UNIVERSITY OF SOUTHAMPTON

FACULTY OF ENGINEERING AND THE ENVIRONMENT

Centre for Environmental Sciences

The Charcoal Sector in Southern Malawi: A Livelihoods Perspective

by

Harriet Elizabeth Smith

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ABSTRACT

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Charcoal has rapidly become the most widely used domestic source of urban energy for cooking and heating in sub-Saharan Africa, yet much of the sector is informally, or not at all regulated, with consequential detrimental impacts on livelihoods and the environment. Across Africa, 75% of urban growth is occurring in urban areas with populations of less than 1 million. Yet, these charcoal markets, their value chains, and the actors' livelihood outcomes are severely under researched. This thesis focuses on Zomba, a city of 164,000 people in southern Malawi. The research applies questionnaires, semi-structured interviews and a suite of rapid rural appraisal techniques to investigate actors' motivations, roles and livelihood outcomes along the charcoal value chain, examining processes at market, community and individual scales. By viewing the charcoal sector through a livelihoods lens, this thesis attempts to provide evidence and examine its implications for debate surrounding emerging charcoal policies across sub-Saharan Africa.

The core findings of this thesis demonstrate that engaging in the production and transportation of charcoal strengthened actors' financial assets and delivered other benefits, such as improved access to goods and services and opportunities for livelihood diversification. These benefits contributed to reducing actors' vulnerability and improved their livelihoods. However, benefits were dependent on resource availability and a lack of charcoal resource management in the region has led to unsustainable harvesting practices. This resulted in localised forest degradation and charcoal-livelihood benefits were subsequently unsustainable in the longer-term. Lack of an environmentally sustainable commercial sector and enforcement of punitive regulations increased actors' vulnerability to reduced income, undermining market and livelihood security whilst having little positive impact on forest resource protection.

This thesis provides original insights into the rural components of the value chain of small urban charcoal markets, the motivations of actors and livelihood outcomes. Combining a Value Chain Analysis with the Sustainable Livelihoods Framework supported an analysis of livelihood outcomes amongst actors along the chain and within the same node. The findings identify gendered nuances in participation and livelihood outcomes and in the distribution of enforcements amongst actors. This study confirms the importance of the charcoal sector for rural income generation, provides new context-specific insights into the contribution of charcoal to forest degradation and raises concerns over the levels of rent-seeking activities by authorities.

Declaration of Authorship

I, Harriet Elizabeth Smith

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.

The Charcoal Sector in Southern Malawi: A Livelihoods Perspective

I confirm that:

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

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Date: .....

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Currencies

Malawi Kwacha	We use rate USD $1 = K394 throughout the thesis (adjusted to the average exchange rate during the field work period).

Abbreviations

AEDC	Agricultural Extension Development Coordinator
BEST	Malawi Biomass Energy Strategy
DFID	UK Department for International Development
ESCOM	Electricity Supply Corporation of Malawi Limited
ESPA	Ecosystem Services for Poverty Alleviation
EU	European Union
EUEI-PDF	European Union Energy Initiative Partnerships Dialogue Facility
FAO	Food and Agricultural Organization of the United Nations
FEWSNET	Famine Early Warning Systems Network
FGLG	Forest Governance Learning Group
FISP	Farm Input Subsidy Programme
FLARE	Forests and Livelihoods: Assessment, Research and Engagement
GDP	Gross Domestic Product
HIV/AIDS	Human immunodeficiency virus infection and acquired immune deficiency syndrome
ICRAF	World Agroforestry Centre
IDS	Institute of Development Studies
IEA	International Energy Agency
IFMSLP	Improved Forest Management for Sustainable Livelihoods
IIED	International Institute for Environment and Development
IPCC	Intergovernmental Panel on Climate Change
IRLADP	Irrigation, Rural Livelihoods and Agricultural Development Project
MALGA	Malawi Local Government Association
MDG	Millennium Development Goals
NAPA	National Adaptation Programmes of Action
NSO	National Statistics Office of Malawi
NTFP	Non-Timber Forest Product
PEP	Poverty Environment Partnership
PLA	Participatory Learning and Action
PRA	Participatory Rural Appraisal
RRA	Rapid Rural Appraisal
SEI	Stockholm Environment Institute
SLF	Sustainable Livelihoods Framework
UN	United Nations
UN-Habitat	United Nations Human Settlement Programme
UNCHS	United Nations Centre for Human Settlements
VCA	Value Chain Analysis
VDC	Village Development Committee
VNRMC	Village Natural Resource Management Committee

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Zikomo Kwambiri.

1

Introduction

Chapter 1: Introduction

1.1 Overview

Across sub-Saharan Africa, charcoal is a crucial domestic urban source of energy and its production and transportation provides opportunities for income generation, livelihood support, poverty alleviation and domestic market expansion (Monela et al. 1993; Ribot 1998; Arnold et al. 2006; Herd 2007; Kambewa et al. 2007; Malimbwi and Zahabu 2008; Openshaw 2010; Khundi et al. 2011, Agyeman et al. 2012; Jones et al. 2016). Charcoal is an ecosystem service surrounded by controversy. It has the potential to be a sustainable energy source, contributing substantially to reducing carbon emissions and greenhouse gases (Iiyama et al. 2014). However, much of the production and trade in sub-Saharan Africa is unregulated and environmentally unsustainable (Mugo and Ong 2006; Biomass Technology Group 2010; Neuberger 2015). Current approaches to charcoal sector governance are largely punitive, characterised by weak enforcement, corruption and limited understanding of the motivations and livelihood outcomes of the people involved in its production and trade (Arnold et al. 2006; Schure et al. 2013; Zulu and Richardson 2013). Large research gaps in the charcoal literature have led to a lack of evidence-based decision-making and a failure of basic, formal approaches to regulate the sector (ICRAF 2015).

This study combines a value chain analysis (VCA) and sustainable livelihoods framework (SLF) to examine the rural components of the charcoal market in Zomba, a medium-sized city in southern Malawi. A combined framework helps to understand the complexities of commercial forest products, their markets and associated rural livelihoods. It assists in understanding the flows of products, trade governance and how the ruralsector impacts different actors' livelihood outcomes. Using a suite of research methods including questionnaires, semi-structured interviews and rapid rural appraisal techniques, the study investigates the motivations, roles and outcomes of actors involved in the production and transportation of charcoal, examining processes across a range of spatial scales from the market landscape level, down to the individual.

The study contributes to our understanding of the livelihood outcomes of commercial ecosystem services, governance of informal value chains and the socio-ecological dynamics of forest product trades. In addition to contributing new empirical data to the largely under-developed charcoal literature, this investigation also generates new information on the rural components of small urban markets, produces important local-level data on charcoal in Malawi and provides some of the evidence required to inform policy.

This first chapter introduces the research topic by giving a brief overview of the research problem, presenting the research questions and outlining the report structure.

1.1.1 Research problem

Increased rates of urbanisation and resource demands will perpetuate future fuel demands, especially in many of the very poorest countries where woody biomass such as charcoal is a primary domestic energy source (Mwampamba 2007; Clancy 2008). Managing deforestation and forest degradation is challenging due to the associated difficulties in understanding drivers and lack of data available, which leads to uncertainties in policy interventions (Ahrends et al. 2010; Chidumayo and Gumbo 2013). The links between wood-based energy production, deforestation and forest degradation have led to conservation-orientated management approaches that discourage the extraction and production of woodfuels and have condemned the livelihoods of an estimated 13 million people across sub-Saharan Africa into illegality (Macqueen and Korhaliller 2011). The lack of effective governance means that the sector is largely unregulated, environmental damage is challenging to prevent, governments are deprived of a profitable economic sector and peoples' livelihoods are vulnerable to change.

