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The role of formal institutions in delivering equitable drinking-water access across seasons and extreme weather events: A case study of Zomba District, Malawi

by

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Thesis for the degree of Doctor of Philosophy

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Abstract

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Access to drinking-water is central to poverty eradication and food security, yet it remains a critical challenge for marginalised households. While water access is considered as a governance issue, gaps remain in the scholarship of how formal water governance institutions affect access to drinking-water among marginalised households in developing countries across seasons. The extent to which seasonality and extreme weather events affect the design and implementation of formal water institutions to ensure equitable and continuous drinking water access is largely unknown. Drawing on drinking-water and institutions literature, the aim of this thesis is therefore, to assess how local formal institutions in rural Malawi address equitable access to drinking-water for marginalised households across seasons and extreme weather events. To deliver this aim, the study has three objectives: (i) determine the extent to which national water policy and institutional design incorporate equitable access to drinking-water for marginalised households across seasons and extreme weather events; (ii) establish how well local formal water institutions implement policy and deliver equitable access to drinking-water for marginalised households and; (iii) explore how seasonality and extreme weather events affect the ability of local formal water institutions to deliver equitable access to drinking-water for marginalised households. Marginalised households refer to rural poor households, those lacking education and women. Using a case study of a rural watershed in Zomba District, guided by Ostrom's Socio-Ecological Systems framework, the study uses mixed methods, including policy document analysis (n=41); key informant interviews with water officials and water executive committee members (n=17); analysis of secondary data from a household survey (n=306, dry season and n=311, wet season); focus group discussions (n=13) and participant observation in four villages. Zomba District was selected because it has low improved water access and is prone to floods and water disasters.

In relation to the three objectives, there are five key findings. In relation to the design of local formal water institutions: National Water Policy is not written to allow consideration of marginalisation and seasonality of drinking-water. In relation to local equitable access to water,

the study reveals spatial inequalities and inequalities by socioeconomic characteristics at the local level (between villages and within the village). Surprisingly, some households experience access challenges during the rainy season, resulting in widespread use of unimproved water sources. Criteria for executive committee membership explicitly exclude vulnerable groups (i.e. illiterate people, who are mostly poor), inhibiting service delivery in marginalised areas. The national water policy emphasises community-based management of water that partly gives community water committees mandate to oversee borehole installation. However, water committees have inadequate technical knowledge and district level support to oversee installation of boreholes and other supply systems. Hence, water source failures are common leading to reduced access to drinking-water especially during the dry season and following extreme events.

The study concludes that a demand-responsive system for drinking-water provision does not serve those who are marginalised by geography and/or socio-economic status. Furthermore, it highlights that seasonality assessments are critical in monitoring service delivery outcomes in marginalised communities because they help to understand when marginalised groups face access challenges and to identify which subgroup is affected.

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Research Thesis: Declaration of Authorship

Print name:	Miriam Dalitso Kalanda Joshua
Title of thesis:	The role of formal institutions in delivering equitable drinking-water access across seasons and extreme weather events: A case study of Zomba District, Malawi

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. None of this work has been published before submission

Signature: Date: 31 January 2020

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Definitions and Abbreviations

ADC	Area Development Committee
AFIDEP	African Institute for Development Policy
ASSETS	Attaining Sustainable Services from Ecosystems through Trade-off Scenarios
CBNRM	Community Based Natural Resources Management
CBM	Community Based Management
CBO	Community Based Organisation
CCRST	County Council of Research Science and Technology
CDD	Consecutive number of Dry Days
CIAT	Chartered Institute of Architectural Technologists
CWD	Consecutive number of Wet Days
DC	District Council
DCT	District Coordinating Team
DDA	Demand-Driven Approach
DEC	District Executive Committee
DJF	December January February
DoDMA	Department of Disaster Management Affairs
DRA	Demand-Responsive Approach
DRR	Disaster Risk Reduction
EAD	Environmental Affairs Department
EMA	Environment Management Act
FAO	Food Agriculture Organization
FGDs	Focus Group Discussions

Definitions and Abbreviations

FHHs	Female Headed Households
GLAAS	Global Analysis and Assessment of Sanitation and Drinking-water
GoM	Government of Malawi
IDWSSD	International Drinking-water Supply and Sanitation Decade
IFAD	International Fund for Agricultural Development
IPCC	Intergovernmental Panel on Climate Change
IWA	International Water Association
LUO	Local Utility Operator
LR	Logistic Regression
MASDAP	Malawi Spatial Data Platform
MCA	Multiple Correspondence Analysis
MHHs	Male Headed Households
MDGs	Millennium Development Goals
MGDS	Malawi Growth and Development Strategy
MIWD	Ministry of Irrigation and Water Development
MPRS	Malawi Poverty Reduction Strategy
NAPA	National Adaptation Programme of Action
NEAP	National Environmental Action Plan
NEP	National Environmental Policy
NGO	Non-Governmental Organisation
NWDP	National Water Development Programme
NWRA	National Water Resources Authority
PAI	Population Action International
PRA	Participatory Rural Appraisal

PRCPTOT	Annual total wet day precipitation
SADC	Southern African Development Community
SDGs	Sustainable Development Goals
SESs	Social-Ecological Systems
SSA	Sub-Saharan Africa
RWSP	Rural Water Supply Programme
UN	United Nations
UN DESA	United Nations Department of Economic and Social Affairs
UN Habitat	United Nations Human Settlements Programme
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations International Children's Emergency Fund
VDC	Village Development Committee
WASH	Water, Sanitation and Hygiene
WEHAB	Water, Energy, Health, Agriculture and Biodiversity
WHO	World Health Organization
JMP	Joint Monitoring Programme on water
WFP	World Food Programme
WPC	Water Point Committee
WUA	Water Users Association
WUC	Water Users Committee
WWAP	United Nations World Water Assessment Programme

Chapter 1 Introduction

1.1 Overview

This thesis contributes an empirical and theoretical understanding of how local formal institutions in rural Malawi address equitable access to drinking-water for marginalised households across seasons and extreme weather events. This chapter provides an introduction to the study, starting with an overview of research themes, rationale, research gaps and the significance of formal (*de jure*) institutions in enhancing access to drinking-water. The next section provides the specific aims and objectives of the study. This is followed by an outline of the thesis structure summarising the main content of each of the subsequent chapters. The final section reviews my position as a researcher within and alongside the Attaining Sustainable Services from Ecosystems through Trade-off Scenarios (ASSETS) research project (www.espa-assets.org).

1.2 Thesis themes

1.2.1 Trends in access to drinking-water and the effect on rural poor and women

The post-2015 United Nations development agenda, articulated through the Sustainable Development Goals (SDGs), focuses on addressing inequalities and discrimination that were inadequately addressed by the 2000-2015 development agenda (the Millennium Development Goals - MDGs) (United Nations, 2018). Although the MDGs have produced significant global gains, no progress has been made for the most marginalised households in society (De Albuquerque, 2012; Satterthwaite and Winkler, 2012; United Nations, 2018). In this thesis, marginalised households refer to rural poor households and women (Government of Malawi, 2011c; UNICEF/WHO, 2012) who are relatively voiceless: hence the need to understand the extent to which they are affected by lack of access to drinking-water.

Access to drinking-water is central to the SDG goals of poverty eradication (Goal #1) and food security (Goal #2), and remains a critical challenge in marginalised households. In this thesis the term 'drinking-water' is shorthand for water that is used for drinking and food preparation, cooking and cleaning up (WHO, 2017).

The commonly adopted approaches to rural drinking-water supply in developing countries include a combination of community-based management (CBM), community participation, and the demand-responsive approach (Cleaver and Toner, 2006; Quin et al., 2011) – discussed below. They aim to ensure effectiveness and sustainability of rural drinking-water service provision

(Cleaver and Toner, 2006; Imoro and Fielmua, 2011; Smits et al., 2013). In CBM, water users are responsible for the operation and management of their water supply (Quin et al., 2011; Smits et al., 2013). 'Drinking-water service' is a term used to define "*the accessibility, availability and quality of the main source used by households for drinking, cooking, personal hygiene and other domestic uses*" (WHO and UNICEF, 2017a). Community participation means involving water users in water development processes including need identification (expressing demand), site and technology selection, labour and materials' contribution, and funds mobilisation for capital, operations and management (Jimenez and Perez-Foguet, 2010; Quin et al., 2011; Naiga et al., 2015). In a demand-responsive approach, water users select the type of services they require based on their perceived needs and capability to manage the service – thus giving more responsibility to water users (Jimenez and Perez-Foguet, 2010; Quin et al., 2011; Moriarty et al., 2013b; Rout, 2014; Naiga et al., 2015). These approaches are in contrast to an earlier focus on supply-driven approaches in which government and development partners take a central role in choosing, operating and managing the drinking-water service (Quin et al., 2011; Black, 1998). The apparent lack of sense of ownership by local communities is considered to be the main reason why supply-driven approaches have failed to provide and sustain improved water supply in rural areas (Naiga et al., 2015; Imoro and Fielmua, 2011; Whaley and Cleaver, 2017).

Water is considered safe for drinking when it is treated, cleaned or filtered and meets certain microbiological and chemical standards set by the World Health Organisation (WHO) as well as country specific standards (WHO and UNICEF, 2010). The quality of household drinking-water[1] is usually classified into five service levels (often referred to as 'rungs on a ladder') that relate to quality namely: (1) safely managed, (2) basic, (3) limited, (4) unimproved and (5) surface water (WHO, 2017). This five rung categorisation is used throughout the thesis, as it enables a move away from the simple characterisation of with/without access to improved water facilities, and allows for the reporting of disparities in service levels (UNICEF and WHO, 2015 p42). Using five water service level categories is a notable shift away from the simple improved/non improved dichotomy used in the MDGs. Table 1.1 provides descriptions of each category.

[1] Household drinking water refers to the water that is used for drinking, cooking, food preparation and cleaning up (WHO, 2017).

Table 1.1 Drinking-water service ladder

Service level	Description
Safely managed	Drinking-water from an improved water source which is located on the premises, available when needed and free of faecal and priority chemical contamination
Basic	Drinking-water from an improved source, provided collection time is not more than 30 minutes for a roundtrip including queuing
Limited	Drinking-water from an improved source, where collection time exceeds 30 minutes for a roundtrip to collect water, including queuing
Unimproved	Drinking-water from an unprotected dug well or unprotected spring
No service (Use surface water)	Drinking-water collected directly from a river, dam, lake, pond, stream, canal or irrigation channel

Source: WHO (2017) and WHO and UNICEF (2017c)

Improved drinking-water sources are those which deliver safe water such as piped water, boreholes or tubewells, protected dug wells, protected springs, rainwater, packaged and delivered water (WHO and UNICEF, 2017c; WHO and UNICEF, 2017d; United Nations, 2018). *Unimproved water sources* are "*unprotected dug wells and unprotected springs*" (WHO, 2017 p13). This thesis does not include chemical analysis, hence improved water is used as a proxy for potability/safety.

Access to improved water has improved over the past decade but inequalities persist. Between 1990 and 2015 over 2 billion of the global population and 17% of those living in developing countries, gained access to improved drinking-water, thus raising coverage to 91% and 89% with access to improved water globally and in developing countries respectively (WHO, 2012; UNICEF/WHO, 2012; WHO and UNICEF, 2014; Pullan et al., 2014; UNICEF and WHO, 2015). Despite this significant gain, over 800 million people globally lack access to basic drinking-water service (United Nations, 2018) of whom 663 million are in developing countries (WHO, 2012; WHO and UNICEF, 2014; Pullan et al., 2014). Sub-Saharan Africa accounts for about half (48%) (319m people) of the deprived population (WHO and UNICEF, 2017c; WHO, 2017; Loftus, 2015; Stoler, 2012). More than one-fifth of the population in most of the Southern African Development Community (SADC) region still rely on unimproved water sources (WHO and UNICEF, 2017c). Furthermore, urban-rural inequities are widespread in the water sector (Satterhwaite, 2012). Similarly, by rural wealth quintile, variations in the gaps are also evident between richest and poorest quintiles – an important measure of inequality (Mckay, 2002). An understanding of factors influencing these inequalities is therefore essential for informed policy and interventions.

1.2.2 Access to drinking-water in poverty reduction

Malnutrition is one of the major causes of morbidity in developing countries (FAO et al., 2014). Therefore, this thesis focuses on drinking-water because drinking-water is central to poverty reduction and food security in the rural areas of developing countries (WHO, 2017).

The concept of food security is broadly agreed to cover four areas: access, availability, utilisation and stability (Barrett, 2010; Poppy et al., 2014a). This thesis provides insight into the utilisation dimension of food security[2] which is fundamental to the attainment of nutritional security (Misselhorn et al., 2012). Utilisation covers health issues, such as safe and proper preparation of food and the nutritional quality of household diets (Richardson, 2010; Méthot, 2012). Compromised utilisation can cause undernourishment (FAO et al., 2014). Despite achieving high agricultural productivity and economic growth over the past 50 years, 98% of undernourished children (stunted, underweight and with micronutrient deficiencies) reside in developing countries. Hosting about 25% of this population, Sub-Saharan Africa experiences the highest prevalence of undernourished children in the world (Richardson, 2010; Ringler et al., 2010; Kimani-Murage et al., 2011; Misselhorn et al., 2012; FAO et al., 2014).

Lack of access to drinking-water forces households to use insufficient and contaminated water which results in inadequate food consumption or malnutrition and water related diseases (Dungumaro, 2007; Stoler, 2012; Tarrass and Benjelloun, 2012; Pullan et al., 2014). For example, lack of access to drinking-water means that contaminated water is used for cooking food such as rice and beans. If not heated for long enough this can lead to health problems such as diarrhoea, one of the leading factors of undernutrition. Dodos et al. (2017 p284) cite several studies that agree that the three main "*causes of undernutrition, namely unsuitable or insufficient food intake, poor care practices, and infectious diseases, are directly or indirectly related to inadequate access to water*". Every year, about 11% of the 7.6 million under-five child deaths in developing countries are attributed to diarrhoea due to contaminated water (Liu et al., 2012; Prüss-Ustün et al., 2008). In Malawi about half of the reported illnesses are related to water-borne diseases such as diarrhoea, and rural areas are the most vulnerable (Pritchard et al., 2007; 2008).

A growing body of literature points to the conclusion that the provision of drinking-water can significantly reduce childhood mortalities, which come as a result of exposure to water-borne diseases, (Buor, 2004; Fotso et al., 2007; Geere et al., 2010; Prüss-Ustün et al., 2014; Wolf et al.,

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[2] Food utilisation has two groups of indicators. The first group "*encompasses variables that determine the ability to utilize food, notably indicators of access to water and sanitation. The second group focuses on outcomes of poor food utilisation, i.e. nutritional failures of children under five years of age, such as wasting, stunting and underweight*" (FAO, IFAD & WFP 2014 p13).

2014). While there are many studies recognising the health implications of inadequate access to drinking-water, limited attention is given to the effects of a constrained access to drinking-water on food security (Dodos et al., 2017; Liu et al., 2015; Joshi and Amadi, 2013). This thesis recognises the importance of linkages between drinking-water access and food consumption in limiting development potential and in increasing morbidity, however the thesis focus is on the role of formal institutions in drinking-water access for marginalised groups. See Appendix 1 for additional literature.

Satterthwaite and Winkler (2012) explain that discrimination based on many identities (such as race, language and religion) is widespread in many developing countries, especially in rural areas where inequalities in access to water and sanitation services are severe. This unequal access to water and sanitation is attributed to multiple underlying causes including: gender ideologies and inequalities (Boone et al., 2011; Baguma et al., 2013), poverty (Sorenson et al., 2011; Wilk and Jonsson, 2013), seasonality (Chambers, 2012), proximity (Boone et al., 2011) and water governance crisis (UNDP, 2006; Naiga et al., 2015; Tir and Stinnett, 2012).

The water governance crisis relates to the institutions that govern water resource use. Institutions are often defined as both formal and informal humanly devised constraints that shape interactions in any system (North, 1991; Rodríguez-Pose, 2013). Formal institutions are universal and transferable rules that "include constitutions, laws, charters, bylaws, regulations … and property rights" while informal institutions are tacit, including "norms, traditions and social conventions, interpersonal contacts, relationships, and informal networks" (Rodríguez-Pose, 2013 p1038). Despite, these differences, many studies agree that both types of institutions have the ability to influence human interactions or moderate the effect of other factors on these interactions (Rodríguez-Pose, 2013; Ostrom, 2000; North, 1990). For example, the institutions that determine how water is allocated and used within a community influence other factors (such as affordability, gender, climate risks and seasonality) that affect access to water. However, the mediating role of these institutions in the effect of the other factors on access to drinking-water is least covered in water scholarship and the mediating role of formal institutions is least investigated by the UN system (e.g. WHO/UNICEF Joint Monitoring Programme on water) relative to socioeconomic and geopolitical factors (Satterthwaite and Winkler, 2012; 2012; Tir and Stinnett, 2012; Linke et al., 2018). Examples include the moderating effect of formal institutions on the effects of climate risks on water related conflicts/access challenges and resolutions among users, however, these examples are largely related to agricultural water (Tir and Stinnett, 2012; Linke et al., 2018). Studies focussing on developing countries that investigate the moderation effects of institutions on factors influencing drinking-water access among marginalised households are generally rare.

1.2.3 Formal institutions governing access to drinking-water

Formal institutions, specifically legislation, policies and regulations, are seen as central to translating "*human rights obligations into meaningful action on the ground with respect to human rights principles ('non-discrimination and equality, information, participation and accountability')*" in access to water (De Albuquerque, 2014a p8)[3]. Recognition of the right to water in domestic legal frameworks "*provides a critical reference point for policy makers*", government offices, judiciary and the civil society in fulfilling their mandates related to water service provision (De Albuquerque, 2012 p51) contrary to *de facto* institutions which are informally established and whose ways may be widely practised but lack legal recognition. In response to access challenges, governments in Sub-Saharan Africa have revised national water-related policies, guidelines, strategies and legislations to enhance their people's access rights to drinking-water and eliminate formal discrimination (De Albuquerque, 2012; De Albuquerque, 2014a; Lande, 2015). However, little is known about how formal institutions affect access rights of the marginalised households in rural areas of sub-Saharan Africa, especially how these institutions address formal or *de facto* discrimination. This thesis, using Ostrom's Socio-Ecological Systems Framework (details in Section 2.4), addresses this gap using four rural communities located in Zomba District, Southern Malawi, as a case study.

1.2.4 Physical dimensions of drinking-water access: the effect of seasons and extreme weather events

The significance of the effects of seasonality on development cannot be over-emphasised. Seasonality describes the cyclical and regular patterns linked with seasons, and is a major factor that explains variations in many social and natural systems (Lisovski et al., 2017). Seasonal variations affect the whole spectrum of development including economic opportunities, health and wellbeing, agricultural access and education. Seasonality affects poverty and the impacts of natural disasters (Chambers, 2012), seasonality affects agriculture and hence hunger (Khandker and Mahmud, 2012), seasonality affects disease prevalence and spread (Altizer et al., 2006) and seasonality affects water access and utilisation (Wilbers et al., 2014; Reynaud et al., 2018), all of which affect development. For example, several studies highlight the uneven distribution and availability of water in both the dry and wet seasons (Kostyla et al., 2015; Wright et al., 2012) as well as during extreme weather events (Republic of South Africa, 2004; GENDERCC Southern Africa et al., 2011; Government of Malawi, 2011c; Batisani, 2011; Henry et al., 2011; Hu et al.,

[3] Often cited, de Albuquerque was the first UN Special Rapporteur on the right to safe drinking-water and sanitation (2008-14).

2011; Ryu et al., 2011). Furthermore, there is growing recognition of links between drinking-water access and food utilisation (Richardson, 2010; Méthot, 2012; Poppy et al., 2014a). Hence seasonality of drinking-water access and access during extreme weather events are likely to affect food utilisation/malnutrition levels in marginalised households. Most aspects of development are affected by seasons, and hence policies and interventions could be improved by taking seasonal differences into account. Understanding how local formal institutions consider seasonality and extreme weather events in ensuring equitable access is therefore one entry point in addressing marginalisation and food security in developing countries. However, seasonality is not often discussed in development planning and in the water literature, and it is understudied in developing countries (Chambers, 2012).

1.2.5 Access to drinking-water in Malawi

This study was conducted in Malawi. Malawi is located in Southern Africa; west and south of Tanzania, east of Zambia, and west and north of Mozambique. Its geographical coordinates are 13 30 S, 34 00 E (Fig. 1.1). About one third of its total area coverage (118,484 sq km land) is water.

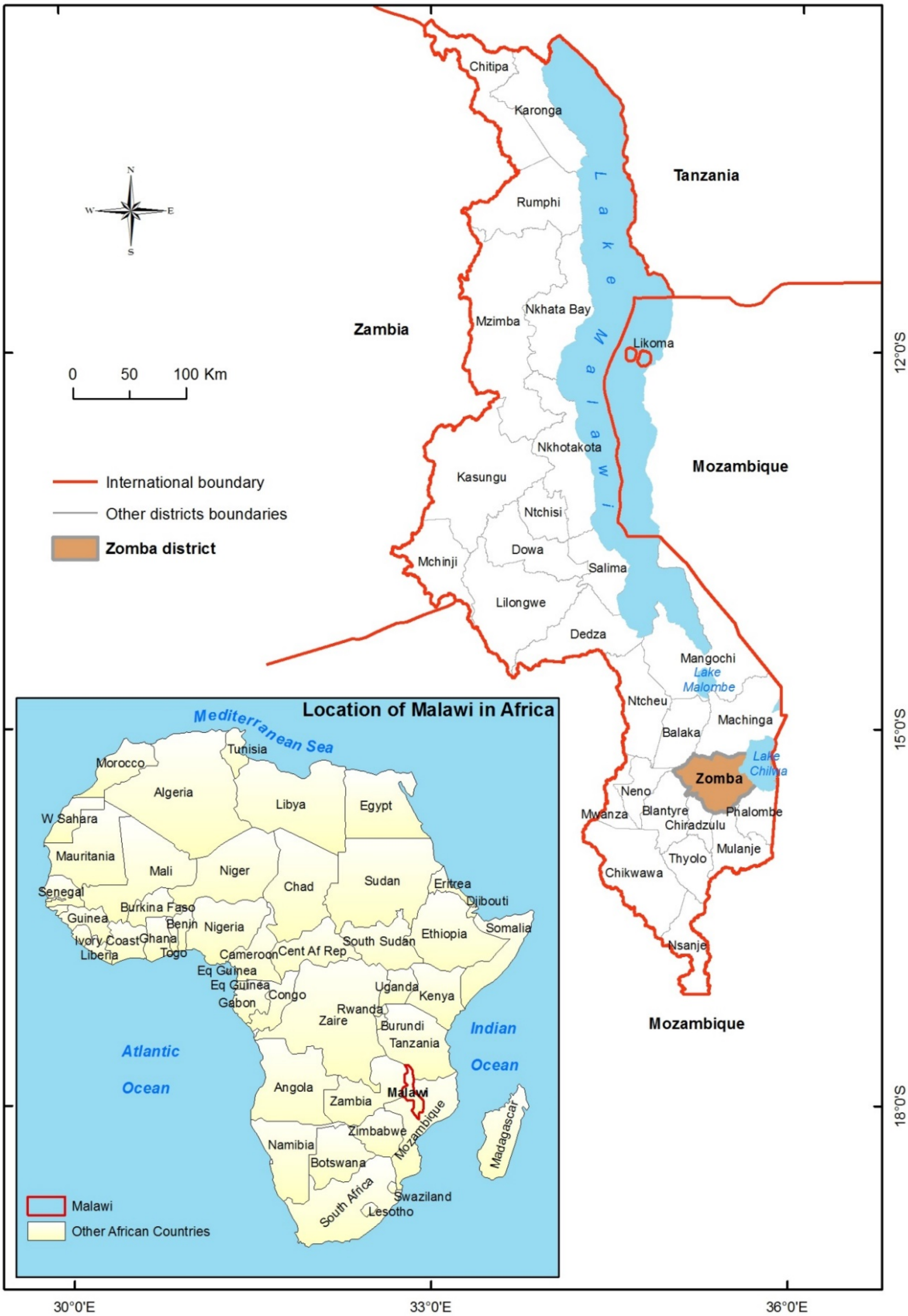


Figure 1.1 Location of Zomba within Malawi and of Malawi in Africa

Source: Map of Africa from ArcMap and Malawi from National Spatial Data Center (2014)

This study was conducted in Malawi for five reasons.

1. Access to drinking-water remains a challenge. Despite some progress made in improving access to drinking-water, 17% of the population in rural areas still lack access (Government of Malawi, 2011c; Pritchard et al., 2007; 2008). This statistic excludes non-functional water facilities and households that experience seasonal water access challenges in rural areas. Hence, the actual proportion without continuous access to drinking-water is high.
2. Linkages between poor access to drinking-water and food insecurity are widely acknowledged (Government of Malawi, 2007b; 2010d; Government of Malawi and WFP, 2012; Sassi, 2012; Poppy et al., 2014b). The country has high rates of malnutrition and about 50% of the under-five population has stunted growth and 15% is underweight (FAO et al., 2014; National Statistical Office and ICF, 2016).
3. There are high rates of deaths due to water borne diseases (Pritchard et al., 2007; 2008).
4. Malawi is experiencing increasing temperatures and a decreasing rainfall pattern, with frequent shocks from *El Niño* and *La Niña* which in part contribute to seasonal water issues and further make the country prone to extreme weather events (water disasters) (Government of Malawi, 2011e; 2006c; 2011c; 2006b; 2010c; Ngongondo et al., 2011b; Ngongondo et al., 2015; Arnell and Gosling, 2016; Winsemius et al., 2015; World Bank, 2016; Government of Malawi, 2015).
5. There is no study that has assessed how formal institutions affect access to drinking-water in marginalised households in rural areas.

1.3 Research Aim and objectives

1.3.1 Research aim

The aim of this study is to assess how local formal institutions affect access to drinking-water for marginalised households across seasons and extreme weather events, in rural Zomba, Malawi.

1.3.2 Specific Objectives

1. To determine the extent to which national water policy and institutional design address equitable[4] access to drinking-water for marginalised households across seasons and extreme weather events

[4] Equitable access means progressive reduction and elimination of inequalities between population subgroups (WHO, 2017).

2. To establish how well the local formal water institutions implement policy and deliver equitable access to drinking-water for marginalised households
3. To explore how seasonality and extreme weather events affect the ability of local formal water institutions to deliver equitable access to drinking-water for marginalised households.

1.4 Thesis structure

This thesis is divided into eight chapters. Following the present introductory chapter, Chapter 2 reviews the literature on access to drinking-water in developing countries, and its importance for development. The aim is to create an understanding of access patterns of drinking-water and their implications for marginalised households in Sub-Saharan Africa as well as identifying gaps that need to be addressed in this thesis.

Chapter 3 is the methods section, which outlines the site selection, research methods and the conceptual framework for the study. The case study approach is justified, and the multiple methods approach is described in detail. These methods include qualitative data collection (document review, key informant interviews, focus group discussions and participant observation) and a quantitative household survey.

Chapter 4 provides a description of the Zomba study site and the four study villages, focusses on climatic and social economic characteristics and presents selected descriptive study findings.

Study results are organised around the specific objectives, in chapters 5 to 7. Chapter 5 focuses on specific objective number 1 – water policy analysis. It analyses the international, national and local policy context, identifying the policy intentions relating to drinking-water access for rural households across the seasons, outlining the demand-responsive system for providing improved water access in Malawi and policy response to seasonality and extreme precipitation conditions.

Objectives 2 and 3 are both covered in chapters 6 and 7. Chapter 6 analyses service delivery outcomes in marginalised households across seasons and during extreme weather events. The role of local formal institutions in explaining the observed service delivery outcomes is covered in Chapter 7, focussing on marginalised households across seasons and during extreme weather events.

Chapter 8 draws on the empirical evidence presented in the preceding chapters to comment on the overarching aim of the thesis, highlighting the study's contributions to the literature, its methodological limitations and insights, future research recommendations, policy recommendations and conclusions.

1.5 Researcher position in ASSETS Project research work

This study was undertaken in association with the Attaining Sustainable Services from Ecosystems through Trade-off Scenarios (ASSETS) research project led by Professor Guy Poppy of the University of Southampton in collaboration with researchers from CIAT (Colombia), University of Malawi – Chancellor College, World Fish (Malawi), Basque Centre for Climate Change Research (Spain), Conservation International (USA) and the University of Dundee. The ASSETS project aimed to quantify the linkages between the natural ecosystem services that affect – and are affected by – food security and nutritional health for the rural poor at the forest-agricultural interface, with case studies in Malawi, Peru and Colombia. As a lecturer at Chancellor College, the researcher was part of the ASSETS Malawi team and took part in both the design of the qualitative and quantitative methods and in the data collection. Participation in, and analysis of, some of the ASSETS qualitative data provided me with a good general understanding of how households rely on and access local natural resources. However, the information on water governance was not detailed enough to help answer the research questions posed in this thesis. It was therefore necessary to design and implement additional participatory research exercises as well as to undertake key informant interviews at different levels (see Chapter 3 for more details). To supplement this qualitative information, the researcher analysed a sub-set of relevant quantitative data from the ASSETS household surveys. This research provides the understanding of the mediating role of formal institutions on access – by rural poor households in Malawi – to drinking-water.

Chapter 2 Literature review on access to drinking-water in developing countries: issues, institutions, and seasonality

2.1 Introduction

Recently, considerable attention has been given to the subject of access to drinking-water (water that is used for drinking and food preparation, cooking and cleaning up) but literature on this is sparse, especially in developing countries like Malawi. This chapter examines literature on access to drinking-water in developing countries, and its importance for development. It is divided into three sections. The first section reviews drinking-water access, issues and challenges. The second section will show the role of institutions in shaping drinking-water access. The third section will present the theoretical framework guiding the thesis. This assessment will be achieved through an analysis of key themes in water scholarship including both trends in access and the implications for marginalised groups, and the role of institutions in shaping access. Furthermore, the chapter analyses drinking-water access determinants including the implications/issues and challenges in developing countries. Consequently, the dynamics and implications of poverty, gender, extreme weather events, seasonality and institutions, on access to drinking-water will be considered. More particularly, the chapter analyses links between poverty and marginalised households; gender and equity issues of access to drinking-water; the impacts of limited access to water for women and the rural poor; seasonality of water availability and effect on access to drinking-water and how institutions affect access to water in Sub-Saharan Africa. It is hoped that a careful study of these issues will lead to a better understanding of access patterns to drinking-water and their implications on marginalised households in Sub-Saharan Africa.

2.2 Drinking-water access in developing countries, issues and challenges

2.2.1 Drinking-water access trends in developing countries

Despite the central role of drinking-water access in addressing poverty, improving access remains a challenge in developing countries. Globally, over 2 billion people reportedly gained access to drinking-water between 1990 and 2010 (WHO and UNICEF, 2013). By 2015, 71% of the global population (5.2 billion) used safely managed drinking-water services (located on the premises, readily available and free from contamination). About 33% of these lived in rural areas. 80% (5.8 billion people) used improved sources located on the premises and 75% (5.4 billion) used improved sources free from contamination. About 89% used a basic source (improved source within 30 minutes round trip) (WHO and UNICEF, 2017c). Similar progress has been reported in many developing countries (Government of Malawi, 2010e; Republic of South Africa, 2010; Republic of Zimbabwe, 2010; WHO and UNICEF, 2010).

Despite these significant gains in drinking-water access during the MDG era, inequalities in water access persist in many developing countries (De Albuquerque, 2012; Pullan et al., 2014; WHO and UNICEF, 2014; WHO and UNICEF, 2017c), with about half of the deprived population living in Sub-Saharan Africa (Loftus, 2015; Stoler, 2012; WHO and UNICEF, 2017c). Widely reported inequalities include rural-urban gaps (WHO and UNICEF, 2013; Pullan et al., 2014) and socio-economic disparities (De Albuquerque, 2012; Satterthwaite and Winkler, 2012). Similar access challenges are in hard-to-reach areas (Pullan et al., 2014). The United Nations post-2015 development agenda (e.g. Sustainable Development Goals) in the water sector focuses on addressing inequalities across developing countries (Satterthwaite and Winkler, 2012). Specifically, the current focus is on achieving universal access rather than improving the proportions of the population with access – a focus of the Millennium Development Goals (MDGs) which reportedly failed to address persistent marginalisation (De Albuquerque, 2012; Satterthwaite and Winkler, 2012). Understanding how such inequalities occur at subnational level, particularly in rural areas of developing countries, is important because it can help to prioritise resource allocation and track progress towards achieving universal access (Pullan et al., 2014). However, limited published studies and data exist at a small scale on geographic inequalities and socio-economic disparities to inform policy (Pullan et al., 2014; Yu et al., 2014) and shape appropriate interventions to address access challenges in marginalised households.

Additionally, although the WHO and the UN recognise the importance of both water quality and quantity sufficiency in "*all aspects of life and sustainable development*" (United Nations, 2018 p27), there are gaps in the water literature on marginalised households' attainment of water for drinking and food preparation, especially for rural areas (United Nations, 2018). Many studies, including the WHO/UNICEF Joint Monitoring Programme, emphasise access to safe water. WHO and UNICEF (2017c) and United Nations (2018) acknowledge data gaps on quantity, especially in rural areas and areas with limited access to tap water. Addressing these gaps can help relevant stakeholders "*better identify and target disadvantaged groups*" (United Nations, 2018 p44). One of the main challenges relates to factors that affect access and water use behaviours in marginalised households which are often context specific. This thesis contends that a comprehensive understanding of the effect of these factors on marginalised households is essential to help relevant stakeholders identify and target disadvantaged groups (United Nations, 2018). While these factors have been extensively studied in developed countries, wide gaps remain in rural areas of developing countries, specifically Sub-Saharan Africa, where progress is often off-track, as illustrated in the following sections.

There are several factors which contribute to constrained access to drinking-water. In this review, these are (broadly) categorised into three broad groups: biophysical attributes; socioeconomic factors; and institutional arrangements (Andersson and Agrawal, 2011). The factors in each group are very complex. For example, biophysical factors include the effect of aquifer type – permeability of rocks, and soil types on borehole drilling, success rates and yield, and the existence of some localised mineral compositions, e.g. rocks bearing geogenic[5] contaminants such as arsenic and fluoride that can make groundwater unusable. This literature review focuses mostly on socioeconomic factors, specifically gender and poverty, as well as institutional arrangements. It considers one biophysical component: the seasonality of water, and the effects of extreme weather events.

This literature review focuses on institutions because of their mediating role on the effect of the other factors on access to drinking-water. This role is least covered in water scholarship. Second, the mediating role of formal (*de jure*) institutions are least investigated by the UN system (e.g. WHO/UNICEF Joint Monitoring Programme on water) relative to socioeconomic and geopolitical factors (Satterthwaite and Winkler, 2012). Moreover, the role of institutions on access to drinking-water in marginalised households, especially in SSA is understudied (Cleaver and Toner, 2006; Chitonge, 2011; Chowns, 2014; Naiga, 2015). The review in the following sections illustrates these gaps.

2.2.2 Access to drinking-water, poverty and marginalised households

Many studies have concluded that there is a relationship between household economic status, specifically poverty, and access to drinking-water (Sorenson et al., 2011; Wilk and Jonsson, 2013; Woldemariam and Narsiah, 2014; Vázquez-García and Sosa-Capistrán, 2017). Studies agree that the relationship between poverty and access to drinking-water is complex and that the poor are likely to have limited access (Kendie, 1996; Dungumaro, 2007; Wilk and Jonsson, 2013) and to rely on unimproved sources, including open surface water (Emenike et al., 2017). Many empirical

[5] Naturally occurring chemical contaminants

findings relate this to the inability of poor households or the difficulties they face when trying to meet direct and indirect costs of accessing drinking-water. For example, in a study of water access in 44 developing countries, Rahut et al. (2016b p1349) find that in rural areas "*poor households do not have access to quality water either in terms of sources or in methods of treatment*" but spend much on medication. Their willingness to pay for basic water services is affected by their level of income hence, relative to wealthier households, they prefer water from unimproved or open sources, which are often contaminated, making them more vulnerable to water-borne diseases (Rahut et al., 2016b p1350). Similarly, Shrestha et al. (2018) find that in Nepal water is unaffordable among the poor due to the hidden cost of water treatment. A study of the social acceptability of arsenic-safe technologies in rural Bangladesh, (Kundu et al., 2016) generates similar results. While some hidden costs are common, e.g. water treatment and medical costs for consuming unsafe water, some may be unique to specific settings. These hidden costs and their contribution to access inequalities are not fully covered in rural areas of developing countries for well-informed interventions. Similar challenges relate to direct costs.

Direct costs may lead to people having no access to drinking-water, even when water is available in their area, because they have low incomes (Dungumaro, 2007) or cannot afford to pay for the service (Kendie, 1996; Dungumaro, 2007; Vázquez-García and Sosa-Capistrán, 2017). This includes costs for connection and consumption (Isoke and van Dijk, 2014). For example, Woldemariam and Narsiah (2014) argue that although water is available in Addis Ababa, poor households experience differential access because water prices are high and the poor rely on vendors. According to Samra et al. (2011), the 2006 Punjab Rural Water Supply and Sanitation Project (PRWSS) failed to adequately meet the need of poor communities because access to the clean water was unaffordable to some poor households. Vázquez-García and Sosa-Capistrán (2017) draw similar conclusions for rural poor women of Loma Iguana, Mexico, who cannot access water due to inability to pay service connection charges. Similarly, a study in South Africa in 2006 reveals that those with some (stable) income are five times more likely to live in households with access to drinking-water than the lowest income people (Dungumaro, 2007). The Cleaver and Toner (2006) study in rural Tanzania provides similar results; where the poor fail to access drinking-water because they are unable to afford the set price (of water). This implies that the poor have limited access to drinking-water in such areas.

> *"Connection charges are often a significant barrier for those living in extreme poverty, with recent research suggesting that the average connection cost paid by each household to utilities in Africa was USD 186 and in Asia it was USD 169. This is equivalent, in Ghana for example, to approximately a year's income for a low-income household"* (De Albuquerque, 2012 p89).

This justifies the need for adequately informed pro-poor policies and interventions. However, there are large data gaps on the affordability of drinking-water in rural areas (United Nations, 2018) particularly for marginalised households, as few studies disaggregate estimates by household subgroups. Further, many surveys focus on urban areas or report on rural access in general (Adams, 2018; Martinez-Santos, 2017; Aguilar Benitez and Monforte, 2018; Isoke and van Dijk, 2014; Kibassa, 2011). Although a general analysis of place-based inequalities is important, ignoring differences in rural and urban communities prevents an adequate understanding of spatial and social economic inequalities in access to water (Osei et al., 2015). Disaggregation at a small scale is important because it enables the identification and targeting of the most disadvantaged households. Additionally, there is a lack of uniform definition of affordability in most of these earlier studies, as many focus on people's perceptions, hence it is difficult to apply conclusions in different settings. It is, therefore, necessary to understand the affordability of water among different subgroups in rural areas using a standard threshold, e.g. by comparing economic access between the rural rich and poor.

Some studies show that limited access to water among the rural poor is due to lack of service[6] (Emenike et al., 2017). For example, in Sixaola, Costa Rica, low-income rural households have to use unsafe water due to lack of service (Mena-Rivera and Quiros-Vega, 2018). Such studies do not show whether this lack of service is due to low socio-economic status of the households in the area – a gap that needs further investigation for informed interventions. Despite this limitation, this review suggests that various reasons, other than the inability to pay, can also explain why the poor face differential access, and these tend to be diverse and contextualised. Furthermore, these earlier studies focus on access to safe water of poor households, with little assessment of how they meet their minimum water requirements. An understanding of the factors that contribute to access inequalities or affect the pattern of access (both in quality and quantity) in poor households in different setups, specifically at small spatial scale can, therefore, provide a unique contribution towards addressing socioeconomic inequalities in water access.

In addition to economic factors, gender can also contribute to inequalities in societies (United Nations, 2018). The next subsection, therefore, reviews gender dynamics as they relate to equity issues of access to drinking-water.

[6] Service is a system supplying a public need such as utilities/facilities to satisfy a need or demand (e.g. improved drinking-water).

2.2.3 Gender and equity issues of access to drinking-water

Gender is widely recognised in development discourses. It is considered important in understanding many developmental issues that concern economic activity and human wellbeing (such as health practices and implications, livelihood strategies and access to resources), in any given society (Kabeer and Subrahmanian, 1996; Crow and Sultana, 2002; Pearson, 1992). Gender refers to the socially constructed and experienced attributes associated with women and men – including norms, roles and relationships of and between groups of women and men in a society (Agarwal, 1997; Bottorff et al., 2011; Parker et al., 2016). Gender norms are "the collective and often unequal expectations [beliefs], about how women and men should behave, feel, think and interact in a given society" (Moreau et al., 2019 p1). These norms serve as scripts for socially acceptable behaviour based on one's sex (Moreau et al., 2019; Connell, 2012) and they are not historically static and vary from one society to another and social context (FAO/WFP, 2008; Reeves and Baden, 2000; Agarwal, 1997). Thus, exclusion of women in decision-making forums, physical or sexual abuse of women by male partners and male use of "their authority to usurp control over resources targeted at women" (Kabeer and Subrahmanian, 1996 p18) may not apply in all societies.

Gender relations refer to complex hierarchical relations of power between women and men (Kabeer and Subrahmanian, 1996; Agarwal, 1997). The gender relations highlight how each culture or society defines the rights, responsibilities and identities of men and women and how they relate with each other (FAO/WFP, 2008; Bravo-Baumann, 2000). Gender relations are visible in a number of gendered practices including division of labour, ownership and control of resources, decision-making and gendered ideologies (Kabeer and Subrahmanian, 1996; Agarwal, 1997; Bottorff et al., 2011; Buckingham, 2015). Perceptions of masculinities[7] and feminine attributes can create gender-based divisions of work. For example, in South Asia women tend to dominate in domestic work, whereas men dominate in control and ownership of productive assets such as land and resources on it, and further dominate in decision-making arrangements (Crow and Sultana, 2002; Agarwal, 1997; Connell, 2005). In this regard, many studies argue that gender relations often render men more powerful than women, thus, they tend to disadvantage women (Kabeer and Subrahmanian, 1996; Bottorff et al., 2011; Buckingham, 2015; Parker et al., 2016).

[7] Masculinity relates to attributes and qualities associated with men such as "aggressivity, competitiveness, and emotional detachment, which, it is implied, distinguish it from its counterpart, femininity (passivity, cooperativeness, emotionality) (Peterson, 2003 p58).

The impact of gender disadvantage can be seen in a recent study of yield differences related to intensification based on gender, in Malawi, Tanzania and Zambia. Differential (limited) access to farm inputs largely contributed to low crop yields in female-headed households compared to male-headed households (Andersson Djurfeldt et al., 2019). Studies show that although women comprise about half of the agricultural labour force globally, and in many African and Asian countries, their land ownership and access to productive assets is limited compared to men (Grant, 2017; de Jong et al., 2012).

Formal institutions (policies and acts) governing ownership and access to land and water in many (102) countries promote women's exclusion (Grant, 2017; Parker et al., 2016; Salo, 2013) and limit women's effective engagement in poverty eradication (Parker et al., 2016; Fonjong et al., 2013). Furthermore, many studies argue that many societal inequalities, especially in developing countries, are widespread due to gender issues (Buckingham-Hatfield, 2001; Parker et al., 2016). Likewise, Petersen (2003) and Grant (2017), add that there are also variations and exclusions within the gender categories (e.g. age, marital status and remittance flow) as well as similarities between men and women that other studies ignore which can potentially affect social interactions. According to Grant (2017) these differences within a gender category can lead to differential wellbeing outcomes within a gender category. For example, on health outcomes, studies show higher mortality rates for single men and widowers than married men, and improved health for married women due to increased financial stability (Moreau et al., 2019). Understanding of the differences within a gender group is therefore central in designing policies and interventions targeting the most disadvantaged within a gender group. Nevertheless, Sainsbury (2001) reports that due to policy changes over time there appears to be: a weakening dependence on males; an increase in bargaining power by women within their families; and a decline in the breadwinner model which initially excluded women from paid work. This thesis therefore, contends that a detailed analysis and understanding of gender relations, how people in a given community construct their belief systems and their implications in various sectors of life is central to understanding drinking water access and use.

Despite growing recognition of the gendered nature of access to drinking-water, there is inadequate gender-disaggregated data, especially in developing countries. Available studies report the proportion of households with access, by gender of household head, focusing on quality, but rarely report on other dimensions of access like economic accessibility, physical accessibility and quantity. Some studies find a significantly higher proportion of male-headed households with access to drinking-water compared to female-headed households (Rahut et al., 2015). Yet in other contexts, female-headed households have higher access, as reported in national surveys in Malawi by National Statistical Office and ICF (2016). These mixed results point to possible contextual differences, highlighting the need for localised studies to understand and address inequities by gender.

Studies show that women and girls experience discrimination and inequalities affecting their access to water (UN Water, 2015). This is compounded by the fact that women are the main fetchers of water in most traditional societies (UN Water, 2015), partly influenced by gendered ideologies in the context of division of labour. Many studies have established that in many rural areas, across developing countries, the roles of drinking-water collection are predominantly borne by women (Benería, 1995; Makoni et al., 2004; Singh et al., 2005; Geere et al., 2010; Boone et al., 2011; Sorenson et al., 2011; Earle and Bazilli, 2013). However, Hawkins and Seager (2010) argue that this conclusion is based on scant data because, in some countries, such as those in South America, the largest burden is borne by men. Nevertheless, recent data from 45 developing countries confirm that in almost 64% of the households, water collection is largely borne by women, while men are responsible for water collection in about 24% of households (WHO and UNICEF, 2010; UNICEF and WHO, 2015). A similar picture is drawn for Sub-Saharan African countries (UN Water, 2015; UNDESA, 2010; UNICEF and WHO, 2008; WHO and UNICEF, 2010; Sorenson et al., 2011; Baguma et al., 2013; WHO and UNICEF, 2017c). This explains why gender is a necessary tool/framework for social analysis, and is critical in understanding equity outcomes, if we are to avoid simplistic generalisations that equate water availability with access. To date, the impact of gender on access to water in developing countries has not been sufficiently examined.

Studies also show that in rural areas of Africa and Asia women and girls are excluded from drinking water decision-making processes. For instance, women are often not consulted about the siting of water points or the best suitable technology, based on their needs, despite their important role in water fetching and food preparation (De Albuquerque, 2012). It is therefore essential to analyse this in specific communities, to determine whether or how the lack of participation contributes to constrained access and persistent marginalisation. Constrained access to drinking-water by gender can also be studied through the lens of poverty.

Within rural populations, women are often disproportionately poor (UNEP, 2002; UNDESA, 2010) and may therefore face more challenges in accessing drinking-water. However, Cagatay (1998) argues that this situation should not be generalised across the globe because evidence shows that comparative poverty between female-headed households (FHHs) and male-headed households is not universal. Cagatay (1998) points out that it is important to distinguish different types of female heads, for example female-maintained households (where women are breadwinners) and FHHs due to male migration, which may be relatively well-off if remittances are high. Relative poverty aside, it is possible for people to experience water shortages because of unfavourable gender ideologies. Such ideologies are central in governing the processes of production, consumption and distribution in any given society (De Albuquerque, 2012). Reeves and Baden (2000) argue that culturally determined gender ideologies decree people's rights and responsibilities and what is acceptable/appropriate behaviour for men and women, including access to and control over resources and engagement in decision making.

Women spend much time on water collection (Boone et al., 2011) with inadequate water infrastructure in many rural areas. Studies show that the total collection time (return trip) in many rural areas, often exceeds 30 minutes (WHO and UNICEF, 2017c). Significantly, this situation affects the quantity of water collected, and studies show that lack of access to drinking-water forces households to use insufficient and contaminated water, resulting in malnutrition and water-related diseases such as cholera, dysentery and diarrhoea (Dungumaro, 2007; Stoler, 2012; Tarrass and Benjelloun, 2012; Pullan et al., 2014) in most of Sub-Saharan Africa. Although addressing gender ideologies to improve water access is a key policy issue in Sub-Saharan Africa, data gaps exist on linkages between gender ideologies and water use, e.g. quantity and quality of water collected specifically for drinking (Hawkins and Seager, 2010; UNDESA, 2010; Sorenson et al., 2011). Furthermore, Hawkins and Seager (2010) argue that because gender roles are contextual, a reliable picture of social relationships and a broader understanding about gender and water should be based on locally specific case studies, rather than making large-scale generalisations based on limited data sets. Addressing these gaps is therefore important for informed policy in Sub-Saharan Africa. For example, quantity and quality of water fetched by gender per household reveals who needs drinking-water most (Sorenson et al., 2011) in a particular community. This can help to track progress towards attainment of universal coverage of drinking-water in Sub-Saharan Africa (Pullan et al., 2014).

2.2.4 Implications of limited access for rural women and the poor

The impacts of water access challenges are highly gendered and contentious. It is widely acknowledged that multiple impacts of limited water access for rural women in most developing countries are largely unknown due to "*the lack of gender-disaggregated data*" (Sorenson et al., 2011 p1525) or are under-documented due to topical sensitivity in different cultural settings (Sommer et al., 2014). Despite this research gap, the available literature reveals the implications of everyday experiences of water access challenges for women (as main water fetchers in rural areas). These relate to: inadequate infrastructure, water shortages, increased distance or travel time or difficult terrain to water sources. Classic examples include studies by Cooper-Vince et al. (2018), who looked at water-related health risks in rural Uganda, Baker et al. (2018) and Rahut et al. (2016a) who similarly analysed water-related health risks in rural India, Sommer et al. (2014)

and Stevenson et al. (2012) who explored water insecurity related violence in rural Ethiopia, and Sorenson et al. (2011) who analysed the burden of water access on women in 44 developing countries.

These studies all reveal that women in developing countries face more structural constraints than their male counterparts. These include health problems (Geere et al., 2010; Geere et al., 2018), psychological and socioeconomic challenges (Sorenson et al., 2011; Baker et al., 2018). Violence-related examples include experiences of sexual violence (rape) while collecting water from distant water sources in rural India, Eastern Congo and Ethiopia (Baker et al., 2018; Sommer et al., 2014), physical fights in rural Uganda and Ethiopia while queuing for scarce water, and domestic violence over water (Sommer et al., 2014). Women in water insecure hotspots of rural Uganda have suffered distress from water insecurity (Cooper-Vince et al., 2018). This is partly due to increased challenges that women face in fulfilling their reproductive roles including child care, washing, cleaning and cooking (Cooper-Vince et al., 2018).

Other health-related implications include experiences of physical stress, high caloric expenditures from multiple trips during drought, injuries from falling on uneven, steep routes to water sources in Guatemala, especially when the women are pregnant, carrying babies or have recently given birth (Sorenson et al., 2011; Caruso et al., 2015). In India, the physical and psychological stress related to water access challenges have been associated with an increased risk that Indian women will have low birth weight outcomes. This is one of the major causes of neonatal and under-five illnesses and deaths, in low and middle income countries like India, and increased incidences in Africa (Baker et al., 2018). Fatigue from multiple trips also has adverse effects on women's wellbeing, productivity, available energy and time for productive activities (Sorenson et al., 2011; Caruso et al., 2015). This observation is supported by a large body of empirical evidence. For example, in rural poor households of South Africa, women who are responsible for fetching water spend less than 25% of their time on paid employment (WWAP, 2016). Similarly, a study in rural China reveals that distant water sources, or more time spent getting to water sources, greatly decreases women's availability for off-farm occupations, relative to their male counterparts (Zhou and Turvey, 2018). However, this thesis cautions that this impact depends on family structure and a person's role in the family. For example, Boone et al. (2011) argue that, in rural Madagascar, the effect of fetching water on women is not statistically significant.

Nevertheless, studies in 44 developing countries have also revealed opportunity costs of spending much time on water fetching, related to the school attendance of young women and their participation in income-generating activities (Sorenson et al., 2011; Boone et al., 2011; Emenike et al., 2017). The fear of, and increased vulnerability to these risks, force women to use convenient unsafe water sources or prioritise food consumption and drinking and minimise water for other uses, e.g. personal hygiene and sanitation (Sorenson et al., 2011; Stevenson et al., 2012; Caruso et al., 2015).

These gendered challenges of limited water access are more pronounced in low-income areas (WWAP, 2016) hence the call for special policy consideration of gender dynamics of water access in rural areas. However, even with these gaps identified, the varying implications and responses that women may adopt in different contexts, suggest that more studies are needed in developing countries to guide local policy and interventions.

Another factor in need of research is the seasonality of water availability and its effects on water access.

2.2.5 Extreme events, seasonality of water availability and their effect on drinking-water access

It is increasingly acknowledged that access to water could be better understood through the lens of seasonality of water availability. Seasonality, which is defined as a regular pattern or variation associated with seasons[8] (Chambers, 2012 p1), affects rural people's access to drinking-water (Chambers, 2012). There is a growing body of literature that shows that surface water quality and availability in developing countries follow seasonal patterns (Kostyla et al., 2015; Wright et al., 2012) with implications on household access (WWAP/UN-Water, 2018; Wright et al., 2012). Several studies provide evidence of how seasons and seasonality of weather events affect drinking-water systems. One example is the reported effects of a long dry season in Sub-Saharan Africa on groundwater and surface water availability, and the knock-on effects on rural household water demand, the choice of a main water source and the willingness to pay for water (Kelly et al., 2018). Similarly, Shaheed et al. (2014b) in Kandal Province, Cambodia, report that households use different sources and quantities of drinking-water depending on the season. Many households use rainwater as a primary source during the rainy season, and stored rainwater becomes a secondary source during the dry season. A study in rural China reveals that during the rainy season, ground water in shallow wells/hand pumps can become contaminated with agricultural pesticides due to rising water tables (Zhao and Pei, 2012).

There is increasing evidence that the seasonality of water availability and quality is compounded by climate change effects. However, climatic effects are not the only factors explaining water

[8] A season refers "*to either astronomical divisions of the year (winter, spring, summer, autumn) or to divisions based on climatic periods (e.g., wet season(s), dry season)*" (Kostyla, 2015 p334).

quality parameters and availability (Chambers, 2012; Basu et al., 2015; Rosinger, 2018; Tucker et al., 2014). Of particular importance are changes in seasonality of climatic factors or trends including temperature trends and rainfall patterns (in relation to onset, distribution and cessation).

Recent scientific analyses confirm perceived changes in climate, changing rainfall patterns which are altering hydrological systems, consequently affecting water availability and quality, both in surface and ground water sources (IPCC, 2014; Omondi et al., 2014; Zhang et al., 2017). Many studies agree that climate change is affecting temperature trends and rainfall patterns which directly contribute to the stability of water supplies (Almazroui et al., 2012; Hu et al., 2011; Ryu et al., 2011; Shrestha et al., 2012). For example, in addition to warming temperatures, there appears to be a changing intensity and frequency of extreme rainfall events (such as storms, floods and droughts) and changes in the rainfall season (onset, cessation and length) (Brown et al., 2012; Alexander et al., 2006; Donart et al., 2013; Zhang et al., 2017; Ngongondo et al., 2011b; Ngongondo et al., 2014). These changes are widespread in Sub-Saharan Africa and beyond (FAO et al., 2018). Figure 2.1 illustrates trends of reported floods[9] and droughts in Africa from 1900 to 2015. These have affected most of Southern Africa and the increased frequency is partly due to better reporting, but there is also some agreement of attribution to climate change (Bola et al., 2014). Many studies agree that from a water supply perspective, flooding results in massive economic losses and destruction of infrastructure (including water supply infrastructure) (Christensen et al., 2007; Anderson et al., 2010; Rosinger, 2018). These trends have, therefore, affected the seasonal availability of water for domestic use – with evident source failure or water shortages in the dry season in Sub-Saharan Africa. For example, a study by Tucker et al. (2014) confirms this in rural Ethiopia.

[9] Flooding is a universal natural hazard and ranked third of the most damaging globally (Kiem, 2014).

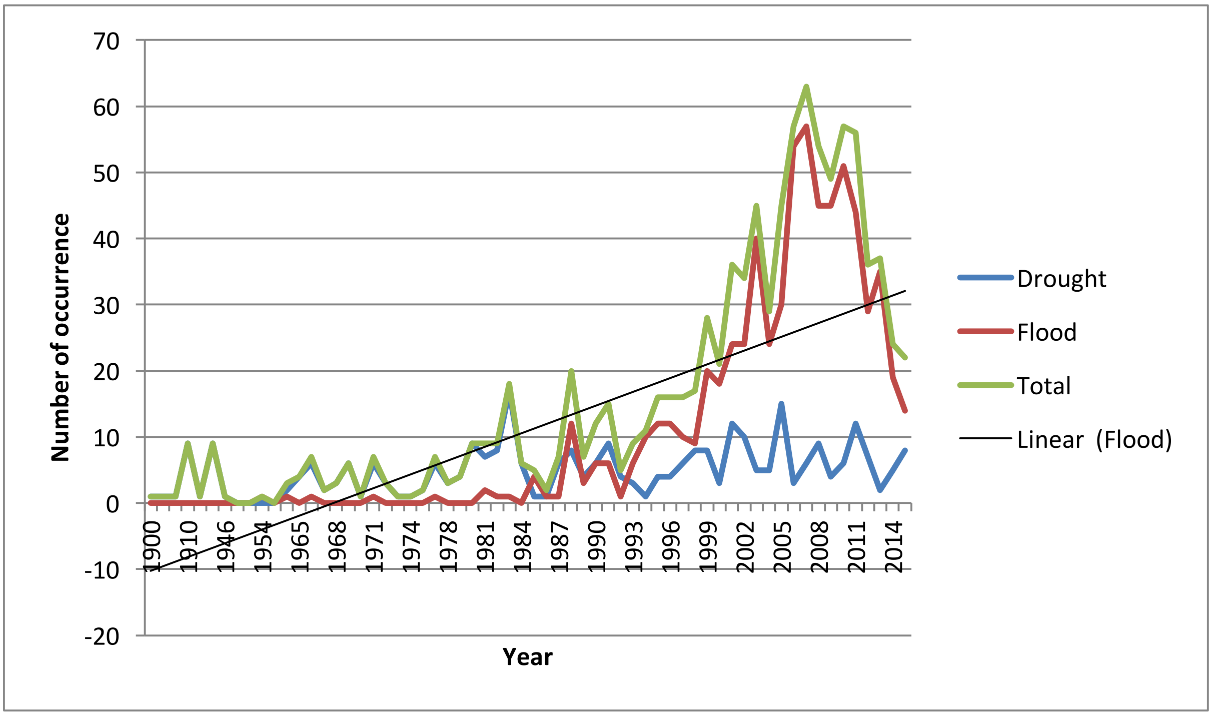


Figure 2.1 Reported floods and droughts (natural disasters) in Africa, 1900-2015

Source: Guha-Sapir et al. (2015)

Many studies suggest a declining rainfall trend in the region since 1950 and an increasing frequency of cyclone activity in the South West Indian Ocean region (Christensen et al., 2007; Lasolle, 2012). A similar pattern is seen in the observed and projected frequency of extremely dry years for Southern Africa (Table 2.1) (Christensen et al., 2007; Anderson et al., 2010). The presence of cyclones in the region is associated with extensive flooding (Christensen et al., 2007; Anderson et al., 2010). Increases in intensity and frequency of rainfall events and storms are expected to cause an increase in runoff, erosion and destruction of infrastructure, and consequently a detrimental effect on the provision of water and services (Dodman et al., 2009; Farrell, 2010; Brown et al., 2012; Rosinger, 2018). At the same time a projected decrease in precipitation is expected to affect river discharge and groundwater recharge, which consequently results in reduced water availability, leading to exacerbated water stress in countries which are already water stressed (Cornway, 2009; UN-HABITAT, 2011; Baguma et al., 2013).

Table 2.1 IPCC reported climate change projections in Africa comparing the current climate with a projection for 2080-2099

Region	**Median Projected temperature increase[10] by 2100 (°C)**	**Median projected precipitation increase by 2100 (%)**	**Agreement on precipitation among models**	**Projected frequency of extreme warm years by 2100 (%)**	**Projected frequency of extreme wet years by 2100 (%)**	**Projected frequency of extreme dry years by 2100 (%)**
West Africa	3.3	+2	Not strong	100	22	
East Africa	3.2	+7	Strong for increase in DJF, MAM, SON	100	30	1
Southern Africa	3.4	-4	Strong for decrease in JJA, SON	100	4	13
Sahara	3.6	-6	Strong for decrease in DJF, MAM	100		

Source: Anderson et al. (2010) and Christensen et al. (2007)

While many scholars argue that climate change and variability effects are difficult to identify due to data gaps, the projected and observed effects on groundwater recharge rate and depths of groundwater table, seasonal runoff regime and inter-annual runoff variability imply that climate change and variability will prove an additional burden for water service provision (Bates et al., 2008; Batisani, 2011). With limited water storage facilities, people therefore experience fluctuations in supply which can affect access to drinking-water (Tucker et al., 2014; Bates et al., 2008). Vulnerabilities and adaptation are site specific and socially varied (Basu et al., 2015). Thus, whilst we may assume that the poorest and women are the most vulnerable due to their role in water collection, the situation may be context specific. Very little is known about how different groups of people are affected and cope in times of water disasters and how formal arrangements in Sub-Saharan Africa respond to such trends, to ensure equitable access to drinking-water. Understanding seasonality of access during water disasters, and normal (dry and wet) seasons in marginalised households is therefore critical in understanding and then addressing inequalities.

Despite wide recognition of the implications of climate risks on water availability and access (GENDERCC Southern Africa et al., 2011; Batisani, 2011; Henry et al., 2011; Hu et al., 2011; Ryu et al., 2011), many scholars argue that seasonality has received little attention in the literature or statistics (WWAP/UN-Water, 2018; Chambers, 2012). Most studies hide seasonal trends or deprivation and "*statistics too have seasonal biases, often recording data on an annual or*

[10] Temperature increase from the 1980-1999 averages.

averaged basis, which does not include seasonal variations" (Chambers, 2009 p1). This may result from the frequent collection of data in one season leading to an assumption of results for the whole year. Studies argue that 'dry season bias' is common in many surveys (Wright et al., 2012; Kostyla et al., 2015) partially due to logistical challenges associated with the rainy season (Wright et al., 2012). Hence, the gaps of knowledge exist for normal (dry and wet) seasons, seasonality and disasters such as floods and droughts (Chambers, 2012). This implies that the reported proportions of households with access, may not reflect reality on the ground. Lack of research on seasonality aspects of access to drinking-water may lead to poorly informed policy, consequently intensifying marginalisation of the rural poor (Chambers, 2012) and women.

While these social, economic and physical factors are important, some studies argue they may not adequately explain the state of water access in many countries. These studies claim that good water governance is central to the elimination of access inequalities (De Albuquerque, 2012; De Albuquerque, 2014a; United Nations, 2018). Water governance is the "*political, institutional and administrative rules, practices, and processes (formal and informal) through which decisions are taken and implemented, stakeholders can articulate their interests and have their concerns considered, and decision-makers are held accountable in the management of water resources and the delivery of water services*" (Akhmouch and Clavreul (2016 p2) and Woodhouse and Muller (2017 p226)). Water governance regulates development and management of water resources and service provision to attain desirable standards (Pahl-Wostl, 2019). Institutions are part of governance. The following section reviews the link between institutions and access to drinking-water.

2.3 The role of institutions in shaping access to drinking-water

2.3.1 How institutions shape access to drinking-water

The role of institutions in governing water access is increasingly recognised in scholarship. Institutions are commonly defined as "*the humanly devised constraints that structure political, economic and social interaction*", which consist of "*both informal constraints (sanctions, taboos, customs, traditions, and codes of conduct), and formal rules (constitutions, laws, property rights)*" (North, 1991 p97). Property rights are viewed "*as sets of rules that define access, use, exclusion, management, monitoring, sanctioning, and arbitration behaviour of users with respect to*" drinking-water resources (Agrawal, 2003 p245). In addition to governing patterns of use, property rights institutions are "*also the principal mechanisms through which policies regarding resource management work*" (Agrawal, 2003 p245). Property rights help to define a resource boundary, who claims rights to what resources, who has access to the natural resources, and who has the responsibility for managing these resources. Property rights are a critical factor in determining how resources are used and managed, and how benefits from these resources are distributed. These are fundamental in matters of fairness, equity and justice. Hence, institutions are conceptualised as 'rules of the game', socially devised to bring order and reduce uncertainties in human interactions (North, 1989; North, 1991) through their successful functioning, well-established norms of behaviour and elaborate mechanism of interactions (Leković, 2011).

Ostrom (1990) defines three tiers of institutions: operational, collective and constitutional rules. Collective and constitutional choice rules may be viewed as rules of policy process that govern what is allowed during the specification of operational rules. *Constitutional choice rules* stipulate: 1) membership rules for structures that are established to govern resource use; 2) rules for creating these governance structures and selection criteria; 3) rules followed in collective decision making and powers associated with each office or structure. *Collective choice ru*les "*determine how operational rules can be changed and who participates*" in the modification of the operational rules (Ostrom, 1990 p52). *Operational rules* specify what may and may not be done in daily appropriation and provisioning activities (Ostrom, 1990; Luckert et al., 2011). For example, these include boundary rules and authority rules that specify how much water is allowed and how much input is required of each user. Where rules apply, they specify membership and specific requirements that the group members must meet to exercise their right (Schlager and Ostrom, 1992) – for example, membership to a community and payment of user fees before drawing water from a communal water tap. In this context failure to meet these criteria leads to exclusion from access to or use of the tap. Similarly, institutional arrangements (rules), regulations and conflict management procedures determine how, when and where communities can access and use the resources (Dietz et al., 2003; Agrawal et al., 2013; Ostrom, 1990; Thomson and Freudenberger, 1997). This, therefore, shows that institutions influence the choice set of actors and outcomes. Institutional outcomes generally refer to the consequences of behaviours that individuals choose to take in response to incentives or disincentives created by institutions (Thomson and Freudenberger, 1997; North, 1989).Thus, institutions and their enforcement mechanisms influence human behaviour and consequently determine outcome performance (Dhakal and Bhatta, 2009). This implies that institutions can constrain or enhance access rights to drinking-water.

In the context of this review, institutional arrangements can mediate the influence of biophysical factors and resource users' characteristics on access to drinking-water in the local context. For example, Andersson and Agrawal (2011 p868) argue that the influence of these factors depends on the "*nature and effectiveness of local governance institutions*." Similarly, Luh and Bartram (2016) find that national progress towards universal water access is not correlated with the social and economic characteristics of a country and may be better explained by the effectiveness of established institutions (government policies and institutional commitment and capacity). They call for more research to see whether robust governance arrangements have the potential to address the access challenges faced by the rural poor. As highlighted by De Albuquerque (2012 p20), "*a focus on wealth disparities cannot*" adequately "*address the root causes of exclusion and lack of access to … water… Sometimes, the barriers to access for certain groups are not financial, but rather it is the existence of laws, policies or cumbersome administrative procedures that lead to their exclusion*". The causes of poor access – and corrective policy responses – may differ from place to place and deserve further attention. Similarly, how water governance considers seasonality, climate risks and gender issues is central to understanding how institutions affect access for marginalised groups. Effective institutions may also help to mitigate climate change and variability effects and address economic problems that affect communities' access to drinking-water. For example, effective institutions can ensure water supply that is insensitive to short-term or inter-annual rainfall variations and seasonality. They can also ensure an affordable supply of water to the poorest households. Additionally, properly structured institutions can help reduce water conflicts among various users and those resulting from water shortages and management crises.

Some studies argue that institutional outcomes depend on the consideration of the principal elements of good water governance. The widely recognised elements are effectiveness, responsiveness and accountability of actors, adaptability to change (temporal-spatial fitness – no one size fits all); openness and transparency with information sharing; and stakeholders' inclusiveness[11] (e.g. allowing participation/engagement of resource users in decision making related to water development and management) (Akhmouch and Clavreul, 2016; Woodhouse and Muller, 2017; United Nations, 2018). Pahl-Wostl (2019) adds other related essential processes or characteristics including knowledge generation for evidence-based decisions/interventions, conflict resolution, representativeness of all stakeholders, legitimacy, monitoring and evaluation for adaptive governance and management. This claim takes into account complex characteristics of water (including its uneven distribution, highly variable and finite nature), diversity of users and uses and their diversified water needs (Pahl-Wostl, 2019; Woodhouse and Muller, 2017; Wei et al., 2018). For example, there is an extensive body of literature that emphasises the benefits

[11] Inclusiveness considers "*social justice, equity, and the wide participation of all stakeholders in social development, addressing the common issues of being excluded from development, unfairness, and marginalisation*" (Wei et al., 2018 p408).

accrued when resource users participate in an institution's design and implementation and when institutions are adaptive to social and temporal conditions.

Participation includes rule formation (e.g. operational rules) and enforcement, conflict resolution, sanctioning and sharing of benefits (Agarwal, 2010). Ferragina et al. (2002) highlight significant benefits that are realised when resource users participate in the planning, implementation, operation and maintenance of water works. One benefit is that this supports water policy implementation broadly in the community and enhances capacity in its operation and maintenance. Tucker (2010) adds that the participation of users in the formation of institutions makes institutions context specific and more likely to produce expected outcomes. Similarly, Yamia et al. (2009) add that in Sub-Saharan Africa the participation of local users has ensured the design of site-specific and locally-owned sanctions, resulting in higher compliance with rules. Working in Mexico and India, Bardhan and Dayton-Johnson (2007) also find a positive association between rule compliance and participation in rule formation. Some studies argue that men and women are likely to frame different rules, and access and use rights due to gender-defined differences in their responsibilities and priorities (Charnley and Poe, 2007). For example, women may use water for domestic roles that include food preparation, whereas men may want to enhance access to drinking-water mainly for commercial purposes, e.g. irrigation. Additionally, people of different classes are likely to formulate different rules based on their needs (Agarwal, 2009). Poor people prioritise resources that meet their subsistence whereas the decisions of the well-off may be driven by commercial motives. Mixed groups could, therefore, incorporate diverse views that attempt to address the needs of different community members. This suggests that rules, or property rights, enforcement mechanisms and outcomes are dependent on the people who actively participate in the formation or review of the rules. This review highlights that in the design and management of community water sources or service, community water committees or institutions which integrate views of the poor and other marginalised community members (including women) are more likely to produce benefits that reach these groups of people. However, this depends on the level and nature of participation or engagement, determined by the three tiers of the institutions, as well as cultural settings (Agarwal, 2001; Akhmouch and Clavreul, 2016). In Africa, 90% of water collection and food preparation tasks are performed by women, (WWAP, 2016; UNDESA and UN-Water, 2013). Non-productive participation of women could, therefore, have a negative impact on a household's drinking-water access and food consumption (Agarwal, 2001).

Pavri and Deshmukh (2003) argue that an institution is effective if managers consider the spatio-temporal[12] conditions for institutional settings. This argument is based on their findings from India where access to forest resources such as firewood varies over time and among castes, suggesting that property regimes should be flexible to adapt to changing conditions (natural, social and economic) and interactions between involved social actors. Although the India study focuses on forest resources, this review contends that this argument can also apply to other *common property resources*[13] such as water. In the context of climate change, water resources are threatened, hence their management rules should be flexible to adapt to the changes. For example, Zomba District in Malawi experiences high inter-annual rainfall variability ranging from 50-60% which affects stream flows and water tables and leads to water access problems in rural areas which depend predominantly on boreholes and taps (getting water from within the district) (Government of Malawi and WFP, 2012). In such conditions, overly rigid water institutions may be ineffective, with negative impacts on water-dependent activities like food utilisation.

Poteete and Ostrom (2004) argue that there is a tendency in developing countries to impose particular sets of institutions on local resource user groups "*without conducting prior research on the factors that are associated with successful … management by national, regional, or local governments or by local*" users themselves (Poteete and Ostrom, 2004 p453). These usually fail because they may be inappropriate to the user group. Poteete and Ostrom (2004) argue that there is no single institution fit for all situations. The same institution can generate varied outcomes in different settings and times (North, 1991). Diverse characteristics of resource users, as well as a diversity of ecological conditions that they face, imply therefore that rules that are successful in governing access to one group may or may not apply to another group. This suggests that diversity in the design of institutional rules is necessary, including the consideration of gender and wealth differences among the users. McDermott and Schreckenberg (2009) also argue that the benefits of communal resource management are linked to equity, which incorporates concepts of fairness and social justice in the distribution of benefits as well as individual and community capacity and empowerment.

[12] Spatio-temporal fitness of institutions means institutions that are appropriate at a particular place and time

[13] Common property goods are a subset of public goods. They are common to all people who want to use them (Ostrom, 1999; Adhikari et al., 2004) but are finite (rivalry) and have some form of control or rules and regulations governing access and use (Fischer et al., 2004; Ostrom, 2002; Wade 1987). Common property resources are also excludable to non-community or group members governing access to the resource. This can lead to inequitable allocation of the water resource. The hardest hit may be the excluded who may not participate due to their marginalised status (e.g. temporal, spatial and economic marginalisation).

Institutional analysis should therefore assess the extent to which these principal elements are considered, in order to understand water access in marginalised households. However, the often-debated question is: which types of institutions are necessary to address access inequalities?

2.3.2 Types of institutions involved in water resources management and their linkages: theory and practice

Institutions can be formal or informal, based on their origin or transformation (i.e. how they are formulated or how they evolve), structure and membership, enforcement characteristics and means of communication. It is widely agreed that formal institutions have rules and procedures that are written and enforced through state structures (North, 1989; 1991; 1994) including *"state institutions (courts, legislatures, bureaucracies) and state-enforced rules (constitutions, laws, regulations)"* (Helmke and Levitsky, 2004 p727). According to Mogomotsia et al. (2018) and De Albuquerque (2014a), in the context of water resources, formal institutions include national policies, statutes, directives and laws designed to regulate water use and management. Proponents argue that formal institutions include well-defined rights, rules, boundaries and monitoring, enforcement and conflict-resolution mechanisms that form the basis of access conditions and in some cases measures for long-term ecological sustainability (Dietz et al., 2003). Nevertheless, other scholars criticise the design of formal institutions. These argue that in a strictest sense, Hardin's 'Tragedy of the commons' theory (which refers to open access resources) underlies generation, adoption and implementation of most formal institutions, see Ostrom (2000) for example. This theory stipulates that the sustainability of natural resources is only likely when resource users are excluded from policy making. Hardin's work claimed that *"only two state established institutional arrangements – centralized government and private property – could sustain commons... and he presumed that resource users were trapped in a commons dilemma, unable to create solutions"* (Dietz et al., 2003 p1907).

Critics argue that these institutions therefore typically follow top-down arrangements, in which there is low participation of resource users, suggesting that their needs, technical and cultural preferences as well as intimate knowledge of local resource ecology, are overlooked (Tucker, 2010; Quinn et al., 2007). Centralised mechanisms for policy and planning imply that control and coordination are managed by a government body, comprising senior officials from various water-related ministries and departments (Ferragina et al., 2002). Thus, procedures and designs adopted by formal institutions are usually exogenous to local resource users and may end up serving the needs of the elite. The institutions are formally communicated to the resource users through water officers located close to the resource users. These officers are also responsible for monitoring compliance. This approach is therefore criticised for underrating the capacity of resource users to participate effectively in the management of their resources (Yamia et al., 2009). In this regard, critics of formal institutions advocate for the use of informal institutions in water resources management.

