (2017). The role of social capital and sense of ownership in rural community-managed water systems: Qualitative evidence from Ghana, Kenya, and Zambia. *Journal of Rural Studies*, 56, 156-166.
- Kendie, S. (1996). Some factors influencing effective utilization of drinking water facilities: Women, income, and health in rural North Ghana. *Environmental Management*, 20(1), 1-10.
- Kerapeletswe, C. K., & Lovett, J. C. (2001). The role of common pool resources in economic welfare of rural households. University of York Digital Library of the Commons, York.
<https://dlc.dlib.indiana.edu/dlcrest/api/core/bitstreams/c9a1e458-073a-45c4-94e9-dfe0e9967182/content>, last accessed 26th July 2024.
- Kezer, M., & Cemalcilar, Z. (2020). A comprehensive investigation of associations of objective and subjective socioeconomic status with perceived health and subjective well-being. *International Review of Social Psychology*, 33(1).
- Khalil, G. M. (1992). Cyclones and storm surges in Bangladesh: some mitigative measures. *Natural Hazards*, 6(1), 11-24.
- Khan, S., Yahong, W., & Zeeshan, A. (2022). Impact of poverty and income inequality on the ecological footprint in Asian developing economies: Assessment of Sustainable Development Goals. *Energy Reports*, 8, 670-679.
- Khanian, M., Serpoush, B., & Gheitarani, N. (2019). Balance between place attachment and migration based on subjective adaptive capacity in response to climate change: The case of Famenin County in Western Iran. *Climate and Development*, 11(1), 69-82.
- Khazaeian, S., Kariman, N., Ebadi, A., & Nasiri, M. (2017). The impact of social capital and social support on the health of female-headed households: a systematic review. *Electronic physician*, 9(12), 6027.
- Kidner, D. W. (2007). Depression and the natural world: Towards a critical ecology of psychological distress. *International Journal of Critical Psychology*, 19(2007).
- Kim, J.-H., Jung, S.-h., Yang, S.-y., & Choi, H.-j. (2019). Job security and workaholism among non-permanent workers: The moderating influences of corporate culture. *Journal of Psychology in Africa*, 29(5), 443-451.
- Kim, Y., Kee, Y., & Lee, S. J. (2015). An analysis of the relative importance of components in measuring community wellbeing: Perspectives of citizens, public officials, and experts. *Social indicators research*, 121, 345-369.
- Kingdon, G. G., & Knight, J. (2006). Subjective well-being poverty vs. income poverty and capabilities poverty? *The Journal of Development Studies*, 42(7), 1199-1224.
- Kingdon, G. G., & Knight, J. (2007). Community, comparisons and subjective well-being in a divided society. *Journal of Economic Behavior & Organization*, 64(1), 69-90.
- Kitzinger, J. (1995). Qualitative research: introducing focus groups. *BMJ*, 311(7000), 299-302.
- Klasen, S., & Blades, D. (2013). Issues and challenges in measuring national income, wealth, poverty, and inequality in sub-Saharan African countries: An introduction. *Review of Income and Wealth*, 59, 1-8.
- Klasen, S., & Lahoti, R. (2021). How serious is the neglect of intra-household inequality in multidimensional poverty and inequality analyses? Evidence from India. *Review of Income and Wealth*, 67(3), 705-731.

- Klinkenberg, E., McCall, P., Hastings, I. M., Wilson, M. D., Amerasinghe, F. P., & Donnelly, M. J. (2005). Malaria and irrigated crops, Accra, Ghana. *Emerging infectious diseases*, 11(8), 1290.
- Kloosterman, R. C., Rusinovic, K., & Yeboah, D. (2016). Super-diverse migrants—similar trajectories? Ghanaian entrepreneurship in the Netherlands seen from a Mixed Embeddedness perspective. *Journal of Ethnic and Migration Studies*, 42(6), 913-932.
- Knapp, M. (2003). Hidden costs of mental illness. *The British Journal of Psychiatry*, 183(6), 477-478.
- Knight, J., & Yueh, L. (2008). The role of social capital in the labour market in China 1. *Economics of transition*, 16(3), 389-414.
- Knight, J., Lina, S., & Gunatilaka, R. (2009). Subjective well-being and its determinants in rural China. *China economic review*, 20(4), 635-649.
- Knight, J., & Gunatilaka, R. (2010a). Great expectations? The subjective well-being of rural–urban migrants in China. *World Development*, 38(1), 113-124.
- Knight, J., & Gunatilaka, R. (2010b). The rural–urban divide in China: Income but not happiness? *The Journal of Development Studies*, 46(3), 506-534.
- Knight, J., & Gunatilaka, R. (2012). Income, aspirations and the hedonic treadmill in a poor society. *Journal of Economic Behavior & Organization*, 82(1), 67-81.
- Kobayashi, J., & Hommerich, C. (2017). Are happiness and unhappiness two sides of the same coin? An analysis of happiness and unhappiness. *Sociological Theory and Methods*, 32(1), 49-63.
- Kofinti, R. E. & Annim, S. K. (2016). Child deprivation and income poverty in Ghana. In: Arndt, C. & Tarp, F. (eds) *Measuring Poverty and Wellbeing in Developing Countries* (pp. 178-193). Oxford University Press, Oxford.
- Koko, I. A., Misana, S. B., Kessler, A., & Fleskens, L. (2020). Valuing ecosystem services: stakeholders' perceptions and monetary values of ecosystem services in the Kilombero wetland of Tanzania. *Ecosystems and People*, 16(1), 411-426.
- Kollamparambil, U. (2020). Happiness, happiness inequality and income dynamics in South Africa. *Journal of Happiness Studies*, 21(1), 201-222.
- Konadu-Agyemang, K. (2000). The best of times and the worst of times: structural adjustment programs and uneven development in Africa: the case of Ghana. *The Professional Geographer*, 52(3), 469-483.
- Konadu-Agyemang, K., & Adanu, S. (2003). The changing geography of export trade in Ghana under structural adjustment programs: Some socioeconomic and spatial implications. *The Professional Geographer*, 55(4), 513-527.
- Kondo, N., Kawachi, I., Subramanian, S., Takeda, Y., & Yamagata, Z. (2008). Do social comparisons explain the association between income inequality and health?: Relative deprivation and perceived health among male and female Japanese individuals. *Social Science & Medicine*, 67(6), 982-987.
- Koomson, D., Davies-Vollum, K. S., & Raha, D. (2020). Characterising the vulnerability of fishing households to climate and environmental change: Insights from Ghana. *Marine Policy*, 120, 104142.
- Korboe, D., Dogbe, T., & Marshall, C. (2011). Participatory poverty and vulnerability assessment (PPVA): Understanding the regional dynamics of poverty with particular focus on Northern Ghana. Report produced by GOG/DFID/UNICEF/World Bank, Accra, Ghana.
<https://www.gov.uk/government/publications/participatory-poverty-and-vulnerability-assessment-ppva-understanding-the-regional-dynamics-of-poverty-with-particular-focus-on-ghanas-northern-upper-east-and-upper-west-regions>, last accessed 26th July 2024.
- Kozma, A., Stone, S., & Stones, M. (2000). Stability in components and predictors of subjective well-being (SWB): Implications for SWB structure. In Diener, E and Rahtz, D (eds) *Advances in quality of life theory and research* (pp. 13-30). Springer..
- Kraus, J. (1991). The struggle over structural adjustment in Ghana. *Africa Today*, 38(4), 19-37.

- Krefis, A. C., Schwarz, N. G., Nkrumah, B., Acquah, S., Loag, W., Oldeland, J., Sarpong, N., Adu-Sarkodie, Y., Ranft, U., & May, J. (2011). Spatial analysis of land cover determinants of malaria incidence in the Ashanti Region, Ghana. *Plos one*, 6(3), e17905.
- Kretsch, C., & Keune, H. (2016). Ecosystem services and human health. Report from the *OpenNESS Synthesis Paper: 'Ecosystem Services and Human Health'*. <https://oppla.eu/sites/default/files/uploads/sphealth.pdf>, last accessed 26th July 2024.
- Kripke, G. (2015). "Poor" versus "low-income": What term should we use? OXFAM blogpost. <https://politicsofpoverty.oxfamamerica.org/poor-versus-low-income-what-term-should-we-use/>, last accessed 26th July 2024.
- Kubik, Z., & Maurel, M. (2016). Weather shocks, agricultural production and migration: Evidence from Tanzania. *The Journal of Development Studies*, 52(5), 665-680.
- Kuenzer, C., & Renaud, F. G. (2012). Climate and environmental change in river deltas globally: expected impacts, resilience, and adaptation. In Renaud, F and Kuenzer, C (eds) *The Mekong delta system* (pp. 7-46). Springer.
- Kuivanen, K., Alvarez, S., Michalscheck, M., Adjei-Nsiah, S., Descheemaeker, K., Mellon-Bedi, S., & Groot, J. C. (2016). Characterising the diversity of smallholder farming systems and their constraints and opportunities for innovation: A case study from the Northern Region, Ghana. *NJAS: Wageningen Journal of Life Sciences*, 78(1), 153-166.
- Kuruvilla, A., & Jacob, K. (2007). Poverty, social stress & mental health. *Indian Journal of Medical Research*, 126(4), 273.
- Kutsoati, E., & Morck, R. (2014). Family ties, inheritance rights, and successful poverty alleviation: Evidence from Ghana. In Edwards, S; Johnson, S & Weil, D (eds) *African Successes, Volume II: Human Capital* (pp. 215-252). University of Chicago Press.
- Kvale, S., & Brinkmann, S. (2009). *Interviews: Learning the craft of qualitative research interviewing*. Sage.
- Kwankye, S., Anarfi, J. K., Tagoe, C. A., & Castaldo, A. (2009). Independent North-South child migration in Ghana: The decision making process. *Development Research Centre on Migration, Globalisation and Poverty, Sussex Centre for Migration Research Working Paper T-29*.
- Kwarteng, K. A. (2012). *Duties & Responsibilities of Children in Ghana: Perspectives of Children and Adults in Kumasi*. Thesis submitted to the Norwegian Center for Child Research. <https://ntnuopen.ntnu.no/ntnu-xmlui/handle/11250/269055>, last accessed 26th July 2024.
- Laderchi, C. R., Saith, R., & Stewart, F. (2003). Does it matter that we do not agree on the definition of poverty? A comparison of four approaches. *Oxford development studies*, 31(3), 243-274.
- Lai, Y., Li, Q., Li, J., Zhou, Q., Zhang, X., & Wu, G. (2021). Evolution of frequency and intensity of concurrent heavy precipitation and storm surge at the global scale: implications for compound floods. *Frontiers in Earth Science*, 9, 619.
- Lamarche, C., Santoro, M., Bontemps, S., d'Andrimont, R., Radoux, J., Giustarini, L., Brockmann, C., Wevers, J., Defourny, P., & Arino, O. (2017). Compilation and validation of SAR and optical data products for a complete and global map of inland/ocean water tailored to the climate modeling community. *Remote Sensing*, 9(1), 36.
- Lambrecht, I. B. (2016). "As a husband I will love, lead, and provide." Gendered access to land in Ghana. *World Development*, 88, 188-200.
- Lambrecht, N. J., Wilson, M. L., Baylin, A., Folson, G., Naabah, S., Eisenberg, J. N., Adu, B., & Jones, A. D. (2021). Associations between livestock ownership and lower odds of anaemia among children 6–59 months old are not mediated by animal-source food consumption in Ghana. *Maternal & Child Nutrition*, 17(3), e13163.
- Lamptey, M., & Ofori-Danson, P. (2014). The status of fish diversity and fisheries of the Keta Lagoon, Ghana, West Africa. *Ghana Journal of Science*, 54, 3-18.
- Landgraf, A. J., & Lee, Y. (2020). Dimensionality reduction for binary data through the projection of natural parameters. *Journal of Multivariate Analysis*, 180, 104668.

- Landry, R., Amara, N., & Lamari, M. (2002). Does social capital determine innovation? To what extent? *Technological Forecasting and Social Change*, 69(7), 681-701.
- Langer, A., & Ukiwo, U. (2008). Ethnicity, religion and the state in Ghana and Nigeria: perceptions from the street. In Stewart, F. (ed.) *Horizontal Inequalities and Conflict* (pp. 205-226). Springer.
- Langer, A., Mustapha, A. R., & Stewart, F. (2009). Diversity and discord: Ethnicity, horizontal inequalities and conflict in Ghana and Nigeria. *Journal of International Development*, 21(4), 477-482.
- Lanjouw, P., & Paternostro, S. (1998). *Poverty and the economic transition: how do changes in economies of scale affect poverty rates for different households?* World Bank Publications.
- Lanz, K., Gerber, J. D., & Haller, T. (2018). Land grabbing, the state and chiefs: The politics of extending commercial agriculture in Ghana. *Development and Change*, 49(6), 1526-1552.
- Lattera, P., Nahuelhual, L., Vallejos, M., Berrouet, L., Pérez, E. A., Enrico, L., Jiménez-Sierra, C., Mejía, K., Meli, P., & Rincón-Ruiz, A. (2019). Linking inequalities and ecosystem services in Latin America. *Ecosystem Services*, 36, 100875.
- Lauria, V., Das, I., Hazra, S., Cazcarro, I., Arto, I., Kay, S., Ofori-Danson, P., Ahmed, M., Hossain, M. A., & Barange, M. (2018). Importance of fisheries for food security across three climate change vulnerable deltas. *Science of the Total Environment*, 640, 1566-1577.
- Lawrance, E., Thompson, R., Fontana, G., & Jennings, N. (2021). *The impact of climate change on mental health and emotional wellbeing: current evidence and implications for policy and practice*. Grantham Institute briefing paper no. 36, available at; <https://www.imperial.ac.uk/grantham/publications/all-publications/the-impact-of-climate-change-on-mental-health-and-emotional-wellbeing-current-evidence-and-implications-for-policy-and-practice.php>, last accessed 28th March 2024.
- Lawson, E. T., Gordon, C., & Schluchter, W. (2012). The dynamics of poverty–environment linkages in the coastal zone of Ghana. *Ocean & Coastal Management*, 67, 30-38.
- Lawson, K. D., Mercer, S. W., Wyke, S., Grieve, E., Guthrie, B., Watt, G., & Fenwick, E. A. (2013). Double trouble: the impact of multimorbidity and deprivation on preference-weighted health related quality of life a cross sectional analysis of the Scottish Health Survey. *International journal for equity in health*, 12(1), 1-9.
- Layard, P. R. G., & Layard, R. (2011). *Happiness: Lessons from a new science*. Penguin UK.
- Lazega, E., & Pattison, P. E. (2017). Social capital as social mechanisms and collective assets: The example of status auctions among colleagues. In Dubos, R. (ed.) *Social capital* (pp. 185-208). Routledge.
- Le Phan, H. L. & Tortora, C. (2019). K-means clustering on multiple correspondence analysis coordinates, a paper accessed via the Archives of Data Science, Series B, published by KIT Scientific Publishing Vol 1, No. 1.
- Leach, M., Mearns, R., & Scoones, I. (1999). Environmental entitlements: dynamics and institutions in community-based natural resource management. *World Development*, 27(2), 225-247.
- Leahy, J., & Lyons, P. (2021). Place Attachment and Concern in Relation to Family Forest Landowner Behavior. *Forests*, 12(3), 295.
- Leavy, J., & White, H. (1999). Rural labour markets and poverty in sub-Saharan Africa. Report produced by the Institute of Development Studies, University of Sussex. https://www.researchgate.net/profile/Jennifer-Leavy/publication/228744467_Rural_Labour_Markets_and_Poverty_in_Sub-Saharan_Africa/links/09e415086f6b87df1c000000/Rural-Labour-Markets-and-Poverty-in-Sub-Saharan-Africa.pdf, last accessed 26th July 2024.
- Leichenko, R., & Silva, J. A. (2014). Climate change and poverty: vulnerability, impacts, and alleviation strategies. *Wiley Interdisciplinary Reviews: Climate Change*, 5(4), 539-556.
- Lele, U., Masters, W. A., Kinabo, J., Meenakshi, J., Ramaswami, B., Tagwireyi, J., & Goswami, S. (2016). *Measuring food and nutrition security: An independent technical assessment and user's guide for*