There are colossal gaps in the charcoal literature. Rural stakeholders are rarely represented in formal decision-making structures (Laird, Wynberg, et al. 2010); the lack of quantifiable and empirical information on rural stakeholders undermines attempts to successfully move towards equitable and sustainable scenarios that do not further marginalise the rural poor (Schure et al. 2013). Furthermore, unsystematic assessments of socioeconomic and environmental impacts have underplayed the significance of woodfuels (including charcoal), further hampering policy debates (Cerutti et al. 2015).

Research related to the charcoal sector has predominantly focussed on large cities, their supply areas, and the dominance of an 'urban elite' who monopolise and control the market (e.g. Ribot 1998). But, there is little evidence to suggest whether smaller cities have comparable markets, governance structures or actors to their larger counterparts. Limited empirical research has been carried out in small and medium urban areas, which are defined as having a population of less than one million. However, 75% of future urban population growth in Africa is going to occur in urban areas of this size (UN-Habitat 2014). There are evidently enormous research gaps surrounding the charcoal markets of small and medium urban areas that deserve attention given the significance of the expected growth.

The charcoal sector provides households with benefits through employment and income generation. However, there are limited empirical studies that measure broader livelihood

outcomes (Arnold et al. 2006). Charcoal is a highly politicised and economically valuable ecosystem service and its governance should be addressed at local scales "to ensure that policies match the realities on the ground" (Mwampamba et al. 2013, p. 83). The literature surrounding the socio-political and spatial trade dynamics are based on a limited number of larger-scale studies. Due to unknown issues and their interactions within different market landscapes, large-scale studies and broad-scale interventions may struggle to effectively recognise locally relevant factors.

1.1.2 Research questions

The motivation of this thesis is to provide evidence and examine its implications for debate surrounding emerging charcoal policies in sub-Saharan Africa. By viewing the charcoal sector through a livelihoods perspective, the objective of this thesis is to:

Contribute to the empirical knowledge base of Malawi's charcoal sector and identify rural actors' key livelihood outcomes.

In order to achieve the research objective, this research uses Zomba, a medium-sized city in Southern Malawi as a case study. It explores the rural components of Zomba's charcoal market and focuses on four research questions:

1. What are the rural components of the charcoal value chain, and what are the characteristics of the actors?
2. Why do people participate in the rural charcoal value chain?
3. What are the benefits and trade-offs from participating in the rural charcoal value chain?
4. What are the constraints to charcoal-based livelihoods?

1.1.3 Report structure

The thesis is presented in a 'three-paper PhD' format, and comprises seven chapters. Following this first chapter, which has presented the research problem and research questions, chapter two outlines the research context. It first situates the research in the broader environment and development literature, introducing the concepts of ecosystem services and livelihood resilience. It then reviews the socio-ecological literature surrounding the charcoal sector, highlights the gaps in the literature and then describes the current situation in Malawi. Chapter three outlines the theoretical background to the research by presenting the frameworks for analysis, the methodological design and describes the methods and techniques applied to the research. Chapters four to six present the research results in the form of three, stand-alone journal articles,

of which two are published (Chapter 5 and 6) and one is submitted. Each data chapter contributes in part to answering aspects of all the research questions (Table 1.1). Inevitably there is some unavoidable duplication in the introduction and methods sections of these chapters. Chapter seven summarises the findings and concludes the thesis.

Table 1.1: Overlap between the research questions and the data chapters

	Research Questions			
Data Chapter	**Who participates in the production and transportation of charcoal?**	**Why do people participate in the production and transportation of charcoal?**	**What are the livelihood outcomes obtained from participating in the production and transportation of charcoal?**	**What are the constraints to charcoal-based livelihoods?**
1- Socio-economic factors affecting the spatial-temporal dynamics of charcoal extraction				
2- Criminals by necessity: the risky life of charcoal transporters in Malawi				
3- Livelihood diversification: the role of charcoal production in southern Malawi				

2

The charcoal sector in sub-Saharan Africa

Chapter 2: The charcoal sector in sub-Saharan Africa

Discussions about the woodfuel sector are hampered by confusing terminology. For example, 'woodfuel' has predominantly been used to refer to both charcoal and 'firewood', while 'fuelwood' has been used interchangeably with 'firewood', 'woodfuel' and charcoal. Mwampamba et al. (2013) argue that the interchangeable use of ambiguous terms such as 'woodfuels', 'fuelwood', 'wood energy' and 'biomass energy' leads to the distortion of knowledge and interventions. Thus, to start with clarity, this thesis uses the following defined terms:[1]

Biomass energy: Energy derived from organic matter (excluding fossil-fuels), from plant-based materials (e.g. food crops, wood) and animal- based materials such as dung and animal fats.

Woodfuel: Generic term for all wood-based fuels

Firewood: Unprocessed wood for the purpose of burning

Charcoal: Carbonised wood, for the purpose of burning

This chapter is split in four parts. The first part (section 2.1) situates the research in the broader environment and development literature, introducing the concepts of ecosystem services and livelihood resilience. The second part (sections 2.2) introduces the charcoal sector in sub-Saharan Africa: How and why charcoal consumption has changed, how the charcoal sector is governed across sub-Saharan Africa, examining how historical perspectives have shaped present day perceptions, the current mechanisms that govern the sector and associated challenges with formalising the sector. The section then explores the socio-ecological aspects of the sector by reviewing charcoal's environmental and socioeconomic impacts, and finally reviews existing charcoal-livelihood literature, highlighting the research gaps. The third part of the chapter (section 2.3) focuses in on Malawi, reviews domestic trends in energy consumption, governance of the charcoal sector and the impacts on charcoal-based livelihoods. The chapter concludes (section 2.4) with some reflections on research expectations, based on the existing theories and findings highlighted in this chapter.

2.1 Charcoal: A complex, socio-ecological issue

Complex environmental issues such as resource scarcity, climate change, biodiversity loss and resource degradation need to be examined in an interdisciplinary manner that reflects the

[1] Non-defined terms may be written in quotations.

interactions between social and ecological systems (Folke 2006, Ostrom 2009, Binder et al 2013). The charcoal sector in sub-Saharan Africa is one such complex environmental issue. However, there are substantial gaps in our understanding of socio-ecological systems and there is still a weak understanding of how the environment contributes to different aspects of development, poverty and the wellbeing of people (MA 2005; Carpenter et al 2009; Raudsepp-Hearne et al 2010; Coulthard et al 2011; Daw et al 2011; Fisher et al 2013; Reyers et al 2013; Howe et al 2014; Suich et al 2015).

2.1.1 Ecosystem services and livelihood resilience

Concepts such as ecosystem services and livelihood resilience (conversely, vulnerability) are useful approaches when thinking about socio-ecological systems and relationships (Folke et al. 2002, Folke 2006, Lele et al. 2013). Ecosystem services are the benefits that people obtain from ecosystems and can be grouped into four broad categories of regulating, provisioning, supporting and cultural services (see MA, 2005). They explicitly link ecosystems with human wellbeing (ibid.). Defined as "the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks" (Walker et al. 2004), resilience examines shocks and stresses to explore "the dynamics of livelihoods, highlighting the importance of scale and uncertainty" (Marschke and Berkes 2006). Stresses can be defined as "continuous or slowly increasing pressure[s] […] commonly within the range of normal variability", and shocks (or perturbations) are "major spike[s] in pressure […] beyond the normal range of variability in which the system operates" (Turner et al. 2003, pp. 8079). One part of resilience is adaptability (Folke et al. 2010), which in socio-ecological systems focusses on "the capacity of humans to manage resilience" (Walker et al. 2004) and represents the "capacity to adjust responses to changing external drivers and internal processes" (Folke et al. 2010).