In contrast to formal institutions, informal institutions are defined as socially shared rules and norms that govern water management, use and allocation (Jacobson et al., 2013). These are usually unwritten, generated, communicated and enforced through unofficial structures (Helmke and Levitsky, 2004; Ranganathan et al., 2010). Advocates argue that these are developed by local communities and are *“embedded with the existing customs, traditions, rules of conduct, and beliefs”* (Ranganathan et al., 2010 p17). This implies that they are site-specific and not applicable in other communities. Community members share tacit or explicit knowledge of informal norms, and enforcement is informal, usually by attitudes and the behaviour of others within the community (North, 1989; Hodgson, 2006). They thus reflect the social economic and political settings of a community. Similar to formal rules, they may be dynamic.

In practice, both management regimes (formal and informal) have produced mixed results in different spatial systems – both success and failure. Many scholars have argued that formal rules have worked well especially in governing use of open access resources, such as abstraction of irrigation water from rivers and underground sources, but so do informal institutions (Ferragina et al., 2002; Sokile et al., 2005; Ranganathan et al., 2010). However, other studies have established that in the formal approach has failed to produce intended outcomes. For example, for the past four decades, many countries in Africa adopted a supply-driven approach to govern access to drinking-water and ensure equitable distribution (Government of Malawi, 1999; Naiga, 2015; Kleemeier, 2000). However, this has failed to address water access challenges in many rural areas (Naiga, 2015). Bhattacharjee et al. (2019b) report that in Bangladesh, the National Water Policy of 1999 and Water Act of 2013 have failed to provide effective guidelines on permission, abstraction and pollution control of groundwater, leading to a governance crisis and including inequitable distribution. In Bangladesh, the challenges are largely due to corruption, the limited participation of relevant stakeholders, mismanagement and empirical assessments (Bhattacharjee et al., 2019b). Some studies argue that when access and use of resources such as water are governed by formal institutional arrangements, the resource becomes ‘open access’ resulting in overuse and degradation (Quinn et al., 2007). Examples from Bangladesh illustrate this argument. Many studies suggest that enforcement of formal institutions is usually ineffective (North, 1991; Tucker, 2010) because of the low capacity (financial, technical and human resources) of implementing agencies, the rigidity and complexity of rules and because community members consider the rules to be illegitimate. This implies that in most cases, formal institutions are applied without consideration of spatial and social fitness (including variability in human needs) (Tucker, 2010).

This disadvantages resource users (Agrawal, 2001) especially the marginalised who are voiceless. In view of this, many researchers have advocated recognition of informal institutions in governing access and use of water resources (Ferragina et al., 2002; Sokile et al., 2005; Ranganathan et al., 2010).

These scholars argue that for many decades, prior to colonial and post-colonial development of formal rules, water resources were governed by customary rights generated through informal systems. Others further argue that these rules still apply in the present time (Quinn et al., 2007; Jacobson et al., 2013) because large bodies of water in developing countries are governed by informal institutions (Ranganathan et al., 2010; Jacobson et al., 2013). For example, Bhattacharjee et al. (2019b p69) argue that up to the present time "*many countries of Asia, Africa and South America adopt informal or customary laws to protect and manage their groundwater*". This suggests that informal water-related institutions are significant in governing access to drinking-water. Many studies have attributed this contribution to several factors as explained in the following paragraph. Some studies indicate that because informal institutions are agreed by resource users, enforcement is effective, as users see these institutions as legitimate (Acheson, 2006; Leković, 2011; Dietz et al., 2003; Poteete and Ostrom, 2004; Hodgson, 2006). It is widely agreed that this agreement is enhanced by active community participation, high mobilisation of "*social capital and shared beliefs among CPR users and the presence of well-established village structures*" (Yamia et al., 2009 p157).

Social capital, which is defined as "*features of social life - networks, norms, and trust that enable participants to act together more effectively to pursue shared objectives*" (Putman, 1995), serves to capture how people in a given community interact with each other, and how these social interactions in turn yield benefits for the individuals and collectively (Brunie, 2009). Dietz et al. (2003 p1908) explain that social capital contributes to effective commons governance because it can "*increase the potential for trust, allow people to express and see emotional reactions to distrust, and lower the cost of monitoring behaviour and inducing rule compliance*". It is argued that social capital underpins collective action, defined as "*action taken by a group of people (resource users) to achieve common goals/interests*" (Andersson, 2006 p4). Studies report that in the context of any natural resource management this collective action focuses on decision-making processes, the formation of and compliance with rules and sanctions governing the resource use and access (Cleaver, 2007; Cleaver and Toner, 2006). Collective action is therefore seen as central in overcoming social exclusion (Cleaver and Toner, 2006; Cleaver, 2007) because it helps to achieve communal beneficial goals or enhance equitable access and avoid "*tragedy of the* *commons*[14] *outcomes in which individual users*" pursue decisions on resource use that are self-centred (Andersson, 2006 p28). This argument disputes Hardin's conceptualisation of natural resources management. In contrast to an open-access regime, many water resources fall under common property regimes where "*there is shared ownership and rules that dictate each resource user's access and use of the resource*" (Quinn et al., 2007 p101).

Despite these important contributions, studies have also highlighted some limitations of informal institutions in governing common property resources such as water. For example, Yamia et al. (2009) argue that their site-specific nature means they are not easily applicable in other settings. This is corroborated by North (1991). This means that informal institutions in Sub-Saharan Africa are generally ineffective when dealing with governance challenges of water resources crossing borders or those used by many communities. Similarly, some scholars view them not fit to address widespread challenges such as rapid and dramatic environmental changes (such as extreme events) that increase the chances of non-compliance with the rules (Banana et al., 2007). Additionally, because informal institutions are based on cultural dynamics, they may create marginalisation, e.g. when a community has unfavourable gender ideologies. For example, power differences based on gender can affect other users' participation in collective action (Agrawal, 2003; Andersson and Gabrielsson, 2012). Yamia et al. (2009) also argue that informal institutions have been increasingly eroded over time "*due to growing diversity in religious beliefs among users and development interventions overriding the local values and norms associated with the existing practices*" in resource management. Informal institutions are also criticised for facilitating exclusion in many areas in Sub-Saharan Africa (Quinn et al., 2007), especially where socioeconomic heterogeneity affects levels of social capital in relation to the informal institutions, and/or where ethnic differences lead to conflicts between resource users (Yamia et al., 2009). Other scholars point out that informal institutions lack a legal mandate to hold actors accountable for their actions, including non-compliance with rules or failure to deliver services (De Albuquerque, 2014a). De Albuquerque, therefore, recommends a stable formal institutional framework as necessary for governing access and use of such water sources and to address marginalisation (De Albuquerque, 2012; 2014a; 2014b; 2014d). However, Agrawal (2003) counter argues that such challenges can be moderated by appropriate institutional arrangements instituted through appropriate water governance arrangements.

[14] Tragedy of the commons is when individual users of a shared resource act independently in their self-interest (maximising benefits) by depleting or degrading the resource contrary to the common goals of all users.

Some scholars argue that formal and informal institutions are interdependent (Helmke and Levitsky, 2004; Grzymala-Busse, 2010; Leković, 2011). They coexist and evolve together (Gaviria, 2001). It is therefore important to understand their relationship because it influences behavioural as well as institutional outcomes (Leković, 2011). A number of studies have argued that although, in some instances, informal institutions have failed to succeed, so have Hardin's proposed alternatives of private and state ownership (Dietz et al., 2003; Cleaver and de Koning, 2015). Thus, both types of institutions have strengths and weakness and, in many situations, neither can work effectively in isolation. This observation concurs with the argument by North (1989) that formal rules themselves are insufficient to determine outcomes. According to Helmke and Levitsky (2004), the significance of informal institutions in this relationship becomes relevant, especially when formal institutions are weak. This suggests that the emergence and transformation of informal institutions depends on the strength or effectiveness of formal rules (Helmke and Levitsky, 2004). However, Grzymala-Busse (2010) argues that the emergence of, and changes in, informal institutions, are not always dependent on the strength of the formal institutions. Informal institutions can provide templates and substitutes for formal choices. Nevertheless, the informal institutions can help reinforce, complement (support), or undermine (weaken) formal institutions (Helmke and Levitsky, 2004; Leković, 2011). For example, informal institutions can contribute to the effective enforcement of the formal rules if the formal rules are not in conflict with the informal norms of the society (Leković, 2011). Thus, even in the absence of a government officer, community members can agree on ways of coercion to ensure compliance with formal laws (Leković, 2011) because they understand the costs and benefits of the rules. For example, a lawbreaker can be forced by fellow community members to pay fines or experience expulsion from the community. Bhattacharjee et al. (2019b) point out that in some cases, such as in Tanzania, there is a mix of informal and formal laws to limit water abstraction and control contamination.

Being cognisant of the reality that, in many cases "*governance problems and issues remain highly local and contextual*" (Naiga et al., 2015 p239), reveals that there are no generalisable ideal institutional arrangements for addressing poor service delivery; what works best tends to be location specific (Naiga et al., 2015). It is therefore necessary to examine what works best in specific contexts and localities. Naiga et al. (2015) further argue that scholarship on institutional dynamics and how they operate on the ground remain underdeveloped in many developing countries; hence more studies are needed to enhance the understanding of water access in marginalised households in different contexts. This includes the implications of policy shifts to improve water governance.

2.3.3 Policy shifts and water access governance – policy-implementation gaps

For many years, governments have recognised the central role of formal institutions, specifically legislation, policies and regulations, in ensuring access to drinking-water among the marginalised groups, because these are "*legally binding and (generally) of a permanent nature*" (De Albuquerque, 2014a p8). Hence, the past two decades have seen policy shifts to address the weaknesses of formal institutions in water access governance. However, as outlined next, institutional analyses fail to adequately explain how these institutions affect access to drinking-water used in marginalised households in Sub-Saharan Africa.

A key recent policy shift has been the "*devolution of control and management from state to local level, with more responsibility put on local institutions*" (Quinn et al., 2007 p101). Here emphasis is on *participatory approaches* – involving resource users by gender and social economic status in designing and managing their own resources (Solanes and Gonzalez-Villarreal, 1999; De Albuquerque, 2014d). Several studies have assessed the participation of actors in surface water and ground water governance institutions (Tantoh and Simatele 2018; Naiga et al., 2015; Nawab and Nyborg, 2009; Bhattacharjee et al., 2019b; Mogomotsia et al., 2018), reporting a mix of success and failure in different contexts. For example, in rural Rajasthan, O'Reilly and Dhanju (2012) find that decentralisation and marketisation were combined with a community participatory approach to improve sustainability of the drinking-water supply but implementation yielded contradictory results – users paid for contaminated water. However, a similar approach has been successful in some villages in Cameroon (Tantoh and Simatele 2018). Similarly, Naiga et al. (2015) argue that the concept of participation has been emphasised in Zambia, Tanzania and Uganda with mixed results. In Tanzania, this has not improved access – rural women still travel long distances while in Zambia the situation has improved. Cleaver and Toner (2006) report that, despite a review of water policy, drinking-water remains unaffordable for rural poor households in Tanzania. Given this heterogeneity of outcomes, this review agrees with Naiga et al. (2015) that the role of institutions has to be contextualised. Therefore, more studies are needed at local level to enhance understanding and guide better policies and interventions aimed at addressing marginalisation in developing countries. This conclusion agrees with the United Nations (2018) report that although participation and multi-stakeholder engagement play important roles in policy processes, their effectiveness is understudied in many developing countries. A similar approach applies to the consideration of other elements of good water governance.

There is a dearth of knowledge about how institutions consider marginalised groups, seasonal availability of water, quality and access in marginalised households. Some studies take a broader perspective such as Mogomotsia et al. (2018), who analyse how the design of formal water institutions (e.g. laws and regulations) contributes to water scarcity or sustainability of water supply in Botswana. While the study analyses the broader picture, it does not focus on the access of marginalised groups and makes little mention of seasonality aspects (drought conditions). A similar limitation relates to a comparative study by Kayser et al. (2015) of the national laws, policies and organisations that govern drinking-water quality in Brazil, Ecuador and Malawi. Although the study reveals important challenges experienced with the governance (monitoring and evaluation) of water quality in these countries, a focus on one parameter 'quality' leaves gaps in understanding how these processes apply to other important parameters, e.g. affordability and quantity. The Kayser et al. (2015) study does not assess the temporal or spatial fitness of the legislation, nor is there consideration of access for marginalised groups. Thus, it fails to adequately analyse the mediating role of the local institutions in relation to the other factors that affect access (e.g. seasonality and gender dynamics) in marginalised households. As argued by Pavri and Deshmukh (2003 p73), regime effectiveness is not only dependent on "*design principles or regime access conditions (i.e., well-defined rights, rules, boundaries, and monitoring, enforcement and conflict resolution mechanisms), economic viability, and in some cases, long-term ecological sustainability*", but also on other factors such as spatio-temporal fitness (Pavri and Deshmukh, 2003 p73). Overall, gaps remain in scholarship of the temporal and spatial fitness of the designs and implementation of local formal water institutions to address persistent marginalisation of rural households in Sub-Saharan Africa.

Participatory approaches to drinking-water service delivery (e.g. community management), emphasise the use of local management structures such as water user associations/committees/groups, also known as WUAs/WUCs/WUGs (henceforth these are referred to collectively as WUCs). Proponents of community-based management argue that effective/functional participatory WUCs are central to effective rural drinking-water service delivery under CBM (Whaley and Cleaver, 2017). In many countries WUCs are mandated to coordinate drinking-water development and management activities. Their roles can include, *inter alia*: (i) collection of financial contributions for capital costs; (ii) setting and collecting tariffs for effective operation and maintenance of the service; (iii) formation and enforcement of access rules (Prokopy, 2005; Koehler et al., 2015; Leclert et al., 2016; Whaley and Cleaver, 2017); and (iv) undertaking repair and maintenance work (Whaley and Cleaver, 2017; Naiga, 2015).

To ensure effectiveness and efficiency of water service delivery, participatory approaches/WUCs are designed to empower communities (e.g. in control and decision making) and to consider equity issues in service delivery (Nelson and Wright, 1995; Prokopy, 2005; Leclert et al., 2016). However, the lack of uniformity in outcomes suggests a complex set of factors has to be considered simultaneously considered to make a participatory approach work. For example, Chowns (2014) argues that ignoring questions of power and politics has a major influence on water service delivery outcomes including access outcomes to services, while Prokopy (2005) and Leclert et al. (2016) highlight lack of consideration of rural people's willingness and ability to engage effectively. The diversity of factors influencing the effectiveness of water committees in drinking-water service delivery are contextual hence assessments should be contextualised.

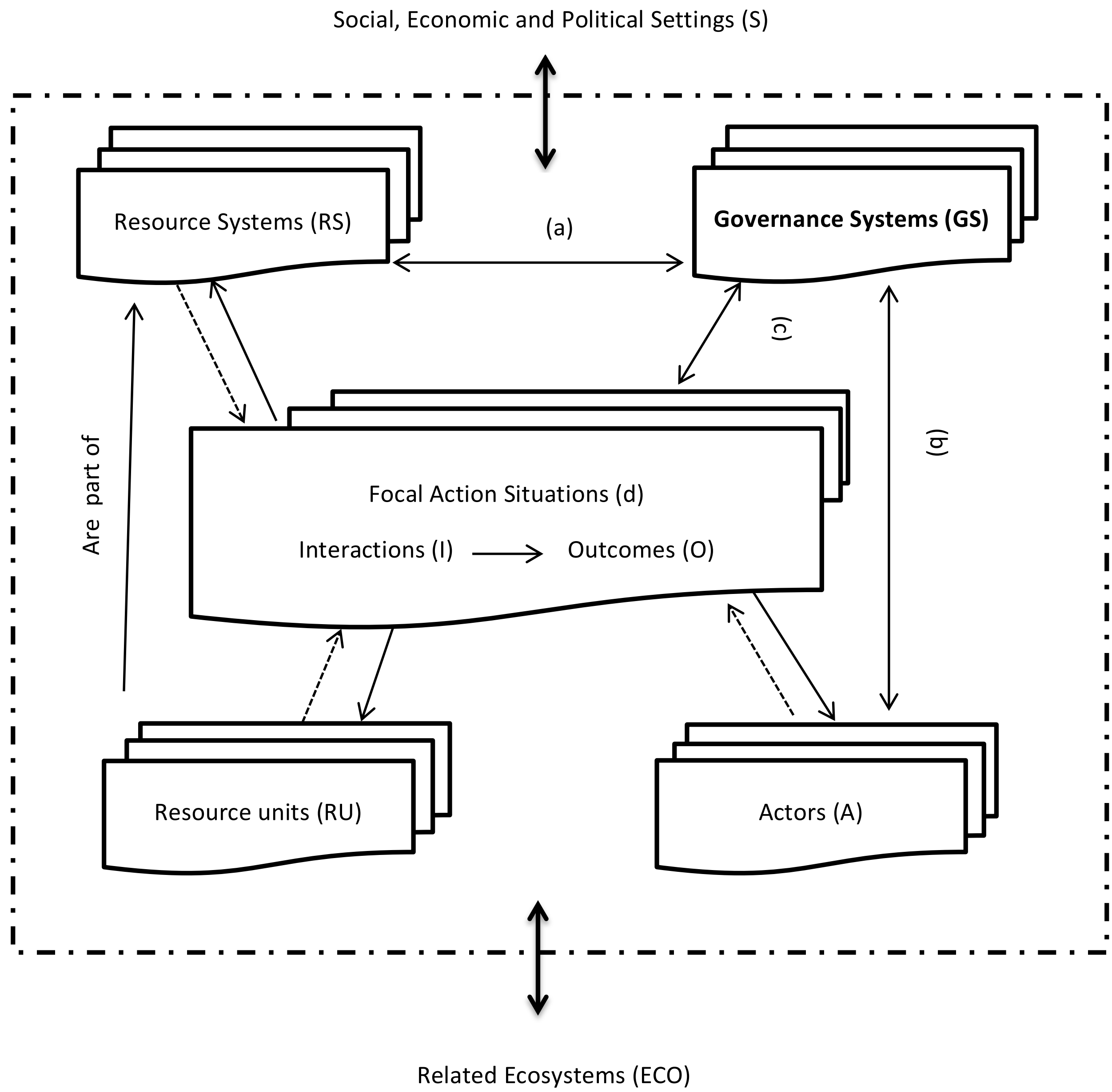
There have been mixed results in studies assessing how participatory approaches/WUCs manage equitable access (marginalisation). For example, the local community-based structures have contributed to improvements in service delivery in rural Uganda (Naiga, 2015) and Zambia (Chitonge, 2011). Other studies, however, argue that participatory arrangements have produced only marginal improvements in operations and maintenance of rural water supply (Chowns, 2015). In Karnataka and Uttar Pradesh, India, use of WUCs produced expected outcomes on tariff collection and infrastructure effectiveness but not universal access (Prokopy, 2005). However, this finding is based on evidence collected only four months after project implementation (Prokopy, 2005). Thus, it is not clear whether reported outcomes on water infrastructure were sustainable and to what extent equitable access was addressed in the long term. Research from Tanzania identified that 25% of water points failed within two years after completion, suggesting a failure of WUCs to manage the sustainability of water supply (Taylor, 2009). Similarly, about one-third of the newly installed water facilities in Kenya became non-functional within three years of installation partly due to lack of adequate management capacity (e.g. book record keeping and tariff management) and accountability by WUCs, which undermined willingness to pay among water users (Leclert et al., 2016). The extent to which WUCs are capable of managing seasonality issues is largely unknown. Hence questions remain as to whether use of water user associations/committees/group is a suitable approach to address equitable access in rural communities and sustain drinking-water service in different seasons and extreme rainfall conditions.

The next section presents the theoretical framework guiding this thesis. Rural drinking-water in Malawi is mostly delivered as a common property resource hence it is crucial to undertake studies that enhance understanding of its governance and how this relates to marginalisation, using an appropriate theoretical framework that pull together all the issues discussed in this chapter.

2.4 Theoretical framework

To pull together the preceding sections of the literature review, the social-ecological systems (SES) framework is used to guide the thesis (Ostrom, 2009). Ostrom's framework (Fig. 2.2) emphasises that effective governance of common property resources, such as water, depends on the extent to which institutions integrate a set of interlinking factors and their interactions in social-ecological systems (SES) (McGinnis and Ostrom, 2014). Access to drinking-water is affected by many factors such as resource type, resource management, users and their organisation. Key points associated with these factors and their linkages are reflected in this literature review notably in: Section 2.1 which discusses persistence of marginalisation/inequalities in drinking-water access; Section 2.2, which discusses the effects of gender, poverty and seasonality on drinking-water access; and Section 2.3 which discusses the mediating role of institutions. Sections 2.2 and 2.3 also capture the interlinks between these factors, and gaps that remain in scholarship on how their interactions influence drinking-water access in marginalised households. These factors align with Ostrom's SES framework and hence this SES framework is adopted to shape the analysis. The SES framework is more relevant than Ostrom's earlier institutional analysis and development (IAD) framework[15] (Ostrom, 1990) which is commonly used in environmental institutional analyses (Pagdee et al., 2006; Quinn et al., 2007; Thoms, 2008; Van Laerhoven, 2010). The IAD fails to unpack the biophysical variables that affect an action situation (Ostrom, 2009; McGinnis and Ostrom, 2014; Whaley and Weatherhead, 2014) and which are a critical factor in determining types of drinking-water access points.

[15] IAD provides relevant variables for analysing complex systems including the three interdependent sets of exogenous variables namely: the biophysical and material world, attributes of the community and the rules in-use. All these factors influence actors' behaviour in an action situation (Whaley and Weatherhead, 2014). However, IAD does not provide the specific variables for empirical assessments and is more developed on the social or institutional than the biophysical aspects of the SES.



Notes:

--------> =Directly affect access but effect not assessed in this thesis;

–·–·–·– =Represents completeness of the SES subject to external influences from “related ecological systems or social-economic-political settings” (McGinnis and Ostrom, 2014);

Triple layers of each subsystem signify hierarchical tiers of variables;

(a)=RS characteristics (e.g. clarity of system boundaries and seasonal distribution of resource units) set conditions for institutions’ design and implementation. In turn, institutions set conditions for appropriation in RS and RU;

(b) =Characteristics of actors/users such as social capital and social economic attributes of resource users affect design and implementation of institutions while institutions define withdrawal rules for users;

(c) =GS set conditions for focal action situations;

(d) =In focal action situations, interactions can affect design of effective institutions that guide approaches to enhance access outcomes

Figure 2.2 Ostrom’s framework for analysing socio-ecological systems

Adapted from: Ostrom (2009) and McGinnis and Ostrom (2014)

The SES framework in contrast stipulates that all environmental resources are embedded in complex social-ecological systems composed of multiple sub-systems that interact to produce desirable or undesirable "*outcomes at the SES level which, in turn, affect the subsystems and their components and other larger or smaller SESs*" (Ostrom, 2009 p419). The four first-level core subsystems are resource systems, resource units, resource users/actors and governance systems, which are important "*in influencing individual preferences, collective choices, unintended consequences and ultimate outcomes*" (McGinnis and Ostrom, 2014). The SES framework provides a diversity of explanatory variables arranged in a series of tiers for each of the four first level core subsystems, related ecological systems, and broader social-political-economic settings (Ostrom, 2009; McGinnis and Ostrom, 2014) (Fig. 2.2). This thesis focused on variables that fit characteristics of water as a common property resource as shown in Table 3.5 and Appendix 2. These variables have been used to design research methods (see Chapter 3), and as deductive codes – see section 3.4.1 (Niemeijer, 2002; Hennink et al., 2011) in content analysis of national and international water policy documents that has been applied to examine the effect of *de jure* institutions on access to drinking-water (see Chapter 3).

This thesis is particularly concerned with understanding the effect of governance systems (in bold, Fig 2.2), namely: government organisations; village committees; property rights systems; operational rules; constitutional choice rules; collective choice rules; and monitoring and sanctioning processes (Ostrom, 2011; 2009; Cox et al., 2010). The use of the SES framework enables an understanding of how the theoretical structure and implementation of formal institutions and the application of property rights systems match or adapt to, the attributes of the resource systems, resource units, differences among resource users, and the interactions of these institutions to produce equitable or inequitable outcomes in the context of related ecological systems and broader social-political-economic settings.

Table 2.2 summarises how the key points discussed in sections 2.1, 2.2 and 2.3 are captured in the SES framework and outlines which specific SES variables were used to address each key issue.

Table 2.2 How key points from the literature review fit into the SES framework

SES high and second-level variables	**Key points *(section)***
Resource systems (RS) – Availability and quality of ground and surface water	- Inadequate infrastructure and difficult terrain affect drinking-water access (2.2.4) - Seasons and seasonality of weather events affect drinking-water systems and water users (*2.2.5*)
Resource units (RU) -Status of water sources (taps, boreholes, springs, wells) - numbers, spatial and seasonal distribution and functionality, functionality during extreme weather events	- Relative importance of improved versus unimproved drinking-water sources for different users *(2.2.2)* - Sources of drinking-water differ by season and location (*2.2.5*)
Actors (A) – social economic attributes (women and poor households)	- Persistent access challenges in marginalised households *(2.1.1)* - Economic factors affect drinking-water inequalities (*2.2.2*) - Gender norms and gender relations influence access to drinking-water (*2.2.3*)
Governance systems (GS) - Government structures, Non-governmental organisations, institutional rules (Operational-choice rules, Collective-choice rules, Constitutional choice Rules), Monitoring and sanctioning rules	- Quality of water governance (including participation by women and the marginalised) determines access inequalities (*2.3.1*) - Institutional arrangements mediate equitable access to drinking-water across seasons in the local context (*2.3.3*) - Relationship between formal and informal institutions (*2.3.2*)
Interactions (I) – Information sharing, deliberation processes, conflicts, self-organising activities	- Interaction of gender and economic status affects drinking-water access outcomes (*2.2.3*) - Institutional outcomes are affected by effectiveness, responsiveness and accountability of actors (*2.3.3*) - Operation of institutions on the ground is affected by seasons and extreme rainfall conditions (*2.3.3*)
Outcomes (O) – performance measure - equity (Access outcomes)	- Marginalised rural households' limited attainment of sufficient drinking-water (*2.1.1*)
Social, Economic, and Political Settings (S) - other governance systems	- Interaction of local institutions with those at other levels to manage common water resources (*2.3.2*) - Impact of policy shift towards participatory approaches on drinking-water access (*2.3.3*)
Related ecosystems (ECO) – Climate patterns	- Seasons and extreme weather events, potentially affected by climate change, affect drinking-water systems and water users (*2.2.5*)

2.5 Conclusion

In summary, access to drinking-water is central to poverty eradication. However, the rural poor and women in SSA still face challenges in accessing water. Constrained access is attributed to many and complex factors that interact in various ways to enhance or reduce access. For instance, this review has demonstrated that institutions are important because they determine how water is allocated and used in a community which, in turn, affects the influence of other factors like poverty, seasonality and gender dynamics on access to drinking-water. While physical and socioeconomic factors have received notable attention, the role of formal institutions in governing access by marginalised households is adequately covered neither in scholarship nor by the UN system (e.g. WHO/UNICEF Joint Monitoring Programme on water). Gaps remain in our understanding of how formal local water institutions consider marginalised groups, seasonality, climate risks, how they have a spatial-temporal fit and how these affect access to drinking-water in marginalised groups. The review reveals that scholarship has largely focussed on the access constrained by various socio-economic trends and given little attention to the effect of institutions on drinking water access. While this is commendable, understanding local formal water institutions and their mediating role in drinking-water governance (e.g. their effect on access to drinking-water by women and the poorest members of the population during different seasons and climate risks, such as floods) in Sub-Saharan Africa is essential to contribute to informed decisions and for tracking progress towards addressing persistent marginalisation in Sub-Saharan Africa. Just as important is the investigation of how legislation and policy integrate governance principles and apply them in the case of water service provisioning. The review further shows that policy shifts which have integrated good water governance principles to address marginalisation have had mixed and context-specific results. Hence, this thesis addresses a research gap around how formal institutions mediate year-round access to drinking-water for poor and marginalised households, using rural Malawi as a case study and Ostrom's SES framework to guide the research design.

Chapter 3 Research design and implementation

This chapter outlines the methods used to assess the effect of local formal institutions on access to drinking-water of marginalised households. As outlined in Chapter 1, 'marginalised' households refer to rural poor households (Government of Malawi, 2011c; UNICEF/WHO, 2012) and women (Government of Malawi, 2009b). The chapter begins by justifying the case study nature of the research design and the selection of the study site and villages. This is followed by a detailed discussion of the data collection and analysis methods. These include several qualitative data instruments (policy document review, key informant interviews, participatory rural appraisal (PRA) exercises and participant observation) as well as quantitative analysis of household survey data. The chapter finishes with a brief outline of ethical considerations.

3.1 Research design

This thesis applies a case study design which involves an in-depth study of one rural site (Bouma and Atkinson, 1995; Bechhofer and Paterson, 2000) and a comparison of patterns across sub-entities, (e.g., villages/communities[16]) within the study site (Berg and Lune, 2012). Single case or small-N comparative studies are widely used in institutional analyses of common property resources (CPR) scholarship, but are criticised for biased interpretations and for failing to provide general conclusions for a larger population (Lipsey and Wilson, 2001; Cooper et al., 2009; Anastas, 1999; Yin, 2003). Despite this, a case study design is the most suitable vehicle for this PhD research because of its narrow focus and the fact that institutional analysis is relatively new in the study site. The design is recommended for a narrow study which is conducted in an area with limited data to test the applicability of a theory (Anastas, 1999; Yin, 2003) and to generate strong hypotheses for future research (Van Laerhoven, 2010). The lack of relevant previous studies in Malawi means that the alternative method of a meta-analysis of case studies, as frequently used (Ostrom, 1990; 1993; 2000; 2002; Ostrom et al., 1999; Anderies and Janssen, 2012; Poteete and Ostrom, 2004) for analysis of self-governance case studies, would not have been possible. Similarly, a lack of baseline data combined with time constraints ruled out the possibility of a longitudinal approach (Bouma and Atkinson, 1995; Thompson et al., 2001; Cleaver and Toner, 2006; O'Reilly and Dhanju, 2012).

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[16] In this thesis the term community is used interchangeably for village.

3.2 Selection of study site and villages

The study took place in four rural villages of Zomba District in Southern Malawi. Zomba District was selected because of the researcher's involvement with the ASSETS project (see Section 1.5), which gave her a high level of familiarity with the area as well as access to both quantitative and qualitative data to complement her own. Zomba District is representative of the country in a number of aspects, such as drinking-water access challenges, poverty levels, food security status and occurrence of extreme weather events. With respect to the researcher's research interests in how drinking-water is provided to marginalised households and across seasons, Zomba is a useful study site as it (i) has particularly high poverty levels (70%) (National Statistical Office, 2005; Government of Malawi, 2012a), (ii) has higher rates of rural households with limited access to access to drinking-water (Government of Malawi, 2012a), and malnutrition (Government of Malawi, 2011b; 2011d) than the Northern and Central regions and (iii) is known to experience highly variable seasonal weather conditions (National Statistical Office, 2009; Zomba District Assembly, 2009). The district is also prone to extreme weather events (Ngongondo et al., 2011b; World Bank, 2016; Government of Malawi, 2009a) (See Chapter 4, Section 4.2, for details).

The ASSETS project worked in six villages which were chosen based on a transect of different levels of access to natural resource hotspots from Lake Chilwa to the Zomba-Malosa State Forest Reserve. For this thesis four of these six villages were selected to represent two groups within two catchments: upper catchment villages located close to the headwaters (that supply drinking-water to all villages within the catchment including downstream communities), hereafter called upstream villages, represented by Mtuluma and Kasonga (located adjacent to the Zomba-Malosa Forest Reserve) and lower catchment villages located at the lower elevation, hereafter called downstream villages, represented by Makombe and Mpheta (located about 20 km from the forest reserve) which makes them a good case for comparing access to drinking-water. The four villages are described in greater detail in Chapter 4.

3.3 Data collection methods

Case study design is compatible with many qualitative and quantitative research methods. Drawing on lessons from earlier studies (Ostrom, 1990; 1993; 2000; 2002; 2009), this thesis employs a convergent parallel mixed methods approach to assess the effect of formal institutions on the access to drinking-water of marginalised households. Mixed methods approaches use triangulation between methods[17] (Brannen, 1992) to examine different aspects of the research problem. In this thesis, the qualitative methods comprise a document review of policies and legislation, key informant interviews, participatory rural appraisal (PRA) exercises (some within the scope of the ASSETS project and some implemented specifically for this PhD research), and formal participant observation. On the quantitative side, data from the ASSETS project household survey which the researcher helped to collect, was analysed. Table 3.1 shows the methods used for each of the study's three specific objectives.

Table 3.1 Link between research objectives and methods used

Research objectives	**Methods used**
1. To determine the extent to which national water policy and institutional design address equitable access to drinking-water for marginalised households across seasons and extreme weather events	• Document review • Key informant interviews
2. To establish how well the local formal water institutions implement policy and deliver equitable access to drinking-water for marginalised households	• Household survey • PRA exercises • Key informant interviews
3. To explore how seasonality and extreme weather events affect the ability of local formal water institutions to deliver equitable access to drinking-water for marginalised households	• PRA exercises • Key informant interviews • Participant observation

3.3.1 Qualitative data collection methods

3.3.1.1 Document review

A document review is a systematic analysis of documentation (Patton, 2002) frequently used in institutional analyses (Ostrom, 2011). This thesis reviewed 44 official documents (Table 3.2) used to govern drinking-water access in rural Malawi, to understand the theoretical structure of formal institutions and whether and how they consider access by marginalised groups and their adaptation to extreme weather events and seasonality. Most of these documents, excluding by-laws, are available online through Government official websites (Appendix 7). The remainder

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[17] Using different methods to the same participants on the same problem under study (Brannen, 1992).

were identified through discussion with key informants and from a further literature review. By-laws were obtained from the District Water Office and Water Users Association Office.

Table 3.2 Number and type of document reviewed

Type	**Water specific**	**Crosscutting**	**Total**
International	11	6	17
National	11	14	22
Local	1	1	2
Total	**17**	**15**	**44**

3.3.1.2 Semi-structured interviews with selected key informants

Semi-structured interviews were held with 18 purposively sampled 'key informants' in their official capacity as part of the water resources governance structure at either district or village level (Table 3.3). Appendix 6 summarises the contacts that were made with the key informants during data collection.

Table 3.3 Numbers (and identification codes) of key informants interviewed

<table>
<tr><th>Group</th><th>Code</th><th>Meaning</th><th colspan="4">Village</th></tr>
<tr><td></td><td></td><td></td><td>Mtuluma</td><td>Makombe</td><td>Mpheta</td><td>Kasonga</td></tr>
<tr><td>Village leaders</td><td>VL1-VL4</td><td>Village chief</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td></td><td>VLWC1-VLWC6</td><td>Village-level Water committee chairperson/executive member</td><td>3</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>NGO officers</td><td>NGO1</td><td>NGO staff member working at community level</td><td colspan="2">1[a]</td><td>N/Av</td><td>FTC</td></tr>
<tr><td></td><td>NGO2</td><td>NGO staff member working at district level</td><td colspan="3">1[b]</td><td>N/Av</td></tr>
<tr><td>Government officers</td><td>GC1-GC2</td><td>Government staff member working at community level</td><td>1[c]</td><td>N/Av</td><td>N/Av</td><td>1</td></tr>
<tr><td></td><td>GD1-GD4</td><td>Government water officer working at district level</td><td colspan="4">3</td></tr>
</table>

N/Av: Non-existence/availability of informant in the community.
FTC: Failure to contact those that do work in the area.
[a] Same officer covers both villages, Mtuluma and Makombe
[b] Same officer covers all the villages except Kasonga due to remoteness
[c] Work at group village headman level

Key informant interviews were used to complement data from official documents. The interviews covered issues pertaining to formation and enforcement of institutions, definition of membership, participation of marginalised groups in organisational structures, and application of property rights. The interviews were conducted from November 2013 to March 2014 starting with district-level government officers, moving down to village-level officers and village leaders. Contradictory information from PRA exercises were explored by follow-up key informant interviews at both district and village level. Each interview lasted 30 to 90 minutes and all except one were recorded, translated into English and transcribed by the researcher (Bryman, 2004). The single unrecorded interview was recorded in a notebook and notes were typed up after the interview (Bryman, 2004).

3.3.1.3 Participatory rural appraisal tools

PRA is a methodology that involves local people in the process of finding out/sharing, enhancing and analysing information about particular issues in their environment/locality (Chambers, 1994c; Chambers, 1994b). Several PRA tools were used. Firstly, a resource walk was undertaken. This was followed by several focus group discussions (FGDs) around selected topics, often supported by matrix scoring, Venn diagrams and household system diagrams (see below for more detail). While not intended as participatory action research, participants felt that they gained some insights from the joint analysis:

> *"Now, we have understood these research issues and implications on the environment and our lives, whether we have some object in the eyes, the object has gone, the eyes are clear… now we will go and tell people the truth"* [FGD2_W_Makombe]

PRA tools are considered a reliable data collection method in rural settings (Chambers, 1994a). In the study area, the PRA focus on diagrams was helpful because up to 40% of residents are illiterate.

3.3.1.3.1 Resource walks

Resource walks (transect walks) are a tool used to describe and show the location and distribution of a particular resource in a community (Chambers, 1994b). Resource walks were conducted with water resource users to identify the water sources used at different times of the year in order to understand how they selected sources (and justified site selection for improved water sources), and access rights. Village chiefs selected two to three participants knowledgeable about and concerned for water resources. These were mostly women. The walks were conducted in September 2014, the driest period of the year. During the walks, path conditions were observed and participants were asked about rainy season-related access difficulties. GPS coordinates of each source were recorded and used to draw maps depicting water sources used for drinking in each village (see Figs 3.1-3.4). Identification of water sources took 40 to 90 minutes per resource walk. One resource walk was conducted per village.

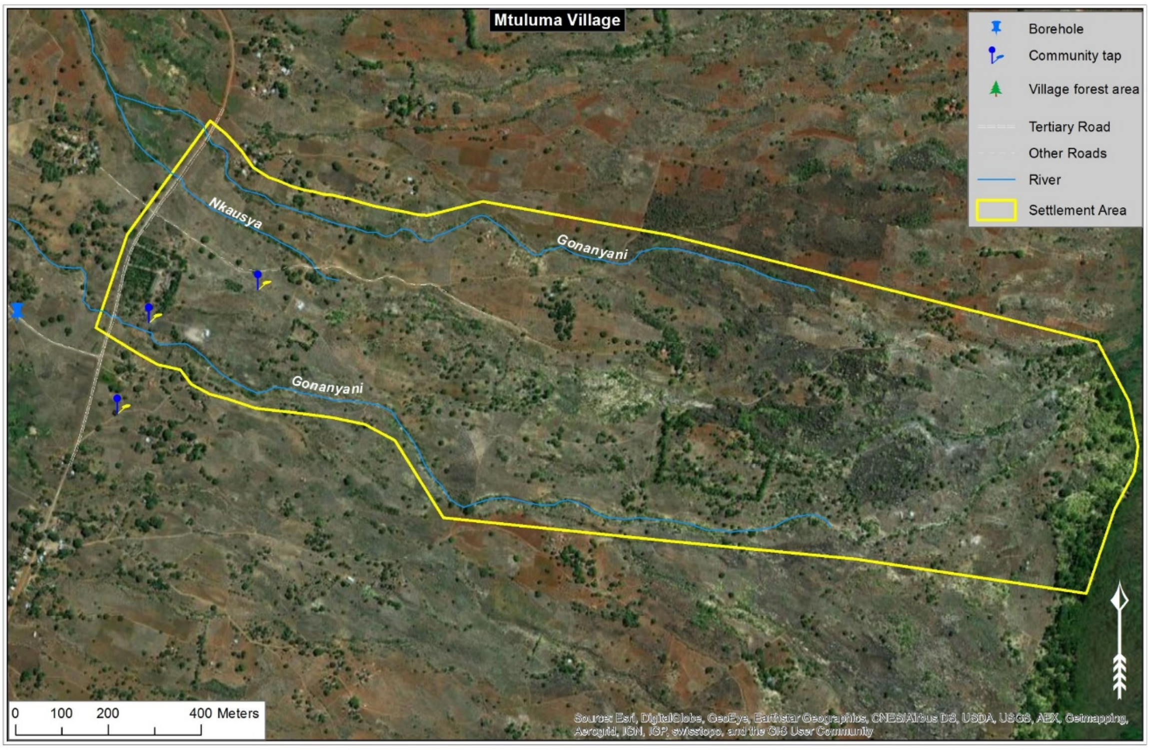

Figure 3.1 Sources of drinking-water in Mtuluma village

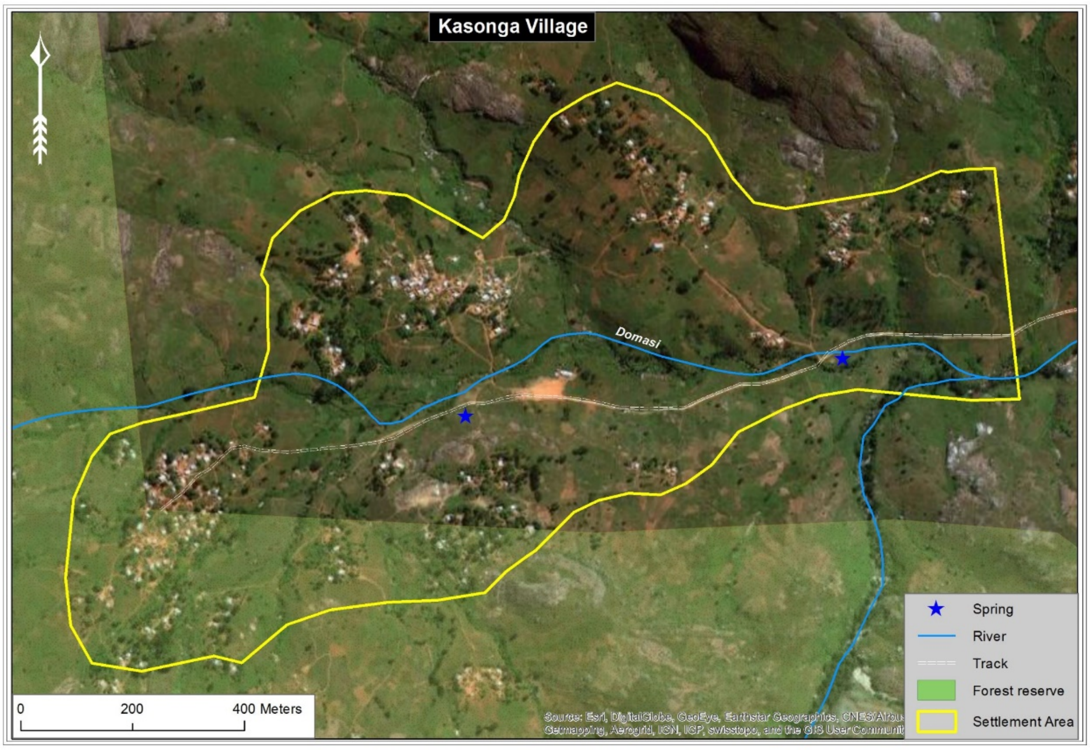

Figure 3.2 Sources of drinking-water in Kasonga village

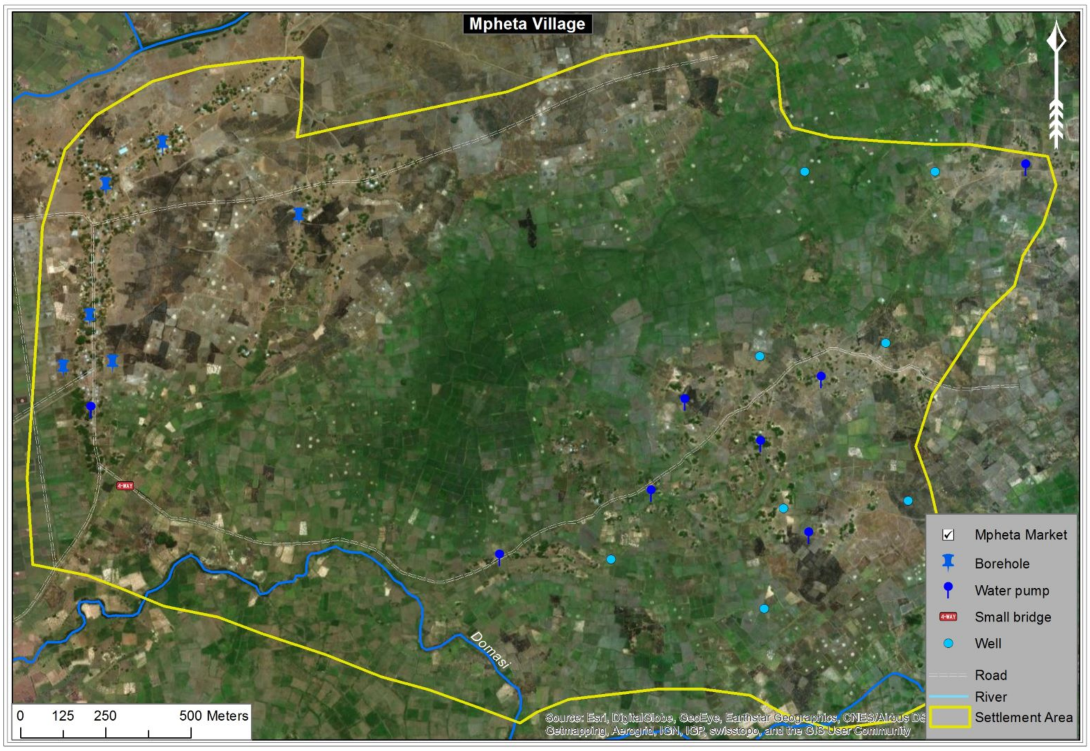

Figure 3.3 Sources of drinking-water in Mpheta village

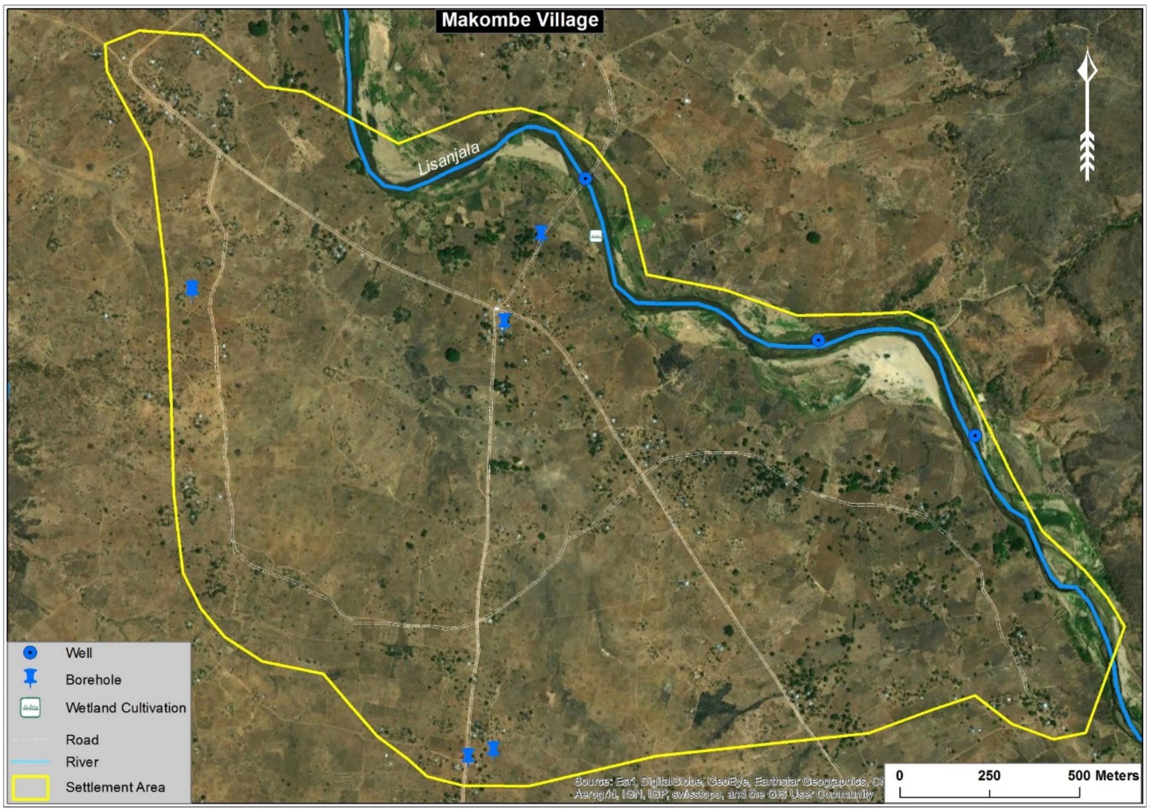

Figure 3.4 Sources of drinking-water in Makombe village

3.3.1.3.2 Focus group discussions

Focus group discussion (FGD) is a technique where a pre-selected group of people with similar experiences or backgrounds/characteristics (e.g. age, gender, ethnicity and economic class) are gathered together to discuss specific issues of interest based on their perceptions and socio-cultural situation (Hennink et al., 2011; Hennink, 2014; Nyumba et al., 2018). FGDs allow for group reflection and therefore provide a more in-depth understanding of perceptions. FGDs use open-ended questions to get context-specific (Stewart and Shamdasani, 1998; Bryman, 2012) "*in depth responses about people's experiences, perceptions, opinions, feelings and knowledge*" (Patton, 2002 p4) directly from respondents. Participant interaction enables commenting on each other's responses, modification and additions to the responses. Researcher-participant interaction allows probing for an in-depth explanation of responses and, consequently, access to a wide variety of diversified views and rich volumes of data representing collective responses, that may better address research problems within limited time and budget (Burgess et al., 1988; Berg and Lune, 2012; Bryman, 2012) than individual in-depth interviews, documentary analysis, or household surveys (Ostrom, 2002; Thoms, 2008; Pandit and Bevilacqua, 2011).

In each village, three FGDs were conducted: two with poor participants (one mixed gender and one women-only) and one with better-off participants (mixed gender). An additional unplanned mixed FGD was conducted in one village. This resulted in nine mixed and four women-only FGDs. Participants were aged over 18 and under 70, to ensure meaningful participation, and were purposively selected based on their knowledge level of the subject in the four villages. The selection was aided by the village chief and his/her counsellors, who generated a household list categorising the residents into different well-being groups. The participants were coded into two groups – better-off (FGD1_mixed[18]) and poor (FGD2_mixed and FGD2_W[19]) – based on subjective indicators identified through participatory well-being and livelihoods exercises carried out by the ASSETS Project (see Appendix 4), to ensure cross-sectional group representation, equal participation and consensus in discussions (Arnold, 2001). Four groups involved women only, drawing on empirical evidence from diverse sources that in most rural areas women's concerns are inadequately heard in the presence of men, largely due to cultural attitudes (Clarke, 1987; Rojas, 1994; Wilde and Vainio-Mattila, 1995; Arnold, 2001).

Each FGD consisted of two sessions. A matrix and Venn diagrams were used in session 1 and household diagrams in session 2 (these are explained later in this section). These were implemented at a time and place convenient to the participants. FGDs were designed to have about seven participants to ensure easy and meaningful participation (Berg and Lune, 2012; Bryman, 2012; Hennink, 2014). Each group comprised five to 11[20] participants (Table 3.4).

Table 3.4 Number and type of focus groups and participants in each

Village name	**Number of participants in each focus group**			
	'Better-off' mixed gender [FGD1_mixed]	'Poor' mixed gender [FGD2_mixed]	'Poor' women-only [FGD2_W]	Ad hoc mixed gender
Mtuluma	5	7	11	4
Kasonga	4	10	5	
Mpheta	7	6	5	
Makombe	7	7	5	

[18] Mixed genders.
[19] Women only.
[20] This range was meant to address no-show cases because data collection coincided with the farming season.

The FGDs used a discussion checklist (Box 3.1) organised around seven questions designed to address two of the three research objectives. This and subsidiary checklists (see below) were translated into Chichewa, a local language widely spoken by the community members (see appendices 8) for easy facilitation of the exercises.

Box 3.1. Discussion guide for focus group discussions

1. Where do households obtain water at different times of the year?
    a. What is the preferred source of water at different times of the year?
        i. Use matrix scoring
    b. What factors affect choice of source of water at different times of the year?
2. Which groups of people are important in supply of water to a household and community?
    a. How do they influence supply and access?
        i. Construct a Venn diagram of both formal and informal groups responsible for water provisioning to a household and community.
3. How do established institutions affect households' *de facto* and *de jure* access and use rights to water resources in different seasons?
    a. What are the existing user rights for water resources?
    b. Which community members use specific water resources?
4. Which groups of people benefit or are disadvantaged from enforcement of the rules at different times of the year?
    a. How do access or enforcement of rules affect different groups of people?
    b. How does each group cope with access rules?
    c. How much time is spent (round trip) on water collection by gender and wealth group in the dry and rainy seasons?
    d. What is the average distance covered in water collection by gender and wealth group in the dry and rainy seasons?
    e. How much water is consumed by season and income group?
    f. How much water is used for food preparation by season and income group?
5. How does access to water affect food preparation and consumption in households?
    a. How does quantity of water affect food consumption?
    b. How does water quality affect food consumption?
    c. How does access to water vary with the seasons?
6. How do *de jure* and *de facto* access to water affect food consumption at different times of the year?
    a. How does access to water vary by gender and wealth group?
    b. Who are responsible members for water collection in households?
    c. How much time is spent on water collection by gender and wealth group?
    d. How do food choices vary with access to water?
    e. How does food consumption pattern vary with seasons?
    f. How do food choices vary with seasons?

Note: indicates where the diagrams were used

All group discussions were tape recorded, translated into English, and transcribed. Responses generated from many people proved difficult, hence transcription focused on selected relevant sections of the discussions. This was done after listening closely to the recorded discussions at least twice (Bryman, 2004). The transcription in this thesis focused on what was said and not how the response was presented.

Matrix scoring was used to support the discussion around the first question in the FGD. This PRA tool allows participants to compare options or items through scoring using criteria, who consequently arrive at a preferred item/option or action (Chambers, 1994b; Chambers, 1994a). In this thesis matrix scoring was used to analyse how much and why people prefer different water sources (Guijt and Woodhill, 2002). During the exercise, participants were asked to identify sources of drinking-water by season (dry and rainy seasons). For each source, the participants were asked to say the 'goodness' and 'badness' of each source and their answers were used to set the scoring criteria. The participants were then assisted to draw a matrix with sources used in each season across the top as column headings and criteria in the rows down the side (Narayanasamy, 2009). Later, they were asked to score each cell across the rows between 1 (very low) and 10 (very high). This was repeated for all the criteria. Lastly, total scores for each source were noted at the bottom of the table. The highest scored source was the preferred source in each season (Guijt and Woodhill, 2002) and the result was agreed with the participants. The discussions were recorded and transcribed. However, there is a limitation here. The criteria were not weighted so the scoring assumes that all criteria carry equal weight. This is because the purpose of the exercise was to stimulate discussion rather than to produce a definitive result.

Venn diagrams were used to support the second question on the FGD checklist. Venn diagrams, also known as institutional or 'chapati' diagrams, are a PRA tool used to identify important institutions and individuals in and for a community and the closeness of their relationships are depicted by overlapping circles (Chambers, 1994a). In this thesis, focus group participants drew Venn diagrams on flip charts to analyse institutional arrangements regarding village water resources governance. Participants were asked to mention actors important both at household and village levels, including their grouping, i.e. government, NGO or community, and their roles in influencing water access at different times, their level of importance and their working relationships regarding influencing access. The participants were also asked to indicate the time when these actors influence(d) access. Participants were then asked to diagrammatise this information using different circle sizes and distances between them (see Figs. 3.5 and 3.6).

Figure 3.5 Venn diagram for Mtuluma community – wealthier focus group

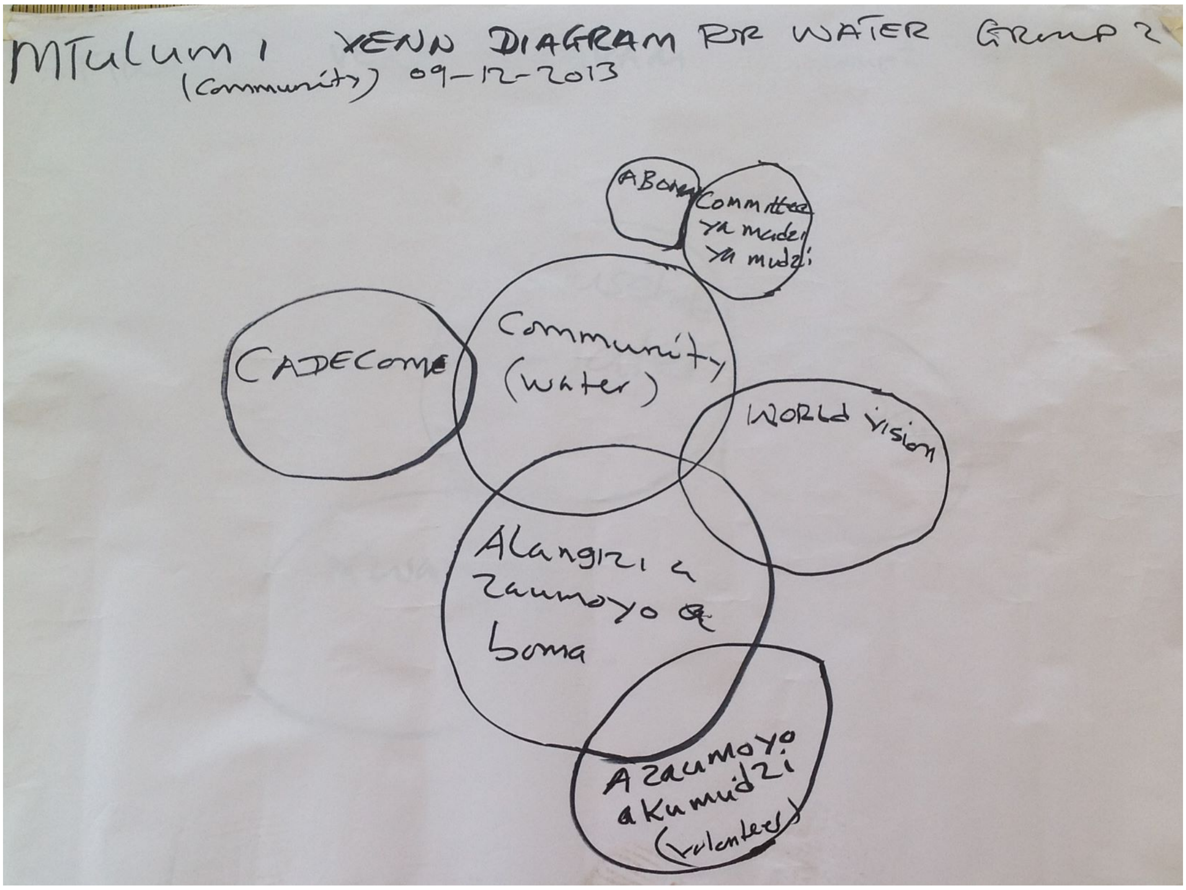

Figure 3.6 Venn diagram for Mtuluma community – poorer focus group

The circle at the centre represented a household or community. Circles representing other actors were sized to illustrate the degree of importance of the actor to the household or community; small circles represented less important actors. Proximity of the circles illustrated the strength of interaction between actors. This diagram indicated which actors are important in influencing access to water in the village as well as at household level, type of influence, timing and spatial differences, and similarities. The exercises produced two diagrams from each village: one for water at household level and another focused on water at village level.

Household system diagrams are participatory data collection tools that can be used to visualise the nature of local/household wellbeing, livelihood strategies (including sources, inputs and outputs) and their effectiveness (Schreckenberg et al., 2016). In this thesis a household system diagram with a separate checklist (Appendix 8.3) was used in the second FGD session to help tackle issues also raised in questions 1 and 5 in the first FGD, i.e. to identify drinking-water sources and the household members responsible for water collection and food preparation. Participants were asked to provide this information, note it down, and illustrate it on a diagram using relevant symbols selected by the participants. The discussions were recorded and photos of the diagrams captured (see Figs. 3.7 and 3.8).

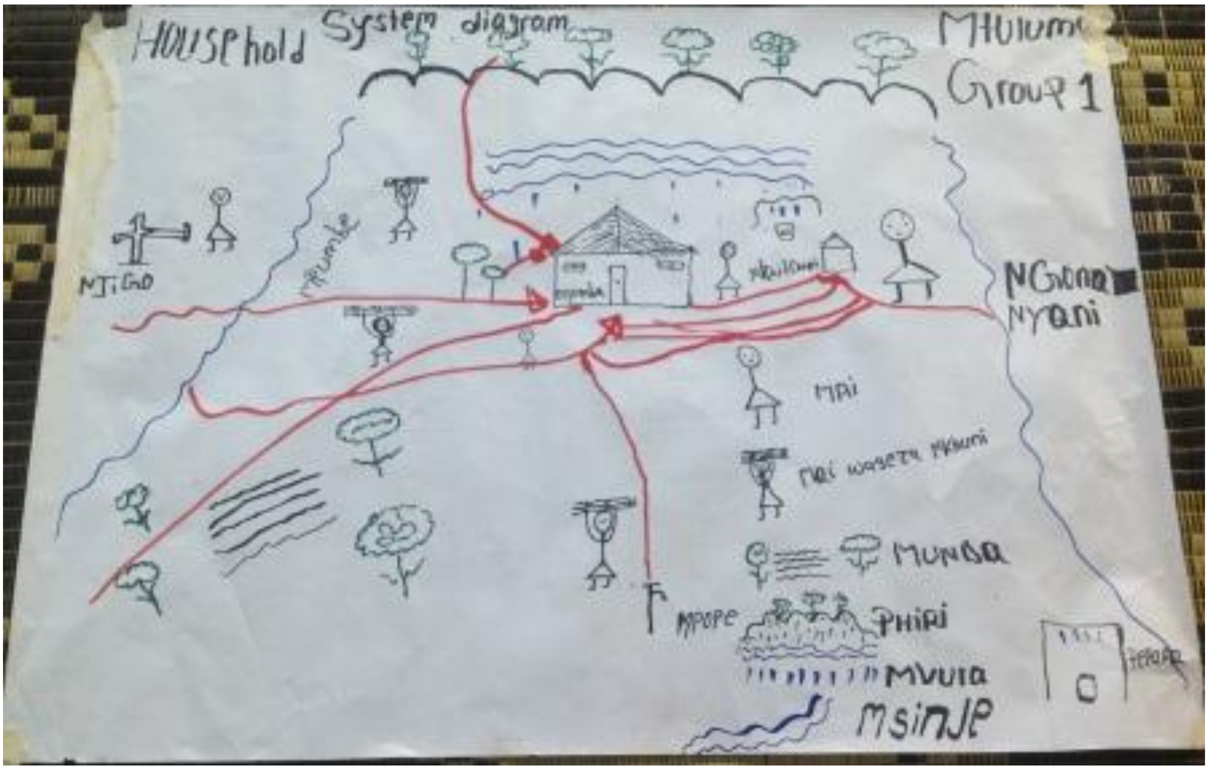

Figure 3.7 Mtuluma household system diagram – wealthier focus group

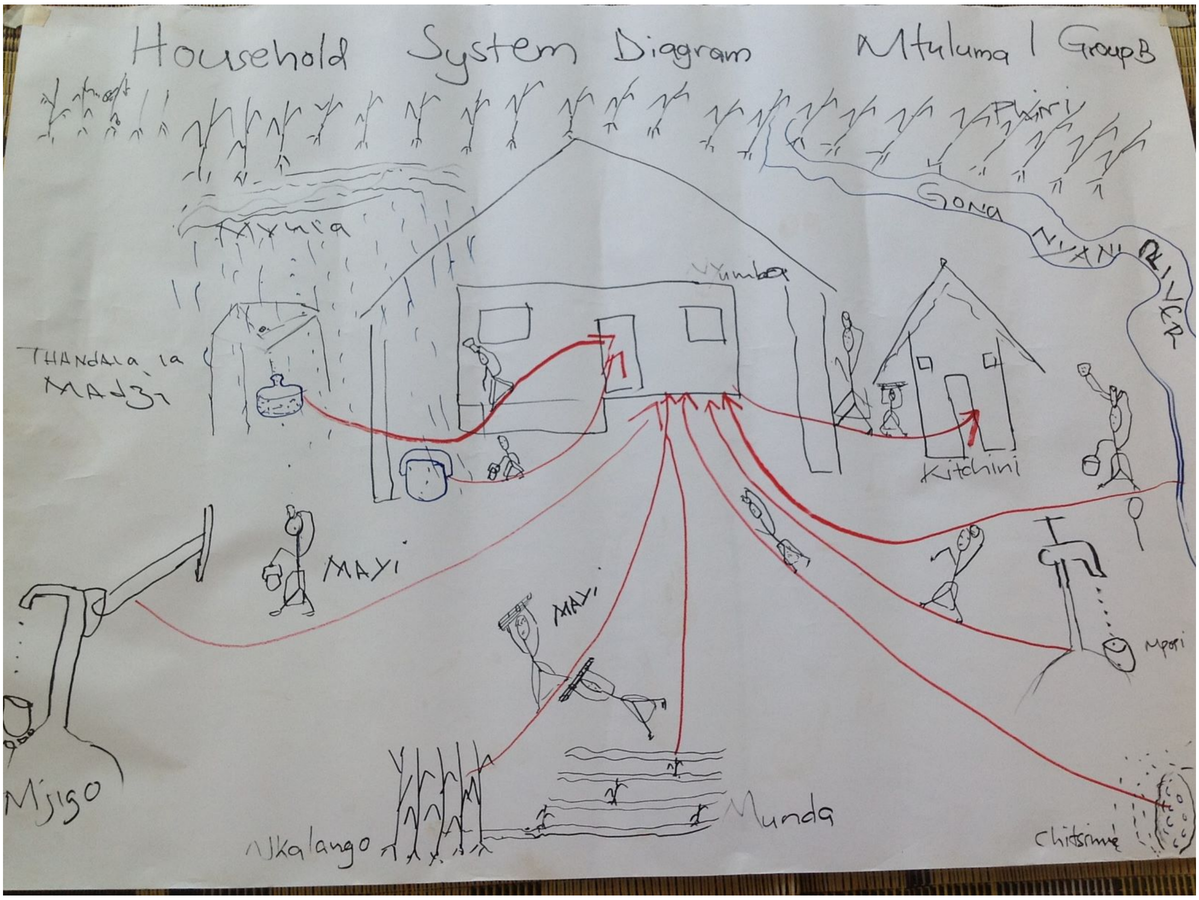

Figure 3.8 Mtuluma household system diagram – poorer focus group

3.3.1.4 Qualitative data collected as part of the ASSETS project

The study also used PRA data generated by the ASSETS project on natural resource governance and food security during 2013. The researcher was involved in designing and implementing a large range of participatory exercises (Schreckenberg et al., 2016) in the six ASSETS study villages. Of particular interest to this thesis were a number of group discussions on resource governance, including Venn diagrams. In each village, these were conducted separately with a group of resource management committee members and a group of non-committee members. Issues covered included actors involved in resource governance; their categories, roles and interrelationships; participation of community members in decision making; membership of committees, and information sharing. Another exercise was undertaken with eight mixed groups of women and men disaggregated into poorer and wealthier groups to draw household system diagrams depicting household responsibilities related to ensuring food security. The ASSETS PRA exercises were not fully transcribed; they were written up as field reports by the facilitators. For the purpose of this thesis, these reports provided a useful background for the development of my own more focused PRA exercises. Because the participants were drawn from the same study sites, they also provided "*parallel insights into the experiences of different stakeholders*'' (Barbour, 2008 p155) which aided comparison of responses to similar questions.

3.3.1.5 Formal observations for triangulation

PRA methods can provide information on how participants perceive things are supposed to be, rather than how they really are, hence the usefulness of triangulating with direct observation (Patton, 2002). How good a PRA exercise is depends not only on the level of trust between participants and facilitator but also on the sensitivity of the topic. These exercises are therefore less likely to reveal the realities of complex governance situations than seasonal water changes. There is also a risk of 'group think' – that they provide a consensus view with less opportunity for people to present divergent individual perceptions (Cooke and Kothari, 2001; Christens and Speer, 2006). For all these reasons, drawing on other sources, like observation, is useful. Thus, data collection also involved formal observation of non-verbal communication and people's behaviour (Stewart and Shamdasani, 1998; Kawulich, 2005).

Some studies argue that observation is prone to 'representation bias' shaped by the way in which issues are represented by participants, and the researchers' interests (Schensul et al., 1999; DeWalt and DeWalt, 2002; Ratner, 2002). However, observation can improve the validity of studies when combined with other research methods (Kawulich, 2005). This qualitative method is widely used in studies exploring people's reported or perceived behaviours and events in their natural settings (Kawulich, 2005). For example, it has been used in a survey of medication implementation among community health service providers in Tucson, Arizona, USA (Bhattacharjee et al., 2019a) and the use of long-lasting insecticidal nets for the prevention of malaria in the Peruvian Amazon (Iyer et al., 2019). In this thesis, observations were undertaken in the following ways:

- Attendance (without commenting on the deliberations) at one Water User Committee (for tap water) for about 2 hours, in Mtuluma and two (borehole) Water User Committee meetings which lasted about an hour each, in Mpheta village (Table 3.5) to note:
    - How people were discussing issues
    - The numbers of participants by gender and levels of participation
    - Differences in group discussion participation (including speaking up and influencing decisions) between men and women, and between people in different well-being groups.
- Participation in two drinking-water collection trips with two women in Mpheta and one woman in Kasonga, Mtuluma and Makombe villages in the dry season and one trip with one woman in Kasonga, Mtuluma and Mpheta in the wet season (Table 3.5). In all the water collection trips, the researcher carried the water on her head and participation in water collection was to:

- Note who was collecting the water and how long it took
- Observe seasonal differences in access to drinking-water, in both poorer and wealthier households
- Validate the findings from FGDs and key informant interviews.

Table 3.5 Number of formal observations in committee meetings and domestic work

Village	**Type of observation**	
	Observation in committee meetings	Observation - participating in water collection
Mtuluma	1	2
Kasonga	0	2
Mpheta	2	3
Makombe	0	1
Total	**3**	**8**

3.3.2 Quantitative data collection methods

3.3.2.1 Household questionnaire surveys

This thesis had access to secondary data from the household survey undertaken by the ASSETS project. Of particular interest to this thesis were questions on: type of water source used in homes, estimated quantity of water fetched in a day, time taken to fetch water, household member responsible for fetching water and money spent on drinking-water (WHO/UNICEF, 2006). Though the researcher had some input into the design of the questionnaire, she did not have the final say on its content. Hence, some key questions that would have been useful for this current study, e.g. those related to participation of water users in water governance structures, were left out because the household questionnaire was considered too long. Additionally, the researcher had limited control over the way some questions of concern were structured because the questionnaire was not primarily meant for this thesis. Examples include questions on time taken to collect water and expenditure on water. The consequences of this are discussed in Chapter 6.

The survey involved 500 households randomly sampled from the six communities involved in the ASSETS project. The communities had a sampling frame of 1064 households, a sample large enough to produce representative results for the communities under study. However, this current study focused on just four of the six study communities with a sample size of 306 households in the dry season and 311 households in the wet season, representing about 44% of the sampling frame of 702 households.

The ASSETS household survey focused on adults only, specifically, household heads or their spouses and the interviews were conducted by trained enumerators. The survey used repeat visits to cover the household heads not available when visited. Dropouts between the first and second visit were replaced. Replacements were high in Mpheta village. Responses were captured directly onto the computer in the field by the enumerators using the Surveybe computer package.

The ASSETS survey was originally designed to take place over two rounds, firstly in the wet season and again in the dry season. However, for logistical reasons and because of annual variability in rainy season onset, the implementation of the first and second survey rounds (from 7 May 2014 to 6 December 2014 and 19 September 2015 to 14 February 2016) did not exactly coincide with the dry and wet seasons. Satellite-derived daily gridded rainfall estimates were therefore downloaded and used to identify household interviews that took place in the wet and dry seasons. The wet season was defined as the period between onset and cessation of rains while the dry season was outside this range (Ngongondo et al., 2014). The rainfall onset and cessation dates were identified using the Malawi (national) official definition of onset (itself modified from (Nicholson et al., 2014 p318)) as 25mm rainfall accumulated in a 2/3-day period without 10 consecutive dry spell days (1mm) afterward. Cessation is the last day in the season (October to April) with more than 10 mm of rainfall. Data collection did not coincide with the cessation period, hence this thesis used the onset date of rains only to define the dry and wet seasons, using time-series daily precipitation for the four study villages. The daily rainfall was extracted with the help of Terry Yu from the Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS, http://chg.geog.ucsb.edu/data/chirps/) and WGS84 coordinate system. The spatial resolution is 5km. Households were therefore assigned to dry/wet season based on the date of data collection (October – April = rainy season, and May – September = dry season) and rainfall onset. In the dry season, analysis focused on households that were interviewed before the onset of the rainy season (7th December 2014 for Kasonga and 8th December 2014 for Mtuluma, Makombe and Mpheta) (Fig 3.9).

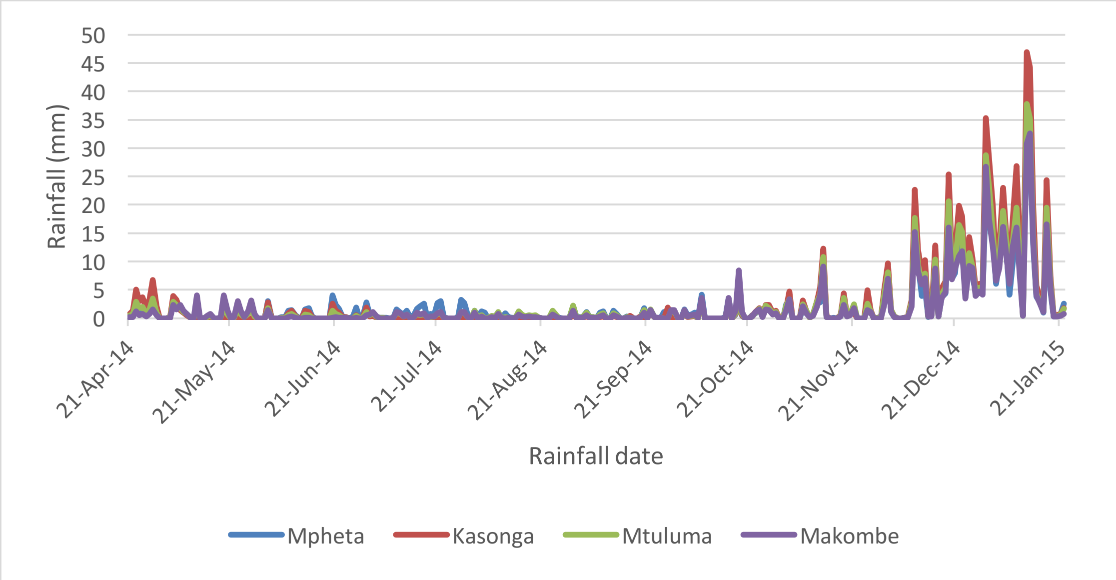

Figure 3.9 Rainfall days during the 2014 household survey data collection period

Source of rainfall data: http://chg.geog.ucsb.edu/data/chirps/. Extracted and shared by Terry Yu.