- existing indicators*. A paper produced by the technical working group on measuring food and nutrition security, with the Food Security Information Network (FSIN).
- Lemanski, C. (2011). Moving up the ladder or stuck on the bottom rung? Homeownership as a solution to poverty in urban South Africa. *International Journal of Urban and Regional Research*, 35(1), 57-77.
- Lent, R. W. (2004). Toward a unifying theoretical and practical perspective on well-being and psychosocial adjustment. *Journal of Counseling Psychology*, 51(4), 482.
- Lentz, E. C. (2017). Keeping up with the neighbors? Reference groups in Ghana. *Economic Development and Cultural Change*, 66(1), 91-112.
- Leviston, Z., Walker, I., Green, M., & Price, J. (2018). Linkages between ecosystem services and human wellbeing: A Nexus Webs approach. *Ecological indicators*, 93, 658-668.
- Lewchuk, W., Clarke, M., & De Wolff, A. (2008). Working without commitments: precarious employment and health. *Work, employment and society*, 22(3), 387-406.
- Li, C., Zuckerman, M., & Diener, E. (2019). Culture moderates the relation between income inequality and subjective well-being. *Journal of Cross-Cultural Psychology*, 50(10), 1221-1241.
- Li, L., Zhang, Z., & Fu, C. (2020). The subjective well-being effect of public goods provided by village collectives: Evidence from China. *Plos one*, 15(3), e0230065.
- Libório, M. P., de Abreu, J. F., Ekel, P. I., & Machado, A. M. C. (2022). 1354 Effect of sub-indicator weighting schemes on the spatial dependence of multidimensional phenomena. *Journal of Geographical Systems*, 25(2), 185-211.
- Limbu, F. (1999). Agricultural technology, economic viability and poverty alleviation in Tanzania. Paper presented at the Structural Transformation Policy Workshop organized by the ECAPAPA, Tegemeo Institute, and Michigan State University, Nairobi, 27-30 June.
- Lin, N. (1999). Building a network theory of social capital. *Connections*, 22(1), 28-51.
- Lin, N. (2000). Inequality in social capital. *Contemporary sociology*, 29(6), 785-795.
- Lipton, M. (1986). Seasonality and ultrapoverty. *Ids Bulletin*, 17(3), 4-8.
- Liu, Y., Li, Y., Li, S., & Motesharrei, S. (2015). Spatial and temporal patterns of global NDVI trends: correlations with climate and human factors. *Remote Sensing*, 7(10), 13233-13250.
- Lloyd, C. B., & Gage-Brandon, A. J. (1993). Women's role in maintaining households: family welfare and sexual inequality in Ghana. *Population Studies*, 47(1), 115-131.
- Lloyd, P. C. (2018). *The new elites of tropical Africa*. Routledge.
- Lo, A. Y., & Chan, F. (2017). Preparing for flooding in England and Wales: the role of risk perception and the social context in driving individual action. *Natural Hazards*, 88(1), 367-387.
- Lobell, D. B., Bänziger, M., Magorokosho, C., & Vivek, B. (2011). Nonlinear heat effects on African maize as evidenced by historical yield trials. *Nature climate change*, 1(1), 42-45.
- Lomuscio, S. (2021). Getting Started with the Kruskal-Wallis Test. <https://data.library.virginia.edu/getting-started-with-the-kruskal-wallis-test/#:~:text=Sample%20size%20%E2%80%93%20each%20group%20must,size%20of%205%20or%20more>, last accessed 26th July 2024.
- Long, S. P., Ainsworth, E. A., Leakey, A. D., Nösberger, J., & Ort, D. R. (2006). Food for thought: lower-than-expected crop yield stimulation with rising CO2 concentrations. *Science*, 312(5782), 1918-1921.
- Lopez-Calva, L. F., & Ortiz-Juárez, E. (2009). Medición multidimensional de la pobreza en México: significancia estadística en la inclusión de dimensiones no monetarias. *Estudios Económicos*, 3-33.
- Loveridge, R., Sallu, S. M., Peshu, I. J., & R Marshall, A. (2020). Measuring human wellbeing: A protocol for selecting local indicators. *Environmental Science & Policy*, 114, 461-469.
- Luechinger, S., & Raschky, P. A. (2009). Valuing flood disasters using the life satisfaction approach. *Journal of public economics*, 93(3-4), 620-633.

- Lufumpa, C. L. (2005). The poverty–environment nexus in Africa. *African Development Review*, 17(3), 366-381.
- Luginaah, I., Arku, G., & Baiden, P. (2010). Housing and health in Ghana: The psychosocial impacts of renting a home. *International Journal of Environmental Research and Public Health*, 7(2), 528-545.
- Lutz, W., Striessnig, E., Dimitrova, A., Ghislandi, S., Lijadi, A., Reiter, C., Spitzer, S., & Yildiz, D. (2021). Years of good life is a well-being indicator designed to serve research on sustainability. *Proceedings of the National Academy of Sciences*, 118(12), e1907351118.
- Lutz, W. (2022). The Demography of Sustainable Human Wellbeing, proceedings from the Population-Environment Research Network Cyberseminar, 21st March 2022.
- Lynch, J. W., Smith, G. D., Kaplan, G. A., & House, J. S. (2000). Income inequality and mortality: importance to health of individual income, psychosocial environment, or material conditions. *BMJ*, 320(7243), 1200-1204.
- Lyon, F. (2000). Trust, networks and norms: the creation of social capital in agricultural economies in Ghana. *World Development*, 28(4), 663-681.
- Lyon, F. (2003). Community groups and livelihoods in remote rural areas of Ghana: How small-scale farmers sustain collective action. *Community Development Journal*, 38(4), 323-331.
- Ma, Z., Guo, S., Deng, X., & Xu, D. (2022). Place attachment, community trust, and farmer's community participation: Evidence from the hardest-hit areas of Sichuan, China. *International Journal of Disaster Risk Reduction*, 73, 102892.
- Mabe, F. N., Sienso, G., & Donkoh, S. A. (2014). Determinants of choice of climate change adaptation strategies in Northern Ghana. *Research in Applied Economics*, 6(4), 75-94.
- Mahadea, D., & Rawat, T. (2008). Economic growth, income and happiness: An exploratory study. *South African Journal of Economics*, 76(2), 276-290.
- Mahama, T. A.-K., & Nkegbe, P. K. (2021). Impact of household livelihood diversification on welfare in Ghana. *Scientific African*, 13, e00858.
- Mahmood, T., Yu, X., & Klasen, S. (2019). Do the poor really feel poor? Comparing objective poverty with subjective poverty in Pakistan. *Social indicators research*, 142(2), 543-580.
- Mallick, B. (2019). The nexus between socio-ecological system, livelihood resilience, and migration decisions: Empirical evidence from Bangladesh. *Sustainability*, 11(12), 3332.
- Marcus, C. C. (2006). *House as a mirror of self: Exploring the deeper meaning of home*. Nicolas-Hays, Inc.
- Marivoet, W., & De Herdt, T. (2015). Poverty Lines as Context Deflators: A Method to Account for Regional Diversity with Application to the Democratic Republic of Congo. *Review of Income and Wealth*, 61(2), 329-352.
- Marks, G. N. (2007). Income poverty, subjective poverty and financial stress, an Australian Government Social Policy Research Paper no. 29.
- Markussen, T., Fibæk, M., Tarp, F., & Tuan, N. D. A. (2018). The happy farmer: self-employment and subjective well-being in rural Vietnam. *Journal of Happiness Studies*, 19(6), 1613-1636.
- Marmot, M. (2013). *Fair society, healthy lives: The Marmot Review*. The Marmot Review.
- Marshall, N. A., Fenton, D. M., Marshall, P. A., & Sutton, S. G. (2007). How resource dependency can influence social resilience within a primary resource industry. *Rural Sociology*, 72(3), 359-390.
- Martel, P., Mbofana, F., & Cousens, S. (2021). The polychoric dual-component wealth index as an alternative to the DHS index: Addressing the urban bias. *Journal of global health*, 11, 04003.
- Mastrothanasis, K. (2020). *How can I make interpretation of Kendall's Tau-b correlation magnitude?* <https://www.researchgate.net/post/How-can-I-make-interpretation-of-kendalls-Tau-b-correlation-magnitude#:~:text=Kendall's%20tau%20DB%20values%3A,or%20%2D%200.30%20or%20above%3A%20strong>, last accessed 26th July 2024.
- Mateu, P., Vásquez, E., Zúñiga, J., & Ibáñez, F. (2020). Happiness and poverty in the very poor Peru: measurement improvements and a consistent relationship. *Quality & quantity*, 54(3), 1075-1094.

- Mathbor, G. M. (2007). Enhancement of community preparedness for natural disasters: The role of social work in building social capital for sustainable disaster relief and management. *International Social Work*, 50(3), 357-369.
- Mattah, P. A. D., Kwarteng, A. J., & Mensah, J. (2018). Indicators of service quality and satisfaction among graduating students of a higher education institution (HEI) in Ghana. *Higher Education Evaluation and Development*, 12(1), 36-52.
- Maunganidze, L. (2019). Getting to grips with gatekeepers in African migrant research. *Botswana Notes and Records*, 51, 49-63.
- Mawere, M. (2012). Buried and forgotten but not dead: Reflections on Ubuntu in environmental conservation in South Eastern Zimbabwe. *Afro Asian Journal of social sciences*, 3(3.2), 1-20.
- McCusker, B., & Carr, E. R. (2006). The co-production of livelihoods and land use change: Case studies from South Africa and Ghana. *Geoforum*, 37(5), 790-804.
- McFadden, D. (1977). Quantitative methods for analysing travel behaviour of individuals: some recent developments. Cowles Foundation Discussion Papers No. 707.
- McGrail, M. R., & Humphreys, J. S. (2009). The index of rural access: an innovative integrated approach for measuring primary care access. *BMC Health Services Research*, 9(1), 1-12.
- MEA. (2005). *Ecosystems and human well-being*. Island Press, Washington, DC.
- Meier, E. S., Kienast, F., Pearman, P. B., Svenning, J. C., Thuiller, W., Araújo, M. B., Guisan, A., & Zimmermann, N. E. (2010). Biotic and abiotic variables show little redundancy in explaining tree species distributions. *Ecography*, 33(6), 1038-1048.
- Mensah, J. T., & Botchway, E. (2013). Ghana's salt industry: A neglected sector for economic development? *Resources Policy*, 38(3), 288-294.
- Mesch, G. S., & Manor, O. (1998). Social ties, environmental perception, and local attachment. *Environment and behavior*, 30(4), 504-519.
- Metz, T. (2012). An African theory of moral status: A relational alternative to individualism and holism. *Ethical Theory and Moral Practice*, 15, 387-402.
- Meyer, B. (1998). The power of money: politics, occult forces, and Pentecostalism in Ghana. *African Studies Review*, 41(3), 15-37.
- Mfofo-M'Carthy, M., & Grischow, J. (2022). Hierarchy and inequality in research: Navigating the challenges of research in Ghana. *Qualitative research*, 22(5), 729-742.
- Miescher, S. F. (2021). Ghana's Akosombo Dam, Volta Lake Fisheries & Climate Change. *Daedalus*, 150(4), 124-142.
- Mihaylov, N., & Perkins, D. D. (2014). Community Place Attachment and its Role in Social Capital Development. In Manzo, L. & Devine-Wright, P. (eds.), *Place Attachment: Advances in Theory, Methods and Research* (pp. 61-74), Routledge.
- Milbourne, P. (2014). Poverty, place, and rurality: material and sociocultural disconnections. *Environment and Planning A*, 46(3), 566-580.
- Miller, D. L., Scheffler, R., Lam, S., Rosenberg, R., & Rupp, A. (2006). Social capital and health in Indonesia. *World Development*, 34(6), 1084-1098.
- Millner, S. Y. (1994). Free grace in the wilderness. An aesthetic analysis of land and space in African American culture: In the narratives of Henry Bibb, Harriet Jacobs and Josiah Henson. Thesis submitted to Temple University. <https://www.proquest.com/docview/304119759?pq-origsite=gscholar&fromopenview=true&sourcetype=Dissertations%20%20Theses>, last accessed 26th July 2014.
- Mills, A., Ataguba, J. E., Akazili, J., Borghi, J., Garshong, B., Makawia, S., Mtei, G., Harris, B., Macha, J., & Meheus, F. (2012). Equity in financing and use of health care in Ghana, South Africa, and Tanzania: implications for paths to universal coverage. *The Lancet*, 380(9837), 126-133.