Amongst rural communities in a developing country context, many households directly rely on the environment to support their daily needs and to adapt to shocks and stresses. For example, livelihood strategies such as agriculture rely on supporting services such as nutrient cycling and crop pollination, households consume provisional services such as potable water and fuel (Shackleton and Shackleton 2004) and may also harvest and trade natural products, such as charcoal, to generate an income (Angelsen et al 2014). Ecosystem services support households and can enhance their resilience, for example by providing safety-net, gap-filling and smoothing functions to meet households' every day and seasonal requirements (Shackleton and Shackleton 2004; Sunderlin et al. 2005; Wunder et al 2014). However, seasonality, policies, economic drivers and variations in the availability of, and access to natural resources, create stresses and shocks

that impact rural livelihoods (Ziervogel and Calder 2003, Tompkins and Adger 2004, Adger et al. 2005, MA 2005, Gibbs 2009, Sallu et al. 2010; Tesso et al. 2012).

2.1.2 Benefits and tradeoffs

Benefits from ecosystem services are not automatically derived; furthermore the cost of acquiring particular ecosystem services falls differently amongst different stakeholders. For example, women and children predominantly collect water and firewood in many developing countries (Ilahi and Grimard 2000; Biran et al 2004; Koolwal and van de Walle 2013) and certain resources may only be accessible to particular members of society (e.g. commercial timber extraction rights). Mechanisms such as access (Ribot and Peluso 2003) and circumstances (Sikor 2013) mediate access to ecosystem service benefits (Daw et al 2011; Hicks and Cinner 2014). Thus trade-offs emerge due to differences in factors such as power, access, human capacity and agency, preference, perception and resource distribution (Ribot and Peluso 2003; Ronnback et al 2007; Daw et al 2011; Spangenberg et al 2014; Felipe-Lucia et al 2015; Martin-Lopez et al 2016).

Disaggregation of beneficiaries is particularly relevant in the pursuit of development and environmental goals (Dawson and Martin 2015). It is a crucial component for the assessment and equitable management of ecosystem services (Daw et al 2011; Brooks et al 2014) and helps highlight the most vulnerable and least resilient segments of society (Cinner et al. 2015). Aggregated analyses can overlook distinctions between stakeholders, thus research and policy potentially risks missing significant tradeoffs, further marginalising the most vulnerable (Rodriguez et al 2006; Dawson and Martin 2015). Disaggregating by socioeconomic factors such as stakeholder groups (e.g. along the value chain) or marginalised social groups (e.g. women) is fundamental in identifying how different groups use, access and depend upon ecosystem services and how resilient, or vulnerable their livelihoods are (Dawson and Martin 2015;).

Trade-offs occur at a range of spatial and temporal scales (Rodriguez et al 2006) and, for example in the case of multi-national supply chains with spatially mismatched supply and demand, events and decisions in one location can have repercussions on socio-ecological systems in distant locations (e.g. Swinnen 2007; Meyfroidt et al 2013). Arguably, trade-offs need to be understood for both ethical and instrumental reasons; instrumentally, management decisions may be sabotaged by stakeholders whose wellbeing would be negatively affected and ethically, the livelihoods of the most vulnerable tend to be those most at risk (Daw et al 2015). Identifying trade-offs (for example of a particular land-use practice or management regime) helps policy makers target specified interventions at those who are made worse off, thus potentially reducing negative outcomes and improving fairness (Vira et al 2011; Villasante et al 2016).

There is still limited understanding of stakeholder diversity, people's motivations and preferences for ecosystem services. For example, many studies focus on the contribution of ecosystem services to income (Suich et al 2015), yet there is a need to look at more than just incomes when measuring progress in development and poverty reduction, as broader measures of livelihoods encompass a wide range of factors, such as vulnerability and resilience (Sen 1985; Chambers 1995; DFID 1999; MA 2005; Scoones 2009, Bennett et al 2015).

2.2 The charcoal sector in sub-Saharan Africa

2.2.1 Trends in domestic charcoal consumption

Globally around 2.7 billion people rely on solid biomass energy for domestic activities and by 2030 this figure is only predicted to decrease to 2.3 billion (IEA 2015). By 2050, biomass is predicted to constitute 30% of the global primary energy mix (IEA 2010), 87% of global biomass consumption is estimated to originate from woodfuels (IEA 2009) which are one of the largest outputs from the forest sector (Arnold and Persson 2003).

Access to improved energies such as electricity and gas in sub-Saharan Africa is limited and constraints to accessing them are associated with an unreliable source, inaccessible initial costs, subsequent bills and additional investment in appliances such as cookers (Haanyika 2008; Arthur et al. 2010; Prasad 2011). An estimated 57% of sub-Saharan Africa's population do not have access to electricity (IEA 2012). Limited access to modern energies has increased reliance on biomass consumption, predominantly in form of firewood and charcoal (Mohammed et al. 2015). As such, 89% of sub-Saharan Africa's population are dependent on biomass for their energy needs (Macqueen and Korhaliller 2011). In urban markets, charcoal is particularly popular due to a higher energy content, ease of storage and relatively low smoke production compared with firewood (Arnold et al. 2006; Ouedraogo 2006; Zulu 2010; Mwampamba et al. 2013).

Although geographically varied, charcoal consumption in Africa is projected to increase at higher rates than in any other regions in the world (Zulu and Richardson 2013) and is expected to double from 2000 to 2030 (Arnold et al. 2006). Africa has, and will continue to have, the highest rate of population growth in the world, increasing at a rate of 2.55% per year (UN 2015b). Urban populations are predicted to increase from 40% of the total population in 2014 to 56% by 2050 (UN 2014). An estimated 1% increase in urbanisation leads to a 14% rise in charcoal consumption (Hosier and Kipondya 1993). As long as the supply of electricity continues to fail to provide these growing populations with a reliable and affordable energy source, charcoal consumption is inevitably going to increase and remain irreplaceable for the foreseeable future (MARGE 2009).

2.2.2 Governance of the charcoal sector in sub-Saharan Africa

Changing perspectives

Before reviewing charcoal governance, it is important to understand how historical perspectives have influenced present day perceptions. During the mid-1970s, it became apparent that woodfuels were the primary source of domestic energy in developing countries (Arnold et al. 2006). Limited data on woodfuel supply and demand produced rough estimates of firewood and charcoal consumption; these were compared against forest growth rates and the results projected a woodfuel 'gap' between demand and supply. The key study of the time, produced for the 1981 United Nations conference on New and Renewable Sources of Energy (De Montalembert and Clement 1983), predicted that 200 million people depended on biomass fuel in 1980 and that by the year 2000, 2.4 billion people would be "in situations of acute woodfuel scarcity" (Arnold et al. 2006, pp. 597). Additionally, it was predicted that increased scarcity would result in increased distance travelled to harvest woodfuels, reducing time to complete other activities and forcing people to use 'inferior' fuels such as dung and crop residue causing adverse impacts on health, nutrition and income (Eckholm 1975a; 1975b). These findings led to policy initiatives, funding aimed at improving woodfuel usage (e.g. by using improved stove technologies) and reforestation schemes to enhance forest stock (Arnold et al. 2006).

By the mid-1980s, it emerged that the predicted shortages were not occurring. Findings associated with the overestimation of energy-use patterns and responses to scarcity began to question the role of woodfuel as a significant cause of deforestation (Dewees 1995; Zulu 2010). The original analysis failed to include regenerative, non-forest areas such as scrub and farm trees, wood harvested from the felling of trees was often as a result of agricultural conversion and additionally the analysis did not include users' coping strategies (Arnold et al. 2006). Rather than a global occurrence, research demonstrated that crises were local and quite often village-level phenomena (Dewees 1989). By the 1990s the antithesis hypothesis became widely accepted, which led to a reduced focus on woodfuels and a decline and withdrawal of forest programmes associated with the 1970s crisis mentality (Arnold et al. 2006; Mwampamba 2007; Zulu 2010).