For the wet season sample, all households that were interviewed after the onset of the rains in 2015 (4th November for Kasonga and Mtuluma, 13th December for Makombe and 14th December for Mpheta) were included (Fig 3.10).

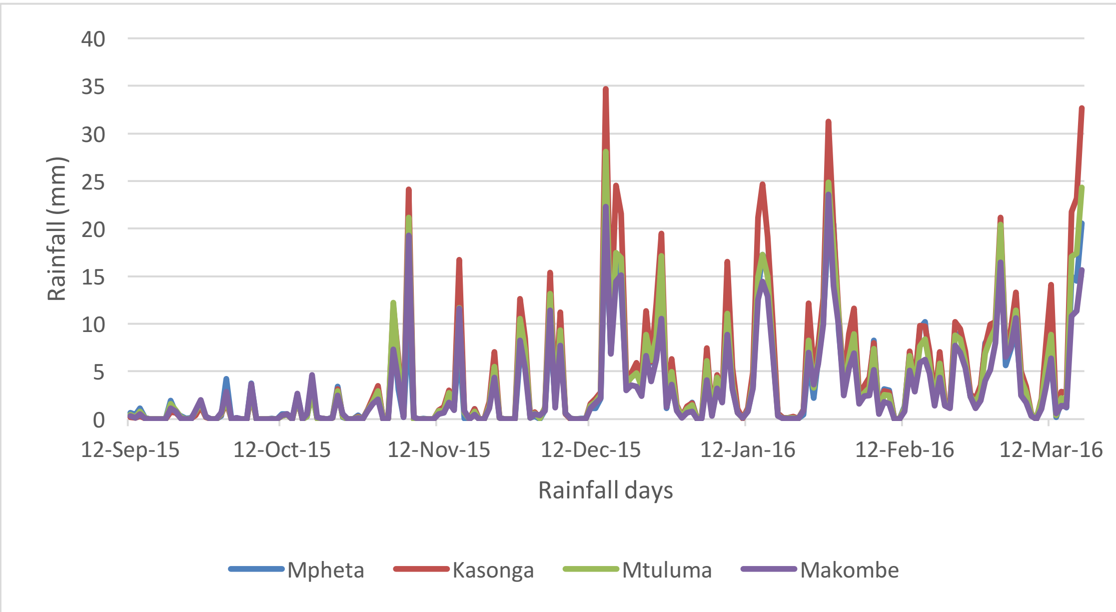

Figure 3.10 Rainfall days during the 2015-2016 household survey data collection period

Source of rainfall data: http://chg.geog.ucsb.edu/data/chirps/. Extracted and shared by Terry Yu.

These two data sets provide adequate data for seasonal comparison of access to drinking-water and other variables for descriptive and logistic regression analysis.

3.4 Data analysis methods

3.4.1 Qualitative data analysis

Content analysis was applied to policy documents and all texts from key informant interviews and FGDs using NVivo, a computer application (see Appendix 5). Content analysis is a technique that involves systematic coding (transformation) of large amounts of complex text into highly organised and concise results based on the analyst's judgement (Erlingsson and Brysiewicz, 2017; Nyumba et al., 2018). The process produces categories or themes from the raw data which help to identify patterns that form the basis of interpretation of the study findings (Stewart and Shamdasani, 1998; Bryman, 2012; Erlingsson and Brysiewicz, 2017). The study used theory-driven coding as opposed to the alternative approach of inductive coding (allowing the codes to emerge from the raw material) (Braun and Clarke, 2006). As indicated in the last section of Chapter 2 (see Fig. 2.1), this thesis applied Ostrom's Socio-ecological Systems (SES) theoretical framework to guide data collection and analysis. Table 3.6 shows the higher and lower level variables derived from Ostrom (2009), McGinnis and Ostrom (2014) and related literature, that were used to code the qualitative data.

In this thesis, social, economic and political settings (S) refer to international water policies and legislation governing access to drinking-water. Governance system (GS) are national/local policy, legislation, constitution, laws, guidelines, all rules and formal structures/organisations governing access to drinking-water in rural Malawi. Resource systems (RS) refers to drinking-water systems such as ground and surface water. Resource units (RU) are water points such as boreholes, taps, springs and wells. Actors are water users and their socio-economic characteristics. Interactions are activities involving relevant stakeholders including water users and service providers, in rural drinking-water service governance. These include participatory approaches and information sharing. Related ecosystems are external factors (specifically seasonality and climate risks) influencing access. Outcomes (O) of interest are equitable or inequitable access to drinking-water.

Table 3.6 List of variables or codes and sub-codes from SES framework

High level variables (all from Ostrom, 2009)	**Lower level variables**	**Sources for lower level variables**
Social, economic and political settings (S)	Other governance systems or policies	Ostrom (2002)
	Demographic trends, e.g. population pressure	Ostrom (2009)
Resource systems (RS)	Sector, e.g. ground and surface water sources	Ostrom (1990); Cox et al. (2010)
	Clarity of the resource boundary	Ostrom (2009)
	Size of the resource	Ostrom (2009)
	Productivity of the resource system	Meinzen-Dick and Di Gregorio (2004)
	Human constructed facilities	Ostrom (2009)
	Location	Wade (1987)
Resource units (RU)	Spatial and temporal distribution	Pavri and Deshmukh (2003)
Governance system (GS)	Government organization	Ostrom (2009); (Ostrom, 2011); (Cox et al., 2010)
	Non-governmental organization	
	Property rights systems	
	Constitutional choice rules	
	Collective choice rules	
	Operational choice rules	
	Monitoring and sanctioning rules and activities	
Actors (A)	Socio-economic attributes (poverty, gender)	Agarwal (2009)
	Number of users (with access rights)	Wade (1987)
	Importance of resource to livelihoods (dependence)	Wade (1987)
	Social capital (interactions)	Nguyen Ngoc et al. (2011)
	Leadership	
Interactions(I)	Information sharing	Dietz et al. (2003);
	Deliberation processes (participatory approach)	Agarwal (2010); Persha et al. (2011)
	Self-organizing activities	Wade (1987); Ostrom (2002)
Outcomes (O)	Equitable access	WHO and UNICEF (2010)
Related ecosystems (ECO)	Climate patterns	McGinnis and Ostrom (2014)
	Flows into and out focal SES	Ostrom (2009)

3.4.1.1 Policy documents

International and national (local) policy documents were reviewed using computer assisted qualitative data analysis in NVivo, as recommended by Bryman (2012). Hierarchically organised coding categories (called 'nodes' in NVivo) were generated from the deductive variables included in the SES framework (Table 3.6) – see Appendix 2 for their names and descriptions. The high-level variables became parent nodes while explanatory variables became child nodes. Similar codes were merged. Coding strips, a facility in NVivo, were used to see coded texts and nodes applied to them. Multi-coloured or overlapping codes suggested that the units *"were coded with more than one node"* (Saunders et al., 2012 p558), implying interrelationships (Bryman, 2012;

Saunders et al., 2012). After coding all texts, all coded instances "*of a particular node*" (Bryman, 2012 p603) were retrieved as a coding summary by node or source reports. Where necessary outputs were generated, including specific node frequencies in the documents.

All the coded texts were skimmed through to get a broad overview of their content. Detailed reading followed including analysis of "*type of issues raised, depth of discussion on each issue, and whether some issues had been raised repeatedly*" (Hennink et al., 2011 p220). The second part of the analysis involved a detailed analysis of all the segments/excerpts that featured a particular variable, to understand the context in which the variable was used, to generate meaningful finding interpretations. A detailed review and interpretation focused on texts from national (local) policy documents because they have direct relevance and impact on local governance of access to drinking-water for subsistence or domestic use in rural Malawi. These include the by-laws, sectoral forest and water policies, and Acts and guidelines (Government of Malawi, 1969; 1995; 1996b; 1997b; 2003a; 2003b; 2007b; 2010d; 2004b; 2013b). A less detailed review was undertaken of international policies which cover issues more broadly (De Albuquerque, 2014a).

3.4.1.2 Key informant transcripts

The transcripts were subjected to qualitative content analysis by importing them into NVivo with key informant transcripts labelled according to source. SES theoretical framework-derived deductive codes (Table 3.6) were then applied to all transcripts. Coding included a transcript line, sentence(s) or complete paragraph (Saunders et al., 2012). The respective coded texts (Bryman, 2012) were critically analysed for emerging patterns in issues raised and to see the extent to which the findings supported or contradicted findings from policy documents.

3.4.1.3 PRA transcripts

All PRA exercises and group discussion transcripts were subjected to qualitative content analysis. Transcripts bearing focus group names, were uploaded in NVivo and analysed using the deductive codes in Table 3.6. While the analysis of the policy documents provided an insight into the theoretical aspect of access, the FGDs provided a picture of implementation of the policy on the ground. Comparisons were made between a series of focus groups and participant subgroups. Codes with similar attributes were then combined into categories which were used to analyse relationships and "*develop a conceptual understanding of issues*" (Hennink et al., 2011 p245) raised in the data. NVivo allows minimal quantitative analysis, e.g. frequencies (Bouma and Atkinson, 1995; Bryman, 2004; Silver and Lewins, 2014). However, the FGD transcripts were not analysed in a quantitative manner because a frequently mentioned topic, or one that is talked about for a long time, does not necessarily imply that a majority agrees to the idea.

3.4.2 Quantitative data analysis

3.4.2.1 Descriptive statistics, wealth analysis, and Logistic regression analysis for household survey data

3.4.2.1.1 Descriptive statistics

Summary statistics (means, proportions), cross-tabulations, t-tests and chi-square tests were applied to household survey data to investigate the distribution and associations between implementation of formal institutions and household access to drinking-water. This analysis provided results on sources of water for drinking, estimated quantities fetched in a day for domestic use, distance to water sources, household members responsible for water collection, and time use. Households were disaggregated by geographical position, education, age and gender of household headship and wealth group.

3.4.2.1.2 Household wealth analysis

Consumption is widely "*accepted as the most accurate and direct measure of household socio-economic status (SES)*" (Mwanga et al., 2015 p553). To assess household wealth level, the study applied household wealth analysis using consumption expenditure and asset-based approaches.

The *consumption expenditure approach* applied the World Bank standard – comparing households that live below and above the poverty line[21]. It is assumed that households regulate their consumption expenditure better than their incomes (Howe et al., 2012). This measurement is estimated "*by summing expenditures on a wide range of items to form an aggregate measure of total expenditure*" (Howe et al., 2012 p875). For this thesis, wealth analysis using consumption expenditure took into account food and non-food consumption for twelve months (Deaton and Zaidi, 2002). Food consumption refers to all food items from purchases, own production and in-kind. Non-food items considered: education and health expenses, consumption of durables and housing, particularly rent and utilities. All expenses were then put together to generate a total household consumption. The total household consumption was divided by household size to generate consumption per capita. This analysis created nominal values. The study did not apply relative rates of inflation in the four villages to get real values because study villages were close to each other hence prices did not differ much, and because datasets were small. Similarly, temporal

[21] The study used two poverty lines: internationally recognised benchmark (US$1.90) and national poverty line (US$0.32).

deflation was not considered because the dataset used concerned a single time frame (one year). It was, thus assumed that purchasing power/living conditions would be almost the same over all four study communities during the limited time frame of one year.

The *asset based wealth index* in this thesis was applied as a relative/proxy measure for consumption expenditure (Howe et al., 2008; Howe et al., 2009; Mwanga et al., 2013; Wittenberg and Leibbrandt, 2017) because of its simplicity, (Kabudula et al., 2017), wide application and reliability relative to direct measures such as income or consumption expenditure, especially in middle income and resource poor countries (Filmer and Pritchett, 2001; Nkonki et al., 2011; Mwanga et al., 2015; Kabudula et al., 2017). Assets are also generally viewed as durable and less susceptible to temporal variations and therefore likely to provide a "*better picture of long-term standards of living*" than income or expenditure (Ward, 2014 p617).

A household wealth index was based on household ownership of durable assets (e.g. car or bicycle or motorcycle, television, cell phone) and livestock; ownership of dwelling unit and housing characteristics (e.g. cement floor and iron-sheet roof material) and access to basic services including energy source for cooking and lighting (Kabudula et al., 2017; Howe et al., 2008; Mwanga et al., 2013; National Statistical Office and ICF, 2017). Households were given scores "based on the number and kinds of consumer goods possessed and household characteristics" and classified into two equal groups (Mwanga et al., 2013; National Statistical Office and ICF, 2017) the wealthier and poorer. Multiple correspondence analysis (MCA) using dummies (0/1 variable) was applied: the more '1's, the wealthier the household and the more the 'zeros', the poorer the household. These scores/indices were derived with MCA using STATA version 13.1[22]. This MCA method was statistically appropriate for this thesis because the data contained categorical variables with multiple categories (Booysen et al., 2008; Howe et al., 2008; Wittenberg and Leibbrandt, 2017; Traissac and Martin-Prevel, 2012).

3.4.2.1.3 T-test statistics

T-tests were applied in this thesis to show if differences in continuous household characteristics between groups were statistically significant. Statistical significance/p-value is set at 0.05[23] (Wu et al., 2011). The study compared differences in time spent on water collection (in minutes) by households based on household geographical position (upstream and downstream villages), wealth group (rich and poor) and gender of household head (male-headed and female-head). T-

[22] STATA 13.1 was also used to run descriptive analyses.
[23] This value gives us confidence that there is a 95% chance that these figures are related.

tests were applied to the variables to calculate the means for each group and check if the differences in the means of these categories were statistically significant. There are three separate tests: 1) upstream vs downstream, 2) male-headed vs female-headed, 3) wealthy vs poor. In this regard, for the first test, a statistic of <0 means downstream households spend less time than upstream households; 0 means no difference. >0 means downstream households spend more time fetching water than upstream households.

3.4.2.1.4 Logistic regression analysis

Quantitative data were further analysed using logistic regression (LR) (see Appendix 5) to investigate the association between the observed access outcomes (access to drinking-water and water quantity) and multiple explanatory variables (household factors). Logistic regression is a multi-predictor regression model that relates multiple predictors to a dichotomous (binary) outcome variable (Peng et al., 2002; Vittinghoff et al., 2005; Hayes and Matthes, 2009). It is a widely used multivariable method for modelling binary outcomes (Al-Ghamdi, 2002; Ayalew and Yamagishi, 2005; Larsen and Merlo, 2005) especially when the explanatory variables include both continuous and categorical variables and are not uniformly distributed (Vittinghoff et al., 2005). Logistic analyses model the likelihood of an event's occurrence and the influence of one or more predictor (independent) variables on the observed outcomes (O'Connell, 2006).

The model is appropriate for this thesis because the outcome variables (access to drinking-water and water quantity) have binary response options where yes =1 and no =0. Outcome variables depend on a number of explanatory variables which can be continuous or categorical measurements. Additionally, linear relationships between the outcome variable and the predictors are not assumed. LR estimates were used to classify households as likely to experience e.g. adequate and drinking-water access or not. Multi-predictor regression helped to establish multiple independent predictors of e.g. access to drinking-water, and to understand how these independent variables jointly influence access outcomes (Vittinghoff et al., 2005). Results from the content analysis of the policy documents, key informant interviews and FGDs informed the selection of variables.

Logistic regression was run in Stata version 13.1 to determine whether the dependent variables could be predicted from the selected independent variables (Hosmer and Lemeshow, 2000). To avoid underestimation of the strength of relationships between the dependent and the independent variables, some variables were further transformed into ordinal (categorical) independent variables before including them in the model (http://www.statisticssolutions.com/assumptions-of-logistic-regression/). For example, education is usually recorded as a continuous variable. To ensure appropriate estimation of the strength of relationships between the dependent and independent variables, this education variable was transformed into groups which were computed as categorical data such that highest education levels were coded from no education to secondary+ levels. According to Armitage et al. (2002) logit transformation provides the method of logistic regression. The model estimated on these predictor variables is given below:

$$Y = log\ it(p) = log\left[\frac{p(y=1)}{1-p(y=1)}\right] = \beta_0 + \beta_1 * X_{i1} + \beta_2 * X_{i2} + \ldots \beta_n * X_{in} = ln\left[\frac{p}{(1-p)}\right]$$
$$= \beta_0 + \beta_1 * X_1 + \beta_2 * X_2 + \ldots \beta_n * X_n$$

Where p is the probability that the dependent variable (Y) is 1, $p/(1-p)$ is the odds or likelihood ratio, β_0 is the intercept, and $\beta_1, \beta_2, \ldots, \beta_n$ are coefficients, which measure the contribution of independent factors (X1, X2, . . ., Xn) to the variations in Y. Proper interpretation of the model uses the coefficients as a power to the natural log(e). The outcome shows the likelihood (odds ratio) that an event will happen divided by the probability that it does not occur (Ayalew and Yamagishi, 2005). In this thesis:

$$Y\ (ACCESS) = ln\left[\frac{p}{(1-p)}\right]$$
$$= \beta_0 + \beta_1 * Gender + \beta_2 * Age\_head + \beta_3 * hhsize + \beta_4 * income\_level + \beta_5 * distance\_minutes + \beta_6 * upper\_catchment + \beta_8 * education$$

Where

ACCESS: Is access to drinking-water

$$Y\ (QUANTITY) = ln\left[\frac{p}{(1-p)}\right]$$
$$= \beta_0 + \beta_1 * Gender + \beta_2 * Age\_head + \beta_3 * hhsize + \beta_4 * income\_level + \beta_5 * distance\_minutes + \beta_6 * upper\_catchment + \beta_7 * dependancy\_ratio + \beta_8 * education$$

Where:

QUANTITY: Is quantity of water drawn for drinking (<20 litres=0 and 20+ litres=1)

β_0 Constant

β_1……… β_9 Coefficients

Gender: Gender of household head where Gender = 1, for male-headed households and 0 for female-headed households

Age_head: Age of household head

hhsize: Household size

income level: Wealth group of household where income level (or lnpcapcons) =1, if household is rich and = 0, if household is poor

distance_minutes: Round trip distance to water source in minutes

upper_catchment: Household geographic region where upper_catchment =1 for households located upstream and 0 for households located downstream

education: Education level of household head where education = 0 for non-educated household head, 1 for one with primary school as highest level, 2 for household head with secondary school and above as highest level

QUANTWAT: Quantity of water drawn for drinking where QUANTWAT = 1 for households with ability to fetch ≥20 litres and 0 for households who fetch <20 litres of water

QUALWAT: Quality of water drawn (for drinking) where QUALWAT = 1, for drinking water and 0 for non-drinking-water.

To fit logistic regression models, this thesis first cross-tabulated categorical predictors against response outcomes; then fitted univariate logistic regression models; and then fitted a multivariate logistic regression model.

3.5 Ethical considerations

This research adhered to the University of Southampton's Research Ethics Policy (https://www.southampton.ac.uk/about/governance/policies/ethics.page) and requirements of the Chancellor College Research Committee, Malawi. Approval to conduct this research was obtained from the University of Southampton ethics committee and the Chancellor College ethics committee. The study used information sheets (See Appendix 3.1) to inform participants about the purpose of the study, its requirements and how the information collected was to be used. Since PRA exercises involved repeated visits to the community, participants were told in advance that they might be asked to participate in multiple sessions. Confidentiality of the data collection and anonymity in data reporting were also assured to the study participants. Actual names of individuals were not mentioned in the transcripts. High levels of illiteracy led to the use of an oral consent form (Appendix 3.2) which was read out to the study participants and which they were asked to sign or mark to confirm their understanding and willingness to participate. For key informants interviewed in their official capacity, a separate consent form, which did not insist on anonymity (Appendix 3.3) was provided. For participant observation, a general consent was obtained from the village chief and committee chairpersons. A similar ethics approval process was followed in the ASSETS project to undertake the household surveys used in the study for quantitative data.

3.6 Conclusion

This chapter outlines how Ostrom's (2009) general framework of socio-ecological systems was used as an analytical framework to understand the effect of *de jure* institutions on access to drinking-water as a common property resource, by marginalised households.

The study employed a case study design to provide an in-depth understanding of the effect of *de jure* institutions on drinking-water access of marginalised households because of its ability to provide the needed data within the specified study time and context. The study used a convergent parallel mixed methods approach to seek answers to the research problem in order to respectively maximise and minimise strengths and weaknesses of data generated through single methods. To obtain the desired in-depth understanding, a wide range of methods was used, combining: document reviews; multiple key informant interviews with water officials, water executive committee members; participatory rural appraisals (FGDs); participant observation; and a household survey.

This thesis applies document reviews and key informant interviews findings in Chapter 5. Chapter 6 uses results from household survey, key informant interviews and FGDs. Key informant interviews and FGDs are further used in Chapter 7 in combination with participant observation. The next chapter describes the study site.

Chapter 4 Area description

This chapter introduces the study area by describing its social and ecological characteristics. The chapter also includes a brief analysis of temperature and rainfall trends, types and prevalence of extreme events in the study area and key variables affecting seasonality of water supply using findings from earlier studies and empirical data from selected nearby meteorological stations from 1960 to 2016. The chapter begins with an overview of the demographic, weather and drinking-water-related characteristics of Malawi before focusing on the study site in rural Zomba.

4.1 General background to Malawi

4.1.1 Malawi population trends and water access need

Malawi’s population was estimated at 13,077,160 in 2009 (National Statistical Office, 2009) and 17,563,749 in 2018 representing an overall population increase of 35% at an annual growth rate of about 2.9% (Government of Malawi, 2018). A rapidly increasing population creates greater demand and competition for drinking-water, overwhelming the government’s ability to provide the service (Buor, 2004; Mutunga et al., 2012; AFIDEP AND PAI, 2012; Baguma et al., 2013) and consequently leading to increased pressure on available water infrastructure/facilities (Government of Malawi, 2011c; AFIDEP AND PAI, 2012). Many people are exposed to water shortages (Mutunga et al., 2012) with negative consequences on their livelihoods (Population Action International (PAI), 2012).

Over 80% of Malawi’s population is rural (National Statistical Office and ICF, 2017). According to UN projections, about 70% of the population are likely to continue living in rural areas by 2050 (Fig. 4.1) (UNDESA, 2012; UNDESA, 2018), hence the need to pay special attention to the rural population.

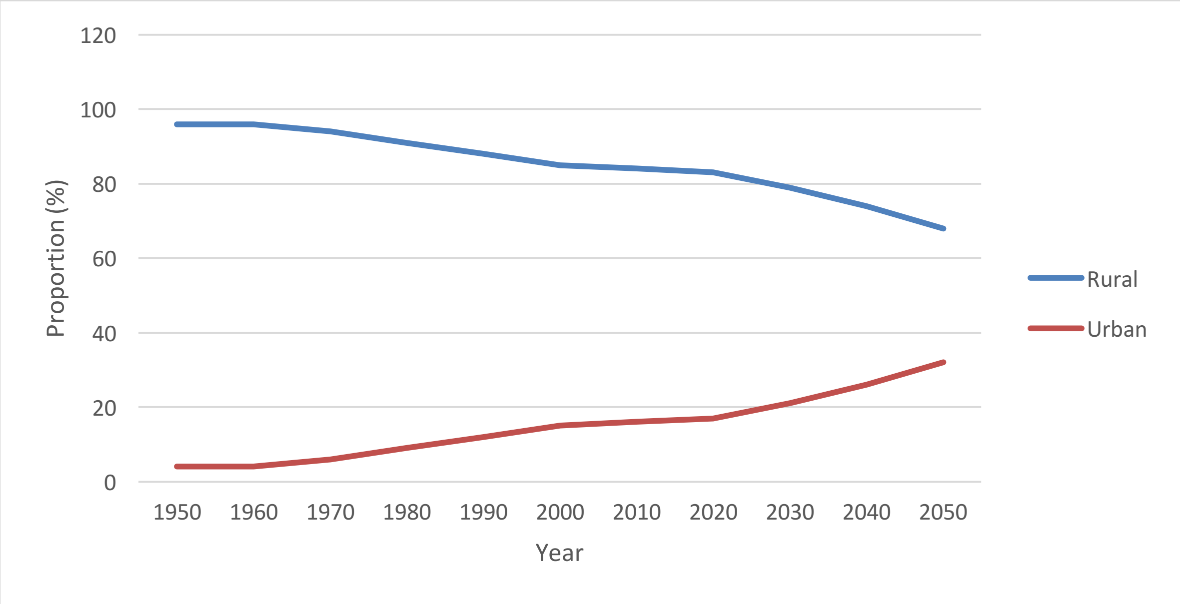

Figure 4.1 Malawi population distribution by rural-urban locality, 1950 -2050

Source: UNDESA (2012); UNDESA (2018)

Malawi has a youthful population with about half (48%) aged below 15 years (National Statistical Office and ICF, 2017) and about 51% aged below 18 (Government of Malawi, 2018). Projections for the next four decades depict a similar picture (National Statistical Office, 2010; Bureau, 2003; Government of Malawi, 2016a). This age structure suggests a high birth rate and short life expectancy in upper age groups caused by factors, including poor living conditions and poor nutrition (Waugh, 2002; Rubenstein, 2011) which are indicators of poverty. Because "*a youthful population also creates population momentum*" (AFIDEP AND PAI, 2012 p12), "*the population will continue to grow even after fertility reaches replacement level (about 2.1 births per woman)*" (AFIDEP AND PAI, 2012 pp11-12; Government of Malawi, 2016a), leading to rising demand on water resources for the next decades. Furthermore, a persistent progressive age structure partly suggests minimal or lack of effectiveness of the interventions and institutional arrangements that aim to tackle the challenges of food insecurity and poverty. This prompts the need to assess and review the institutional arrangements influencing people's welfare, including water institutions, as failure to do so may contribute to holding back Malawi's development.

4.1.2 Malawi climate profile, occurrence of extreme weather events and access to water

Malawi generally has a tropical continental wet and dry climate influenced by altitude and its proximity to Lake Malawi (Government of Malawi, 2011e). The climate is strongly seasonal with two distinct seasons, a single rainy season running from November to April and a dry season from May to October (Government of Malawi, 2011e; Ngongondo et al., 2011b). Furthermore, the country's climate is largely linked "*with relief units and altitude and is therefore, classified into* *three: (i) semi-arid (Shire Valley and some parts along the Lakeshore Plain), (ii) semi-arid to sub-humid (Medium Altitude Plateaus), and (iii) sub-humid (High Altitude Plateaus and hilly areas)"* (Government of Malawi, 2011e p23). Combined with seasonal patterns of precipitation, the areas experience different rainfall and temperature trends which likely influence water availability and access. The present study was partly motivated by the need to understand how water availability and access compares in varying localities during different seasons.

Malawi is prone to both human and natural hazards some of which are closely associated with the occurrence of disasters that affect availability and access to water in different localities (UNECA, 2015; Government of Malawi, 2017b; Holmes et al., 2017; World Bank, 2017). Over 90% of these disasters are weather related (Fig. 4.2).

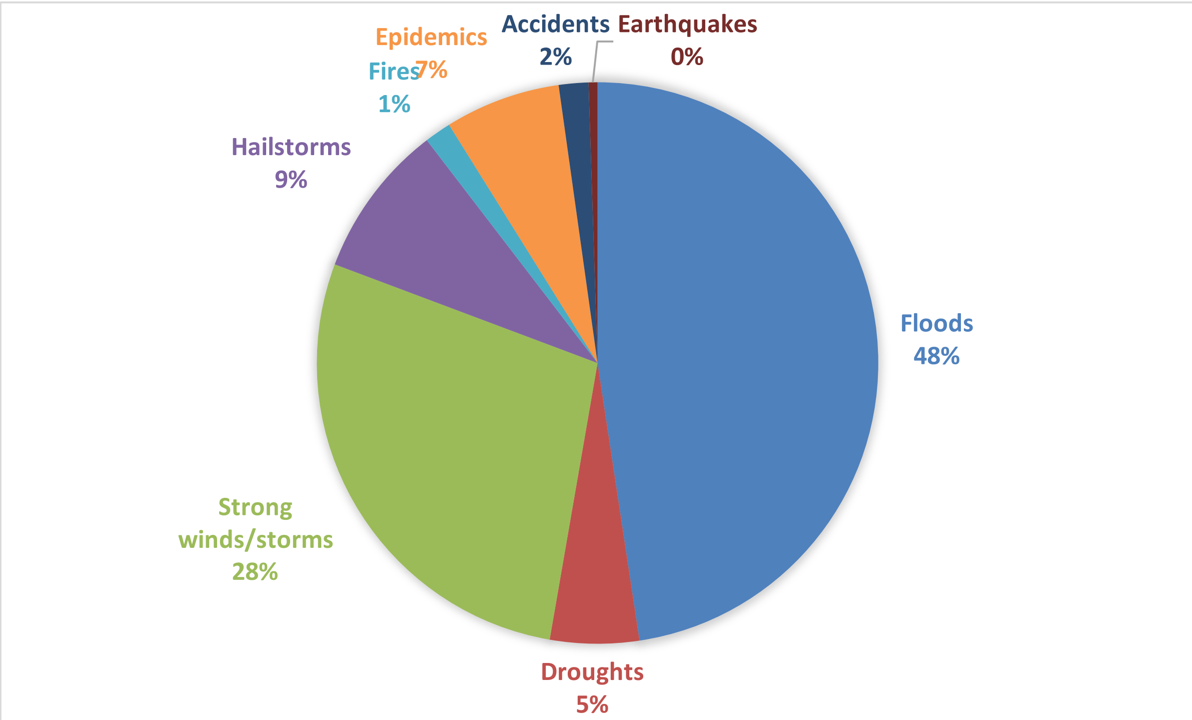

Figure 4.2 National Profile for Disasters, 1946-2013

Source: DoDMA (2013); UNECA (2015)

Figure 4.3 presents a summary of common hazards and affected districts in the country.

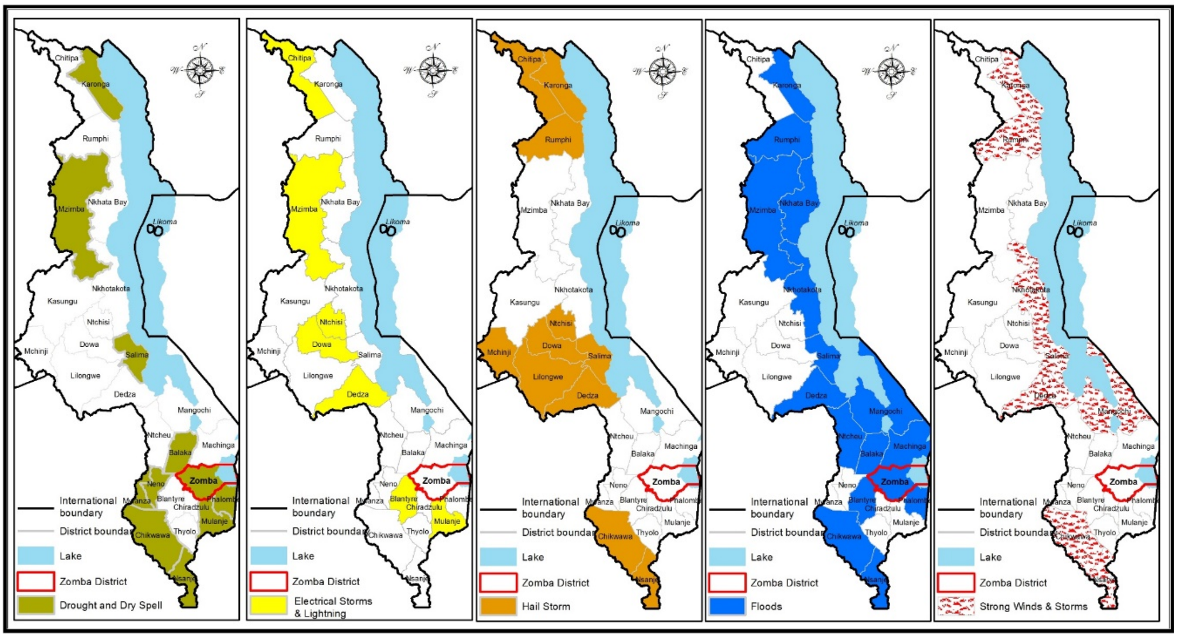

Figure 4.3 Common hazards and geographical distribution in Malawi

Source: Hazard data from DoDMA (2013); UNECA (2015); Pourazar (2017)

Maps from National Spatial Data Center (2014)

More disasters are being reported, with 90% of disasters reported to have occurred in the last 20 years (Guha-Sapir et al., 2015) – although this could be an artefact of improved disaster reporting globally since the 1980s. Figure 4.3 shows the frequency of weather-related shocks by district from 2000 to 2013. The most common hazards are droughts and floods (Fig. 4.4).

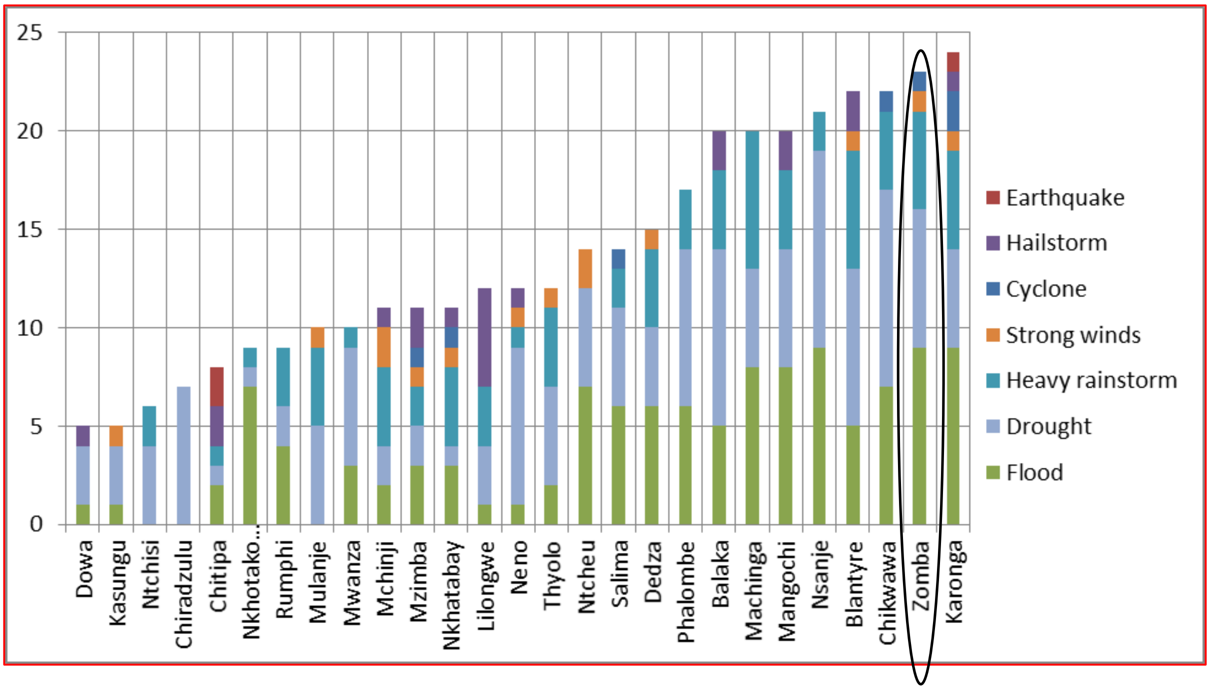

Figure 4.4 Frequency of Shocks by District (2000-2013)

Source: adopted from World Bank (2017)

While droughts and floods are central to water availability and access, floods are key in this thesis because they are the most frequently occurring (Holmes et al., 2017) (Fig. 4.3), accounting for over 70% of the climate-related disasters. Furthermore, they show an increasing trend since the 1970s (Government of Malawi, 2011e; Pourazar, 2017) (Fig. 4.5) and the number of affected districts has increased over the past two decades.

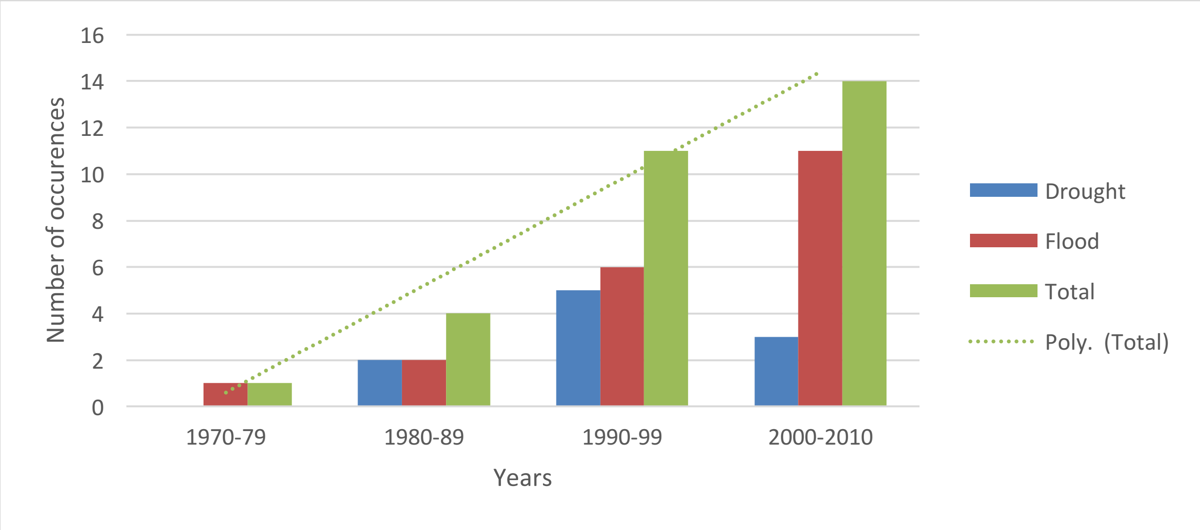

Figure 4.5 Occurrence of droughts and floods, 1970-2010

Source of data: Action Aid (2006); Centre for Research on the Epidemiology of Disasters - CRED (2012)

Floods affect over half of Malawi's 28 districts, with eight of them located in the Southern Region (Fig. 4.3) making southern Malawi most prone to flooding events (Winsemius et al., 2015). National records provide a summary of the recorded severe floods that have occurred in Malawi since 1946 (Nilsson et al., 2010; DoDMA, 2013; UNECA, 2015). The worst flooding event on record occurred in 2015 (Government of Malawi, 2015 p1) with over 1 million people affected by end of January 2015 (Government of Malawi, 2015; Government of Malawi, 2017b). By geographical coverage, the Southern Region was the most affected; it contributed 11 of the 15 most affected districts (Government of Malawi, 2015), which are also poor, and among which Blantyre, Nsanje, Chikwawa, Zomba and Mulanje emerged as the worst affected areas (Government of Malawi, 2015).

The occurrence of floods has largely been associated with inter-annual rainfall variations which are mostly attributed to changes in the Indian Ocean's sea surface temperatures induced by the El Niño southern oscillation (UNECA, 2015; McSweeney et al., 2008; Environmental Affairs Department, 2002a). El Niño conditions are historically characterised by a rainfall deficit and dry spells, while La Niña years are usually associated with above normal (heavy) rainfall in many parts of central and southern Malawi (UNECA, 2015; McSweeney et al., 2008; Environmental Affairs Department, 2002a). La Niña conditions are usually characterised by flooding (UNECA, 2015; World Bank, 2016) resulting from excessive runoff in rivers and streams created by the heavy rains. In Southern Malawi the most flood-prone areas are the Lower Shire River valley and lake shore areas of Lakes Chilwa and Malombe (UNECA, 2015; Government of Malawi, 2009a).

Recurrent disasters resulting from extreme weather events, specifically floods, have far-reaching impacts on health, water and food security (UNECA, 2015; Government of Malawi, 2011e; Government of Malawi, 2009a). For example, water and sanitation was one of the three most affected sectors during the 2015 flooding disaster (Table 4.1) (Government of Malawi, 2015; Government of Malawi, 2017b). However, there are data gaps relating to the period of recovery and reconstruction and how affected rural households responded to the disaster, yet this information is very important due to high poverty levels of some of these affected areas.

Table 4.1 Physical asset damaged/destroyed in the water sector, 2015 flooding, Malawi

Physical asset damaged/destroyed	**Quantity**
Boreholes	2991
Shallow wells	493
Water intake structures	36
Water treatment plants	6
Water supply conveyance pipeline	(m) 9,363
Water supply distribution pipeline	(m) 8,152
Hydrological stations	15
Dams	4

Source: Government of Malawi (2015 p2)

The increasing frequency, intensity and magnitude of floods over the past few decades are considered to have had adverse consequences on water security in rural areas (Government of Malawi, 2013a; Nilsson et al., 2010; Government of Malawi, 2015; Pourazar, 2017). Although records show an increasing trend from 1974, the highest frequency of flooding occurred between 2004 and 2013, attributed to climate change (UNECA, 2015; Government of Malawi, 2011e).

Although historically, Malawi has a very variable climate, the observed and projected trends in temperature suggest increases in mean annual temperatures and both negative and positive trends (-13% to +32%) in mean rainfall (Government of Malawi, 2013a; Ngongondo et al., 2011b; McSweeney et al., 2008; McSweeney et al., 2010). Temperatures are expected to "*increase by 1.1 to 3.0°C by the 2060s, and 1.5 to 5.0°C by the 2090s*" (Government of Malawi, 2013a p4). Projections further suggest an increase in the number of hot days and a decrease in cold days. These conditions make Malawi more prone to damaging climate risks and the related consequences for water availability and access.

Climate change, therefore, poses an additional threat to water resources, namely "*additional pressures on water availability, water accessibility and water demand*" (Government of Malawi, 2013a p4). This means climate change is expected to worsen "*the impacts of other stresses such population growth*" on water (Government of Malawi, 2013a p8). Service provision as well as the underpinning water policy and legislation will therefore need to respond adequately to the threats to ensure sustainable and equitable access to drinking-water in vulnerable localities. However, it is not clear whether Malawi's institutional arrangements are adequate to respond to climate-related shocks. For example, UNECA (2015) and Pourazar (2017) highlight the limited integration of disaster risk reduction (DRR) measures in national policies and strategies. One of the motivations for my study is the lack of information about how the National Water Policy has responded to this emerging challenge, specifically floods and droughts and associated impacts on drinking-water access for marginalised households in rural areas.

4.1.3 Drinking-water access trends, gender and equity issues

Over the past four decades, the Government of Malawi has developed and revised its national institutional framework to ensure access to drinking-water. The framework includes national development strategies, by-laws, sectoral (Forest and Water) policies, Acts and guidelines, which are examined in detail in Chapter 5. This led to the majority of households gaining access to an improved water source (piped water, public taps, stand pipes, tube wells, boreholes, protected dug wells and springs, rainwater and bottled water if used for cooking/washing) (National Statistical Office and ICF, 2017; National Statistical Office and ICF, 2016)[24] (Fig. 4.6). However, improving statistics at national level hide a persistent gap between rural and urban areas (Fig 4.6), suggesting that access varies by place of residence.

[24] Unimproved water sources include unprotected dug well, unprotected spring and surface water (National Statistics Office and ICF, 2017).

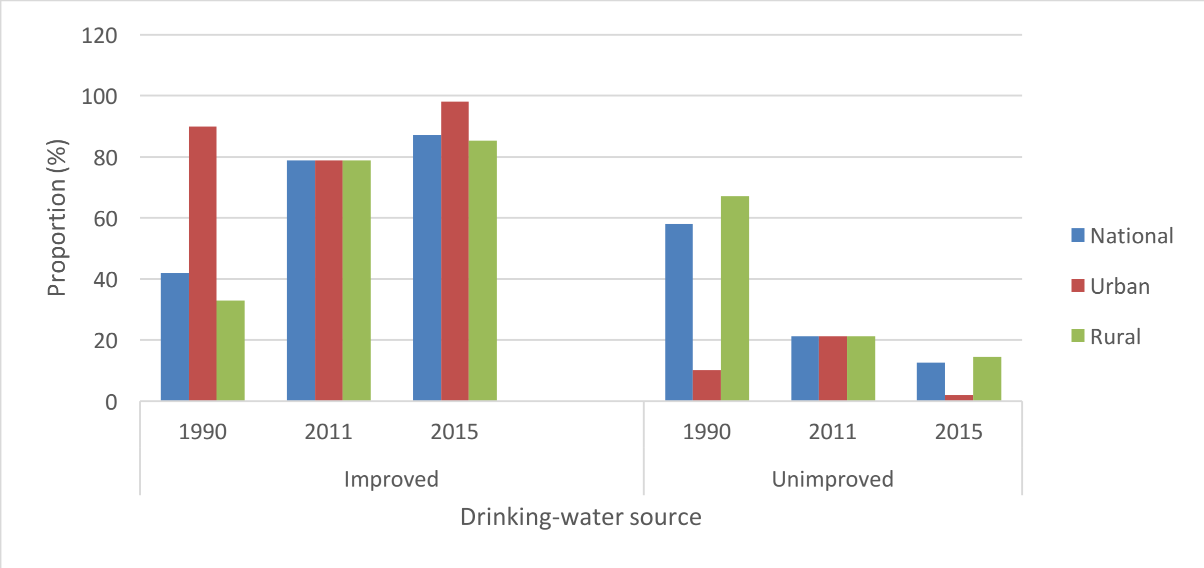

Figure 4.6 Access to drinking-water urban-rural gap in Malawi

Source of data: WHO and UNICEF (2014); National Statistical Office and ICF (2016); Government of Malawi (2012a)

The statistics further show that education and wealth levels are key factors in determining whether a household uses an improved source of drinking-water. Households led by a household head with secondary education and those in the richest wealth index quintile have almost universal access to improved sources of drinking-water (National Statistical Office, 2015). The poorest group has a lower proportion of households (75%) with access to drinking-water than wealthy households (84%) (Government of Malawi, 2012a)(Fig. 4.7).

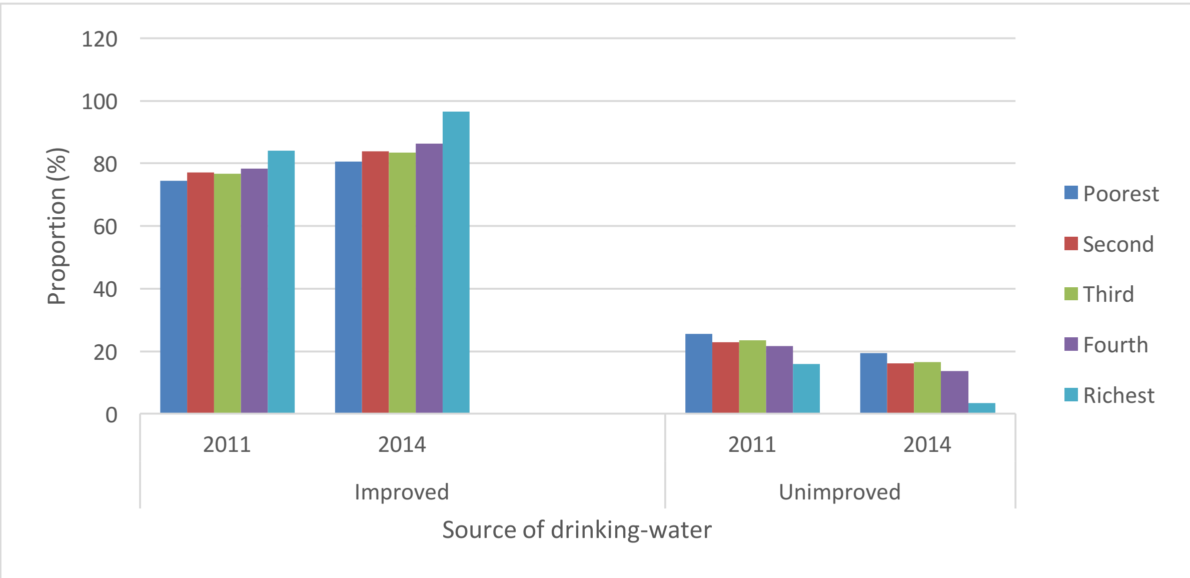

Figure 4.7 Access to drinking-water by wealth quintile in Malawi

Source of data: Government of Malawi (2012a); National Statistical Office and ICF (2016)

Further variations are seen by gender – with slightly higher access to improved water sources in female headed than male-headed households (Fig. 4.8).

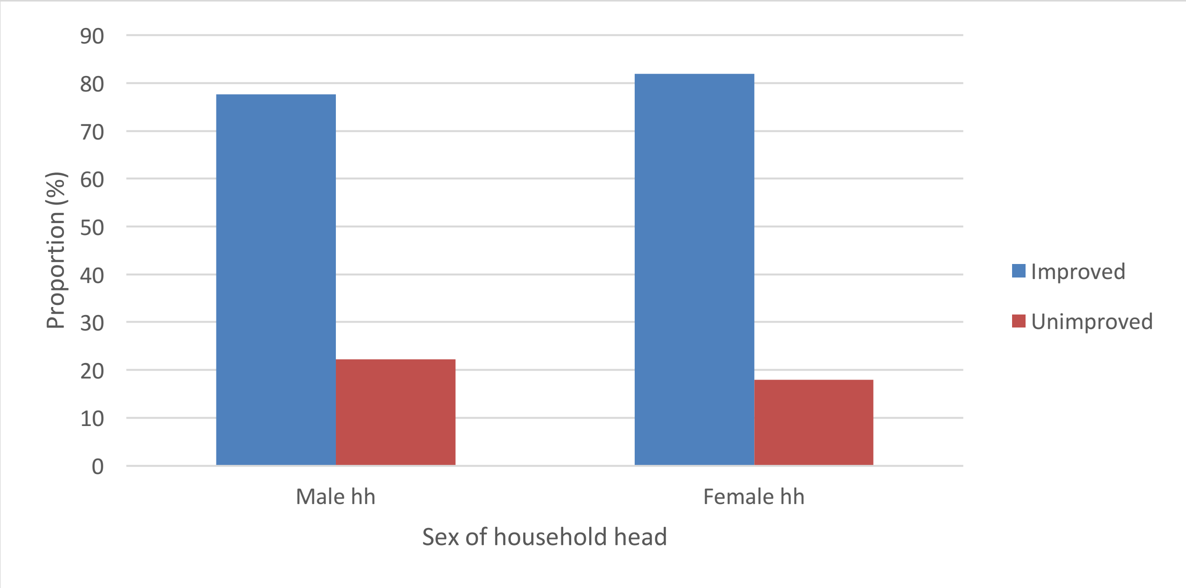

Figure 4.8 Access to improved water source by sex of household head, 2011

Source of data: Government of Malawi (2012a); National Statistical Office and ICF (2016)

While these spatially aggregated data provide a general picture at national level, they mask spatial variations at lower level. They also do not show whether households meet their drinking-water requirements, nor the role of formal institutions or the national policy framework in determining drinking-water access of marginalised households. Annually aggregated data can hide temporal variations in access as they do not consider periods when areas experience water shortages due to seasonality or the effects of extreme weather events such as floods and droughts. Therefore, an important motivation for this thesis was to gain a more spatially and temporally disaggregated understanding of drinking-water access.

4.1.4 Linkages between access rights to drinking-water and poverty reduction

This research focuses on access rights to water because access to drinking-water is central to poverty reduction, through its impact on food security, in Malawi (Lautze and Manthrithilake, 2012). Access to drinking-water is one indicator of food security (Government of Malawi and WFP, 2012). Food insecurity and poverty often coexist and influence each other (Harrigan, 2008; Oluoko-Odingo, 2011). National statistics also suggests that the poor have challenges in accessing drinking-water (National Statistical Office, 2015). This means improvement in drinking-water access addresses the two challenges of food insecurity and poverty simultaneously (Oluoko-Odingo, 2011).

4.1.4.1 Malawi poverty rates and implied linkages to food security

Malawi is one of the least developed countries in the SADC region with high rates of poverty (Ellis et al., 2003; Peters, 2006; Sassi, 2012; UNDP, 2013). The government defines people as poor if they live in households with annual consumption below a national poverty line of MK37,002[25] (equivalent to about US$247 in 2012) (Government of Malawi, 2012a). Using the internationally accepted poverty line, $1.90 a day, about 70% of the population are poor (UNDP, 2013; IMF, 2017). Using the national poverty line, the rates are lower (Government of Malawi, 2012a), however, poverty metrics still indicate persistent poverty over the past decade (Fig. 4.9) (World Bank, 2016; IMF, 2017). Figure 4.9 shows that the approximately 50% of the population classed as poor in 2005 has remained static until 2012. Poverty is greatest and most stagnant in rural areas (World Bank, 2016), particularly among female-headed households (Ellis et al., 2003; National Statistical Office, 2005; Government of Malawi, 2012a; National Statistical Office, 2015) and "*rural households are particularly vulnerable to becoming trapped in a cycle of poverty, due to their high exposure to shocks and their low level of capacity to manage these shocks*" (World Bank, 2016 p26).

[25] Minimum annual per capita (food and non-food) consumption "*deflated to February/March 2010 prices*" (Government of Malawi, 2012a p203).

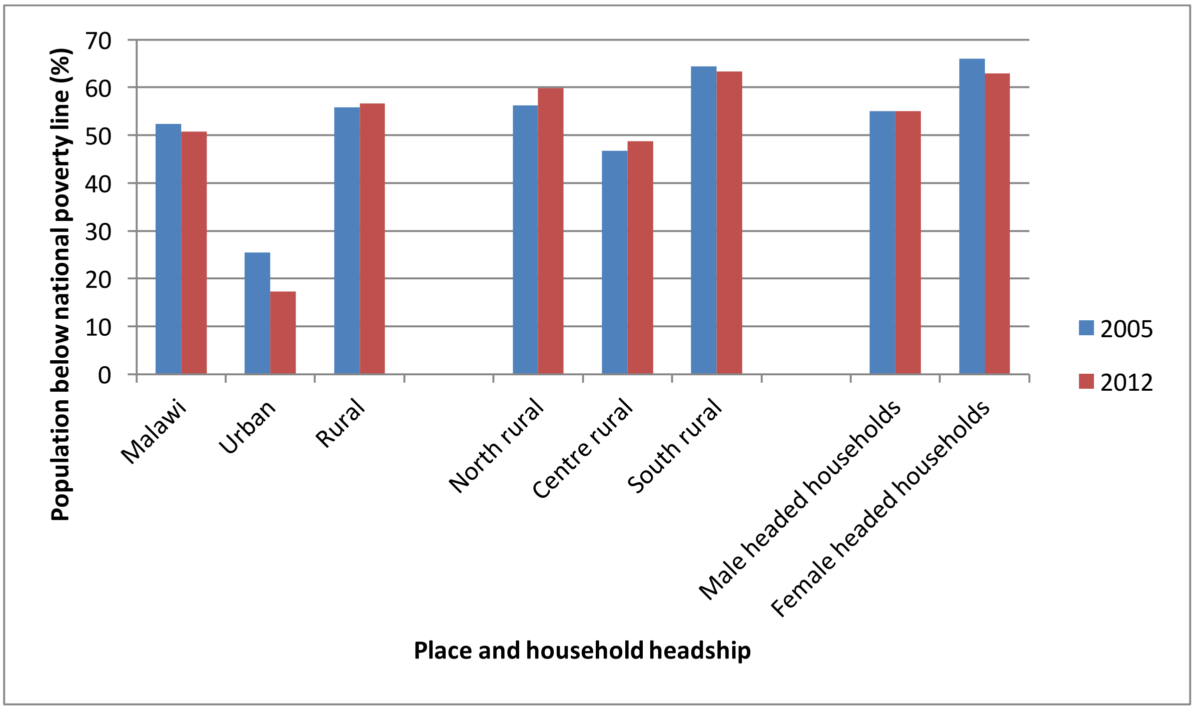

Figure 4.9 Population living below the national poverty line in Malawi, 2005 and 2012

Source of data: National Statistical Office (2005); Government of Malawi (2012a).

In Malawi over half of the population are both poor and food insecure (Harrigan, 2008) and it is widely accepted that chronic poverty is the principal cause of food insecurity and malnutrition (Government of Malawi, 2006a; 2012a; Government of Malawi and WFP, 2012; Sassi, 2012).

4.1.4.2 Poverty in Malawi - Why focus on water institutions?

Constrained access to drinking-water by water institutions can, in part, contribute to persistence of poverty in Malawi (Chinsinga, 2005; Miller et al., 2011; Sassi, 2012), especially among female-headed households and the rural poor with higher rates. These are also households with limited access to drinking-water. However, there are data gaps on how drinking-water access affects poverty (and food insecurity) and how institutions affect access rights to drinking-water in marginalised households.

4.2 Study area description

4.2.1 Physical location

Within Malawi, the study focused on the Southern region, with Zomba District (Figs. 1.1 and 4.10) as a case study. See Section 3.2 for the reasons for this case study selection.

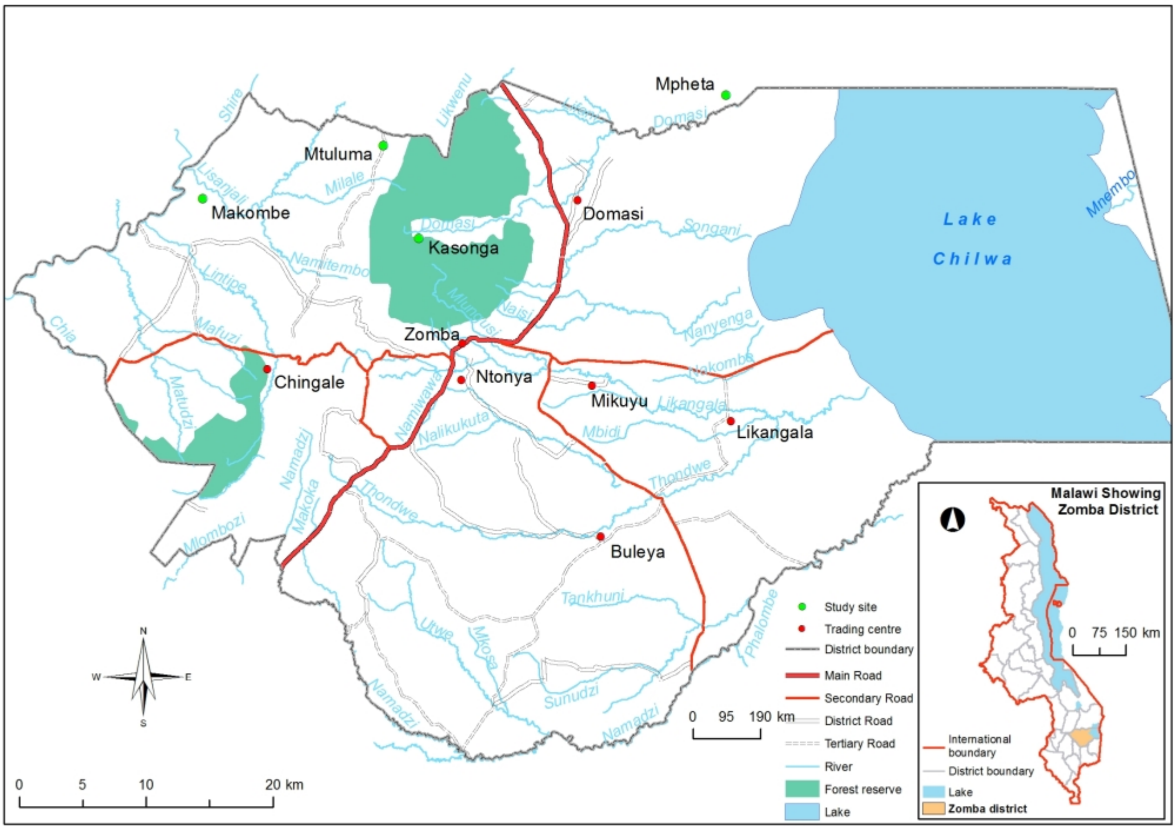

Figure 4.10 Map of Zomba District showing the four study communities

Source: National Spatial Data Center (2014)

4.2.2 Climate of Zomba and trends of water disasters

Zomba District experiences a tropical climate as presented in section 4.1.2 with two distinct seasons. The hottest months are September, October and November with mean temperatures of 28-30°C. June and July are the coldest months, with minimum average temperatures of 10°C. The district receives an average of 1050 mm (ranging from 600 to 1500 mm) annually (Zomba District Assembly, 2009). Spatial distribution of rainfall is affected by the Zomba Plateau (2085 masl), which is the site of a forest reserve (shown on the map in Fig. 4.10). The eastern side of Zomba Mountain is the windward side as it is exposed to south easterly winds from the Indian Ocean (Ngongondo et al., 2011b p946), hence it receives more rain than the west of the Zomba plateau. The wet season runs from November to March. February is the wettest month (Zomba District Assembly, 2009).

The district is characterised by extreme rainfall events which trigger floods (Ngongondo et al., 2011b; World Bank, 2016; Government of Malawi, 2009a) making the district one of most prone to climate risks including droughts, floods (Fig. 4.4 and Fig. 4.5) and water disasters since 1940 (Government of Malawi, 2009a). National records provide summaries of the severe flooding events in the district (Nilsson et al., 2010; UNECA, 2015; Government of Malawi, 2015). In 2015, the district suffered very severe flooding when over 150mm fell in 24 hours (based on Chancellor College weather station), leading to several casualties and homelessness. The 2015 flooding is the worst since Tropical Cyclone Edith in 1946 (Government of Malawi, 2015), followed by the 2019 floods (Government of Malawi, 2019b).

Recent studies on spatial and temporal characteristics of rainfall in Southern Malawi[26] from 1961 to 2009 by Ngongondo et al. (2011a) show more spatial variability in rainfall with highlands getting higher annual means than lower elevations and recording higher precipitation levels in the main rainfall season. At the same time, the dry season has registered lower mean rainfall and there is a late onset of rainfall (Ngongondo et al., 2014). Although there is no statistically significant change in annual rainfall trends (Ngongondo et al., 2011b; Ngongondo et al., 2014), the region shows a significant increase in the concentration of heavy daily rainfalls during the rainy season (Ngongondo et al., 2014).

The increasing concentration of heavy rains within a few days can lead to flooding while lengthier dry spells or early cessation of rains may cause drought conditions within the same season. This pattern is crucial for both surface and ground water availability especially during the dry season. For example, reduced seepage means low water tables which can result in low water yield for boreholes, hence access challenges for villagers. Additionally, high dry season temperatures can lead to heat stress hence affecting water quantities needed for domestic use, regardless of where it is from. However, effect of temporal trends of climate extremes on access to drinking-water in rural Malawi has not been extensively studied, a gap addressed by this thesis.

4.2.3 Hydrology and access to drinking-water in Zomba District

Both surface and ground water play an important role in water availability and access in Zomba but they are unevenly distributed. Zomba District is crossed by ten rivers, all but two of which (Shire and Phalombe) have their source on the Zomba Plateau (Zomba District Assembly, 2009). These rivers form part of the Lake Chilwa Catchment Area (Fig. 4.5) and in addition to lakes and ground water, are important sources of rural drinking-water. Groundwater is important especially in areas of low stream flow (Government of Malawi, 2010). Although the district has vast resources of freshwater, availability varies spatially and seasonally due to several factors including rainfall variability, droughts (Government of Malawi, 2010c; Government of Malawi and WFP,

[26] The study analysed annual, seasonal (wet and dry) and monthly mean rainfall distribution at the selected study stations

2012), forest degradation and deforestation[27] (Government of Malawi, 2007b; Zomba District Assembly, 2009; Government of Malawi, 2010c). Most rivers experience reduced flow during the dry season while a few are ephemeral (Government of Malawi, 2010c). Therefore, some parts of the district experience water scarcity particularly during the dry season. This seasonality pattern affects availability of water for various activities including domestic use. Although access to improved water sources in Zomba is reported to have increased to 91% in 2015-2016, from 80% in 2009 (National Statistical Office and ICF, 2017; National Statistical Office, 2009), data on seasonal access to drinking-water in the district are rare, hence making it difficult for policy-makers to address seasonality problems in informed ways.

In addition to inadequate temporal distribution of drinking-water services, service distribution in Zomba District also seems to be spatially inadequate. Of the seven Traditional Authorities[28] in Zomba, four have no access to improved water sources (Senior Chief Chikowi, Traditional Authority (TA)(chief) Mwambo, Mkumbira and Kuntumanji). One area, TA Malemia has the highest number of communal taps in the district, while TA Mlumbe (with 33,376 households) has the highest number of boreholes (221) (Zomba District Assembly, 2009), each serving about 150 households, which is lower than the 250 expected by the government (Government of Malawi, 2010a). Traditionally, boreholes are the principal sources of drinking-water in the district. However, this proportion includes an unrecorded number of disfunctional boreholes as well as those which run dry during the dry season due to the reduced water table. Large parts of TA Malemia and part of TA Mlumbe are urban hence the recorded number of water facilities includes both for rural and urban households. The reported figures, therefore, provide a blurred picture of functioning water points and the extent to which households in rural Zomba meet their drinking-water needs in both the dry and rainy season, and of actual villages and proportion of households with limited access to drinking-water. Additionally, the water users' association (WUA)[29] concept had recently been introduced in rural Malawi and was being piloted in rural Zomba at the time of the study to improve access to tap water in the study villages (GD2). Information on the impact of WUA arrangements on access to drinking-water in marginalised households is, therefore, essential for informed upscaling decisions. This thesis aims to contribute to this information gap.

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[27] The District' "*natural vegetation has been reduced and disturbed*" recently due high rate of deforestation resulting from fires, woodfuel and demographic pressure (Zomba District Assembly, 2009 p3).

[28] Traditional authorities are chiefs - "*acknowledged leaders of their respective communities and custodians of customary lands and traditional values*" ibid.

[29] WUA is a group of water users who contribute their resources (financial, technical, material and human) towards operation and maintenance of a drinking-water system. This arrangement is a decentralised system.

4.2.4 Demographic trends in Zomba and implications on water access

Zomba District is one of the three poorest Districts in Malawi, with 70% of the population considered income poor (National Statistical Office, 2009; Zomba District Assembly, 2009). Rural poverty is estimated at 57% (Government of Malawi and WFP, 2012). Zomba District is also the most densely populated (with 316 people/km²) in the Southern region of Malawi, after Chiradzulu, Thyolo, Mulanje and Phalombe (Government of Malawi, 2019a). It has about 746,724 people comprising 48% men and 52% women (Government of Malawi, 2019a). The District has similar household sizes (4.4) to national levels but slightly higher than Southern region level (4.3) (National Statistical Office and ICF, 2016; Government of Malawi, 2017a; Government of Malawi, 2019a). Although its annual population growth rate of 2.5% is lower than the national rate (2.9%), the proportion of youth (⩽ 18 years) is almost similar (48%) to the national level (49%) (Government of Malawi, 2018). At sub-district level, the study villages are located in Traditional Authorities (Malemia and Mlumbe) which have the largest share of the District population (Government of Malawi, 2018).

Very few people in Zomba have completed either primary school (11.2%) or secondary education (7.2%). About 32% of the population is illiterate (Government of Malawi, 2019a). About 74% of the households are male headed (Government of Malawi, 2017a). These trends are similar to national ones (National Statistical Office and ICF, 2017; Government of Malawi, 2017a). However, the relationship between these variables and water governance and consequently ability to access drinking-water and adequate quantities for food consumption is inadequately covered in literature at the local level.

4.2.5 Drinking-water access and morbidity/mortality links in Zomba

Water-related problems contribute significantly to morbidity and mortality. For example, malaria is ranked first and diarrhoea fifth in causes of morbidity across the District (Government of Malawi, 2017a). Diarrhoea is a water-borne disease that can occur after consumption of unsafe water (Pritchard et al., 2007; Pritchard et al., 2008). Malnutrition is also one of the leading causes of mortality in the district and it ranks third after malaria and pneumonia. During the past decade, an increase in malnutrition has been linked to low crop yields (Zomba District Assembly, 2009), however, it can also be attributed to access to drinking-water (Bogardi et al., 2012; Lautze and Manthrithilake, 2012; Loftus, 2015), hence the present study which explores access to drinking-water.

4.3 Conclusion

This chapter has described the social and ecological characteristics of the study sites and reasons for their selection. The links between poverty and drinking-water are widely acknowledged in Malawi where food insecurity and undernutrition persist. The country has high numbers of deaths from water-borne diseases. Malawi experiences high temperatures, seasonal rains and frequent extreme precipitation conditions from El Niño and La Niña which in part contribute to seasonal water issues. The country has high poverty rates and access to drinking-water remains a challenge especially in rural areas where the reported aggregated data likely underestimate actual number of households with access problems. The aggregate data (whether at national or district level) further hide great spatial and temporal variability in drinking-water access. In addition, Malawi has formal institutions governing access to drinking-water, but few studies have assessed the effect of these institutions on access to drinking-water for marginalised households in rural areas. Within Malawi, the area chosen for study was Zomba rural, a district that is reasonably representative of Malawi. It has high poverty levels, is prone to extreme rainfall events including flooding and experiences seasonal water availability affecting drinking-water access. Water service distribution seems inadequate in many areas. The next chapter looks at the extent to which these spatial and temporal variations in drinking-water are recognised in national policy and the design of water delivery institutions, followed by two chapters exploring (and explaining) water delivery outcomes in the study villages.

Chapter 5 Analysis of the extent to which national water policy and institutional designs address equitable access to drinking-water for marginalised households across seasons and extreme weather events

5.1 Introduction

5.1.1 Chapter aim

This chapter presents research findings on the structure of local formal institutions that manage access to drinking-water in rural Malawi. The aim is to analyse how water policy and legislation in Malawi at different levels ensure equitable water access for marginalised groups and deal with seasonality and extreme weather events. In Chapter 2, sections 2.3 and 2.4, the literature reviewed shows persistent inequalities in drinking-water in marginalised households and this partly relates to water governance. Chapter 2, section 2.4 recognises that since 1980, there have been policy shifts in most developing countries to improve drinking-water access, but the extent to which formal institutional design integrates access for marginalised groups is understudied, particularly in Sub-Saharan Africa. This chapter contributes to this gap using rural Malawi as a case study. It focuses on several elements of Ostrom's SES framework, notably examining how national drinking-water policies and laws (Governance Systems) relate to international water policies and laws (Social, economic and political settings) and take account of marginalised groups (Actors) across different seasons and in extreme weather conditions (Related ecosystems).

In Malawi, local level institutions designed by policy and legislation at international and national[30] levels determine access to drinking-water. Although the institutional analysis in this thesis covers institutional arrangements at these different levels (Appendix 7), the research focuses on Malawi national legal frameworks based on the premise that the frameworks constitute country-specific legally binding aspirations and commitments, relative to international human rights law within its

[30] In this thesis national policy and laws or legislation include all documents at national and subnational (regional, district and local) level.

broad context. As the first UN Special Rapporteur on the right to safe drinking-water and sanitation, De Albuquerque (2014a p8) points out that for all countries, "*the detailed parameters for the provision of water ... services that will bring taps... to people can only be set in the context of each State*". Therefore, special attention needs to be given to local formal institutional arrangements for rural drinking-water supply because many of the marginalised households in developing countries are in the rural areas (WHO and UNICEF, 2013; Pullan et al., 2014).

Formal rural drinking-water supplies in Malawi comprise piped water and borehole systems. Piped water in rural Malawi is predominantly gravity-fed from perennial mountain streams and rivers, supplying downstream communities (Government of Malawi, 1999; Government of Malawi, 2010b). Water is sometimes pumped from dams where there are no perennial streams and rivers (Government of Malawi, 2010b). Borehole systems include deep boreholes up to 200m in depth and pumps drawing on shallow aquifers (Government of Malawi, 2010b; Government of Malawi, 2016b). Maximum borehole depth depends on the type of pump or technology utilised (Government of Malawi, 2010b).

5.1.2 Specific objectives

This chapter seeks to analyse:

- the design of local formal water institutions to evaluate whether the needs of marginalised groups (women and the poor) are considered, specifically policy statements about structures needed to provide the rural poor with drinking-water.

- whether and how local formal water institutions are designed to consider the challenges of seasonality and extreme precipitation events; floods and droughts.

The chapter draws on a review of international and national water policy documents, and on key informant interviews with village chiefs (VL1-VL4), chairpersons or members of water committees (VLWC1-VLWC6), NGO staff working in village-level water related interventions (NGO1), NGO staff at district level (NGO2) and government staff (community (GC1-GC2) and district water officers (GD1-GD4)). See Chapter 3, section 3.5.1 for more details.

Section 5.2 of this chapter analyses the design of local formal water institutions and assesses policy statements and legislation about structures needed to provide drinking-water for the rural poor. Section 5.3 analyses whether and how local formal water institutions are designed to consider the challenges of seasonality and extreme weather events, specifically floods and droughts. The final section discusses the results.

5.2 Consideration of policy and legislation in relation to water access by marginalised groups

This section analysing policy concerning drinking-water provision to marginalised groups has six subsections. The first analyses provisions addressing marginalised groups in international policy and legislation. The second reviews human rights principles, guidelines[31] and standards of human rights to water. The third analyses provisions for equitable water access to drinking-water in national and local policy and legislation. The fourth evaluates how the national and local water legislation delivers with respect to international principles. The fifth evaluates how well the national and local water legislation adheres to international standards and guidelines. The last subsection analyses specific institutional arrangements for drinking-water systems in rural Malawi. The section draws on data from analysis of international, national and local policy and legislation. Table 5.1 presents international policy documents reviewed and their timelines (see Appendix 7 for a detailed version).

[31] Guidelines are the international policy recommendations, which have no force in national legislation.

Table 5.1 International policy documents reviewed

Water sector documents	Timeline	Other sector documents
	1948	The Universal Declaration of Human Rights (INTC3)
	1965	International Convention on the Elimination of All Forms of Racial Discrimination (INTC6)
	1966	The International Covenant on Economic, Social and Cultural Rights (INTC4)
The Resolution of the Mar del Plata Conference in March (INTW9)	1977	
The New Delhi Statement (INTW7)	1990	
The Dublin Statement (INTW8)	1992	Agenda 21 (INTC2)
African Water Vision 2025 (INTW10)	2000	UN General Assembly Resolution A/RES/54/175 The Right to Development (INTC5)
SADC Water Vision 2025 (INTW11)	2000	Resolution adopted by the General Assembly: 55/2. United Nations Millennium Declaration (INTC1)
Revised Protocol on Shared Watercourses in the Southern African Development Community (SADC)(INTW2)	2000	
General Comment No. 15- Committee on Economic, Social and Cultural Rights (INTW4)	2002	
SADC Regional Water Policy (INTW1)	2005	
UN General Assembly Resolution on the Right to Water and Sanitation (INTW5)	2010	
UN Human Rights Council Resolution on Human Rights and Access to Safe Drinking-water and Sanitation (INTW6)	2010	
Convention on the Law of the Non-navigational Uses of International Watercourses (adopted by the UN General Assembly on 21 May 1997, Entered into force on 17 August 2014) (INTW3)	2014	
	2015	Resolution adopted by the UN General Assembly on 25 September 2015 A/RES/70/1-Transforming our world: the 2030 Agenda for Sustainable Development (INTC7)

Note codes: INTW = International policy documents specific for the water sector; INTC = Crosscutting international policy documents

The subsections below illustrate how various provisions in these international policy documents (Table 5.1) have evolved over time. The analysis starts with 1948, when human rights first received legal attention at a global level.