- Miñarro, S., Selim, S., & Galbraith, E. D. (2022). Does catching more fish increase the subjective well-being of fishers? Insights from Bangladesh. *Ambio*, 51(7), 1-14.
- Mireku-Gyimah, N., Apanga, P. A., & Awoonor-Williams, J. K. (2018). Cyclical cholera outbreaks in Ghana: filth, not myth. *Infectious Diseases of Poverty*, 7(03), 72-76.
- Mkrtchyan, G., Blam, I. Y., Kovalev, S. Y., & Tselodub, Y. O. (2018). Impact of climate change on the subjective well-being of households in Russia. *Regional Research of Russia*, 8(3), 281-288.
- Mohammed, A. S., Derbile, E. K., & Mordzeh-Ekpampo, M. I. (2013). The White Volta Basin, climate change and food security: Perspectives of riparian communities in northern Ghana. *Journal of Environmental Science and Engineering. B*, 2(6B), 350.
- Mohapatra, B., & Mohamed, A. R. (2013). Place attachment and participation in management of neighbourhood green space: a place-based community management. *International Journal of Sustainable Society*, 5(3), 266-283.
- Mohammed, A., Li, J., Elaru, J., Elbashier, M. M., Keesstra, S., Artemi, C., Martin, K., Reuben, M., & Teffera, Z. (2018). Assessing drought vulnerability and adaptation among farmers in Gadaref region, Eastern Sudan. *Land use policy*, 70, 402-413.
- Mol, A. P., & Spaargaren, G. (2000). Ecological modernisation theory in debate: A review. *Environmental politics*, 9(1), 17-49.
- Moraiti, C., Nakas, C., & Papadopoulos, N. (2014). Diapause termination of *Rhagoletis cerasi* pupae is regulated by local adaptation and phenotypic plasticity: escape in time through bet-hedging strategies. *Journal of Evolutionary Biology*, 27(1), 43-54.
- Morley, L., Leach, F., & Lugg, R. (2009). Democratising higher education in Ghana and Tanzania: Opportunity structures and social inequalities. *International Journal of Educational Development*, 29(1), 56-64.
- Morse, S., McNamara, N., & Acholo, M. (2009). *Sustainable Livelihood Approach: A critical analysis of theory and practice*. Springer, Guildford.
- Morton, P. (2004). *Job Quality in Micro and Small Enterprises in Ghana: Field Research Results*. International Labour Organization SEED Working Paper No. 69. <https://researchrepository.ilo.org/esploro/outputs/encyclopediaEntry/Job-quality-in-micro-and-small/995328520702676/filesAndLinks?index=0>, last accessed 19th July 2024.
- Mortreux, C., & Adams, H. (2015). *Setting the scene: national and deltaic migration trends in India, Bangladesh and Ghana*. DECCMA Working Paper, IDRC Project Number 107642. <https://environmentalmigration.iom.int/sites/g/files/tmzbd1411/files/documents/2023-11/final-working-paper-on-migration-130715.pdf>, last accessed 19th July 2024.
- Moseley, W. G. (2001). African evidence on the relation of poverty, time preference and the environment. *Ecological economics*, 38(3), 317-326.
- Moss, R. H., Brenkert, A. L., & Malone, E. L. (2001). Vulnerability to climate change: a quantitative approach. Report prepared for the U.S. Department of Energy.
- Munsaka, E., & Mutasa, S. (2020). Flooding and its impact on education. *Natural Hazards - Impacts, Adjustments and Resilience*, edited by Ehsan Noroozinejad Farsangi. <https://www.intechopen.com/chapters/73784#>, last accessed 26th July 2024.
- Musah-Surugu, I. J., Ahenkan, A., Bawole, J. N., & Darkwah, S. A. (2017). Migrants' remittances: A complementary source of financing adaptation to climate change at the local level in Ghana. *International Journal of Climate Change Strategies and Management*, 10(1), 178-196.
- Muttarak, R., & Lutz, W. (2014). Is education a key to reducing vulnerability to natural disasters and hence unavoidable climate change? *Ecology and Society*, 19(1).
- Nabbali, E. M. (2016). On becoming 'White' through ethnographic fieldwork in Ghana: Are ideas imperial by course. *Language, Discourse, & Society*, 4(1), 83-110.
- Nafukho, F. M. (2006). Ubuntu worldview: A traditional African view of adult learning in the workplace. *Advances in Developing Human Resources*, 8(3), 408-415.

- Nahian, M. A., Ahmed, A., Lázár, A. N., Hutton, C. W., Salehin, M., & Streatfield, P. K. (2018). Drinking water salinity associated health crisis in coastal Bangladesh. *Elem Sci Anth*, 6, 2.
- Namara, R. E., Hanjra, M. A., Castillo, G. E., Ravnborg, H. M., Smith, L., & Van Koppen, B. (2010). Agricultural water management and poverty linkages. *Agricultural water management*, 97(4), 520-527.
- Nanor, M. A., Poku-Boansi, M., & Adarkwa, K. K. (2021). Determinants of subjective wellbeing in rural communities: Evidence from the Juaben Municipality, Ghana. *Cities*, 113, 103140.
- Narayan, D., & Petesch, P. (2002). *Voices of the poor: From many lands*. World Bank and Oxford University Press.
- NASA. (2022). MODIS Vegetation Index Products (NDVI and EVI). <https://modis.gsfc.nasa.gov/data/dataproduct/mod13.php>, last accessed 26th July 2024.
- National Ocean Service (2022). *What is storm surge?* <https://oceanservice.noaa.gov/facts/stormsurge-stormtide.html>; last accessed 7th January 2024.
- National Research Council. (1989). *Recommended dietary allowances*. National Academies Press (US), Washington DC.
- Navarro O., Michel-Guillou E. (2014). Analyse des risques et menaces environnementales. Un regard psycho-socio-environnemental. In Marchand D., Depeau S., Weiss K. (eds.). *L'individu au risque de l'environnement. Regards croisés de la Psychologie environnementale* (pp. 271–297), Editions in Press.
- Navarro, O. (2017). Social inequality and environmental risk perception. In Fleury-Bahi, G; Pol, E and Navarro, O (eds) *Handbook of environmental psychology and quality of life research* (pp. 503-518). Springer.
- Ndabarora, E., Chipps, J. A., & Uys, L. (2014). Systematic review of health data quality management and best practices at community and district levels in LMIC. *Information Development*, 30(2), 103-120.
- Ndamani, F., & Watanabe, T. (2015). Farmers' perceptions about adaptation practices to climate change and barriers to adaptation: A micro-level study in Ghana. *Water*, 7(9), 4593-4604.
- Nelson, J. A. (1988). Household economies of scale in consumption: theory and evidence. *Econometrica: journal of the econometric society*, 56(6), 1301-1314.
- Neria, Y., Nandi, A., & Galea, S. (2008). Post-traumatic stress disorder following disasters: a systematic review. *Psychological medicine*, 38(4), 467-480.
- Nesbitt, R. C., Gabrysch, S., Laub, A., Soremekun, S., Manu, A., Kirkwood, B. R., Amenga-Etego, S., Wiru, K., Höfle, B., & Grundy, C. (2014). Methods to measure potential spatial access to delivery care in low-and middle-income countries: a case study in rural Ghana. *International journal of health geographics*, 13(1), 1-13.
- Newton, J. (2007). Structures, regimes and wellbeing. ESRC Research Group on Wellbeing in Developing Countries, WeD Working Paper 30.
- Ng, W., & Diener, E. (2014). What matters to the rich and the poor? Subjective well-being, financial satisfaction, and postmaterialist needs across the world. *Journal of personality and social psychology*, 107(2), 326.
- Ngamaba, K. H., Panagioti, M., & Armitage, C. J. (2017). How strongly related are health status and subjective well-being? Systematic review and meta-analysis. *The European Journal of Public Health*, 27(5), 879-885.
- Ngure, F. M., Reid, B. M., Humphrey, J. H., Mbuya, M. N., Pelto, G., & Stoltzfus, R. J. (2014). Water, sanitation, and hygiene (WASH), environmental enteropathy, nutrition, and early child development: making the links. *Annals of the New York Academy of Sciences*, 1308(1), 118-128.
- Niang, I., Ruppel, C., Abdrabo, M-A., Essel, A., Lennard, C., Padgham, J., Urquhart, P. (2014). Africa. In: Barros, V. R., Field, C. B., Dokken, D. J., Mastrandrea, M. D., Mach, K. J., Bilir, T. E., Chatterjee, M., Ebi, K. L., Estrada, Y. O., Genova, R. C., Girma, B., Kiseel, E. S., Levy, A. N., MacCracken, S., Mastrandrea, P. R. & White, L.L. (eds) *Climate Change 2014: Impacts, Adaptation, and*

Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge.

- Nicholls, R. J., & Cazenave, A. (2010). Sea-level rise and its impact on coastal zones. *Science*, 328(5985), 1517-1520.
- Nicholls, R., Adger, N., Hutton, C. & Hanson, S. (2020). Delta Challenges and Trade-Offs from the Holocene to the Anthropocene. In: Nicholls, R., Adger, N., Hutton, C. & Hanson, S. (eds) *Deltas in the Anthropocene* (pp.1-22). Palgrave Macmillan, Cham.
- Nielsen, L., Jørgensen, N. O., & Gelting, P. (2007). Mapping of the freshwater lens in a coastal aquifer on the Keta Barrier (Ghana) by transient electromagnetic soundings. *Journal of Applied Geophysics*, 62(1), 1-15.
- Nieman, A. (2006). Social capital and social development. *Social Work/Maatskaplike Werk*, 42(2).
- Nieswand, B. (2014). The burgers' paradox: Migration and the transnationalization of social inequality in southern Ghana. *Ethnography*, 15(4), 403-425.
- Nieto, K., & Mélin, F. (2017). Variability of chlorophyll-a concentration in the Gulf of Guinea and its relation to physical oceanographic variables. *Progress in oceanography*, 151, 97-115.
- Nketiah-Amponsah, E., & Hiemenz, U. (2009). Determinants of consumer satisfaction of health care in Ghana: does choice of health care provider matter? *Global journal of health science*, 1(2), 50.
- Nkosi, V., Haman, T., Naicker, N., & Mathee, A. (2019). Overcrowding and health in two impoverished suburbs of Johannesburg, South Africa. *BMC public health*, 19(1), 1-8.
- Nkrumah, F., Klutse, N. A. B., Adukpo, D. C., Owusu, K., Quagraine, K. A., Owusu, A., & Gutowski, W. (2014). Rainfall variability over Ghana: model versus rain gauge observation. *International Journal of Geosciences*, 5(7), 673.
- Noble, M., Zembe, W., & Wright, G. (2014). Poverty may have declined, but deprivation and poverty are still worst in the former homelands. Article produced by the Southern African Social Policy Research Institute.
- Nortey, S. T., Aryeetey, G. C., Aikins, M., Amendah, D., & Nonvignon, J. (2017). Economic burden of family caregiving for elderly population in southern Ghana: the case of a peri-urban district. *International journal for equity in health*, 16(1), 1-9.
- Nosratabadi, S., Khazami, N., Abdallah, M. B., Lackner, Z., S Band, S., Mosavi, A., & Mako, C. (2020). Social capital contributions to food security: A comprehensive literature review. *Foods*, 9(11), 1650.
- Novignon, J. (2010). Estimating household vulnerability to poverty from cross section data: an empirical evidence from Ghana. Paper produced by the Munich Personal RePEc Archive. https://mpra.ub.uni-muenchen.de/39900/1/MPRA_paper_39900.pdf, last accessed 26th July 2024.
- Nthiwa, D., Alonso, S., Odongo, D., Kenya, E., & Bett, B. (2019). A participatory epidemiological study of major cattle diseases amongst Maasai pastoralists living in wildlife-livestock interfaces in Maasai Mara, Kenya. *Tropical Animal Health and Production*, 51, 1097-1103.
- Nuijten, E. (2011). Combining research styles of the natural and social sciences in agricultural research. *NJAS: Wageningen Journal of Life Sciences*, 57(3-4), 197-205.
- Nunan, F. (2015). *Understanding poverty and the environment: analytical frameworks and approaches*. Routledge.
- Nussbaum, M. C. (2001). *Women and human development: The capabilities approach* (Vol. 3). Cambridge University Press.
- Nyamwanza, A. M. (2012). Livelihood resilience and adaptive capacity: A critical conceptual review. *Jàmbá: Journal of Disaster Risk Studies*, 4(1), 1-6.
- Nyumba, T., Wilson, K., Derrick, C. J., & Mukherjee, N. (2018). The use of focus group discussion methodology: Insights from two decades of application in conservation. *Methods in Ecology and evolution*, 9(1), 20-32.

- Obeng-Odoom, F., & Amedzro, L. (2011). Inadequate housing in Ghana. *Urbani izziv*, 22(1), 127.
- Odotei, I. K. (2002). Sea Power, Money Power: Ghanaian Migrant Fisherman and Women in the Republic of Benin. Produced by Institute of African Studies, University of Ghana, Legon.
<https://search.worldcat.org/title/55286192>, last accessed 26th July 2024.
- Oduro, A. D., & Ackah, C. G. (2017). Closing the Gender Gaps in Ghana. In Aryeetey, E. & Kanbur, R. (eds) *The Economy of Ghana Sixty Years after Independence* (pp. 317-332), Oxford University Press.
- OECD. (2008). *Handbook on constructing composite indicators: methodology and user guide*. OECD publishing.
- OECD. (2011). *What are equivalence scales?* A note produced by the OECD project on income distribution and poverty. <https://www.oecd.org/els/soc/OECD-Note-EquivalenceScales.pdf>, last accessed 25th July 2024.
- OECD. (2013). *OECD framework for statistics on the distribution of household income, consumption and wealth*. OECD Publishing.
- OECD. (2020). *How's Life? 2020: Measuring Well-being*, OECD Publishing, Paris,
- OECD. (2022). Better Life Index. <https://www.oecdbetterlifeindex.org/#/35131111111>, last accessed 26th July 2024.
- OECD. (2023). *Household disposable income*. <https://www.oecd.org/en/data/indicators/household-disposableincome.html#:~:text=Definition,Household%20disposable%20income%20is%20the%20sum%20of%20household%20final%20consumption,and%20income%20from%20financial%20investments>, last accessed 15th February 2025.
- OECD/WHO. (2003). *Poverty and Health*, DAC Guidelines and Reference Series, OECD Publishing, Paris.
- Ofori, B. D., Lawson, E. T., Ayivor, J. S., & Kanlisi, R. (2016). Sustainable livelihood adaptation in dam-affected Volta Delta, Ghana: Lessons of NGO support. *Journal of Sustainable Development*, 9(3), 248.
- Ofori-Danson, P. K., Sarpong, D. B., Sumaila, U. R., Nunoo, F., & Asiedu, B. (2013). Poverty measurements in small-scale fisheries of Ghana: A step towards poverty eradication. *Journal: Current Research Journal of Social Sciences*, 5(3), 75-90.
- Oguntunde, P. G., Friesen, J., van de Giesen, N., & Savenije, H. H. (2006). Hydroclimatology of the Volta River Basin in West Africa: Trends and variability from 1901 to 2002. *Physics and Chemistry of the Earth, Parts A/B/C*, 31(18), 1180-1188.
- Ohemeng, F., Small, B., & Molinari, V. (2020). Social activities and subjective well-being of Older Adults in Ghana. *Journal of Population Ageing*, 13(4), 443-463.
- Okorosobo, T., Okorosobo, F., Mwabu, G., Orem, J., & Kirigia, J. (2018). Economic burden of malaria in six countries of Africa. *Journal of Business Market Management*, 3(6), 42-63.
- Okwi, P. O., Ndeng'e, G., Kristjanson, P., Arunga, M., Notenbaert, A., Omolo, A., Henninger, N., Benson, T., Kariuki, P., & Owuor, J. (2007). Spatial determinants of poverty in rural Kenya. *Proceedings of the National Academy of Sciences*, 104(43), 16769-16774.
- O'Mahony, T. (2022). Towards 'sustainable wellbeing': advances in contemporary concepts. *Frontiers in Sustainability*, 3, 1-17.
- ONS. (2018) *An expenditure-based approach to poverty in the UK: financial year ending 2017*.
<https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/incomeandwealth/articles/anexpenditurebasedapproachtopovertyintheuk/financialyearending2017>, last accessed 25th July 2024.
- Opare-Addo, M. N., Osei, F. A., Buabeng, K. O., Marfo, A. F., Nyanor, I., Amuzu, E. X., Ansong, D., & Owusu-Dabo, E. (2020). Healthcare services utilisation among patients with hypertension and diabetes in rural Ghana. *African Journal of Primary Health Care and Family Medicine*, 12(1), 1-8.
- Orkoh, E., Blaauw, P. F., & Claassen, C. (2020). Relative effects of income and consumption poverty on time poverty in Ghana. *Social indicators research*, 147(2), 465-499.