Despite an apparent U-turn on forestry policy in the 1990s, the crisis mentality persists and woodfuels continue to be perceived in a largely negative light, associated with environmental degradation and energy insecurity among low-income households (World Bank 2001). Put simply: "what is needed to effectively promote the use of tree-based biofuels is a shift in perception to improve their negative image" (ICRAF 2015, pp. 1).

Approaches to charcoal governance

Charcoal is often included under the umbrella of non-timber forest products (NTFP). A common issue with NTFP policies is limited understanding about the products, the people and the activities associated with their regulation. NTFPs have a broad range of species, ecologies, cultures, livelihood outcomes and diverse market chains, and different species react differently to different management plans. For example, Albers and Robinson (2013) reviewed the spatial economics of NTFP extraction and their implications for policy. They found that a lack of spatial assessment of NTFP extraction reduced the efficiency of policies because they didn't target or enforce the right forest areas. Furthermore, failure to acknowledge extractors' reactions and infrastructure (e.g. market or road access, buffer zones) results in the ineffective design of protected areas and leakage. Particular NTFPs should have specifically designed policies (Laird, Wynberg et al. 2010), however NTFP policies are difficult to implement and often, formal NTFP laws have been transferred directly from timber regulations with the use of quotas and permits common practice (Laird, Wynberg et al. 2010). As such, the development of formal mechanisms for some NTFPs such as woodfuels (including charcoal) has not primarily been for 'development' but rather as a means to manage and control economically valuable resources (Schure et al. 2013). The regulations of NTFPS are frequently controlled by multiple government sectors such as forestry, conservation, agriculture, mining, intellectual property rights and labour laws. Poor integration and coordination between formal and informal policies results in confusion and unclear formal mechanisms, which may lead to ineffective resource management (Laird, Wynberg et al. 2010).

According to the energy ladder hypothesis, an increase in household income leads to a transition up the energy ladder from traditional fuels such as firewood, to modern fuel sources such as electricity (Hiemstra-van der Horst and Hovorka 2008). Many governmental policies in developing countries follow this theorised transition and include policies that promote household electrification and subsidies (Gaunt 2005; Haanyika 2006; Shackleton and Madubansi 2006; Goacutemez and Silveira 2010; Cook 2011; Gurung and Oh 2013). However this approach has been criticised as misguided and disjointed (Zulu 2010), as other factors such as energy preference and insurance against unreliable supply result in energy mixes as opposed to a full energy transition. Current woodfuel policies in sub-Saharan Africa are based on two false assumptions: fossil fuels and electricity can substitute biomass, and biomass energy use will reduce in the future (Owen et al. 2013). Woodfuels are used for cooking and heating whereas electricity is predominantly used for lighting and powering appliances, therefore it is difficult to substitute one for the other.

Charcoal production in sub-Saharan Africa tends to be dominated by environmentally unsustainable and largely informal practices, which are associated with "weak, misguided,

neglected, underdeveloped, disjointed, overly prohibitive, contradictory or non-existent woodfuel policies and laws, combined with poor enforcement and regulatory capacity" (Zulu and Richardson 2013, pp. 3). Mugo and Ong (2006) found that in East Africa, very few countries had specific charcoal policies and there were no specific institutions with a designated responsibility to manage charcoal production programmes; instead charcoal policies were covered under a combination of energy, forestry and agricultural policies. Only two countries – Sudan and Kenya – had specific legislation related to charcoal production. Other studies confirm the lack of political coordination (Angelsen and Wunder 2003; World Bank 2009; Zulu 2010), which not only contributes to deforestation and forest degradation, but also favours corruption and fails to recognise a source of national economic revenue from taxes.

There is a "lack of evidence-based decision making relating to tree-based bioenergy" (ICRAF 2015, pp. 5). Governments often lack implementation capacity, suffer from low level awareness, inadequate resource allocation and corruption at higher levels (Owen et al. 2013). Due to unsuccessful formal governance of woodfuels, reported contributions of forestry sectors to the national economy is marginal because many domestic woodfuels are informal and are not quantified in national statistics. As a result, forestry governance receives insufficient budgetary allowance, which can lead to limited "human, technical and enforcement capacities" in local forestry governance (Chidumayo and Gumbo 2013, pp. 7). Dovie et al. (2004) argue that policies should reflect the importance of woodfuel in the energy sector. Restricting access to forest resources can lead to increased income inequality (Kamanga et al. 2009) whereas opening woodfuel markets can deliver social, economic and environmental benefits to countries with dominant woodfuel sectors (Kituyi 2004). As such, it has been argued that restrictive policies "should be removed in a measured manner that produces more win–win situations, reflecting the economic importance of woodfuels and their ecologically sustainable supply while fighting poverty" (Zulu 2010, pp. 3729).

Challenges with formalising the charcoal sector

Informal customary practices often dominate local production of NTFPs and these should not be ignored when formalising the charcoal sector (Schure et al. 2013). Effective local participation has been shown to increase forest stock (De Miranda et al. 2010), increase incomes (Khundi et al. 2011) and increase access to social infrastructure such as health and educational institutions (Alio 2004 as cited in Schure et al. 2013). However, when a product becomes commercially valuable, formal mechanisms tend to be more effective in mitigating negative environmental pressures and ensuring social equity (Laird, Wynberg et al. 2010), as a result resource scarcity and pressures often stimulate institutional formalisation (Schure et al. 2013).

When devising formal policies, consultations with stakeholders tend to be the best way to gather information (Schure et al. 2013). Charcoal value chains involve a large array of stakeholders, however producers and harvesters are often rural and marginalised. Rural stakeholders don't necessarily have the coordination, knowledge or capacity to be included in decision-making structures and are thus rarely represented (Laird, Wynberg et al. 2010; Schure et al. 2013). Outcomes of formalising NTFPs typically favour stakeholders who have access to land, capital and technical capacity. This excludes poorer producers who instead rely on harvesting 'wild' resources (Wynberg et al. 2012). As a result, the formalisation of charcoal value chains risks marginalising rural livelihoods and favour urban elites instead (Ribot 1995; Schure et al. 2013). They can criminalise extraction practices, promote corruption (as ineffective coordination of policies gives rise to conflict, misunderstanding and confusion) and obstruct effective customary mechanisms (Arnold and Perez 2001; Laird, McLain et al. 2010). Therefore care needs to be taken to ensure that formalisation does not restrict actors' access to benefits (Jones et al. 2016). 'Informal' taxes amongst officials are deeply embedded in many African cultures; this ultimately obstructs the transition towards a formalisation of the system (Schure et al. 2013). Official government sanctions and the resultant informal nature of the charcoal sector breeds rent-seeking activities and additionally excludes a potential source of legitimate tax revenues, reduces market access and restricts the use of charcoal as a poverty reduction tool (Dewees 1995; Angelsen and Wunder 2003; Zulu 2010).

Even when formal systems do exist they can be difficult to access, which exacerbates problems with environmental management and reducing environmental degradation. For example, the uptake of improved production kilns is slow in sub-Saharan Africa. In Kenya, reports suggest that more than 90% of producers use inefficient kilns (Seidel 2008). In addition to high initial capital investment and a lack of necessary skills to construct and maintain kilns, reasons for a slow uptake are associated with governance issues, the legality of the sector and a lack of incentives for producers to convert to more efficient technologies (Kammen and Lew 2005; Seidel 2008; Malimbwi and Zahabu 2009; Janssen and Rutz 2012). Charcoal producers are unwilling to construct in situ kilns, as this may increase their vulnerability to both formal and informal regulatory measures, such as rent seeking, official taxes, and confiscation (Janssen and Rutz 2012). Schure et al. (2013) assessed the charcoal sector in Central and West Africa and found that the large quantities of 'illicit' charcoal production in sub-Saharan countries demonstrated difficulties in accessing formal systems. Initial capital investment (such as installation of charcoal kilns and obtaining permits) and a lack of information restricted certain stakeholders. Additionally the acquisition of a permit did not necessarily provide protection against informal taxes. As a result, stakeholders found it easier and more efficient to avoid formal mechanisms, thus the

regulation of charcoal production and its associated environmental impacts was hampered by inaccessible and inefficient formal systems.