5.2.1 Provisions addressing marginalised groups in international policy and legislation

The first key legal document to recognise human rights and to tackle inequality and discrimination was the UN Universal Declaration of Human Rights (UDHR) (1948) (INTC3). INTC3 emphasises the universal recognition of basic rights and fundamental freedoms as essential to all humans without any form of discrimination or marginalisation. Article 25 (1) states that: "*everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care and necessary social services*" (INTC3). The Declaration makes no explicit mention of access to drinking-water as a human right but emphasises universality, equality and non-discrimination.

The specific right to drinking-water in international law was first provided by the International Covenant on Economic, Social and Cultural Rights (ICESCR) (adopted on 16th December 1966) in Part (III) *Article 11*(1) (INTC5). The human right to water was subsequently taken up more widely. The Resolution of the Mar del Plata Conference in March 1977 (INTW9) p66, for example, explicitly declares that "*all peoples, whatever their stage of development and their social and economic conditions, have the right to have access to drinking-water in quantities and of a quality equal to their basic needs*". INTW9 on p67 recommends "*that where human needs have not yet been satisfied, national development policies and plans should give priority to the supplying of drinking-water for the entire population*". Likewise, the New Delhi Statement (1990) (INTW7) p1, formalized the need to provide sustainable access to safe and sufficient water for all, emphasising the "*some for all rather than more for some*" approach. Similarly, the Dublin Statement, adopted on 31st January 1992, focuses on four guiding principles that emphasise universal access to water resources, recognizing different user needs and paying capacities, and highlighting involvement of all resource users, including the marginalised, in participatory decision-making arrangements and water resources management (INTW8).

Universal access to drinking-water is reemphasised in the Resolution adopted by the General Assembly on 25 September 2015 (INTC7) in which countries pledge that '*no one will be left behind*'. In this context, countries made a commitment in sustainable development goal (SDG) 6.1 to *'achieve universal and equitable access to safe and affordable drinking-water for all*' by 2030 (INTC7). In the preceding Millennium Development Goals (MDGs) up to 2015, under target 7c, the indicator concerned **coverage** and halving the proportion of people without access to safe (i.e. improved) water and sanitation (United Nations, 2015). That left potential for inequalities in safe water access through systematic differences in the socio-economic, gender, and ethnic composition of those with and without access to safe water.

In the new SDG system (Pacheco, 2019), there are crucial changes, such as:

- Targets 6.1 and 6.2 talk about **universal** access to safe water and ending open defecation, with 6.2 specifically referencing marginalised groups.
- Target 6.B is specifically about local community representation in the water, sanitation and hygiene (WASH) sector.
- The UNICEF/WHO Joint Monitoring Programme set up a task force to examine inequalities which now routinely reports on inequalities in their annual global reports, with the task force delivering more specialised reports in this area (WHO and UNICEF, 2017b; UNICEF and WHO, 2019).

This has marked a shift in international WASH policy between the MDG and SDG eras.

At regional level, the Southern African Development Community (SADC) Regional Water Policy (INTW1) recognises equitable access, drawing on the Dublin Principles. For example, section 4.1.2 of the policy calls for access to water for the poor at an affordable price (INTW1).

On 28 July 2010, the UN General Assembly formally recognised the human right to water, based on its earlier resolutions on water and the declarations on human rights (INTW5). In September 2010, the UN Human Rights Council on Human Rights and Access to Safe Drinking-water (INTW6) affirmed it as a part of existing international law and confirmed that states are obliged legally to fulfil these rights. INTW6 calls upon states to "*work towards achieving universal [including that of marginalised groups] access to [drinking] water…, being guided by human rights principles and the standards of the human rights to water*" (INTW6). Recognition of these principles and standards in national legislation, therefore, turns the right to drinking-water "*into a legal entitlement*" that holds actors accountable for its fulfilment (WASH United et al., 2012 p14).

5.2.2 Human rights principles, standards and guidelines of the human rights to water

Over time, pressure from water activists has led to inclusion of specific mention of water in human rights principles (Clark, 2017). The general human rights principles have come to "*include safeguards that relate to the process of realising the specific human rights to water*" (De Albuquerque, 2014a p13). These are: "*non-discrimination and equality, information, participation* *and accountability*" (De Albuquerque, 2014a p13; De Albuquerque, 2014c) which are central in ensuring equitable access to drinking-water. Thus, they form the basis of human rights related to drinking-water and govern service delivery (Bos, 2016).

Human rights and international guidelines or minimum standards, related to drinking-water include availability, accessibility, quality, affordability, acceptability and sustainability/reliability (De Albuquerque, 2014a; De Albuquerque, 2014d). The World Health Organization (WHO) regards these as "*basic service parameters of a drinking-water supply" deserving consideration when "undertaking an assessment of the adequacy of the drinking-water supply*" (Uhlendahl et al., 2011 p83). These have become international minimum standards and criteria for monitoring compliance of nations to international obligations and agreements on meeting universal access to drinking-water, following General Comment No.15 on the Right to Water of the United Nations Committee on Economic, Social and Cultural Rights (INTW4). INTW4 paragraph 12, pp4-6 launches three main criteria (availability, quality, accessibility), with accessibility sub-divided into physical, economic, non-discrimination and information accessibility. According to WASH United et al. (2012 p24), "*the first three criteria (availability, quality and accessibility) are consistently ranked as the most important in national monitoring systems (followed by reliability and affordability)*". INTW4 outlines levels of acceptable access to water (Uhlendahl et al., 2011) but refrains from providing absolute international values/benchmarks for human rights standards, related to drinking-water, due to differential contextual factors and limited evidence (Bos, 2016). This limitation creates challenges in making international comparisons on progress towards achievement of the standards set (see (WHO and UNICEF, 2017c)). Despite this, (Bos, 2016 pp18-19) argues that the WHO provides "*an indication for a range of values*" for "*quantities based on levels of service and linked to levels of public health concern*". The WHO Guidelines for Drinking-water Quality (Uhlendahl et al., 2011) provide water quality/safety guidelines. While the WHO does not risk undermining national sovereignty by imposing standards on national governments, its guidelines do provide an advisory framework for informing national standards and associated legislation. This thesis therefore uses INTW4 to understand human rights standards, principles and national obligations concerning water (see INTW4 excerpts in column 2 of Tables 5.3 and 5.4). This thesis also uses WHO reports for guideline values concerning specific drinking-water standards/criteria. The next sections focus on national policy and legislation to see how far they are compatible with the human right to water and international laws.

5.2.3 Provisions for equitable access to drinking-water in national and local policy and legislation

This subsection analyses national and local policy documents (Table 5.2), particularly the Malawi Constitution (NATC1), National Water Policy (NATW3), and Water Resources Act (NATW4). The Malawi Constitution is the supreme law of the land, providing a framework for all other legislation, therefore it "*provides the strongest general guarantee of human rights within national legal frameworks*" (De Albuquerque, 2014a p11). The constitution has legally binding provisions for the promotion and protection of human rights (De Albuquerque, 2014a). Thus, the constitution is expected to address Malawi's national commitments to international treaties and agreements on water-related issues. The National Water Policy (2005), hereafter NATW3, and The Water Resources Act (2013) (NATW4) are legal documents established to govern access rights to water in rural areas. Their provisions are reflected in national and district water strategies, implementation guidelines and bylaws (GD1) (Table 5.2, see Appendix 7 for a detailed version). Their structures are guided by internationally accepted water-related provisions in other national environmentally related policies and legislations, development strategies, including the National Water Supply and Sanitation Programme (WSSP), and the country's Constitution. The provisions include guiding principles and strategies aimed to ensure equitable and efficient access to drinking-water for all Malawi's people (GD1).

Table 5.2 National and local policy documents reviewed and their timelines

Water sector documents	Timeline	Crosscutting documents
Water Resources Act (NATW1)	1969	
Technical Manual for Piped Water (NATW11)	1983	
Water Works Act (NATW2)	1995	
	1996	Environmental Management Act (NATC6)
	1996	National Forestry Policy (NATC12)
	1997	Constitution of Malawi (NATC1)
	1998	Vision 2020 (NATC2)
	1998	The National Decentralisation Policy (NATC7)
	1998	Local Government Act (NATC8)
	2001	Malawi National Forestry Programme: Priorities for Improving Forestry and Livelihoods (NATC13)
	2002	Malawi National Land Policy (NATC14)
	2002	National Environment Action Plan (NATC3)
	2002	Strategy for the Decentralisation of Environmental Management (NATC10)
	2004	National Strategy for Sustainable Development (NATC4)
	2004	National Environmental Policy (NATC5)
National Water Policy (NATW3)	2005	
	2008	Kasonga Catchment Management Plan (bylaw) (LOCC1)
Water Users Association Training Manual (NATW6)	2009	
Market Centre and Rural Piped Water Supply and Sanitation Programme: Guidelines for Establishment of Water Users Association in Malawi (NATW5)	2010	
Water Supply and Sanitation District Operational Manual (NATW7)	2010	
Implementation Guidelines for Rural Water Supply and Sanitation (NATW8)	2010	
Implementation Manual For Piped and Point Water Supply Systems (NATW9)	2010	
	2011	Malawi Growth and Development Strategy II (2011-2016) (NATC9)
	2012	Revised Decentralised Environmental Management Guidelines (NATC11)
Water Resources Act (NATW4)	2013	
The Constitution of Zomba West Water Users Association (LOCW1) (Undated)	2014	
Technical Manual - Water Wells and Groundwater Monitoring Systems (NATW10)	2016	
Gravity Fed for Rural Piped Water Schemes: Technical Manual (NATW11)	2016	

Note codes: NATW = National water sector policy documents; NATC = Crosscutting national policy; LOCW = Local/community level water policy; LOCC = Crosscutting community level policy

Like other international legislation, the Constitution of Malawi (NATC1) mentions the elimination of marginalisation (Chapter 3, fundamental principle iv and chapter 4, sections 20 and 30) but does not explicitly recognise equitable access to drinking-water in section 30. However, explicit provisions feature in the NATW3 and NATW4, discussed in the next section.

5.2.4 Evaluating how national and local water legislation delivers on international principles

National policy and legislation principles for equitable water supply closely mirror those for ensuring equitable access at international level in INTW6 (See section 5.2.2 and Appendix 10 for details). Table 5.3 shows how national policy and legislation meet the principles at international level.

Table 5.3 Human rights principles for ensuring equitable drinking-water access in national water institutions

Principles	**Examples of provisions in international policy and legislation**	**Adequate reflection of principles in national legislation**		
		Yes	No	Partial
Non-discrimination and equality	*"equitable access to water for drinking should be guaranteed"* (INTW1) Providing drinking-water to all (INTW4, INTW5, INTW6, INTW7, INTW9), including the *"marginalised sections of the population,"* (INTW4) emphasizing the "*some for all rather than more for some*" (INTW7)	NATC1, NATW3, NATW4, NATW7, NATC9		
Information	*"Individuals and groups should be given full and equal access to information concerning water, water services …, held by public authorities or third parties*" (INTW4 paragraph 48)	NATW3, NATW4, NATW5, NATW6, NATW7		
Participation	*"water development and management based on a participatory approach, involving users, planners and policy makers at all levels"* (INTW1, INTW8, INTC2) Special recognition of the central role of women in *the provision, management and safeguarding of water (*INTW1, INTW8)	NATW3, NATW4, NATW7		
Accountability	*"an effective regulatory system must be established, …, which includes independent monitoring, genuine public participation and the imposition of penalties for non-compliance"* (INTW4 paragraph 24)	NATW4, NATW5, NATW7, NATW8, G2		

The subsections (5.2.4.1-5.2.4.4) below provide detailed analyses of how each human rights principle is reflected in national legislation.

5.2.4.1 Non-discrimination and equality

As stated in section 5.2.3, provisions in the Constitution of Malawi (NATC1) are not explicit. NATC1 mentions equality, non-discrimination and human rights considerations without directly relating them to access to drinking-water. For example, Chapter 3, fundamental principle iv, calls for the State and all people to "*recognise and protect fundamental human rights and afford the fullest protection to the rights and views of all individuals, groups and minorities whether or not they are entitled to vote*". According to international human rights laws, fundamental human rights include a right to an adequate standard of living, including a right to access drinking-water. Similarly, De Albuquerque (2014a) argues that the inclusion of human rights guarantees water as a human right, because by their nature, the provisions of national constitutions are less detailed than those in laws, regulations and policies. Likewise, Chapter 4(20) of NATC1 prohibits discrimination based on "*race, colour, sex, language, religion, political or other opinion, nationality, ethnic or social origin, disability, property, birth or other status"*. Such practices may be criminal and "*punishable by the courts*". By implication, this inclusiveness appears to prohibit any form of social exclusion affecting access to drinking-water. Regardless of the constitutional silence on the need to address marginalisation or inequalities related to water access, both the National Water Policy (NATW3), the Water Resources Act (NATW4), and the water-related regulations explicitly address water access problems for marginalised groups.

There are explicit provisions of non-discrimination and equality in NATW3, NATW4 and other water regulations. NATW3, p6 recognises these aspects through its aims, objectives and strategies (See Appendix 10), aiming to: *"make water equitably accessible by all Malawians."* One of its guiding principles, 3.4.1 states *"all people shall have access to drinking-water*". Similarly, the Water Supply and Sanitation District Operational Manual (NATW7) promotes the "*'Some for all' not 'all for some'"* approach via a communal service to "*ensure that all communities have access to a minimum standard of water supply*". Emphasis in all these policy provisions is thus on ensuring equitable access for all.

The NATW3 strategies present deliberate measures and affirmative action for targeting marginalisation such as: "*adopting demand responsive and demand driven approaches in the provision of water … services; and, encouraging participation of women, youths, persons with disabilities and vulnerable persons in water … activities*" (NATW3, pp11-12). The same aspects are reflected in national and district water management strategies (Appendix 10/Table 5.3). The Water Resources Act of 2013 (NATW4) and the associated bylaws consider and highlight marginalised groups in institutional arrangements for water governance.

5.2.4.2 Participation

In line with addressing non-discrimination and equality, the National Water Policy (NATW3) recognises the importance of participatory local level management of water facilities and collective action. One of its three guiding principles states that: "*Water resources management shall be based on the concept of decentralisation and local participation*" (3.4.3, p6). Thus, devolution of power from central to local government and communities is highlighted.

The National Water Policy's (NATW3) emphasis on collective action and participatory approaches follows current global and regional trends (see Section 2.4.3) in water development and utilisation programmes, aimed at ensuring equitable access to water (NATW3). This move is influenced by several factors:

1) The Government's realization that they lack capacity to manage water resources effectively;
2) A general trend towards decentralisation as part of a democratisation process (and – in regions with indigenous peoples – also a recognition of their human rights), a belief that local people (with a large stake in a resource) might be better placed than central government to manage it;
3) Lessons drawn from empirical studies and own experiences where self-governance has led to improved resource systems and collective benefits to resource users (Wade, 1987; Ostrom, 1990; Baland and Platteau, 1996; Walker et al., 2000; Ostrom, 2002; Balooni et al., 2008; Government of Malawi, 2010f); and
4) Conformity to international declarations or agreements advocating a participatory approach.

A participatory approach involves recognition of resource users' right to devise their own institutions by external governmental authorities (Ostrom, 1990; 1993; 2002) and facilitates recognition of stakeholders' voices and rights in needs assessments and water project implementation (see Section 2.4). This principle is based on arguments that local resource users have a more in-depth knowledge of local conditions and local resource management than external people. Furthermore, involving resource users in rule formation increases the chances of rule compliance, because the rules are considered legitimate compared with externally imposed rules. In this regard, the national legislation emphasises that Local Authorities and communities are expected to participate in "*all stages of the implementation cycle from needs identification, choice of technology, levels of service, design, construction, mobilisation of contribution towards capital costs, operation, maintenance and management of the systems*" (NATW7 p1, NATW8). This is in line with the Decentralisation policy (NATW7, NATW9, NATC8) or participation principle of the Human Rights Law (NATW6). NATW3 emphasises promotion of decentralisation specifically concerning rural drinking-water supply through:

- *"demand-responsive and demand driven approaches*[32]
- *user participation in catchment protection and water conservation related activities*
- *active participation of youth, women and vulnerable persons in the planning and implementation of rural water supply activities and*
- *community-based management of rural water supply programmes in consultation with local authorities"* (NATW3 pp11-12).

To achieve these objectives, the NATW3 advocates participation of marginalised people, including women, in water-related activities; and cost-sharing and establishment of Water Users Associations (WUAs) (NATW3 p12). These strategies are embedded in the National Rural Water Supply and Sanitation Programme (RWSSP) for enhancing sustainable drinking-water access in rural areas and in implementation guidelines and manuals for borehole and piped water supply systems, e.g. NATW9. This is a departure from the pre-1999 supply-driven approach whereby government and its development partners monopolised technology and site selection and water facility operation and maintenance at the expense of community participation. The concept of cost sharing is in line with cost recovery principles promoted by regional water policy to make water resources development and management efficient and financially sustainable (INTW1). However, if not properly monitored, the concept can become an easy excuse for governments not to provide for the basic needs of the poor. Additionally, a participatory approach is inadequate on its own. Appropriate information-sharing mechanisms are one prerequisite of effective participation of water resource users in planning, development and management.

5.2.4.3 The Principle of Information in national legislation

Both the National Water Policy (NATW3) and Water Resources Act (NATW4) provide for information collection and dissemination in water development and management. For example, NATW3's guiding principle 3.4.7 (p.6) emphasises "*reliable continuous data collection, management, and analysis to ensure accurate assessment of water resources and dissemination of information for effective planning of water resources development".* In the same context, Section 18 of NATW4 provides for national monitoring mechanisms for **"***collection and management of data and information regarding water resources and their management"* and its

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[32] A demand-responsive approach is a "*strategy that empowers a community to initiate, choose and implement a water project that it is willing and able to sustain and that elicits the appropriate response from the sector actors and stakeholders*". A demand-driven approach is a "*strategy through which communities are empowered to operate and manage their water services including aspects of water related hygiene during the course of project implementation*" (NATW3). DRA focuses on the process of bringing the drinking-water service into the community while DDA is concerned with service operation and management once provided.

dissemination. Payment of a prescribed fee is expected from all members of the public to access such information. However, the NATW4 does not make provision for the poorest, who may not be able to afford prescribed fees to access information in the national records. This contradicts the international legislation recommendation that all people should be given "*full and equal access to information concerning water, water services …, held by public authorities or third parties*" (INTW4). This limitation has the potential to create information gaps between the poorest groups and the rest of the community, and to compromise the right to water of the poor members of society. The principle of information available to all is therefore not adequately translated in the national legislation.

5.2.4.4 Accountability

Accountability is reflected in national legislation through the provision of courts, offices, and participation in monitoring, and a complaints process for rights violations (NATW4, NATW5, NATW7, NATW8, G2). For example, part VIII of the Water Resources Act (NATW4) has provisions on prevention and control of water pollution that include penalties for noncompliance. Additionally, PartXII__122. of the Water Resources Act provides for the establishment of a Water Tribunal which "*shall have jurisdiction throughout Malawi, with power to conduct hearings anywhere in Malawi*". In Part XII_129(2) (4) any person aggrieved by the decision of the Water Tribunal may apply to the High Court for a judicial review. Whilst these provisions are commendable, the national water legislation is silent on the sanctions that would apply to various drinking-water-related offences by service providers, e.g. for failing to meet equitable allocation of drinking-water facilities and services or discriminatory water charges. This gap can further marginalise under-serviced, typically rural, populations.

5.2.5 Evaluating how national and local water legislation delivers on international standards and guidelines

This section analyses whether and how national policy and legislation comply with international guidelines by WHO (Uhlendahl et al., 2011; WHO, 2019), standards prescribed by the UN Human Rights Council on Human Rights and Access to Safe Drinking-water in September 2010, International Human Rights Law (INTW6) and recent guidelines for the SDG era (INTC7). Importantly, the content of International Resolution (INTC1, INTW6) on drinking-water has changed significantly since 2015. The MDG era focused mono-dimensionally on 'improved' sources, whereas the SDG era emphasises multiple dimensions (see Table 5.4). When looking at international standards and guidelines, the analysis reveals that the standards for equitable water supply in national policy and legislation very closely mirror those at international level (INTC1, INTC7, INTW4, INTW5, INTW6, INTW7, INTW9) (See Section 5.2.2 and Appendix 11). These standards are also used as criteria for monitoring compliance of the obligations of actors in relevant legislation and on the ground (WASH United et al., 2012). Although some of the standards at local level adopt the same wording used in the international legislation, others show differences in wording and thresholds. On the whole, the national provisions provide details of the standards that are required in Malawi. Table 5.4 shows how national policy and legislation meet the standards and guidelines at international level. See Appendix 11 for detailed provisions.

Table 5.4 International human rights standards and guidelines for ensuring equitable drinking-water access in national legislation and policy

Standards and guidelines	**Examples of provisions in international policy and legislation**	**Does national legislation adequately reflect standards/guidelines in international legislation**		
		Yes	No	Partial
Availability	*"The quantity of water available for each person should correspond to World Health Organization (WHO) guidelines"* (INT4) Provision of sufficient quantities and continuous supply of drinking-water to all is emphasised (INTC2, INTW4, INTW7, INTW9)			NATW3, (NATW7, (NATW8, NATC9, G2, NGO1
Accessibility: *Physical accessibility*	*"Water, adequate water facilities and services, must be within safe physical reach for all ... Sufficient, safe and acceptable water must be accessible within, or in the immediate vicinity, of each household…" (INTW4*)			NATW3, NATW7, G2
Quality/safety: Safe and water safety plan following WHO Guidelines	Drinking-water *"must be safe, therefore free from micro-organisms, chemical substances and radiological hazards that constitute a threat to a person's health"* (INTW4) Safety of drinking-water for all people is emphasised (INTC2, INTW5)			NATW3, NATW4, NATW7
Affordability	Drinking *"water, water facilities and services, must be affordable for all"* (INTW4, INTW5). *"The direct and indirect costs and charges … must be affordable …(*par.12(c)(ii)) … including *appropriate pricing policies such as free or low-cost water"* (INTW4 par. 27)			NATW3, NATW4 NATW7
Acceptability	Drinking *"water should be of an acceptable colour, odour and taste"* (INTW4) to all	NATW4, NATW7		
Sustainability	Ensure realisation of drinking-water right to all (INTW4, INTW7), emphasizing the "*some for all rather than more for some*" (INTW7)	NATW7, NATC9		

Concerning water quantity, WHO guidelines require access to a basic 20 litres per capita per day, of which 7.5 litres is for consumption (drinking (5.5l) and food preparation (2l)) in above-average temperature conditions or 4 litres (drinking (2l), food preparation (2l)) in average temperature conditions (Howard and Bartram, 2003a; WHO, 2004). This sufficient supply should be available when needed (WHO, 2019). Collection of drinking-water should be within 1000m of home or a 30 minutes return trip (Howard and Bartram, 2003a; WHO, 2004). In relation to affordability, the UN mentions two benchmarks, 3% of household income is suggested by UNDP (UNHCR et al., 2010) while 5% is suggested by UNW-DPAC and WSSCC (2012). Thus, there is no single global standard on affordability - countries can use the 3% or 5% benchmark.

In relation to water quality, the international framework's focus has broadened from quality only to water safety, which incorporates water quality analysis, assessment of pollution sources and management plans. For example, the top rung of the UNICEF / WHO JMP water ladder (see Table 1.1, Chapter 1) is 'safely managed' water supplies (WHO, 2017; WHO and UNICEF, 2017c; UNICEF and WHO, 2019). In addition to drinking-water having no detectable *Escherichia coli* (*E. coli*) bacteria, such supplies should have a water safety plan (WSP)[33] available for inspection. WSPs are basically a well-established management document/framework for maintaining good quality water (WHO, 2017). WHO's promotion of water safety plans for a good decade has led to their application in 93 countries globally, with legal frameworks promoting WSPs in place in 69 countries (WHO, 2019; WHO and IWA, 2017). Before 2015, WSPs focused on drinking-water supply safety but did not address equity issues (WHO, 2019; WHO and IWA, 2017). In the SDG era, however, international WSPs have promoted equitable water safety planning to ensure safe and sufficient drinking-water for all diverse water users. 5 stages of a WSP integrate equity issues: preparation, system assessment, regular monitoring, management and communication, and feedback and improvement (WHO, 2019). It is envisaged that this recently developed approach provides an opportunity to contribute to the attainment of the SDGs and the human right to water (WHO, 2019). The WHO Guidelines for drinking-water quality allow national and local standards on drinking-water quality and safety plans. These mostly refer to water from improved drinking-water sources: household connections; public standpipes; boreholes; protected dug wells; protected springs; rainwater[34].

[33] Water safety plans "*are a systematic risk assessment and risk prevention approach encompassing all steps in the water supply system, from the catchment through to the consumer*" (WHO, 2017 p43).
[34] http://www.who.int/water_sanitation_health/mdg1/en/

5.2.5.1 Water availability and sustainability

This subsection analyses the incorporation of sufficient and sustainable drinking-water in national legislation. WHO argues that this standard should be assessed together with physical and economic accessibility because it is generally agreed that "*the quantities of water collected and used by households*" decrease with increasing distance to the water source or increasing total collection time as well as "*reliability and cost of the water*"(Uhlendahl et al., 2011 p84). These factors define service delivery levels on the drinking-water service ladder (Uhlendahl et al., 2011 p84). Service delivery promoted by Malawi's national water policies meets the 'basic service' level of delivery (which requires water to be available within 1km or 30 minutes round trip), as quoted below[35]:

- Policy aims to ensure that all people in Malawi "***have convenient access to sufficient quantities*** *of* [drinking] *water of acceptable quality …at any time and* ***within convenient distance***" (NATW3 p5) – defined as **within 500m distance** (NATW7, NATC9) and sufficient quantities are defined as **20 litres per capita** (NATW8).
- To ensure continuous supply of drinking-water, contractors are expected to ***"drill boreholes beyond the fluctuation level of the water table*** (NGO1) - ***ranging from 21m to 45m*** *or more* (GD2), *have* ***more than five meters of water supply in depth*** *and, the* ***minimum yield for boreholes for pump Alfredo is 0.25m^3/s*** (NGO1)

However, national policy and legislation are silent on water cost as a proportion of household income, thereby only meeting the international standard partially. On cost, the National Water Policy (NATW3) uses a hidden threshold, 'affordable' lacking uniform interpretation. This policy gap has potential to constrain household access to sufficient quantities of drinking-water, for example, through the use of discriminatory fees.

5.2.5.2 Water accessibility: physical accessibility

Concerning physical accessibility, NATW3 meets international water standards/guidelines through the following specific, local provisions:

- The promotion of cost effective/affordable "*technologies to* ***enable easy*** *access to water… services by all manner of people*" (NATW3).

[35] Text has been bolded by the researcher to highlight parts of a policy provision which are specific for a particular standard or guideline.

- To ensure that all people in Malawi "***have convenient access*** *to sufficient quantities of water of acceptable quality …at any time and* ***within a convenient distance***" (NATW3 p5) – defined as within a distance of 500m (NATW7, NATC9).
- *"Boreholes fitted with hand pumps should* ***serve maximum number of 250 people per borehole, within the radius of 500 metres*** (NATW7, GD3).
- *A communal tap point is designed to* ***serve a maximum number of 120 people within the radius of 500 metres"*** (NATW7, NATW9, GD1, GD3).
- *The National Rural Water Supply and Sanitation Programme has set* ***75 for the population of communities eligible for*** service provision (NATW7).

While the provisions reflect international standards/guidelines, their implementation may discriminate against widely-spaced, smaller populations (less than 75 households). This can, therefore, defeat the aim of attaining universal access to drinking-water. Service providers are not legally obliged to consider areas that are sparsely populated, where the number of households within a 500m radius falls below a minimum threshold of 75, consequently risking marginalisation. This policy gap is likely to constrain full implementation of demand- led approaches, where users are expected to request services suited to their situation. Additionally, national legislation does not cover 'safe physical accessibility to water sources', hence it is likely to be ignored in service delivery.

5.2.5.3 Water quality

NATW3 includes some of the international WHO guidelines (Uhlendahl et al., 2011; WHO, 2019). For example, it emphasises provision "*of water of acceptable quality*" (NATW3 p5), via a proxy drinking-water quality measure based on water from "*piped water supply systems, boreholes fitted with hand pumps, protected shallow wells and springs*" (NATW7). The Implementation Manual for Piped and Point Water Supply Systems (NATW9 p23) provides minimum standards for boreholes, including acceptable pH values (6.00 – 9.5), total dissolved solids (2000mg/l), turbidity (0-25 NTU), faecal coliform and streptococci (0-50 colony forming units (cfu) per 100ml). These water quality parameters are generally within WHO recommended guidelines, except for a few, such as the faecal indicator which is less strict than the WHO guideline value of <1cfu/100ml. However, NATW4 does not include provisions for ensuring that actors comply with quality standards in drinking-water service delivery.

The Water Resources Act (NATW4) implicitly recognises chemical and faecal parameters in service provision. For example, section 74 states that **"***Every person abstracting groundwater by means of* *a borehole shall, in order to prevent contamination or pollution of the water__ (a) effectively seal off to a sufficient depth any contaminated or polluted surface or shallow water in rock openings or soft broken ground*". Similarly, the legislation includes both water quality management and monitoring mechanisms to ensure compliance (NATW4) as illustrated below:

> *"Where any borehole is being constructed within eight hundred metres of an existing borehole, the Authority may, by notice require the person constructing the borehole to apply tests, to be specified in the notice, to the existing borehole and to supply to the Authority the particulars of the results of such tests…"* (NATW4, Section 70._1).

However, the lack of any explicit recognition of chemical parameters in the National Water Resources Act (NATW4) can limit responsible government officials from holding actors accountable for providing lower quality water to users. In addition, NATW4 is silent on the regularity of water quality monitoring after drinking-water facility installation. This is likely to contribute to irregular checks of drinking-water quality, which in turn can lead to more temporal and spatial disparities in safe water access than reported in scholarship.

Furthermore, despite the provisions stated above, there are legislative inadequacies likely to inhibit realization of the right to water through pollution control. Many studies agree that contamination is greater in shallower aquifers (Zhao and Pei, 2012; Bartzas et al., 2015; Baki et al., 2017; Oni et al., 2017), particularly because of non-point source contamination with agro-chemicals (Bartzas et al., 2015). This vulnerability of groundwater to contamination is acknowledged in the Technical Manual - Water Wells and Groundwater Monitoring Systems (NATW10 p26) which recommends that "*properly constructed well aprons are mandatory*"[36]. The manual outlines recommended borehole depths for different aquifers to reduce groundwater pollution risk. The service providers and government water officers are conversant with the stated requirements. For example, from key informant interviews (GD2, GD3, NGO1), the minimum recommended depth for boreholes is between 20-45 metres to ensure quality and sustainable supply of water. However, this recommendation is yet to be included in the National Water Resources Act (NATW4). Therefore, implementation of this recommendation lacks a legal basis. The existence of this gap is likely to affect enforcement of the standard on the ground.

[36] A 'well apron' is a concrete feature constructed on the ground surface around the borehole to seal any features between the borehole lining and wall of the excavated hole. This directs spilt water away from the borehole to a drainage channel and hence, prevents seepage of polluted surface water down the sides of the borehole (NATW9).

Additionally, the national water policy documents make no reference to a verified equitable water safety plan. This implies the lack of extensive risk assessments for drinking-water users, with consequent underestimation of the number of households using unsafe drinking-water.

5.2.5.4 Affordability

The Water Resources Act (NATW4) and National Water Policy (NATW3) include provisions on promoting affordable service provision to rural communities and the poor. For example, the NATW3 promotes cost effective/affordable "*technologies to enable easy access to water… services by all manner of people*" and "*pricing and charging systems that recognise water as both a social and economic good*" *(*NATW3). This is also in line with demand-responsive and demand-driven rural water supply approaches, whereby water users are supposed to ask for a service and technology they want, based on their willingness to pay and ability to manage and maintain the service provided (The World Bank Water Demand Research Team, 1993; Moriarty et al., 2013a). Consequently, this approach aims to address marginalisation in drinking-water service delivery.

However, some provisions in national legislation, e.g. flat pricing for rural piped water systems (NATW4) and uniform user financial contributions towards borehole preconstruction costs, contradict the international guidelines on affordability. Service providers can, therefore, use these provisions as justification for overlooking the inability of the poorest to pay for the set water use charges. Additionally, although the international legislation (INTW4 par 27) (see Table 5.4) does not suggest free service delivery for all poor, it explicitly allows that provision where necessary. This specification is absent in national legislation. Without clear guidance on how to provide for the poorest water users, service providers may charge discriminatory tariffs or leave some marginalised groups unserved. As outlined in section 5.2.5, the United Nations uses two affordability benchmarks, less than 3% or 5% of household income spent on water. Empirical evidence in Africa (Zimbabwe, Nigeria, Tanzania, Kenya), India, Pakistan and Brazil shows that rural households are able to spend 3-5% of household income on water (The World Bank Water Demand Research Team, 1993; Bos, 2016). However, these studies indicate that though income was not a major determinant, generally there was low willingness to pay for improved water services in very poor households. This suggests that, in the absence of clear legal controls, the poorest are likely to fail to pay for water whose cost is high, or may decide not to spend more than 5% of their income on drinking-water access, thereby obtaining insufficient good quality water. This situation already exists, since there is increasing evidence that shows households have limited access to drinking-water even when water is available in their area 'because they are income-poor' (Dungumaro, 2007) or cannot afford to pay for the service (Kendie, 1996; Dungumaro, 2007; Vázquez-García and Sosa-Capistrán, 2017).

5.2.6 Institutional arrangements for drinking-water systems in rural Malawi

Water legislation for rural Malawi provides for borehole and piped water governance systems to ensure attainment of the international water principles and standards. These include management structures; establishment and membership rules for water governance structures; decision-making rules in these structures; access/operational rules and penalties for noncompliance. This section documents what is recommended in international legislation to meet the international water principles and standards, and the gap, if any, between the international standards and the national policy.

5.2.6.1 Established drinking-water management structures at national level

The Water Resources Act of 2013 (NATW4) provides for the establishment of the National Water Resources Authority (NWRA) as an autonomous government-sponsored structure to provide advisory and regulatory roles on Water Resources Policy and Act respectively (NATW4). NWRA replaces the water resources board established by the Water Resources Act of 1969 (NATW1, GD1). NWRA has the mandate to: develop principles, guidelines and procedures for water resource allocation; determine water use charges or permits; manage and protect water catchments; and liaise with relevant stakeholders. NWRA has to fulfil its mandates under the direction of a governing board, which consists of members appointed by the Minister, including a representative of one of the established catchment management committees; associations of water users; a non-governmental organization (NGO) engaged in the water sector; private sector stakeholders, and ex-officio members – secretaries or their representatives from relevant government bodies with a stake in the water sector. The NWRA is expected to establish regional offices close to or in catchment areas (NATW1, GD1). During the current data collection period, however, these were not yet established (GD1).

5.2.6.2 Structures governing access to drinking-water at district and sub district levels

Although the Malawi rural water supply programme is decentralized to district and sub-district levels, this thesis considers Zomba's local structures in the context of national-level bodies (Fig. 5.1). This is because the district and sub-district structures may not be analysed in isolation as current legislation mandates that the NWRA can influence their establishment and operations (NATW1). The structures reflect the Decentralisation Policy and Local Government Act (NATW9, NATC8, NATC9). Rural water governance is portrayed as involving multiple stakeholders or a network of actors, each playing a significant role at various levels. Details of composition and roles are captured in NATW7, NATW8, NATW9 and Appendix 9. Although the structure in Figure 5.1 is applicable to the whole rural water supply and sanitation programme, it is particularly relevant to the borehole water system. The piped water system is more closely linked with the Water Users Association (WUA) approach (Fig 5.2).

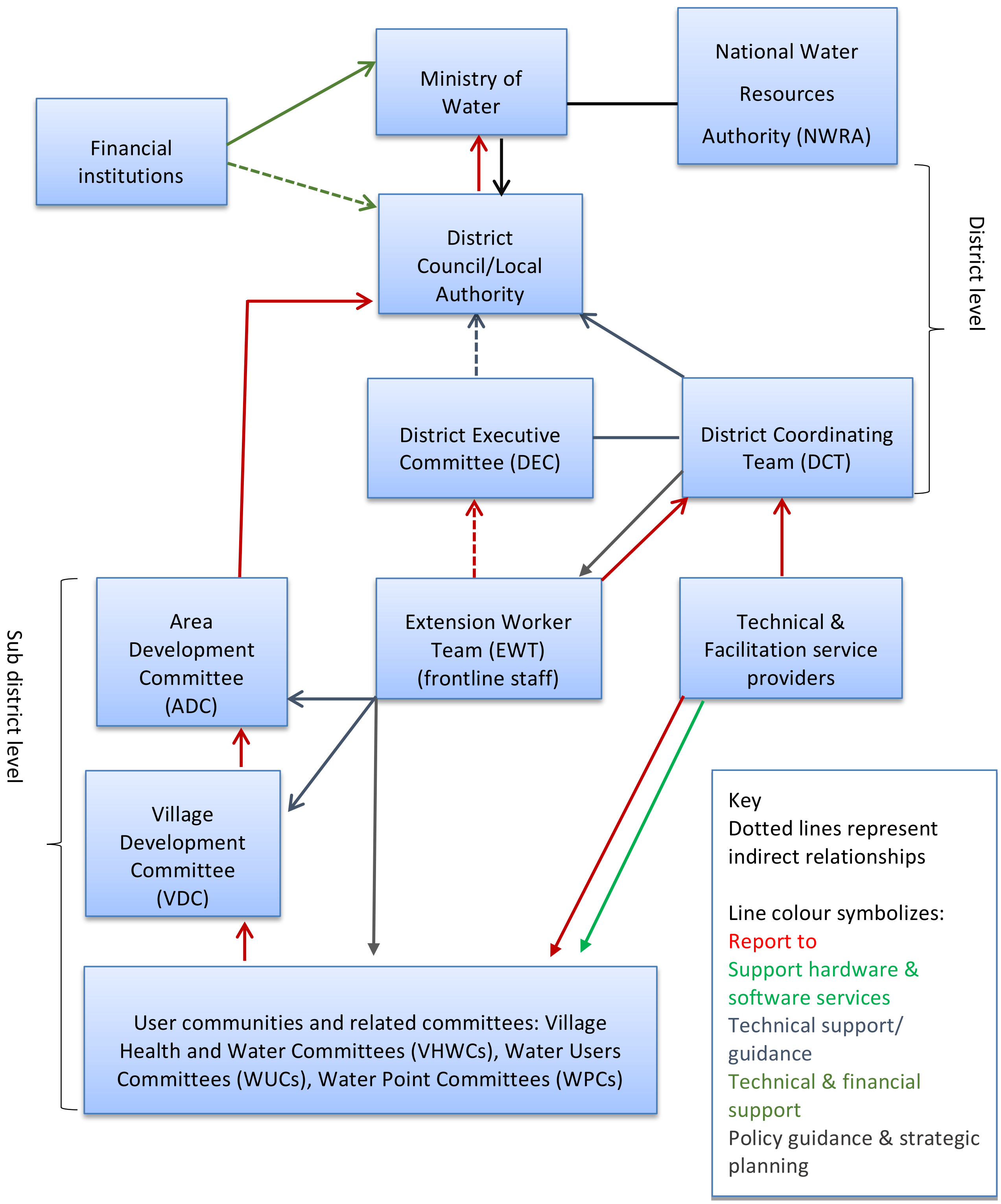

Figure 5.1 District structure for implementation of the Rural Water Supply and Sanitation Programme

Source: drawn by author

5.2.6.2.1 Water Users Associations (WUA)

A WUA is a "*community management structure instituted by the user community responsible for facilitating and overseeing water supply services in market centres, groups of villages sharing rural piped systems and in some low income areas in the urban areas*" (NATW7). The WUA approach has recently been adopted by the Government of Malawi to improve piped water system development and management in market centres and rural areas via a participatory approach (NATW5). The WUAs are a departure from the traditional committee management style, to the creation of "*mini water boards*" at community level (NATW5). The WUAs are expected to operate the water supply schemes through three main organs: the general assembly, board of trustees, and secretariat (Local Utility Operator - LUO). Water users are key stakeholders and the Local Authority (District Assembly) is the highest policy making body at district level (Fig 5.1, Appendix 9). Following NATW3 and the rural water supply programme, the WUA is expected to collaborate with various stakeholders including "*area development committees, village development committees, District coordination teams, extension worker teams, Ministry of Irrigation, Water and Development, Water Boards and other Service Providers*" (NATW5). Figure 5.2 illustrates the WUA organisational structure.

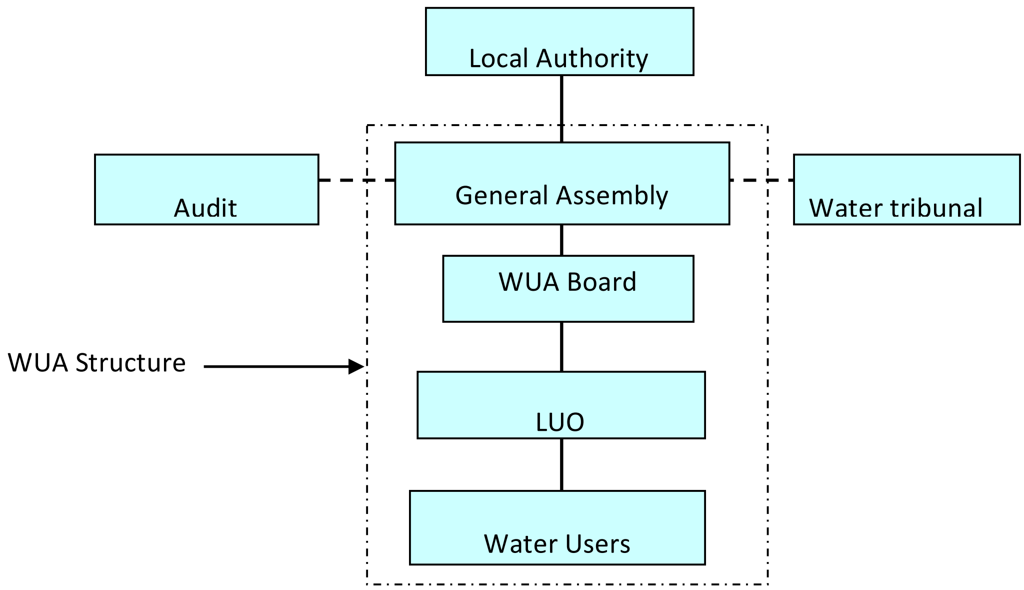

Figure 5.2 Organizational structure of the WUA

Source: NATW5, NATW6

In the WUA structure (Fig. 5.2), the user committees, as depicted in Figure 5.1, are at Water Users level. These include water users' committees (WUC) and tap committees.

The WUAs are expected to guide the planning of the piped water supply system, recruit and supervise the Local Utility Operator (LUO) to manage "*routine operations and maintenance*", organise "*long term technical assistance*" to assist LUOs in improving efficiency and expand the system to cover many users. The "*LUOs are accountable to water users for operating and maintaining water*" facilities; collecting tariffs and management; "*providing regular and accurate reports on performance to WUAs*"; and expanding the system (NATW5).

5.2.6.2.2 Catchment approach

The WUA concept is expected to operate together with the catchment protection approach. The latter aims at improving water quality and quantity through catchment rehabilitation and enrichment. These are two key strategies recently adopted by the Government of Malawi to manage piped water provision. The two initiatives need to collaborate, their current concern is to do with their integration into the national rural water supply programme (NATW5, NATW6, NATW7, GD1).

5.2.6.3 Institutional rules in management structures governing access to drinking-water in rural areas

This subsection analyses institutional rules in borehole and piped water management structures. Tables 5.5 to 5.7 below (combined details in Appendix 12) illustrate the nature of institutional rules in the current water management structures established to govern rural access to drinking-water. Building on Ostrom (1990)'s three institution tiers, (see Section 2.3.1) include constitutional choice (establishment and membership) rules; operational (access, monitoring and sanctioning) rules and collective choice (decision-making) rules for borehole and piped (WUA) water systems. Focus is on community-level water governance structures.

Table 5.5 presents constitutional choice rules for bodies established to manage rural drinking-water. It shows that structures for both borehole and piped systems emphasise participation of local resource users and gender consideration in membership. The aim is to ensure representative decisions and instil a sense of ownership (NATW9). However, illiterate people do not qualify for executive positions, hence decision-making arrangements may not be representative of this group.

Table 5.5 Constitutional (Establishment and Membership) rules for rural drinking-water systems

<table>
<tr><th rowspan="2">Rules</th><th colspan="2">Water system</th></tr>
<tr><th>Borehole</th><th>Piped (WUA concept)</th></tr>
<tr><td>Operate at traditional authority level that comprises of a group of villages</td><td>dna</td><td>NATW5, NATW6, NATW7, NATW8, VLWC1</td></tr>
<tr><td>Membership is compulsory for all residents</td><td>dna</td><td>NATW5</td></tr>
<tr><td>Each committee is representative of its community members</td><td>dna</td><td>NATW5, NATW6, VLWC1</td></tr>
<tr><td>Members democratically elected from user households served by a point source</td><td>NATW8</td><td>dna</td></tr>
<tr><td>Membership to follow 50:50 gender ratio</td><td>NATW8
NGO1</td><td>NATW5, NATW6, NATW7, NATW8, VLWC1</td></tr>
<tr><td>Membership rules for executive officers:</td><td></td><td></td></tr>
<tr><td>• Drawn democratically from the Area Development Committee</td><td>dna</td><td rowspan="2">G2, NATW5, NATW6, NATW7, NATW8, VLWC1, VLWC3</td></tr>
<tr><td>• 50:50 gender ratio</td><td></td></tr>
<tr><td>• Community membership</td><td>NGO1, VL2</td><td rowspan="3">NATW5, NATW6, NATW7, NATW8, VLWC1</td></tr>
<tr><td>• Literate</td><td>NATW8</td></tr>
<tr><td>• Voluntary participation</td><td>GD1, GD3, GC3, NGO1</td></tr>
</table>

Note: dna= does not apply.

Table 5.6 shows decision-making rules for both borehole and piped systems. These are similar to constitutional rules e.g. the formation and implementation of access rules are participatory. However, in both types of water supply systems some decision-making arrangements, such as setting water costs, seem to exclude those not in leadership positions. This means that such decision-making rules are likely to adversely affect some operational rules and may consequently marginalise the voiceless water users.

Table 5.6 Collective (decision-making) rules for rural drinking-water systems

Rules	Water system	
	Borehole	Piped (WUA concept)
Managed by borehole committees	NATW8, GD1, GD3, NGO1, NGO2	dna
Managed by the general assembly, board of trustees and Local Utility Operator - shift from water management committees	dna	GD1 and VLWC1
Participatory decision-making, e.g. formation of operational rules – involve local communities	GD1-GD3, NATW8, NGO1	NATW5, NATW6
Financial contributions to capital costs fixed by government while post-construction costs are fixed by local leadership	GD1-GD3, NGO1	

Note: code, dna= does not apply.

Operational rules for both borehole and tap water systems (Table 5.7) follow 'demand-driven' and 'demand-responsive' approaches (NATW9). These stipulate pre-service conditions and rules to be met after service provision. For boreholes, communities should participate fully in planning, needs identification, and financing (in cash and kind) operation and maintenance of their water services (GD1, GD3, NATW8, NATW9). The planning phase details preservice conditions which include choosing the type of water technology and siting, preparation of "*a facility management plan*" and mobilizing funds/commitment fees (NATW9) with the facilitation of an extension worker team (NATW8, Fig. 5.1). Additionally, the communities are expected to form a Water User Committee (NATW7). The purpose of the fees is debatable. The RSSWP view the fees as a contribution towards capital costs (NATW7, NATW8) while all key informants saw them as maintenance funds deposited in the bank before facility installation (NGO1, NGO2, GD1, GD3).

Application for the service and its delivery should follow after meeting all the preservice delivery conditions through the decentralised structures at community and district level (NATW8). The local community is expected to submit the application through the village development committee (VDC) which passes it to the Area Development Committee for forwarding to the District Council (Fig. 5.1). At the district office, the District Coordinating Team (DCT, a technical arm of the District Executive Committee) is expected to conduct a desk review of applications and conduct a field visit to the community for verification (Fig. 5.1, NATW8). If pre-service conditions are not met, the community application for a drinking-water facility is withheld.

Table 5.7 Operational rules for rural drinking-water systems

Rules	**Water system**	
	Borehole	**Piped (WUA concept)**
Communities are expected to participate fully in:		
• *planning*	GD1, GD3, NATW8	NATW5, NATW6, NATW7, GD3
• *needs identification*		
• *financing the operation and maintenance*		
• *catchment protection*	No mention	NATW4, NATW6
• *monitoring and evaluation of water projects and work of service providers*	GD3	NATW5, NATW6, NATW7
• *formation of management committees and election of local leadership*	NGO1	
Non-payment of user fees or tariffs leads to denied access	NGO1, VL1, VL4	VLW1, VLWC3
Noncompliance in catchment protection attracts an administrative penalty and; K1,000,000[37] and 4 years' imprisonment for further noncompliance	No mention	NATW4

Following borehole installation, borehole users are expected to finance facility maintenance through a borehole committee (NATW8, NATW9). The size and frequency of post-construction contributions towards maintenance is site-specific, depending on local conditions (NGO1, NATW9).

Similar operational rules to borehole systems apply in WUA arrangements (NATW5, NATW6, NATW7), though there are some WUA-specific provisions (Table 5.7). For example, community participation in planning, needs identification, operation financing and maintenance apply in both

[37] About US$2400.

borehole and piped systems. Similarly, water committee participation in monitoring and evaluating service installation and performance applies to both drinking-water systems (NATW9). However, community participation in catchment protection seems mandatory only in the WUA approach (NATW4, NATW6). Catchment protection and monitoring is emphasised to ensure management and maintenance of water quality and quantity both at piped system sources and downstream (GD1, LOCC1, NATW12). This is partially in line with water safety planning. However, despite international prominence of water safety plans (WHO, 2019), there is no reference at all to water safety planning or related equity issues at local level. Furthermore, at the time of data collection, the national water safety plan framework for the inspection of the drinking-water supply systems was yet to be published. Hence, it would be difficult to hold service providers accountable for non-compliance with international guidelines on equitable water safety planning – an agenda for the SDG era. This limitation applies to both piped and borehole water systems.

In addition, similar operational rules, such as preservice and post-construction financial contributions by water users, have divergent purposes in the WUA approach. For example, in the WUA approach water users are expected to meet 5% of capital costs, and full operation and maintenance costs, with some replacement and/or expansion savings. This includes the costs of spares and technicians' salaries (GD1, GD2). Communities should meet these costs through metering or flat rate charges (NATW4).

The study established contradictions in the design of the same operational rules within the WUA approach between the NATW3 and local bylaws, specifically with regard to initial/preservice financial contributions for drinking-water connection. The contradictions are similar to those of the borehole system. While national water legislation (NATW4) and policy (NATW5, NATW6, NATW7) and government officers (GD1, GD2) agree that initial financial contributions are a prerequisite for tap water connection, in LOCW1 (WUA constitution/bylaw), the initial contribution applies to private connections only. Communal taps are connected at no charge. Despite these differences, both NATW4 and LOCW1 emphasise flat rate tariffs for operation and maintenance. Failure to pay leads to denied access (VLWC1, VLWC3). This implies limited recognition of marginalised groups unable to pay the flat rate water tariffs due to poverty. This situation may defeat the NATW4 goal of equitable access, also emphasised in the WUA approach.

The WUA approach also applies the "*Some for all*" not "*all for some*" recommendation, emphasising communal service provision to "*ensure that all communities have access to a minimum standard of water supply. Those who want private connections are expected to pay high costs*" (NATW7). However, as stated above, attainment of this objective is threatened.

Water users are mandated to participate in catchment protection and conservation. Non-compliance is sanctioned in both national legislation and bylaws (Table 5.7). National legislation (NATW4) provides for the establishment of a gender-sensitive catchment committee comprising representatives from the farming community, NGOs, experts, and agencies responsible for water-related resources in the catchment area (NATW4). The committee, which works alongside government extension workers, mostly from the forestry department, is responsible for water resources conservation (catchment enrichment and rehabilitation), water use and allocation, by-law formulation, hotspots plan and catchment management plans, and monitoring catchment rehabilitation (GD1). NATW4 also provides for a fund in sections 29(2) and 31(1) as an incentive, a percentage from water charge proceeds, in accordance with section 120, and from any other lawful source for catchment management. The Water Resources Act (NATW4) mandates the NWRA to provide this fund regularly, by request, and produce a catchment management strategy to provide mechanisms and facilities for enabling community participation.

5.3 Policy consideration of seasonality and extreme weather events

Section 2.3.5 highlights seasonal water availability and quality patterns in developing countries (Kostyla et al., 2015; Wright et al., 2012) and their implications for household access to water (WWAP/UN-Water, 2018; Wright et al., 2012). Several studies provide evidence on how seasons and the seasonality of weather events affect drinking-water systems. One example is the long dry season effect, in Sub-Saharan Africa, on groundwater and surface water availability, its consequences on rural household water demand, the choice of main water source and people's willingness-to-pay for water (Kelly et al., 2018).

Studies now agree that climate change is happening; changing rainfall patterns are altering hydrological systems, consequently affecting water availability and quality both in surface and ground water sources (IPCC, 2014). Many studies also show (Section 2.3.5) how seasonality of water availability and quality is compounded by climate change effects (Chambers, 2012; Basu et al., 2015; Rosinger, 2018; Tucker et al., 2014). These include effects of warming temperatures, changes in the intensity and frequency of extreme rainfall events (such as storms, floods and droughts) and changes in the rainfall season (onset, cessation and length) (Brown et al., 2012). Examples of extreme weather effects on water availability include evident source failure or water shortages in the dry season in Sub-Saharan Africa, following drought or flood, as confirmed by (Tucker et al., 2014) in rural Ethiopia. Despite wide recognition of the risk implications of seasons and climate variability and change on water availability and access, Chapter 2 showed there are gaps in current scholarship on how formal institutions address seasonality and climate risks in relation to drinking-water availability and access. This section contributes to this gap.

5.3.1 Provisions of seasonality of drinking-water supply in international legislation

There is no clear articulation of how seasonality is handled within international legislation. Of the 19 policy documents analysed, 16 do not mention seasonality, varying dry and wet season water supply, nor how to cope with access challenges during these seasonal fluctuations. In three documents where seasonality of water is mentioned, the language is vague - it offers no guidance. There are three policy documents that do highlight temporal variation in water availability (the SADC Regional Water Policy (INTW1), UN General Comment No. 15 and the related General Assembly Resolution (INTW4), and the 2030 Agenda for Sustainable Development (INTC7)). However, they are unclear on what temporal variations mean, as illustrated in the following quote: "*Water resources (surface water, groundwater, and rainfall) are unevenly distributed in time and space in the SADC region*" (INTW1, P6). The temporal variation does not specify whether it refers to a dry or a wet season. Further, INTW1, p6, highlights that the overall freshwater resources picture for the SADC region hides "*seasonal, annual and spatial variability*" but focuses mostly on the regularity and future occurrence of extreme weather events (droughts and floods) and implications for future availability of water in dry seasons, as the following quote illustrates:

> "*This high variability in availability of water resources has led to localized deficits in water. Projections of population, water demand, and water development indicate that by 2025 six SADC countries will experience water quality and quantity problems in the dry season, three countries will experience "water stress" and at least two countries (Malawi and South Africa) will experience "absolute scarcity*".

This quotation suggests periods beyond regular seasons, but it does not consider the present seasonal pattern of water availability.

International policy documents specify what precautions to take when there are temporal fluctuations, without specificity or clear guidance, but do not articulate how households should cope during dry and wet seasons. Provisions allude to seasonality management but lack detail. For example, INTW4 emphasises that drinking-water supply must be sufficient and continuous. The word 'continuous' implies consideration of all times, thus implicitly recognising seasonality. To ensure this, in paragraph 28, INTW4 calls for states and involved parties to plan for:

> *(a) reducing depletion of water resources through unsustainable extraction, diversion and damming; …(c) monitoring water reserves; …(e) assessing the impacts of actions that may*

impinge upon water availability and natural-ecosystems watersheds, such as climate changes, desertification and increased soil salinity, deforestation and loss of biodiversity; …(g) reducing water wastage in its distribution"(INTW4).

Some strategies in INTW4 are reemphasised by INTW1 and INTC7. INTW1, p8 recognises impacts of "*high variability of available water resources"* on water reliability and emphasises "*need for regulating the variable flows so as to secure reliable supplies under varying climatic and hydrological conditions*" and "*construction of storage dams, inter-basin transfers and large scale water distribution networks*". INTC7, p18 concerning the sustainable development goal (SDG) on drinking-water states:

> "*6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity*"

> "*6.a By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies*"

Neither provision (in older or new international legislation) is articulated clearly for specific seasons, describing specific seasons, climate risks and crosscutting issues, without clarity.

Furthermore, the provisions focus on water availability and quality with little consideration of other seasonality aspects such as physical accessibility of drinking-water sources, acceptability and affordability standards that could affect equitable access. Similar inadequacies appear in national legislation.

5.3.2 Seasonality in national legislation and policy responses

As with international legislation, 25 of the 28 national policy documents reviewed make no mention of seasonality. Provisions specifically for normal dry and wet seasons are not clearly articulated and the language used in most provisions is vague, as illustrated in the following quote (NATW3, p7): "*Malawi has abundant surface water and groundwater resources. However, these resources are of variable quality and quantity, unevenly distributed in time and space*". The phrase 'in time' lacks specificity as do the provisions for managing the situation. Examples of management strategies in NATW3 p8-9 include:

"4.2.4 Undertaking and promoting efforts towards water resources conservation, harvesting and protection in an integrated manner including development of small community and medium to large multipurpose dams;…

4.2.6 Undertaking appropriate integration between surface water and groundwater resources management;

4.2.7 Identifying, delineating and protecting water resources conservation areas;…

4.2.9 Establishing a sustainable groundwater monitoring network and improving a surface water monitoring network including developing water quality maps;…

4.2.12 Conducting comprehensive research and studies to establish surface and ground water resources potential to guide management and development of the resources;…

4.2.17 Encouraging the development and adoption of rainwater harvesting technologies in human settlements and infrastructure developments."

Hence, the national legislation largely offers no clear guidance on how to handle drinking-water systems during the dry and wet seasons, to ensure equitable access for marginalised households.

Despite the silence of the NATW4, the Implementation Manual For Piped and Point Water Supply Systems (NATW9), Technical Manual - Water Wells and Groundwater Monitoring Systems (NATW10 p26), Technical Manual for Piped Water (NATW11) and Technical Manual for Rural Piped Water (NATW12) consider seasonality aspects, including water availability during dry and wet seasons, for both piped and borehole water systems. There are specific provisions made for the system design and service implementation stages. For example, during the design stage NATW9, p14 highlights: "*Hydrological data of the water source. The critical is the dry season data for river flows i.e. low flow measurement*". Thus, service providers should consider dry season river flows when selecting a piped system's source. NATW9, pp5, 11 further repeatedly emphasises: "*reliability of the water source to meet the peak demand during different seasons".* Similarly, NATW10 emphasises seasonal considerations in borehole construction:

> *"Areas where seasonal water level fluctuations exceed 10m are relatively rare, but if the area is hydro-geologically 'known' to have large fluctuations then clearly a reserve column of 15 - 20m will be necessary. In sub artesian conditions, the borehole can be considerably deeper than the norm for hand pumps of the 50-60m, because the water level will rise. It should be noted that the shallower the water table the greater the danger of groundwater pollution, hence properly constructed well aprons are mandatory" (NATW10, p26).*

A similar provision for springs that provide rural piped drinking-water is included:

> "*1) Ensure the rate of flow is reliable throughout the year. Great fluctuations of spring flow indicate an unreliable source which may also be susceptible to contamination. Measure the flow rate of the spring by digging a 10L bucket into the slope of the spring and measure the time taken for the spring water to fill-up the container*" (NATW10, p28).

However, lack of specific seasonality considerations in the NATW3 and Water Resources Act (NATW4) potentially undermines compliance by service providers. A similar challenge relates to national legislation; it does not consider seasonal income variation and its effect on the affordability of rural drinking-water.

NATW9, p37 suggests irregular drinking-water payments for rural households, giving due consideration to periods when most households are able to pay. This follows international affordability standards affordability (INTW4) but contradicts flat pricing and regular payments for operation and maintenance advocated by the NATW3 and WUA Constitution (LOCW1) for rural piped water systems. In this context, the implementation of NATW9 lacks a strong legal basis to hold service providers accountable for noncompliance.

5.3.3 Integration of extreme weather events effects on drinking-water resources and policy response

Similar to seasonality of water issues, only four of the 18 international policy documents ((Agenda 21 (INTC2), SADC Regional Water Policy (INTW1), Revised Protocol on Shared Water Courses in the SADC (INTW2), Convention on the Law of the Non-navigational Uses of International Watercourses (INTW3) and UN General Comment No.15 (INTW4)), mention climate risks in relation to drinking-water supply. The four that do particularly comment on risks adversely affecting water availability, domestic supply, quality and infrastructure (INTC2). They highlight strategies for addressing these challenges to ensure sustainable and equitable access for all users (INTW1, INTW2, INTW3). Table 5.8 outlines climate events related to water supply, including extreme weather events.

Table 5.8 Climate events related to water supply systems

Climate patterns	**Mentioned in international legislation**	**Mentioned in national legislation**
Extreme weather conditions - droughts	INTC2, INTW1, INTW2, INTW3	NATC4, NATC9, NATC11, NATW1, NATW3, NATW4
Extreme weather conditions - floods	INTC2, INTW1, INTW2, INTW3	NATC4, NATC9, NATC11, NATW3
Prolonged dry spells		NATC9
Decreasing precipitation	INTC2	NATC9
Excess precipitation		NATC9, NATW3
Rising temperatures	INTC2	NATC9, NATC11
Rainfall variability/unpredictable rainfall pattern	INTC2, INTW1	NATC9, NATC11

The climate events are reflected in national legislation in combination with provisions for their management, with droughts and floods most commonly mentioned. Table 5.9 outlines strategies for their management.

Table 5.9 Strategies to manage climate patterns

Management strategies	**Mentioned in international legislation**	**Mentioned in national legislation**
Integrated water resources management	INTW2	NATC11
Infrastructure development and extension	INTC2, INTW2	NATW3
Infrastructure rehabilitation		NATW3
Capacity building in water sector, disaster management		NATC11, NATW3
Data collection and sharing on hydrological, meteorological, hydrogeological and ecological nature and related to water quality and future trends	INTC2, INTW2, INTW3	NATC4, NATC9, NATC11
Catchment rehabilitation/protection		NATC4, NATW3
Mainstreaming climate change issues in informal and formal education		NATC9
Enhancing legal and regulatory framework in climate change		NATC4, NATC9
Policy and legislation harmonization on climate change		NATC4, NATC9
Suspension of water rights		NATW1, NATW4

Overall, the provisions for managing climate risks in international legislation are not well developed. Table 5.9 highlights those strategies mentioned in four out of 18 policy documents that contained any such references. These include catchment management, water infrastructure development (community and multipurpose dams to regulate variable water flows and flood control) and capacity-building in the water sector. However, some strategies such as integrated water resources management and climate change education are mentioned without specificity or clear explanation on how they relate to climate risk. Furthermore, in some contexts the provisions mentioned are not directly related to climate risk management, but to water resource degradation resulting from environmental degradation (INTW1), specifically, deforestation and soil erosion (INTC2) (See Table 5.10). In this context, international legislation design does not adequately address extreme weather events. Similar challenges apply to national legislation (See Table 5.9 and Table 5.10).

Table 5.10 Strategies for addressing water resources degradation

Strategy	**Sub strategy**	**Source** International legislation	**Reflected in National policy**
Catchment protection within the river and lake basins		INTC2, INTW4, INTW7	NATC4, NATC5, NATC13, NATC14, NATW1, NATW3, NATW4, NATW8
Implementation of allocation decisions e.g. water demand management			NATC5, NATW3
Promotion of water conservation	Improved water-use efficiency	INTC2, INTW4, INTW7	NATW3
	Wastage minimization schemes for all users	INTC2, INTW4	NATW3
	Rehabilitation of defective systems	INTC2	NATC4, NATC5, NATW3, NATW8
	Safe reuse of water and waste-water	INTC2, INTW7	
	development of water-saving devices	INTC2	
	Rainwater harvesting using cost effective and user-friendly technologies	INTW7	NATC5
Establish and strengthen the institutional capabilities	Legislative and regulatory arrangements, to ensure adequate assessment of water resources and provision of flood and drought forecasting services	INTC2	NATW3
	Monitor hydrological regime including ground water balance, penetration, transpiration of water quality and related climate factors	INT2, INTW1, INTW4	
	Construct water development projects e.g. dams, multipurpose or community dams to regulate variable water flows and flood control	INT2, INTW1, INTW4	NATC4, NATC5, NATW3

Despite the inadequacies mentioned above, there are few national legislation provisions in NATC4, NATC5, NATW3, NATW4, NATW9, NATW10, NATW11 and NATW12 that clearly offer guidance on water supply management in relation to extreme weather events. Some provisions are general for any water system. For example, NATW4 makes provision for catchment protection and water conservation. It also notes that the Minister may declare any part a controlled area and control water use such as irrigation in response to drought or water shortage (NATW4, sections 86 & 87). Subsection 38(5) of NATW4 gives an individual the right to harvest rainwater for domestic purposes on their own land or on communal land. The National Water Policy specifically highlights the importance of contingency resources during extreme weather events:

> *"Ensure the existence of strategic and contingency water resources development and management plans that guarantee availability of water in cases of droughts, floods and population pressures*" (NATW3, P5).

NATW1 and NATW4 mandate the Minister responsible for Water resources to suspend water rights and regulate its abstraction during water scarcity. NATC5 promotes use of affordable and user-friendly rainwater harvesting techniques for local communities. Six policy documents (NATW3, NATW4, NATW9, NATW10, NATW11 and NATW12) concern piped and borehole systems and Table 5.11 provides examples of relevant statements in these documents.

Table 5.11 Provisions on extreme weather events in policy and legislation for borehole and piped systems

Topic	**Details in policy and legislation**
Catchment rehabilitation and protection	Rehabilitation of catchment areas, as a safeguard to reduce the impact of supply shocks from droughts (NATC4; NATC5)
Expansion, rehabilitation and maintenance of water supply systems	Rehabilitation of boreholes and gravity-fed water supplies as a safeguard to reduce the impact of supply shocks from droughts (NATC4; NATC5) NATW3 promotes undertaking rehabilitation and reduction of unaccounted-for-water of existing community water supply schemes (gravity-fed water supply schemes and boreholes) as a priority. A WUA is expected to "*construct, rehabilitate, operate and maintain any works for the purposes of management of the water resource in its area of operation* Borehole drilling, construction of small community dams, expansion of gravity-fed water supply systems (NATC4)
Water rationing	WUAs are also expected to *agree by consensus of its members equitable reductions in the quantities of water abstracted from the source under its responsibility in times of drought or other restrictions on resource availability*" (NATW3 2013 p81). "*where it is established that.. the natural flow in a watercourse available to all users has dropped or is likely to drop so that more water is permitted to be diverted, stored, or used than is available in the watercourse, the Authority shall hold a public hearing into the matter and thereafter may amend any or all licences to divert, store, or use water from that watercourse in an equitable and fair manner as the Authority may deem appropriate"* (NATW3, Section 52)
Contingency planning	Ensure the existence of strategic and contingency water resources development and management plans that guarantee availability of water in cases of droughts, floods and population pressures (NATW3)
Relief supply	Ensure "*timely provision of drinking-water… for vulnerable communities especially children, women … during water-related disasters*;" and provision of "*basic requirements of drinking-water supply to all affected areas*" through provision of "*emergency water supply systems including boreholes, hand-dug wells and portable treatment units*"(NATW3, 15-16)

Provisions mainly focus on regulating variable water flows, flood control and ensuring equitable consumption under water fluctuations (NATW1, NATW4) or following associated adverse effects on "*existing infrastructure, domestic water supply, and the availability of water resources*" (NATW3, p2). National legislation like NATW11 and NATW12 also provides guidance on construction of trenches, laying of pipes and intakes, with due consideration to flood risk: "*Trench depths*: *1.20m for AC lines, 0.75m for PVC lines smaller than 75mm* and *0.90m for PVC lines above 75mm"* (NATW11, p70). Laying should consider:

> *"Course of River: Many rivers tend to change course during the rains, when they will cut out a new path for themselves, and continue along that path in the following dry season. Information should be obtained from the people living near the river, who will explain how the river behaves during the rains. Mark the places where they say the course of the river has been steady. Also mark the position of the highest water level during the floods. If the people say that the river carries branches and trees when it is in spate, then for safety, an extra 2m should be added to the highest flood level, and this height marked out"* (NATW11, p70; NATW12, pp40-41).

Additionally, for methods of crossing a river; "(i) *Utilising Existing Structure … such as a bridge or drift, the pipe* should be placed *on the upstream side, to prevent it from being washed away during a flood. For laying below the river, Pipe should be buried to at least one metre… Piping to be steel"* (NATW11, p71; NATW12, pp41-42).

While commendable, these policy provisions may not be in line with current extreme weather trends events (see Section 4.1.2). According to one district-level key informant, service providers should use historical hydrological trends and return periods of 50 - 100 years in designing water infrastructure to ensure adequate flood (GD2). This contrasts with current advice that past, present and future trends should inform water infrastructure designs (Muller, 2007; Gahi et al., 2015). This implies that current national policy provisions are likely to fail to attain their climate risk objectives.

5.4 Discussion

5.4.1 The consideration of needs of marginalised water users by local formal water institutions

This section discusses the study results on how national policy documents incorporate the drinking-water needs of marginalised water users. The first part discusses policy strengths while the second focuses on policy inadequacies or gaps.

5.4.1.1 Areas where policy is strong

Elimination of marginalisation in drinking-water access has been a central issue in both international and national policy documents, particularly since 2015. Although some legislation, particularly earlier documents, does not explicitly mention drinking-water, clarifications in later legislation provide a legal basis for marginalised groups' needs through recognition of human rights principles and international standards related to drinking-water. The principles: non-discrimination, universality, equality, participation, information-sharing and accountability are, for example, emphasised in many national policy documents, as guiding principles in service governance, to ensure attainment of access rights for all. This includes the emphasis of affirmative action targeting marginalised groups in drinking-water development and management, to address concerns of underserved populations.

The significance of guiding principles in meeting international water standards is widely recognised in water literature. For example, the United Nations' Joint Monitoring Programme (tasked with monitoring progress towards the Sustainable Development Goal Number 6 (SDG6) since 2016) calls for countries to monitor and report their progress on elimination of inequalities in different levels of drinking-water access. Indicators used "*correspond with human rights criteria of quality, availability, accessibility, acceptability and affordability*" (WHO and UNICEF, 2017d p3). Similarly, McDermott and Schreckenberg (2009) call for equity considerations for effective institutional arrangements. To achieve equity outcomes De Albuquerque (2012); (2014b) and many other studies call for meaningful participation of resource users in decision-making forums. For example, it is widely acknowledged that involving a mixed group of resource users or a group disaggregated by gender (Charnley and Poe, 2007) and economic status (Agarwal, 2009) in formulating operational rules, produces community-sensitive and acceptable rules (Charnley and Poe, 2007; Agarwal, 2009; De Albuquerque, 2012; De Albuquerque, 2014b), hence institutional sustainability (De Albuquerque, 2012; De Albuquerque, 2014b). Chiweza et al. (2015) further add that in water governance, participation is essential because it can ensure integration of users' rights in planned investments or policy and legal frameworks. The process also ensures allocation that fits local requirements that consumers are willing to pay for and local user commitment to participation in sustainable management and water utilisation (Chiweza et al., 2015; WHO, 2012).

5.4.1.2 Policy inadequacies

Despite policy emphasis on user participation in water development and management, local water policy and legislation neither specifies the level of participation (e.g. normative, passive, consultative or interactive participation) in decision-making forums nor provides clear guidance on how the marginalised groups should contribute to water facility management. This unclear guidance can perpetuate marginalisation because there is no legal basis for holding actors in service delivery accountable for lack of interactive participation.

Additionally, there is no representation of illiterate people, who account for 40% of the population (Government of Malawi, 2009b), in decision-making bodies such as the water resources board (NATW4) and WUA general assemblies, because they cannot be on the committee if they cannot read or write (NATW8). It may be argued that in resource management, targeting illiteracy through policy pronouncements is challenging because the needs of communities vary, and policy generally has to have national applicability. However, by not addressing illiteracy in decision-making, this could defeat the goals of both inclusive decision-making and demand driven and demand-responsive approaches which are designed to ensure equitable water access. This is a serious observation, especially given that national statistics suggest a similar proportion of illiterate people at national level and in rural areas with higher proportions among the poor (47%) and women (57%) (Government of Malawi, 2012a). This finding agrees with De Albuquerque (2014b p26)'s observation that "*sometimes, the barriers to access for certain groups are … the existence of laws, policy or cumbersome administrative procedures that lead to their exclusion*". Furthermore, there is no explicit mention of access to drinking-water of marginalised groups in the Malawi constitution. The policy, however, generally meets the guiding principles on international water standards and provides criteria for assessing how far policy implementation meets international standards on the ground.

5.4.2 Policy consideration of challenges of seasonality and extreme precipitation weather events

The National Water Policy (NATW3) and the Water Resources Act (NATW4) acknowledge an increasing frequency of extreme precipitation weather events, specifically floods and droughts, as well as associated water access challenges. These challenges are also reflected in drinking-water service delivery implementation guidelines and manuals (e.g. NATW7, NATW8, NATW9, NATW10). The policy documents also recognise temporal variations of drinking-water access. These results align with numerous studies conducted worldwide including Southern Africa and within Malawi (Republic of South Africa, 2004; GENDERCC Southern Africa et al., 2011; Government of Malawi, 2011c; Batisani, 2011; Henry et al., 2011; Hu et al., 2011; Ryu et al., 2011). In response, the policy documents include provisions aimed at addressing these challenges, including associated water access challenges. The provisions include water demand management strategies, control of certain water uses and water rationing in times of drought. These provisions have the potential to reduce demand as well as to motivate more water-efficient behaviour among users, consequently reducing negative seasonality impacts and inequalities of access (Madungwe and Sakuringwa, 2007; Mulwafu et al., 2003). This is in contrast to earlier studies, e.g. (Mulwafu et al., 2003), that have indicated that there is limited adaptation of laws and bylaws to seasonal patterns of water use and availability. In this regard, both international and the national legislation addresses issues related to seasonality and extreme weather events.

Policy provisions may not be in line with current and future trends of climate risks, e.g. design standards of piped water systems. The dependence on historical hydrological trends and return periods of 50-100 years in designing water infrastructure to ensure that it is well protected from a 50-100-year flood (GD2) does not take into account current and future trends of occurrence of extreme weather events. This means that the current national policy provisions in addressing extreme weather events, are inadequate. As stated earlier, this approach is in contrast to the current thinking in climate debates where consideration of past, present and future trends should inform water infrastructure designs (Muller, 2007; Gahi et al., 2015). According to (Muller, 2007), this is a common problem in developing countries, specifically in Africa.