- Osei, S. (2016). Social capital and climate change adaptation strategies: the case of smallholder farmers in the Central region of Ghana. Thesis submitted to the University of the West Cape. <https://core.ac.uk/download/pdf/58916226.pdf>, last accessed 26th July 2024.
- Osei-Tutu, A., Dzokoto, V. A., Affram, A. A., Adams, G., Norberg, J., & Doosje, B. (2020). Cultural models of well-being implicit in four Ghanaian languages. *Frontiers in psychology*, 11, 1798.
- Osman, A., Mariwah, S., Yawson, D. O., Kankam, S., & Mensah, E. A. (2022). Broadening The Narrative Of Landscape Ecosystem Services: Assessing Perceived Services From Nature And Services To Nature. *Journal for Nature Conservation*, 68, 126188.
- Osumanu, I. K., Kosoe, E. A., & Ategeeng, F. (2019). Determinants of open defecation in the Wa municipality of Ghana: empirical findings highlighting sociocultural and economic dynamics among households. *Journal of environmental and public health*, 2019, 1-10.
- Oswald, A. J., & Wu, S. (2009). Objective confirmation of subjective measures of human well-being: Evidence from the USA. *Science*, 327(5965), 576-579.
- Oteng, S. A., Manful, E. & Akuoko, K. O. (2021). Retiring in the informal economy: Implications for social policy intervention for ageing workers in Ghana. *Ageing International*, 47, 1–18.
- Owusu, G., & Lund, R. (2004). Markets and women's trade: exploring their role in district development in Ghana. *Norsk Geografisk Tidsskrift-Norwegian Journal of Geography*, 58(3), 113-124.
- Owusu, G. (2005). The role of district capitals in regional development: Linking small towns, rural–urban linkages and decentralisation in Ghana. *International Development Planning Review*, 27(1), 59-90.
- Owusu, G., & Agyei-Mensah, S. (2011). A comparative study of ethnic residential segregation in Ghana's two largest cities, Accra and Kumasi. *Population and Environment*, 32(4), 332-352.
- Owusu, M. (2017). Gender vulnerability to climate change and livelihood security in urban slum communities in Accra, Ghana. Thesis submitted to The University of Adelaide. <https://digital.library.adelaide.edu.au/dspace/bitstream/2440/105374/2/02whole.pdf>, last accessed 26th July 2024.
- OXFAM. (2021). Towards a Wellbeing Economy that services People and Nature. A joint report published by OXFAM Germany. <https://climateofchange.info/wellbeingeconomyreport.pdf>, last accessed 26th July 2024.
- Ozili, P. K. (2023). The acceptable R-square in empirical modelling for social science research. In Saliya, C.A. (ed.) *Social research methodology and publishing results: A guide to non-native English speakers* (pp. 134-143). IGI Global.
- Pacillo, G. (2016). Market participation, innovation adoption and poverty in rural Ghana. Doctoral dissertation, University of Sussex.
- Palmer, R. (2005). *Beyond the basics: post-basic education, training and poverty reduction in Ghana*. Post-Basic Education and Training (PBET) PBET Policy Brief No3, available at https://assets.publishing.service.gov.uk/media/57a08c3ded915d622c001205/Palmer_PBET_PB3_ghana.pdf; last accessed 12th April 2023.
- Palmer, R., Wedgwood, R., Hayman, R., King, K., & Thin, N. (2007). Educating out of poverty?: a synthesis report on Ghana, India, Kenya, Rwanda, Tanzania and South Africa. A DFID funded report by the Centre of African Studies, University of Edinburgh. <https://assets.publishing.service.gov.uk/media/57a08c0d40f0b64974000f7a/ResearchingtheIssuesNo70.pdf>, last accessed 26th July 2024.
- Pan, Y., & Jackson, R. T. (2008). Ethnic difference in the relationship between acute inflammation and serum ferritin in US adult males. *Epidemiology & Infection*, 136(3), 421-431.
- Panday, S., Rushton, S., Karki, J., Balen, J., & Barnes, A. (2021). The role of social capital in disaster resilience in remote communities after the 2015 Nepal earthquake. *International Journal of Disaster Risk Reduction*, 55, 102112.
- Parby, J. I., Lozano Gracia, N., Mason, D., Lall, S. V., Dasgupta, B., & Young, C. (2015). *Stocktaking of the housing sector in sub-Saharan Africa: Challenges and opportunities*. A World Bank report, available at <https://openknowledge.worldbank.org/server/api/core/bitstreams/cbd15195-caac-5a28-ae6a-599371d2b7d2/content>; last accessed 12th February 2023.

- ParCITYpatory. (2017). *Participatory Methods: Transect Walks*.
<https://parcitypatory.org/2017/10/29/transect-walks/>, last accessed 26th July 2024.
- Parfit, D. (1984). *Reasons and persons*. Oxford University Press.
- Parliament of the Republic of Ghana. (2006). *The Minerals and Mining Act 2006*.
<https://faolex.fao.org/docs/pdf/gha85046.pdf>, last accessed 7th August 2023.
- Partey, S. T., Dakorah, A. D., Zougmore, R. B., Ouédraogo, M., Nyasimi, M., Nikoi, G. K., & Huyer, S. (2020). Gender and climate risk management: evidence of climate information use in Ghana. *Climatic Change*, 158(1), 61-75.
- Pata, U. K., Yilanci, V., Hussain, B., & Naqvi, S. A. A. (2022). Analyzing the role of income inequality and political stability in environmental degradation: Evidence from South Asia. *Gondwana Research*, 107, 13-29.
- Patt, A., Klein, R. J., & de la Vega-Leinert, A. (2005). Taking the uncertainty in climate-change vulnerability assessment seriously. *Comptes Rendus Geoscience*, 337(4), 411-424.
- Paudyal, K., Baral, H., Lowell, K., & Keenan, R. J. (2017). Ecosystem services from community-based forestry in Nepal: Realising local and global benefits. *Land use policy*, 63, 342-355.
- Peachey, S., & Roe, S. (2004). *Access to Finance: A Study for the World Savings Banks Institute*. Oxford Policy Management report, available at <https://www.findevgateway.org/sites/default/files/publications/files/mfg-en-paper-access-to-finance-2004.pdf>; last accessed 8th August 2023.
- Peduzzi, P., Concato, J., Kemper, E., Holford, T. R., & Feinstein, A. R. (1996). A simulation study of the number of events per variable in logistic regression analysis. *Journal of clinical epidemiology*, 49(12), 1373-1379.
- Peek, L., & Fothergill, A. (2009). Using focus groups: Lessons from studying daycare centers, 9/11, and Hurricane Katrina. *Qualitative research*, 9(1), 31-59.
- Peng, S., Roth, A., & Perry, B. L. (2021). A latent variable approach to measuring bridging social capital and examining its association to older adults' cognitive health. *Social Neuroscience*, 16(6), 684-694.
- Perez-Heydrich, C., Warren, J. L., Burgert, C. R., & Emch, M. (2013). *Guidelines on the use of DHS GPS data*. <https://dhsprogram.com/pubs/pdf/SAR8/SAR8.pdf>, last accessed 5th August 2023.
- Perrings, C. (1989). An optimal path to extinction?: Poverty and resource degradation in the open agrarian economy. *Journal of Development Economics*, 30(1), 1-24.
- PERSEUS. (2022). *DPSWR framework*. <http://www.perseus-net.eu/site/content.php?artid=2181>, last accessed 26th July 2024.
- Person, K., May, M. S., & Mayer, C.-H. (2016). The meaning of work for South African women: A phenomenological study. *Journal of Psychology in Africa*, 26(2), 134-140.
- Peters, E., Baker, D. P., Dieckmann, N. F., Leon, J., & Collins, J. (2010). Explaining the effect of education on health: A field study in Ghana. *Psychological science*, 21(10), 1369-1376.
- Pickering, A. J., & Davis, J. (2012). Freshwater availability and water fetching distance affect child health in sub-Saharan Africa. *Environmental science & technology*, 46(4), 2391-2397.
- PLDR. (2024). *Small Area Mental Health Index*. <https://pldr.org/dataset/2noyv/small-area-mental-health-index-samhi>, last accessed 15th March 2025.
- Place, F., Adato, M., & Hebinck, P. (2007). Understanding rural poverty and investment in agriculture: An assessment of integrated quantitative and qualitative research in western Kenya. *World Development*, 35(2), 312-325.
- Pogge, T. (2005). *World Poverty and Human Rights: Cosmopolitan Responsibilities and Reforms*, Cambridge University Press.
- Pokimica, J., Addai, I., & Takyi, B. K. (2012). Religion and subjective well-being in Ghana. *Social indicators research*, 106(1), 61-79.
- Poku-Boansi, M., Amoako, C., Owusu-Ansah, J. K., & Cobbinah, P. B. (2020). The geography of urban poverty in Kumasi, Ghana. *Habitat International*, 103, 102220.

- Pollnac, R. B. & Poggie, J. J. (2008). Happiness, well-being and psychocultural adaptation to the stresses associated with marine fishing. *Human Ecology Review*, 15(2), 194–200.
- Poortinga, W. (2006). Social relations or social capital? Individual and community health effects of bonding social capital. *Social Science & Medicine*, 63(1), 255–270.
- Poortinga, W. (2012). Community resilience and health: The role of bonding, bridging, and linking aspects of social capital. *Health & place*, 18(2), 286–295.
- Porter, G., & Lyon, F. (2006). Groups as a means or an end? Social capital and the promotion of cooperation in Ghana. *Environment and Planning D: Society and Space*, 24(2), 249–262.
- Porter, G. (2007). *Transport, (Im) Mobility, and Spatial Poverty Traps: Issues for Rural Women and Girl Children in Sub-Saharan Africa*. A paper prepared for the international workshop “Understanding and addressing spatial poverty traps: an international workshop” 29 March 2007, Spier Estate, Stellenbosch, South Africa. Hosted by the Chronic Poverty Research Centre and the Overseas Development Institute.
- Pörtner, H.-O., Roberts, D. C., Adams, H., Adler, C., Aldunce, P., Ali, E., Begum, R. A., Betts, R., Kerr, R. B., & Biesbroek, R. (2022). *Climate change 2022: Impacts, adaptation and vulnerability*. IPCC Geneva, Switzerland.
- Posel, D. R., & Casale, D. M. (2011). Relative standing and subjective well-being in South Africa: The role of perceptions, expectations and income mobility. *Social indicators research*, 104(2), 195–223.
- Posel, D., & Rogan, M. (2016). Measured as poor versus feeling poor: Comparing money-metric and subjective poverty rates in South Africa. *Journal of Human Development and Capabilities*, 17(1), 55–73.
- Power, A. G. (2010). Ecosystem services and agriculture: tradeoffs and synergies. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 365(1554), 2959–2971.
- Pradhan, M., & Ravallion, M. (2000). Measuring poverty using qualitative perceptions of consumption adequacy. *Review of Economics and Statistics*, 82(3), 462–471.
- Prakash, S. (1997). Poverty and environment linkages in mountains and uplands: Reflections on the ‘poverty trap’. Centre for Research in Experimental Economics and Political Decision Making (CREED) Working Paper No. 12.
- Pretty, J. (2003). Social capital and the collective management of resources. *Science*, 302(5652), 1912–1914.
- Pretty, J., & Ward, H. (2001). Social capital and the environment. *World Development*, 29(2), 209–227.
- Pritchett, L., & Summers, L. H. (1993). Wealthier is healthier. World Development Report Working Paper. <https://documents1.worldbank.org/curated/en/684651468741004317/pdf/multi0page.pdf>, last accessed 26th July 2024.
- Pröbstl-Haider, U. (2015). Cultural ecosystem services and their effects on human health and well-being—a cross-disciplinary methodological review. *Journal of Outdoor Recreation and Tourism*, 10(1), 1–13.
- Pyne, J. M., French, M., McCollister, K., Tripathi, S., Rapp, R., & Booth, B. (2008). Preference-weighted health-related quality of life measures and substance use disorder severity. *Addiction*, 103(8), 1320–1329.
- Qasim, M., & Grimes, A. (2021). Sustainability and wellbeing: the dynamic relationship between subjective wellbeing and sustainability indicators. *Environment and Development Economics*, 27(1), 1–19.
- Quaye, W., Dowuona, S., Okai, M., & Dziedzoave, N. (2016). Gender dimensions of decision-making on production assets and challenges facing women. *Development in practice*, 26(1), 77–90.
- Quayesi-Amakye, J. (2017). Pentecostalism, the Akan Religion and the Good Life. *International Journal of Pentecostal Missiology*, 5, 111–128.
- Quinn, C. E., & Halfacre, A. C. (2014). Place matters: An investigation of farmers' attachment to their land. *Human Ecology Review*, 20(2), 117–132.