Governance issues related to forest product value chains are still under-researched (Ingram, Levang et al. 2014). The charcoal sector in sub-Saharan Africa is complex and follows a pattern of unclear regulations, conflicting and confusing policies and exclusive environments that inhibit rural stakeholders from participating in formal systems. Although formalising charcoal value chains can lead to improved capacities for more effective resource management, there is a very real risk of marginalising poor rural stakeholders and pushing them further into poverty. The limited amount of quantifiable and empirical knowledge on the stakeholders, livelihood outcomes, organisation and governance of charcoal production and trade (Schure et al. 2013) undermines attempts to successfully move towards formal settings that are not only equitable and inclusive, but also pro-poor and pro-livelihood.

2.2.3 Environmental impacts of the charcoal sector

If produced and used sustainably, charcoal is a renewable source of energy that can contribute to reducing carbon emissions and greenhouse gases in sub-Saharan Africa and "has a high potential to become a climate-smart technology" (Iiyama et al. 2014, pp. 196). However, unsustainable harvesting techniques of forest products, such as those currently pursued by much of the charcoal sector in sub-Saharan Africa, may result in deforestation and forest degradation (Kirubi et al. 2000; Anang et al. 2011; Oduori et al. 2011).

Forest loss is associated with changes in climate regulation and affects regional cloud cover and precipitation (McGuffie et al. 1995; Kanae et al. 2001; Durieux et al. 2003), greenhouse gas emissions (Costa and Foley 2000; Gibbs and Herold 2007) and impacts global atmospheric circulation (Mabuchi et al. 2005; Snyder 2010; Schneck and Mosbrugger 2011). Deforestation and forest degradation[2] reduce biodiversity (Brooks et al. 2002; Foley et al. 2005; Pandit et al. 2007; Raoul et al. 2008; Loiselle et al. 2010; Trisurat et al. 2010), alter hydrological cycles (D'Almeida et al. 2006; Cui et al. 2007; D'Almeida et al. 2007; Jaafar et al. 2009) and impact elements of soil regulation such as erosion (Zheng 2005; Khormali et al. 2009), physical and chemical composition (Hajabbasi et al. 1997; Sahani and Behera 2001) and nutrient availability (Turrion et al. 2000; Mainville et al. 2006; Vera et al. 2007; Huth et al. 2012).

Across much of sub-Saharan Africa, where charcoal production is illegal, production processes tend to be mobile and temporary (Seidel 2008) and traditional kilns are reported to produce

[2] Deforestation is a decrease in the area covered by forest, whereas forest degradation is a quality decrease in forest condition, rather than a reduction of forest area (Lanly, 2003).

charcoal at low efficiencies in the range of 8-20% (Walubengo and Kimani 1993; Seidel 2008; Malimbwi and Zahabu 2009; Janssen and Rutz 2012) compared with improved kilns such as brick, steel, Casamance and Adam-retort, which produce charcoal at efficiencies of 30-75% (Kammen and Lew 2005; Seidel 2008; Adam 2009; Malimbwi and Zahabu 2009; Janssen and Rutz 2012). The inefficiency of traditional charcoal production practices increases the amount of wood used, and exacerbates forest degradation (Kirubi et al. 2000; Kammen and Lew 2005). Charcoal has a higher calorific value than the original wood equivalent (Wood and Baldwin 1985) and indigenous, slow growing trees are often targeted for harvesting because of local user preference, not necessarily because they have greater calorific values than alternative wood sources, such as Pine and Eucalyptus (Shackleton 1993; Zulu 2010). This often results in the over-harvesting of indigenous trees, which negatively impacts local biodiversity, species richness and ecosystem services (Shackleton 1993; Chikuni 1996; Kirubi et al. 2000; Ahrends et al. 2010). Across sub-Saharan Africa, charcoal production tends to be widely dispersed on a small-scale, predominantly in rural areas. As a result, its environmental impacts are challenging to monitor and control (Mugo and Ong 2006). In addition to forest degradation, charcoal production is also associated with air pollution, localised soil degradation and increased pressure on local resources (Hosier 1993; Monela et al. 1993; Kirubi et al. 2000; Pennise et al. 2001; Estela Gomez-Luna et al. 2009; Fae Gomes and Encarnacao 2012; Butz 2013; Chidumayo and Gumbo 2013; Minten et al. 2013).

Africa accounts for nearly 80% of charcoal-based deforestation in tropical areas (Chidumayo and Gumbo 2013) and woodfuel demands are “growing at a rate close to that of population growth” (Arnold et al. 2006, pp. 599). However, whether or not urban woodfuel demand is the primary cause of deforestation and forest degradation is highly debated as “deforestation is […] best explained by multiple factors and drivers acting synergistically rather than by a single-factor causation” (Geist and Lambin 2002, pp. 146). There are some that argue that charcoal production is the main cause of forest degradation on the African continent (e.g. Hosonuma et al. 2012), however others argue that woodfuel harvesting rarely causes long-term deforestation (Hiemstra-van der Horst and Hovorka 2009) and data suggest that woodfuel harvesting for the urban market impacts less than 2% of African wood areas (Modan, unpublished as cited in Chidumayo and Gumbo 2013).

Dovie et al. (2004) highlight the causal impact of wood harvesting on deforestation, Geist and Lambin (2002) argue that “in Africa the harvesting of fuel wood and poles by individuals for domestic uses dominates cases of deforestation associated with wood extraction” (pp. 145) and Luoga et al. (2000) demonstrate that woodfuel extraction is a major contributor to deforestation when urban demand is significant. In an attempt to reduce travel distance (travel distance can be used as a proxy for wood scarcity (Dovie et al. 2004)), urban harvesters transgress to live tree cutting as dry-wood becomes scarce (Hiemstra-van der Horst and Hovorka 2009). This results in

expanding trends of deforestation (Soussan et al. 1990; van der Plas and Abdel-Hamid 2005; Hiemstra-van der Horst and Hovorka 2009) where “waves of forest degradation […] emanate from major demand centres and expand into nearby forested areas” (Ahrends et al. 2010, pp. 14556). However, some ague that driving forces behind peri-urban deforestation are arguably from infrastructural development; even if woodfuel harvesting were to stop, peri-urban deforestation would still occur because ‘‘it is absurd to keep land under trees when it can be put to profitable uses’’ (World Bank 2001, pp. 25). Furthermore, urban woodfuel supplies often originate from agricultural clearance (SEI 2002; Arnold et al. 2006) and urban self-collectors tend to harvest semi-formally allocated rural land parcels, which limits urban and rural competition (Hiemstra-van der Horst and Hovorka 2009).

To summarise, the underlying drivers and causes of forest loss are complex, spatially variable and rise from a combination of socio-politico-economical and environmental factors. There is still debate over the significance of charcoal as a driver, and although not a globally consistent threat to deforestation, it is a regionally specific proximate cause that, when urban demand is significant, can lead to local levels (in the urban periphery) of forest degradation.