5.5 Conclusion

The international water policy (e.g. INTW4, INTW5, INTW6, INTW7, INTW9) strongly targets concerns of marginalised groups but there are policy gaps and inconsistencies that can perpetuate aspects of marginalisation. The international policy context – both water sector specific and other sectors – focusses on addressing marginalisation. Although earlier legislation does not explicitly mention drinking-water, the emphasis is on the promotion of human rights and addressing inequalities (INTC3). This fundamental principle of addressing inequalities in drinking-water access becomes clear in the later international legislation where the human right to drinking-water is clearly defined (INTC5, INTW4, INTW5, INTW6, INTW7, INTW9). However, consideration of seasonality and extreme weather events, with reference to the human right to drinking-water, is not well defined in the international legislation.

At the national level, the water sector policies and cross cutting policies reflect provisions in international legislation, though there are some context specific provisions and mismatches with international legislation. Similar to international legislation, most national policies related to drinking-water access emphasise equitable access (NATC1, NATW3, NATW4, NATW7, NATC9). Although not directly mentioned in the Malawi Constitution (NATC1), non-discrimination in water development and management is emphasised in many national policy documents through community-based approaches (NATW3, NATW4, NATW7, NATC9). However, the Water Resources Act (NATW4) and rural water guidelines (e.g. NATW5, NATW7) and the WUA Constitution (LOCW1) fail to recognise that illiterate people have become marginalised groups in decision-making bodies, in spite of the fact that they represent a significant proportion (40%) of the local population. Thus, improvement in access to drinking-water is likely to remain a challenge until the conceived approaches fit the local situation. National legislation contains weaknesses relating to extreme weather events, notably the lack of explicit mention of seasonality and unclear provisions for managing seasonal water fluctuations – one of the key factors affecting access to drinking-water in many rural households.

Despite the identified policy and legislation inadequacies at both the national and international scales, the policy documents analysed in this chapter set out standards and guidelines for service governance and service delivery. For example, the standard international criteria for assessing how well local formal water institutions deliver equitable drinking-water access are: availability, accessibility, quality, affordability, acceptability and sustainability. These international standards emphasise consideration of all water users including marginalised groups.

Chapter 6 focuses on analysing how well the local formal water institutions deliver equitable access to drinking-water among marginalised households across seasons and during extreme weather events. Thus, the chapter looks at how the four study communities manage, or do not manage, to achieve those minimum service delivery standards.

Chapter 6 Analysis of how well local formal water institutions deliver equitable access to drinking-water among marginalised households

6.1 Introduction

Chapter 5 looked in detail at the extent to which Malawi's national water policy articulates the needs of marginalised people and deals with seasonality and extreme weather events. Cognisant of continued rural access challenges, many developing countries have made policy shifts emphasising equitable access to drinking-water, and specifically targeting the unserved populations (Naiga et al., 2015). While the national and international policies acknowledge marginalised peoples' needs, various studies have found that there is a gap between stated policies and their implementation on the ground. For example, India has "*constitutional provisions in place that frame water as a human right*[38] *guaranteed to all people*" and water policy provisions targeting the needy (Allen et al., 2006 p33). Despite this, drinking-water requirements in India are yet to be met (Cronin et al., 2016) and specifically, Srivastava (2012) argues that the Indian water policy objective of 'Some for All' remains unachieved in rural areas. Similarly, a pro-poor rural water strategy is yet to achieve equitable water access in certain villages in semi-arid Mozambique (Ducrot and Bourblanc, 2017) and to meet availability and quality water standards among the poor in Lebanon (Makdisi, 2007). Naiga et al. (2015) argue that policy reforms to improve drinking-water access in rural households of many countries in sub Saharan Africa have been a mixture of success and failure. One of the main challenges relates to water service delivery.

For most developing countries, water service delivery[39] is not well documented in either academic literature or intergovernmental organisations reports. Many studies focus on assessments of

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[38] The right to water "*entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses*" that include drinking and food preparation (UN Economic and Social Council, 2002 p2).

[39] Water service delivery is defined as define "*the accessibility, availability and quality of the main source used by households for drinking, cooking, personal hygiene and other domestic uses*" (WHO & UNICEF,

water quality (WHO and UNICEF, 2017c; Masanyiwa et al., 2015; Boone et al., 2011) and distance covered to water source (WHO and UNICEF, 2010; Masanyiwa et al., 2015; Geere et al., 2010; WHO and UNICEF, 2017c; Boone et al., 2011). Yet, very little is known about what water service delivery looks like in practice in many areas, particularly in relation to quantity, affordability, and seasonal changes of water used for drinking. Seasonal assessments of water access, in particular, are scarce for developing countries (Arouna and Dabbert, 2010; Hadjer et al., 2005). Those that exist tend to focus on delivery of quality standards (Rahut et al., 2015; Ntouda et al., 2013; Irianti et al., 2016; He et al., 2018). Consequently, gaps remain in our understanding of seasonal access trends specifically in relation to quantity, affordability and distance standards in rural Sub Saharan Africa. This thesis from rural Malawi contributes to addressing this research gap.

This chapter focuses on the Outcomes element of Ostrom's SES framework, examines how national policy plays out in practice by comparing drinking-water service delivery (access) outcomes of different households in the four study communities (Actors) in both dry and wet seasons (Related ecosystems). There are four objectives relating to the attainment of minimum water services delivery standards for households in the dry and wet seasons, (identified in section 5.2.2): (i) explore quantity (sufficiency) of drinking-water; (ii) evaluate use of higher quality (improved) drinking-water sources; (iii) assess physical accessibility of drinking-water sources, and (iv) assess affordability of drinking-water.

In this chapter the primary sources of data are the ASSETS household survey (described below), supported by 18 key informant interviews and 13 focus groups (described in detail in section 3.5). The ASSETS household survey data is used to analyse the service delivery standards that can be quantified, while also providing seasonal trends. The qualitative data from key informants and focus group discussions complement this quantitative data and help to understand the household and village dynamics with respect to service delivery that cannot be revealed by the quantitative data. Detailed methods are described in chapter 3.

'Drinking-water' in this thesis is shorthand for 'water that is used for drinking and food preparation, cooking and cleaning up' (See section 1.2.1). The ASSETS household survey questions explicitly and implicitly referred to drinking-water rather than water for drinking, food preparation, cooking and cleaning up, as the focus of this thesis. Nevertheless, several previous studies have shown the water source types used for cooking closely mirror those for drinking (WHO, 2006; Bain et al., 2014; Golozar et al., 2016) and the qualitative data corroborate this too.

2017a). Available: https://washdata.org/monitoring/drinking-water [Accessed 16 January 2018 2018]. See Table 1.1 in chapter 1 for more details on the water service delivery ladder.

Section 6.2 describes the data collected and provides descriptive characteristics of households participating in the survey. Sections 6.3 to 6.6 present the quantitative and qualitative results on water service delivery outcomes, focussed around: sufficiency, use of improved water, physical access and affordability. Section 6.7 discusses the results and section 6.8 concludes the chapter.

6.2 Data collected and characteristics of households participating in the ASSETS survey

6.2.1 Overview of ASSETS survey, key informant interview and focus group participants

The ASSETS dataset comprises 306 households in the dry season and 311 in the wet season. See Chapter 3 (section 3.5.2) on determination of wet and dry seasons as well as seasonal samples. This household survey was supported by 18 purposively selected key informants ((including village chiefs (VL1-VL4), water committee chairpersons (VLWC1-VLWC6), NGO staff working in village-level water related interventions (NGO1), NGO staff working at district/regional level (NGO2), government staff in the community (GC1-GC2), and district water officers (GD1-GD4)) and 13 focus group discussions (4 all-women and 9 mixed genders) in the four study communities. The focus group participants were grouped into two wellbeing types: better-off (FGD1_mixed[40]) and poorer (FGD2_mixed and FGD2_W[41]) based on subjective indicators identified through participatory well-being and livelihoods exercises carried out by the ASSETS Project (www.espa-assets.org) (see Chapter 3, section 3.3.1 for more details).

The quantitative data were analysed using Chi-square statistic/Fisher's exact test, to determine whether there was a significant relationship between selected categorical variables. T-tests were used to show if differences in means of continuous household characteristics between groups were statistically significant. Logistic regression was used to establish which of the factors (predetermined through institutional analysis in chapter 5) associate with use of improved water and the quantity collected for drinking. The analysis is based on village and household type, specifically, gender and highest education level of household head, geographic location (upstream / downstream), household size, dependency ratio and wealth group of household. Disaggregated results can reveal subnational inequalities (WHO and UNICEF, 2017c). No target can be considered

[40] Men and women.
[41] Women only.

met unless this is true for all population subgroups disaggregated by socioeconomic characteristics (WHO, 2017; WHO and UNICEF, 2017d) including "income, gender, age, geographic location and other characteristics relevant in national contexts"(WHO and UNICEF, 2017d p3).

6.2.2 Characteristics of households participating in the ASSETS survey and PRAs

35% of the households live below the national poverty line (US$0.32/person/day[42]) in the dry season, while 85% live below national poverty line during the wet season (Table 6.1). Poverty levels are higher in the wet season. Average household size is 4.3 (SD= 2.080; min= 1; max=10) in the dry season and 4.8 (SD= 2.179; min= 1; max=12) in the wet season. Most households are headed by males in both seasons (75% - dry, 72% - wet). Education levels are very low; 38% of the household heads are illiterate. Many of the educated household heads seem to disappear[43] in the wet season and many more households are poor in the wet season than in the dry season. Geographically, 29% of the households are in the upstream and 71% are located downstream.

Table 6.1 Characteristics of households participating in ASSETS survey

Variable	**Percentage of households (absolute number) or mean**	
	Dry season (n=306)	**Wet season (n=311)**
Characteristics related to water access		
Main source of drinking-water		
• Improved water sources:	72% (219)	80% (248)
○ Piped into dwelling/yard	1% (2)	1% (3)
○ Public tap	6% (18)	4% (12)
○ Borehole	57% (173)	59% (183)
○ Protected well in yard/ public/spring	8% (26)	16% (50)
• Unimproved sources:		
○ Open well in yard / public	14% (42)	11% (33)
○ River/stream	15% (45)	9% (27)
Water consumption		
• ≥20 l/c/d[x]	70% (215)	53% (164)

[42] MK85,852/person/year using 2013 prices.
[43] They do not die but may relocate to other areas for work.

Variable	**Percentage of households (absolute number) or mean**	
	Dry season (n=306)	**Wet season (n=311)**
• ≥7.5 l/c/d	97% (296)	98% (304)
• ≥4 l/c/d	100% (305)	99% (309)
Average time taken to water source, including queuing	Not applicable	15 minutes
Characteristics related to institutional analysis (in chapter 5)		
Household geographic position:		
• Upstream (Upstream)	29% (88)	28% (88)
• Downstream (Downstream)	71% (218)	72% (223)
Wealth group (national poverty line -US$0.32):		
• Rich (above poverty line)	65% (199)	15% (47)
• Poor (below poverty line)	35% (107)	85% (264)
Household size (absolute number of people in a household, including children – not in Adult Equivalent Units)	4.3 (mean)	4.8 (mean)
Age of household head in years	42 (mean)	42 (mean)
Gender of household head:		
• Male	75% (228)	72% (224)
• Female	25% (78)	28% (87)
Household head highest education level attained:		
• No education	84% (258)	96% (300)
• Primary education	10% (29)	2% (5)
• Secondary education	6% (19)	2% (6)

[x] l/c/d =litres per capita per day; percentage or number of households in the final two columns do not add to 100% or number of households because they are comparing the proportions of a given population subgroup between the dry and wet seasons.

As outlined in Chapter 5, there are three benchmarks for household water requirements (4, 7.5 and 20 litres/capita/day (l/c/d)). 70% of households meet the 20l/c/d benchmark in the dry season and only 53% in the wet season. However, almost all households meet 7.5l/c/d and 4l/c/d benchmarks in both seasons (Table 6.1).

Furthermore, 72% of the households have access to improved water sources (including piped water, boreholes and protected wells) in the dry season and 80% in the wet season (Table 6.1).

6.3 Analysis of households' water sufficiency

6.3.1 Households with sufficient/insufficient water quantity (supply)

This section describes how well the four study villages meet the minimum 20 l/c/d basic access standard of water requirements for drinking, set out in the international and national water policies (indicated in chapter 5, section 5.2.5). Two less stringent benchmarks (7.5l/c/d and 4l/c/d) are also examined.

To calculate water requirements, household size (household members) was multiplied by three WHO benchmarks (4l/c/d, 7.5l/c/d, 20l/c/d). Table 6.1 shows that households on average were bigger in the wet season, therefore, water requirements (based on 20l/c/d) for 54% (168) of the 311 households were higher in the wet season (Appendix 13).

Water consumption refers to the actual quantity of water drawn per household. The water quantities used in the analysis represent water collected for drinking by households in general. Household respondents estimated an average quantity of water they had drawn in the past 7 days based on the number of 20l or 30l buckets used.

Relative to the dry season, water consumption increased during the wet season in 71% (211) of the 311 households, especially among households consuming larger quantities, i.e. between 60 and 120 litres/day (Appendix 14). In contrast, water consumption declined in households with low consumption (i.e. between 20 and 40 litres/day) and with very high consumption (over 120 litres/day). Thus, households move up/down into another category in the wet season. This change relates to increase in household sizes (Table 6.1) and for some households (with high consumption) "*the water is readily available, the source is near*" (FGD2_W_ Makombe).

Water shortfall is the difference between water requirements (assuming 20l/capita/day) and water consumption. In the dry season, 30% (91) of the 306 households had a shortfall (Table 6.1).

In the wet season, a greater proportion (47%; 147 households) of the 311 households experienced a shortfall (Table 6.1)[44].

Although higher proportions of households drew sufficient water during the dry season than the wet season, the trend varied by village (Table 6.2). Almost half of the households in Mtuluma had a shortfall in the dry season. Water shortfall was least severe in Mpheta. Similarly, though more households across all villages had insufficient quantities in the wet season, the situation seemed most severe in Mtuluma (57%) and Makombe (55%). These figures show that the association between village and insufficient quantities drawn is statistically significant (n=306, Chi^2=16.04, p<0.001) in the dry season, but not the wet season (n=311, Chi^2=4.11, p<0.250).

Table 6.2 Proportion of households obtaining insufficient quantities of water by village

By village (ordered by upstream (U) or downstream (D) position in their catchment)	Season	Total households	Insufficient, i.e. <20l/c/d (absolute number)
Mtuluma (U)	Dry	29	48% (14)
	Wet	28	57% (16)
Kasonga (U)	Dry	59	37% (22)
	Wet	60	48% (29)
Mpheta (D)	Dry	156	20% (31)
	Wet	167	43% (71)
Makombe (D)	Dry	62	39% (24)
	Wet	56	55% (31)

6.3.2 Drivers of water quantity sufficiency in wet and dry seasons

In this section, the main factors affecting water sufficiency (based on literature review, Chapter 2 and PRAs in this study) are considered: gender and education of household head, household income status, geographic location within catchment, seasonal access challenges and flooding. Water sufficiency is assessed both quantitatively (using the ASSETS survey data – see section 3.5.2), and qualitatively (based on focus group discussions with men and women in each village – see section 3.5.1). Due to different outcomes from the household survey and the focus groups,

[44] However, see section 6.3.2.5 for a discussion about other sources of water revealed by FGDs which suggest that total water consumption, particularly in the wet season, may be higher than the quantities reported as drawn in the household survey.

the results are presented separately, and I then reflect on possible causes for the difference between the qualitative and quantitative findings.

6.3.2.1 Geographic location and water sufficiency

Household geographic location is associated with attainment of the 20 l/c/d standard (n=306, Chi^2=7.38, p<0.007) during the dry season only. More downstream households (75%) than upstream/upstream households (59%) met the 20 l/c/d standard in the dry season (Table 6.3). The pattern remains the same during the wet season, but is not statistically significant (n=311, Chi^2=0.74, p=0.391).

Both univariate (unadjusted) and multivariate (adjusted) logistic regression models confirm that attainment of the 20 l/c/d standard is significantly lower in upstream households (unadjusted odds ratio [OR] =0.487 [0.289-0.823] p<0.05; adjusted OR=0.387 [0.202-0.742] p<0.05) (Appendix 15 and Appendix 16).

Table 6.3 Proportion of households obtaining insufficient quantities of water by household geographical location and season

Geographical location	Season	Total households	Insufficient i.e. <20l/c/d (absolute number)
Upstream	Dry	88	41% (36)
	Wet	88	51% (45)
Downstream	Dry	218	25% (55)
	Wet	223	46% (102)

6.3.2.2 Wealth group and water sufficiency

75% of rich households met the 20 l/c/d standard, compared to 62% and 49% of poor households in the dry and wet seasons respectively (Table 6.4). This association is statistically significant both in the dry (n=306, Chi^2=5.80, p<0.016) and wet seasons (n=311, Chi^2=10.49, p<0.001). Regardless of their gender and socio-economic composition, all focus group results reinforced this finding: "*differences are there* [*quantities vary by household wealth status]*" [Mtuluma mixed FGD].

Women FGD participants explained that wealth status-based variation was due to differences in water needs, ability to pay for labour especially during the dry season, and access to collection buckets as noted by a Mtuluma resident:

> *"The wealthier have many buckets. Using these many buckets they can draw sufficient water. But you a poor person may have one bucket and a second for the bathroom. You*

*take the bucket and fill the bathroom bucket and the second trip you keep for food preparation. By the time you want to cook, the water may not be sufficient. But the wealthier fetch sufficient supplies at once." (*Female, FGD2_mixed_Mtuluma*).*

Univariate logistic regression indicated wealth group significantly influenced the ability to get sufficient water in both seasons (dry OR=1.851 [1.117-3.069] $p<0.05$; wet OR=3.052 [1.516-6.145] $p<0.05$). Thus, the odds of having sufficient water is higher in the wealthier group than the poorer in both seasons (dry OR=1.851; wet OR=3.052). The effect of logged household per capita income is statistically significant (OR=1.304 [1.087-1.566] $p<0.05$) in the unadjusted/univariate dry season model, but insignificant in the wet season and adjusted/multivariate model (Appendices 15 and 16).

Table 6.4 Proportion of households obtaining insufficient quantities of water by wealth group and season

Wealth group	**Season**	**Total households**	**Insufficient, i.e. <20l/c/d (absolute number)**
Rich	Dry	199	25% (50)
	Wet	47	26% (12)
Poor	Dry	107	38% (41)
	Wet	264	51% (135)

Household income level is positively related to daily water consumption in many previous studies (Fan et al., 2013; Mohammad and Sanaullah, 2017; Hunter et al., 2010). However, these earlier studies do not disaggregate the data by season. In this thesis, the clear distinction by season gives an indication on when household income strongly influences household consumption, and this information can help planners not only to investigate and understand seasonal causal factors but also to inform plans for achieving equitable access throughout the year.

6.3.2.3 Education, gender of household head and water sufficiency

Education only appeared to be an important driver of water sufficiency in the wet season[45], when there was a more pronounced difference in having sufficient water between those with secondary

[45] When the number of household heads with no education suddenly doubles. No evidence was collected as to why this occurs, but I hypothesise that this is possibly due to seasonal migration or broken marriages.

education (83%) and no education (52%) (Table 6.5). However, there is no evidence of association either in the dry season (n=306, p=0.263, Fisher's exact test) or in the wet season (n=311, p=0.256, Fisher's exact test). Both unadjusted and adjusted models confirm an insignificant relationship in the dry season but a significant association (adjusted OR=2.032 [0.053-.773] $p<0.05$) in the wet season. This suggests that water shortfalls per capita per day are higher in households with no/low education, especially in the wet season.

Gender of household head in comparison, showed no statistically significant relationship with water sufficiency per capita in either wet season (n=311, Chi^2=3.25, p=0.072) or dry season (n=306, Chi^2=1.45, p=0.299).

Table 6.5 Proportion of households obtaining insufficient quantities of water by gender and education

By gender and education	Season	Total households	Insufficient i.e. <20l/c/d (absolute number)
By gender			
Male headed	Dry	228	32% (72)
	Wet	224	51% (113)
Female headed	Dry	78	24% (19)
	Wet	88	39% (34)
By education			
None	Dry	156	30% (77)
	Wet	300	48% (143)
Primary	Dry	29	38% (11)
	Wet	5	60% (3)
Secondary	Dry	19	16% (3)
	Wet	6	17% (1)

6.3.2.4 Household size and water sufficiency

As households increase in size (Fig. 6.1), daily water consumption per capita declines significantly in both the dry season (unadjusted OR = 0.562 [0.489-.645] $p<0.001$; adjusted OR = 0.528 [0.449-0.620] $p<0.001$) and the wet season (unadjusted OR=0.524 [0.441-0.623] $p<0.001$; adjusted OR=0.518 [0.430-0.624] $p<0.001$) (Appendices 15 and 16). Thus, the odds of having sufficient water is lower in the large households than in the small households.

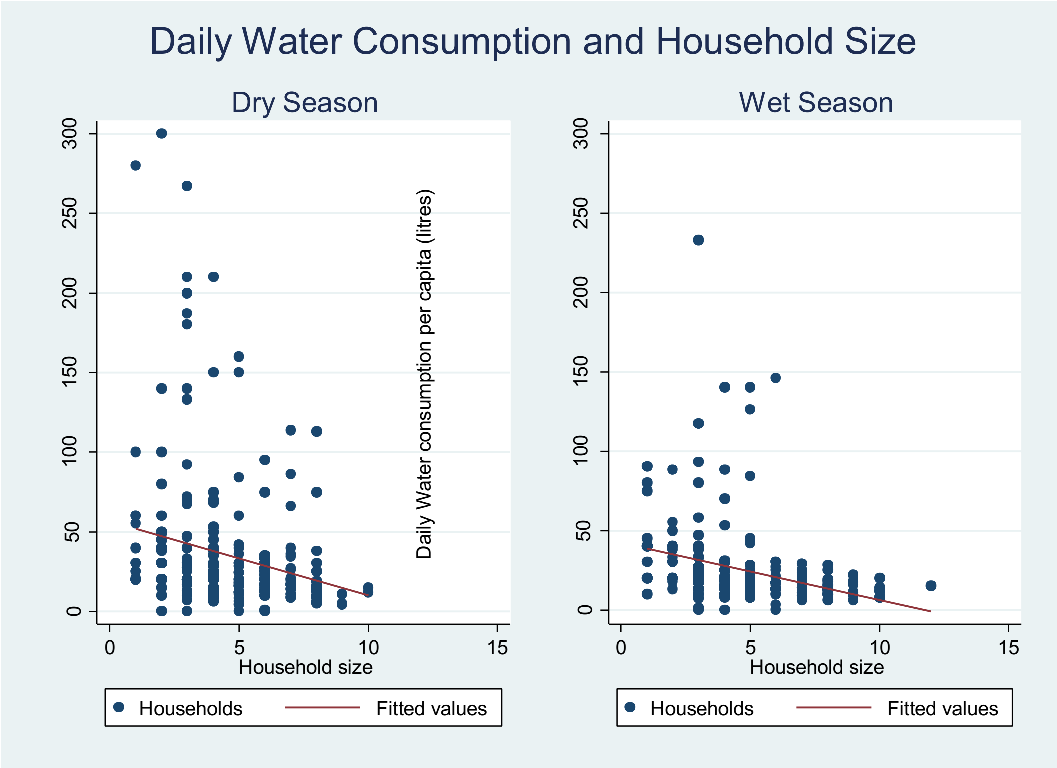

Figure 6.1 Daily water consumption per capita and household size in dry and wet season

6.3.2.5 Time (in minutes) to water source and water sufficiency

The ASSETS survey and my focus groups generated contrasting findings concerning the impact on water sufficiency of the time taken to reach the water source.

The ASSETS survey showed that, in the wet season, mean distance (in minutes) to water source was slightly lower (but statistically significant) for households collecting sufficient water quantities (>20lcd), compared to households with insufficient water (Paired T-test, t= 2.001, p<0.05) (Appendix 17). This relationship was significant in the univariate logistic regression model (OR=0.979 [0.959-1.000] p<0.05) but not in the multivariate model (OR=0.985 [0.961-1.009] p<0.211) (Appendices 15 and 16). The multivariate model results contradict previous study findings that distance/time taken to water source affects quantity of domestic water drawn (Rahut et al., 2015; Howard and Bartram, 2003b; Hunter et al., 2010). Thus, other factors appear to determine adequacy of water collected in the study households such as reliability of water source, cost of social relations among users (e.g. some households failing to draw water from a convenient drinking-water source due to poor relationships with fellow water users (Women, FGD2_W, FGD2_Mixed, Mtuluma)) and culture (Hunter et al., 2010). The multivariate model findings could be a result of the household survey question, which did not include explicitly other indirect costs such as the effort required to carry water associated with terrain conditions, which are more difficult during the wet season.

Surprisingly, FGD results on quantities drawn during the wet season were mixed, and they partially contradict findings from the household survey, both univariate and multivariate logistic regression results. The focus groups unanimously agreed that households consume more water during the rainy season than the dry season due to rising water tables and rainwater harvesting:

> *"The difference is there [in terms of water quantities fetched]. During the dry season, access is limited due to interruptions or shortages. Whereas in the rainy season we can get rains in the mornings and harvest using our plastic paper technology. Others use iron sheet roofs – hence we get more water from rainwater harvesting."* [FGD2_W_Mtuluma].

Further, due to high water tables, many households (especially in Mpheta, Mtuluma and Makombe) construct on-plot or near plot hand-dug shallow wells that provide easy access to domestic water:

> *"…those of us who live here [in the upper section of the village], we use boreholes only, while at Bango [wetland section in the village] they dig wells which they use in dry season because of distance to get to the borehole. During the rainy season, some just dig wells around their homes those who live far from boreholes.*" [FGD2_W_Mpheta]

A resource walk in this section of the village showed the presence of these hand dug wells in almost all households. Another situation was observed in Mtuluma village where a number of streams flow close to many households during the wet season. In such situations, many households used the water directly from the source. Hence, in the absence of probing, many FGD participants found it difficult to estimate the water quantities fetched in the wet season. Despite this, the FGDs reported various access challenges both during the dry and the wet season as well as during and after flooding (up to six months post flooding of January 2015).

Dry season challenges included an intermittent supply of tap water, low yield in boreholes and the drying up of other sources (see Appendix 18 for illustrative quotes). However, the trends varied spatially. For example, in Mtuluma, the tap water supply was available for an average of 10 hours per day (FGDs), with four of these hours at night. Similar results were captured in Kasonga village. Figures 6.2 and 6.3 show dry season access challenges depicted by different modes of drawing water from the same source in dry and wet seasons. In Mpheta, only one part (upper part with 56% of the total households) of the village enjoyed continuous daily and annual supply. The section adversely affected, with about 44% of the total village households, had a supply of shallow

(Maldev) pumps which dried up during the dry season due to low water tables (Appendix 18). Similarly, in Makombe, four of the five boreholes dried up during the dry season forcing the whole village to rely on one borehole. This situation forced households to use insufficient water (FGDs) (Appendix 18).

Figure 6.2 Drawing water from a protected well following low water table in Kasonga village – dry season

Photo by: Clifford Mkanthama and Miriam Joshua

Figure 6.3 Drawing water from the same protected well (Fig 6.2) in Kasonga village – wet season

Photo by: Clifford Mkanthama and Miriam Joshua

The FGDs identified wet season access challenges including intermittent supply from taps (Mtuluma) and unacceptable colour for borehole water (e.g. in Mpheta and Mtuluma) which had similar effects on household access to water. These FGD findings therefore suggest that the water sources in all the study villages generally were not able to provide a sufficient and safe year-round supply to all households. In this context, although the household survey results show larger shortfalls during the rainy season, this is probably due to survey respondents' omission of water from rainwater harvesting and on-plot hand dug wells and streams, when reporting water quantities consumed in the wet season. The use of both household survey data and FGD data leads to a conclusion that different seasonal drinking-water access challenges affected adversely, sufficiency of water collected and safety of water used in the study villages across seasons. Further, it highlights that mixed methods are important to understand water access dynamics that may not be revealed by the quantitative data alone.

6.3.2.6 Flooding and water sufficiency

Household water sufficiency also needs to be considered in the context of flooding events. The January 2015 flood was recorded as the worst compared with previous flood seasons, “in terms of geographical coverage, severity of damage and extent of loss” (Government of Malawi, 2015 p1) (see section 4.1.2 for details). Key informant interviews and FGDs in all the study villages established that flooding in January 2015 led to rivers flooding and wells filling up with mud, resulting in notable damage to water infrastructure and disruption to service. Community members noted differences between the 2015 and previous rainfall seasons as reported by key informants from Mtuluma and Makombe:

> “*Last season rain was heavy because was damaging. The way it was falling, before nothing of this nature had happened*” (VL2_Mtuluma).
>
> “*Flooding damaged a lot and it has never happened before*” [a flood of this size has not occurred before in the respondent’s lifetime in their village] (VL1_Makombe).

Damages from flooding were extensive. For the taps, the entire system from intake to distribution was impacted by the high flow velocities and discharges (VLWC1, Mtuluma). The water intake structures were clogged with excess silt and in many cases washed away (FGD2_W, Mtuluma, VLWC1, Mtuluma). The distribution system piping and fittings that were laid underground along culverts and under bridges were all washed away (VLWC1, Mtuluma). Boreholes were least affected (FGD2_W, Mpheta, FGD2_W, Makombe), thus agreeing with earlier study results (in Africa) that deep groundwater is more resilient to short-term climate variability (Bonsor et al., 2011; MacDonald, 2011) because supply is not linked to very recent rainfall (MacDonald, 2011). The flood damage to water infrastructure challenges adversely affected in the study area. Table 6.6 shows effects of flooding on household access to drinking-water. The effects included supply failure or intermittency in taps, increased distance to available water sources, and dirty water.

Table 6.6 Effects of floods on access to water from FGD and key informants' perspective

Drinking-water source	**Effect on access to water**	**Village mentioned**				**Access challenge during and post flooding period, illustrative examples**
		Mtuluma	Kasonga	Mpheta	Makombe	
Tap	Intermittent to no supply	√	-	-	-	"*People struggled for water to access drinking-water. The situation was different from previous years*" (VL1_Mtuluma) "*We were affected much in the sense that when water was flooding there was so much rain that we were failing to find where to access water. It took about four days of rains, nonstop, so we were failing to get water*" (FGD2_W_Makombe) Six months after the floods, "*water is coming here though irregular. It can last one week without water and sometimes three days while some are maintaining the damaged site temporarily*" (VLWC1_Mtuluma)
Borehole	Congestion - long waiting time	-	-	-	√	"*we were very affected such that we were scrambling for water*" because water sources were "*flooded… rain fell all day and night hence going to the river to access water was impossible.*" (VL1_Makombe)
	No effect	√	-	-	√	
	Milky/dirty water in upper section of the village	-	-	√	-	"*When we pumped water from boreholes, it was very dirty with mud. Because the water is underground when we pumped, the water was very dirty* ("*abii*")" (FGD2_W)
Spring	Increased distance to source	-	√	-	-	
	Water contamination Wait for five hours to access water	-	√	-	-	"*we were waiting for the flooding water to go... Five hours of waiting for the flooding water to go*" (FGD2_W_Kasonga).
Well	Limited access & dirty water	√	-	-	-	"*The problem was there and still exists till now* [over six months after floods].. *it was repaired but there is difference as compared to the previous time that the well was constructed properly. It was just that*

Drinking-water source	Effect on access to water	Village mentioned				Access challenge during and post flooding period, illustrative examples
		Mtuluma	Kasonga	Mpheta	Makombe	
						we should drink not that it was repaired permanently" (FGD2_W_Mtuluma). "wells were affected by flooding "*very much and the problems are still prevalent, they have not yet ended. The river where people were accessing water was flooded a lot so right now water access is difficult*" (VL1_Mtuluma).
	Dirty water and some collapsed	√	-	√	-	sources including "*wells [had] dried up so quickly because of the sand which came from the mountain to fill the wells"* relative to same period during the previous year (FGD2_W, Mtuluma) "*The individual wells collapsed…. When they collapsed and people failed to access water, they turned to fetch water from rivers and irrigation channels*" (VLWC4_Mpheta).
	No access	-	-	-	√	
River	Limited access and dirty water – muddy sand	√	-	-	√	"*when flooding water came it filled the wells with a lot of sand. When the sand filled up, the other side was like it was dug or deeply eroded by the flooding water. So we had a problem about where can we drink water? To get access to clean water for drinking, where can we find water*?" (FGD2_W_Makombe)

Note: √ = yes; - = not mentioned

Source: Focus group discussions and key informant interviews

Reported access challenges during and post flooding conditions were similar to, but worse than, those experienced during a normal rainfall season because water sources were inaccessible for prolonged periods and delayed repairs to costly infrastructure damage (Table 6.6). For example, FGD participants in Kasonga reported that during the rains, women struggled to draw water because paths to sources become impassable (FGD2_W_Kasonga) but during flooding, additional hours were spent waiting for water levels to subside:

> "*we were waiting for the flooding water to go... Five hours of waiting for the flooding water to go*" (FGD2_W_Kasonga).

Although the whole study area was exposed to flooding, the effects varied spatially and were most felt in two villages, Mtuluma (upstream) and Makombe (downstream), and one section of Mpheta village (downstream, located in the Lake Chilwa wetland) as reported by one key informant in Makombe:

> "*we were very affected such that we were scrambling for water*" because water sources were "*flooded… rain fell all day and night hence going to the river to access water was impossible.*"(VL2_Makombe).

Six months after the flooding, Mtuluma and Makombe villages still experienced access problems while the other villages only experienced access challenges during the flooding period itself (Table 6.6). In Mtuluma, access challenges persisted for over six months after floods for both the tap water system and wells, as reported in the group discussion (FGD2_W) and by key informants (see illustrative quotes in Table 6.6).

The quantitative household survey for the wet season took place during the post flooding months when the damaged infrastructure was yet to be repaired. Hence, in addition to regular wet season challenges, the access challenges after the flooding in part explain the larger wet season shortfalls in the household survey findings.

In summary, large shortfalls were experienced in the wet season dependent on household wealth group, household size, education level of household head, time taken to water source, seasonal access challenges and flooding. The effect of wealth group and household size is significant throughout the year, while for the household geographical location, influence is significant in the dry season only. Thus, the poor and large households are the ones most likely to have insufficient water quantities throughout the year and in all seasonal conditions.

6.4 Assessment of use of improved drinking-water

Water quantity alone does not determine water service delivery outcomes. Water quality also plays an important role. This section therefore assesses to what extent households use water of good quality following WHO Guidelines. According to the international and national water policies, the water for 'drinking use must be safe' - free from contamination (as noted in chapter 5). As a proxy for higher water quality, this thesis assesses household use of an improved main water source, i.e. one which protects against faecal contamination by nature of its design (WHO and UNICEF, 2017d; WHO and UNICEF, 2017c). This division was chosen, as reasonably large numbers of households use improved sources and unimproved sources. Household survey data and FGD data are used to identify the main sources of water for each village, and then analyse the factors influencing use of improved sources.

6.4.1 Main source of water by village in the dry and wet season

72% of study area households used improved water sources in the dry season and slightly more (80%) in the wet season (Table 6.1). In the dry season, 15% (45) relied on surface water compared to 9% (27) in the wet season. Significantly more households used improved sources in downstream villages compared to upstream villages (dry season n=306, Chi^2=67.40, p<0.001; wet season n=311, Chi^2=54.25, p<0.001). Most households in Mpheta (dry – 88%, wet – 92%) and Makombe (dry – 72%, wet – 88%)[46] used basic (good quality) water in both the dry and wet seasons, while households in Mtuluma (dry – 28%, wet – 40%) and Kasonga (dry – 41%, wet – 55%) had less access to improved water, particularly in the dry season (Table 6.7).

[46] During the dry season, some households in this village are restricted by long distance to the borehole and long queues (as many boreholes ran dry) to use hand dug shallow wells constructed on riverbanks close to their houses. In contrast, during the wet season, most households use boreholes because all the boreholes have running water and households located farther from the boreholes switch to boreholes because the shallow wells are covered by silt (FGD2, Makombe)

Table 6.7 Household[a] main source of water in different villages

Village	**Percentage of households for each source (absolute numbers)**						
	Improved drinking-water				**Unimproved drinking-water**		
	Best quality (Very advanced service level)	Good quality			Poor quality	Poorest quality (No service at all)	Total
	On premises	Basic			Unimproved water sources	Surface water	
	Piped into dwelling / public	Public tap /standpipe	Borehole	Protected well in yard/ public/spring[b]	Open well in yard / public[b]	River / stream	
Mtuluma(U) (n=29)[dry]	7% (2)	28% (8)	0%	3% (1)	0%	62% (18)	100%
(n=28)[wet]	7% (2)	36% (10)	0%	4% (1)	4% (1)	50% (14)	100%
Kasonga(U) (n=59)[dry]	0%	7% (4)	8% (5)	26% (15)	42% (25)	17% (10)	100%
(n=60)[wet]	2% (1)	3% (2)	13% (8)	39% (23)	29% (17)	14% (9)	100%
Mpheta(D) (n=156)[dry]	0%	4% (6)	80% (125)	4% (6)	11% (17)	0%	100%
(n=167)[wet]	0%	0%	76% (126)	16% (26)	8% (13)	0%	100%
Makombe(D) (n=62)[dry]	0%	0%	69% (43)	3% (2)	0%	27% (17)	100%
(n=56)[wet]	0%	0%	88% (49)	0%	4% (2)	9% (5)	100%

Notes: [a]: The household quantitative survey did not investigate household use of water treatment. Nevertheless, this was captured qualitatively through key informant interviews (KIs) and FGDs; [b]: Two/three water source categories merged because not many households have them; [dry]dry season value; [wet] wet season value; U= upstream; D=downstream . Source: Household survey question h_25: What is your main source of drinking-water?

Despite many households using improved water sources in Mpheta and Makombe, many households in all villages used only unimproved sources in both seasons.

6.4.2 Main source of water by household type

More downstream households (84%) used improved sources than upstream (catchment) households (40%) in the dry season (Table 6.8), with similar wet season patterns. Both dry (n=306, Chi^2=61.37, $p<0.001$) and wet season (n=311, Chi^2=52.69, $p<0.001$) relationships are significant.

Significantly more rich households (75%) than poor households (65%) used improved water in the dry season (n=306, Chi^2=4.06, $p<0.05$), but differences were insignificant in the wet season (n=311, Chi^2=0.04, p=0.850; Table 6.8). There was no relationship between the household head's gender and use of improved water in either season (n=306, Chi^2=2.27, p=0.132); (n=311, Chi^2=1.30, p=0.255), nor with their educational level (n=306, p=263, Fisher's exact test); (n=311, p=0.606, Fisher's exact test).

Table 6.8 Proportion of households using unimproved water source by household type, dry and wet season

	Season	Total households	Unimproved (absolute number)
By gender			
Male headed	Dry	228	31% (70)
	Wet	224	22% (49)
Female headed	Dry	78	22% (17)
	Wet	88	16% (14)
By education			
None	Dry	156	27% (70)
	Wet	300	20% (60)
Primary	Dry	29	41% (12)
	Wet	5	20% (1)
Secondary	Dry	19	26% (5)
	Wet	6	33% (2)
By geographic location			
Upstream	Dry	88	60% (53)
	Wet	88	47% (41)
Downstream	Dry	218	16% (34)
	Wet	223	10% (22)
By wealth group			
Rich	Dry	199	25% (49)
	Wet	47	21% (10)
Poor	Dry	107	36% (38)
	Wet	264	20% (53)

Source: Household survey question h_25: What is your main source of drinking-water?

Univariate models show that only logged per capita income (wealth status) and household location significantly relate to improved water source use. Household location is significant both in the dry (OR=0.122 [0.070-.214] $p<0.001$) and wet season (OR=0.126 [0.068-0.231] $p<0.001$) while wealth status only matters in the dry season (OR=1.220 [1.009-1.474] $p<0.05$) (Appendices 20 and 21). Thus, the odds of using an improved water source is lower in the upstream households than the downstream households in both seasons, and the odds are higher in the wealthier group than the poorer group in the dry season only. In contrast, multivariate models show three variables are significant. Gender of household head (OR=0.453 [0.212-.968] $p<0.05$) and wealth status (OR=1.342 [1.014-1.776] $p<0.05$) are significant in the wet season only, while household location is significant in both seasons ((OR=0.110 [0.060-.202] $p<0.001$) (OR=0.114 [0.060-0.217] $p<0.001$)). The results show that there is a high probability of female-headed, richer and downstream households using improved water sources in the wet season while in the dry season, the probability is high in downstream households only.

The FGDs and KIs capture similar findings. Use of improved water sources increased during the rainy season because many improved water sources were functional and community health officers provided villagers with Water Guard and chlorine for water treatment. However, the FGDs and KIs reported that use of water treatment varied socioeconomically and seasonally. While one key informant reported that water treatment chemicals were distributed to households throughout the year (GC1-Mtuluma), all the FGDs and other key informants indicated that the supply was irregular (All FGDs; GC2) due to insufficient provisions (GC2– Kasonga). At the time of data collection, supply was restricted to rainy season as reported repeatedly in the poorer FGD (FGD2_W) in Makombe:

> "… *we… have HSAs* [health surveillance assistant – government health officers working at community level] *who provide us with water guard*[47]*, because in the water there are some diseases*".

However, this is only supplied "*when it's rainy season*" (FGD2_W). Similarly, Kasonga village had stayed almost a year without provision of water guard or chlorine as reported by the health surveillance assistant:

> "*in the past when chlorine was easily found, people were applying but now chlorine is scarce so it looks like applying chemicals … has stopped relatively,… but those who have access to a little money they can go buy water guard and apply but are a few households who do that"* (GC2– Kasonga).

The study established that those with sufficient supplies were better-off households who could afford supplementary packets. Since the household survey did not capture water treatment in either season, this qualitative result may mean that after accounting for household water treatment richer households are even less exposed to contaminated water, relative to the poor, than survey-based improved source coverage figures suggest. However, intermittent supply forced all households to use unsafe water sources (FGDs). Shifts in water sources by seasons are further depicted in Table 6.9 below.

[47] Water guard is a chemical for drinking-water treatment, usually at household level.

Table 6.9 Summary of preferred sources of drinking water chosen by households in dry and wet seasons

Season	**Water source**	**Village**							
		Mtuluma		Makombe		Mpheta		Kasonga	
		Wealth-ier	Poor	Wealth-ier	Poor	Wealth-ier	Poor	Wealth-ier	Poor
Dry season	Borehole	1	2	1	1	1	1		
	Tap	4	4						
	River	2	3	2				3	
	Well	3	1	3	2	2		2	
	Spring							1	1
Rainy season	Borehole	2	3	2	1	3	1		
	Tap	4	5						
	River	2	2	3				4	
	Well	3	4		2	2	2	2	3
	Spring							1	1
	Rainwater harvesting	1	1	1	3	1		3	2

Key: 1 = most selected; 5 = least selected

Source: Focus group discussions

The findings in Table 6.9 show stated preference and access changes between seasons. In Makombe, many households shift from wells to boreholes in the wet season and back to shallow wells in the dry season. In Mtuluma, many households using tap water and boreholes in the dry season shift to shallow wells and rainwater harvesting in the wet season. Multiple reasons for the seasonal shifts include:

- Reliability of service – e.g. intermittent supply of tap water forced many households in Mtuluma to shift to wells and rivers in both the dry and wet seasons and drying of boreholes forced households to rely on handdug wells in Makombe in the dry season;
- Affordability of traditional water sources (e.g. wells and rivers) compared to tap tariffs in Mtuluma influenced poor households to shift to traditional water sources;

- Long distances/physical accessibility to water sources was also a critical factor influencing shifts to unimproved water sources in both seasons in Mtuluma, Makombe and Mpheta (wetland section) and shift to rainwater harvesting in Mtuluma.
- Preferred taste of rainwater was also an additional factor in all the villages.

The seasonal shifts in the rainy season are largely towards unimproved sources (particularly rain water harvesting). However, even improved systems may not always be safe; for example, intermittent piped water supply systems (as is the case in Mtuluma village) are often subject to microbial contamination events (Kumpel and Nelson, 2016; Kumpel and Nelson, 2013). In this context, improved source coverage estimates from the household survey may under-estimate exposure to contaminated water.

6.5 Assessment of physical accessibility

This section analyses how well the four study communities managed to meet the minimum standards of physical accessibility - within 1000 metres and 500 metres. These thresholds are set in the international water policies and national water policies stipulated in chapter 5. According to Malawi's National Water Policy (Government of Malawi, 2007b) (through the National Water Development Programme), households are likely to collect sufficient quantities of water when return distance is within a 500m radius/1000m (National water policy/International water policy) or when total collection time is less than 30 minutes (NATW4; INTW1). The household survey measured total water collection times, including queuing, in the wet season, but only one-way water collection trip times in the dry season. It was therefore only possible to compare household survey data to the national standard round-trip time of 30 minutes in the wet season; dry season survey data had to be excluded from analysis.

Table 6.10 shows results at village level while Table 6.11 shows results by household type. Almost all households (97%) obtained water within 30 minutes in the wet season, though significantly fewer (n=311, p<0.001, Fisher's exact test) did so in Mtuluma (79%). Fewer households in Mtuluma fetched water within 30 minutes (roundtrip) because services were far from households (Appendix 19). In contrast, findings from FGDs reported reduced total collection time in the rainy season due to rising water tables. Thus, the proportions of households obtaining water within 30 minutes in the three villages are far greater than the national rural average of 44% (National Statistical Office and ICF, 2016). However, this national figure may hide seasonal variations.

Table 6.10 Time taken to fetch water (total trip time including queuing) in the wet season by village

Village (ordered by upstream (U) or downstream (D) position in their catchment)	Total households	More than 30 minutes (absolute number)
Mtuluma (U)	28	21% (6)
Kasonga (U)	60	0%
Mpheta (D)	167	1% (2)
Makombe (D)	56	5% (3)

In terms of household types (Table 6.11), only the relationship between household geographic position and travel time (within 30 minutes) is significant (n=311, Chi^2=3.87, p=0.049). There is no relationship between household headship, education or wealth group and travel time.

Table 6.11 Time taken to fetch water (total trip time including queuing) in the wet season – over 30 minutes by household type

	Total households	More than 30 minutes (absolute number)
By gender		
Male headed	224	4% (9)
Female headed	87	2% (2)
By education		
None	300	3% (10)
Primary	5	20% (1)
Secondary	6	0%
By geographic location		
Downstream	223	2% (5)
Upstream	88	7% (6)
By wealth group		
Rich	47	2% (1)
Poor	264	4% (10)

Source: ASSETS household survey, Water and Electricity Q.8. ModWater3 (wet season): How much time do you usually spend during **each trip to fetch water**, including the time required to get to the sources, filling your containers and coming back home?

Despite the quantitative data limitations, the qualitative FGDs included waiting times for both seasons. The qualitative survey found that in the dry season, travelling time is shorter and waiting time is longer while in the wet season travel time is longer and waiting time is shorter especially for upstream households because of the steep and slippery terrain. The participants unanimously agreed that people spend more time collecting during the dry season due to lowered water tables and source failures: (see Appendix 18 for other illustrative quotes)

> "*water is what is our main problem. Especially during this season [dry season]. Even taps may become dry because of low levels at the intake. Frequent interruptions. The water may come early in the morning or by noon there is no water in the taps"* (FGD1_mixed - Mtuluma).

> *"When other sources dry up we draw from the same source, [in] September and October. In the morning there is no problem. But the water does not last long. When 20 people draw the water, it gets depleted. We wait long hours for the water … During dry season we use a pail to get water from it [the spring due to low water table]"* (FGD2_W-Kasonga).

In line with household results, FGD participants also partly reported longer water collection time in the rainy season due to steep and slippery routes especially in Kasonga (see Appendix 18 for illustrative quotes) and Mtuluma; and inaccessibility of alternative traditional sources e.g. in Makombe village wells are covered by silt. In Makombe, this situation forces households close to these wells to turn to boreholes which are located over 30 minutes return trip from their households. FGDs established that time spent on water collection was dependent on the proximity of the household to the water source and to the season, as highlighted by one male FGD participant in Mtuluma:

> *It depends on proximity to the source. For example from mid-section of the village to get tap water one spends about 1 hour….To get water from the [public] well (Mpumbe or Kambende) women spend over 2 hours round trip; for households up the mountain, about 1 hour*.

These results suggest that while most households in the study villages met the 30 minutes/1km international standard, notable proportions of certain household types in some villages did not meet the 15 minutes/500m national standard of physical access.

Similar conditions appear during flooding conditions when households, e.g. in Makombe, spend a long time queuing for water at available water sources when others become inaccessible (FGD2_W, Makombe). Another situation relates to long waiting time spent at home, waiting for water levels to subside (FGD2_W, Kasonga, FGD2_W, Mtuluma). These findings suggest that during flooding conditions, households also fail to meet the 15 minutes/500m national standard of physical access.

However, the ASSETS household survey, similar to national household surveys do not reveal this access challenge.

Drinking-water access is also closely related to affordability.

6.6 Assessment of water affordability

This section examines drinking-water affordability, including both direct costs (e.g. water tariffs, user fees for facility development and maintenance) and indirect costs (e.g. transport costs associated with fetching water, labour payments for fetching water, water treatment, costs for purchasing/procuring water harvesting equipment). The household survey grouped the direct and indirect costs together, asking respondents to estimate the total amount spent on water (including monetary expenditure and in-kind payments), while the FGDs and key informant interviews disaggregated the costs qualitatively. In the household survey, water affordability was examined through analysis of household expenditure on water and proportion of household expenditure spent on water – a commonly used proxy measure of affordability in many countries (WHO and UNICEF, 2017c). There is no international standard for affordability, so countries use benchmarks ranging from 2% to 6% of household expenditure spent on water (WHO and UNICEF, 2017c; Martins et al., 2016). The study applies 3% and 5% thresholds suggested by international water policy (see chapter 5).

6.6.1 Household expenditure on water

Only 25 (7%) households spent money on water during the dry season and 19 (6%) households in the wet season (Figure 6.4). Most households (79%) that pay in the dry season live above the national poverty line while in the wet season most households (84%) paying for water are poor. This pattern can relate to household wealth category change by season - 35% of the households live below the national poverty line in the dry season, while 85% are in the poor category during the wet season (Table 6.1). This implies that the same household may pay in both seasons, but in different wealth categories. In the dry season, most (64%) water expenses are spent on boreholes, followed by 28% on tap water, 4% on protected public wells and 4% on stream and river water. In the wet season, 42% is spent on borehole water, 42% on tap water, 5% on protected public wells, and 11% on open public wells. Some households therefore pay for water from unimproved sources and surface water, similar to findings from WHO and UNICEF (2017c). However, WHO/UNICEF's annual and regional averages mask seasonal and village level variations.

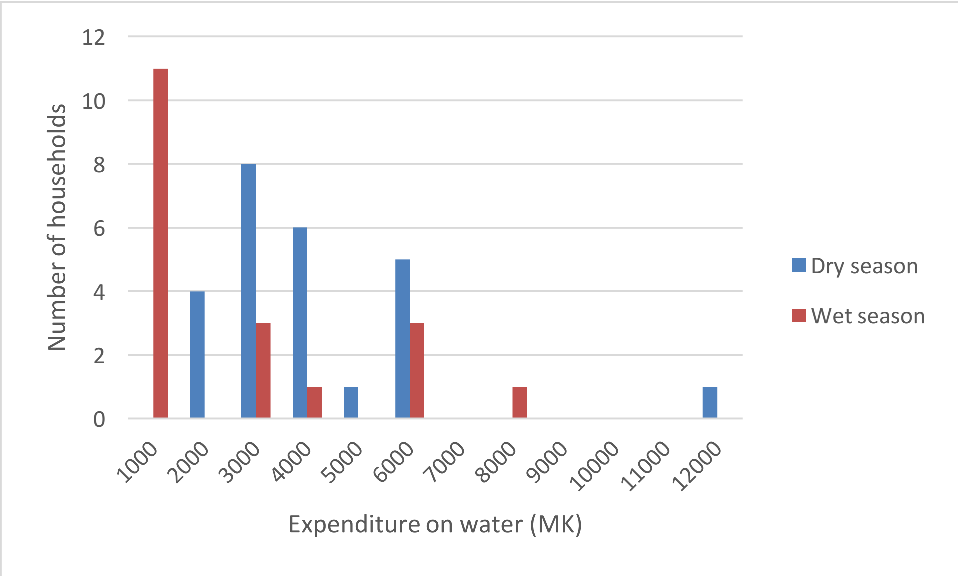

Figure 6.4 Household expenditure on water in the dry and wet seasons

Source: Household survey results – h_29: What was the total cost of drinking-water for your household last month?

Analysis by village shows that no households in Kasonga spent any money on water, confirming findings from the FGDs that there were no water service tariffs in the village. A small proportion in Mpheta and Makombe paid for water services in both seasons. From FGDs and key informant interviews, these comprised borehole fees. Mtuluma had the highest proportion (28%) of people paying for water services during the dry and wet seasons (32%). This reflects the WUA monthly tariff (USD0.14/0.28) (MK100/K200) for a communal tap. While both quantitative and qualitative findings agree on expenses on borehole and tap water, there was no direct mention in the FGDs and KIs of expenses on unimproved sources and surface water. This probably relates to indirect expenses which were mentioned during the FGDs such as payment for labour for water fetching and for water treatment chemicals.

Analysis by household type shows slightly more poor households and those located upstream, paying for water during the wet season, than dry season (Table 6.12). However, the relationship is not statistically significant (dry season [n=306, Chi^2=0.27, p=0.606], wet season [n=311, Chi^2=3.63, p=0.057]) nor is it significant by wealth group (dry season [n=306, Chi^2=2.29, p=0.181]; wet season [n=311, Chi^2=0.01, p=1.000]).

Table 6.12 Paying for water in dry and wet seasons by household type

	Season	Total households	Paying for water (absolute number)
By geographic location			
Upstream	Dry	88	9% (8)
	Wet	88	10% (9)
Downstream	Dry	218	7% (16)
	Wet	223	5% (10)
By wealth group			
Rich	Dry	199	10% (19)
	Wet	47	6% (3)
Poor	Dry	107	5% (5)
	Wet	164	10% (16)

6.6.2 Proportion of household income spent on water

This section analyses water affordability based on the proportion of household expenditure spent on water per month. The study applied World Bank Guidelines for Welfare Analysis to construct a household consumption aggregate (see section 3.4.2.1.2).

Figure 6.5 shows the proportion of total household expenditure, as a percentage, on water for households that paid for it. In the dry season, water expenditure was less than 5% of total household expenditure in all households. However, five (26%) of the 19 paying households spent more than 5% of their total household expenditure on water in the wet season and eight (42%) more than 3% (WHO and UNICEF, 2017c). This means that affordability is related to seasons. Access to drinking-water is generally affordable to many, including those who are paying, particularly in the dry season. Water becomes unaffordable for some (five or 11) households during the wet season probably because income levels are low during this time, when 85% of the households live below the national poverty line. Notably, most households (84%) paying for water during the wet season, are the poor. This could explain why the study had contradictory results from key informant interviews and FGDs. For example, from key informant statements, the tap tariff was generally perceived to be low (VL2, WUA) contradicting FGD findings in Mtuluma as highlighted in the following quote:

> "*Those who may be able to pay are three families…the financial contribution at the tap is just too much, to pay monthly, so, for one to raise that money it's difficult*"
> (FGD2_women, Mtuluma).

However, except for the poor women in Mtuluma (FGD2_women, Mtuluma, see section 7.4.2), no respondents considered seasonal differences in affordability. These findings agree with those of Totouom and Fondo (2012) in Cameroon who, similarly, used per capita expenditure as a proxy for household welfare and concluded that better off households are more likely to choose improved quality water than are the poor. However, the Cameroon study did not consider the seasonal trend.

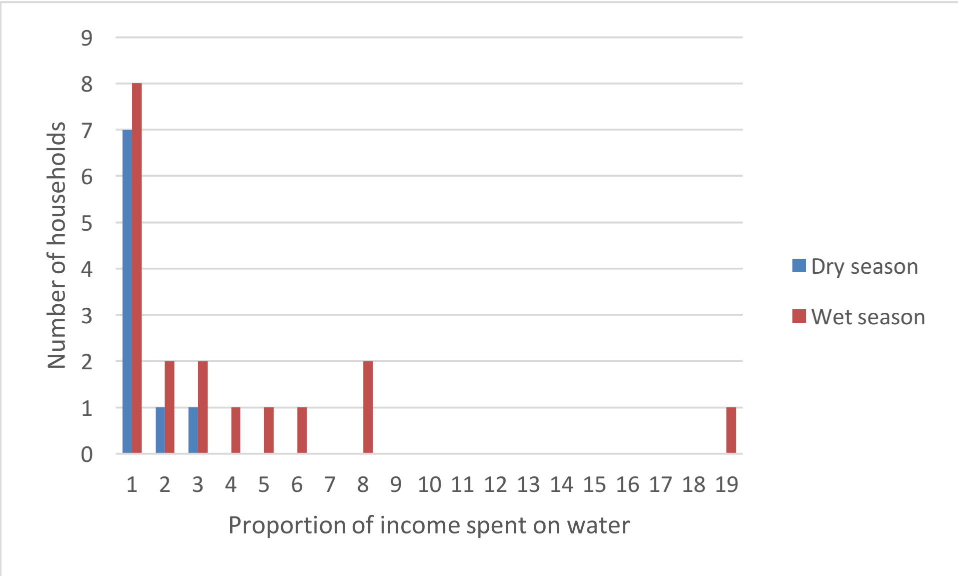

Figure 6.5 Percentage of household expenditure spent on water in dry and wet seasons

Furthermore, the picture that water is generally affordable and that many households are not paying for the service in the study area, should be handled with caution as "*spending less on water does not always result from water being cheaper; rather, in most instances it is an indicator that there is a lack of services*" (Soares et al., 2002 p392). This observation is applicable for villages such as Kasonga and Mtuluma where a large proportion of households have no service in either season.

6.7 Discussion

The second and third objectives in this thesis, in part, sought to assess the management of seasonality and equitability of access to drinking-water in practice. This section therefore discusses the ability of households to meet service standards namely sufficiency, quality, physical accessibility and affordability at village scale in both the dry and wet seasons. Qualitative and quantitative data were consistent on some aspects, notably: i) failures in service delivery standards; ii) inequalities in service access at a local level; and iii) seasonal variability in service access

6.7.1 Failures in service delivery standards

The results show that although almost all the households in the study villages met their water requirements for drinking at 4 l/c/d and 7.5 l/c/d standards, fewer met the 20l/c/d standard. Access to very advanced service level ('safely managed') was almost non-existent in all the four villages and a few (15%) households relied on surface water (they had no service at all). This is a common picture across rural areas in Malawi (National Statistical Office and ICF, 2016) and sub Saharan Africa (UNICEF and WHO, 2015). Understanding the pattern across different subgroups and the contributing factors is therefore one step towards addressing the challenge.

6.7.2 Inequalities in service access at local level

The study reveals important geographic and socio-economic inequalities in access, both in use of sufficient and improved water at the local level (between villages and within the village), often not possible to spot with routine survey and census data. There are also clear differences in affordability and time taken to obtain water.

Significant shortfalls in use of sufficient water (20 l/c/d) were evident in households located in upstream villages which were characterised by lack of service. This suggests failure of water policy to meet basic water needs for households located in these upstream locations. The shortfalls were also significant in poor households, and those with large household sizes and no or low education. The inequalities by education confirm the study findings by Shrestha et al. (2013) and Fan et al. (2013) in Nepal and China respectively, that education level of household head is a significant determinant of water consumption in households. Similarly, the result on household sizes agrees with a study by Fan et al. (2013) in rural China but contradicts several studies (Totouom and Fondo, 2012; Fan et al., 2013; Mohammad and Sanaullah, 2017; Arouna and Dabbert, 2010; Totouom, 2013) which found significant increase in water quantity drawn with increased household sizes. The differential quantities by wealth status were, in part, associated with the report that rich households possess an adequate supply of buckets and have the ability to pay for labour to aid in water collection. The household survey did not explicitly measure these indirect costs, hence their effect on quantity collected in poor households could be underestimated or hidden in the average values from the household surveys.

Furthermore, most affected were villages where service distribution was spatially inadequate[48]. This explains partly why the study area had a much higher proportion of households fetching water from surface water sources than both national rural estimates (0.2%) (National Statistical Office and ICF, 2016) and regional and global estimates, at 10% and 4% respectively (UNICEF and WHO, 2015). The national Water Policy agenda of ensuring equitable drinking-water access for all is, therefore, yet to be realised in the study area.

In relation to the use of improved water, there were observable differences by village and household type. Household access was better where boreholes were present. Problems of access to improved water are persistent significantly in households located upstream. The notable spatial inequities in service level within the study community means that the policy has not performed well in improving service provision of drinking-water in the study villages. However, this dimension of disparity at village level is hidden in regional, national, district and rural urban averages. Although application of the ladder for water quality in the analysis does not impact the results much, it reveals the spatial inequalities of service level at lower scales. These study results suggest that service distribution is highly variable within the same district, which, in turn, suggests that communities with good distribution receive preferential treatment with repeated service allocations while others are ignored. Similar findings on large disparities between communities have been reported by Chipofya et al. (2012) who analysed service coverage in rural Malawi against the recommended standards of quality and distance. The study noted that although the Government of Malawi in the past five decades had installed a significant number of drinking water facilities (>27,000 boreholes to serve about 6,750,000 people, >79 gravity-fed piped water supply schemes with over 10,000 taps to serve over 1,200,000 people), about 34% of households still had no access to drinking water. According to Baumann and Danert (2008) and Chipofya et al. (2012), the figure could reach about 60% due to non-functionality of about 30% of the installed water facilities. However, these studies hide subgroups that are entirely without access.

The results further show that access to water is affordable to many of the households. However, the odds that a richer household will use an improved water source are higher than those for a poor household, suggesting greater access to improved drinking-water for richer households than for poorer ones. Thus, access may depend on a household's ability to earn sufficient income. This is in line with Majuru et al. (2016 p12) who argue that "lower income households are more likely

[48] Spatially inadequate means that households which were widely spaced were not served with drinking-water facilities if the total number of households did not meet the minimum size eligible for service provision.

to accommodate unreliability and adopt time- and labour-intensive strategies such as rescheduling activities and collecting water from alternative sources" which may be of lower quality, e.g. shallow wells which pose health risks. In this regard, as highlighted in the qualitative study findings, time spent on water collection depends on the distance to this alternative water source or time spent on queuing (Majuru et al., 2016). The ASSETS household survey question asks about the direct and indirect costs of obtaining water in monetary terms. However, there is evidence that poorer households often incur non-monetary costs accessing water (via their own time and labour). Women spend much time on water collection (Boone et al., 2011) because of inadequate water infrastructure in many rural areas. Other examples include opportunity costs of spending much time on water fetching, related to young women's school attendance and participation in income-generating activities (Sorenson et al., 2011). Another cost relates to medical payments after consumption of contaminated water, as suggested by the current qualitative findings and supported by study results in 44 developing countries (Rahut et al., 2016b).

6.7.3 Seasonal variability in service access

In the study area, there are differences in access to water by season. There are significant differences in where and how (marginalised) households meet their water requirements in the rainy and dry seasons. For example, the rich (who also have high proportions that collect sufficient water per capita per day) experience no change at all between the dry and wet seasons, suggesting that they use the same (reliable) sources year round or are least affected by seasonal availability of water, while the poor experience a huge change between the dry and wet seasons. This is probably due to seasonal migration / seasonal income/expenditure variation in the study area, as illustrated by the household characteristics in Table 6.1. The implications of this are discussed in Chapter 8.

The other key finding is that some drinking-water source types are managed by formal institutions (piped water, boreholes), whereas others (e.g. rainwater, shallow wells) are not, and households use different source types by season. Similarly, there were observable differences in the use of improved water by village and household type. Generally, there was a reported improvement in the wet season. However, use of in-dwelling or on-plot facilities was limited. Many households collected drinking-water from public improved water sources located away from their homes and mostly used open containers. Additionally, water treatment was inadequate. Clasen et al. (2015) argue that water treatment has to be consistent, microbiologically effective, and sustained to deliver health benefits –such water treatment is not happening in the study sites. This argument is in line with international Human Rights Law (INTW4 para. 12) which emphasises that access to safe drinking-water should be continuous for each person. This idea is developed further in Chapter 8.

This brief discussion takes into account limitations of the study analysis. Examples include the study's use of improved/unimproved source which is known to be an uncertain proxy for exposure to unsafe water because of health risks associated with some improved sources and evidence of microbial or chemical contamination after collection and interrupted piped supplies following breakdowns (Bain et al., 2014; Shaheed et al., 2014a; Shaheed et al., 2014b). The measure of time travelled to obtain water excluded dry season survey data because it measured only one-way collection trip times. Furthermore, the expenditure measure does not capture explicitly all the costs associated with water, e.g. indirect costs. Additionally, as the household survey did not ask about seasonal access challenges, analysis of this point draws only on qualitative data. Despite these limitations, the study findings add some new knowledge to the water scholarship.

6.8 Conclusion

In summary, there are areas where quantitative and qualitative survey findings are consistent including failures in service delivery standards, inequalities in service access at a local level and seasonal variability in service access. Results show 70% of the households meeting the 20 l/c/d standard in the dry season and fewer households (53%) or a larger gap (47%) in the wet season. Results further show about 3% failing to access water within the recommended time (30 minutes) in the wet season, over 10% without service throughout the year, 46% and >25% of households spending more than 3% and 5%, respectively, (using 3% and 5% thresholds), of their total household expenditure on water during the rainy season. Although there are few areas where my quantitative and qualitative survey findings are inconsistent, these results suggest water policy failure to provide equitable and continuous access to drinking-water in rural Malawi. The impact of dry and wet seasons on access is shown clearly in this chapter, and it can be concluded that improving access to drinking-water and meeting households' water requirements in marginalised households is likely to remain a challenge until seasonality issues are considered. For example, assessments are required showing how rural communities respond to meet their households' drinking-water needs during extreme weather events. The issue of seasonality and extreme weather events receives little attention in the water scholarship and policy discourses. Seasonal assessment of access to drinking-water is essential for informed policy and interventions to ensure continuous and equitable access. Furthermore, although universal standards are important in calculating attainment of sufficiency and access to drinking-water, inadequacies identified suggest a need to include other factors in such assessments. Examples include the nature of the terrain, time taken to water source and indirect costs such as number of buckets or ability to pay for labour in water collection for affordability calculations. The next chapter analyses the institutional factors that are behind this pattern of service delivery. This includes how seasonal access challenges are considered in practice.

Chapter 7 The role of local water institutions in explaining why water service delivery outcomes vary among marginalised households across seasons

7.1 Introduction

Chapter 5 showed that national policies and legislation promote delivery of equitable access to drinking-water. However, Chapter 6 found that the quantity of drinking water collected, use of improved water sources and household expenditure on water differed from policy-based expectations, varying according to village, household type (geographical location within the catchment, income status and household size) and season. By village, per capita use of drinking-water and use of improved water sources were least in Mtuluma. By household type, access challenges were greater in upstream, poor, large households and those whose head had a low level of education. By season, more households experienced larger gaps in water sufficiency, used improved water sources less and spent more than 5% of their expenditure on water in the wet season than in the dry season. The findings presented in Chapter 6 (section 6.4) further show shifts in preference and access changes of water sources between seasons. Much of the seasonal shifts are from formal water sources (e.g. taps and boreholes) to informal water sources (e.g. hand-dug wells and rivers) which are unimproved. Formal institutions link to formal water sources (boreholes and taps), whereas hand-dug wells, and rivers are informally managed and are unimproved drinking water sources. This leads to the examination in this chapter of the role of local formal institutions in explaining the variation in drinking-water service delivery outcomes.

Various studies have found that there is a link between water service delivery and service governance (Yamia et al., 2009). For example, persistent water supply challenges in several countries are in part "*attributed to a water governance crisis*" (Naiga et al., 2015 p238). In response, many countries have attempted to address the situation by applying good governance standards based on human rights principles in International Human Rights Law (INTW4, INTW6), such as: (i) inclusiveness (non-discriminatory and equal service provision); (ii) effective information sharing; (iii) local community participation in design and management of the system (including regulation and monitoring); and (iv) accountability of actors (Srivastava, 2012; Chitonge, 2011; Ducrot and Bourblanc, 2017; Kemerink et al., 2013; O'Reilly and Dhanju, 2012). However, implementation of governance standards has yielded both success and failures in different countries (Chitonge, 2011; Gain and Schwab, 2012; Nawab and Nyborg, 2009; Srivastava, 2012; Naiga et al., 2015; Ducrot and Bourblanc, 2017). Furthermore, it is widely acknowledged that "*governance problems and issues remain highly local and contextual*" (Naiga et al., 2015 p239), with no ideal or 'one-size-fits-all' institutional arrangements for addressing poor service delivery (Poteete and Ostrom, 2004; Pavri and Deshmukh, 2003; Singh, 2013). Specific gaps exist in our knowledge and understanding of how institutional dynamics play out in many rural areas of Sub-Saharan Africa (Naiga et al., 2015).

This chapter focuses on the governance system (GS) element of Ostrom's SES framework. It examines service governance, including participation of marginalised groups (Actors) in decision-making structures, accountability of service providers (Interactions) and adaptability to seasonality and extreme weather conditions (Related ecosystems)) in each of the four study villages and their role in explaining drinking-water service delivery (Outcomes). Drawing on the good governance standards explained in Section 5.2.4 (summarised in a process diagram, Fig. 7.1), and taking into account seasonality of supply, and impacts of extreme weather events, this chapter specifically assesses the extent to which

(i) service governance is non-discriminatory and equal (Section 7.2);
(ii) marginalised users can find out about their water access (Section 7.3);
(iii) the poor and women participate in decision-making forums and water service management (Section 7.4); and
(iv) service providers and other relevant actors are accountable to user demands (Section 7.5).
(v) As a fifth specific objective, this chapter also analyses how water delivery institutions address seasonality and extreme weather events (Section 7.6).

In this chapter, use of 'water policy' refers to all national policy documents, i.e. the National Water Policy, district guidelines and implementation guidelines and manuals for drinking-water service delivery. 'Legislation' includes formal laws or acts and processes of implementing these acts at national, district and local level. These national policy documents and legislation are distinguished from 'international policy' and 'international laws or legislation'.

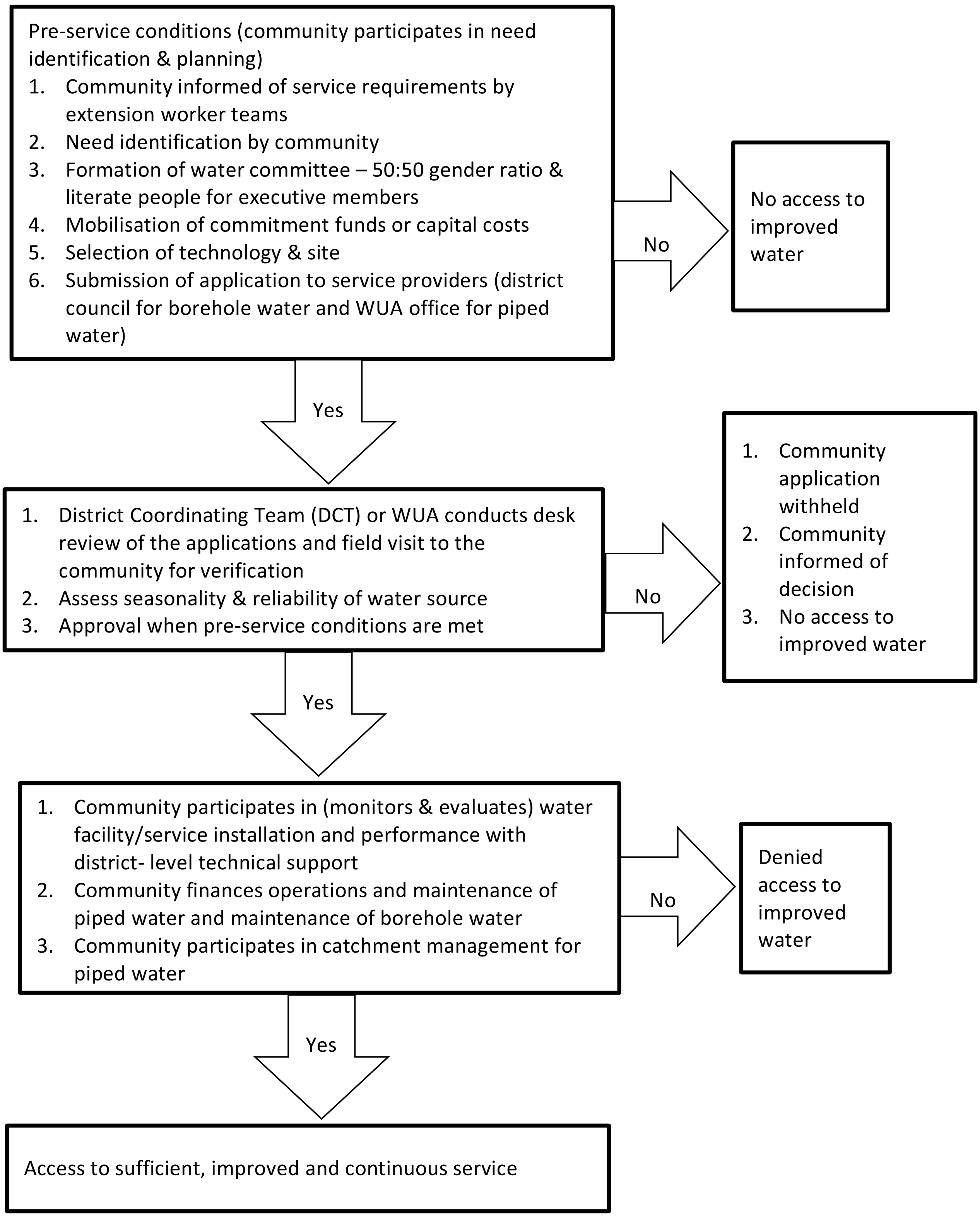

Figure 7.1 National Water Policy process for communities to obtain access to rural drinking-water

Source: Summary of institutional arrangements analysed in Sections 5.2.4 and 5.2.6

The chapter draws on qualitative findings from 19 purposively selected key informants ((including village chiefs (VL1-VL4), water committee chairpersons or executive members (VLWC1-VLWC6), NGO staff working in village-level water related interventions (NGO1), NGO staff working at district or regional level (NGO2), government staff at community (GC1-GC2), and district water officers (GD1-GD4)) and 13 focus group discussions (4 all-women and 9 mixed genders) in the four study communities. The focus groups were categorised into two wellbeing types: better-off (FGD1_mixed[49]) and poorer (FGD2_mixed and FGD2_W[50]) based on subjective indicators identified through participatory well-being and livelihoods exercises carried out by the ASSETS Project (www.espa-assets.org) (see Section 3.5.1 for more details).