- Quisumbing, A. R., & Pandolfelli, L. (2010). Promising approaches to address the needs of poor female farmers: Resources, constraints, and interventions. *World Development*, 38(4), 581-592.
- Rahaman, M.A., Rahman, M.M., Nazimuzzaman, M. (2020). Impact of Salinity on Infectious Disease Outbreaks: Experiences from the Global Coastal Region. In: Filho, L; Wall, W; Azul, A.M; Brandli, L & Özuyar, P.G. (eds) *Good Health and Well-Being. Encyclopedia of the UN Sustainable Development Goals* (pp. 415-424), Springer, Cham.
- Rahman, M. K., & Schmidlin, T. W. (2014). The perception and impact of natural hazards on fishing communities of Kutubdia Island, Bangladesh. *Geographical Review*, 104(1), 71-86.
- Raj, J., Bangalath, H. K., & Stenchikov, G. (2019). West African Monsoon: current state and future projections in a high-resolution AGCM. *Climate dynamics*, 52(11), 6441-6461.
- Ram, R. (2006). Further examination of the cross-country association between income inequality and population health. *Social Science & Medicine*, 62(3), 779-791.
- Ramalhete, I., Farias, H., & da Silva Pinto, R. (2018). Overcrowding and Adequate Housing: The Potential of Adaptability. *International Journal of Architectural and Environmental Engineering*, 12(12), 1203-1213.
- Ramón-Hidalgo, A.-E., & Harris, L. M. (2018). Social Capital, political empowerment and social difference: A mixed-methods study of an ecotourism project in the rural Volta region of Ghana. *Journal of Sustainable Tourism*, 26(12), 2153-2172.
- Rao, N. D., van Ruijven, B. J., Riahi, K., & Bosetti, V. (2017). Improving poverty and inequality modelling in climate research. *Nature climate change*, 7(12), 857-862.
- Rao, N., Singh, C., Solomon, D., Camfield, L., Sidiki, R., Angula, M., Poonacha, P., Sidibé, A., & Lawson, E. T. (2020). Managing risk, changing aspirations and household dynamics: Implications for wellbeing and adaptation in semi-arid Africa and India. *World Development*, 125, 104667.
- Rashid, L., Alzafari, K., & Kratzer, J. (2020). Founder personalities, behaviors and new venture success in Sub-Saharan Africa. *Technological Forecasting and Social Change*, 151, 119766.
- Rasool, M. S. A., Harun, M. F. M., Salleh, A. M., & Idris, N. (2011). Poverty measurement in Malaysia: A survey of the literature. *Akademika*, 81(1), 73-81.
- Ravallion, M., & Lokshin, M. (2002). Self-rated economic welfare in Russia. *European Economic Review*, 46(8), 1453-1473.
- Ravallion, M., Himelein, K. & Beegle, K. (2013). *Can subjective questions on economic welfare be trusted? Evidence for three developing countries*, a World Bank Development Research Office working paper no. 6726.
- Ravallion, M. (2014). *Poor, or just feeling poor? On using subjective data in measuring poverty*, a World Bank Development Research Office working paper no. 5968.
- Ravallion, M. (2015). *The economics of poverty: History, measurement, and policy*. Oxford University Press.
- Ray-Bennett, N. S. (2009). The influence of caste, class and gender in surviving multiple disasters: A case study from Orissa, India. *Environmental Hazards*, 8(1), 5-22.
- Read, U. M., Adiibokah, E., & Nyame, S. (2009). Local suffering and the global discourse of mental health and human rights: An ethnographic study of responses to mental illness in rural Ghana. *Globalization and Health*, 5(1), 1-16.
- Reardon, T., & Vosti, S. A. (1995). Links between rural poverty and the environment in developing countries: asset categories and investment poverty. *World Development*, 23(9), 1495-1506.
- Reason, C., Hachigonta, S., & Phaladi, R. (2005). Interannual variability in rainy season characteristics over the Limpopo region of southern Africa. *International Journal of Climatology: A Journal of the Royal Meteorological Society*, 25(14), 1835-1853.
- Refaeli, T., & Achdut, N. (2022). Perceived poverty, perceived income adequacy and loneliness in Israeli young adults: Are social capital and neighbourhood capital resilience factors? *Health & Social Care in the Community*, 30(2), 668-684.

- Regier, G., Zereyesus, Y. A., Dalton, T. J., & Amanor-Boadu, V. (2019). Do adult equivalence scales matter in poverty estimates? A Northern Ghana case study and simulation. *Journal of International Development*, 31(1), 80-100.
- Reinhard, I., & Wijeratne, K. (2000). The use of stunting and wasting as indicators for food insecurity and poverty. Poverty Impact Monitoring Unit (PIMU) Working Paper 27.
- Reisinger, A., Howden, M., Vera, C., Garschagen, M., Hurlbert, M., Kreibiehl, S., Mach, K. J., Mintenbeck, K., O'Neill, B., & Pathak, M. (2020). *The concept of risk in the IPCC Sixth Assessment Report*. A summary of cross-working group discussions, Guidance for IPCC Authors. <https://www.ipcc.ch/site/assets/uploads/2021/01/The-concept-of-risk-in-the-IPCC-Sixth-Assessment-Report.pdf>, last accessed 7th March 2024.
- Reisinger, J. (2022). Subjective well-being and social desirability. *Journal of public economics*, 214, 104745.
- Rekolainen, S., Kämäri, J., Hiltunen, M., & Saloranta, T. M. (2003). A conceptual framework for identifying the need and role of models in the implementation of the Water Framework Directive. *International Journal of River Basin Management*, 1(4), 347-352.
- Republic of Ghana (2020). *President Akufo-Addo Cuts Sod For €85 Million Keta Water Supply Project*. <https://www.presidency.gov.gh/index.php/briefing-room/news-style-2/1673-president-akufo-addo-cuts-sod-for-85-million-keta-water-supply-project>, last accessed 26th July 2024.
- Reuveny, R. (2007). Climate change-induced migration and violent conflict. *Political geography*, 26(6), 656-673.
- Reyes-García, V., Babigumira, R., Pyhälä, A., Wunder, S., Zorondo-Rodríguez, F., & Angelsen, A. (2016). Subjective wellbeing and income: Empirical patterns in the rural developing world. *Journal of Happiness Studies*, 17(2), 773-791.
- Richterman, A., Franke, M. F., Constant, G., Jerome, G., Ternier, R., & Ivers, L. C. (2019). Food insecurity and self-reported cholera in Haitian households: An analysis of the 2012 Demographic and Health Survey. *PLoS neglected tropical diseases*, 13(1), e0007134.
- Ridhwan, M. M., Nijkamp, P., Ismail, A., & M Irsyad, L. (2022). The effect of health on economic growth: a meta-regression analysis. *Empirical Economics*, 63, 1-41.
- Rishworth, A., Elliott, S. J., & Kangmennaang, J. (2020). Getting old well in sub-Saharan Africa: Exploring the social and structural drivers of subjective wellbeing among elderly men and women in Uganda. *International Journal of Environmental Research and Public Health*, 17(7), 2347.
- Riverson, J., Gaviria, J., & Thriscutt, S. (1991). Rural roads in sub-Saharan Africa. Report prepared under the Rural Travel and Transport Project of the sub - Saharan Africa Transport Program (SSATP). <https://documents.worldbank.org/en/publication/documents-reports/documentdetail/128471468204559918/rural-roads-in-sub-saharan-africa-lessons-from-world-bank-experience>, last accessed 26th July 2024.
- Roberts, J. T. (2001). Global inequality and climate change. *Society & Natural Resources*, 14(6), 501-509.
- Rodríguez-Díaz, P., Almuna, R., Marchant, C., Heinz, S., Lebuy, R., Celis-Diez, J. L., & Díaz-Sieffer, P. (2022). The Future of Rurality: Place Attachment among Young Inhabitants of Two Rural Communities of Mediterranean Central Chile. *Sustainability*, 14(1), 546.
- Roessler, P., Pengl, Y. I., Marty, R., Titlow, K. S., & van de Walle, N. (2022). The cash crop revolution, colonialism and economic reorganization in Africa. *World Development*, 158, 105934.
- Rojas, M. (2006). Life satisfaction and satisfaction in domains of life: Is it a simple relationship? *Journal of Happiness Studies*, 7(4), 467-497.
- Rojas, M. (2011). The 'Measurement of economic performance and social progress' report and quality of life: moving forward. *Social indicators research*, 102(1), 169-180.
- Rojas, Y., & Carlson, P. (2006). The stratification of social capital and its consequences for self-rated health in Taganrog, Russia. *Social Science & Medicine*, 62(11), 2732-2741.
- Roland, A. A., Erasmus, H. O., & Rosina, A. K. (2019). Impacts of climate variability on salt production in Ghana: Case of Songor salt project. *Journal of Sustainable Development*, 12(1), 1-9.

- Rollero, C., & De Piccoli, N. (2010). Place attachment, identification and environment perception: An empirical study. *Journal of environmental psychology*, 30(2), 198-205.
- Rominski, S. D., Gupta, M., Aborigo, R., Adongo, P., Engman, C., Hodgson, A., & Moyer, C. (2014). Female autonomy and reported abortion-seeking in Ghana, West Africa. *International Journal of Gynecology & Obstetrics*, 126(3), 217-222.
- Rooks, G., Klyver, K., & Sserwanga, A. (2016). The context of social capital: A comparison of rural and urban entrepreneurs in Uganda. *Entrepreneurship theory and Practice*, 40(1), 111-130.
- Rose, D., Wadhwa, A., Bottone, R., Miller, D., Hjelm, L., Mathiassen, A., & Horjus, P. (2013). *Food Security Assessment at WFP: Report on Continued Development and Testing of a Standardized Approach*. A World Food Programme Paper, available at <https://docs.wfp.org/api/documents/WFP-0000107748/download/>; last accessed 8th August 2023.
- Rose, R. (2000). How much does social capital add to individual health? *Social Science & Medicine*, 51(9), 1421-1435.
- Rotberg, F. J. (2010). Social networks and adaptation in rural Bangladesh. *Climate and Development*, 2(1), 65-72.
- Rözer, J., & Kraaykamp, G. (2013). Income inequality and subjective well-being: A cross-national study on the conditional effects of individual and national characteristics. *Social indicators research*, 113(3), 1009-1023.
- Rutakumwa, R., Mugisha, J. O., Bernays, S., Kabunga, E., Tumwekwase, G., Mbonye, M., & Seeley, J. (2020). Conducting in-depth interviews with and without voice recorders: a comparative analysis. *Qualitative research*, 20(5), 565-581.
- Ryff, C. D., & Singer, B. (1996). Psychological well-being: Meaning, measurement, and implications for psychotherapy research. *Psychotherapy and psychosomatics*, 65(1), 14-23.
- Sachs, J. D. (2019). Introduction to the 2019 Global Happiness and Wellbeing Policy Report, in the Global Happiness and Wellbeing Policy Report 2019.
- Sachs, J. D. (2022). The Demography of Sustainable Human Wellbeing, proceedings from the Population-Environment Research Network Cyberseminar, 21st March 2022.
- Sacks, D. W., Stevenson, B. & Wolfers, J. (2010). Subjective well-being, income, economic development and growth, a National Bureau of Economic Research working paper no. 16441.
- Sagoe-Addy, K., & Addo, K. A. (2013). Effect of predicted sea level rise on tourism facilities along Ghana's Accra coast. *Journal of Coastal Conservation*, 17(1), 155-166.
- Saha, M. K., Biswas, A. K. M. A. A., & Faisal, M. (2024). Livelihood vulnerability of coastal communities in context of the climate change: A index-based assessment. *World Development Sustainability*, 4, 100152.
- Sahn, D. E., & Stifel, D. C. (2003). Urban-rural inequality in living standards in Africa. *Journal of African economies*, 12(4), 564-597.
- Salehin, M., Chowdhury, M., Arefin, M., Clarke, D., Mondal, S., Nowreen, S., Jahiruddin, M., & Haque, A. (2018). Mechanisms and drivers of soil salinity in coastal Bangladesh. In Nicholls, R., Hutton, C., Adger, N., Hanson, S., Rahman, M. & Salehin, M. (eds) *Ecosystem services for well-being in deltas* (pp. 333-347). Palgrave Macmillan, Cham.
- Salmond, J. A., Tadaki, M., Vardoulakis, S., Arbuthnott, K., Coutts, A., Demuzere, M., Dirks, K. N., Heaviside, C., Lim, S., & Macintyre, H. (2016). Health and climate related ecosystem services provided by street trees in the urban environment. *Environmental Health*, 15(1), 95-111.
- Sam, D. L., Tetteh, D. K., & Amponsah, B. (2015). Satisfaction with life and psychological symptoms among international students in Ghana and their correlates. *International Journal of Intercultural Relations*, 49, 156-167.
- Santiago, C. D., Wadsworth, M. E., & Stump, J. (2011). Socioeconomic status, neighborhood disadvantage, and poverty-related stress: Prospective effects on psychological syndromes among diverse low-income families. *Journal of Economic Psychology*, 32(2), 218-230.

- Santos, M. E., & Ura, K. (2008). *Multidimensional poverty in Bhutan: Estimates and policy implications*. Oxford Poverty & Human Development Initiative (OPHI) Working Paper 14.
- Santos, M. E., & Villatoro, P. (2018). A multidimensional poverty index for Latin America. *Review of Income and Wealth*, 64(1), 52-82.
- Sarku, R., Dewulf, A., van Slobbe, E., Termeer, K., & Kranjac-Berisavljevic, G. (2020). Adaptive decision-making under conditions of uncertainty: the case of farming in the Volta delta, Ghana. *Journal of Integrative Environmental Sciences*, 17(1), 1-33.
- Sarracino, F. (2008). Subjective well-being in low income countries: Positional, relational and social capital components. *Studie Note di Economia Anno XIII*, 3, 449-477.
- Sarracino, F. (2010). Determinants of subjective well-being in high and low income countries: Do happiness equations differ across countries? *Journal of Socio-Economics*, 42, 51-66.
- Saunders, P. (2021). *A nation of home owners*. Routledge.
- Scannell, L., & Gifford, R. (2010). The relations between natural and civic place attachment and pro-environmental behavior. *Journal of environmental psychology*, 30(3), 289-297.
- Schaafsma, M., & Gross-Camp, N. (2021). Towards capturing human well-being-nature relationships in poverty assessments in rural Malawi and Rwanda. *Case Studies in the Environment*, 5(1), 1425104.
- Schelzig, K. (2005). *Poverty in the Philippines: income, assets, and access*. Report written for the Asian Development Bank. <https://www.adb.org/sites/default/files/publication/29763/poverty-philippines.pdf>, last accessed 26th July 2024.
- Schleicher, J., Schaafsma, M., Burgess, N. D., Sandbrook, C., Danks, F., Cowie, C., & Vira, B. (2018a). Poorer without it? The neglected role of the natural environment in poverty and wellbeing. *Sustainable Development*, 26(1), 83-98.
- Schleicher, J., Schaafsma, M., & Vira, B. (2018b). Will the Sustainable Development Goals address the links between poverty and the natural environment? *Current Opinion in Environmental Sustainability*, 34, 43-47.
- Schneider, K., & Gugerty, M. K. (2011). Agricultural productivity and poverty reduction: Linkages and pathways. *Libraries Test Journal*, 1(1), 56-74.
- Schneider, S. M. (2016). Income inequality and subjective wellbeing: Trends, challenges, and research directions. *Journal of Happiness Studies*, 17(4), 1719-1739.
- Schnittker, J. (2004). Education and the changing shape of the income gradient in health. *Journal of Health and Social Behavior*, 45(3), 286-305.
- Schoo, A., Lawn, S., & Carson, D. (2016). Towards equity and sustainability of rural and remote health services access: supporting social capital and integrated organisational and professional development. *BMC Health Services Research*, 16(1), 1-5.
- Schreckenberg, K., Torres Vitolas, C., Willcock, S., Shackleton, C., Harvey, C., & Kafumbata, D. (2016). Participatory Data collection for Ecosystem Services Research a Practitioner's Manual. Ecosystem Services for Poverty Alleviation Working Paper No: 003/June 2016.
- Schueler, V., Kuemmerle, T., & Schröder, H. (2011). Impacts of surface gold mining on land use systems in Western Ghana. *Ambio*, 40(5), 528-539.
- Schueller, S. M., & Seligman, M. E. (2010). Pursuit of pleasure, engagement, and meaning: Relationships to subjective and objective measures of well-being. *The Journal of Positive Psychology*, 5(4), 253-263.
- Schultz, A. F. (2019). Status determinants, social incongruity and economic transition: Gender, relative material wealth and heterogeneity in the cultural lifestyle of forager-horticulturalists. *Plos one*, 14(9), e0220432.
- Schutte, L., Wissing, M. P., Fadji, A. W., Mbowa, S., Shoko, P. M., & Schutte, W. D. (2022). Exploration of harmony as a quality of happiness: Findings from South Africa and Ghana. In Schutte, L; Guse, T &