2.2.4 Socio-economic impacts of the charcoal sector

By 2030, over 12 million people will be involved in sub-Saharan Africa’s charcoal sector (Mwampamba et al. 2013). Forest derived incomes contribute considerably to rural livelihoods, providing a “means to accumulate assets and […] a pathway out of poverty” (Angelsen et al. 2014, pp. s13). Commercial forest products, such as charcoal, can “help lift the household out of poverty by functioning as a source of savings, investment, accumulation, asset building, and lasting increases in income and wellbeing” (Sunderlin et al. 2005, pp. 1386). Rising demand for charcoal has increased the opportunity for income generating activities, livelihood support, poverty alleviation and domestic market expansion (Monela et al. 1993; Ribot 1998; Arnold et al. 2006; Herd 2007; Kambewa et al. 2007; Malimbwi and Zahabu 2008; Openshaw 2010; Khundi et al. 2011; Agyeman et al. 2012; Jones et al. 2016). Charcoal production is particularly attractive to those with limited assets, as it requires minimal financial capital (Kambewa et al. 2007). Income generated from charcoal production has been shown to provide rural households with capital to pay for basic needs, invest in other livelihood activities such as agriculture, livestock and fishing, thus contributing to household income diversification (Schure et al. 2013) and provides an income source for women, independent of their husbands (Butz 2013; Jones et al. 2016). A recent study by Ozturk and Bilgili (2015) demonstrated that policies aimed at reducing biomass energy consumption will have negative impacts on economic growth in sub-Saharan Africa. Indeed, forest loss through energy production was a widely recognised issue that hampered key Millennium Development Goal (MDG) achievements (UN 2011). However, often the requirements to generate

substantial incomes from forest products (for example by commercialization and up-scaling production and trade) are often unattainable for poorer households, as this requires access to certain assets such as capital, tenure security and business contacts. By definition, the poor do not have access to these things (Belcher and Schreckenberg 2007).

It is estimated that forests provide important resources for rural populations, with "over 800 million people living in forests and woodlands in the tropics alone" (Chomitz et al. 2007, pp. xi). In providing timber and NTFPs such as food, medicine, housing materials, fodder and fuel, forests directly contribute to human wellbeing by delivering access to basic materials and income generation (Shackleton and Shackleton 2004; Shackleton, Shackleton et al. 2007; Timko et al. 2010; Paumgarten and Shackleton 2011; Shackleton, Delang et al. 2011; Mahapatra and Shackleton 2012; Wunder, Börner et al. 2014). However, unsustainable charcoal production practices can lead to forest degradation (see section 2.3) and the degradation of the forest resources that rural populations rely upon. Time spent producing charcoal can conflict with other livelihood strategies such as agricultural production and can lead to the outward migration of male workers, which further increases the work demand for those who do not leave (Luoga et al. 2000; Kambewa et al. 2007). Health issues such as respiratory illnesses are associated with production and consumption of charcoal (Dutt et al. 1995; Ellegård 1996; Tzanakis et al. 2001; Torres-Duque et al. 2008; Bautista et al. 2009; Johnson et al. 2011). The exchange of sexual favours between poor women and male charcoal sellers is linked to increases in HIV/AIDS (Kalipeni and Ghosh 2007) and informal charcoal sectors have been linked to the funding of extremist militant groups (Rembold et al. 2013; Nellemann et al. 2014).

2.2.5 Gaps in charcoal-livelihood literature

Although there is some evidence to suggest the significance of charcoal as a livelihood activity, there are still limited empirical studies that measure the benefits and tradeoffs (Arnold et al. 2006). An overview of charcoal studies in sub-Saharan Africa demonstrates some obvious trends, and outlines some noticable gaps in research.

The literature focuses on a narrowly defined set of livelihood outcomes. Inkeeping with the broader ecosystem valuation literature (e.g. De Groot et al 2012; Costanza et al 2014), there is an overzealous focus on monetary valuation, specifically on income generation and the vertical distribution of these benefits among actors at different stages in the value chain (Monela et al. 1993; Brouwer and Magane 1999; Kambewa et al. 2007; Khundi et al. 2011; Agyeman et al. 2012; Agbugba and Obi 2013). Horizontal distributon of economic benefits among different actors carrying out the same role in the value chain receives less attention (Ribot 1998; Knöpfle 2004; Herd 2007; Shively et al. 2010) and very few studies extend their analysis to include non-monetary

outcomes for actors (van Beukering et al. 2007; Zulu and Richardson 2013; Jones et al. 2016). Rather the emphasis is on the impact of access (power), social and political elements on economic outcomes (Ribot 1998; Brouwer and Magane 1999; Agbugba and Obi 2013; Minten et al. 2013; Schure et al. 2013). Analysis of trade-offs focus strongly on the environmental impacts, which are presented in a stark manner, such as the levels and rates of forest degradation (Monela et al. 1993; Luoga et al. 2000; Herd 2007; Kambewa et al. 2007; van Beukering et al. 2007; Agyeman et al. 2012). The consequences of the environmental degradation for individuals and communities are only described in a general fashion (Zulu and Richardson 2013) with little detail of how the impacts actors experience affect other livelihood outcomes. Analyses of the spatial and socio-political dynamics of the sector are beginning to understand the complexities associated with a highly politicised and economically valuable ecosystem service (Monela et al. 1993; Ribot 1993; Knöpfle 2004; Herd 2007; Kambewa et al. 2007; van Beukering et al. 2007; Khundi et al. 2011; Schaafsma et al. 2012; Butz 2013), but they are based on only a few empirical studies. Reliable income from natural resources can encourage people to manage the resource sustainably (van der Plas and Abdel-Hamid 2005; Anang et al. 2011; Sandker et al. 2012). Although the literature demonstrates the obvious economic benefits and environmental trade-offs, the less tangible direct and indirect benefits and trade-offs remain unclear. In order to improve the management of charcoal resources, a holistic understanding of charcoal's contribution to livelihoods is required, one that goes beyond a narrow focus on economic and environmental outcomes.

When observing 'who' the studies focus on, many examine the entire value chain, and attempt to include multiple actors involved in the sector (Monela et al. 1993; Ribot 1998; Brouwer and Magane 1999; Knöpfle 2004; Kambewa et al. 2007; van Beukering et al. 2007; Shively et al. 2010; Agbugba and Obi 2013; Schure et al. 2013; Zulu and Richardson 2013). The actors who receive most specific attention are producers (Luoga et al. 2000; Herd 2007; Khundi et al. 2011; Butz 2013; Jones et al. 2016), other groups such as transporters and retailers receive little, or no focussed attention (Minten et al. 2013), and only a few studies examine the characteristics (e.g. demographic indicators) of individual participants in the value chain. Studies indicate that across sub-Saharan Africa, men dominate the production and transportation of charcoal, with producers typically under 40 years of age (Herd 2007; Shively et al. 2010; Khundi et al. 2011; Agyeman et al. 2012).

The spatial scale of research studies is highly variable. They range from international (Schure et al. 2013; Zulu and Richardson 2013) to national (Ribot 1998; van Beukering et al. 2007; Openshaw 2010; Minten et al. 2013), sub-national regions (Shively et al. 2010; Khundi et al. 2011; Agyeman et al. 2012; Agbugba and Obi 2013) rural production zones (Luoga et al. 2000; Herd 2007; Schaafsma et al. 2012; Butz 2013; Jones et al. 2016), trade routes (Monela et al. 1993) and down to the urban consumption zone (Brouwer and Magane 1999; Knöpfle 2004; Bailis 2005; Kambewa

et al. 2007). However, the majority of urban consumption zones that have been studied are capital cities. Subsequently there is limited empirical evidence from urban areas with populations of less than one million, yet 75% of future urban growth in Africa is expected to take place in these regions (UN-Habitat 2014). These urban areas represent significant charcoal consumption zones and a source of income for an unknown number of people involved in the charcoal sector. There is inadequate evidence on the charcoal value chains of smaller urban areas and whether their actors, benefit distribution, resource demands, supply zones or governance structures are comparable to their larger counterparts.