7.2 Non-discrimination and equality in service governance

Non-discrimination and equality mean inclusiveness to ensure that everyone enjoys or exercises a human right to water (De Albuquerque, 2014b; UN Water, 2015). A key finding of Chapter 6 was that none of the four study villages was able to provide universal access to drinking-water for all households in both wet and dry seasons. As outlined in Chapter 5 (Box 5.1), the Water Resources Act (2013) recommends two governance actions to ensure universal access, neither of which were applied across all four study villages (see Sections 6.2 to 6.6). The first involves taking affirmative measures[51] to target service delivery to unserved and under-served localities. This was found to have worked in Makombe and Mpheta but not in Mtuluma and Kasonga which, despite villagers' requests for borehole and piped water, remained unserved due to their remote location.

The second recommendation is that pricing strategies for water abstraction should specifically consider the needs of different categories of water users within the village by, for example, adjusting user fees according to people's ability to pay. Such actions were taken in three of the study villages (Table 7.1).

In Mtuluma, the fee for using the community tap had been set at a low level to make it affordable for all, but there was no further provision for the very poor. In Makombe, there was no formal consideration of people's ability to pay for borehole access, but – in practice – it seems that those too poor to pay were not prevented from accessing water (FGD2_W, VLWC6). Informants differed

[49] Mixed genders.
[50] Women only.
[51] Relate to decisions taken at higher and local level about where services should be delivered.

in their opinion on how widespread this special consideration was. One NGO staff member said that:

> "*we have never had a case where someone has really been denied that privilege and most of the times the chief is the overseer of the water point committee*" (NGO2).

However, the village chief himself emphasised that the practice applied only to the elderly:

> "*Because some are very old, they cannot be able to raise that money, those people, if they see me, as a chief, they tell me their concerns, so, I say, leave them, let us assist them, they are old, we can assist them, in different ways, so, we, just leave them to draw water*" (VLC4, Makombe).

Given that the chief (a traditional and unelected position though with formal responsibilities) is not a formal member of the Water Users Committee, this indicates an interesting dynamic between the formal committee and traditional power structures with the latter perhaps being more responsive to the needs of different community members. In Mpheta, borehole user fees were paid quarterly and the poorest were exempt. This result is contrary to a flat rate requirement stipulated by the national policy and legislation for tap water (Government of Malawi, 2007b; Government of Malawi, 2013b) but in line with recommendations of the International Water Policy (Southern African Development Community, 2005) and the National Water Resources Act (section 119) for water charges where a charging system is to be determined based on users' paying capacity.

Table 7.1 Consideration of the poor in setting and application of user fees in each village

Water system	Consideration of the poor in setting and application of user fees in each village [a]			Illustrative examples from FGDs and key informants
	Mtuluma	Mpheta	Makombe	
Tap	Yes	N/A	N/A	*"We set the fees at K100 for community tap so that the poor should be using the community tap. For those who do not want quarrels, considering their wealth status, they can have a private tap. Beyond this, there is no other considerations, including providing free access to the poorest"* (VLWC1, Mtuluma)
Borehole	No	Yes	No (formally) Yes (in practice)	*"all have to contribute … those who are not contributing funds should be denied access"* (NGO1) *"those who don't pay, are not allowed to draw water unless they pay"* (FGD2_W, Makombe)

[a] Kasonga was not included as it had neither taps nor boreholes; N/A: Not applicable

Source: Study findings - Key informant interviews and focus group discussions

These results suggest that formal institutions in Mtuluma and Makombe were not adaptive to income status of poor households. As Chapter 6 revealed, the proportion of households living below the national poverty line increases during the wet season. A flat rate therefore means no consideration of wealth status shifts by season. This probably explains why many households living below the poverty line spent more than 5% of their expenditure on water during the wet season and explains divergent views expressed by the key informants and FGDs.

7.3 Access by marginalised users to information about water access

This section analyses communications between service providers and water users, specifically downward and upward information-sharing regarding water development and management. Focus group discussions and key informants reported that users were informed through inclusive village meetings organised by service providers through the local formal structures (WUA Board, government extension workers) and in collaboration with the village chiefs. These provided information about the process of establishing the service, or the process of obtaining water, equitable supply, sustaining the service and how to complain prior to and after service was established:

"*We held a community meeting at Ntangala involving private tap holders and chairmen of community tap committees. We introduced the concept to them and told them that Government has shifted management of water resources to community and that free access is gone. For us to know the importance of water/take management responsibility, now people have to pay for the service. Without this there is wastage. When a tap breaks down, people leave water to waste unattended. We told them that Government has seen the importance of water and hence shifted management of water resources to community. We should pay a little for the service and be responsible for repairs. Initially, people resisted the change but later they accepted and we are doing this together*" (VLWC1, Mtuluma).

"*The water point committee works hand in hand with the chiefs, but in terms of information…our understanding is that they should have monthly meetings in terms of people to be addressed on borehole, they are responsible for the dissemination of information, in terms of the funds they have in their books so far, maybe if there are new rules or if there are new developments from the further trainings, they communicate*" (NGO2)

"*We were told that for each constructed tap, each household has to pay [USD0.28] K200 per month. This is for the LUO*[52]*. The LUO we have recruited for water management would be charging to government. So it will be like us in the village are the ones who will be paying for water management. It will be the responsibility of the LUO to maintain the water services. He will be checking water status at the intake, are people having access, and are there debris? He will be adding chlorine. He may employ others to do that. Us we will just be using the water, check efficiency on his behalf and report problems to him*" (Female, FGD mixed_opportunistic, Mtuluma).

These results show that, to a large extent, information-sharing with marginalised water users was reflected in service governance specifically with regards to planning for service provision. However, it appears that some people did not understand how the system was going to change. Furthermore, complaints about intermittent supply compounded by initial construction activities

[52] Local Utility Operator (LUO) was described as the "…*engineer, operator. He is the one who would be distributing water from his offic*e" (Female, FGD mixed_opportunistic, Mtuluma).

of WUA services in Mtuluma suggest that the villagers were not adequately informed of initial challenges of the interventions as highlighted below:

> "*In the near past people could get access. But now with the coming of HEMA [contractor], when they have diverted water from the river and constructed large tanks, with big pipes, the taps have no water now. They have left people without water. People are suffering to get water*" (Male, FGD2_ mixed, Mtuluma).

> "*We are not able to see the difference because, here water access has reached zero level – we are failing to access tap water. Even when we conduct meetings, community members fail to understand. We try to explain to them that government seems to bring problems but they are solving the problem. So what they have done here is like, they are creating a problem but in the end we may access drinking-water. However, people fail to understand. This is because HEMA [contractor] has constructed additional tanks, water channels and extended pipes. When they test the supply, a lot of water is being wasted – when communities experience water shortages at the same time. We who are sensitised are able to understand the process*" (Female, FGD mixed_opportunistic, Mtuluma).

This highlights that water service delivery is complicated with lots of people involved and lack of clear communication from policy makers and technical staff at district level to extension worker team (frontline staff) and service providers about how to deliver relevant information to underserved and unserved households (Fig. 5.1). Consequently, there is a lack of clear communication from extension workers and service providers to community water users about the implications of processes involved in drinking-water service delivery.

7.4 Participation of women and the poor in decision-making forums and water service management

The significance of participation of marginalised groups in water governance is widely acknowledged (Akhmouch and Clavreul, 2016; Woodhouse and Muller, 2017; United Nations, 2018). In Chapter 5, I established that one principle to ensure equitable water access is through a participatory approach, identified in the National Water Policy (NATW3) as: "*a planning approach in which all stakeholders including users, planners and policy makers are involved at all levels including decision and management processes*". This section analyses the extent to which service governance considers participation of the poor and women in water decision-making forums and service management, including planning, cost sharing in water development and management to promote sense of ownership and to ensure water services sustainability (Naiga et al., 2015).

The ability of women and the poor to influence decision-making forums was identified by analysis of key informant interviews relating to: committee member selection criteria, the actual composition of water committees, and participation by women and the poor in decision making for the formation of operational rules. The key informants were also asked to describe the nature or level of participation in meetings and discussions. Appendix 22 shows that the extent to which a range of participation indicators are achieved varies between villages, with Makombe and Mpheta mostly performing better than Mtuluma and Kasonga. Indicators are derived from institutional rules designed for management structures governing access to drinking-water in rural areas (Section 5.2.6.3). The next sections provide detailed findings for a sub-set of these indicators.

7.4.1 Engagement of the poor and women in decision-making forums

Formal decision-making structures are the water point committees for boreholes and taps, the village health and water committee (which acts as an umbrella body for both piped and borehole water), and the WUA Board and General Assembly for piped water. According to the water policy and legislation (NATW5, NATW7, NATW8, NATW9), water point committees (for individual taps and boreholes) are voluntary formal structures responsible for managing drinking-water access at local level (See Section 5.2.6). Their responsibilities include formulating and implementing operational (e.g. access) rules, planning, and managing service provision (see Section 5.2.6.3, NATW7, Appendix 9). Membership of these structures provides an opportunity to contribute to formulating and implementing rules governing drinking-water service delivery as well as acquiring skills for water management. This understanding was articulated by all the key informants at district and local level as well as the FGDs:

> "*The rules are established by the committee*" (NGO1);
>
> *"Those who formulate [rules] at community level is the whole group using a given tap or I should say a committee that is selected for the tap*" (VLWC3, Mtuluma);
>
> "*[Those who formed water collection rules are] only those who went for training - Tap point committees, participated representing the whole village. These are the ones which were involved in WUA training"* (Female, FGD_mixed_opportunistic, Mtuluma);
>
> "*water point committees, their main role is … operation and maintenance of that borehole at local level*" (NGO2).

Sometimes, the above stated roles for the water point committees are fulfilled by the village health and water committees which oversee all health and water related issues in a village, whereas a water point committee is only responsible for a single water facility (NGO2, GC3, see also Section 5.2.6.2, Appendix 5.1). Training on access to drinking-water and the associated rule-making processes is only available for committee members. This means that the process of selecting committee members is critical in determining who participates in rule formation concerning drinking-water access.

Key informants explained that water management committees are set up by the community (men, women and the youth) in a process facilitated by government staff at sub-district level (i.e. from health or water, specifically the water monitoring assistants), area mechanics or area pump mechanics (NGO1, NGO2, VLC1, VLC3, VLWCs). All community members regardless of socio-economic status, are invited to a meeting (organised by the village chief) where members of the water management committees are nominated through a system of votes guided by the facilitators and a set of predetermined selection criteria (NGO1, NGO2, VLC1, VLC3, VLWCs).

Key informants (NGO1, NGO2, VLC1, VLC3, VLWCs) confirmed that locally-applied selection criteria for committee membership conformed to the water policy and legislation specifications (NATW4, NATW5, NATW6, section 5.2.6.3). For example, all the villages understood that committee membership should achieve a 50:50 gender ratio and had tried to attain this ratio (Table 7.2). However, Kasonga Catchment committee which focuses on forest protection to sustain a piped water system has 60% men who were nominated by the village chief (VLWC4) (Table 7.2). Some drinking-water committees have higher proportions of women because there are more women than men in the villages (GC2, NGO1, VLWC3) (e.g. Mpheta and Makombe borehole water committees in Table 7.2) or because one gender has little interest in participating (GC2, Kasonga). In the Kasonga case, membership appears to be equal on paper but, in practice, few men attend committee meetings:

> "*By gender, it's difficult. These voluntary works are very difficult. So, many whom we work with are women. These are those who are found in groups in majority. You will find men maybe two and some just have a name but when we say let's meet, they are not available… For so many reasons, as that a man is the one who provides basic needs in the household… when we meet them and hold a meeting, women are in majority. Often there may be one man or two men, that's all. But on paper we can see that there is balance may be five: five*" (GC2, Kasonga)

> *"They can be many women. There can be six women and four men. Sometimes, there can be seven women and three men. Most times to have 50:50 gender ratio especially in our*

> *village, it becomes difficult because many are women. Hence, large numbers are women"* (VLCW3, Mtuluma).

Although women are clearly included in decision-making forums, none of the key informants mentioned income status of selected individuals as a criterion for membership. Rather they emphasised that participation was voluntary and depended on individual interest. This implies that these committees may exclude the poor because there is no specific mention of including poorer community members in the selection criteria.

Further analysis was done to examine engagement of women and the poor in the leadership roles that have some influence on drinking-water access rules. Within the water committee in every village, there was an Executive Committee comprising the chairperson, deputy chairperson, treasurer and secretary (and sometimes a vice-secretary). This body has a leadership role and is very influential in decision-making, e.g. water rules formation and ensuring compliance (VLWC2, Mtuluma; VLC4, Makombe):

> "*Chairperson is the one who monitors whole management of the tap, lead users to formulate rules for proper tap management and hygiene practices and manage other tap related activities for things to work well"* (VLWC3, Mtuluma).

The results show that women held 40-66% of the key positions, but information on the economic status of members was not obtained (Table 7.2). Women on the water management committee were likely to be established community residents (who would not move in the next three to four years) (NGO2). Education level was identified as an important selection criterion and several key informants indicated that a person's chances of becoming an executive member were almost nil if they were illiterate (NGO2, VLC1, VLC3, VLWCs):

> *"When they are electing people [for drinking-water committees], first of all they should be willing, because this work is voluntary. There are no salaries. And also they should include people who know how to write and read. That is what we advise them*" (GC2);

> *"[For tap water], there was a need to have 13 board members. Hence in each group village headman, there was a requirement of one board member and two members for general assembly. The selection criteria included literacy level. The members had to be literate. However, the education level for the two groups is different. The level of general assembly is a bit lower than the board*" (VLWC1, Mtuluma).

This implies that illiterate people were not considered eligible for executive positions. According to the household survey, 37% of the study population considered themselves illiterate (16.3% of women and 20.7% of men) which means that close to half of the population were excluded from executive committee positions. Given that illiterate people are often poor (as established by the participatory wellbeing ranking carried out by the ASSETS project, see Appendix 4), poor people are unlikely to hold executive positions. This means that neither poor households nor poor women will be effectively represented in the Executive Committees. Such exclusions may affect the nature of operational rules for drinking water in the villages which can potentially limit access to drinking water for the poor across seasons and during extreme weather conditions.

Table 7.2 Committee structure and gender composition of key positions

Name of village	Name of committee	Structure of committee	Gender composition of key positions (M=man, W=woman)	Women's participation in decision making
Makombe	Village Health and Water committee	10: 5 men and 5 women	Chairperson (M) Secretary (W) Treasurer (W)	Passive
	Borehole (point source) committee	6 members: 4 women and 2 men (NB. The village has more women than men)	Chairperson (W) Secretary (W) Treasurer (M)	Low
Mtuluma	Tap committee	10 members: 5 men and 5 women	Chairperson (W) Vice-chair (M) Secretary (M) Vice-secretary (W) Treasurer (W)	Very active
Kasonga	Village Health and Water committee	10: 5 men and 5 women	2 women and 2 men	High
	Catchment committee	35 members: 21 men and 14 women	Chairperson (M) Vice-chair (M) Treasurer (W) Secretary (M) and Vice secretary (W)	Low (nominal)
Mpheta	Borehole	10 members: 7 women and 3 men	Chairperson (M) Vice-chair (W) Secretary (M) Vice secretary (W) Treasurer (W)	Low - voice is less recognised in borehole maintenance
	Village health and water committee	10: 5 males and 5 females	2 women and 2 men	Active

Source: Key informant interviews and focus group discussions

Information obtained from observation, key informants and focus groups about the extent to which women participate and speak up in formal meetings about drinking-water painted a varied picture (Table 7.2). Key informants indicated that the women were very active in the Mtuluma tap committee, and in the Mpheta and Kasonga Village Health and Water committees (VLWCs, GC2, Female, FGD mixed_opportunistic, Mtuluma). However, despite a large number of women being formally named on the committee, they were considered to be passive or nominal members in Makombe and Mpheta borehole committees (FGD2_women, Makombe, FGD2_women_Mpheta). Participant observation confirmed key informant reports for Mtuluma, on the number and active participation of women in formal meetings. The observation further agreed with comments in the Makombe and Mpheta FGDs on women's level of participation in water committee meetings, which contradicted reports from key informants. For example, although women's attendance in the water committee meetings was high in Mpheta and Makombe, they rarely raised their voice in the discussions. Thus, decisions were influenced by the few men present in the meetings. Results from the focus group participants revealed that this lack of voice was ascribed to gender stereotypes, with little recognition of women's voice or contribution by male counterparts (FGD2_W, Makombe, FGD2_W_Mpheta, Male, FGD2_mixed, Mpheta). Service providers are aware of this problem hence they now make deliberate efforts to encourage women to speak up. For example, committee membership based on 50:50 gender ratio is emphasised to encourage women to speak up so that their voice can have an impact, as they are the ones responsible for water collection in the household (NGO1).

Another operational rule for rural drinking-water systems to ensure equitable access relates to water users fulfilling pre-service and post-construction financing conditions. This requirement is analysed in the next section.

7.4.2 Community attainment of pre-service and post-service conditions – cost sharing in water development and management

The water policy states that users should contribute financially towards the maintenance of water facilities prior to service delivery and after pump installation (GD1, GD3, NATW8, NATW9). Pre-construction in-kind contributions include: "*quarry…sand… bricks… and … labour… [to ensure] that the project is demand driven [and]… sustainable*" (NGO2). Failure to meet this prerequisite means no service provision, while failure to contribute regular payments after pump construction can lead to denied access, as reported by FGDs and key informants (VLWC1, VLWC2, VLWC3, VLWC7, VL4, FGD2_women_Mtuluma, FGD2_women_Makombe). For example, in Mtuluma, for private tap connections, individuals were required to make a one-off payment of USD11.07-13.83 (K8,000 or K10,000) to the WUA in advance of installation. The K10,000 charge was a payment for construction pipes, if supplied by the WUA, but a charge of K8,000 was allowed if the applicant asked for a discount (VLWC1, Mtuluma). For communal taps, the initial charge depended on community contributions (VLWC1). At the time of the study, communal taps in Mtuluma were constructed at no cost, but community members had to transport the pipes and to provide cement (at an approximate cost of USD8.20 (K6,000)) (Female, FGD_mixed_opportunistic, VLWC1, Mtuluma). The additional connection fees were waived for communal taps to ensure access to improved drinking-water to the poor households (VLWC1, Mtuluma). For both private and communal connections in Mtuluma village, users paid unconditional monthly flat tariffs into the operations and management revolving funds. The communal users paid a monthly tariff of USD0.14 (K100) or USD0.28 (K200) or more, depending on the number of users of the tap, and a further payment of USD0.28 (K200) per year for tap maintenance (VLWC2, Mtuluma). Private tap owners paid a monthly tariff of USD1.04 (K750) or USD2.04 (VLWC2, Mtuluma). However, this tariff structure was considered discriminatory, especially in the poor FGDs, as some households could not afford such fees throughout the year (women, FGD2_mixed, Mtuluma, FGD2_women, Mtuluma) and the communal users collectively paid more than those with private on-plot connections:

> *"the money which is supposed to be paid at the tap is just too much, to pay monthly, so, for one to raise that money it's difficult… The money is a problem, we don't have it all the time…those people who are benefiting, are the ones who have money every year or every month, these are the ones who are benefiting from, and water at their households is not a problem*" (FGD2_women, Mtuluma)
>
> "*last time they [with private connections] were paying K1500, but for us [communal users] whether we are 20 in number, everyone is supposed to pay [USD0.28] K200 and for [USD0.28] K200 I think the money is [USD5.6] 4000 in total every month when we pay" (FGD2_women, Mtuluma)*.

It seems, therefore, that although pre-service connection fees for piped water were adaptive to the economic status of the intended users, they failed to recognise seasonality of income levels for the poor households which could affect their fee-paying capacity. As shown in Chapter 6, Mtuluma was the village with the highest number of households that paid for drinking-water in the wet season and these payments were predominantly for tap water. Ignoring the seasonal paying capacity of households partly explains the larger proportion of households spending over

3% or 5% of their household income on water costs in the wet season rather than the dry season (see Section 6.6).

In the borehole water system, present everywhere except Mtuluma, each community was expected to have USD20.75 (K15,000) in its bank account before borehole construction (GD3, NGO1, NGO2). Key informants explained that this fee was set by government and was uniform across all participating communities (NGO1). However, the water policy does not actually stipulate a fixed fee but rather requires a percentage (5%) contribution towards construction costs which could vary by site and technology selected (NATW8 p4, NATW9). Despite these differences between the key informants and the water policy, both agreed that the financial contribution was mandatory, regardless of gender or income levels of households. A community that failed to meet this pre-qualification would not be serviced (NGO1, NGO2, NATW8, NATW9). However, operational rules and sanctions for post-construction borehole maintenance contributions differed between the communities. One NGO informant explained that:

> "*Users agree depending on situation. They can agree to contribute [USD0.07] K50 each and month end they bank it topping the initial [USD20.75] K15,000 mobilized prior to construction work….Others agree to contribute [USD0.14] K100 a month...[or have] a garden which they farm and sell the produce and [use the proceeds for borehole maintenance]"* (NGO2).

In Mpheta, users of a single borehole paid a quarterly fee of USD0.35 (K250) per household, a payment system based on paying capacity. Here the borehole committee, with advice from the village chief, decided that the poor should pay less or by instalments while the poorest community members were exempted (FGDs, VLWC5), making the borehole water affordable to all. This may explain why all the poor FGD participants in Mpheta living in close proximity to boreholes mentioned boreholes as their principal source of drinking-water (FGD2_W, Mpheta), and the fact that many households in Mpheta reported using improved water in both the dry and wet season (Section 6.4.1). This finding further shows that traditional leadership is central in addressing inequalities in access caused by differential household income levels. In other villages, with no equivalent pressure from the chiefs however, water committees were not so considerate of poor people's needs.

7.4.3 Community training in monitoring and supervision of construction, operation and know-how to manage minor repairs

The Implementation guidelines for rural water supply and sanitation (NATW8, pp20-21) stipulate that water point committees are expected to participate in monitoring and supervising drinking-water service projects to ensure that design and quality standards are met and sustained. Therefore, communities, through their water point committee, receive pre- and post-drilling training to ensure adequate implementation of the policy provision. As reported by key informants in the context of the borehole water system, two female and two male caretakers undergo pre-drilling training to monitor and supervise contractors so that boreholes are sunk at an appropriate depth. After pump installation, hands-on post-drilling training is provided focusing on village-level operation and maintenance, including water, sanitation and environmental hygiene issues as well as financing (NGO2, District level). Nevertheless, construction supervision by community water committees was often inadequate due to limited technical knowledge and availability of district level support to oversee installation of boreholes and other supply systems (GD3, Participant observation). This limitation is illustrated by the reported frequent breakdowns and flow discontinuity (GD2 and NGO1), as exemplified by Makombe village's experience during the dry season partly due to poor workmanship in construction (NGO1). This finding is in contrast to the claim from one district level key informant:

> "*During drilling time we also involve the water monitoring assistants to supervise in terms of their technical aspects which cannot be monitored by the villagers…They are on site full time from the time drilling starts up to the drilling end, they are the ones who certify the borehole*" (NGO2, District level).

The study revealed similar findings (i.e. limited construction supervision by water committees) in the analysis of tap water under WUA arrangements. In both cases, further service governance challenges emerged in the context of seasonality and extreme weather events (Section 7.6).

Despite gender balance considerations in post-drilling training which involve two female and two male caretakers (NGO2), gender stereotypes hindered effective application of knowledge and skills by female caretakers. In all the study villages, borehole maintenance was considered by FGD participants to be the responsibility of men (Women, FGD2_mixed, Kasonga, FGD2_W, Makombe, FGD2_W_Mpheta, Male, FGD2_mixed, Mpheta). During maintenance work, women caretakers were allowed to "*just watch, observe and learn so that they may conduct the maintenance at a later date when responsible men have travelled away*" (Male, FGD2_mixed, Mpheta). Key informants explained that, culturally, it was assumed that maintenance is a man's job and women could not manage the heavy work (VLWCs). Women's contribution was ignored in this context except in establishing and enforcing hygiene rules at the water pump as they relate these hygiene rules directly to women's reproductive roles (FGD2_women, Makombe, FGD2_women_Mpheta, Male, FGD2_mixed, Mpheta). Service providers were aware of this challenge and reported that the 50:50 gender ratio in training sessions was one way of addressing it in addition to a monitoring strategy, but they were yet to assess the effectiveness of these two approaches (NGO2):

> "*in our trainings we involve them practically. We actually identify boreholes nearby, maybe they actually pull out all the stuff from the ground and then fix them again as a training, however, it's quite difficult to go against tradition. Tradition in a rural set up is that women are left out of duties of such nature. In our trainings these days we are emphasising…by involving 50:50 selection of these caretakers it's one way of addressing such a problem. Because…in the past… we ended up having only males, so what we have done now is that we have 50:50 gender balance, at least we should have two males, two females. We have not monitored them so far because this approach was just started last year … But now because we have included a monitoring strategy where if the water point has been broken down, they have to record it as we have records it has been broken down and this was a problem and we fixed, who fixed that, that should reflecting in the report. They report that to the water monitoring assistance of that area*" (NGO2).

Unfortunately the trained men often migrated out of the villages either for marriage or in search of greener pastures, hence leaving a gap of skilled male committee members to maintain the water points when they broke (Women, FGD2_mixed, Kasonga, FGD2_W, Makombe, FGD2_W_Mpheta). This may in part explain abandoned boreholes in Mpheta and Kasonga (Appendix 19) and also why fewer households used borehole water during the dry season (Section 6.4) when boreholes require additional pipes and rods to reach deep aquifers. This means that the policy is simply not sufficiently reflective of the situation on the ground, and a more realistic approach might be to train more men in the first place, to stand in if some are absent.

7.4.4 Participation in catchment management

Water users within the study catchments are expected, by the Malawi Water Resources Act, to participate in catchment protection and conservation (NATW4, pp23-25, sections 27-31). The Malawi Water Resources Act (Government of Malawi, 2013b) has established a National Fund for Catchment Protection (NFCP) (in line with sections 29(2) and 31(1)). The NFCP receives about 20% from the proceeds of the collection of water charges and fees in accordance with section 120 of NATW4 and from any other lawful source (such as the Water Resources Trust Fund), for catchment management (NATW4). A small proportion of this NFCP is required to be given by the National Water Resources Authority (NWRA) to the catchment committees following a formal request, as an incentive for catchment protection (NATW4). However, the Kasonga and Mtuluma villagers, who are part of the catchment management programme in Zomba rural area, did not know about the NFCP and relied on individual financial contributions when performing catchment protection and conservation activities such as patrols (VLWC4, Kasonga).

In both Mtuluma and Kasonga, a more important incentive for villagers to participate in catchment protection than the unknown NFCP would be access to improved drinking-water:

> "*we are expected to manage the catchment area supplying drinking-water to downstream communities…[yet] we have limited access to drinking-water*" (Woman, FGD2_mixed, Kasonga);

> "*The way we are in this village, Mgonanyani [River] is capable of supplying improved water to the village. It is used for irrigation in schemes in neighbouring villages throughout the year and upstream has abundant supply. Water providers just constructed a tank on Ntanangala – pipes supply water to other villages away from this village. It would be nice if they could consider constructing a tank on this river*" (Woman, FGD2_mixed, Mtuluma).

As established in Section 6.4, some households in Mtuluma and all in Kasonga were unserved, despite formal applications for drinking-water service delivery (FGDs, VLC1, GC1). One government official explained that these villages were excluded from the piped water connections due to poor terrain (higher elevation) and increased pumping costs (GD1). Yet adjacent to one of the unserved villages/households, there was a commercial structure with access to piped water. This suggests that these villages were marginalised in service provision despite policy aspirations of ensuring equitable access to drinking-water. These results in part explain why the two villages had high proportions of households using unimproved and surface water (see Section 6.4).

7.5 Accountability

The extent to which service delivery actors were accountable to communities is summarised in Table 7.3. The results show that three of the study villages had well-established institutions to regulate service delivery, e.g. to monitor compliance with standards. Despite communities meeting pre-service conditions, the responsible actors were not responsive to the marginalised and were not transparent in their responses. Details follow below.

Table 7.3 Achievement of 'Accountability' standard in the study villages

Indicators[a]	**Extent to which 'accountability' indicators are achieved**			
	Village			
	Mtuluma	Makombe	Mpheta	Kasonga
Village had established institutions to regulate drinking-water service delivery, e.g. monitoring compliance of standards	√	√	√	x
DCT or WUA board received community service applications according to user needs	√	√	√	√
Extension worker teams verified need for service	√	√	√	√
Authority was responsive to marginalised groups' needs – processed application and offered service	x	√	√	x
Authority processed application and provided feedback for non-provision of service	x	N/A	N/A	x
Authority received community complaints related to water service, e.g. tariffs and interrupted service.	√	√	√	N/A
Service providers responded to community complaints, e.g. tariffs agreed through dialogue	Partially	√	√	N/A

[a] Standards are derived from NATW8 based on operational rules for rural drinking-water service delivery and functions or roles of various actors (e.g. DCT or WUA board, extension worker teams and service providers). Also see Sections 5.2.4 and 5.2.6.

Source: FGDs and key informant interviews

7.5.1 Community demand for water service and authority response

According to the Water Policy, community members are expected to apply for service provision through the established decentralised formal structures (NATW5, NATW6, NATW8). Tap water applications are submitted to the WUA Board (Fig. 5.2) while borehole water requests are sent to the District Coordinating Team (DCT) through the Village Development Committee (VDC) or Area Development Committee (ADC), (Fig. 5.1) (NATW5, NATW6, NATW8, VL2, NGO1). All four communities reported that they had submitted their applications for a water service (Mtuluma and Kasonga requested both piped and borehole water, while Makombe and Mpheta requested borehole water only) to the relevant authorities and had largely met all the pre-service conditions (Section 5.2.6.3). However, only Mpheta and Makombe were successful in obtaining the requested service. Kasonga and Mtuluma villages failed despite apparently meeting the criteria (VL1, FGD2_W, Mtuluma) and received no explanatory feedback:

> "*here when a person raises a problem concerning water, the assistance is not enough, for them to consider that one, is difficult, so, people are just staying, not knowing what to do… I don't know [why they don't come when I submit a request of water] because it is now a long time, since I started requesting this, but am not assisted*" (VL1, Mtuluma).

An interview with several key informants confirmed and elaborated on the situation in Mtuluma:

> "*the village chief has been approaching us with the concern that her people upstream face water access challenges. We approached one organisation to construct a borehole in the area but when they did their assessment they indicated that the area is proposed for tap water connection through government programme. I notified them that the tap was connected but down the village. The borehole is needed for upstream community. Alternatively, we construct pipes for tap connection. However, it was noted that because of rocks, people may fail to construct channels for pipes. So when we say people drink safe water, it is community down the village that use taps but up the village, they draw from wells…[Additionally, the village chief] indicated that she would discuss with the committee to go and raise concerns to WUA chairperson who should provide them with pipes… At the moment I don't know the progress of the issue*" (GC1, Mtuluma).

At the time of data collection, neither the service providers nor the extension worker team or officer had gone back to the community to explain the decisions on the submitted applications for drinking-water (GC1). Another key informant (GD2) reported that Kasonga and Mtuluma (upper section) villages were excluded from the WUA connections due to being at higher elevation, leading to increased pumping costs, while local leadership (VLWC1) blamed government's poor implementation of the policy and limited access to funds by the WUA office to expand service distribution to unserved and underserved communities. For example, the WUA Board Chairperson commented:

> "*What the communities are saying is very true… Because this is government arrangement, we just watch when programmes are poorly implemented…. in all [upper] communities, upstream households do not have access to drinking water, yet this is where water is coming from. It is lower communities who have access… We expect the WUA programme to change this approach to provide water to upstream communities*" (VLWC1).

This suggests that unserved communities understand and can follow the processes involved in the demand-responsive approach to ensure access to safe drinking-water. However, the service providers fail to deliver their role adequately due to lack of horizontal accountability specifically with regards to communicating responses on applications and providing alternative options to unserved upstream communities. Thus, they do not provide equal attention to drinking service applications following the formal process (see Fig. 7.1). This probably explains why Mtuluma village has a high proportion of households using insufficient water (Section 6.3.1), surface water (Section 6.4.1) and with physical access challenges (Section 6.5) across seasons. Kasonga shares similar characteristics to Mtuluma except for physical accessibility of drinking-water sources. These results therefore show that the demand-responsive approach does not always work.

7.6 How water delivery institutions address seasonality and extreme weather events

This section analyses how water delivery institutions address seasonality and extreme weather events, to help understand the seasonal variations in access revealed in Chapter 6.

7.6.1 How local formal water institutions prepare for seasonality and extreme weather events in the study villages

National legislation gives limited attention to seasonality and climate risks with very few guidelines on management of seasonality (NATW9, NATW10, NATW11) and climate risks (NATW3, NATW4, NATW9, NATW10, NATW11) in the delivery of drinking-water. The Implementation Manual For Piped and Point Water Supply Systems (NATW9, p14) provides one design guideline which calls for service providers to consider river flows during the dry season when selecting a water source for a piped water system. NATW9, pp5 and 11, further emphasises consideration of reliability of the water source across seasons when choosing a source of piped water. Similarly, the Technical Manual - Water Wells and Groundwater Monitoring Systems (NATW10 p26) emphasises that service providers should construct boreholes during the dry season and match the borehole depth to the required yield with respect to seasonal availability and quality of water (see Section 5.3.2 for details). In practice, the key informants at district level indicated that, prior to tap water service provision, service providers assess if the water source is perennial and sufficient to meet the demand (GD4). Designs of formal water infrastructure consider seasonality and climate risk effects on water availability, level or flows in the location of utility systems including intakes, distribution and storage for piped water systems as well as ground water sources, specifically boreholes. Four key informants at district level agreed that service providers use historical hydrological trends (based on oral histories where necessary) and return periods of 50-100 years to ensure that water supply infrastructure, such as intakes and trenches, can withstand a 50-100-year flood (GD1, GD2, GD3, GD4).

Three key informants emphasised that aquifer assessments should be conducted by the contractor before construction of a borehole and these should be bored to a minimum depth of 45 metres to ensure continuous water supply (GD3, NGO1, NGO2). Thus in principle, water infrastructure construction conforms to the design standards stipulated in the water policy. However, this thesis established that the design standards were not strictly followed by the contractors. Personal observation of selected infrastructure, specifically intakes and distribution pipes, showed limited application of design standards (See Figs. 7.2[53] and 7.3[54]). This observation was echoed in one key informant's report that "*most structures are constructed or rehabilitated by local artisans supervised by untrained people who do not know the implications of under-designed structures*" (GD4). This can result in the intakes being above the ground water level during dry seasons and in drought conditions: "*[during the dry season], the communal taps, the intake dries*" (GD1). This can also result in destruction of water infrastructure during the wet season or flooding conditions as occurred in the 2015 flooding event: *"All pipes which were installed there are gone"* (VLWC1).

[53] Pipe broken deliberately by a few households to supply water for brick making.
[54] Intake structure constructed inappropriately because it is placed too high in the dam wall to take in water in the dry season and withstand heavy water flow during flooding.

Figure 7.2 Broken distribution pipe in Mtuluma laid below minimum recommended depth of 1m

Source of photo: Matthews Tsirizeni, LEAD

Figure 7.3 Intake structure in Mtuluma – not suitable for dry or flooding weather conditions

Source of photo: Matthews Tsirizeni, LEAD

A similar contradiction relating to borehole construction was depicted by the seasonal functionality of some boreholes. For example, in Makombe, five of the seven boreholes and in Mpheta, 15 of the 21 boreholes, had no water during the dry season (See Appendix 19). This thesis established that the boreholes were constructed during the dry season as specified by the NATW10 (p26) (GD3, NGO1, NGO2). However, the drying up of pumps during the dry season, suggests that the design standards were not followed adequately during the boreholes' construction as highlighted by one district government officer:

> "*Many boreholes … are being drilled without following established rules … the committee is established to monitor how borehole drilling is implemented. Funny enough when you go to the villages, you will find that…when the borehole is being drilled, once the first waters come out, there is ululating…they will just celebrate there. And the main problem is that maybe the contractor doesn't finish the drilling process because they have got water, maybe they will just drill a bit. Water may be found in the first aquifer and the contractor may not go to the second aquifer…The recommended depth is 45 metres. From 45m going down*" (GD3).

Other than focusing on historical hydrological trends, there was no mention of consideration of current and future projections of climate (rainfall and temperature) trends in the design standards of water infrastructure, e.g. siting of tanks, intakes and trenches. This means the current drinking-water infrastructure has been designed and constructed based on the past climate and may not be resilient to current and future climate risks, including future projections of increased warming, heavier precipitation and more frequent floods and droughts (GD1, GD4). These results partly explain the seasonal access challenges that limit households' attainment of sufficient, safe and affordable water across seasons and during extreme precipitation conditions (see Sections 6.2 to 6.6). Consideration of these climatic factors and the resulting extreme weather events is important during design of drinking-water infrastructure because they exert a notable influence on the seasonality of water services and the security of water infrastructure design. Additionally, it is important to consider management of seasonality and climate risks beyond the design stage.

7.6.2 How institutions function during different seasons

This section analyses how local formal institutions function, during different seasons, to ensure equitable access to water, and implications for the poor, underserved and unserved households. The study noted multiple uses of water (e.g. irrigation, brick making and aquaculture), through participant observation in the study villages and surrounding villages, which reduced or cut off supply to downstream households and consequently was likely to contribute to adverse implications on management of equitable access to drinking water. For example, Figure 7.2 shows a distribution tap water pipe that was broken deliberately by a few elite households to supply water for brick making. Diversion of water for irrigation and aquaculture is also a common practice by the elites in the village who are also close to the village chief. Most members of the water user committees are from the elites, hence it is easy for the elites to break the water management rules with impunity. However, the formal institutions are not set up to manage these other uses even though they may impact drinking-water outcomes. Key informant interviews and focus group discussions described several strategies and operational rules that the local formal water governance structures, such as the WUA office, health office, borehole and tap water committees, catchment committees and village health and water committees, applied to ensure continuous and equitable access to drinking-water during different seasons. These included establishment of catchment management committees, mobilisation of user fees, water rationing and distribution of chemical water treatments. The strategies and operational rules were enacted simultaneously or separately by different stakeholders and some of these strategies and rules were unique to particular communities.

7.6.2.1 Establishment of catchment management committees

In accordance with the National Water Policy (NATW3) and the Malawi Water Resources Act (NATW4), the District Water Office in collaboration with the District Forest Office established catchment management committees for Zomba-Malosa Forest Reserve for catchment protection and conservation (GD1, GD2). Kasonga and Mtuluma catchment committees were two of these committees. Their aim was to rehabilitate the degraded catchment and ensure sustainable flows for the gravity-fed piped water system (GD1, FGDs, Mtuluma and Kasonga, VLWC4). This strategy had operational rules with implications for seasonal availability and quality of water. Examples included control of certain activities in the catchment, such as collection of firewood and poles, and using water sources for moulding bricks and washing nappies (FGD_W, Mtuluma, FGD2_women, Kasonga, VLWC4).

However, at the time of data collection (2014-16), the catchment committee in Kasonga was not functional (VL2, VLW4). The focus group discussions and key informants explained that the committee members were demotivated because the community was geographically marginalised by service providers (FGD2_W, Kasonga, VL2, VLWC4). Several key informants and women focus group participants from both Mtuluma and Kasonga villages felt drinking-water service providers were not concerned with their local water needs (FGD_W, Mtuluma, FGD2_W, Kasonga, GC1, VL1, VL2, VLWC1, VLWC4).

The fact that the Kasonga committee had stopped working, contradicted information from district government officers who stated that the catchment committee was functional in its operations (GD1, GD2). In Mtuluma, the catchment area falls within the agreed non-harvestable areas of a forest block that is part of a forest co-management agreement between the villagers and the Forest Department; and co-management incentives are clear (GD2, Men, FGD1_mixed, Mtuluma). The villagers in Mtuluma benefited from honey and timber production under the co-management agreement, which motivated them to be actively involved in catchment management activities (GD2, Men, FGD1_mixed, Mtuluma). Despite this, both in Kasonga and Mtuluma, lack of access to improved drinking-water was emphasised in all focus group discussions and key informant interviews as a disincentive for some catchment committee members to participate meaningfully in catchment protection. This result partially explains why some drinking-water sources such as springs in Kasonga, boreholes in Mpheta and Makombe, and water intakes and taps dry up persistently during the dry season and force more households to shift to other sources which are usually unsafe or located far from households (Section 6.4).

7.6.2.2 Mobilisation of user fees

In conformity with the water policy (NATW5-NATW12), the water committees mobilise funds from water facility (borehole or tap) users for rehabilitation or management including access challenges associated with seasons (All FGDs and VLWCs in Mtuluma, Makombe and Mpheta, NGO1, NGO2). Although the water policy (NATW5-NATW12) does not directly link this operational rule with management of seasonality issues, the communities stated that implementation of this rule in part addresses seasonal drinking-water access challenges (All FGDs in Makombe and Mpheta). According to the FGD participants, maintenance and replacement of water point parts (e.g. pipes and rods for boreholes) integrated consideration of seasonality effects on functionality or operation of the water facilities. Communities in Makombe and Mpheta mentioned that the funds contributed by water users were partly used to purchase additional borehole rods which were fitted in the dry season to tap water at greater depths when the water table drops (VLWC6, VLWC7, All FGDs in Makombe and Mpheta). However, effectiveness of the funds for pump maintenance depended on availability of male committee members who had received training. For example, in Kasonga, despite purchasing the spare parts, a borehole was abandoned after premature breakdown because the young men who were trained in maintenance had migrated out of the village (FGD2-W, Kasonga). This finding partly explains the higher proportions of households using unsafe water in Kasonga, Makombe and Mpheta.

In addition to pump maintenance, the water committee in Makombe used the user fees to control water demand and ensure equitable access during the dry season. They did this by doubling user fees for non-registered water point members from other villages or other boreholes with no dry season supply (who thus had secondary rights to functional boreholes):

> "*In this season, the demand for water is high, because other boreholes which are in neighbouring villages dry up; as a result everyone comes to collect water at the borehole which is situated in Makombe 1 village…We experience quarrels and fights at this time..., the rule is first come, first serve. Outsiders pay [USD0.14] K100 if they want to draw water from the borehole, while members of this village Makombe 1 pay [USD0.07] K50, the fee is per year. That money is used for maintenance of the borehole*" (Male, FGD1_mixed, Makombe).

As stated in Section 7.4.2, financial contributions in Mtuluma (for piped water) and Makombe did not consider the capacity of the poorest to pay, hence forcing them to rely on unsafe sources. Similarly, double pricing for non-water point members in Makombe reduced long queues and competition or fighting for water at the water point because those who failed to pay were denied access to drinking water as highlighted by participant 3 in the poorer women FGD: *"During this* *time the ones who do not pay user fees turn to the wells in the river...*"(FGD2_W, Makombe). This may have contributed to the higher numbers of households using unimproved water during the dry season in Makombe (Section 6.4). This suggests that for many households, unsafe sources offered seemingly better alternatives when they could not afford or were unwilling to pay user fees or tariffs.

At the same time as user fees were prohibitive for some, it seems that the total collected was not sufficient to ensure a good service. This arose because user fees funds were only applied to formal drinking-water sources (boreholes and taps) for which there was limited spatial and seasonal coverage, forcing villagers to turn to (no-fee) traditional sources instead (VLC1, FGD2_W). The challenge of inadequate revenue for sustaining WUA operations was evident in Mtuluma which suffered from water shortages resulting from poor infrastructure and limited coverage, as well as high turnover and high vacancy rate of technical staff at the WUA office (VLWC1, observation). The key informants emphasised that the WUA office failed to fulfil tasks like regular removal of debris at the water intakes during the wet season due to financial constraints resulting from low revenue collection (VLWC1, VLWC2). At the time of data collection, the office was staffed by a plumber and had no local utility operator at community level:

> *"Secretariat came with initial three months funding from Government but when the three months elapsed the whole secretariat left leaving us alone… When the secretariat left, new secretariat was recruited but we are left with a plumber, guards, revenue collector and office watchman. All these are under the control of the plumber"* (VL2).

The plumber's effectiveness was compromised because he combined his roles with administration roles. This partly explained seasonal access challenges for tap water and households collecting insufficient water in the rainy season in Mtuluma (see Sections 6.3.2 and 6.4).

7.6.2.3 Water rationing in the dry season

Water rationing was an important strategy adopted by committees to ensure equitable access during the dry season. However, the same strategy was applied differently by different service providers and for different types of water sources (formal and traditional water sources). For example, in Mtuluma, poorer focus group participants said villagers were not informed when and how water was expected to be rationed (FGD2_W, Mtuluma). The strategy was enforced externally from the District Office [through the WUA office] (FGD2_W, Mtuluma), hence partly explaining insufficient water quantities collected during the dry season (Sections 6.2 and 6.3). This was in contrast to the bylaws and informal rules established and enforced at community level for boreholes and springs or traditional water sources. These bylaws and informal rules were well known among community members (FGD2_W, Makombe, Kasonga). For example, when water was scarce, people in Kasonga and Makombe were expected to ration the available water fairly, i.e. one bucket per person at a time (FGD2_W, Kasonga, VLWC4, VL4). From the FGD's perspective, water rationing ensured all households had an optimum amount of water (FGD2_W, Kasonga). People who did not comply had their water access rights suspended for that particular day or had to wait until all in the queue had had their turn. Repeated noncompliance led to expulsion from the village – but this was an empty threat. These rules were enforced by the water committees with the support of the village chiefs (FGD2_W, Kasonga, FGD2_W, Makombe, VL4). However, the better-off were reported to bend the rule through use of hired labour to fetch more water (FGD2_W, Makombe). This partly explains why wealthier households had a higher likelihood of collecting sufficient quantities of drinking-water than poorer households.

7.6.2.4 Chemical water treatment in the rainy season

The use of chemical water treatments was an important strategy employed by authorities to manage access challenges during the rainy season. Recognising that many rural households in the study district have limited access to safe drinking-water and turn to unsafe sources of water, the Ministry of Health and its partners (through their community health workers) distributed Water Guard and/or chlorine to villagers to ensure that all used safe water for drinking (GC1, GC2). While this report agreed with key informants and focus group participants reports in three villages (Makombe, Mtuluma and Makombe), the supply of these chemicals was irregular (All FGDs; GC2) due to inadequate stocks (GC2). At the time of data collection, supply was restricted to the rainy season, as reported repeatedly in the poorer FGD (FGD2_W) in Makombe: "… *we… have HSAs who provide us with Water Guard, because in the water there are some diseases*". However, this is only supplied "*when it's rainy season*" (FGD2). Similarly, Kasonga village had stayed almost a year without the provision of Water Guard or chlorine, as reported by the health surveillance assistant:

> "*in the past when chlorine was easily found, people were applying but now chlorine is scarce so it looks like applying chemicals … has stopped relatively,… but those who have access to a little money they can go buy Water Guard and apply but are a few households who do that"* (GC2).

The study established that those with adequate supplies of water treatment chemicals were better-off households, who could afford supplementary packets, while poor households faced many access challenges during water shortages. This suggests a weak institutional management of seasonality effects on household access to drinking-water and partly explains why the wealthier households have significantly greater access to improved water than the poorer households.

7.6.3 Institutional responses to flooding challenges in the study villages

The study established that formal institutions mainly focused on infrastructure rehabilitation and community sensitisation in order to ensure households were able to draw adequate quantities of water both during periods of good water availability and during periods of low or no supply (VLWC1). Nevertheless, focus group discussions (FGD2_W, Mtuluma), observation and key informant reports (VL1, VLWC1) made it clear that rehabilitation work, especially for piped water infrastructure, was ineffective or unfit for the 2015 flood damage (which was particularly bad, see Section 4.1.2). For example, in Mtuluma, some water intakes only had temporary repairs undertaken due to lack of resources (VLWC1). Key informants (VL1, VLWC1), reported that these water intakes might be washed away if not completed before the onset of the rainy season:

> *"I should say the way we have repaired is temporary. That means this time the dry season will work but when we reach November, December when rainy season comes, these places will be washed away again even though water can be a little. As of now there is no protection. If the support can come very quickly and maintain all the places they can be strong and places like river crossing putting the GI [Galvanised iron pipes] there can still remain intact even when there can be heavy rainfall as we normally have all times"* (VLWC1).

Thus, the repairs would not be suitable for any rainy season (not just the flooding conditions). For one intake, maintenance work was yet to be done at the time of data collection (2015-2016) due to massive destruction caused by the 2015 flood as reported by one key informant:

> *"All pipes which were installed there are gone. Now we are planning that the government should come and see it such that it should be moved away to upper site. Where there was an intake it has been dug or eroded like a tree [heavily eroded]… But moving the pipes there, e.g. the GI [Galvanised iron] and plastic pipes which are installed deep down, requires a lot of money. The contractor we engaged estimated that we need to get almost [*US$63,636*] K35 million to rectify the problem and have intake intact. That money is required to rebuild the Chigumula intake. All the intakes mostly in river crossing areas all pipes were washed away and we have just done temporary work. All these need to be worked on* (VLWC1).

This was because the rehabilitation costs (US$63,636) exceeded local capacity. These results suggest that local formal structures have limited capacity to manage effects of floods on water infrastructure. The study did not establish if the funds for managing such disasters exist in the Ministry of Water. However, such challenges are managed by the Department of Disaster

Management Affairs which has the mandate to assess national disasters, mobilise and allocate funds to affected sectors/areas (Government of Malawi, 2015; Government of Malawi, 2019b).

Additionally, regardless of the importance of traditional water sources (shallow wells and rivers) in areas of inadequate service or during times of water shortages, the formal institutions responsible for the rehabilitation of water infrastructure only focused on formal water sources. Hence, some traditional sources, especially damaged springs and wells, were abandoned because they were heavily eroded, filled with silt or seemed to be irreparable (VL1, VLWC1, FGD2_W, Mtuluma). Key informants (VL1, VLWC1) and all FGDs in Mtuluma highlighted the unique role of chiefs and community cohesion (non-formal water institutions) in covering this gap to address water access challenges. Following flooding, traditional chiefs initiated maintenance of some damaged sources, specifically unprotected wells and open water sources (rivers) to improve access to water. The chiefs called for village meetings and organised the community level workforce to maintain water sources, as reported by both the chief and the FGD (that):

> *"It took the chief's initiative to mobilise us after seeing that her people have a water problem. It was the chief who said let us all jointly do the development work. Let's repair our place, we should drink water so that when we are drawing the water should not be muddy and unclean or full of filth. So we all went there to do the task"* (FGD2_W, Mtuluma).

Chiefs in Makombe and Mpheta played a similar role for public wells in their villages (FGD2_W, Makombe, FGD2_W, Mpheta). The role played by chiefs in ensuring access to drinking-water during extreme weather events is not formally recognised by water institutions.

7.6.4 Individual responses to all seasonal challenges

The study found that individuals had different ways of responding to access challenges during different seasons and flooding conditions. In the dry season, unsafe sources were the most easily accessible. Sometimes women would cover long distances to fetch drinking water or beg from a close relation or neighbour (FGD2_W, Mtuluma). During the wet season most households relied on rainwater harvesting which usually consisted of collecting water using plastic papers (with a water collection hole at the centre) mounted on four posts, umbrellas, leaves attached on a tree branch and from iron sheets (all FGDs). Additionally, some households, particularly in Mtuluma and Mpheta, fetched water from unsafe sources, especially open water sources, including streams and unprotected wells located close to their houses (FGD2_mixed and FGD2_W, Mtuluma, FGD1_mixed, Mpheta). This was common when formal sources were located far away or only had intermittent supply. These findings highlight the importance of self-supply and social capital in managing seasonal access challenges.

Similarly, to cope with limited access to water sources following flooding, many households relied on rainwater harvesting using various techniques, as illustrated in the following quotes: "*People struggled a lot to have access to water. For example, some people used water from iron sheets … Some drunk from bad wells, it wasn't fine*" (VLWC1, Mtuluma) and:

> "*when water was flooding there was so much rain that we were failing to find where to draw water. It took about four days of rains, nonstop, so we were failing to get water. We used umbrella for those who had it and put it on top of bucket to direct water from rains and use it for domestic use. So we used it to access water and for those who have iron sheets houses could use the water from the iron sheets for domestic use. Some used plastic paper to trap water. And those without umbrellas also used water from grass thatched houses for use*" (FGD2_W, Mtuluma).

Table 7.5 presents the coping strategies that households used during flooding. In Makombe, Mtuluma and Mpheta, many (particularly those close to boreholes) relied on boreholes because they were least affected by flooding. For example, in Makombe, FGDs emphasised this contribution: "*If we did not have the borehole we could face a lot of problems for us to access water for drinking and cooking food*" (FGD2_W, Makombe). However, this applied to those who managed to pay for the user fees. As stated earlier those who failed to pay turned to unsafe sources of water (Table 7.1).

Table 7.4 Coping strategies following flooding

Village	**Source**	**Coping strategy**
Makombe	VL1	Sourced from borehole (leading to queues) and rainwater harvesting
	FGD2_W	Sourced from borehole and rainwater harvesting (rooftop and plastics)
Mtuluma	VL1	Sourced from borehole and rainwater harvesting
	VLWC1	Sourced from well, rivers and rainwater harvesting (rooftop)
	FGD2_W	Sourced from borehole (for households at lower side of the village); streams; rainwater harvesting (rooftop, umbrellas and plastics)
Kasonga	GC2	Shift to other springs
	FGD2_W	Boiled water from same source – normal practice in all rainfall seasons
Mpheta	VLWC6	Sourced from earth irrigation channels
	FGD2-W	Sourced from earth irrigation channels and river

Results show the lack of appropriate collection infrastructure, technologies and guidance, e.g. water harvesting from trees, umbrellas and thatched roofs. This suggests that, during flooding, formal institutions are challenged in their responsibility to provide good quality water, hence households were more likely to use unimproved sources of water.

Overall, the study findings suggest that for many households, unsafe sources (which are typically managed – if at all – by traditional leaders) offer seemingly better alternatives when faced with intermittent supply due to negative seasonality or climate risks or when formally-managed drinking-water sources are located far from consumers or are not available. The results partly explain the access trends reported in Chapter 6, e.g. many households collecting insufficient quantities of water and using surface water in Mtuluma in the wet season.

7.7 Discussion

This section discusses the study findings in relation to the link between service governance and service delivery and the ability of local formal institutions to address seasonality and the effects of flooding.

7.7.1 Ability of local formal institutions to address seasonality and flooding effects

Dry and wet season access challenges and constrained access during flooding suggest that local formal institutions are inadequately equipped to deal with these situations. Drinking-water infrastructure is not functioning properly under different temperature and rainfall patterns partly because the current rainfall and temperature trends and projections are not factored into the design standards of these water facilities. This finding is in contrast to the definition of a resilient system as "*an infrastructure network that is resilient to today's natural hazards and prepared for future changing climate…by ensuring that an asset is located, designed, built and operated with the current and future climate in mind*" (HM Government, 2011 pp17, 33). The washing away of intakes suggests that the existing water infrastructure has not been constructed properly in the first place and hence is not resilient to flooding. In addition to inadequate technical training of local artisans and their supervisors, this may be attributed to several factors including:

First, there is limited capacity of engineers to integrate climate risks into the design and maintenance regimes of water infrastructure. This suggests a limited knowledge of climate change science or inadequate application of IWRM principles, which would ensure integration of all relevant stakeholders in the development and management of water resources (Savenije and Van Der Zaag, 2000; 2008). It is widely agreed that water infrastructure designs usually use return periods of extreme events, e.g. 1 in 50 or 100 years, to withstand effects of climate variability (Glenn et al., 2012). However, with the increasingly unpredictable frequency of floods, governments and relevant actors in water supply are expected to "*rethink and review"* the vulnerability of their assessments, not to rely *"on historical forecasts, and to plan for more extreme circumstances outside previous assumptions*" (UNICEF and WHO, 2011 p75). Infrastructure designs should be able to cope with uncertainties without excessive failure and management costs (HM Government, 2011). Additionally, existing water infrastructure needs rehabilitation to ensure that maintenance regimes consider resilience to climate risks (HM Government, 2011).

Second, the technology guidance provided in water policy does not sufficiently recognise the significance of flooding. The National Water Policy (NATW3) agenda has emphasised low cost local technologies to ensure sufficient and efficient service provision (Government of Malawi, 2007b). While this is commendable, following the 2015 and 2019 flooding events, and the observed trend of increasing numbers of extreme weather events and associated "*increased loss of functioning infrastructure*" (UNICEF and WHO, 2011 p48), the evidence reported in this thesis suggests that special attention paid to improving the resilience of drinking-water infrastructure is central to addressing equitable access during extreme precipitation conditions. The IWRM framework promotes resilient freshwater management systems to ensure water security, especially for vulnerable groups (Savenije and van Der Zaag, 2008). According to de Albuquerque (Undated p36), this includes consideration of "*new approaches and innovative technologies, sufficient infrastructure investments, capacity development, and technology transfer*." Nevertheless, UNICEF and WHO (2011) argue that such interventions should consider that all the available water technologies have some adaptive potential that only require improvements to maximise their resilience. This calls for the vulnerability of technologies to be considered in relation to specific extreme events as well as their local environmental conditions (UNICEF and WHO, 2011). This implies that if technology transfer is adopted, expert engagement is needed to guide the selection of technologies that are appropriate for specific environments. This should involve a screening process, assessing the costs and benefits before adoption, because some technologies cannot be sustainable in all localities (WHO, 2009). Support for appropriate endogenous (locally invented) technologies should also be supported.

Third, local formal institutions lack the capacity to operate and maintain water infrastructure during extreme precipitation and floods, in part due to insufficient funds collected from user fees[55]. Traditional structures (via chiefs) play an important role in filling the service delivery gap but this is from unimproved water sources (like village wells or springs) or from household-managed rainwater harvesting. This issue is discussed further in Chapter 8.

7.7.2 Relationship between service governance and the service outcome for each village

The thesis found there was inequality and discrimination in drinking-water service delivery outcomes in the study villages (Fig. 7.4). The main reasons for this were terrain, financial constraints, and water availability. As shown in Section 7.5.1, underserved or unserved areas had difficult terrain for borehole installation and pumping water for taps leading to high cost implications for service delivery. Hence, without access to improved water, households turn to unimproved sources of water. Consequently, inequalities persist. This supports observations by Baumann and Danert (2008) that, despite impressive water infrastructure development in rural Malawi, achieving universal access is difficult due to the remoteness of unserved areas and limited water availability. A critical analysis of these delivery and service governance challenges is necessary to ensure equitable access to drinking-water (De Albuquerque, 2014a). However, the present study has noted that the ability of institutions to fulfil their obligations depends on technical capacity, clear lines of decision making and sufficient financial resources – all of which need to be adequate for both 'normal' and unusual weather patterns, and be adaptive to the needs of a non-homogeneous user group. Inequalities and discrimination in service delivery are strongly related to inadequate delivery of service governance and to the attitudes of some users, as detailed below.

[55] The system is designed to bring in enough money to cover all costs associated with operations and maintenance, including the flood damage (LOCW1, VLWC1, VLWC2, also see Section 5.2.6.3).

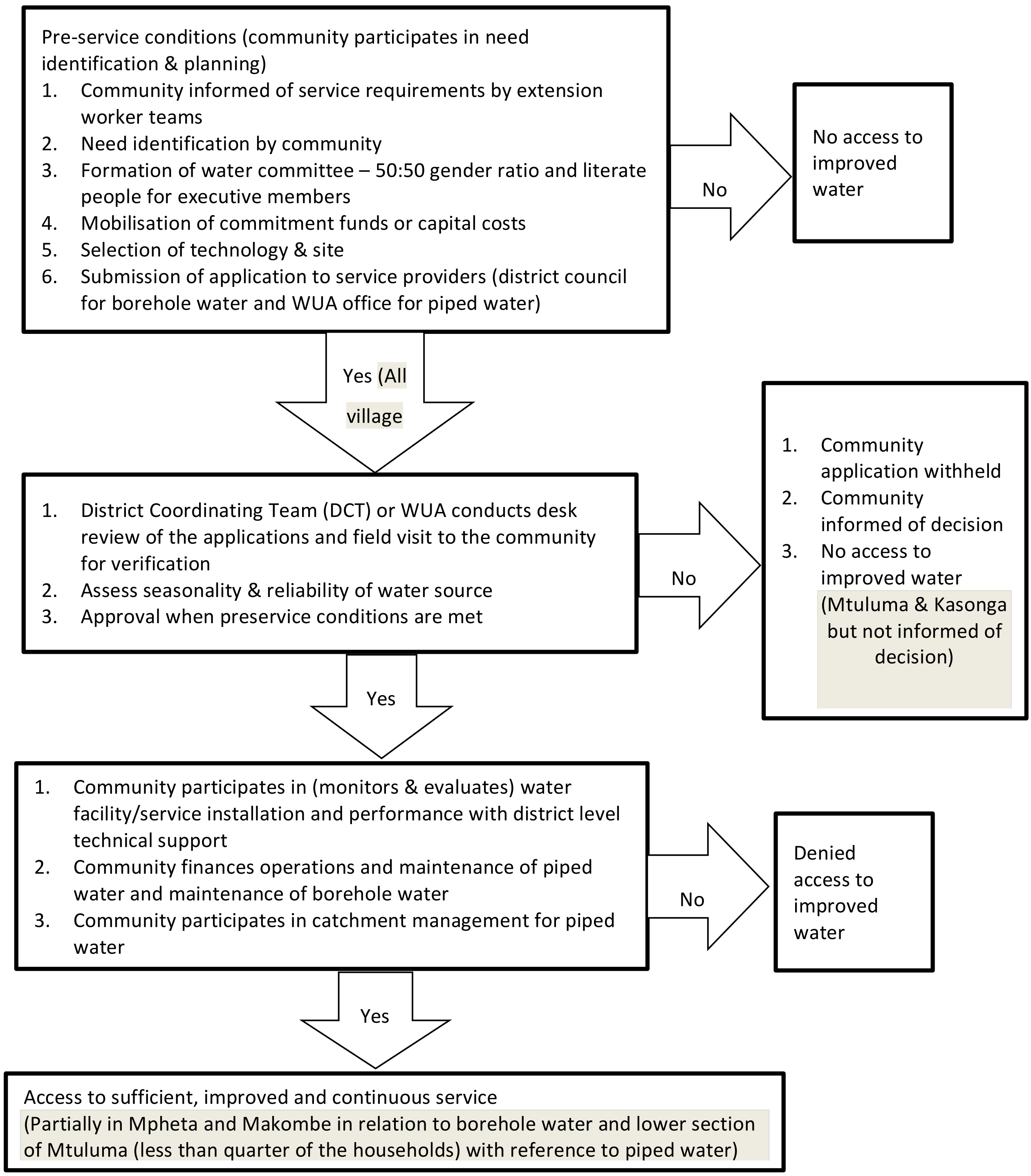

Figure 7.4 Implementation of National Water Policy process for communities to obtain access to rural drinking-water and location of study villages in this process

Note: Parts highlighted in grey show where the different study villages currently lie on this figure

7.7.2.1 Ineffective participation in decision-making of marginalised groups

Despite policy emphasis on inclusive decision-making in water-related activities, the villages had a range of practices and this variation, in part, explains variations in operational rules and consequently access rights between the poor and better-off households. Overall, in the decision-making bodies, such as the executive committees for water points, water resources board and WUA general assemblies, there was no effective representation of illiterate people, thus excluding approximately 40% of the population, because illiterate people are deemed ineligible for executive committee membership. This exclusion is based on the criteria set in the water policy (NAWT8) for executive membership selection. This proportion is too large to be neglected. Thus, the criteria for executive membership explicitly exclude vulnerable groups.

Women's membership in established structures at district and village level, was mostly high following water policy specifications (NATW8, NATW9, NATW10, NATW11) but meaningful participation in committee activities such as decision-making and application of skills learnt in managing water facilities was largely normative or passive, excluding Mtuluma village. The women either did not attend important meetings or their voices were less heard, suggesting that consideration of the 50:50 gender ratio is not a guarantee for women to have influence in decision-making. This result contradicts the findings of Agarwal (2010) that, in developing countries, high numbers of women on committees encourage women to speak out and voice their concerns. Thus, the requirement of equal representation does not necessarily deliver effective participation.

7.7.2.2 Inadequate participation in monitoring installations and water point maintenance

Water users' participation in monitoring is central for holding service providers to account for their decisions and service delivery (De Albuquerque, 2014b). Water committees have a legal mandate to monitor drillers' activities, including monitoring water point installation. However, members of these committees tend to have inadequate technical knowledge and no district level support to oversee installation of boreholes and other supply systems; this is a common challenge to community-based water facilities management in rural Malawi. Baumann and Danert (2008) analysed the operation and maintenance of rural water supply in Malawi and also found that the caretakers had limited technical backstopping and inadequate understanding of groundwater resources for appropriate monitoring. Thus, water access challenges are partly out of the control of a village when given poor quality materials and inadequate training. A decade has passed since Baumann and Danert's work, which suggests persistent institutional failures to provide technical expertise during drilling and installation. Similarly, Chowns (2015); (2014) describes the failings of community management in rural Malawi as being down to technical, financial and institutional issues. Hence, the findings here agree with the observation by Grönwall et al. (2010) that service delivery under most situations in low-income countries is equally a governance and a technical challenge. There is therefore an urgent need to review relevant provisions of the National Water Policy and legislation to make it gender responsive, and to acknowledge that adequate committee participation in monitoring service delivery requires adequate technical knowledge and district level support.

7.7.2.3 Inadequate implementation of demand-responsive approach

In the National Water Policy (NATW3), the demand-responsive approach covers a number of critical aspects of water provision, including the full involvement of water users, cost sharing for water resources development and management to promote stewardship among users and sustainability of water facilities. Participation of all users at all levels is, therefore, central to effective implementation of a demand-responsive approach. Such participation may be witnessed during planning of service delivery where, among other things, the process requires villages to apply for the service they need following well-defined procedures, including financial contributions for pre-service operation and maintenance funds. Yet despite expressing their demand and meeting all the application regulations, the applications of the upstream villages were not considered, apparently due to projected high construction costs linked to difficult terrain. This suggests that successful application for services is dependent on village location. Thus, the equity standard is undermined by discrimination based on geographical position of households. This contradicts the inclusive policy provision of the demand-responsive approach. The selective application of this approach, therefore, explains poor service distribution in Mtuluma and Kasonga villages. In contrast, Mpheta had spatial variation in borehole service distribution owing to the non-availability of viable aquifers in areas without boreholes. Therefore, borehole distribution in some areas may be attributed to environmental conditions rather than institutional structures.

7.7.2.4 Inadequate interpretation of international policy at local level and contradictions in national policy

Many studies show that households in both developed and developing countries are excluded from access if they fail to meet water costs (Garcia et al., 2010; Martinez-Santos, 2017). International and national water policies and legislation advocate for the provision of affordable drinking-water services to all people. However, management structures at local level tend to be contradictory. For example, to improve efficiency and sustain service provision in poorly serviced areas, the SADC Regional Water Policy advocates for cost recovery policies, e.g. through water pricing that considers local conditions and the social economic status of users. It particularly calls for policies that "*must consider the special requirements of the poor and the vulnerable in society"* (Southern African Development Community, 2005). Similarly, Malawi's national legislation and policy guarantees affordability to all households without any form of discrimination (GoM 2005; GoM 2013) and it advocates flat pricing or metering for rural piped water systems (WUA Approach). This national legislation provision was being strictly followed in the implementation of the WUA approach in Mtuluma, causing the flat rate to exclude the poorest water users with limited ability to pay. In contrast, although the borehole charging system in Mpheta contravenes the flat rate requirement in national policy and legislation (Government of Malawi, 2007b; Government of Malawi, 2013b), it is in line with recommendations of international water policy, namely that water charges should be dependent on the paying capacity of users (Southern African Development Community, 2005). Thus, such operational rules integrate elements of fairness, social justice in distribution of benefits, and individuals' capacity, which are central to equity (McDermott and Schreckenberg, 2009).

The partial implementation of DRA is another example of inadequate implementation of the international and national water policies. The selective implementation of the DRA by the District Assembly through the advice of the DCT, and limited consideration of the poor in tariff structures are further examples of inadequate policy implementation. This contrasts with the policy principle of non-discrimination in ensuring equitable access rights to drinking water.

The study shows that access to drinking-water is affected by drinking-water governance structures at multiple levels. In this study, institutional arrangements, both formal and informal, play a central role in drinking-water access in the study villages. The governance level located at community level, e.g. chiefs and village committees, can determine how any available water is distributed (operational rules). However, governance at district level determines whether demands by communities for water are met in the first place. The study established that community-level governance structures have little power to influence decisions at district level, contradicting the intention of the DRA policy. This finding concurs with Nunan et al. (2018) who highlight that a key challenge for multi-level natural resource governance systems is to ensure that local voices are effectively heard at higher decision-making levels.

7.8 Conclusion

Theoretically, principles of water service governance enhance the attainment of water service delivery standards (refer to chapter 5). For example, participatory approaches, demand-driven approaches, and inclusiveness in addressing the water needs of the poor, women and the underserved are assumed to deliver equitable access rights to drinking water, putting an affordable service of adequate quantity and quality within easy reach. However, reality in the villages varied widely. Despite recognition of service governance standards in policy, implementation on the ground was found to be generally inadequate in this case study. Critically, the strong policy agenda at both international, national and district scales to target the concerns of women and the poorest, does not appear to translate into effective participation of the two groups in decision-making forums that affect their access rights. This leads to decisions which do not take into consideration the specific needs of marginalised groups such as their inability to pay for water point user fees. Hence, although water was affordable to many, poorer households and households in some catchment villages had greater difficulty in accessing drinking water, and many lived far from an improved water source. These contestations and legislation deficiencies, therefore, contributed to further marginalisation of already marginalised households. Thus, formal institutions contribute to choice and shifts in drinking water sources by season in all the study villages as summarised in table 7.5 below.

In other words, improving access to drinking-water remains a challenge until meaningful implementation of marginalised-oriented service governance principles are achieved.

Table 7.5 Main Source of drinking water by season in the study villages

Dry season source of water	**Institutions influencing choice**	**Rainy season source of water**	**Institutions influencing choice**
MTULUMA: *Majority*: wells in the village and in neighbouring village and rivers *Few*: Borehole and communal taps in neighbouring villages (for the few households close to the tap and borehole)[56] upon payment of annual maintenance fees. There is also intense intermittent supply in taps due to low water levels at intakes	*NATIONAL LEGISLATION:* Low coverage due to rigidity in applying rules on threshold for access (75 for taps and 250 households for boreholes). *NATIONAL LEGISLATION GAP - FINANCIAL MANAGEMENT OF WUA FOR SERVICE EXPANSION:* Low coverage due to pumping or construction costs *WEAK ORGANISATIONAL STRUCTURE OF WUAS:* Lack of horizontal accountability for failure to provide service *WUA RULES:* Uniform application of tariffs across seasons and without considering the poorest INFORMAL MANAGEMENT/TRADITIONAL STRUCTURE: Access to water from rivers is managed by informal systems	**MTULUMA:** *Majority*: Water from rivers/streams due to close proximity to households and absence of improved source of water in the upper and mid parts of the village. Due to turbidity many rely on water harvesting from roof tops and black plastic sheets supported by four poles. *Few*: Those close to tap and borehole in neighbouring villages. There is also intermittent supply in taps due to clogging and washing away of pipes	*NATIONAL LEGISLATION*: Low coverage due to rigidity in applying rules on threshold for access. *NATIONAL LEGISLATION GAP - FINANCIAL MANAGEMENT OF WUA FOR SERVICE EXPANSION:* Low coverage due to pumping or construction costs *NATIONAL LEGISLATION* – CBM PRINCIPLES: Reliance on inadequately trained committee members to oversee borehole installation and manage repairs *NATIONAL LEGISLATION* – CBM PRINCIPLES: Inadequately trained artisans to install and repair intakes for tap water INDIVIDUAL HOUSEHOLD BASED DECISION and CLOSE PROXIMITY – Choice of rainwater harvesting and on-plot hand-dug wells INFORMAL MANAGEMENT: Access to water from streams is managed by informal systems

[56] River in the middle section of the village is ephemeral

Dry season source of water	**Institutions influencing choice**	**Rainy season source of water**	**Institutions influencing choice**
Makombe: *Majority*: Unprotected wells dug on riverbanks and wetlands (*dambo*) - especially for households close to Lisanjala river. *Few*: Only one borehole works (all five are operational in rainy season). Mainly used by those located close to it.	*NATIONAL LEGISLATION* – CBM PRINCIPLES: Reliance on inadequately trained committee members to oversee borehole installation and manage repairs *NATIONAL LEGISLATION*: No consideration of the poor in water user fees for boreholes *NATIONAL LEGISLATION*: Low coverage (in many households located away from available boreholes) due to rigidity in applying rules on threshold for access (75 for taps and 250 households for boreholes) WEAK ORGANISATIONAL STRUCTURE OF WUAS AND BOREHOLES WATER SYSTEMS: and lack of horizontal accountability for failure to provide service	**Makombe:** *Majority*: Boreholes *Few*: unprotected wells dug in wetlands (*dambo*) - (wells are covered with flood water) and rainwater.	None - Individual household decision making
Mpheta: *Majority:* Boreholes (7), maldev pumps (8) and *Few*: shallow wells for households far from maldev pumps especially in Bango area	*NATIONAL LEGISLATION*: coverage based on threshold rules for access while choice of technology is based on geological/aquifer condition of part of the village (boreholes for upper part while maldev pumps for wetland section of the village) TRADITIONAL STRUCTURE – village chief intervention: Exemption of the poorest from payment of borehole user fees	**Mpheta:** *Majority:* Boreholes (7), maldev pumps (8) and shallow wells for households far from maldev pumps especially in Bango area	*NATIONAL LEGISLATION*: coverage based on threshold rules for access while choice of technology is based on geological/aquifer condition of part of the village (boreholes for upper part while maldev pumps for wetland section of the village) TRADITIONAL STRUCTURE – village chief intervention: Exemption of the poorest from payment of borehole user fees

Dry season source of water	Institutions influencing choice	Rainy season source of water	Institutions influencing choice
		Few: Rain water harvesting	INDIVIDUAL HOUSEHOLD BASED DECISION and CLOSE PROXIMITY – Choice of rainwater harvesting and on-plot hand-dug wells
Kasonga: *Majority:* Springs, unprotected wells *Few*: rivers (for households upstream)	WEAK ORGANISATIONAL STRUCTURE OF WUAS AND BOREHOLES WATER SYSTEMS: No access to improved water at all (because of failings in the formal system) - no horizontal accountability for failure to provide service or alternatives *NATIONAL LEGISLATION GAP -FINANCIAL MANAGEMENT OF WUA FOR SERVICE EXPANSION:* Low coverage due to pumping or construction costs INFORMAL MANAGEMENT: Access to water from springs and rivers is managed by informal systems	**Kasonga:** *Majority:* Springs, wells and rain *Few*: rivers (for households upstream)	WEAK ORGANISATIONAL STRUCTURE OF WUAS AND BOREHOLES WATER SYSTEMS: No access to improved water at all (because of failings in the formal system) - no horizontal accountability for failure to provide service or alternatives *NATIONAL LEGISLATION GAP -FINANCIAL MANAGEMENT OF WUA FOR SERVICE EXPANSION:* Low coverage due to pumping or construction costs INFORMAL MANAGEMENT: Access to water from springs and rivers is managed by informal systems, and access to rainwater harvesting is a household-based decision

Chapter 8 Discussion and conclusions

8.1 Introduction

Access to drinking-water is central to poverty eradication, yet it remains a critical challenge for marginalised households in developing countries (De Albuquerque, 2012; Pullan et al., 2014; WHO and UNICEF, 2014; WHO and UNICEF, 2017c). Understanding the persistence of marginalisation in access to drinking-water in rural areas of developing countries can help to inform interventions and track progress towards universal drinking-water access (Pullan et al., 2014). While some studies have quantified inequalities (Pullan et al., 2014; Yu et al., 2014), very few understand the root causes of these inequalities (Naiga et al., 2015) (see Section 2.4.3). This thesis seeks to address that gap.