- Wissing, M (eds) *Embracing Well-Being in Diverse African Contexts: Research Perspectives* (pp. 319-343). Springer.
- Schwarz, N., & Strack, F. (1999). Reports of subjective well-being: Judgmental processes and their methodological implications. In Kahneman, D., Diener, E. & Schwarz, N. (eds) *Well-being: The foundations of hedonic psychology* (pp. 61–84). Russell Sage Foundation.
- Scolobig, A., De Marchi, B., & Borga, M. (2012). The missing link between flood risk awareness and preparedness: findings from case studies in an Alpine Region. *Natural Hazards*, 63(2), 499-520.
- Scoones, I. (1998). Sustainable rural livelihoods: a framework for analysis, an Institute of Development Studies (IDS) working paper no. 72.
- Scott, L. (2006). *Chronic poverty and the environment: A vulnerability perspective*. Chronic Poverty Research Centre Working Paper No. 62.
- Secombe, K. (2002). “Beating the odds” versus “changing the odds”: Poverty, resilience, and family policy. *Journal of Marriage and family*, 64(2), 384-394.
- Sedda, L., Tatem, A. J., Morley, D. W., Atkinson, P. M., Wardrop, N. A., Pezzulo, C., Sorichetta, A., Kuleszo, J., & Rogers, D. J. (2015). Poverty, health and satellite-derived vegetation indices: their inter-spatial relationship in West Africa. *International health*, 7(2), 99-106.
- Sekulova, F., & Van den Bergh, J. (2016). Floods and happiness: Empirical evidence from Bulgaria. *Ecological economics*, 126(C), 51-57.
- Selfa, T., Marini, V., & Abrams, J. (2021). Place attachment and perceptions of land-use change: cultural ecosystem services impacts of eucalyptus plantation expansion in Ubajay, Entre Ríos, Argentina. *Ecology and Society*, 26(4).
- Seligman, M. E. (2002). *Authentic happiness: Using the new positive psychology to realize your potential for lasting fulfillment*. Simon and Schuster.
- Selman, P. (2001). Social capital, sustainability and environmental planning. *Planning theory & practice*, 2(1), 13-30.
- Sen, A. (1983). Poor, relatively speaking. *Oxford Economic Papers*, 35(2), 153-169.
- Sen, A. (1999). *Commodities and capabilities*. Oxford University Press
- Sen, A. (2005). Human rights and capabilities. *Journal of human development*, 6(2), 151-166.
- Senadza, B. (2012). Education inequality in Ghana: gender and spatial dimensions. *Journal of Economic Studies*, 39(6), 724-739.
- Senik, C. (2004). When information dominates comparison: Learning from Russian subjective panel data. *Journal of public economics*, 88(9-10), 2099-2123.
- Serdeczny, O., Adams, S., Baarsch, F., Coumou, D., Robinson, A., Hare, W., Schaeffer, M., Perrette, M., & Reinhardt, J. (2017). Climate change impacts in Sub-Saharan Africa: from physical changes to their social repercussions. *Regional Environmental Change*, 17(6), 1585-1600.
- Shackleton, S., Cobban, L., & Cundill, G. (2014). A gendered perspective of vulnerability to multiple stressors, including climate change, in the rural Eastern Cape, South Africa. *Agenda*, 28(3), 73-89.
- Shaffer, P. (2013). Ten years of “Q-Squared”: Implications for understanding and explaining poverty. *World Development*, 45, 269-285.
- Shaffer, P. (2017). Seasonal hunger in the Northern Territories of the gold coast, 1900-40. *Economic History of Developing Regions*, 32(3), 270-300.
- Shammi, M., Rahman, M., Bondad, S. E., & Bodrud-Doza, M. (2019). Impacts of salinity intrusion in community health: a review of experiences on drinking water sodium from coastal areas of Bangladesh. *Healthcare*, 7(1), 50.
- Sharma, S., & Prakash, A. (2021). Intergenerational transmission of inequality in psychological health. *Science Insights*, 39(5), 379-390.

- Sharpe, J. P., Martin, N. R., & Roth, K. A. (2011). Optimism and the Big Five factors of personality: Beyond neuroticism and extraversion. *Personality and Individual Differences*, 51(8), 946-951.
- Shifa, M., & Leibbrandt, M. (2018). Relative economic position and subjective well-being in a poor society: Does relative position indicator matter? *Social indicators research*, 139(2), 611-630.
- Shoko, T. (2016). *Karanga indigenous religion in Zimbabwe: Health and well-being*. Routledge.
- Shrivastava, P., & Kumar, R. (2015). Soil salinity: A serious environmental issue and plant growth promoting bacteria as one of the tools for its alleviation. *Saudi journal of biological sciences*, 22(2), 123-131.
- Siisiainen, M. (2003). Two concepts of social capital: Bourdieu vs. Putnam. *International journal of contemporary sociology*, 40(2), 183-204.
- Simiyu, S., Bagayoko, M., & Gyasi, R. M. (2022). Associations between water, sanitation, and depression among older people in Ghana: empirical evidence from WHO-SAGE Wave 2 survey. *Aging & mental health*, 26(6), 1112-1119.
- Simmons, R., & Birchall, J. (2008). The role of co-operatives in poverty reduction: Network perspectives. *The Journal of Socio-Economics*, 37(6), 2131-2140.
- Sims, K. R. (2010). Conservation and development: Evidence from Thai protected areas. *Journal of environmental economics and management*, 60(2), 94-114.
- Singh, A. (2018). Salinization of agricultural lands due to poor drainage: A viewpoint. *Ecological indicators*, 95, 127-130.
- Sinha, J. B., Sinha, T., Verma, J., & Sinha, R. (2001). Collectivism coexisting with individualism: An Indian scenario. *Asian journal of social psychology*, 4(2), 133-145.
- Siposné Nándori, E. (2011). Subjective poverty and its relation to objective poverty concepts in Hungary. *Social indicators research*, 102(3), 537-556.
- Sipsma, H., Ofori-Atta, A., Canavan, M., Osei-Akoto, I., Udry, C., & Bradley, E. H. (2013). Poor mental health in Ghana: who is at risk? *BMC public health*, 13(1), 288.
- Siri, J. G. (2014). Independent associations of maternal education and household wealth with malaria risk in children. *Ecology and Society*, 19(1), 33.
- Siteur, K., Eppinga, M. B., Karssenberg, D., Baudena, M., Bierkens, M. F., & Rietkerk, M. (2014). How will increases in rainfall intensity affect semiarid ecosystems? *Water Resources Research*, 50(7), 5980-6001.
- Slekiene, J., & Mosler, H.-J. (2019). The link between mental health and safe drinking water behaviors in a vulnerable population in rural Malawi. *BMC psychology*, 7(1), 1-14.
- Small, N., Munday, M., & Durance, I. (2017). The challenge of valuing ecosystem services that have no material benefits. *Global environmental change*, 44, 57-67.
- Smith, L. M., Case, J. L., Smith, H. M., Harwell, L. C., & Summers, J. (2013). Relating ecosystem services to domains of human well-being: Foundation for a US index. *Ecological indicators*, 28, 79-90.
- Smith, L. T. (2021). *Decolonizing methodologies: Research and indigenous peoples*. Bloomsbury Publishing.
- Smith, M. D., Kassa, W., & Wesselbaum, D. (2024). Food insecurity erodes trust. *Global Food Security*, 40, 100742.
- Smith, M. L., Kakuhikire, B., Baguma, C., Rasmussen, J. D., Perkins, J. M., Cooper-Vince, C., Venkataramani, A. S., Ashaba, S., Bangsberg, D. R., & Tsai, A. C. (2019). Relative wealth, subjective social status, and their associations with depression: Cross-sectional, population-based study in rural Uganda. *SSM-population health*, 8, 100448.
- Sommet, N., Morselli, D., & Spini, D. (2018). Income inequality affects the psychological health of only the people facing scarcity. *Psychological science*, 29(12), 1911-1921.
- Spangenberg, J. H., & Settele, J. (2010). Precisely incorrect? Monetising the value of ecosystem services. *Ecological Complexity*, 7(3), 327-337.

- Stanke, C., Kerac, M., Prudhomme, C., Medlock, J., & Murray, V. (2013). Health effects of drought: a systematic review of the evidence. *PLoS currents*, 5;5.
- Steel, P., Schmidt, J., & Shultz, J. (2008). Refining the relationship between personality and subjective well-being. *Psychological bulletin*, 134(1), 138.
- Steger, M. F., Frazier, P., Oishi, S., & Kaler, M. (2006). The meaning in life questionnaire: assessing the presence of and search for meaning in life. *Journal of Counseling Psychology*, 53(1), 80.
- Steiger, D., Mainieri, T., & Stinson, L. (1997). Subjective assessments of economic well-being: Understanding the minimum income question. Proceedings of the Joint Statistical Meetings Section on Survey Research Methods of the American Statistical Association.
- Stein, W., & Weisser, R. A. (2018). The impact of local shocks on well-being: Only a matter of perception? Hannover Economic Papers (HEP), No. 634, Provided in Cooperation with: School of Economics and Management, University of Hannover.
- Steinert, J. I., Nyarige, D. A., Jacobi, M., Kuhnt, J., & Kaplan, L. (2021). A systematic review on ethical challenges of 'field' research in low-income and middle-income countries: respect, justice and beneficence for research staff? *BMJ global health*, 6(7), e005380.
- Stern, N. (2006). *Stern review on the Economics of Climate Change*. Cambridge University Press.
- Stifel, D. C., Minten, B., & Dorosh, P. (2003). Transactions costs and agricultural productivity: Implications of isolation for rural poverty in Madagascar. Transactions Costs and Agricultural Productivity: Implications of Isolation for Rural Poverty in Madagascar (February 2003). International Food Policy Research Institute, MSSD Discussion Paper (56).
- Stiglitz, J., Sen, A., & Fitoussi, J. (2009). *Report by the Commission on the Measurement of Economic Performance and Social Progress*. <https://ec.europa.eu/eurostat/documents/8131721/8131772/Stiglitz-Sen-Fitoussi-Commission-report.pdf>, last accessed 26th July 2024.
- Stokols, D., Misra, S., Runnerstrom, M. G., & Hipp, J. A. (2009). Psychology in an age of ecological crisis: From personal angst to collective action. *American Psychologist*, 64(3), 181.
- Stoler, J., Weeks, J. R., & Fink, G. (2012). Sachet drinking water in Ghana's Accra-Tema metropolitan area: past, present, and future. *Journal of Water, Sanitation and Hygiene for Development*, 2(4), 223-240.
- Straub, A. M., Gray, B. J., Ritchie, L. A., & Gill, D. A. (2020). Cultivating disaster resilience in rural Oklahoma: Community disenfranchisement and relational aspects of social capital. *Journal of Rural Studies*, 73, 105-113.
- Streak, J. C., Yu, D., & Van der Berg, S. (2009). Measuring child poverty in South Africa: Sensitivity to the choice of equivalence scale and an updated profile. *Social indicators research*, 94(2), 183-201.
- Streeten, P., & Burki, S. J. (1978). Basic needs: some issues. *World Development*, 6(3), 411-421.
- Streeten, P. P. (1979). Basic needs: Premises and promises. *Journal of Policy Modeling*, 1, 136-146.
- Streeten, P. (1984). Basic needs: some unsettled questions. *World Development*, 12(9), 973-978.
- Striessnig, E. (2015). Too educated to be happy? An investigation into the relationship between education and subjective well-being. IIASA Interim Report. IIASA, Laxenburg, Austria: IR-15-015.
- Su, J. G., Dadvand, P., Nieuwenhuijsen, M. J., Bartoll, X., & Jerrett, M. (2019). Associations of green space metrics with health and behavior outcomes at different buffer sizes and remote sensing sensor resolutions. *Environment international*, 126, 162-170.
- Suárez-Varela, M., Guardiola, J., & González-Gómez, F. (2016). Do pro-environmental behaviors and awareness contribute to improve subjective well-being? *Applied Research in Quality of Life*, 11(2), 429-444.
- Sulemana, A., & Dinye, R. D. (2014). Access to healthcare in rural communities in Ghana: a study of some selected communities in the Pru District. *European Journal of Research in Social Sciences*, 2(4).
- Sulemana, I. (2015). An empirical investigation of the relationship between social capital and subjective well-being in Ghana. *Journal of Happiness Studies*, 16(5), 1299-1321.