2.3 Malawi's charcoal sector

The charcoal sector in Malawi reflects the situation across most of sub-Saharan Africa, where people are heavily dependent on charcoal for domestic urban consumption and where the supply of charcoal is unsuccessfully regulated. Malawi's national population exceeded 13 million people in 2008 (NSO 2009), continuing to grow at an annual estimated rate of 2.9%. Eighty-six per cent of the population is rural, however urban population growth is occurring at an annual rate of 5.2% and is concentrated in four major cities: Blantyre, Lilongwe, Mzuzu and Zomba (Government of Malawi 2010). Malawi's population is concentrated in the Southern region (185 people/km^2) (NSO 2009), an area where natural resources are sparse and dwindling. Forest and woodlands cover an estimated 3,237,000 hectares in Malawi, and deforestation occurs at a rate of 1% per annum; between 1990 and 2010, national forest cover declined from 41% to 34% (FAO 2010).

Charcoal is the main source of domestic fuel in urban areas, used by 44.6% of households (NSO 2012). "Malawi's energy markets face a heavily charcoal-dominated future" (MARGE 2009, pp. 87), with demand for charcoal predicted to increase regardless of whether the country's "ambitious electricity expansion scenarios are realised" (pp. 87). However almost all charcoal comes from indigenous miombo[3] woodlands (Zulu 2010), with 58% originating from government-owned Forest Reserves (Kambewa et al. 2007). An over-reliance on woodfuel for energy has been cited as a major cause of deforestation in Malawi (Government of Malawi 2010).

Charcoal demand fluctuates seasonally due to changes in temperature and rainfall as higher rainfall and lower temperatures increase the urban demand for charcoal (Holmes 2015). Nearly 95% of Malawi's electricity supply is provided by hydropower (ESCOM 2016) and heavy rainfall and drought are known to disrupt electricity supplies across Malawi (ACAPS 2015). In response to

[3] The vernacular name for species of *Brachystegia spp. and* similar trees found in Southern Africa (Coates Palgrave 2002).

the erratic supply of electricity and increased frequency of load-shedding, urban households increase their consumption of charcoal (Afriem 2015) during periods of high rainfall.

2.3.1 Formal governance of Malawi's charcoal sector

This sub-section presents and reviews the formal structures and processes associated with Malawi's charcoal sector. It subsequently discusses the implications of contradictions arising between them.

The National Forest Policy (1996)

The Policy provides the legal framework for the sustainable management of forest resources. It recognises the importance of woodfuels especially for rural livelihoods, the need to improve their sustainable production and supply and explicitly encourages sustainable commercial production of woodfuels. Specific objectives in section 2.3 aim to reduce restrictions on forest products, empower local communities to manage resources, and encourage the commercialisation of woodfuels. The Policy promotes the sustainable harvesting of resources through Village Natural Resource Management Committees (VNRMC), expands on the commercialisation of woodfuels and introduces the notion of market and pricing policy reforms to deliver incentives for tree planting for woodfuel. Simultaneously, the Policy has objectives related to reducing dependence on woodfuels as an energy source, with implementation of this particular objective under the jurisdiction of the Department of Energy.

Although the National Forest Policy provides an encouraging framework on paper, a review from the Biomass Energy Strategy suggests that practical implementation of the policy has been constrained by multiple factors, including "entrenched views amongst politicians and law enforcement authorities that woodfuels should not in fact be encouraged" (MARGE 2009, pp. 16).

The Forestry Act (1997)

The Act enacts recommendations set by the National Forest Policy. The Act creates a Forest Management Board and a Forest Development and Management Fund and procedures for creating co-management agreements, forest reserves, protected areas, customary land forests, afforestation and forest protection programmes and practices for the utilisation of forest products. Charcoal production in Malawi is permitted under the Forestry Act (1997), Section 81:

1. No person shall make or sell charcoal from indigenous timber or tree [sic] except pursuant to a licence issued under this section.

2. Upon application in the prescribed form, a licensing officer may, where the officer finds that the making of charcoal shall utilize plantation timber or indigenous timber or trees

> consistently with the applicable forest management plan or forest management agreement or forest plantation agreement, issue a licence to make charcoal in such quality and from such timber or trees as may be specified in the licence.

Since the Forestry Act in 1997, no indigenous forests have been certified for production. The first and only charcoal production permit in Malawi wasn't authorised until September 2015, took two years to obtain and charcoal will be produced as a by-product from an essential-oils company, from a plantation of *Corymbia citriodora*, a tree native to Australia (personal comm. Tanya Clarke, Kawandama Hills Plantation Director). Aside from the one licence, all other charcoal production and transportation in Malawi is illegal and unregulated.

A review of EU-funded co-management projects (improved forest management for sustainable livelihoods programme (IFMSLP)) highlighted that co-management was not well understood, primarily by non-local forest users. After the completion of the first phase in August 2009, project reports demonstrated that outsiders (people not involved in the co-management agreements) interpreted them to mean that the government had permitted the cutting of trees in forest reserves and incidences of leakage were reported in surrounding reserves (Mauambeta et al. 2010).

National Forestry Programme (2001)

The National Forestry Programme is a strategic framework of priorities and actions intended to improve forestry and livelihoods and aims to link policy and ground-level practices. The Programme goal is the "sustainable management of forest goods and services for improved and equitable livelihoods". In order to achieve this goal, the Programme has developed 12 strategies, three of which pertain to charcoal:

Support community-based forest management: The Programme recognises that high demands for woodfuel are driven by deficiencies in policy, markets, information and education. Tenure over trees is ambiguous and difficult to enforce and policy signals related to forest reserves are conflicting and misinterpreted. This inevitably has negative impacts upon forests. The Programme therefore aims to develop a broad range of village institutions and extension staff to improve collaborative management.

Improve individual smallholder livelihoods: The Programme recognises that rural households tend not to plant trees specifically for firewood, however there is a lack of information on forest management, and the Programme recognises that the ban on unlicensed commercial indigenous firewood and charcoal selling reduces incentives for individual smallholders to manage woodlands and indigenous trees. The Programme therefore aims to "increase the contribution of forest goods to improving smallholder livelihoods through better access to information, high quality

planting material and other inputs, small-scale contracting services, and finance for tree management" (pp. 34).

Influence wood energy supply and demand: The Programme recognises that the failure of past rural woodfuel programmes was due to an inadequate understanding of incentives, coping strategies, shifts to other fuel sources and an overestimation of people's willingness to pay for woodfuels. As a result, this strategy aims to "stimulate private investment in fuelwood production whilst at the same time keeping fuelwood prices affordable for consumers, by focusing regulatory and incentive instruments on specific characteristics of urban fuelwood markets [including charcoal], the tobacco industry, and micro-enterprises" (pp.40).

The Programme has been criticised generally for its implementation failure. Although the Programme defines roles for key players, these roles have not been disseminated amongst the necessary stakeholders and there are no mechanisms to ensure the accountability (e.g. report mechanisms) of implementation (Sibale and Banda 2004). Programme protocol is not widely applied in Malawi as a result of insufficient funding and staff (FGLG 2006), public awareness is low, which results in the persistence of illegal activities (Sibale and Banda 2004). By 2008, seven years after the programme was initiated, there were only a few emerging examples of VNRMCs (FGLG 2008). Mauambeta et al. (2010) argue that the Programme is only used as a reference document for preparing other documents, rather than a tool for implementing forest programmes. An assessment in June 2010 from a training workshop demonstrated that the process was not proactive (Mauambeta et al. 2010).