This thesis contends that drinking-water access in marginalised households is partially explained by social, political, environmental and economic factors. Understanding the effect of these explanatory factors in marginalised households is therefore essential to help stakeholders such as policy makers and service providers better target the most disadvantaged groups (United Nations, 2018). These factors have been understudied in developing countries, particularly in rural areas of Sub-Saharan Africa where progress towards equitable access to drinking-water is often off-track (Chapter 2).

This thesis focuses on local formal institutions because of their mediating role on the effects of other explanatory factors and because their legal basis means service providers can be formally held accountable for their actions (De Albuquerque, 2014a). Moreover, gaps remain in the scholarship of how formal water governance institutions affect access to drinking-water among marginalised households in developing countries specifically in Sub-Saharan Africa (Naiga et al., 2015).

This chapter discusses key findings on how local formal institutions in rural Malawi address equitable access to drinking-water for marginalised households across seasons and extreme weather events. To achieve this, the chapter discusses findings from the three study objectives:

(i) determine the extent to which national water policy and institutional design address equitable access to drinking-water for marginalised households across seasons and extreme weather events;

(ii) establish how well the local formal water institutions implement policy and deliver equitable access to drinking-water for marginalised households; and

(iii) explore how seasonality and extreme weather events affect the ability of local formal water institutions to deliver equitable access to drinking-water for marginalised households (rural poor households and women).

The thesis findings contribute to empirical and theoretical research on how local formal institutions contribute to/affect access to drinking-water in marginalised households across wet and dry seasons and during extreme weather events.

This chapter begins by reflecting on theoretical issues, with Sections 8.3 to 8.5 discussing the key findings for each of the research objectives. Section 8.6 reflects on the methodological limitations and insights of the study followed by policy recommendations in Section 8.7 and a final conclusion in Section 8.8.

8.2 Theoretical reflections on the application of Ostrom's SES framework to drinking-water systems

The research design in this thesis (see Fig. 2.1) was shaped by Ostrom's work on Socio-Ecological Systems (SES), notably her SES framework (Ostrom, 2009), and its application to common-pool resource management situations. This suggests that, under certain conditions, common-pool resource users self-organise internally or with external influence to create their own rules that govern resource system use and sustainability outcomes (Ostrom, 2002). According to McGinnis and Ostrom (2014), governance outcomes of common property resources are determined by the extent to which institutions integrate a set of interlinking factors and their interactions in social-ecological systems. In this thesis, I argue that access to drinking-water is affected by many of the interlinked factors that Ostrom uses in her SES framework, i.e. resource type, resource management, users and their organisation. Ostrom's SES framework has mainly been used to analyse sustainability of SES, e.g. the effect of governance systems on sustainability outcomes of forests (Mohammed and Inoue, 2012) and urban lake commons (Nagendra and Ostrom, 2014). Apart from Naiga et al. (2015), there is little research that applies the SES framework to assess drinking-water access outcomes among marginalised households. This research contributes to this gap.

For the first time, this thesis applies Ostrom's conceptual SES framework to illustrate the role of formal institutions in shaping access to drinking-water in marginalised households across seasons and during extreme precipitation conditions. As detailed in Table 3.5 and Section 3.4, I used variables and interconnections in Ostrom's SES framework to shape the research design including data collection. As outlined in Table 8.1, evidence presented in Chapters 5, 6 and 7 revealed interconnections between: the structure and implementation of local formal institutions (GS), the attributes of the resource systems (RS) (e.g. water availability and quality and geological conditions), resource units (RU) (i.e. drinking-water sources), differences among resource users (A) (marginalised groups/households), and their interactions (I) to produce equitable or inequitable outcomes (O) in the context of related ecological systems (ECO) (e.g. impacts of upstream activities on downstream water access) and broader social-political-economic settings (S) (international policies and legislation), and how all these varied by season. This evidence has been used to elaborate Figure 8.1.

Table 8.1 Thesis chapters that relate to each of the first-tier SES framework variables

Chapter	**SES high-level variables**
Chapter 5	Analysed how broader Social-political-economic settings and Governance systems (as described in international and national policy and legislation) consider Actors' characteristics (marginalised groups), seasonality and extreme precipitation events, and their effects on Resource Systems and Resource Units
Chapter 6	Analysed practical Access outcomes for different Actors and in different seasons
Chapter 7	Analysed how Governance systems determine Interactions, focusing on Access outcomes across different seasons and extreme precipitation conditions

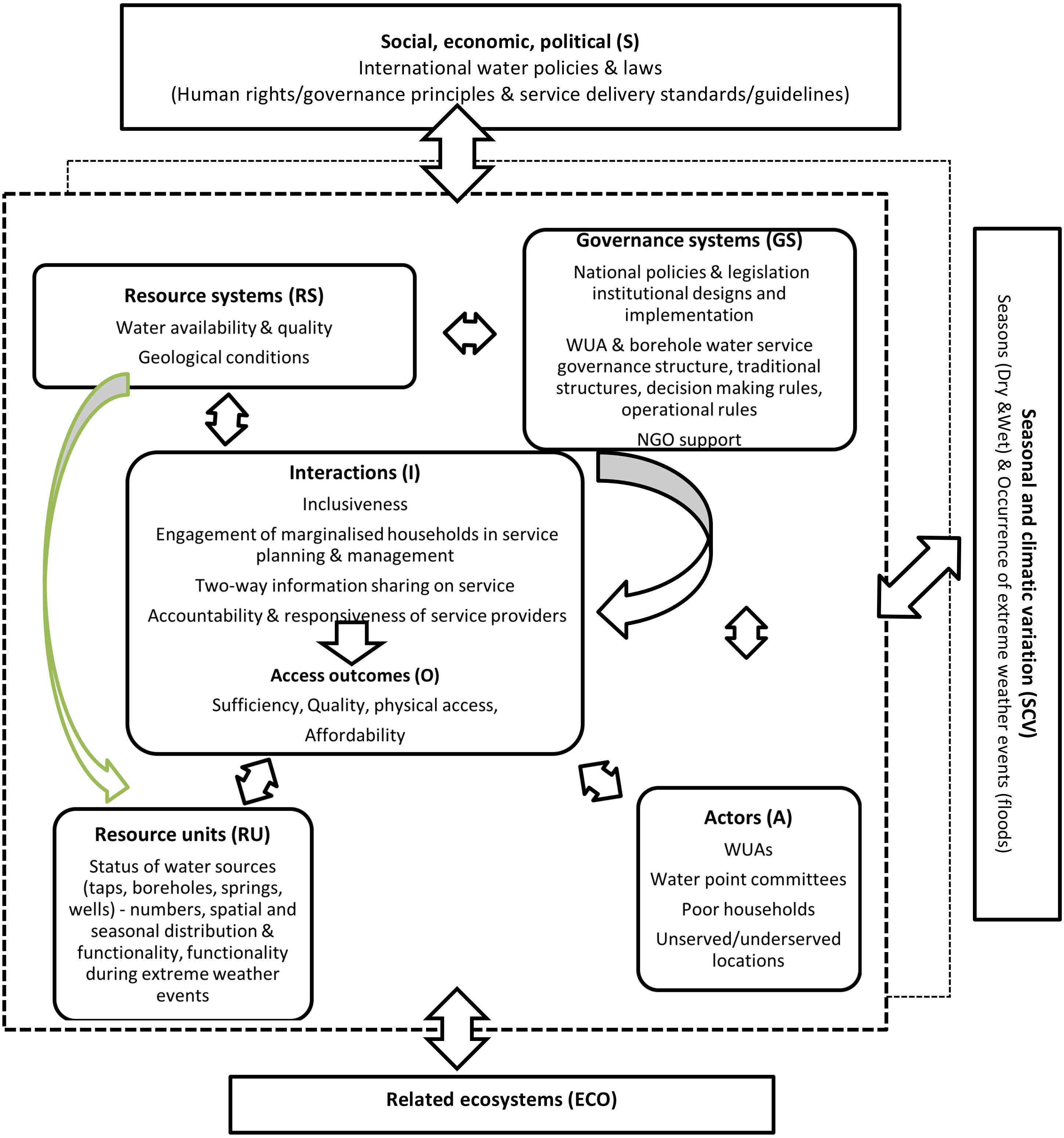

Figure 8.1 Conceptual framework illustrating role of institutions on access to drinking-water

Adapted from McGinnis and Ostrom (2014)

The findings from this thesis show that Ostrom's SES framework, as updated in Fig. 8.1, can be applied to understand the effect of formal institutions on drinking-water access across seasons and during extreme weather events (e.g. droughts and floods) in community-based demand-responsive approach (DRA) systems. To do so requires a few key amendments to the original SES framework. Firstly, Resource units are defined not as living organisms (e.g. trees or fish) but rather water points (taps, boreholes and wells). Secondly, Outcomes for drinking-water access are described in terms of sufficiency, quality, physical access and affordability and (in this thesis) disaggregated for different groups of Actors. Thirdly, relevant Governance systems occur at multiple levels from national bodies to local structures, such as WUAs. Finally, based on my findings that seasonality significantly affects the whole drinking-water system, the updated diagram explicitly incorporates the effects of seasonality and short, medium and long-term climatic variability (new box, SCV).

This thesis has also found that the variables in the SES framework are associative and interactive (Fig. 8.1). Thus, the structure and implementation of drinking-water institutions (both formal and informal) is to some extent influenced by the broader social-political-economic settings (S) (international legal framework) and seasonality and flooding conditions (SCV). Together, these affect the whole system, as well as attributes of resource systems (RS), resource units (RU) and actors (marginalised groups/households) (A) (see Sections 5.2, 5.3, 7.2-7.6). My findings show that the design of local formal institutions (GS) largely reflects the international legal framework (S) and its guidance on how to consider or manage seasonality and flooding (SCV), marginalisation (A), Interactions (I) and access outcomes (O). In practice, therefore, access outcomes (O) for marginalised households (see Sections 6.2-6.6) are affected by the extent to which local formal institutions (GS) consider or respond to seasonality and climate risks (SCV), marginalisation (A) and biophysical factors (RS and RU) and how well they mediate interactions (I) between service providers and users (see Sections 5.2, 5.3, 7.2-7.6).

These findings confirm the argument of Andersson and Agrawal (2011) based on forest governance outcomes that local institutions can simultaneously respond to and condition socioeconomic and biophysical factors in the local context, consequently affecting outcomes negatively or positively. The results also support claims by earlier studies that good water governance is central to elimination of access inequalities (De Albuquerque, 2012; De Albuquerque, 2014a; United Nations, 2018).

8.3 The extent to which national water policy and institutional design address equitable access to drinking-water for marginalised households across seasons and extreme weather events

Chapter 2 emphasised the significance of formal institutions in water governance (e.g. (Agrawal et al., 2013; Woodhouse and Muller, 2017; Hinojosa et al., 2017; Pahl-Wostl, 2019). The reviewed literature demonstrates that integration of good water governance principles is important in addressing inequities (Varua et al., 2018; Masanyiwa et al., 2015; O'Reilly and Dhanju, 2014; Cleaver and Toner, 2006; De Albuquerque, 2014a; O'Reilly and Dhanju, 2012; Naiga et al., 2015; Menard et al., 2018). In the past four decades many countries have introduced policies to address access inequities (Quin et al., 2011), with an emphasis on decentralised processes including participatory approaches (Solanes and Gonzalez-Villarreal, 1999; De Albuquerque, 2014d; Masanyiwa et al., 2015). The reviewed literature also emphasises that water governance is highly contextual and mostly site specific (De Albuquerque, 2014a; Naiga et al., 2015; Singh, 2013), prompting the case-study approach taken in this thesis. As discussed below, the findings presented in Chapter 5 contribute to addressing a research gap around how: (i) the needs of marginalised groups are considered by local formal water institutions, and (ii) seasonality and extreme precipitation events are considered by governance systems.

8.3.1 The needs of marginalised groups as considered by local formal water institutions

Very little is known about how local formal institutions address the drinking-water needs of marginalised groups in rural areas of developing countries. Many studies agree that drinking-water access is a human right (Hall et al., 2014; Meier et al., 2014; Tortajada and Asit, 2017). Thus, everyone is entitled to sufficient, safe, acceptable, physically accessible and affordable water for drinking without any form of discrimination. Many have written on human rights principles such as "*non-discrimination and equality, information, participation and accountability*" related to drinking-water (De Albuquerque, 2014a p13). Similarly, there are many studies on human rights standards/guidelines related to water which include availability, accessibility, quality, affordability, acceptability and sustainability/reliability (Baguma et al., 2013; Boone et al., 2011; Bos, 2016; Sorenson et al., 2011). However, few studies have analysed in detail the extent to which these human rights principles and guidelines are reflected in the national/local institutions specifically in relation to equity consideration/addressing marginalisation.

This thesis has established that consideration of drinking-water needs for marginalised groups has a long history both internationally and nationally but the emphasis on elimination of marginalisation is quite new in some aspects of international policy. Initial emphasis on elimination of marginalisation dates back to 2008-14 when Catarina de Albuquerque was appointed as the first UN Special Rapporteur on the Human Right to Water to champion this. This elimination of marginalisation is reemphasised lately in target 6.1 of SDG 6, which calls on countries to ensure attainment of *'universal and equitable access to safe and affordable drinking-water for all*' by 2030. The MDGs sought to 'reduce by half' the proportion of a population without safe water access. That left the door open to systematic discrimination between haves and have-nots. The SDGs explicitly consider inequality and also aim for universal access, something the MDGs did not do. A combination of community-based water management and demand-responsive approach (DRA) is highlighted as one approach to address this in rural areas (Quin et al., 2011).

The detailed policy analysis in Chapter 5 shows that international principles are adequately reflected in the Malawi National Water Policy and legislation with specific mention of universal and equitable access, including for marginalised groups. The international principles have been further unbundled to fit the local context. Similarly, adoption/ unbundling into national standards is applied to the human rights standards and guidelines.

However, in spite of acknowledging the human right to water, national policy and legislation does not effectively integrate international human rights standards and guidelines around the availability, physical accessibility, quality and affordability of water. For example, national legislation does not emphasise the need for 'safe' physical access – as specified in international standards – hence this requirement is likely to be ignored in service delivery (see Section 5.2.5). Yet many studies have documented the impacts of difficult terrain, dangerous routes, and remote sites of water sources on women: health problems (Geere et al., 2010; Geere et al., 2018) including injuries from falling on very uneven, steep routes to water sources (Sorenson et al., 2011; Caruso et al., 2015) and psychological and socioeconomic challenges (Sorenson et al., 2011; Baker et al., 2018). In rural India, Eastern Congo and Ethiopia, studies show that women can experience violence, including experiences of sexual violence (rape), while collecting water from distant water sources, (Baker et al., 2018; Sommer et al., 2014) - see Section 2.3.4 for details. Fear of such risks can lead women to fetch drinking-water from contaminated sources where they are less likely to experience violence, or to collect insufficient quantities for home consumption hence contributing to further marginalisation.

In relation to water safety, none of the national water policy documents makes reference to a verified equitable water safety plan as promoted by WHO international guidelines for water quality (see Section 5.2.5). This means there are no risk assessments for drinking-water for diverse users. Hence, water quality assessments are likely to underestimate the number of households using unsafe drinking-water.

In relation to affordability, the national legislation provides contradictory statements. For example, it conforms to the international standards/guidelines of affordability by promoting flexible water costs. However, at the same time, the Malawi Water Resources Act of 2013 emphasises flat pricing for rural piped water systems and uniform user financial contributions towards preconstruction costs of borehole water systems. This thesis contends that this policy inconsistency enables service providers to overlook the inability of the poorest users to pay for the set charges.

As outlined in national legislation, the institutional arrangements for borehole and gravity-fed piped water systems under a demand-responsive approach may be confusing for users and limit quality of access. For example, illiterate people do not qualify for executive positions in the Water Users Association (WUA) board and borehole water committees, hence decision-making arrangements may not be representative of this group of people. This finding agrees with De Albuquerque (2014b p26)'s observation that "*sometimes, the barriers to access for certain groups are … the existence of laws, policies or cumbersome administrative procedures that lead to their exclusion*". Furthermore, service providers are not legally obliged to consider sparsely populated households below the minimum threshold (of 75 unserved households per community), consequently marginalising rural or isolated water users. This policy gap is likely to constrain full implementation of demand-responsive and demand-driven approaches where users are expected to request services that suit their situation. This thesis regards this exclusion as one form of formal discrimination likely to contribute to further marginalisation of the poor and directly contradicting the apparent aim of achieving universal access.

These findings on marginalisation at design level by formal institutions to some extent relate to the work undertaken in Kenya (Rodrigues et al., 2015; Leclert et al., 2016). The Kenyan constitution (Article 33d) explicitly gives all people the right to drinking-water, thus implicitly addressing marginalisation. In contrast to the Malawi constitution, the Kenyan Constitution makes an explicit mention of human right to water. In Kenya, this human right to water has been further unbundled into national standards following the international standards and guidelines (Leclert et al., 2016). Apart from Leclert et al. (2016), other studies in developing countries inadequately document national performance on inclusion of the human right to water into the local formal institutions.

Few institutional analyses report on levels of adequacy or explicitly mention equity considerations. Examples include users' perspectives on decentralised rural water services in Tanzania (Masanyiwa et al., 2015), and the study of Jimenez and Perez-Foguet (2010) which acknowledges mention of the right to water and principles of DRA in the Tanzania National Water Policy of 2002 and the Water Act of 2009 with little further detail. Similarly, Martinez-Santos (2017) confirms the presence/integration of human rights guidelines on accessibility and availability in the National Water Policies of South Africa and Tanzania, however not directly associating this to equity issues but to access indicators. Likewise, Shrestha et al. (2018) observe that the Nepal National Urban Water and Sanitation Sector Policy of 2009 promotes provision of safe drinking-water services for all people and recognises this as a basic human right central to attainment of the SDG targets.

While these institutional analyses reveal policy recognition of the human right to water as well as approaches to address this, these studies give no indication of the extent to which the assessed national instrument reflects the international standards and guidelines as illustrated in this study. Most of these studies, e.g. Cleaver and Toner (2006) and Masanyiwa et al. (2015), focus mostly on policy delivery of the human right to water through community-based management, decentralised management, or DRA, without giving much detail of the institutional structure and its consideration of equity issues or marginalisation. This recognition is important because the institutional design can partly explain policy outcomes on the ground.

8.3.2 Consideration of seasonality and extreme precipitation weather events

This thesis confirms Chambers' (2012) observation that despite its significance in rural people's access to drinking-water, seasonality has received little attention in literature. My findings show that consideration of seasonality in national legislation in Malawi is not well developed. Although national policy provisions specifically address temporal water shortages, there is no specific mention of seasonality in the policy and legislation as there is in the international legislation. Additionally, the national legislation provisions do not offer clear guidance to service providers and users on how to manage water supply fluctuations and other supply systems in the dry and wet season, hence, it is difficult to hold service providers accountable for unsatisfactory service in a given season. Similar studies are rare for international comparison. This information gap can lead to poorly-informed interventions on the ground, consequently intensifying marginalisation of the rural poor (Chambers, 2012). This finding is worrisome considering the growing recognition of the effects of seasonality and weather events on water issues (Kostyla et al., 2015; Wright et al., 2012; Zhao and Pei, 2012; Shaheed et al., 2014b; Tucker et al., 2014; Kelly et al., 2018).

Consideration of issues such as equitable access and seasonality in policies does not guarantee effective implementation on the ground. Many studies confirm the existence of policy implementation gaps (see Sections 2.4.3 and 6.1). The next sections therefore discuss the reality of policy implementation as revealed in the case study site.

8.4 Implementation of policy and delivery of equitable access to drinking-water for marginalised households by local formal water institutions.

Responding to the second and third objectives of this thesis, this section discusses the delivery of equitable drinking-water access by household characteristics and season.

8.4.1 Delivery of equitable drinking-water access by household characteristics

In relation to equitable access to drinking-water, several studies have revealed differential access to drinking-water (De Albuquerque, 2012; Pullan et al., 2014; WHO and UNICEF, 2014; WHO and UNICEF, 2017c) and persistent access challenges among marginalised groups (De Albuquerque, 2012; Satterthwaite and Winkler, 2012). However, very few studies have focussed on smaller spatial scales for better analysis of inequalities and informed policy (Pullan et al., 2014; Yu et al., 2014). The village-scale analysis of marginalised groups in this thesis helps address this gap.

This thesis has revealed that drinking-water access varies by household characteristics, specifically by their location, household size and income group. In this study, the hard-to -reach/remote areas (upstream households within the catchment) are associated with insufficient quantity and use of non-improved water. In addition, this study shows that although water is largely affordable in rural areas, the likelihood that a richer household will use an improved water source is greater than for a poor household, suggesting greater access to improved drinking-water for richer households than for poorer ones. These study findings confirm research results carried out in other countries.

Existing literature shows similar conditions in many developing countries, where there are geographic and socio-economic inequalities in access to improved water sources, e.g. at regional, national and sub national (urban-rural) level, (De Albuquerque, 2012; Pullan et al., 2014; WHO and UNICEF, 2014; WHO and UNICEF, 2017c). Many studies have reported spatial inequalities in the use of improved water sources (Chaudhuri and Roy, 2017; Cole et al., 2018; He et al., 2018; Zimbalist, 2017; Pullan et al., 2014; Yu et al., 2014) including important regional inequalities (Stoler, 2012; Loftus, 2015; WHO and UNICEF, 2017c; United Nations, 2018). Some studies have revealed national inequalities (WHO and UNICEF, 2017c; Yu et al., 2014), rural-urban inequalities (WHO and UNICEF, 2013; Pullan et al., 2014; WHO and UNICEF, 2017c; Chaudhuri and Roy, 2017; National Statistical Office and ICF, 2016) and access challenges in hard-to-reach/remote areas (Pullan et al., 2014). There is also recognition of differences in access by gender (Morakinyo et al., 2015; Masanyiwa et al., 2015; Varua et al., 2018), educational level (Arouna and Dabbert, 2010) and wealth (De Albuquerque, 2012; Satterthwaite and Winkler, 2012). These further studies confirm that poor households tend to have limited access to an improved water source (Kendie, 1996; Dungumaro, 2007; Wilk and Jonsson, 2013; Government of Malawi, 2012a; National Statistical Office, 2015; Soares et al., 2002; WHO and UNICEF, 2017c).

Most of these studies mask the picture of marginalisation at the local (small geographic) level. The local inequalities revealed in this thesis suggest persistent (household-level) marginalisation and differential drinking-water access even within areas marginalised by factors such as their geography, and hence the failure of the local water policy to deliver equitable and affordable service to all – threatening the attainment of the SDGs by 2030. Hence this thesis contends that disaggregation of data analysis by socioeconomic characteristics within marginalised groups versus broad conclusions is one important step towards understanding and addressing inequitable drinking-water access for marginalised groups.

8.4.2 Delivery of equitable access by season

There is increased interest in understanding how access to drinking-water is affected by seasonality of water availability. A growing body of literature now shows that surface water quality and availability in developing countries follow seasonal patterns (Kostyla et al., 2015; Wright et al., 2012) with effects on household access (WWAP/UN-Water, 2018; Wright et al., 2012). Yet the seasonal access status in marginalised households of developing countries is underexplored in academic literature. This thesis investigated this problem.

The study findings show that there are differences in access to drinking-water by season in marginalised households. Surprisingly, some households experience access challenges during the rainy season when access might be expected to improve, resulting in use of unimproved water sources. Similar findings are reported by Arouna and Dabbert (2010), who studied the determinants of domestic water use by rural households without access to private improved water sources in Benin. Such drinking-water access challenges can be missed in assessments that conceal seasonal access trends. Hence, it is not sufficient to rely on annual averages, but seasonal analyses of drinking-water access are needed.

Similarly, service delivery varies across the season, and households use different sources by seasons. People move between different water sources seasonally; the shift tends to be away from formally managed services. For example, households shift to shallow wells or rainwater harvesting to cope with intermittent supply or source failure in taps and boreholes during dry or wet season or extreme weather events. This is not an isolated case. Similar findings from diverse settings such as rural South Africa are reported by Majuru et al. (2012) and Majuru et al. (2016). These deficiencies combined with intermittent piped supply systems following breakdowns in both dry and wet seasons as well as flooding conditions often compromise access to safe water. Several studies have found that during water collection and storage as well as such periods of interruptions, water supply systems are often subject to contamination events through backflow or intrusion (Kumpel and Nelson, 2013; Wright et al., 2004). In this context, the use of improved water is lower than the reported proportions. Hence, it is not good to use annual averages.

An important finding was that, in the wet season, time spent getting to the water source was strongly related to water quantity drawn, with more water being collected if the source was closer. This agrees with Smits et al. (2010) who report a decrease in quantities collected with increasing distance between water sources and point of use in rural Ethiopia. The qualitative results gave insights into the complex and localised reality, indicating that more time could be spent travelling to the water source during the wet season, due to slippery and steep terrain, especially in upstream villages. For many households, however, more time was spent during the dry season, due to queuing as a result of low water tables. Such information is often hidden in quantitative surveys.

This result could also relate to multiple uses of water in a drinking-water system. In cases where villages have greater demand for water, beyond the 20 litres per capita per day, due to multiple uses for water (e.g. domestic use as well as brick-making and farm irrigation), there is more likely to be abandonment of the formal rules governing drinking-water access. Although the current study did not investigate this thoroughly, such multiple uses were noted through participant observation and likely reduced supply to other users in the dry season. For example, a distribution pipe was deliberately cut to supply water for brick-making in one community (VL1), leaving service disrupted for downstream households. This thesis therefore asserts that consideration of multiple uses of water is important in ensuring equitable access to drinking-water. This argument is in line with Smits et al. (2010 p103) who maintain that, if a blind eye is turned to multiple uses of water in "*water system planning, design and management*" then households are likely to get insufficient quantities of water for all their domestic needs. This is related to performance and sustainability of services. According to Smits et al. (2010 p103), informal "*access to insufficient water for production often forces users of rural water supply schemes to access it in other ways, e.g. through unauthorised connections, or overusing system capacity, which in turn may contribute to physical breakdowns or conflicts among water users*".

Although water was free (in terms of direct payments) for most of the households in the study villages, this thesis revealed that water expenses exceeded 5% of overall household expenditure in over 25% of households and exceeded 3% in almost half of the households that pay for water during the rainy season. The majority paying during this season are the poor and this is when poverty levels are also very high - 77% of the richer households become less wealthy in the wet season. The high cost of water, and limited financial resources can contribute to failure to use safe drinking-water.

Both quantitative and qualitative results showed that wealth status determined access in both seasons. In the wet season, the likelihood is greater for a richer household to have access to drinking-water than for a poorer household. The qualitative results further showed that inequities exist because the rich could afford to pay for indirect costs such as labour during the dry season and water treatment during the wet season, which can help improve access to drinking-water. The poor had challenges to pay for both direct costs (water tariffs or user fees) and indirect costs (e.g. technologies for self-supply such as rainwater harvesting or water treatment).

These results confirm previous findings that poverty affects use of improved water – the wealthier are more likely to choose improved water sources (Kendie, 1996; Dungumaro, 2007; Wilk and Jonsson, 2013; Government of Malawi, 2012a; National Statistical Office, 2015; Soares et al., 2002). It is easy for the rich to pay for drinking-water services because their ability to pay positively corresponds with their per capita expenditure (Rahut et al., 2015). However, other studies report that household wealth is not a primary factor influencing access to drinking-water in many developing countries (Luh and Bartram, 2016).

In this context, seasonality assessments are critical in monitoring service delivery outcomes in marginalised communities, because they help to understand when marginalised groups face access challenges, as well as to identify which subgroup is affected. Annual averages hide these seasonal variations. However, seasonal assessments of water access are limited in water scholarship for developing countries (Arouna and Dabbert, 2010; Hadjer et al., 2005)

8.5 The effect of seasonality and extreme weather events on the ability of local formal water institutions to deliver equitable access to drinking-water for marginalised households

Chapter 2 shows that the few studies that assess how formal institutions consider equitable access to drinking-water for marginalised groups in Sub-Saharan Africa miss temporal assessments, mainly focussing on annual averages (Cleaver and Toner, 2006; Chitonge, 2011; Naiga et al., 2015; Leclert et al., 2016; Ducrot and Bourblanc, 2017). The impact of different conditions (especially spatial and temporal) on water service delivery outcomes is largely unknown, hence this thesis makes a unique contribution to scholarship and water policy.

This section discusses how seasonality and extreme weather events affect the ability of local formal water institutions to deliver equitable access to drinking-water for marginalised households (poor, women and hard-to-reach/remotely located). This objective was explored through assessment of delivery of service governance and consideration of seasonality and extreme weather events. Service governance was given special attention because it is where decisions concerning water development and management are taken and implemented, users are expected to express their interests and have their concerns considered and actors are held accountable for their responsibilities related to water management and service delivery (Woodhouse and Muller, 2017).

The findings are discussed in the context of the community-based management model of rural drinking-water supply which is complemented by and mostly combined with a demand-responsive approach that theoretically ensures appropriate service provision to users based on the demand, need and capability to operate and manage (Moriarty et al., 2013b; Hutchings et al., 2017). For many decades, governments in developing countries have been promoting community-based management to provide drinking-water service to rural areas – a shift from top-down and supply-driven approaches (Jimenez and Perez-Foguet, 2010; Quin et al., 2011; Moriarty et al., 2013b; Rout, 2014; Naiga et al., 2015; Leclert et al., 2016; Whaley and Cleaver, 2017). The community-based management model empowers rural water users through community participation, decision-making, control, ownership, and cost-sharing principles (Rama Mohan, 2003; Moriarty et al., 2013b; Hutchings et al., 2017; Koehlera et al., 2018). The aim is to address deficiencies of centralised systems in sustaining and meeting rural water needs (Moriarty et al., 2013b). These characteristics imply that governments distance themselves and give more responsibility to local users to operate and manage their drinking-water services (Koehler et al., 2015; Hutchings et al., 2017; Koehlera et al., 2018). Early assessments in developing countries have shown mixed results (Chitonge, 2011; Naiga et al., 2015; Imoro and Fielmua, 2011; Koehler et al., 2015; Leclert et al., 2016; Hutchings et al., 2017; Koehlera et al., 2018) which are difficult to generalise over different spatial systems. Additionally, some studies reveal that many gaps remain in understanding the community-based management model because the performance of these systems is under-reported in most developing countries (especially, Sub-Saharan Africa) (Chitonge, 2011; Naiga et al., 2015; Imoro and Fielmua, 2011; Leclert et al., 2016). This thesis contributes to this scholarship because most recent studies on formal water institutions for Malawi are mostly peri-urban, see Chiweza et al. (2015), Adams et al. (2018) and Adams (2018). These studies focus on informal settlements' drinking-water access and their institutional arrangements and rarely consider seasonality issues.

According to international and national water policy and legislation, service provision should be non-discriminatory, sustainable and affordable for all (INTW4, INTW5), including *appropriate pricing policies such as free or low-cost water* (INTW4 par. 27) (Chapter 5). This is also embedded in demand-responsive and demand-driven rural water supply approaches, whereby water users ask for a service and technology based on their willingness to pay (for the level of service) and their ability to manage the operation and maintenance, and service providers respond to users' demands (The World Bank Water Demand Research Team, 1993; Moriarty et al., 2013a). This means everything concerning water development and management, including both direct and indirect water costs, should be flexible according to context to ensure equitable and continuous access to rural drinking-water. Such information is rare in rural water supply assessments in developing countries. Many available studies focus on assessing the economic flexibility (consideration of the poor) of formal water institutions. Examples include studies by Cleaver and Toner (2006) in rural Tanzania and Ducrot and Bourblanc (2017) in rural Mozambique which assessed pro-poor policy implementation. This gives a partial picture of the flexibility of formal institutions, even when considering water costs, as it leaves gaps in our understanding of the status of households that may find drinking-water less affordable due to physical and temporal issues. This thesis contributes five key findings in relation to service delivery and seasonality.

First, there is a lack of flexibility in application of service delivery rules based on the different spatial, temporal and social characteristics of marginalised areas. This thesis contends that rigid application of national regulations concerning tariff recovery and minimum population density thresholds for piped water installation restricts service delivery in marginalised areas. For example, the '75 households' threshold for piped water service distribution left many households in the sparsely populated upstream area without services. Additionally, the flat rate for piped water under the WUA system excludes the poorest water users with limited ability to pay.

Although the study found that water was affordable to all in the dry season, during the wet period many of the poor could not pay tap user fees and hence were denied access. This compelled them to resort to unsafe sources of water such as rivers and unprotected wells. It is arguable that the poor were further marginalised by the fact that tariffs were approved by the WUA general assembly, which was characterised by limited representation of the poor and hence likely not attuned to the conditions of the poor households. For example, it was established that inadequate consideration was being given to challenges faced by poor households in making monthly contributions.

Findings from the study site show that formal water institutions are not adaptive to spatial differences, seasonal household income dynamics and temporal conditions of the marginalised areas. This corroborates the findings from rural Tanzania where the poorest were discriminated against regarding access to drinking-water through water users' associations because they found the fees unaffordable (Cleaver and Toner, 2006). Likewise, Imoro and Fielmua (2011), have noted that rural households in Northern Ghana cannot afford the 5% of capital costs of water development due to high levels of poverty while many rural settlements in the savanna zones fail to do so because they have very small populations. Although rigidity of institutional arrangement is not mentioned explicitly in the Ghanaian study, their results lead to the same conclusion that lack of flexibility (for example, in financial arrangements for water development and management) contributes to further marginalisation of the poor in already marginalised areas.

Second, results show that a demand-responsive supply does not always work in the marginalised areas. The demand-responsive system for drinking-water provision does not serve those who are marginalised by geography and/or socio-economic status. Despite asking for the service (meeting all the necessary preconditions), upstream households were not served because of difficulties in their terrain. Delivery of the approach, therefore, suggests successful application for services is dependent on geography and village location. There was no downward accountability as applicants were not informed of the service providers' decision and supporting evidence. Thus, the equity standard is undermined by discrimination based on geographical position of households. This is in contrast to the apparently inclusive policy provision of the DRA (Jimenez and Perez-Foguet, 2010; Quin et al., 2011; Moriarty et al., 2013b; Rout, 2014; Naiga et al., 2015). In India, Hutchings et al. (2017) also found mixed results and concluded that DRA partially has failed to address inequities in rural water service provision.

Despite a long history of DRA application in Malawi, its implementation is spatially limited because rural users often fail to meet various requirements. For example, there have been: (i) failures in meeting the service application criterion of 5% financial contribution towards capital costs (sometimes waived), (ii) failures to meet the 100% cost recovery principle, and (iii) limited backstopping from state and district level structures and poor implementation in other areas (no inclusiveness of the non-elite - see Section 7.4.2). Other research into the performance of DRA has found that the approach has improved access to drinking-water, for example, Chitonge (2011) in rural Zambia and Naiga et al. (2015) in rural Uganda. This highlights the importance of contextualising institutional analysis (Naiga et al. (2015). There has been criticism levelled at the positive picture painted of the successes of DRA in improving drinking-water in many rural areas in Sub-Saharan Africa (Moriarty et al. (2013b). Criticisms include reports of non-functionality of rural water supply systems within a few years of installation and substandard services – a situation that is hidden in many DRA evaluation reports. With this consideration, DRA success in developing countries remains contextual and debatable.

Third, DRA formally marginalises some groups due to inadequacies in its structural design. In the case study site, illiterate people were not able to express their demand for water because membership criteria excluded them from executive positions on water committees. Thus, this research agrees with De Albuquerque (2012) that sometimes marginalisation can be formal – enhanced by the structured rules. Likewise, although women were represented on committees, gender stereotypes meant they were not active, not in key roles or lacked hands-on engagement with borehole maintenance. This finding is not unique to the study villages. In many rural areas across Malawi men talk over women who have to listen. For example, these findings agree with Adams et al. (2018) study findings in peri-urban Malawi that the presence of community-based water governance structures does not guarantee equitable or meaningful participation of women. Passive and nominal participation may mean no meaningful influence on operational rules framed by active participants, preventing generated rules from adequately considering women's needs and priorities (Agarwal, 2009; 2010). These results confirm the reported constraint of gender norms on women's participation in developmental issues (Moreau et al., 2019), as well as earlier findings that the poor and women experience discrimination in important decision-making forums or interventions that concern them (Nussbaum and Glover, 1995; Reeves and Baden, 2000; UNDESA, 2010). This means consideration of cultural diversity (including gender norms and relations) and its implications is important in rural water management processes.

The community-based management model for rural water supply places responsibility of water point functionality on water users (Koehler et al., 2015; Walters and Javernick-Will, 2015; Leclert et al., 2016; Whaley and Cleaver, 2017). According to Lockwood et al. (2010) and Whaley and Cleaver (2017), functionality is often seen as a proxy for sustainability. It is assumed that community-based management leads to a sense of ownership among water users which consequently leads to sustainability of service (Moriarty et al., 2013b). However, Imoro and Fielmua (2011) argue that though communities can own the service, in reality, the sense of responsibility to manage it and the expected sustainability are not guaranteed. This thesis contends that although the community-based management approach is supported widely in Sub-Saharan Africa, it fails to consider the adequacy of actors (service providers and resource users) to deliver the model requirements effectively.

Fourth, little attention is given to cultural practices of rural communities in the application of community-based management, hence limiting functionality of drinking-water infrastructure, committees and water access. For example, this thesis found that the National Water Policy partly mandates community water committees to oversee borehole installation and management. However, sustaining water points, taps and committee functionality remains a challenge in the study villages. The water committees were run by volunteers who had inadequate technical knowledge and district level support to oversee installation of boreholes and other supply systems. Furthermore, probably due to lack of (financial) incentives, the trained male committee members/volunteers were less committed to their work and sometimes migrated to other areas for waged employment or for marriage, leaving a gap in available labour for water facility maintenance. Trained women were not given the opportunity to apply (and hence practice and remember) the skills learnt because men were selected for this work due to gender stereotypes. Hence, water source failures were common, leading to reduced access to drinking-water especially during the dry season and following extreme weather events. This finding supports study results in rural Malawi by Chowns (2014) who argues that participatory approaches in rural areas are one of the proximate determinants contributing to functionality/sustainability failures of water points.

These challenges are not unique to Malawi as various studies have established similar findings over the past decades (Koehler et al., 2015; Walters and Javernick-Will, 2015; Leclert et al., 2016; Hutchings et al., 2017; Whaley and Cleaver, 2017; Koehlera et al., 2018) but the contexts differ. For example, the results of this thesis concur with the study findings of Leclert et al. (2016) on sustainability challenges in rural Kenya where trained volunteers running most of the community-managed water systems lose commitment over time and leave for better jobs. Furthermore, these volunteers have low literacy levels and insufficient skills. They are not qualified to operate the systems including pump maintenance, bookkeeping and tariff management which demotivate water users to pay for the service in favour of self-supply from unsafe sources. In this context, community-based management in rural areas fails to manage the very problem it is structured to address. While community-based management characteristics are positive (Koehler et al., 2015), results suggest that application of the principles is locally not suitable. The rural institutions fail to adapt to the local conditions, e.g. population and physical characteristics, as revealed in the current study.

Fifth, due to limited capacity (technical, financial) of formal institutions, informal institutions play an important role in managing drinking-water access in marginalised areas during and after flooding episodes. This thesis showed that, in response to flooding effects on drinking-water access, the Water Users Association (WUA), a formal structure at local level, failed to repair damaged intakes and infrastructure because of lack of funds during and six months after flooding. The gap (in service delivery) was filled by traditional structures (via chiefs) but from unimproved water sources – shallow hand-dug wells on alluvial plains. Piped system intakes were not constructed properly in the first place due to lack of technical training. In this context, the traditional structure proved to be more robust spatially and temporally relative to the conventional service delivery. This means formal institutions are underdeveloped to moderate the effects of seasonality and extreme rainfall events.

The findings of this thesis agree with Linke et al. (2018), who argue (based on study findings from Kenya) that in many rural areas, formal institutions are ill-equipped to manage local problems relative to customary practices/institutions. This commonly happens for many reasons including little recognition of extreme weather events at policy design level (as revealed in Section 5.3) and local institutions and practices which are mostly developed and implemented in line with local structures (Tantoh and Simatele, 2018). Thus, the evidence here supports Butterworth et al. (2013) that self-supply (by non-formal groups) is one way towards attaining universal access to rural water if installation or construction and management are supported technically to reduce contamination, and to ensure reliable and adequate supply. Grönwall et al. (2010) make similar observations on self-supply in addressing seasonality of water availability although their study focused on the urban poor in Bangalore (India) and Lusaka (Zambia) and did not link it to the role of traditional chiefs or leaders. The present study further illustrated the challenges of disaggregating the role of formal and informal institutions in service delivery especially in poorly served areas. Similar findings are reported by Ahlers et al. (2013) and Ahlers et al. (2014) in their analysis of small-scale informal private service provision that fills the gap of formal service delivery in slums or unserved urban areas. This thesis therefore disagrees with Yamia et al. (2009 p155) who argue that the importance of informal institutions in resource management has increasingly eroded over time. It also contradicts some scholars who view informal institutions as not fit to address widespread challenges including rapid and dramatic environmental changes (such as extreme events) that increase chances of non-compliance of rules (Banana et al., 2007).

As established in this current study, the formal water institutions (policies and legislation) guiding management of seasonality and extreme events for equitable and sustainable rural water services are inadequate. They offer weak guidance to actors which probably explains the lack of or less effective continuous and regular support as well as access challenges across seasons and during precipitation extremes in marginalised households.

8.6 Methodological limitations and insights

This section reflects on some of the methodological limitations of the study and how they were overcome by triangulating different methods, and makes suggestions for future research.

8.6.1 Limitations

Limited financial resources meant that this study did not undertake any water quality measurements but rather used improved/unimproved water sources as a proxy for exposure to unsafe water, although it is known that improved sources may be associated with some health risks (Shaheed et al., 2014a; Shaheed et al., 2014b; Bain et al., 2014; Bain et al., 2012). The WHO and UNICEF (2017c) recognise that many developing countries continue to track use of improved and unimproved water because attainment of a basic level of service (relative to safely managed service level) remains the immediate priority in many these countries.

Limited resources also led to the use of secondary quantitative data from the ASSETS household survey tool that caused some challenges. A first problem was that 'wet' and 'dry' season information from the qualitative and quantitative data were not immediately comparable. The ASSETS household survey was initially designed to take place over two rounds, once in the wet season and again in the dry season. However, for logistical reasons and because of annual variability in rainy season onset, the implementation of the first and second survey rounds did not precisely coincide with the dry and wet season. For this reason, satellite-derived daily gridded rainfall estimates were downloaded and used to identify household interviews that took place in the wet versus dry season. Furthermore, as 18% of the households were replaced in the second round, it was difficult to compare service delivery outcomes within the same households longitudinally. To address this, the survey used unmatched datasets to give a general picture of service delivery in the study villages across seasons.

A second issue was the content of the survey. As indicated in Section 3.5.2, although the researcher had some input in the design of the questionnaire, she had no control of the content compared to her own qualitative data. Consequently, some key questions for this thesis, e.g. those related to the participation of water users in water service delivery and access issues during extreme weather events were left out because the household questionnaire was very long. Moreover, the researcher had limited control of the way some questions of concern were structured because the questionnaire was not primarily designed for this study. Examples include questions on household expenditure on water and time taken to collect water. The latter question was modified in the second round of the survey, further complicating seasonal comparisons. This was addressed through the application of the mixed methods approach (see below).

8.6.2 The benefits of triangulation

A variety of methods are used to assess drinking-water access and institutional arrangements (Ostrom, 1990; 1993; 2000; 2002; 2009). Many studies use quantitative methods such as household surveys, living standard surveys and spatial data analysis (Okotto et al., 2015; Osei et al., 2015; Luh and Bartram, 2016; Rahut et al., 2016b; Chaudhuri and Roy, 2017; Martinez-Santos, 2017; Mena-Rivera and Quiros-Vega, 2018; Shrestha et al., 2018; He et al., 2018). Some studies use only qualitative methods, focusing on people’s perceptions (Jimenez and Perez-Foguet, 2010; Naiga et al., 2015; Geere et al., 2018; Hinojosa et al., 2017), while others have applied mixed methods (Geere et al., 2010; Isoke and van Dijk, 2014; Emenike et al., 2017). This thesis employed a convergent parallel mixed methods approach whose results confirm the benefits of triangulation between methods (Brannen, 1992).

In this thesis, triangulation has generated more reliable results than single methods could have done. While generally useful, the quantitative survey failed to capture some important attributes explaining differential drinking-water access by household characteristics and season. For instance, there were notable mismatches between qualitative and quantitative findings around seasonality. As outlined above, some questions in the quantitative survey were ambiguous, poorly phrased or otherwise open to misinterpretation, perhaps because the research tool was not primarily designed for this thesis. The gap was covered by qualitative methods that were formulated and implemented principally for this thesis.

An important finding was that qualitative and quantitative data were inconsistent in relation to the season of water scarcity. The quantitative survey did not explicitly ask about seasonal changes, hence this study inferred seasonal changes by looking at responses to questions in the two different seasons. This showed that, although consumption of water (measured in buckets collected) increased in the wet season, surprisingly some households still failed to meet their per capita requirements. The FGD results suggest that shortfalls for some households could be explained by difficult physical access to some water points in the wet season. However, for many households, the shortfall may not in fact be real, as the quantitative survey failed to account for rainwater harvesting, on-plot hand-dug shallow wells and streams near homes, all of which were mentioned as important wet season water sources in the FGDs. This agrees with Deaton (2001), who highlights the risk of surveys taking shortcuts to understanding consumption processes. Unless a household survey asks people to list how much they use from each source type or each purpose, there is a risk of underestimating quantities of water consumed. In addition, limited probing during the household survey probably contributed to this quantitative problem with amounts of water used, thus agreeing with reported problems of quantitative measurement via household surveys (Stewart and Shamdasani, 1998; Bryman, 2012).

Furthermore, water collection times were not comparable in the quantitative household survey and qualitative research. In the first round of data collection, the ASSETS survey question for the time taken to the water source ('How long does it take you to reach the main water source from your dwelling? (ONE WAY): MINUTES') did not correspond to guidelines of (WHO and UNICEF, 2006)[57], which ask about roundtrip collection time. This means the survey missed queuing time at the water source, which the PRA exercises raised as an important problem particularly in the dry season drinking-water. These kinds of details are hidden in most quantitative surveys, including the Malawi MDG Endline surveys of 2014 (National Statistical Office, 2015) and the Malawi demographic health survey (National Statistical Office and ICF, 2017). These surveys provide no room for probing, and further focus on annual averages, hence they are likely both to underestimate overall water use by marginalised households and miss any seasonal shifts from safe to less safe drinking-water sources.

Mixing of methods helped to gain an in-depth understanding of drinking-water access in marginalised households, not possible based on a quantitative survey alone. In the study, some areas were inadequately addressed by the quantitative study findings, e.g. understanding differential access trends (water sufficiency and affordability) by season and water costs. However, the qualitative methods (PRA exercises, key informant interviews and formal observation) were able to address these limitations. This means mixed methods helped to provide a more comprehensive understanding of the issue under study from multiple perspectives

[57] The WHO and UNICEF guidelines state that the question should ask for the total number of minutes spent on a return trip, including queuing.

(Brannen, 1992; Barbour, 2008; Hennink et al., 2011). This approach generates in-depth data which is critical in creating an adequate understanding of persistent marginalisation to inform realistic policies and interventions aimed to address inequalities. This study therefore finds that triangulation between methods is very useful for reliable results in rural water assessments and particularly when some data used are from secondary sources.

8.6.3 Recommendations for future research

Several questions remain unanswered at present. The thesis findings in chapter 6, sections 6.2 to 6.6, show that household size, income status and education of household head are associated with access to drinking-water and these attributes vary by season. In relation to seasonality, the household size increases during the wet season. Education levels of household heads drop during the wet season when the number of households with non-educated household heads doubles. Similarly, poverty levels changed by season. There are far fewer rich households resident in the wet season. The current study did not investigate the explanation for these trends. Conclusions were based on assumptions. For example, larger household sizes were assumed to be related to seasonal migration while more households living above the national poverty line in the dry season was attributed to higher income obtained by households following crop harvest in the dry season. Further research should be undertaken to investigate these trends.

This thesis focused on access to drinking-water only, in order to have a detailed understanding of this issue. However, lately, much WASH scholarship and policy emphasises human rights to drinking-water and sanitation together, to have a holistic picture of both access to drinking-water and sanitation (De Albuquerque, 2014d). This argument is based on the premise that these influence each other, i.e. poor sanitation affects access to safe water and insufficient water can affect household sanitation management. Additionally, the monitoring activities of the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation focus on a combined global outlook of access to drinking-water, sanitation and hygiene based on harmonised national and regional estimates (WHO and UNICEF, 2017c). It is assumed that progress made in both access to drinking-water and sanitation in developing countries would contribute to the attainment of SDG 6. However, the WHO/UNICEF report provides annual averages. This means that the WHO/UNICEF report hides the seasonal picture of access to drinking-water and sanitation that can show a more realistic estimate of marginalisation or progress by season. Hence, the reported estimates are likely under- or over-estimated. Future research could therefore explore the status and inter-relationships of access to drinking-water and sanitation in marginalised households and examine how this operates across seasons and during extreme weather events in order to inform interventions and policy. Furthermore, observed links (and potential trade-offs) between water used for domestic purposes and for productive activities (like brick-making or irrigation) also need further investigation.

Multiple uses of water in a community e.g. through upstream diversions, are likely to have negative effects on ensuring equitable access to drinking water for downstream households. This thesis did not look at how water could be diverted for other purposes. Future studies should explore this, across seasons.

The effects of constrained drinking-water access on food consumption was mentioned in the focus groups and is underexplored in the literature. Future studies could cover this gap looking at how water use for food consumption occurs across seasons and during extreme weather events. Seasonal assessment is recommended because snapshot analysis or annual averages are likely to hide the seasonal picture.

Concerning water safety, the international framework not only covers water quality parameters, but also water safety planning and management. The top rung of the UNICEF / WHO JMP water ladder comprises ‘safely managed’ water supplies (WHO, 2017; WHO and UNICEF, 2017). To achieve this level a supply system must have a ‘water safety plan’, which is a management document for maintaining good quality water (WHO, 2017) based on a holistic approach to identifying and managing hazards. Following their promotion by WHO, water safety plans have been applied in 93 countries (WHO, 2019; WHO and IWA, 2017). However, this study did not find any evidence of water safety plans existing for the rural study sites in Malawi. Further research could look into how these could be implemented, focusing in particular on potential equity issues in implementing water safety planning; for example, the WHO provides no guidance on how supply managers decide where point-of-consumption water testing takes place (high versus low income neighbourhoods). Unlike the present study, future research could combine water quality/safety testing with survey and interview methods to provide a better understanding of households using unsafe water across seasons and during extreme weather events. If the current study had considered water quality as a component of access, then the measured inequality might be even greater than from considering just improved / unimproved sources (Yang et al., 2013).

8.7 Policy recommendations

Over the past two decades the demand-responsive approach (DRA) has been perceived to be better than the supply-driven approach in governing access to drinking-water and ensuring equitable distribution in the rural areas (The World Bank Water Demand Research Team, 1993; Moriarty et al., 2013a). Yet, the results of this thesis suggest that a DRA does not always address marginalisation in drinking-water service delivery across all areas, whether for piped water or borehole systems. In relation to piped water systems, the WUA approach is in a pilot phase in the study area, hence the study findings contribute directly to an understanding of policy effectiveness, specifically what does and does not work well in the implementation phase. As outlined earlier, the study found that the approach left upstream households unserved, resulted in insufficient district institutional support to provide or maintain effective service, and did not adequately consider the effects of seasonality or extreme weather events on service delivery.

The study therefore proposes some changes in policy design and implementation to address issues of social, geographic and economic marginalisation:

i. There is a need to change the National Water Resources Act to enable the inclusion of illiterate people in executive committees to ensure that the rules formulated in relation to service delivery and management are representative.
ii. Policies related to water should clearly articulate the seasonality of water to offer clear guidance to service providers and water users.
iii. Operational rules should be flexible in how they pursue the overall goal of universal and all-season access to drinking-water. These rules should firstly consider seasonality and socioeconomic status of households, e.g. payment of water costs by households. The definition of the population threshold for service delivery should adapt to spatial conditions of locations, in order to include households in sparsely populated areas which are unserved.
iv. Community participation in service delivery should be accompanied by adequate district technical support, e.g. to oversee borehole drilling or construction and other drinking-water supply systems. This would help borehole contractors and local artisans who manage rural water supply systems to adhere to design standards which would result in continuous service across seasons and during extreme weather events.
v. As permitted in legislation, the Water Department should consider providing piped drinking-water using available springs in upstream-unserved households as an incentive for their active participation in catchment management. Another approach would be to consider the construction of artesian boreholes that can be used to provide piped water to several catchment villages. This would also help address seasonal water challenges associated with piped water such as blockages during the wet season or flooding

conditions, and dry sources due to low water tables in the dry season. The approach would consequently address service inequalities and increase continuous use of improved water in marginalised households because well-designed deep boreholes are less vulnerable to climate risks and contamination.

vi. The formal system that governs access to rural drinking water is set up to provide everyone with equal access to water, but it is not effective in all situations. For example, the drying up of boreholes in dry season is affected by trust in water user committees, washing away of intakes in wet seasons is also affected by trust of water user committees/groups. This means, at certain times of the year many people are accessing water that is not delivered by formal institutions. Therefore, the policy needs to take into account water sources that are not currently managed by formal institutions.

vii. The role of traditional leadership in service provision should be formalised. The thesis found that formal institutions in rural areas can improve their effectiveness in service delivery during extreme events by acknowledging and facilitating the important role of traditional structures in managing traditional water sources when improved sources fail. Rather than focusing only on improved sources, formal institutions should also provide support (in the form of infrastructure design and water quality management) to traditional (unimproved) water sources, to ensure reliable access to drinking water at a low cost for all households in all seasons. This approach recognises the importance of self-supply during and after extreme weather situations which is inadequately addressed in the National Water Policy and legislation. By formalising this informal role, there will be a legal basis for holding actors (both traditional and formal institutions) to account for the support they provide to self-supply systems and thus help to address service inequalities. There is need to promote and strengthen ongoing and continuous post-construction and institutional support for rural water service providers, e.g. regular visits to anticipate problems, respond to emerging issues and provide technical advice. This argument confirms the association of regular monitoring and support from district office with better performance established in the literature. For example, a study of rural water supply services in Ghana found an association between regular monitoring visits by district technical staff and better drinking-water service performance including periodic maintenance and financial management (Adank et al. (2013). Similar findings are shared by Bakalian and Wakeman (2009) from their study on post-construction support and sustainability in community-managed rural water supply in Peru, Bolivia and Ghana. Other research documents mixed results, which both contradict and agree with these claims, e.g. Whittington et al. (2009). This thesis agrees with Smits et al. (2013 p387) who emphasise the need for not just frequent but also good quality support.

8.8 Conclusions

The study has used Ostrom's SES framework for the first time and found it useful in order to study drinking-water service delivery and governance in DRA systems in rural areas. However, this thesis recommends that application of the framework should be contextualised, as institutional arrangements governing access to drinking-water are heterogeneous in different local contexts. Similarly, caution should be taken on the selection of second or third tier variables because some may not apply in certain contexts and others may not be included in the framework. This thesis adopts the suggested approach and found it useful in drawing the following conclusions in relation to formal institutions' effects on drinking-water access for marginalised households across seasons and extreme precipitation conditions.

This thesis concludes that although formal water institutions aim to address equitable access to drinking-water, some design and implementation rules or standards present inadequacies that contradict the water policy intentions. For example, certain rules related to service provision and management promote marginalisation in marginalised households. The rules include exclusion of illiterate people (who are mostly vulnerable groups) for executive committee membership; use of water committees to supervise borehole installation; use of (inadequately) trained local artisans to construct water intakes; application of flat tariffs for all users in piped water service provision and management, and their strict application in reality. The challenges are further compounded by the weak technical and financial capacity of formal institutional arrangements on the ground. Furthermore, the study concludes that a demand-led system for drinking-water provision does not serve those who are marginalised by geography and/or socio-economic status. The study findings also lead to the conclusion that seasonality assessments are critical in monitoring service delivery outcomes in marginalised communities because they help to understand when marginalised groups face access challenges and to identify which subgroup is affected. However, the water policy and legislation provide inadequate attention to seasonality and extreme weather events and hence no clear guidance on how actors (marginalised households and service providers) should manage access during different seasons and extreme weather events. This is reflected partially in different service delivery outcomes (quantity sufficiency and affordability) by season, especially in poor households. IPCC (IPCC, 2014) projections suggest continued warming temperatures, globally, further reduction of mean precipitation in subtropical dry regions, more intense and more frequent occurrence of extreme precipitation events across wet tropical regions. This means continued drinking-water challenges (in marginalised communities) associated with seasonality and extreme precipitation conditions, if the approach to these factors in rural drinking-water service governance remains the same.

Additionally, in the context of service governance, the failure of formal institutions to manage drinking-water access or repair drinking-water infrastructure during, and six months after, a flood event illustrates the weak capacity of formal institutions in managing extreme precipitation situations. This partly explains persistent inequalities in drinking-water access in developing countries and especially among marginalised groups (De Albuquerque, 2012; Satterthwaite and Winkler, 2012). Hence, this thesis recommends formal recognition of the importance of polycentric institutional arrangements that acknowledge the role of informal structures during such conditions and which provide an enabling environment for achieving equitable access to drinking-water across seasons and during extreme precipitation conditions. Using the definition of Carlisle and Gruby (2017) applied to the context of this thesis, functional polycentric governance arrangements include formal and informal institutional arrangements at multiple spatial and temporal scales which are adaptive to social and environmental changes/conditions to ensure desired access outcomes in marginalised households. This need should be considered both at the design and implementation level because inadequacies at the design level offer no, or insufficient, guidance to service providers and water users at the implementation level. Hence, it is difficult to hold them accountable for inequitable access outcomes. Similarly, inadequate consideration of marginalised groups, seasonality and extreme weather events in drinking-water systems during implementation leads to undesirable access outcomes.

This thesis further contends that despite increasing efforts to achieve universal access to drinking-water by 2030, differential access and/or persistent inequitable access among marginalised households remain a challenge in developing countries until seasonality and extreme weather events receive adequate attention in policy related to drinking-water. This thesis therefore recommends a review of water policy and legislation at all spatial scales, including sub-national level, to include adequate provisions for seasonality and extreme weather events. This includes seasonal consideration of all service delivery standards (water sufficiency, quality/safety, distance to water source, affordability and acceptability) in marginalised households. This approach is likely to provide holistic guidance to policy makers and service providers, and a realistic picture on the ground in relation to service delivery and governance in marginalised households. This conclusion supports the argument of Pullan et al. (2014) that understanding how inequalities in drinking-water access occur at sub-national level, particularly in rural areas of developing countries is important for informed decisions, e.g. because this can help to prioritise resource allocation and track progress towards achieving universal access.

For effective delivery of rural water service for marginalised areas, this thesis recommends that the design and implementation of formal institutions, e.g. the community-based management model including use of water user groups, should not be homogenous but adapt to local social economic, cultural, temporal and spatial characteristics of marginalised areas. Consideration of appropriate models in addition to community-based management for specific areas and marginalised groups is also central to effective rural service delivery.

Finally, further research is recommended to address the unanswered questions in this thesis. Key amongst these is the need to determine how water safety plans in rural areas can consider equity issues for marginalised households and across seasons. This needs to be accompanied by a full exploration of how constrained drinking-water access affects household food consumption across seasons and during extreme precipitation conditions. These would provide the holistic understanding needed to achieve universal drinking-water access, as targeted in SDG 6, and thereby also contribute to elimination of poverty (SDG 1) and hunger (SDG 2).

Appendix 1 Linkages between water access and food consumption

1.1 Trends in food security in Sub-Saharan Africa (SSA)

Access to water plays a critical role in delivering household food security. Developing countries face particular challenges in meeting the set goals to achieve food security (Lal, 2016; Misselhorn et al., 2012). According to FAO et al. (2018), 90% of the global population of 821 million undernourished people, live in developing countries. Sub- Saharan Africa has the highest prevalence of undernourished people; 21% (more than 256 million) of its population are food insecure (FAO et al., 2018). Sub-Saharan Africa is one region with a large rural population and extensive poverty, hence, the on-going problem of food insecurity and undernourishment threatens attainment of the United Nations Sustainable Development Goal (SDG) target of hunger eradication by 2030 (FAO et al., 2018).

Four interrelated dimensions of food security (often referred to as the 'four pillars'): food availability, access, utilisation and stability, determine the state of food security (Poppy et al., 2014a; Misselhorn et al., 2012). Access to drinking-water that is used in food consumption, cooking and cleaning, is an important driver affecting food security. There is, nevertheless, a paucity in research on the link between food security and access to drinking-water. The sections that follow will explore the linkage between food security and access to drinking in rural areas of Sub-Saharan Africa.

1.2 Role of drinking-water in addressing food insecurity

Access to drinking-water is central to food security and good health. The health implications of poor access to drinking-water are widely acknowledged (Dungumaro, 2007; Fotso et al., 2007; Pritchard et al., 2007; 2008; Geere et al., 2010; Boone et al., 2011; Dos Santos, 2012; Baguma et al., 2013; Pullan et al., 2014). Many studies have shown the link between limited access to water and increased incidences of water borne diseases such as cholera and diarrhoea (Dungumaro, 2007; Stoler, 2012; Tarrass and Benjelloun, 2012; Pullan et al., 2014; Geere et al., 2010) and increased child mortality (Wolf et al., 2014; Kotloff et al., 2012; Fotso et al., 2007). For example, 90% of diarrhoea deaths are, in part, attributed to inadequate access to drinking-water (Fotso et al., 2007; Bartram and Cairncross, 2010).

Studies show that 73% of deaths due to inadequate access to drinking-water occur in developing countries, mostly in Asia and Africa (Buor, 2004; Ahiablame et al., 2012; Bartram and Cairncross, 2010). A cross sectional child survival survey by De Waal et al. (2006) in rural Ethiopia noted an increase in child mortality because of limited access to drinking-water in drought years. Similarly, Pritchard et al. (2007); (2008), in their chemical analysis of drinking-water in rural Malawi, reached the same conclusion. Conversely, Cook et al. (2016), Prüss-Ustün et al. (2014) and Jeuland et al. (2013) argue that mortality due to poor water consumption has declined in the past two decades because of an increased coverage of *improved water* (see definition in Chapter 1, section 1.2.1). Nevertheless, critical analyses by Kotloff et al. (2012) and Kotloff et al. (2017) indicate that improvement has lagged those in other countries, in Sub-Saharan Africa. What this means is that interventions in effective management of water in Sub-Saharan Africa are able to improve people's livelihood and general health. In fact, the literature is replete with examples and case studies (e.g. studies on global disease burden and their association with water, sanitation and hygiene - WASH - in 145 low and middle income countries) which emphasise the need for improved access to drinking-water (Prüss-Ustün et al., 2014; Wilk and Jonsson, 2013; Zhang and Xu, 2016). Such improvements would result in reduced child mortality.

A growing body of literature points to the conclusion that the provision of drinking-water can significantly reduce childhood mortalities, which come as a result of exposure to water-borne diseases, Buor (2004), Fotso et al. (2007), Geere et al. (2010), Wolf et al. (2014), (Prüss-Ustün et al., 2014). While there are many studies recognising the health implications of inadequate access to drinking-water, limited attention is given to the effects of a constrained access to drinking-water on food security (Dodos et al., 2017; Liu et al., 2015; Joshi and Amadi, 2013). The significance of water in food security discussions is widely linked to two dimensions of food security namely availability and access, through a focus on agricultural productivity and economic growth. Many studies in developing countries have associated food security with a combination of increases in agricultural productivity and economic growth (Ingram, 2011; Kimani-Murage et al., 2011; Smith and Gregory, 2013; Arouna et al., 2017) and others, specifically in Africa have largely attributed it to per capita income (Hazell and Wood, 2008; Smith and Gregory, 2013; Onyutha, 2018). Yet, despite increases in food production and economic growth over the past five decades, high numbers of undernourished children[58] persist in these countries (Richardson, 2010; Ringler et al., 2010; Kimani-Murage et al., 2011; Misselhorn et al., 2012) including areas where food

[58] Prevalence of children undernutrition is one key indicator of food insecurity because children are "the most vulnerable to the harmful consequences of poor food access" FAO, IFAD, UNICEF, WFP & WHO 2018. The state of food security and nutrition in the World 2018. Building climate resilience for food security and nutrition. Rome: FAO.p34.

availability and access are no longer problems (FAO et al., 2014). This suggests that these two factors inadequately address under-nutrition in developing countries. This qualifies food security as a multifaceted problem (Smith and Gregory, 2013) that requires the consideration of other key issues, including the utilisation dimension of food security.

Recently, there is a growing body of literature that suggests that access to drinking-water affects the utilisation[59] dimension of food security (Richardson, 2010; Méthot, 2012; Poppy et al., 2014a). Food security is attained when consumed food is adequate (in quantity – caloric sufficiency and quality - variety, safety and cultural acceptability) and safe enough to meet an individual's physiological requirements (FAO, 1997; Ecker and Breisinger, 2012; Reincke et al., 2018). This thesis argues that water access is one important factor that can determine food choices (that affect nutritional values) and food safety (which affects food utilisation) through activities involved during food preparation, processing, cooking and consumption (Reincke et al., 2018; FAO, 1997). Dodos et al. (2017 p284) cite a number of studies that agree that the three main "causes of undernutrition, namely unsuitable or insufficient food intake, poor care practices, and infectious diseases, are directly or indirectly related to inadequate access to water". In this context, poor access to drinking-water, which includes inconsistent access and insufficient quantity, are likely to contribute to poor or inadequate food consumption and consequently food insecurity in many areas of Sub-Saharan Africa. Poor or inadequate food consumption occurs when a household consumes a one-sided, non-diverse and unhealthy diet.

Households with inadequate food consumption may fail to achieve adequate food utilisation and consequently may be classified as food insecure (Government of Malawi and WFP, 2012). Similarly, the definition applies to households that skip meals (FAO et al., 2018). Most studies show that the rural poor are the most food insecure (FAO et al., 2018; Harrigan, 2008; Oluoko-Odingo, 2011) and poverty is a rural phenomenon in most developing countries (FAO et al., 2018). In addition, FAO et al. (2018) have reported higher prevalence of severe food insecurity among women than men in Sub-Saharan Africa. An assessment of the contribution of drinking-water to food consumption (- a subset of the utilisation dimension of food security) is therefore essential, specifically in rural poor households and among rural women. It is likely that this contribution in these households is frequently overlooked or underestimated because it has received little attention in water and food security scholarship. Of the few studies available (Nordin et al., 2013; Rodriguez-Villamil et al., 2013; Gubert et al., 2010) much of the focus is on urban areas. The few

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[59] **Food utilisation** is "the ability of the human body to ingest and metabolize **food** through adequate diet, clean water, good sanitation and health care to reach a state of nutritional well-being where all physiological needs are met" (http://philfsis.psa.gov.ph/index.php/id/14).

studies with a focus on rural areas are mainly concerned with analysing poor water access as one of the risk factors associated with childhood undernutrition in general (CCRST et al., 2015; Dodos et al., 2017) and not on food consumption in marginalised households in particular. Hence, the link to marginalised households appears not to have been prioritized in water and food security debates in general and in rural areas in particular. Further, there is limited literature analysing the effect of access to drinking-water on dietary habits on a small scale, at sub-national level (e.g. village scale) for adequately informed policy specifically in Sub-Saharan Africa. Dodos et al. (2017 p291) report that this small-scale analysis is essential because the effect of access to safe water and "quantity of water per capita per day" on the status of dietary intake is mostly locally contextualised and location-specific.

Appendix 2 Description of codes and sub codes

Main code		Sub codes/lower level variables	Description
Social, economic and political settings (S)	External factors - contextual factors (e.g. demographic changes and broad governance arrangements) for local institutional arrangements and resource systems	S_demographic_trends	Population patterns/pressure and their influences
		S_other_governance_systems_or_policies	Other governance systems or policies whose state affect the impact of institutions in GS under study – include national/regional/international commitments, obligations and agreements
Resource systems (RS)	Biophysical system (e.g. ground/surface water) from which resource units (water) are extracted and through which these resources are regenerated by natural dynamic processes	RS_clarity_of_resource_boundary	Service area of the resource system e.g. catchment area
		RS_size	Size of the resource system
		RS_productivity_of_resource_system	Temporal and spatial availability - abundance or scarcity/spatial extent of the resource system
		RS_location	Overlap between user group residential area and resource location Includes rural, community, village
		RS_sector	Sources - ground/surface water
		RS_human_constructed_facilities	Dams, boreholes, taps and springs
Resource units (RU)	Attributes of the units extracted from the resource system and may then be consumed	RU_spatial_and_temporal_distribution	Distribution in time (seasonality) and space Includes variability in quality and quantity in time and space

Governance systems (GS)	Prevailing set of processes or institutions through which rules governing access to water are formulated and modified	GS_government_org	Government offices or structures (e.g. authorities and committees) established to govern access to drinking-water
		GS_ngo	Non-governmental organizations relevant in governing access to drinking-water
		GS_property_rights_systems	Bundles of rights for common property e.g. communal taps, boreholes defined and shared by a community Includes: Access rights, abstraction rights,, use or withdrawal/harvest rights domestic use rights, permits, charges, licence, tariffs
		GS_constitutional_choice_rules	Rules that govern "processes through which collective choice procedures are defined" e.g. who is eligible to participate and rules to use in formation of collective choice processes (Mc Ginnis, 2011).
		GS_operational_choice_rules	These are rules that define constraints and guidelines for coordinating daily appropriation and provision activities. They specify what is allowed, forbidden and requirements from resource users. These include boundary rules and authority rules (harvest rules) e.g. how much water one is allowed to draw and; fitness to local conditions.
		GS_collective_choice_rules	These are process oriented rules - specify how operational rules can be changed and eligible participants in changing operational rules (decision making). They are rules that determine membership rules in collective decision making units
		GS_monitoring_and_sanctioning_activities	Monitoring resource conditions and behaviour of resource users; presence of sanctions against non-compliance of

			rules; incentive arrangements and fairness/fitness to local conditions Include: monitoring and sanctions, penalties or fines; monitoring quality, quantity and efficiency, pollution control; rule compliance, patrol
Actors (A)	Characteristics of marginalised resource users appropriating resource units (water) from resource systems (e.g. ground or surface water)	A_socio-economic_attributes	Poor, gender (men and women)
		A_number_of_users	Size and boundary of resource users (with rights to appropriate resource units from the resource system)
		A_importance_of_resource	People's livelihood dependence on the resource
		A_social_capital	Dense social networks or interactions (bonding, bridging and linking) Include: Participation of private sector/ngos/small scale providers, public private partnership, integrated planning
		A_leadership	Local leadership with significance e.g. previous experience and technical knowledge in managing a particular resource
Interactions (I)	Pattern of interactions among actors (including resource users and other relevant actors) and the resources (water) important to their livelihoods	I_information_sharing	Information sharing among users (actors) Include: Information dissemination, awareness creation, sensitization, data collection, management and analysis
		I_deliberation_processes	Involving resource users affected by operational rules in decision making processes – participatory approach including forming and modification of rules, needs assessment and selection of technologies as well as conflict resolution arrangements. Also include collective approach; integrated water resources management (IWRM) principles, conflict resolution

		I_self_organizing_activities	Recognizing the rights of resource users to self-organise/rights of appropriators to devise their own institutions are not challenged by external governmental authorities - includes community based management, demand driven/ responsive, empowerment, ownership, IWRM, water users association, user participation in catchment protection/management, shared responsibility, decentralisation/devolving management roles
Outcome (O)	Equity (social performance measure)	O_equitable_access	Equitable access to drinking-water Include: sufficient to all users, affordable cost, easy access to all, convenient access; quality/improved water access, integrated water resources management principles
		O_adequate_food_consumption	Diversified health diet or good nutrition
Related ecosystems (ECO)	Broader ecological context within which the water resource systems are located, including causes of potential exogenous influences (threats/challenges and opportunities)	ECO_climate_patterns	Climate patterns - threats/challenges and potential responses Include: Climate change, climate variability, extremes, demand management, water harvesting, strategic contingency development, disaster preparedness
		ECO_flows_into_and_out_focal_SES	Upstream or downstream resource availability and appropriation patterns, impact and responses (e.g. deforestation, catchment rehabilitation)

Appendix 3 Participants information sheet and consent forms

3.1 Participant information sheet

Study Title: Assessing the effect of local formal institutions on access to drinking-water and firewood used for food consumption

Researcher: Miriam Dalitso Joshua **Ethics number**: 8234

Please read this information carefully before deciding to take part in this research. If you are happy to participate you will be asked to sign a consent form.

What is the research about?

I am a research student at the University of Southampton in the United Kingdom. I am working on this research towards a PhD qualification. I am particularly interested in understanding how local formal institutions decrease or increase access to firewood and drinking-water used for food consumption. To attain this, I will ask you questions on: process followed in institutions formulation and enforcement, property rights, institutions' changes in response to fluctuations in supply of firewood and water and, effect of institutions constrained access on food consumption. It is hoped that the results of this study will help policy makers to design and enforce appropriate institutions aimed at improving resource conservation and food security simultaneously. The research is being funded by ASSETS project.

Why have I been chosen?

You are selected to participate in this study because I believe you have relevant information I am looking for. You are a member of this community hence likely to know the institutions governing access to drinking-water and firewood and how these influence access and food consumption in your household.

What will happen to me if I take part?

If you agree to participate in this research, we will arrange to meet and hold interviews at a time and place convenient to you. Household and key informant interviews will take approximately one hour whereas focus group discussions may take between one and two hours. The conversation will be recorded and where necessary, pictures will be taken to supplement data obtained from the interviews. I ask you to allow me to use the photos in my research paper and publications. You may be visited more than once if some clarifications are needed.

Are there any benefits in my taking part?

There are no direct benefits to you for your participation in the survey. However, results from this study will be used for informed policy by policy makers. It is hoped that the results of this study will help policy makers to design and enforce appropriate institutions aimed at improving resource conservation and food security simultaneously.

A small compensation will be provided for a bottle of soft drink or lunch if the interviews cover the whole day.

Are there any risks involved?