- Sulemana, I. (2016). Do perceptions about local environmental quality influence self-rated health? Evidence from Ghana. *Environmental Management and Sustainable Development*, 5(2), 287-302.
- Sulemana, I., McCann, L., & James Jr, H. S. (2016). Perceived environmental quality and subjective well-being: are African countries different from developed countries? *International Journal of Happiness and Development*, 3(1), 64-87.
- Sulemana, I., & Agyapong, E. (2019). Subjective well-being and political participation: Empirical evidence from Ghana. *Review of Development Economics*, 23(3), 1368-1386.
- Sultan, B., Defrance, D., & Iizumi, T. (2019). Evidence of crop production losses in West Africa due to historical global warming in two crop models. *Scientific reports*, 9(1), 1-15.
- Sultana, F. (2007). Reflexivity, positionality and participatory ethics: Negotiating fieldwork dilemmas in international research. *ACME: An international journal for critical geographies*, 6(3), 374-385.
- Sumberg, J., Yeboah, T., Flynn, J., & Anyidoho, N. A. (2017). Young people's perspectives on farming in Ghana: a Q study. *Food security*, 9(1), 151-161.
- Swapan, M. S. H., & Sadeque, S. (2021). Place attachment in natural hazard-prone areas and decision to relocate: Research review and agenda for developing countries. *International Journal of Disaster Risk Reduction*, 52, 101937.
- Swinnerton, S. (2006). Living in poverty and its effects on health. *Contemporary nurse*, 22(1), 75-80.
- Syvitski, J. P. (2008). Deltas at risk. *Sustainability science*, 3(1), 23-32.
- Szabo, S., Brondizio, E., Renaud, F. G., Hetrick, S., Nicholls, R. J., Matthews, Z., Tessler, Z., Tejedor, A., Sebesvari, Z., & Foufoula-Georgiou, E. (2016a). Population dynamics, delta vulnerability and environmental change: comparison of the Mekong, Ganges-Brahmaputra and Amazon delta regions. *Sustainability science*, 11(4), 539-554.
- Szabo, S., Nicholls, R. J., Neumann, B., Renaud, F. G., Matthews, Z., Sebesvari, Z., AghaKouchak, A., Bales, R., Ruktanonchai, C. W., & Kloos, J. (2016b). Making SDGs work for climate change hotspots. *Environment: Science and Policy for Sustainable Development*, 58(6), 24-33.
- Szaboova, L., Safrade Campos, R., Adger, W. N., Abu, M., Codjoe, S. N. A., Franco Gavonel, M., Das, S., Siddiqui, T., Rocky, M. H., & Hazra, S. (2021). Urban sustainability and the subjective well-being of migrants: The role of risks, place attachment, and aspirations. *Population, Space and Place*, e2505.
- Tambo, J. A. (2016). Adaptation and resilience to climate change and variability in north-east Ghana. *International Journal of Disaster Risk Reduction*, 17, 85-94.
- Tambo, J. A., & Wünscher, T. (2017). Farmer-led innovations and rural household welfare: Evidence from Ghana. *Journal of Rural Studies*, 55, 263-274.
- Tanner, T., Mensah, A., Lawson, E. T., Gordon, C., Godfrey-Wood, R., & Cannon, T. (2014). Political economy of climate compatible development: artisanal fisheries and climate change in Ghana. *IDS Working Papers*, 2014(446), 1-30.
- Tauseef, S. (2022). Can Money Buy Happiness? Subjective Wellbeing and Its Relationship with Income, Relative Income, Monetary and Non-monetary Poverty in Bangladesh. *Journal of Happiness Studies*, 23(3), 1073-1098.
- Tawiah, E. (2011). Population ageing in Ghana: a profile and emerging issues. *African Population Studies*, 25(2).
- Tay, L., & Diener, E. (2011). Needs and subjective well-being around the world. *Journal of personality and social psychology*, 101(2), 354.
- Tay, L., Zyphur, M. & Batz, C. (2018). Income and subjective well-being: Review, synthesis, and future research. In: Diener, E., Oishi, S. & Tay, L. (eds) *Handbook of well-being* (pp.1-12). DEF Publishers, Salt Lake City.
- TEEB. (2010). *TEEB, the economics of ecosystems and biodiversity: Ecological and economic foundations*. Earthscan, London.

- TEEB. (2022). *Approach*. <http://teebweb.org/about/approach/>, last accessed 26th July 2024.
- Tengberg, A., Fredholm, S., Eliasson, I., Knez, I., Saltzman, K., & Wetterberg, O. (2012). Cultural ecosystem services provided by landscapes: Assessment of heritage values and identity. *Ecosystem Services*, 2, 14-26.
- Teye, J. K., Awumbila, M., & Keseboa Darkwah, A. (2022). Gendered dynamics of the flow and use of migrant remittances in Northern Ghana. *African Geographical Review*, 1-13.
- Thamtanajit, K. (2020). The impacts of natural disaster on student achievement: Evidence from severe floods in Thailand. *The Journal of Developing Areas*, 54(4), 129-143.
- Theodoropoulos, H. (1999). Review of rural/urban problem from an interdisciplinary perspective. *Prospettive proposte mediterranee-Rivista di Economia, Agricoltura e Ambiente*, (3), 24–31.
- Thiry, G., Alkire, S., & Schleicher, J. (2018). Incorporating environmental and natural resources within analyses of multidimensional poverty. Oxford Poverty & Human Development Initiative (OPHI) Research in Progress Series 50a.
- Thomas, K., Hardy, R. D., Lazrus, H., Mendez, M., Orlove, B., Rivera-Collazo, I., Roberts, J. T., Rockman, M., Warner, B. P., & Winthrop, R. (2019). Explaining differential vulnerability to climate change: A social science review. *Wiley Interdisciplinary Reviews: Climate Change*, 10(2), e565.
- Thummapol, O., Park, T., Jackson, M., & Barton, S. (2019). Methodological challenges faced in doing research with vulnerable women: Reflections from fieldwork experiences. *International Journal of Qualitative Methods*, 18, 1609406919843022.
- Tibesigwa, B., Visser, M., & Hodkinson, B. (2016). Effects of objective and subjective income comparisons on subjective wellbeing. *Social indicators research*, 128(1), 361-389.
- Tickner, D., Parker, H., Moncrieff, C. R., Oates, N. E., Ludi, E., & Acreman, M. (2017). Managing rivers for multiple benefits—a coherent approach to research, policy and planning. *Frontiers in Environmental Science*, 5, 4.
- To, P. X., Dressler, W. H., Mahanty, S., Pham, T. T., & Zingerli, C. (2012). The prospects for payment for ecosystem services (PES) in Vietnam: a look at three payment schemes. *Human Ecology*, 40(2), 237-249.
- Togoe, H. (2012). Household burden of chronic diseases in Ghana. *Ghana medical journal*, 46(2), 54-58.
- Tolhurst, R., Amekudzi, Y. P., Nyonator, F. K., Squire, S. B., & Theobald, S. (2008). “He will ask why the child gets sick so often”: The gendered dynamics of intra-household bargaining over healthcare for children with fever in the Volta Region of Ghana. *Social Science & Medicine*, 66(5), 1106-1117.
- Tompkins, E. L., Vincent, K., Suckall, N., Rahman, R., Ghosh, T., Mensah, A., Anderson, K., Chapman, A., Prati, G., & Hutton, C. W. (2020). Adapting to change: People and policies. In Nicholls, R., Adger, N., Hutton, C. & Hanson, S. (eds) *Deltas in the Anthropocene* (pp. 201-222). Palgrave Macmillan, Cham.
- Tonge, J., Ryan, M. M., Moore, S. A., & Beckley, L. E. (2015). The effect of place attachment on pro-environment behavioral intentions of visitors to coastal natural area tourist destinations. *Journal of Travel Research*, 54(6), 730-743.
- Torssander, J., & Erikson, R. (2010). Stratification and mortality—A comparison of education, class, status, and income. *European Sociological Review*, 26(4), 465-474.
- Tosam, M. J., & Mbih, R. A. (2015). Climate change, health, and sustainable development in Africa. *Environment, development and sustainability*, 17, 787-800.
- Trautmann, S., Rehm, J., & Wittchen, H. U. (2016). The economic costs of mental disorders: Do our societies react appropriately to the burden of mental disorders? *EMBO reports*, 17(9), 1245-1249.
- Tripathy, J. P. (2013). Secondary data analysis: Ethical issues and challenges. *Iranian journal of public health*, 42(12), 1478.
- Tsai, M. C., & Dzorgbo, D. B. S. (2012). Familial reciprocity and subjective well-being in Ghana. *Journal of Marriage and family*, 74(1), 215-228.

- Tseklevs, E., Darby, A., Ahorlu, C., Pickup, R., de Souza, D., & Boakye, D. (2020). *Challenges and opportunities in conducting and applying design research beyond global north to the global south*. Paper produced from the Synergy - DRS International Conference 2020.
- Tsikata, D. (2006). *Living in the shadow of the large dams: long term responses of downstream and lakeside communities of Ghana's Volta River Project*. Brill.
- Tufuor, T. (2009). Gender and Women Housing Problems in Accra–The case of Old Fadama. A Report from the Ghanaian Deputy Director, Housing Ministry of water Resources Works and Housing. https://www.hdm.lth.se/fileadmin/hdm/alumni/papers/SDD_2009_242a/Theresa_Tufuor_-_Ghana.pdf, last accessed 26th July 2024.
- Uchida, Y., & Kitayama, S. (2009). Happiness and unhappiness in east and west: themes and variations. *Emotion*, 9(4), 441.
- Udry, C. R., & Conley, T. G. (2004). Social networks in Ghana. *Soc. Econ. Poverty*, 232.
- UN. (2005) *Handbook on Poverty Statistics: Concepts, methods and policy use*. Special project on Poverty statistics. https://unstats.un.org/unsd/methods/poverty/pdf/UN_Book%20FINAL%2030%20Dec%2005.pdf, last accessed 25th July 2024.
- UN. (2022). *THE 17 GOALS*. <https://sdgs.un.org/goals>, last accessed 26th July 2024.
- UNECE. (2017) *Guide of Poverty Measurement*. <https://unece.org/DAM/stats/publications/2018/EECESSTAT20174.pdf>, last accessed 25th July 2024.
- UNESCO. (2007). *International Flood Initiative*. A joint report produced with WMO, UNU and ISDR. <https://unesdoc.unesco.org/ark:/48223/pf0000155652>, last accessed 26th July 2024.
- UNESCO. (2012). *Ghana: Age distribution and school attendance of girls aged 9-13 years*. https://www.who.int/immunization/programmes_systems/policies_strategies/Ghana_country_report.pdf; last accessed 13th December 2022.
- UNICEF MICS. (2019) *Ghana Multiple Indicator Cluster Survey 2017/18*. <https://www.unicef.org/ghana/media/576/file/Ghana%20Multiple%20Cluster%20Indicator%20Survey.pdf>, last accessed 25th July 2024.
- Ura, K., Alkire, S., Zangmo, T., & Wangdi, K. (2012). An extensive analysis of GNH index. A report produced by Oxford Poverty & Human Development Initiative and the Centre for Bhutan Studies. <https://ophi.org.uk/publications/Extensive-GNH-2012>, last accessed 26th July 2024.
- Ustaoglu, E., & Lavallo, C. (2017). Examining lag effects between industrial land development and regional economic changes: The Netherlands experience. *Plos one*, 12(9), e0183285.
- Vaismoradi, M., Turunen, H., & Bondas, T. (2013). Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing & health sciences*, 15(3), 398-405.
- Van den Bergh, J. C. (2010). Safe climate policy is affordable—12 reasons. *Climatic Change*, 101, 339-385.
- Van der Berg, S. (2008). Poverty and education. *Education policy series*, 10(28), 1-28.
- Van Der Geest, K. (2010). Local perceptions of migration from north-west Ghana. *Africa*, 80(4), 595-619.
- Van der Geest, K. (2011). North-South migration in Ghana: what role for the environment? *International Migration*, 49, e69-e94.
- Van der Geest, S. (1997). Money and respect: The changing value of old age in rural Ghana. *Africa*, 67(4), 534-559.
- van Parijs, P. (1992). *Arguing for Basic Income: Ethical Foundations for a Radical Reform*. Verso Books.
- Van Praag, B. M., Frijters, P., & Ferrer-i-Carbonell, A. (2003). The anatomy of subjective well-being. *Journal of Economic Behavior & Organization*, 51(1), 29-49.
- Van Soesbergen, A., Nilsen, K., Burgess, N. D., Szabo, S., Matthews, Z., Chadwick, O., & Renaud, F. (2017). Food and nutrition security trends and challenges in the Ganges Brahmaputra Meghna (GBM) delta. *Elementa: Science of the Anthropocene*, 5: 56.

- Vaznonienė, G. (2014). Wellbeing research for rural development. *Research for Rural development*, 2, 244-251.
- Veenhoven, R. (1993). Is happiness a trait?: Tests of the theory that a better society does not make people happier. *Social indicators research*, (32), 101-160.
- Veenhoven, R. (2005). Apparent quality-of-life in nations: How long and happy people live. *Social indicators research*, 71, 61-86.
- Veenhoven, R. (2007). Subjective measures of well-being. In McGillivray (ed.) *Human well-being* (pp. 214-239). Springer.
- Veenhoven, R. (2009). How do we assess how happy we are? Tenets, implications and tenability of three theories. In Dutt, A and Radcliff, B (eds) *Happiness, economics and politics* (pp. 45-69), Edward Elgar Publishing.
- Vercillo, S. (2020). The complicated gendering of farming and household food responsibilities in northern Ghana. *Journal of Rural Studies*, 79, 235-245.
- Vercillo, S., McCordic, C., & Frayne, B. (2022). Considering gender differences in measuring household food insecurity in northern Ghana. *Development in practice*, 32(4), 551-565.
- Vicente-Serrano, S. M., Cuadrat-Prats, J. M., & Romo, A. (2006). Early prediction of crop production using drought indices at different time-scales and remote sensing data: application in the Ebro Valley (north-east Spain). *International Journal of Remote Sensing*, 27(3), 511-518.
- Vladisavljević, M., & Mentus, V. (2019). The structure of subjective well-being and its relation to objective well-being indicators: evidence from EU-SILC for Serbia. *Psychological reports*, 122(1), 36-60.
- Vollmer, S., Harttgen, K., Subramanyam, M. A., Finlay, J., Klasen, S., & Subramanian, S. V. (2014). Association between economic growth and early childhood undernutrition: evidence from 121 Demographic and Health Surveys from 36 low-income and middle-income countries. *The lancet global health*, 2(4), e225-e234.
- Vorkinn, M., & Riese, H. (2001). Environmental concern in a local context: The significance of place attachment. *Environment and behavior*, 33(2), 249-263.
- Voukelatou, V., Gabrielli, L., Miliou, I., Cresci, S., Sharma, R., Tesconi, M., & Pappalardo, L. (2021). Measuring objective and subjective well-being: dimensions and data sources. *International Journal of Data Science and Analytics*, 11(4), 279-309.
- Vuong, T. N., Dang, C. V., Toze, S., Jagals, P., Gallegos, D., & Gatton, M. L. (2022). Household water and food insecurity negatively impacts self-reported physical and mental health in the Vietnamese Mekong Delta. *Plos one*, 17(5), e0267344.
- Vyas, S., & Kumaranayake, L. (2006). Constructing socio-economic status indices: how to use principal components analysis. *Health policy and planning*, 21(6), 459-468.
- Wahab, I., Hall, O., & Jirström, M. (2018). Remote sensing of yields: Application of UAV imagery-derived NDVI for estimating maize vigor and yields in complex farming systems in sub-Saharan Africa. *Drones*, 2(3), 28.
- Waldman, K. B., Vergopolan, N., Attari, S. Z., Sheffield, J., Estes, L. D., Caylor, K. K., & Evans, T. P. (2019). Cognitive biases about climate variability in smallholder farming systems in Zambia. *Weather, Climate, and Society*, 11(2), 369-383.
- Wales, J., & Wild, L. (2012). The political economy of roads. Report produced by the Overseas Development Institute. <https://cdn.odi.org/media/documents/8173.pdf>, last accessed 26th July 2024.
- Walker-Springett, K., Butler, C., & Adger, W. N. (2017). Wellbeing in the aftermath of floods. *Health & place*, 43, 66-74.
- Walsh, A., Brugha, R., & Byrne, E. (2016). "The way the country has been carved up by researchers": ethics and power in north-south public health research. *International journal for equity in health*, 15(1), 1-11.