There are no real risks associated with this study except during the rainy season when floods may disturb the interviews or one may slip and be injured. However, at times you feel distressed or uncomfortable to share some experiences, you are not obliged to talk or continue with the interview.

Will my participation be confidential?

Confidentiality is recognised in this research. All data will be stored in different folders on password-protected laptop and desktop computer, external hard disks and flash disks bought specially for data maintenance. This implies that different data will be stored separately, for example, IDs of participants and notes from their interviews. This data will be backed up regularly. Paper records will be kept in a locked drawer when not in use. This will be done in line with the University of Southampton's Research Data Policy

What happens if I change my mind?

You have the right to withdraw at any time you feel uncomfortable to continue with the interview and this will not affect any of your legal rights.

What happens if something goes wrong?

In the unlikely event of concern or complaint, you may contact:

Dr Martina Prude, Head of Research Governance

University of Southampton, UK

Phone: +44 (0) 2380 595058,

Email address:mad4@soton.ac.uk).

If you prefer to speak with someone directly in Malawi, you may contact

Dr Mangani Katundu

Chair person, Chancellor College Research and Ethics Committee

University of Malawi,

P.O. Box 280,

Zomba

Phone: +265999438102

Email address: mkatundu@cc.ac.mw

Where can I get more information?

If you want to get more information on my research after reading this information sheet you can contact me on +265999912683 or mdj1g12@soton.ac.uk or you may contact the following:

Prof. Sosten Chiotha

LEAD

Chancellor College

University of Malawi

P.O. Box 280

Zomba

Email address:schiotha@cc.ac.mw

3.2 Focus group participants consent form

Study title: Assessing the effect of local formal institutions on access to drinking-water and firewood used for food consumption

Researcher name: Miriam Dalitso Joshua

Ethics reference: 8234

Please initial the box(es) if you agree with the statement(s):

We have understood the information sheet (10/11/2013 version 1) and have had

We agree to take part in this research project and agree for our data to be

We understand that our responses will be anonymised in reports of the research

We understand our participation is voluntary and we may withdraw at any time

Data Protection

We understand that information collected about us during our participation in this study will be stored on a password protected computer and that this information will only be used for the purpose of this study.

Date:……………………………………………………….

Community name:………………………………………..

Name of participant (Print name)	Signature

3.3 Key informant consent form

Study title: Assessing the effect of local formal institutions on access to drinking-water and firewood used for food consumption

Researcher name: Miriam Dalitso Joshua

Ethics reference: 8234

Please initial the box(es) if you agree with the statement(s):

I have read and understood the information sheet (10/11/2013 version 1) and have had the opportunity to ask questions about the study.

I agree to take part in this research project and agree for my data to be recorded

I understand that my responses will be anonymised in reports of the research

I understand my participation is voluntary and I may withdraw at any time without my legal rights being affected

Data Protection

I understand that information collected about me during my participation in this study will be stored on a password protected computer and that this information will only be used for the purpose of this study.

Name of participant (print name)…………………………………………………

Signature of participant…………………………………………………………..

Date………………………………………………………………………………

Appendix 4 Economic and non-economic indicators for different socio-economic groups

The following Table provides a summary of economic and non-economic indicators obtained from ASSETS Project PRAs which were used to categorise the FGD participants. These groups are summarised here as wealthier or better-off and poor.

Economic and non-economic indicators	**Wealth group**	
	Wealthier	Poorer
Ownership of bank accounts (formal and village banks)	Have bank accounts	Have no or small bank account
Land ownership	Have large plots and rent out land	Have small or no plots for cultivation
Livestock ownership	Have diverse livestock: Goats, chicken, rabbits, doves	Have few/one or no livestock
Food availability	Have adequate food (maize stocks) throughout the year	Experience food shortages 6-8 months
Ability to educate children	Able to educate children up to secondary school level	May fail to send children to school or educate children up to secondary school level due to financial limitations

Appendix 5 Data collection and analysis matrix

Research objective	Data needed	Sources	Data collection methods	Data analysis
Obj. 1 Analyse the structure and function of local formal institutions and application of property rights that govern access to drinking-water:	Inventory of institutions Design of institutions (formation, structure/membership, communication, enforcement mechanism) and intended outcome Linkages between the institutions and bundle of rights to water	Mainly from documents (bylaws, management plans, sectoral guidelines, Acts and polices), participant observation, local leaders, government officers and NGOs involved and partially from focus group participants	1. Partially, focus group discussions with selected community members (6-10 people) disaggregated by wealth group and 2. Key informant interviews with leaders of institutions (e.g. management committees, local government officers and village chiefs) 3. Content analysis of water bylaws, management plans, sectoral policies, Acts and guidelines to determine the structure of rules 4. Participant observation and attending VNRMC selected regular meetings	Content analysis
Obj. 2 How do local formal institutions adapt their structure and function to deal with seasonality	Sources/location of water collection sites Seasonal productivity of water resources and constraints faced in water collection Preferred source of water in different seasons (Patterns of access) Access and use rights in different seasons Design of institutions (formation, structure or membership,	Documents (byelaws, management plans, sectoral guidelines, Acts and polices), Focus group discussions - Ask male and female focus group participants separated by wealth group and individual households (segregated by gender of household head and wealth group) Key informants Matrix ranking for preferred source of water	1. Content analysis of water bylaws, management plans, sectoral policies, Acts and guidelines to determine the structure of rules and how they change over time. 2. Participant observation and attending VNRMC meetings 3. Resource walks with water resources users conducted in parallel with recording of GPS coordinates of location of water points - identifying sources at different times and reasons for site selection 4. Household systems diagrams to identify further sources of water, use,	Content analysis, regression analysis and cross tabulations

Research objective	Data needed	Sources	Data collection methods	Data analysis
	communication, enforcement mechanism Food choices by season and locality		household members responsible for water collection and food preparation. 5. Matrix scoring to determine preferences of sources of water 6. Focus group discussions with selected community members disaggregated by wealth group 7. Key informant interviews with leaders of institutions (e.g. management committees)	
Obj. 3 Analyse how the recent flooding affected people's access to water and how this differed from a normal rainy season	Sources of water Access and use rights	Focus groups and key informants	1. Focus group discussions and key informant interviews	Content analysis
Obj. 4 Analyse the impact of access constrained by local formal institutions on water for food consumption	Households who have access Ability to cook Food choices in households with and with limited access Seasonal trends of meals and reasons Responsible members for water collection, time use and burden Patterns of access by gender, and wealth group	Ask male and female focus group participants separated by wealth group and individual households segregated by gender of household head and wealth group Responsibility – Ask male and female focus group participants separated by wealth group and household heads (responsible members partially from ASSETs PRA data – household food system exercise) Ask male and female focus group participants separated by wealth	1. Focus group discussions with selected community members disaggregated by wealth group and 2. Key informant interviews with leaders of institutions (e.g. management committees) 3. Household survey for assessing responsible members for water collection, time use and burden; food choices and patterns at different times of the year 4. Household system diagram to identify further household members responsible for water collection and food preparation.	Content analysis, Venn diagrams for qualitative data; regression analysis for quantitative data

Research objective	Data needed	Sources	Data collection methods	Data analysis
		group and review by laws and relevant policies	5. Venn diagrams for assess effect of social networks	
Obj 5 identify which groups of people are affected by lack of access to water and how they are affected	Sources/location of water collection sites Status of water resources and constraints faced in water collection Preferred source of water in different seasons (Patterns of access) Access and use rights in different seasons Design of institutions (formation, structure or membership, communication, enforcement mechanism Food choices by season and locality Ability to cook Seasonal trends of meals and reasons Responsible members for water collection, time use and burden Patterns of access by gender, and wealth group	Documents (byelaws, management plans, sectoral guidelines, Acts and polices), Focus group discussions - Ask male and female focus group participants separated by wealth group and individual households segregated by gender of household head and wealth group Key informants Matrix ranking (for preferred source of water Household system exercise	1. Content analysis of water bylaws, management plans, sectoral policies, Acts and guidelines to determine the structure of rules 2. Participant observation and attending VNRMC & block committee meetings 3. Resource walks with water and forest resources users conducted in parallel with recording of GPS coordinates of location of water points - identifying sources at different times and reasons for site selection 4. Household survey for assessing responsible members for water collection, time use and burden; food choices and patterns at different times of the year 5. Household systems diagrams to identify further sources of water, use, household members responsible for water collection and food preparation. 6. Matrix scoring to determine preferences of sources of water 7. Focus group discussions with selected community members disaggregated by wealth group 8. Key informant interviews with leaders of institutions (e.g. management committees)	Content analysis, regression analysis and cross tabulations

Appendix 6 Summaries of contacts with communities

6.1 Key informant interviews

Village	**Section**				**Total contacts**
	Village chief	Water committee leaders	Government	NGO	
Mtuluma	2	3	1	1	**7**
Makombe	2	2			**4**
Kasonga	2	1	2		**5**
Mpheta	2	4			**6**
District			4	1	**5**
Total	**8**	**10**	**8**	**2**	**28**

6.2 Focus group discussions

Village	**Section**		**Total contacts**
	Poorer group	Wealthier group	
Mtuluma	2	2	**4**
Makombe	2	1	**3**
Kasonga	2	1	**3**
Mpheta	2	1	**3**
Total	**8**	**5**	**13**

Appendix 7 Documents referred to in water governance

Type	Code	Water sector documents	Code	Other sectors documents
International	INTW1	Regional Water Policy (Southern African Development Community, 2005) http://www.sadc.int/files/1913/5292/8376/Regional_Water_Policy.pdf and http://www.unep.org/dams/files/Country%20Dialogues/SADCRegionalWaterPolicy.pdf	INTC1	Resolution adopted by the General Assembly: 55/2. United Nations Millennium Declaration (United Nations, 2000)
	INTW2	Revised Protocol on Shared Watercourses in the Southern African Development Community (SADC) (Southern African Development Community, 2000) (http://www.internationalwaterlaw.org/documents/regionaldocs/Revised-SADC-SharedWatercourse-Protocol-2000.pdf)	INTC2	Agenda 21 (United Nations Division for Sustainable Development, 1992) (http://www.un.org/esa/sustdev/agenda21.htm.) (www.un.org/esa/dsd/agenda21/)
	INTW3	Convention on the Law of the Non-navigational Uses of International Watercourses, Adopted by the General Assembly of the United Nations on 21 May 1997 (United Nations, 2014)(http://legal.un.org/ilc/texts/instruments/english/conventions/8_3_1997.pdf)	INTC3	The Universal Declaration of Human Rights (1948) (http://www.un.org/en/documents/udhr/index.shtml)
	INTW4	General Comment No. 15- Committee on Economic, Social and Cultural Rights (2002) (https://www.refworld.org/pdfid/4538838d11.pdf and https://www.internationalwaterlaw.org/documents/intldocs/UNCECSR-General-Comment-right_to_water.pdf)	INTC4	The International Covenant on Economic, Social and Cultural Rights (1966) (http://www.ohchr.org/Documents/ProfessionalInterest/cescr.pdf)

Type	Code	Water sector documents	Code	Other sectors documents
	INTW5	United Nations General Assembly resolution on the right to water and sanitation (July 2010) (www.un.org/ga/search/view_doc.asp?symbol=A/RES/64/292) and (http://www.un.org/es/comun/docs/?symbol=A/RES/64/292&lang=E)	INTC5	UN General Assembly Resolution A/RES/54/175 The Right to Development (2000) (www.un.org/depts/dhl/resguide/r54.htm) and http://www.worldlii.org/int/other/UNGARsn/1999/261.pdf)
	INTW6	United Nations Human Rights Council resolution on human rights and access to safe drinking-water and sanitation (September 2010)(http://daccess-dds-ny.un.org/doc/UNDOC/GEN/G10/166/33/PDF/G1016633.pdf?OpenElement)	INTC6	International Convention on the Elimination of All Forms of Racial Discrimination (1965) (http://www.ohchr.org/EN/ProfessionalInterest/Pages/CERD.aspx)
	INTW7	The New Dehli Statement (1990) https://www.ircwash.org/resources/global-consultation-safe-water-and-sanitation-1990s-10-14-september-1990-new-delhi-india and https://www.ircwash.org/sites/default/files/202.3-90GL-7806.pdf)	INTC7	Resolution adopted by the General Assembly on 25 September 2015 A/RES/70/1-Transforming our world: the 2030 Agenda for Sustainable Development (https://www.un.org/en/development/desa/population/migration/generalassembly/docs/globalcompact/A_RES_70_1_E.pdf)
	INTW8	The Dublin Statement (1992) (http://www.un-documents.net/h2o-dub.htm)		
	INTW9	The Resolution of the Mar del Plata Conference in March1977 (https://www.internationalwaterlaw.org/bibliography/UN/UN_Mar%20del%20Plata%20Action%20Plan_1977.pdf)/(https://www.ircwash.org/sites/default/files/71UN77-161.6.pdf)		

Type	Code	Water sector documents	Code	Other sectors documents
	INTW10	African Water Vision 2025 (2000)(https://www.afdb.org/fileadmin/uploads/afdb/Documents/Generic-Documents/african%20water%20vision%202025%20to%20be%20sent%20to%20wwf5.pdf)/(http://wedocs.unep.org/bitstream/handle/20.500.11822/18415/african_water_vision_2025_to_be_sent_to_wwf5.pdf?sequence=1&isAllowed=y)		
	INTW11	SADC Water Vision 2025 (2000)(https://www.sadc.int/files/9313/5850/8772/Southern_African_Vision_For_Water_Life_and_Environment_In_the_21st_Century.pdf)		
National	NATW1	Water Resources Act (Government of Malawi, 1969) (http://www.malawilii.org/files/mw/legislation/consolidated-act/72:03/water_resources_act_pdf_17368.pdf)	NATC1	Constitution of Malawi (Government of Malawi, 1997a) (http://www.icrc.org/applic/ihl/ihl-nat.nsf/0/4953f2286ef1f7c2c1257129003696f4/$FILE/Constitution%20Malawi%20-%20EN.pdf and http://www.sdnp.org.mw/constitut/dtlindx.html)
	NATW2	Water Works Act (Government of Malawi, 1995) (http://www.malawilii.org/mw/legislation/act/1995/17 and http://faolex.fao.org/docs/pdf/mlw119423.pdf)	NATC2	Vision 2020
	NATW3	National Water Policy(Government of Malawi, 2007b) (http://www.300in6.org/wp-content/uploads/2014/07/3.-National-Water-Policy-by-GoM-2005.pdf)	NATC3	National Environment Action Plan 2002 (Government of Malawi, 2006c)

Type	Code	Water sector documents	Code	Other sectors documents
	NATW4	Water Resources Act (Government of Malawi, 2013b)	NATC4	National Strategy for Sustainable Development (Environmental Affairs Department (EAD), 2004) (http://www.chmmw.org/publications/mwnssd.pdf)
	NATW5	Market centre and rural piped water supply and sanitation programme: guidelines for establishment of water users association in Malawi (Government of Malawi, 2010d)(http://www.ndr.mw:8080/xmlui/bitstream/handle/123456789/1300/Guidelines%20for%20Establishment%20of%20Water%20Users%20Association%20in%20Malawi.pdf?sequence=1)	NATC5	National Environmental Policy (NEP) (Government of Malawi, 2004a) ((http://www.chmmw.org/publications/mwnep.pdf)
	NATW6	Water users association training manual (Government of Malawi, 2009b) (http://www.ndr.mw:8080/xmlui/bitstream/handle/123456789/1289/Water%20Users%E2%80%99%20Association%20Training%20Manual.pdf?sequence=1	NATC6	Environmental Management Act (EMA)(Government of Malawi, 1996a) (http://www.malawilii.org/files/mw/legislation/act/1996/6/environment_management_act_1996_pdf_16513.pdf)
	NATW7	Water supply and sanitation district operational manual (Government of Malawi, 2010f)	NATC7	The National Decentralisation Policy (Government of Malawi, 1998b)
	NATW8	Implementation guidelines for rural water supply and sanitation (Government of Malawi, 2010a) (http://www.rural-water-supply.net/_ressources/documents/default/1-389-2-1346415367.pdf)	NATC8	Local Government Act (Government of Malawi, 1998a) (http://julianalunguzi.com/wp-content/uploads/Local_Government_Act_19981.pdf
	NATW9	Implementation Manual For Piped and Point Water Supply Systems (2010)	NATC9	Malawi Growth and Development Strategy II (2011-2016)(Government of Malawi, 2011c) (http://www.imf.org/external/pubs/ft/scr/2012/cr12222.pdf and http://www.gafspfund.org/sites/gafspfund.org/files/M

Type	Code	Water sector documents	Code	Other sectors documents
				GDS%20II%20final%20document%20january%202012.pdf)
	NATW10	Technical Manual - Water Wells and Groundwater Monitoring Systems (2016) (https://www.rural-water-supply.net/en/resources/details/807)	NATC10	Strategy for the decentralisation of environmental management (Environmental Affairs Department, 2002b)
	NATW11	Technical Manual for Piped Water (1983)	NATC11	Revised Decentralized Environmental Management Guidelines (Government of Malawi, 2012b)(http://www.unpei.org/sites/default/files/e_library_documents/Decentralized%20Environmental%20Managment%20Guidelines.pdf
	NATW12	Gravity Fed for Rural Piped Water Schemes: Rural Piped Water Technical Manual (2016?)	NATC12	National Forestry Policy (Government of Malawi, 1996b) (http://forestry.gov.mw/department-documents/manuals-standards-guidelines and http://www.cepa.org.mw/documents/legislation/policies/National_Forest_Policy_1996.pdf)
			NATC13	Malawi National Forestry Programme: priorities for improving forestry and livelihoods (2001)
			NATC14	Malawi National Land Policy (2002)
Local	LOCW1	The constitution of the registered trustees of Zomba West water users association (The registered trustees of Zomba West water users association)	LOCC1	Kasonga catchment management plan (bylaw) (Kasonga catchment committee, 2008)

Appendix 8 Checklists for key informants and focus group discussions

8.1 Checklist for key informants

The interviews were held with leaders of water related institutions. These include the water committee chair person, village chief, NGOs and the government water officers at village level and district level.

Question 1: How is the structure and function of local formal institutions and application of property rights that govern access to water: Sub questions

1. What is the structure of the local *de facto* and *de jure* institutions which manage access to water?
2. What is the function of the local *de facto* and *de jure* institutions which manage access to water?
3. Which local formal institutions have affected access to water in the past 10 years?
4. How do these institutions change over time?
5. Do these institutions affect households' access/use rights to water resources in different seasons?
6. Explain how these institutions affect households' access/use rights to water resources in different seasons
    a. What are the existing access/user rights for water resources?
    b. Which community members have access/use rights?
7. How are the rules formulated?
    a. Who participates in rule formation?
    b. What is the level of participation for different community members?
    c. How do local formal institutions ensure that the poor and marginalised households contribute in rule formation?
    d. What is the role of government in rule formation?
    e. What is the role of traditional structures in rule formation?
    f. How are the rules communicated to community members?
8. How are the poor considered in formation and implementation of institutions governing access to drinking-water?
9. How are different rules enforced/what are the enforcement mechanisms?

   a. What is the role of the state in rule enforcement?
   b. What is the role of the community formal structures in rule enforcement?
   c. What is the role of the community traditional or informal structures in rule enforcement?
   d. What are the specified *de facto* and *de jure* access/ use rights for encouraging rule compliance?
   e. What sanctions are put in place to enhance rule compliance?
10. Are there informal laws that govern access to water in the village?
   a. How are these informal laws structured?
   b. How do these laws function?
   c. Who participate in their formulation?
   d. Who participate in their enforcement?
   e. What sanctions are put in place to enhance rule compliance?
   f. Does the state have a stake in their formulation?
   g. Does the state have a stake in their enforcement?
   h. How do these laws affect property rights to water?
   i. How do these informal laws ensure efficiency and equity?
11. Where do wealthier and poorer households obtain water at different times of the year?
   a. What factors affect choice of source of water at different times of the year?

Question 2: How do local formal and informal institutions adapt their structure and function to deal with seasonality?

Sub questions

12. How do these institutions affect households *de facto* and *de jure* access and use rights to water resources in different seasons?
   b. What are the existing user rights for water resources?
   c. Which community members have management rights for water resources?
      i. What are management these rights?
   d. Which community members have access/use rights?
13. What options are available for households to access water?
14. How do the institutions adapt their rules/structure /function to deal with seasonality
   a. How do local formal institutions change to deal with seasonal fluctuations of water (water demand management)?
   b. What institutions are used manage times of extreme pressure?
      i. How do you manage access when there are water shortages?

ii. How do you manage access when water resources are in abundance/there is too much water supply?

iii. How do you manage access when there are external influences such as politics?

c. What approach is adopted to ensure efficient and equitable access to drinking-water in times of scarcity and abundance?

d. What incentives are established for consumers to promote efficient and equitable use of water?

8.2 Checklist for focus group discussions

Focus group discussions were held with two groups of participants segregated by wellbeing

Question 1: How do local formal and informal institutions adapt their structure and function to deal with seasonality? Which groups of people are affected by lack of access to water and how they are affected?

Sub questions

1. Where do households obtain water at different times of the year?
    a. What is the preferred source of water at different times of the year?
        i. Draw a preference matrix scoring
    b. What factors affect choice of source of water at different times of the year?
2. Which groups of people are important in supply of water to a household and community?
    a. How they influence supply and access?
    b. Construct a Venn diagram of both formal and informal groups responsible for water provisioning to a household and community.
    c. How do these groups influence water provisioning?
3. How do established institutions affect households *de facto* and *de jure* access and use rights to water resources in different seasons?
    a. What are the existing user rights for water resources?
    b. Which community members have access/use rights to specific water resources?
4. What options are available for households to access water?
5. Which groups of people benefit or are disadvantaged from enforcement of the rules at different times of the year?
    a. How do access restrictions or enforcement of rules affect different groups of people?
    b. How does each group cope with access restrictions or rules?

c. How much time is spent (round trip) on water collection by gender and wealth group in the dry and rainy seasons?
d. What is the average distance covered in water collection by gender and wealth group in the dry and rainy seasons?
e. How much water is consumed by season and income group?
f. How much water is used for food preparation by season and income group?

Question 2: What is the impact of access constrained by local formal and informal institutions on water for food consumption?

Sub questions

1. How do access to water affect food preparation and consumption in households?
    a. How do quantity of water affect food consumption?
    b. How does water quality affect food consumption?
    c. How does access to water vary with the seasons?
2. How do *de jure* and *de facto* access rights to water affect food consumption at different times of the year?
    a. How do access rights to water vary by gender and wealth group/food security group?
    b. Who are responsible members for water collection in households?
    c. How much time is spent on water collection by gender and wealth group?
    d. How do food choices vary with access rights to water?
    e. Which food types that are consumed in households are determined by access to water?
    f. How does food consumption pattern vary with seasons?
    g. How do food choices vary with seasons?

8.3 Checklist for household system diagrams

Two mixed groups of men and women segregated by wellbeing will be asked to draw household system diagrams. The aims are: 1) to identify sources of water used for food consumption and; 2) to identify household members who are responsible for bringing these resources home; 3) to identify household members who are responsible for food preparation in the homes.

Questions:

1. Outline resources used for food preparation and their destination?
2. Where do community members obtain water in dry and rainy season?

3. Who are responsible for water collection in dry and rainy season and percentage of their involvement in each season?
4. What is the destination of the collected water?
    a. How are the collected water used?
5. Does the system allow households acquire enough quantities of water for food preparation and consumption?
    a. How much water is needed for food preparation and consumption per household in a day?
    b. How much water do households manage to access in a day during the dry and rainy season?
6. How has the system changed in the past 10 years?
7. Discuss challenges with regards to collection of drinking-water in each season?

8.4 Amended checklist for focus group discussions and key informant interviews

These discussions and interviews were held with the poorer group and key informants in each community

Question: How did the flooding affect people's access to water and how did this differ from a normal rainy season?

Sub questions

1. How did the recent floods affect your water sources?
    a. Each source in the village
    b. How were the damaged sources repaired?
    c. How long did this work take?
    d. Who initiated and implemented the task?
    e. If damaged source was not repaired, what is the longer term forecast for this water source?
2. How did the recent floods affect your access to water relative to the same period last year?
    a. Were access rules changed during the recent floods?
    b. If rules changed, why were they?
    c. If rules did not change, was this a problem for the respondents?
    d. How would they have liked the rules to change?
    e. How did you cope with the recent floods?

Appendix 9 District and sub district structures, composition and roles in water and sanitation

The following Table provides descriptions of district and sub district structures, composition and their roles in drinking-water services summarised in Figure 5.1, analysed further in section 5.2.6 of Chapter 5 and Chapter 6.

Structure	Composition	Roles
Local Authority (LA)	Councillors, Members of Parliament (MP) and Traditional Authorities (TA) in the district Council. District Commissioner (DC) as the Secretariat of the Council.	Highest policy making body at district level established within the Local Government Act • As community leaders they help to explain RWSSP, • Promote community participation in water development and management, support community efforts to develop their own W&S facilities. • As policy makers, they help to develop W&S plans and bye-laws, select communities to be assisted and monitor progress • Encouraging communities to raise funds and open bank accounts to run their water and sanitation systems. • Monitoring progress at the community level and help to resolve conflicts.
District Executive committee (DEC)	A technical committee comprising all sector heads and NGOs represented at the district, co-opted members and the head of the Assembly	• Implement all aspects of the District Development Planning System (DDPS). • Provide technical guidance to LAs through DCT.
District Coordinating Team (DCT)	Technical arm of the DEC. Comprises the Director of Planning and Development (DPD) as Chairperson, the Director of Public Works DPW), District Water Officer (DWO) as Secretary and as members, the District environmentally related sector officers, the Monitoring and Evaluation Officer (M&EO) and NGO representative working in water and sanitation in the district.	• Day-to-day leadership and coordination for W&S activities in the district in collaboration with Traditional Authorities (TAs), ADCs/VDCs, VHWCs, NGOs, External Development Partners (ESAs), and Private Sector. • Provides all technical guidance in the implementation of the RWSSP in the district.

Structure	Composition	Roles
Extension Workers Team (EWT)	This is the technical arm of the Area Executive Committee (AEC) on water and sanitation in the traditional authority area. Comprises Water Monitoring Assistant (WMA), Assistant Environmental Health Officer (AEHO), Community Development Assistant (CDA), Primary Education Advisor (PEA), Forestry Assistant (FA) and representative NGO working in the area on water and sanitation	• Building the capacity of VDCs and participating communities to plan and manage their water supply • Work directly with the participating communities helping them to mobilize their resources, develop their plans and organise and train for effective promotion, management, operations and maintenance. • Sensitising and mobilising communities on W&S programme. • Collecting baseline data on water and sanitation. • Supporting the development of community managed water and sanitation facilities. • Monitoring, evaluating and supporting the work of service providers and help communities to resolve conflicts. • Producing monthly reports to DCT • Building community awareness of, and demand for, safe water supply and improved hygiene and sanitation; • Helping communities organise, mobilize resources and apply for District assistance; • Assisting in data collection for District profiling and community planning; • Facilitating the formation of Water User Committees (WUCs) and the preparation and submission of Community RWSSP Plans; • Training WUCs for community-based management; • Assisting communities monitor construction and other services; • Supporting WUCs in the selection, training and supervision of H&S promoters, masons, pump caretakers, local utility operators (LUOs) and repair teams.
Area Development Committee (ADC)	Elected members at Traditional Authority's level - Ward Councillors, Traditional Authorities Members of Parliament, AEC Representatives, Elected Members and Interest	• Play a link role between the village and the Local Authority and a planning and support role for W&S initiative within the TAs area. • The ADC, council and VDC members assist to identify water and sanitation development needs, which they present to the council for assistance and monitor its implementation • Assisting in the sensitisation and mobilisation of communities on W&S programmes and how they can participate. • Receiving W&S applications from the VDCs and forward them to the Council.

Structure	Composition	Roles
		• Helping to facilitate inter-village meetings needed to plan piped water supply schemes. • Assisting in the formation of various water and sanitation committees. • Assisting to monitor progress of water and sanitation activities in the community and help to resolve conflicts.
Village development committee	Elected Members and Interest Groups. Ex-Officials: Group Village Headman, Ward Councillors, AEC Representatives	• Like the ADC play an important link between the beneficiary communities and the council and a planning, monitoring and support role for W&S initiative at community level.
Water user committees (WUCs)	Elected members of the community entrusted with the responsibility to plan and manage water supply, hygiene and sanitation program on behalf of the user community	• Plan and manage the water supply, hygiene and sanitation program on behalf of the user community.
Village Health and Water Committee (VHWC)	A sub-committee of the VDC responsible for promoting water and sanitation activities at village level. In a village with more than one water point, VHWCs form WPCs to oversee a particular water point.	• Promotes water and sanitation activities at village level. • In a village with more than one water point, VHWCs form WPCs to oversee a particular water point. • Facilitates community meetings, needs identification and monitor and evaluate of W&S at community level and help to resolve conflicts. • Setting and monitoring village bye-laws on water, sanitation and hygiene.
Water Point Committee (WPC)	A sub-committee of VHWC	• Responsible for managing a single water point • Elected by and accountable to the users of the water point – the "user" community. • Collaborates with "user" community to plan and build the new facility, maintain and operate it, using funds raised from the users themselves.
User communities[p]	Cluster of households using a point source (pump/borehole) or several villages if piped water system	Central for the community W&S development process • Needs identification • Planning, designing, managing and operating water facilities.

Structure	Composition	Roles
Financial institutions	Are all cooperating partners/donors which support water and sanitation programmes	Financial and technical support
Service providers	Companies or NGOs who deliver goods and services to communities to support development of community managed water and sanitation facilities.	There are two types of Service Providers: • Facilitation Service Providers (FSPs) specialise in 'software' services (i.e. community mobilisation and training). • Technical Service Providers (TSPs) specialise in 'hardware' services (i.e. borehole, scheme construction, pump, spare parts supply and civil works).

[P]= Source of definition, NATW7

Appendix 10 Human rights principles related to drinking-water

The following Table shows how international principles related to drinking-water are discussed in different international and national policy documents. This is a longer version of summarised Table 5.3 in Chapter 5.

Principles	**International policy and legislation provision**	**Local policy and legislation translation**
Non-discrimination and equality	***"Everyone is entitled to all the rights***…*"everyone has the right to a standard of living adequate for the health and well-being"* (INTC3) "***All peoples,*** *whatever their stage of development and their social and economic conditions****, have the right to have access to drinking-water in quantities and of a quality equal to their basic needs"*** (INTW9) Calls upon states to "***work towards achieving universal*** *access to water…, being guided by human rights principles and the standards of the human rights to water (*INTW6) *"Water is a basic need and* ***equitable*** *and sustainable* ***access to water for drinking and domestic requirements should be guaranteed"*** (INTW1) Provide sustainable and sufficient quantities of drinking-water **to all**, emphasizing the "***some for all rather than more for some***" (INTW7)	Calls for the State and **all people** to " *…recognise and protect fundamental human rights and afford the fullest protection to the rights"* (NATC1) "***All people*** *have rights to development including equality of opportunity in access to basic resources and infrastructure"* (NATC1) **All people** shall have access to drinking-water (NATW3) Ensures that **all people in Malawi** "*have convenient access to sufficient quantities of water of acceptable quality …at any time and within convenient distance*" (NATW3 p5) – **defined as within 500m distance** (NATW7, NATC9). In rural communities, the policy aims to attain "*sustainable provision of community owned and managed water supply and sanitation services that are* ***equitably accessible to"*** **all water users** "*at affordable cost" (*NATW3*)* Promotion of cost effective/affordable "*technologies to enable easy access to water… services by* ***all manner of people***" and; "*…pricing and charging systems that recognise water as both a social and economic good" (*NATW3*)* Providing water in sufficient quantities and acceptable qualities to **all users** (NATW3)

Principles	International policy and legislation provision	Local policy and legislation translation
	*"Water shall be considered as **a social good** that is essential to human dignity, poverty reduction and social well-being" (INTW1)* "*States parties should ensure that the allocation of water resources, and investments in water, facilitate access to water for all members of society* (INTW4 par.14). *Water and water facilities and services must be accessible to all, including the … marginalised sections of the population, in law…, without discrimination on any of the prohibited grounds* (INTW4) *"Equitable access to safe and clean drinking-water is an integral component of the realization of all human rights (*INTW5)	"*Ensure that **all communities** have access to a minimum standard of water supply. Those who want private connections are expected to pay high costs*" (NATW7) Calls for the State and **all people** to " *…recognise and protect fundamental human rights and afford the fullest protection to the rights* (NATC1) "A***ll people** have rights to development including equality of opportunity in access to basic resources and infrastructure* (NATC1) **All people** shall have access to drinking-water (NATW3) Ensures that **all people in Malawi** "*have convenient access to sufficient quantities of water of acceptable quality …at any time and within convenient distance*" (NATW3 p5) – **defined as within 500m distance** (NATW7, NATC9). In rural communities, the policy aims to attain "*sustainable provision of community owned and managed water supply and sanitation services that are **equitably accessible to"*** **all water users** "*at affordable cost" (*NATW3*)* The Policy, among other issues, aims at: *"make water and equitably accessible **by all Malawians"*** (NATW3) Providing water in sufficient quantities and acceptable qualities to **all users** (NATW3) Promoting and advocating water …services' pricing and charging systems that **recognise water as both a social and economic good** (NATW3)

Principles	International policy and legislation provision	Local policy and legislation translation
		Water resources shall be optimally, **equitably and rationally allocated** and regulated in a transparent and accountable manner to ensure sustainable …and social enhancement (NATW3) *“**Some for all” not “all for some**”* Emphasis here is provision of communal service to “*ensure that **all communities have access to a minimum standard of water supply***” (NATW7) *The water abstraction charges…shall be based on a pricing strategy that takes into consideration__(a) the **need to differentiate among geographical areas, categories of water uses and water users**;* *(b) the **need to achieve an equitable and efficient allocation** of water and water conservation* (NATW4)
Information	*“Individuals and groups should be given full and equal access to information concerning water, water services and the environment, held by public authorities or third parties*” (INTW4)	State and relevant stakeholders are legally obliged to collect, publish and disseminate information ((NATW3, NATW4, NATW5, NATW6, NATW7))

Appendix 10

Appendix 11 Human rights standards/guidelines related to drinking-water

The following Table shows how international guidelines/standards related to drinking-water are discussed in different international and national policy documents. This is a longer version of summarised Table 5.4 in Chapter 5.

Standards/guidelines	**International legislation and policy**	**Local legislation and policy**
Availability: Sufficient quantities and continuous	"*The quantity of water available for each person should correspond to World Health Organization (WHO) guidelines".* These guidelines indicate that 50-100l per day per person are sufficient to meet all basic needs (which goes beyond just drinking-water) (http://www.un.org/waterforlifedecade/human_right_to_water.shtml) and 20 litres per member of a household per day for basic access (http://apps.who.int/iris/bitstream/10665/44584/1/9789241548151_eng.pdf; http://www.who.int/water_sanitation_health/mdg1/en/; INTW4). Water source must be within 1000m from home, cost less than 5% of household income and total collection time less than 30 minutes (http://apps.who.int/iris/bitstream/10665/44584/1/9789241548151_eng.pdf; http://www.un.org/waterforlifedecade/pdf/human_right_to_water_and_sanitation_media_brief.pdf).	Ensures that all people in Malawi "*have convenient access to sufficient quantities of water of acceptable quality …at any time and within convenient distance*" (NATW3 p5) – defined as within 500m distance (NATW7, NATC9). Promotion of cost effective/affordable "*technologies to enable easy access to water… services by all manner of people*" and; "*…pricing and charging systems that recognise water as both a social and economic good* (NATW3). Providing water in sufficient quantities and acceptable qualities to all users (NATW3) – 20 litres per capita (NATW8). Drill boreholes beyond the fluctuation level of the water table (NGO2) - ranging from 21m to 45m or more (GD2), have more than five meters of water supply in depth and, the minimum yield for boreholes for pump Alfredo is 0.25m/s (NGO2).

Standards/guidelines	International legislation and policy	Local legislation and policy
	Year round service (http://apps.who.int/iris/bitstream/10665/44584/1/9789241548151_eng.pdf) "A*ll peoples, …have the right to have access to drinking-water in quantities and of a quality equal to their basic needs”* (INTW9). “*Provide sustainable and sufficient quantities of drinking-water to all, …*" (INTW7). *“Make certain that adequate supplies of water of good quality are maintained for the entire population”* (INTC2).	
Accessibility *Physical accessibility*	*“Water, and adequate water facilities and services, must be within safe physical reach for all sections of the population. Sufficient, safe and acceptable water must be accessible within, or in the immediate vicinity, of each household… All water facilities and services must be of sufficient quality, culturally appropriate and sensitive to gender, lifecycle and privacy requirements. Physical security should not be threatened during access to water facilities and services”* (INT4).	Promotion of cost effective/affordable “*technologies to enable easy access to water… services by all manner of people*” and; “*…pricing and charging systems that recognise water as both a social and economic good”* (NATW3). *“Boreholes fitted with hand pumps should serve maximum number of 250 people per borehole within the radius of 500 metres;* *A communal tap point is designed to serve a maximum number of 120 people within the radius of 500 metres”* (NATW7, G2). *“Taps should be located so that the one way maximum walking distance is not be more than 500m; One tap should serve at least 120 people”* (NATW9 p14).

Standards/guidelines	**International legislation and policy**	**Local legislation and policy**
		"RWSSP has set 75 for the population of communities eligible for" service provision (NATW7).
Quality: Safe following WHO Guidelines	*"The water required for each personal or domestic use must be safe, therefore free from micro-organisms, chemical substances and radiological hazards that constitute a threat to a person's health"* (INTW4). Allow national standards on drinking-water quality Improved drinking-water sources: household connection; public standpipe; borehole; protected dug well; protected spring; rainwater http://www.who.int/water_sanitation_health/mdg1/en/ *"Make certain that adequate supplies of water of good quality are maintained for the entire population of this planet"* (INTC2). Enhance provision of "*safe, clean, … drinking-water for all" (*INTW5).	Ensures that all people in Malawi "*have convenient access to sufficient quantities of water of acceptable quality*" (NATW3 p5) *– water from the following sources piped water supply systems, boreholes fitted with hand pumps, protected shallow wells and springs"* (NATW7). 74. "*Every person abstracting groundwater by means of a borehole shall, in order to prevent contamination or pollution of the water__ (a) effectively seal off to a sufficient depth any contaminated or polluted surface or shallow water in rock openings or soft broken ground*; 70.__(1) *Where any borehole is being constructed within eight hundred metres of an existing borehole, the Authority may, by notice require the person constructing the borehole to apply tests, to be specified in the notice, to the existing borehole and to supply to the Authority the particulars of the results of such tests including the rate of pumping and rest levels of water"* (NATW4). *"Water quality testing should be done before installation of a pump. This is to establish the water quality and a decision should be done whether to put a treatment facility or not, depending on the quality of the water"* (NATW9 p17).

Standards/guidelines	International legislation and policy	Local legislation and policy
		"The surfaces of these sources contaminate water; therefore rainwater should only be used for domestic purposes after treatment" (NATW9 p22).
Affordability	Calls for "*access to water for the poor at a price they can afford based on subsidies directly targeted to the poor" (*INTW1*).* Enhance provision of "*safe, clean, accessible and affordable drinking-water… for all" (*INTW5).	In rural communities, the policy aims to attain "*sustainable provision of community owned and managed water supply and sanitation services that are equitably accessible to*" all water users "*at affordable cost"* (NATW3). Promotion of cost effective/affordable "*technologies to enable easy access to water… services by all manner of people*" and; "*…pricing and charging systems that recognise water as both a social and economic good" (*NATW3). Promote and advocate water…services' pricing and charging systems that recognise water as both a social and economic good (NATW3). "*Ensure that all communities have access to a minimum standard of water supply. Those who want private connections are expected to pay high costs*" (NATW7). *"Contributions should be collected when people are able to pay and may therefore be irregular"* (NATW7). *"The method of collection should not be disproportionately costly to the revenue collected"* (NATW7). The water abstraction charges shall be based on a pricing strategy that takes into consideration__

Standards/guidelines	**International legislation and policy**	**Local legislation and policy**
		(*a*) the need to differentiate among geographical areas, categories of water uses and water users (NATW4).
Acceptability	*Water should be of an acceptable colour, odour and taste for each personal or domestic use (INTW4).*	
Sustainability	Provide sustainable and sufficient quantities of drinking-water to all, emphasizing the "*some for all rather than more for some*" (INTW7). Calls for *sustainable access to safe water supply for basic human needs (*INTW1).	In rural communities, the policy aims to attain "*sustainable provision of community owned and managed water supply and sanitation services that are equitably accessible to*" all water users "*at affordable cost* (NATW3). Drill boreholes beyond the fluctuation level of the water table (NGO2) - ranging from 21m to 45m or more (GD2), have more than five meters of water supply in depth and, the minimum yield for boreholes for pump Alfredo is 0.25m/s (NGO2).

Appendix 12 Institutional arrangements governing access to drinking-water in rural Malawi

The following Table is a longer version of Tables 5.5, 5.6 and 5.7 in Chapter 5 showing institutional arrangements governing access to drinking-water in rural Malawi.

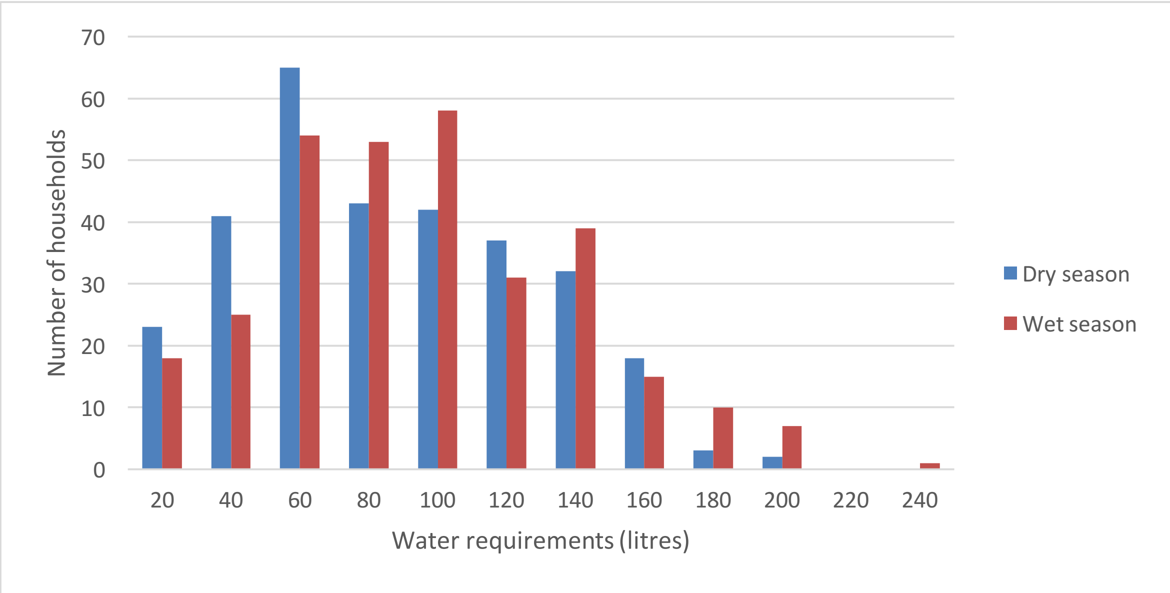
Water system	Rules		
	Constitutional (Establishment and Membership rules)	Operational (Access rules) and penalties for non-compliance	Collective (decision making rules)
Borehole	Committee of 5-10 people democratically elected from user households served by a point source (NATW8). Executive members are to be literate (NATW8). Membership to follow 50:50 gender ratio (NATW8, NGO1, NGO2).	Communities are expected to participate fully in planning, need identification, financing operation and maintenance (NATW8).	To be managed by borehole committees (NATW8, GD2) Participatory decision making (NATW8) and formation of operational rules (G2, NGO2).
Piped (Water User Association WUA concept) & Catchment approach	Establishment of WUAs is to be initiated locally by a group of water users or by the NWRA (NATW4). WUAs operate at traditional authority level that comprises of a group of villages. WUA structure integrates local resource users and gender balance (Figure 2), (NATW5, NATW6, NATW7, NATW8, LOCW1). The general assembly is to draw its membership democratically from the area development committee, following 50:50 gender ratio.	Communities are expected to participate fully in planning, need identification, financing (in cash and kind) operation and maintenance (NATW5, NATW6, NATW7). However, there are variations which are specific to WUA. For example, water users are expected to: • Communities are expected to meet 5% of capital costs and operation and maintenance costs in full with some savings for replacement and/or expansion. This includes costs of spare parts and technicians' salaries (GD1, GD2). Communities	Management applies the WUA approach but prior to 2012 the management was carried out by committees (GD1, GD2). WUA arrangements involve local communities in formation of operational rules. The contributions (water tariffs) from all water points are reviewed and approved by the

Water system	**Rules**		
	Constitutional (Establishment and Membership rules)	Operational (Access rules) and penalties for non-compliance	Collective (decision making rules)
	Members of the general assembly elect up to 13 board members. The secretariat is to be headed by a professional scheme manager or Local Utility operator (LUO) who can be an organisation or individual with either engineering or public health qualification. Under the LUO, there is a cashier and plumbers (G2, NATW5, NATW6, NATW7, NATW8, LOCW1). Women are encouraged to take up leadership roles at community level. Each committee is to be representative of its community members and follow 50:50 gender ratio (NATW5, NATW6. VLWC1). Membership criteria for WUA board, General Assembly and water users include literacy, community membership and volunteerism (NATW5, NATW6, NATW7, NATW8, VLWC1). WUA membership for all residents is compulsory (NATW5); but access to drinking-water depends on payment of tariff charges.	are to meet these costs through metering or flat rate charges (NATW4). However, in Chingale WUA constitution, initial contribution applies to private connections only. Communal taps are connected freely but a flat rate is applied for operation and maintenance contributions with limited recognition of marginalised groups. Failure to pay leads to denied access (VLWC1, VLWC3). • Participate in catchment protection (NATW6). Non-compliance of order attracts an administrative penalty and; a fine of K1,000,000[60] and 4 years imprisonment for further noncompliance (NATW4). • Participate in monitoring and evaluation of water projects (NATW5, NATW6, NATW7) and work of service providers (NATW7). • Form management committees and elect local leadership including General Assembly, WPC, VHWCs and local artisans (NATW5, NATW6, NATW7). • Clean and maintain water facilities (NATW5, NATW6, NATW7).	general assembly but proposed by the WUA Board of Trustees (NATW5, NATW6).

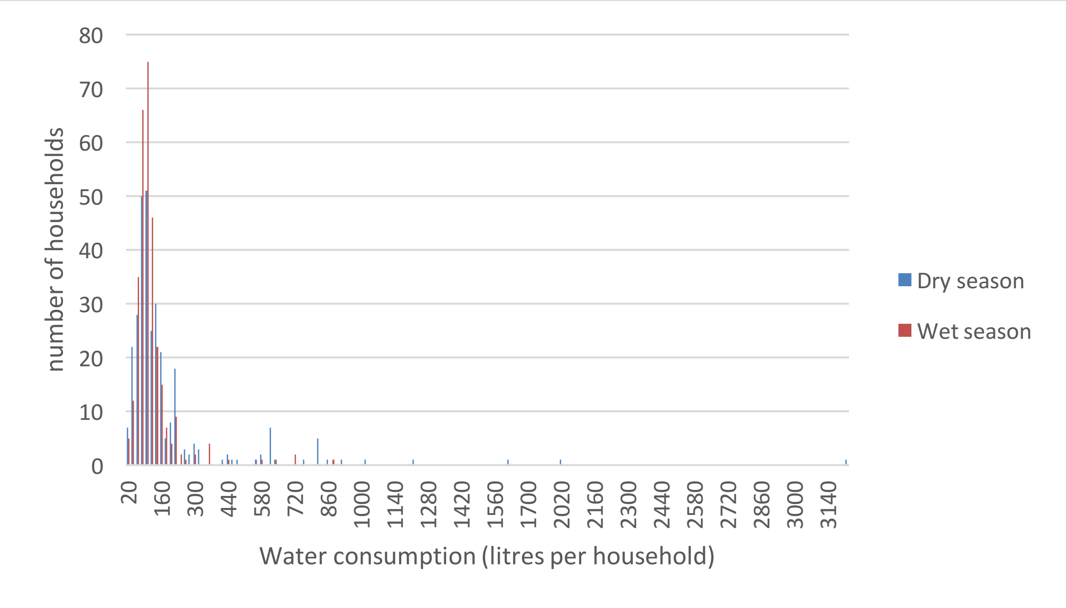
[60] About US$2400.

Water system	Rules		
	Constitutional (Establishment and Membership rules)	Operational (Access rules) and penalties for non-compliance	Collective (decision making rules)
	The catchment committee in design comprises representatives from the farming community, NGOs, people with expert knowledge, and government ministries, departments and other public bodies responsible for matters relating to water resources in the catchment area (NATW4). Membership – gender sensitive The committee is responsible for water resources conservation (catchment enrichment and rehabilitation) alongside the government extension workers mostly from forestry department, water use and allocation, formation of bylaws, hotspots plan and catchment management plans as well as monitoring the catchment rehabilitation processes (G2). The Water Resources Act (NATW4) mandates the NWRA to provide regular funding (by request) for catchment conservation and produce a catchment management strategy to provide mechanisms and facilities for enabling community participation. The NRWA establishes catchment committees (NATW4).	Catchment committees and communities have to participate in catchment enrichment, forest fire break maintenance and patrols (LCC1) – participation is compulsory in Water Resources Act and not in bylaws. Noncompliance attracts a fine of K1,000,000 and 4 years imprisonment (NATW4) but Bylaws e.g. in Kasonga, only provide sanctions/penalties if found conducting prohibited activities in the catchment. Prohibited activities include timber harvest, woodfuel collection without permission from committee, charcoal burning and water pollution.	

Appendix 13 Household water requirements in the dry and wet seasons



Appendix 14 Household water consumption per day in the dry and wet season



Source: Household survey question h_28: In the past 7 days, on average, how much water did you carry per day for your household?

Appendix 15 Water quantity – logistic regression models, dry season

Name of explanatory variable	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Male headed household	.698 (.387-1.257)	0.231	.862 (.401-1.851)	0.703
Age of household head	1.004 (.991-1.018)	0.529	1.015 (.995-1.035)	0.136
Household size	.562 (.489-.645)	0.000***	.528 (.449-.620)	0.000***
Dependency ratio	1.652 (.755-3.615)	0.209	.559 (.201-1.559)	0.266
Education	1.028 (.959-1.102)	0.430	-	-
Primary education	.696 (.314-1.545)	0.373	.796 (.325-1.947)	0.617
Secondary education	2.269 (.641-8.028)	0.204	2.993 (.874-10.248)	0.081*
Upstream (catchment)	.487 (.289-.823)	0.007**	.387 (.202-.742)	0.004**
Rich	1.851 (1.117-3.069)	0.017**	-	-
Logged per capita consumption/income	1.304 (1.087-1.566)	0.004**	1.222 (.976-1.530)	0.080*
Distance in minutes	N/A	N/A	N/A	N/A

Note: * 0.10 ** 0.05 *** 0.01; N/A=Not applicable

Appendix 16 Logistic regression results for water quantity, wet season

Name of explanatory variable	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Male headed household	.630 (.380-1.044)	0.073*	1.047 (.582-1.881)	0.879
Age of household head	1.011 (.999-1.023)	0.083*	1.014 (.998-1.031)	0.079*
Household size	.524 (.441-.623)	0.000***	.518 (.430-.624)	0.000**
Dependency ratio	.901 (.493-1.648)	0.735	1.173 (.588-2.337)	0.651
Education	.997 (.995-.999)	0.011**	-	-
Primary education	.607 (.100-3.697)	0.588	2.032 (.053-.773)	0.019**
Secondary education	4.554 (.524-39.585)	0.169	7.033 (.599-82.568)	0.121
Upstream (catchment)	.806 (.491-1.321)	0.392	.901 (.488-1.665)	0.739
Rich	3.052 (1.516-6.145)	0.002**	-	-
Logged per capita income	1.270 (.980-1.647)	0.071*	1.209 (.971-1.506)	0.090*
Distance in minutes	.979 (.959-1.000)	0.051**	.985 (.961-1.009)	0.211

Note: * 0.10 ** 0.05 *** 0.01

Appendix 17 T-test for time taken to the water source (in minutes) by sufficient quantity of water collected, wet season

Group	**Obs**	**Mean**	**Std. Err.**	**Std. Dev.**	**[95% Conf. Interval]**	
Insufficient	147	15.898	1.012	12.273	13.897	17. 899
Sufficient	164	13.366	.782	10.017	11.821	14.910
Combined	311	14.563	.635	11.194	13.314	15.812
Diff		2.532	1.265		.042	5.022
diff = mean (Insufficient) - mean(Sufficient)					t = 2.001	
Ho: diff = 0			degrees of freedom = 309			
Ha: diff < 0		Ha: diff != 0			Ha: diff > 0	
Pr(T < t) = 0.977		Pr(|T| > |t|) = 0.046			Pr(T > t) = 0.023	

Appendix 18 Seasonal access challenges in each village

Season	Seasonal access challenge	Village				Illustrative examples from FGDs and key informants
		Mtuluma	Mpheta	Makombe	Kasonga	
Dry season	Sources dry up or low supply	Partially	Partially	Partially	Partially	*"water is our main problem. Especially during this season [dry season]. Even taps become dry because of low levels at the intake"* (FGD1_mixed, Mtuluma) *"When other sources dry up we draw from the same source, [in] September and October. In the morning there is no problem. But the water does not last long. When 20 people draw the water, it gets depleted. We wait long hours for the water … During dry season we use a pail to get water from it [the spring due to low water table]"* (FGD2_W, Kasonga) *"those friends downstream, in Makombe experience water challenges during this time of the year because there are a number of boreholes with low water tables. They wait for water sometimes when the ground water reserve gets depleted. Sometimes, the water source becomes dry hence they have to wait until the pipes fill up again. Hence people resort to fetch domestic water from the wells [constructed on riverbanks]"* (NGO1, Makombe). *In this season, the demand for water is high, because other boreholes which are in neighbouring villages, dry up, as a result everyone comes to collect water at the borehole which is situated in Makombe 1 village…We experience quarrels and fight at this time* (FGD2_W, Makombe) [We] *fetch about 25 litres for drinking from the borehole and water for food preparation from the wells* (FGD2_W, Makombe)

Season	Seasonal access challenge	Village				Illustrative examples from FGDs and key informants
		Mtuluma	Mpheta	Makombe	Kasonga	
						now [September] *we are suffering* (participant 2). *When we reach October we draw from rivers* (crosstalk)… *We fetch water at long distance* (Participant 2, FGD2_W, Kasonga).
	Intermittent supply	√	Partially	x	√	*Frequent interruptions. The water may come early in the morning or by noon there is no water in the taps"* (FGD1_mixed - Mtuluma)
Wet season	Colour not acceptable	Partially	√	x	x	*"For those friends drawing water from river they also experience water shortages during rainy season due to turbidity"* (Mtuluma FGD1_mixed) after heavy rains, women wait for about five hours for water to clear before drawing it for household consumption (FGD2_W- Kasonga)
	Intermittent supply	√	X	x	x	"*Blocked pipes at the intake"* following heavy storm also bring similar challenges (FGD1_mixed - Mtuluma).
	Source inaccessible					*Access is a challenge especially during the rainy season… because here for many, access to tap … [and] borehole water is … a challenge. Many rely on rivers. When the rains fall, these rivers become full - during the rainy season- so we take long to eat due to delayed access to less turbid water when rain falls"* (FGD2_W-Mtuluma). [In Kasonga routes to water sources become] "*Slippery and steep*" (crosstalk)… "*Sometimes we fall down and break the pot and go home back home empty handed*" (Participant 2, FGD2_W).

Source: Key informant interviews and focus group discussions

Appendix 19 Functional drinking-water facilities in the village against size of user population

The following table presents results from an analysis of number of water facilities against their user population and how well each village attain the minimum standards outlined in Chapter 6, section 6.1. Maximum size of user group for boreholes is 50 households or +/- 250 people per borehole within the radius of 500 metres (Government of Malawi, 2011a; 2010f)*;* when there is 24 households or 120 people for a protected spring and a *communal tap point within the radius of 500 metres"* (NATW7, G2). Appendix 19 shows number of drinking-water facilities documented during the study period against its user population, collected through key informant interviews and resource walks. In Appendix 19, the figures of drinking-water facilities are split into two to show total number of boreholes or taps and the number that were functioning at the time of the survey.

Village	**Proportion of households for each source**					
	Tap (Recommended minimum standard: 1: 24 households)		Borehole (Recommended minimum standard: 1: 50 households)		Spring (Recommended minimum standard: 1: 24 households)	
	Number of facilities	Number user households and ratio	Number of facilities	Number of user households and ratio	Number of facilities	Number of user households and ratio
Mtuluma (n=55)	1	55 (1:55)	0	N/A	0	N/A
Mpheta (n= 397)	0	N/A	21 (15)	397 (1:27)	0	N/A
Makombe (n= 121)	0	N/A	7 (5)	121 (1:24)	0	N/A
Kasonga (n=129)	0	N/A	1[x]	129 (1:129)	1	129 (1:129)

Note: 'n' represents total number of households in each village. [x]It was established through resource walks that, due to premature failure, this borehole was operating like a public protected well. The pump was removed to allow continued use of the water source after the villagers failed to fix the damaged parts.

Source: Key informant interviews and resource walks.

The results show varied user groups sizes in the study villages. The Mtuluma's and Kasonga's user group sizes exceeded their recommended sizes for taps and boreholes. In both villages, one facility served more than twice the recommended number of households (Appendix 19). In the context of meeting criteria for service provision, Mtuluma's households (n=55) were below 75, the minimum size eligible for service provision, implying that the one communal tap provided was sufficient for the whole village. However, service distribution was spatially insufficient; the distance standard was not met for all (See details in subsection 6.5.2). In contrast, in Mpheta and Makombe, a large number of water points was allocated to small populations of less than 30 user households per borehole versus the recommended 50 households' maximum threshold.

Appendix 20 Logistic regression results for improved water access, dry season

Name of explanatory variable	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Male headed household	.629 (.343-1.155)	0.135	.453 (.212-.968)	0.041**
Age of household head	1.006 (.991-1.022)	0.435	1.002 (.982-1.022)	0.877
Household size	.939 (.832-1.059)	0.307	.928 (.804-1.070)	0.303
Education	.973 (.906-1.044)	0.442	1.011 (.913-1.118)	0.839
Primary education	.528 (.240-1.162)	0.112	-	-
Secondary education	1.043 (.362-3.006)	0.939	-	-
Upstream (catchment)	.122 (.070-.214)	0.000***	.110 (.060-.202)	0.000***
Rich	1.686 (1.011-2.812)	0.045**	-	-
Logged per capita consumption/income	1.220 (1.009-1.474)	0.040**	1.157 (.936-1.431)	0.178
Distance in minutes	N/A	N/A	N/A	N/A

Note: * 0.10 ** 0.05 *** 0.01

Appendix 21 Logistic regression results for improved water access, wet season

Name of explanatory variable	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Male headed household	.685 (.356-1.318)	0.257	.582 (.272-1.245)	0.163
Age of household head	1.012 (.996-1.027)	0.138	1.006 (.986-1.026)	0.550
Household size	.961 (.846-1.091)	0.539	1.011 (.866-1.179)	0.894
Education	.961 (.872-1.060)	0.429	.985 (.881-1.101)	0.790
Primary education	1 (.109-9.144)	1.000	-	-
Secondary education	.500 (.089-2.802)	0.431	-	-
Upstream (catchment)	.126 (.068-.231)	0.000***	.114 (.060-.217)	0.000***
Rich	.929 (.434-1.991)	0.851	-	-
Logged per capita income	1.245 (.981-1.578)	0.071*	1.342 (1.014-1.776)	0.040**
Distance in minutes	.987 (.962-1.013)	0.313	.995 (.970-1.020)	0.673

Note: * 0.10 ** 0.05 *** 0.01

Appendix 22 Achievement of 'Participation' standard in the study villages

Indicators	Extent to which 'participation' indicators are achieved			
	Village			
	Mtuluma	Makombe	Mpheta	Kasonga
Women, the poor and remotely located had the opportunity to participate in decision-making relating to their access to water (choice of appropriate technologies and sites for facilities, setting tariffs)	Partially	Partially	Partially	Partially
Users made formal application for water services to DCT through VDC/ADC according to their local conditions	√	√	√	√
Users met pre-service conditions (formed water committees, raised commitment fees)	√	√	√	√
Users met post construction conditions (met operational or maintenance costs)	x	√	√	N/A
Users were provided with adequate training and know-how to manage minor repairs	Partially	Partially	Partially	Partially
Women got opportunity to exercise their expertise in maintenance of water points	x	x	x	x
Users participated in monitoring and supervision of water service projects to ensure that design and quality standards are met and sustained	Partially	Partially	√	x

Glossary of Terms

Actors: Characteristics of resource users/stakeholders (McGinnis and Ostrom, 2014; Ostrom, 2009).

Area Development Committee (ADC): Elected members at Traditional Authority's level – include Ward Councillors, Traditional Authorities Members of Parliament, AEC Representatives, Elected Members and Interest (Government of Malawi, 2010a).

By-Laws: are a set of regulations governing the smooth running of an organisation such as Water User Association. By-laws can also be called a charter, a constitution or articles of association (Government of Malawi, 2009b).

Collective Action: An "action taken by a group of people (resource users) to achieve common goals/interest" (Andersson, 2006 p4).

Collective Choice Rules: Rules that "determine how operational rules can be changed and who participate" in the modification of the operational rules (Ostrom, 1990 p52).

Common Property Resource: Subset of public goods, common to all people who want to use them (Ostrom, 1999; Adhikari et al., 2004) but is finite (rivalry) and have some form of control or rules and regulations governing access and use (Fischer et al., 2004; Ostrom, 2002; Wade, 1987). Common property resources are also excludable to non-community or group members governing access to the resource.

Community Based Organisations (CBOs): On environment refer to natural resources user groups, NRM Clubs and Associations, Village Natural Resources Committees (VNRMCs), Beach Village Committees (BVCs), Village Level Operations and Maintenance (VLOM) committees and Village Health Committees (VHCs) (Environmental Affairs Department, 2002b).

Community Participation: Means involving water users in water development processes including need identification (expressing demand), site and technology selection, labour and materials' contribution, and funds mobilisation for capital, operations and management (Naiga et al., 2015; Jimenez and Perez-Foguet, 2010; Quin et al., 2011).

Community-Based Management (CBM): Approach where water users are responsible for the operation and management of their water supply (Quin et al., 2011).

Constitutional Choice Rules: Stipulate: 1) membership rules for structures that are established to govern resource use; 2) rules for creating these governance structures and selection criteria; 3) rules followed in collective decision making and powers associated with each office or structure (Ostrom, 1990).

Cost Recovery: The extent to which users are charged for goods and/or services to generate revenue to cover the costs of provision (Southern African Development Community, 2005; Government of Malawi, 2007b).

Demand Driven Approach: Strategy through which communities are empowered to operate and manage their water services including aspects of water related hygiene during the course of project implementation (Government of Malawi, 2007b).

Demand-responsive Approach: It is an approach where water users are empowered to initiate, select and implement the type of services they require based on their perceived needs and capability to manage the service – thus giving more responsibility to water users (Naiga et al., 2015; Jimenez and Perez-Foguet, 2010; Quin et al., 2011; Moriarty et al., 2013b; Rout, 2014).

Development: The process of improving the quality of all human lives. Important aspects of development are raising people's quality of life and living levels, creating conditions conducive to the growth of people's self-esteem and increasing people's freedom of choice (Southern African Development Community, 2005).

Discrimination: Any form of distinction or exclusion that has a purpose of restricting other groups from enjoying or exercising their human rights (De Albuquerque, 2014b).

District Coordinating Team (DCT): Technical arm of the District Executive Committee (DEC). Comprises the Director of Planning and Development (DPD) as Chairperson, the Director of Public Works DPW), District Water Officer (DWO) as Secretary and as members, the District environmentally related sector officers, the Monitoring and Evaluation Officer (M&EO) and NGO representative working in water and sanitation in the district (Government of Malawi, 2010a).

District Executive Committee (DEC): A technical committee comprising all sector heads and NGOs represented at the district, co-opted members and the head of the Assembly (Government of Malawi, 2010a).

Domestic use: Use of water for drinking, washing, cooking, bathing, sanitation and stock watering purposes (Southern African Development Community, 2000; Southern African Development Community, 2005; Government of Malawi, 2013b).

Drinking-water service: A term used to define "the accessibility, availability and quality of the main source used by households for drinking, cooking, personal hygiene and other domestic uses" (WHO and UNICEF, 2017a).

Drinking-water: A shorthand for water that is used for drinking and food preparation, cooking and cleaning up (WHO, 2017).

Economic good: Means that water has an economic value, in addition to its environmental, social and cultural value. It is a scarce resource that is limited in quantities in comparison to the demand for the resource. Treating water as an economic good recognises that water has an opportunity cost, that it must be managed in a way that reflects its economic value for all uses and that the pricing of water will reflect the cost of provision (taking account of the needs of the poor and vulnerable) (Southern African Development Community, 2005).

Equality: Ensuring that all people enjoy their "rights equally of their rights" – does not mean giving identical treatment to "people who are unequal" (De Albuquerque, 2014b p20).

Equitable access: Means progressive reduction and elimination of inequalities between population subgroups (WHO, 2017).

Equity: Benefiting all without any discrimination - "The moral imperative to dismantle unjust differences, based on principles of fairness and justice. It requires a focus on the most disadvantaged and the poorest individuals and groups" (De Albuquerque, 2014b p20).

Extension Workers Team (EWT): The technical arm of the Area Executive Committee (AEC) on water and sanitation in the traditional authority area. Comprises Water Monitoring Assistant (WMA), Assistant Environmental Health Officer (AEHO), Community Development Assistant (CDA), Primary Education Advisor (PEA), Forestry Assistant (FA) and representative NGO working in the area on water and sanitation (Government of Malawi, 2010a).

Financial institutions: Are all cooperating partners/donors which support water and sanitation programmes (Government of Malawi, 2010a).

Formal institutions: Are rules and procedures that are written and enforced through state structures (North, 1989; 1991; 1994) including state institutions (courts, legislatures, bureaucracies) and state-enforced rules (constitutions, laws, regulations) (Helmke and Levitsky, 2004).

Gender ideologies: The collective beliefs, ideas and practices that influence men and women into acting in certain ways in any society. These include division of labour, gender discrimination, gender relations, gender equality and equity.

Gender inequalities: Occur when people are denied same opportunities in life because of their gender (Cagatay, 1998; Nussbaum and Glover, 1995; Reeves and Baden, 2000; FAO, 2005; Nousiainen et al., 2013; Sweetman, 2013).

Gender mainstreaming: A strategy for making women's as well as men's concerns and experiences an integral dimension in the design, implementation, monitoring and evaluation of policies and programmes, in all political, economic and societal spheres so that women and men benefit equality, and inequality is not perpetuated. The ultimate goal is to achieve gender equality (Southern African Development Community, 2005).

Gender: Refers to the socially and culturally constructed roles, privileges, responsibilities, power and influence, social relations, expectations and value of men and women, girls and boys (Southern African Development Community, 2005).

Governance systems: Prevailing set of processes or institutions through which rules governing access to water are formulated and modified (McGinnis and Ostrom, 2014; Ostrom, 2009).

Hygiene: Consistent proper use of sanitary facilities in order to prevent diseases - is a key element for the control and prevention of water and sanitation related diseases (Government of Malawi, 2009b).

Improved drinking-water sources: Are those which deliver safe water such as piped water, boreholes or tubewells, protected dug wells, protected springs, rainwater, packaged and delivered water (WHO and UNICEF, 2017c; WHO and UNICEF, 2017d; United Nations, 2018).

Informal institutions: Are defined as socially shared rules and norms that govern water management, use and allocation (Jacobson et al., 2013).

Institutions: “The humanly devised constraints that structure political, economic and social interaction”. These consist of “both informal constraints (sanctions, taboos, customs, traditions, and codes of conduct), and formal rules (constitutions, laws, property rights)” (North, 1991 p97).

Integrated Water Resources Management (IWRM): A process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems (Southern African Development Community, 2005).

International watercourse: “A watercourse, parts of which are situated in different States” (United Nations, 2014 p3).

Local Authority: Means a District Assembly, Town Assembly, Municipal Assembly or City Assembly constituted under the Local Government Act (Government of Malawi, 1998a).

Malnutrition: Various forms of poor nutrition caused by a complex array of factors including dietary inadequacy, infections, and sociocultural factors. Underweight or stunting and overweight, as well as micronutrient deficiencies, are forms of malnutrition (WHO, 2018).

Marginalisation: Refers to the process that systematically denies people opportunities and resources … available to other members of society, and which would otherwise serve to promote social integration” (De Albuquerque, 2014b p19).

Monitoring: “The systematic and continuous collecting, analysis and using of information for the purpose of management and decision making” (Government of Malawi, 2005).

Operational rules: Specify what may and may not be done in daily appropriation and provision activities (Ostrom, 1990; Luckert et al., 2011).

Participatory Approach: A planning approach in which all stakeholders, and in particular the resource users (by gender and social economic status) are part of the decision process (including the designing and managing their own resources) (Government of Malawi, 2007b; Southern African Development Community, 2005; Solanes and Gonzalez-Villarreal, 1999; De Albuquerque, 2014d).

Permit or licence: Is a “written document granting authorisation to engage in an activity, usually with conditions attached, sometimes with a payment required” (Government of Malawi, 2007a p25).

Poverty: Is the situation facing those in society whose material needs are least satisfied. Inability to afford an adequate standard of consumption because of low income is referred to as income poverty. If, apart from low income, a country is characterised by malnutrition, poor health, low survival rates, low literacy levels, inadequate housing and living conditions, etc., then there is human poverty (Southern African Development Community, 2005).

Property rights: Are “sets of rules that define access, use, exclusion, management, monitoring, sanctioning, and arbitration behaviour of users with respect to” drinking-water resources (Agrawal, 2003 p245).

Related ecosystems: Broader ecological context within which the water resource systems are located, including causes of potential exogenous influences (threats/challenges and opportunities) (McGinnis and Ostrom, 2014; Ostrom, 2009).

Resource rights holders: Are "individuals, groups, households, families or clans, who possess a 'right' of access to collect resources from an area of land without necessarily having title or ownership" (Government of Malawi, 2007a p25).

Resource systems: Biophysical system (e.g. ground/surface water) from which resource units (water) are extracted and through which these resources are regenerated by natural dynamic processes (McGinnis and Ostrom, 2014; Ostrom, 2009).

Resource tenure Refers to the bundle of rights which people may have with respect to the utilisation and the control of its utilisation.

Resource units: Attributes of the units extracted from the resource system and may then be consumed (McGinnis and Ostrom, 2014; Ostrom, 2009).

Safe drinking-water: Water that is treated, cleaned or filtered and meets certain microbiological and chemical standards set by the World Health Organisation (WHO) as well as country specific standards (WHO and UNICEF, 2010).

Season: Refers "to either astronomical divisions of the year (winter, spring, summer, autumn) or to divisions based on climatic periods (e.g., wet season(s), dry season)"(Kostyla et al., 2015).

Seasonality: A regular pattern or variation associated with seasons (Chambers, 2012 p1).

Service providers: Companies or NGOs who deliver goods and services to communities to support development of community managed water and sanitation facilities (Government of Malawi, 2010a).

Shared watercourse: Means a watercourse passing through or forming the border between two or more States (Southern African Development Community, 2005).

Social capital: Defined as " features of social life - networks, norms, and trust that enable participants to act together more effectively to pursue shared objectives" (Putman, 1995).

Social good: Means water as a commodity to which social value is attached, arising from the fact that water is an essential building block for life (Southern African Development Community, 2005).

Social, economic and political settings: External factors - contextual factors (e.g. demographic changes and broad governance arrangements) for local institutional arrangements and resource systems (McGinnis and Ostrom, 2014; Ostrom, 2009).

Stakeholder: Organisation, group or individual that is concerned with or has an interest in water resources and that would be affected by decisions on water resources management and development (Government of Malawi, 2007b).

Supply Driven Approach: Implies government and development partners take a central role in choosing, operating and managing the drinking-water service (Black, 1998; Quin et al., 2011).

Sustainable development: A pattern of development that permits future generations to live at least as well as the current generation (Southern African Development Community, 2005).

Sustainable use: Use in a way and at a rate that does not lead to the degradation or depletion of a natural resource (Southern African Development Community, 2005).

Sustainable utilisation: The "use …of natural resources which guards against the extinction, depletion or degradation… and permits the replenishment…" (Government of Malawi, 1996a).

Tragedy of the commons: Is when individual users of a shared (common pool) resource act independently in their self-interest (maximising benefits) by depleting or degrading the resource contrary to common goals of all users.

Unimproved water sources: Are "unprotected dug wells and unprotected springs" (WHO, 2017 p13).

Universal access: All people are able to use safe water when needed.

User communities: Cluster of households using a point source (pump/borehole) or several villages if piped water system (Government of Malawi, 2010a).

Village Development Committee (VDC): Elected Members and Interest Groups. Ex-Officials: Group Village Headman, Ward Councillors, AEC Representatives (Government of Malawi, 2010a).

Village Health and Water Committee (VHWC): A sub-committee of the Village Development Committee (VDC) responsible for promoting water and sanitation activities at village level. In a village with more than one water point, VHWCs form WPCs to oversee a particular water point (Government of Malawi, 2010a).

Village Natural Resources Management Committee (VNRMC): The committee that coordinates management of natural resources management on customary land (Government of Malawi, 1996b; Government of Malawi, 2003b).

Water Demand Management: The use of price, quantitative restrictions and other devices (e.g., leakage detection and control) to control the demand for water (Southern African Development Community, 2005).

Water governance: Water governance is the "political, institutional and administrative rules, practices, and processes (formal and informal) through which decisions are taken and implemented, stakeholders can articulate their interests and have their concerns considered, and decision-makers are held accountable in the management of water resources and the delivery of water services" (Woodhouse and Muller, 2017; Akhmouch and Clavreul, 2016)

Water Point Committee (WPC): is a sub-committee of Village Health and Water Committee (VHWC) (Government of Malawi, 2010a).

Water Resources Management: Water resources development, apportionment, utilisation, conservation, protection and control that incorporate physical, social economic as well as environmental interdependence (Government of Malawi, 2007b).

Water Supply: For the purpose of this policy, water supply implies human uses of water such as drinking-water, water for livestock use, water for industrial use, and water for municipal use (Government of Malawi, 2007b).

Water User Committees (WUCs): Elected members of the community entrusted with the responsibility to plan and manage water supply, hygiene and sanitation program on behalf of the user community (Government of Malawi, 2010a).

Water Users Association: Is a grouping of water users for the purpose of operating and maintaining water supply and sanitation system. It is set up for the benefit of its members (Government of Malawi, 2009b).

Watercourse: A system of surface and ground waters consisting - by virtue of their physical relationship - a unitary whole normally flowing into a common terminus such as the sea, lake or aquifer (Southern African Development Community, 2000; United Nations, 2014 p3).

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