- Walsham, M. (2020). Internal migration and social pensions in Uganda: The Senior Citizens Grant and its effects on intrahousehold dynamics and wellbeing in 'multi-local households'. Thesis submitted to The University of Manchester. https://pure.manchester.ac.uk/ws/portalfiles/portal/177284662/FULL_TEXT.PDF, last accessed 26th July 2024.
- Wang, B., Zhang, Q., & Cui, F. (2021). Scientific research on ecosystem services and human well-being: A bibliometric analysis. *Ecological indicators*, 125, 107449.
- Wang, H., Zhao, Q., Bai, Y., Zhang, L., & Yu, X. (2020). Poverty and subjective poverty in rural China. *Social indicators research*, 150(1), 219-242.
- Wantchekon, L., & Stanig, P. (2015). *The curse of good soil? Land fertility, roads and rural poverty in Africa*.
- Ward, A., Minja, E., Blackie, M., & Edwards-Jones, G. (2007). Beyond participation—building farmer confidence: experience from Sub-Saharan Africa. *Outlook on Agriculture*, 36(4), 259-266.
- Ward, J., Varua, M., Maheshwari, B., Oza, S., Purohit, R., & Dave, S. (2016). Exploring the relationship between subjective wellbeing and groundwater attitudes and practices of farmers in rural India. *Journal of Hydrology*, 540, 1-16.
- Ward, S. J., & King, L. A. (2016). Poor but happy? Income, happiness, and experienced and expected meaning in life. *Social Psychological and Personality Science*, 7(5), 463-470.
- Warner, K., Afifi, T., Henry, K., Rawe, T., Smith, C., & De Sherbinin, A. (2012). Where the rain falls: Climate change, food and livelihood security, and migration. *Global Policy Report of the Where the Rain Falls Project*. Bonn: CARE France and UNU-EHS.
- Watts, M., Schaafsma, M., Schleicher, J., van Soesbergen, A., & Vira, B. (2019). Links between poverty and environmental aspects in Malawi, Mozambique, Rwanda and Tanzania: A literature review. Report for UNEP-UNDP Poverty-Environment Action for Sustainable Development Goals.
- Weeks, J. R., Getis, A., Stow, D. A., Hill, A. G., Rain, D., Engstrom, R., Stoler, J., Lippitt, C., Jankowska, M., & Lopez-Carr, A. C. (2012). Connecting the dots between health, poverty and place in Accra, Ghana. *Annals of the Association of American Geographers*, 102(5), 932-941.
- Weis, S. W. M., Agostini, V. N., Roth, L. M., Gilmer, B., Schill, S. R., Knowles, J. E., & Blyther, R. (2016). Assessing vulnerability: an integrated approach for mapping adaptive capacity, sensitivity, and exposure. *Climatic Change*, 136(3-4), 615-629.
- Weiss, A., Bates, T. C., & Luciano, M. (2008). Happiness is a personal(ity) thing: The genetics of personality and well-being in a representative sample. *Psychological science*, 19(3), 205-210.
- Western, M., & Tomaszewski, W. (2016). Subjective wellbeing, objective wellbeing and inequality in Australia. *Plos one*, 11(10), e0163345.
- Wheatley, D. (2017). Autonomy in paid work and employee subjective well-being. *Work and Occupations*, 44(3), 296-328.
- White, M. D. (2014). The problems with measuring and using happiness for policy purposes. Mercatus Research, Mercatus Center at George Mason University, Arlington, VA, July 2015.
- White, M. J., & Hunter, L. M. (2009). Public perception of environmental issues in a developing setting: Environmental concern in coastal Ghana. *Social Science Quarterly*, 90(4), 960-982.
- White, S.C. & Ellison, M. (2007). Wellbeing, livelihoods and resources in social practice. In Gough, I. & McGregor, J.A. (eds) *Wellbeing in developing countries: from theory to research* (pp. 157-175), Cambridge University Press.
- White, S. C. (2010). Analysing wellbeing: a framework for development practice. *Development in practice*, 20(2), 158-172.
- White, S. C. (2016). Introduction: The many faces of wellbeing. In White, S and Blackmore, C (eds) *Cultures of wellbeing* (pp. 1-44). Springer.
- WHO. (2011). *Unsafe drinking water, sanitation and waste management*. <https://www.who.int/sustainable-development/cities/health-risks/water-sanitation/en/>

- WHO. (2018) *Climate change and human health*. <https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health>, last accessed 25th July 2024.
- WHO. (2019). Burden of disease attributable to unsafe drinking-water, sanitation and hygiene, 2019 update. Report from the World Health Organization. <https://iris.who.int/bitstream/handle/10665/370026/9789240075610-eng.pdf?sequence=1>, last accessed 26th July 2024.
- WHO. (2020). *WHO global strategy on health, environment and climate change: the transformation needed to improve lives and well-being sustainably through healthy environments*. World Health Organization, Geneva.
- WHO. (2022a). Proportion of population with access to improved sanitation. <https://www.who.int/data/gho/indicator-metadata-registry/imr-details/1199>; last accessed 6th August 2023.
- WHO. (2022b). Proportion of population with sustainable access to an improved water source. <https://www.who.int/data/gho/indicator-metadata-registry/imr-details/1198>; last accessed 6th August 2023.
- WHO. (2023). Expanding and improving mental health care services in Ghana. <https://www.afro.who.int/countries/ghana/news/expanding-and-improving-mental-health-care-services-ghana>, last accessed 26th July 2024.
- WHO/UNICEF. (2005). Water for life: making it happen. Report produced by Joint Monitoring Programme for Water Supply and Sanitation. <https://iris.who.int/bitstream/handle/10665/43224/9241562935.pdf?isAllowed=y&sequence=1>, last accessed 26th July 2024.
- Wiegleb, V. (2019). A literature review on wetlands in Accra. Trier University WaterPower Working Paper Volume No. 5.
- Wiesinger, G. (2007). The importance of social capital in rural development, networking and decision-making in rural areas. *Journal of Alpine Research | Revue de géographie alpine* (95-4), 43-56.
- Wietzke, F. B. (2015). Who Is Poorest? An Asset-based Analysis of Multidimensional Wellbeing. *Development Policy Review*, 33(1), 33-59.
- Wilkinson, R., & Pickett, K. (2011). *The spirit level: Why greater equality makes societies stronger*. Bloomsbury Publishing USA.
- Wilkinson, S. (1998). Focus groups in feminist research: Power, interaction, and the co-construction of meaning. *Women's Studies International Forum*, 21(1), 111-125.
- Williams, I. (2021). How Culture, Climate, and Social Structure Determine Basic Needs. A Population Education blogpost. <https://populationeducation.org/how-culture-climate-and-social-structure-determine-basic-needs/>, last accessed 26th July 2024.
- Williams, P. A., Crespo, O., & Abu, M. (2020). Assessing vulnerability of horticultural smallholders' to climate variability in Ghana: Applying the livelihood vulnerability approach. *Environment, development and sustainability*, 22(3), 2321-2342.
- Willoughby, N., Grimble, R., Ellenbroek, W., Danso, E., & Amatekpor, J. (2001). The wise use of wetlands: identifying development options for Ghana's coastal Ramsar sites. *Hydrobiologia*, 458, 221-234.
- Wireko-Gyebi, R., Puwurayire, P., Nyamekye, K., & Akudugu, J. (2023). Socio-demographic attributes of artisanal small-scale miners and their operations in Ghana. *GeoJournal*, 88(2), 1997-2010.
- Wisner, B., Gaillard, J., & Kelman, I. (2012). *Handbook of hazards and disaster risk reduction and management*. Routledge.
- Wolf, S., McCoy, D. C., & Godfrey, E. B. (2016). Barriers to school attendance and gender inequality: Empirical evidence from a sample of Ghanaian schoolchildren. *Research in Comparative and International Education*, 11(2), 178-193.
- Wolsko, C., & Lindberg, K. (2013). Experiencing connection with nature: The matrix of psychological well-being, mindfulness, and outdoor recreation. *Ecopsychology*, 5(2), 80-91.
- Wong, M. (2006). The gendered politics of remittances in Ghanaian transnational families. *Economic geography*, 82(4), 355-381.

- Wong, S. Y. (2012). Understanding poverty: Comparing basic needs approach and capability approach. Social Science Research Network paper. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2066179, last accessed 26th July 2024.
- Woodroffe, C. D., Nicholls, R. J., Saito, Y., Chen, Z., & Goodbred, S. L. (2006). Landscape variability and the response of Asian megadeltas to environmental change. In Harvey, N. (ed.) *Global change and integrated coastal management* (pp. 277-314). Springer.
- Woolcock, M., & Narayan, D. (2000). Social capital: Implications for development theory, research, and policy. *The world bank research observer*, 15(2), 225-249.
- World Bank. (2005). *Introduction to Poverty Analysis*. <https://documents1.worldbank.org/curated/en/775871468331250546/pdf/902880WP0Box380okPovertyAnalysisEng.pdf>, last accessed 7th March 2024.
- World Bank. (2012). *Three Quarters of The World's Poor Are "Unbanked"*. <https://www.worldbank.org/en/news/feature/2012/04/19/three-quarters-of-the-worlds-poor-are-unbanked>; last accessed 8th July 2023.
- World Bank. (2020) *Ghana Poverty Assessment*. <https://openknowledge.worldbank.org/server/api/core/bitstreams/80f58fc1-bfee-5aa7-a57f-8946cb40e687/content>, last accessed 24th June 2024.
- World Bank. (2021a). *Data: Ghana*. <https://data.worldbank.org/country/ghana>, last accessed 25th July 2024.
- World Bank. (2021b). *What is learning poverty?* An "Understanding Poverty" brief. <https://www.worldbank.org/en/topic/education/brief/what-is-learning-poverty>, last accessed 25th July 2024.
- World Bank. (2022). *Africa's Pulse: An analysis of issues shaping Africa's economic future*. <https://openknowledge.worldbank.org/server/api/core/bitstreams/119040b5-a572-52d1-9405-ae60f9b9dd41/content>, last accessed 22nd July.
- World Food Programme. (2017). *Conducting Food Security Assessments using Household Expenditure Surveys (HES)*. VAM Guidance Paper, available at <https://docs.wfp.org/api/documents/WFP-0000022417/download/>; last accessed 12th June 2023.
- WorldPop. (2016). *Geospatial covariate data layers*. <https://www.worldpop.org/project/categories?id=14>, last accessed 22nd July.
- Wossen, T., & Berger, T. (2015). Climate variability, food security and poverty: Agent-based assessment of policy options for farm households in Northern Ghana. *Environmental Science & Policy*, 47, 95-107.
- Wu, R., & Xie, Z. (2020). Identifying the impacts of income inequality on CO2 emissions: empirical evidences from OECD countries and non-OECD countries. *Journal of Cleaner Production*, 277, 123858.
- Wuni, I. Y., Boafo, H. K., Dinye, R. D., Wuni, I., Boafo, H., & Dinye, R. (2017). Examining the non-participation of some youth in agriculture in the midst of acute unemployment in Ghana. *Int J Mod Soc Sci*, 6, 128-153.
- Yager, Z., Diedrichs, P. C., & Drummond, M. (2013). Understanding the role of gender in body image research settings: Participant gender preferences for researchers and co-participants in interviews, focus groups and interventions. *Body image*, 10(4), 574-582.
- Yaya, S., Bishwajit, G., Ekholuenetale, M., Shah, V., Kadio, B., & Udenigwe, O. (2017). Urban-rural difference in satisfaction with primary healthcare services in Ghana. *BMC Health Services Research*, 17(1), 1-9.
- Yeboah, S. A., Allotey, A. N.-M., & Nani, E. (2013). Environmental effects of socio-economic activities on Songor Ramsar Site in Ada, Ghana. *Journal of Environmental Issues and Agriculture in Developing Countries*, 5(2), 10-18.
- Yengoh, G., Frederick, A., & Svensson, M. G. (2009). Technology adoption in small-scale agriculture: the case of Cameroon and Ghana. *Science, Technology & Innovation Studies*, 5(2), 111-131.

- Yidana, S. M., & Chegbeleh, L. P. (2013). The hydraulic conductivity field and groundwater flow in the unconfined aquifer system of the Keta Strip, Ghana. *Journal of African Earth Sciences*, 86, 45-52.
- Yip, W., Subramanian, S., Mitchell, A., Lee, D., Wang, J., & Kawachi, I. (2007). Does social capital enhance health and well-being? Evidence from rural China. *Social Science & Medicine*, 64(1), 35-49.
- Yiran, G. (2016). Mapping social capital for adaptation to climatic variability in a Savannah Ecosystem of Ghana. In Yaro, J. & Hesselberg, J. (eds) *Adaptation to Climate Change and Variability in Rural West Africa* (pp. 215-237). Springer.
- Zakari, S., Ying, L., & Song, B. (2014). Factors influencing household food security in West Africa: The case of Southern Niger. *Sustainability*, 6(3), 1191-1202.
- Zakaria, A.-R., & Matsui, K. (2021). Water Governance Performance Assessment of Riparian Communities: a case study of the Volta River basin. *Sustainable Water Resources Management XI*, 23-33.
- Zapata, O. (2021). Happiness in the tropics: climate variables and subjective wellbeing. *Environment and Development Economics*, 27(3) 250-271.
- Zhang, K., Dearing, J. A., Dawson, T. P., Dong, X., Yang, X., & Zhang, W. (2015). Poverty alleviation strategies in eastern China lead to critical ecological dynamics. *Science of the Total Environment*, 506, 164-181.
- Zhang, Q., & Churchill, S. A. (2020). Income inequality and subjective wellbeing: Panel data evidence from China. *China economic review*, 60, 101392.
- Zheng, W. (2010). A social capital perspective of innovation from individuals to nations: where is empirical literature directing us? *International Journal of Management Reviews*, 12(2), 151-183.