National Energy Policy (2003)

The Energy Policy provides an operational framework and guidelines on energy development, supply, use, distribution, pricing and industry governance. The Policy follows the Vision 2020, which advocates a reduction in the dependence on woodfuel, but acknowledges that in the short term woodfuels are necessary until alternative energy sources are available.

Woodfuels are mentioned throughout the policy, but mostly in a descriptive manner and with the overall aim to "reduce the dependence on firewood and charcoal" through the creation of "affordable and reliable alternative sources of energy" and "alternative incomes for households currently involved in firewood and charcoal vending (Part IV, pp. 56). The Policy directly addresses charcoal production, firstly by acknowledging that conversion rates are low and secondly, in Part V BSI section, by outlining the following specific actions:

"Government of Malawi will ensure the efficient utilisation of biomass in an environmentally sound and sustainable manner by promoting, through market priming activities:

i. the use of efficient charcoal carbonisation technologies

ii. the use of non-indigenous wood for charcoal production from sustainable sources

iii. the use of efficient biomass end-use technologies through civic education

iv. training and research in production, use and marketing of biomass technologies

v. stakeholder participation, including local communities, in producing and marketing biomass technologies. "

Although the Policy apparently encourages sustainable charcoal production, in practice this has not happened. The overall attitude towards woodfuels in the Policy is decidedly negative and heavily associated with 'the poor'. For example, under the second objective the Policy states "Government of Malawi notes that the availability and quality of biomass for energy is declining because of […] the energy needs of the urban poor […] Government of Malawi recognises that a more sustainable and realistic solution to the fuel wood crisis, which is strongly linked to poverty" (pp. 44-45). Reference to a 'fuel wood crisis' demonstrates that the Policy identifies with a 1970s crisis mentality and an association with 'the urban poor' carries negative connotations. Throughout the Policy, there is a negative poverty association with the use of woodfuels and a focus on a transition to 'modern' fossil fuels. This is clearly demonstrated in the final section: Energy Policy Priority Actions. The 'Priority Actions' of the National Energy Policy are targeted at coal, electricity, liquid fuels and gas supply. Renewable energy sources, which include charcoal and firewood, are not mentioned once.

The Energy Policy categorises charcoal and firewood under the same heading of biomass, stating: "for planning purposes, these resources are conveniently categorised". While it may be true that charcoal and firewood can be classified as biomass energy, they are two very different sources of energy and have different markets, value chains and end-users (as rural users almost exclusively rely on firewood). They also have different environmental impacts (for example firewood requires no processing) and separate legislation (Section 81 of forestry Act: Charcoal). The effectiveness of combining the two in the same category "for planning purposes" is therefore questionable.

National Environmental Policy (2004)

In the guiding principles, the Policy recognises that "sustainable fuel wood production may not only be economically efficient, but can also make a contribution to the arrest of global warming" (pp.39). Specific Policy goals related to woodfuels are directed at sustainable utilisation and management of natural resources, local community, non-governmental and private sector participation in natural resource management and "long term self-sufficiency in […] fuel wood and

other energy requirements" (pp.4). Strategies outlined in forestry and energy sections acknowledge that whilst pressures on woodfuels need to be reduced, woodfuels can and should be used sustainably. For this to happen, government policies should encourage their sustainable utilisation and promote efficient technologies and market strategies to create an enabling environment. The Policy also recognises that forest resources (including woodfuels) can be used as a mechanism for poverty alleviation, sustainable economic development and environmental protection.

National Adaptation Programmes of Actions (2006)

In its preamble, the National Adaptation Programmes of Actions (NAPA) states that Malawi is "highly vulnerable to the adverse impacts of climate change and extreme weather events" due to "an over-dependency on biomass for household energy" and "increasing deforestation to meet the increasing demands for energy".

NAPA ranks adaptation needs for urgency (high, medium, low) and identifies five urgent activities, of which two relate to woodfuels:

- Improving community resilience to climate change through the development of sustainable rural livelihoods;
- Restoring forests in the Shire River Basin to reduce siltation and the associated water flow problems.

Under the activity to improve community resilience to climate change, NAPA gives examples of sustainable livelihood interventions for coping with natural hazards such as: domestication of indigenous fruit trees and small animals, using agroforestry practices and water management, purification and utilization. Woodfuels (and charcoal) receive no mention. Under the second activity to restore the Shire River Basin, NAPA specifies a short-term output of "increased supply of trees that can be sustainably harvested for firewood".

NAPA identifies the Energy and Forestry sectors as requiring urgent attention. It focuses on local communities and improving livelihoods in order to reduce vulnerability. However in its delivery, it separates the harvesting of 'firewood' and the improvement of sustainable rural livelihoods. Rather than being included as a sustainable livelihood intervention, firewood harvesting is included as a short-term output to the restoration of the Shire River basin; charcoal receives no mention.

Biodiversity Strategy and Action Plan (2006)

The Biodiversity Strategy and Action Plan recognises that biodiversity is a "source of livelihoods and [an] engine of economic growth". However, woodfuels are not included in the Plan. The only specific mention of woodfuels is for descriptive purposes, e.g. "Poverty […] forces people to depend on natural resources for energy (woodfuel) […]. There has been extensive deforestation of Miombo woodlands outside protected areas for various reasons e.g. fuelwood for domestic purposes" (pp. 12). Whilst charcoal is under the jurisdiction of the Departments of Energy and Forestry, the Biodiversity Plan's lack of inclusion of woodfuels and the negative poverty association, demonstrates a pervasive perception that woodfuels (including charcoal) are seen as problematic, rather than a solution.

Malawi Biomass Energy Strategy (2009)

Historically, national policies have focussed on reducing Malawi's dependency on biomass energy towards greater reliance on alternative sources, primarily electricity. However, the Government recognised that simultaneously a more pragmatic approach to biomass energy was required. In 2007 the Government of Malawi requested assistance from the European Union Energy Initiative Partnership Dialogue Facility (EUEI-PDF) to help design of a national Biomass Energy Strategy (BEST). The objective was to:

> "Develop a rational and implementable approach to the management of Malawi's biomass energy sector through a combination of measures designed to improve the sustainability of biomass energy supply, raise end-user efficiencies and promote appropriate alternatives" (Section 1, 1.1).

The Strategy identifies that biomass is the most important fuel in Malawi, and woodfuels specifically are the most significant traded fuel, estimated to have had a market value of K15.5billion (USD $105 million) in 2008. The strategy found that the woodfuel business employs the equivalent of 130,000 full-time people in the growing, production, transportation and trade, over 80% of whom live in rural areas. The main, and indeed the most important conclusion of the strategy was that Malawi's energy markets face a heavily charcoal-dominated future and therefore it was necessary to design policies that encouraged this future in a sustainable manner. The strategy presents an overall objective to "ensure a sustainable supply of affordable woodfuels"(pp. 89), and has three specific objectives:

- Increase the supply of sustainable woodfuels;
- Increase the efficiency of energy use;
- Create the institutional capacity to manage the biomass energy sector effectively and implement the Strategy.

The Strategy states that the first (and most important) step for implementation is the acceptance of the research findings, and acceptance of their implications for the energy sector.

Growth Development Strategy (2011-2016)

The Growth Development Strategy is the second medium term national development strategy aimed at achieving Malawi's longer-term development objectives. The Strategy recognises that unemployment, interventions aimed at ensuring growth, fostering job creation, empowering rural communities, sustainable use of the environment and inadequate energy generation are important areas for development.

Throughout the 291-page document, the word firewood is written twice, the words biomass and charcoal are each written once and the words fuelwood and woodfuel do not appear. The words that have been written are only used for descriptive purposes, for example: "women tend to be more reliant on the environment than men for food and are primary gatherers of water and firewood" (35-36) "During the implementation of the Millennium Development Goals (MDG), the energy sector registered a number of Achievements […] training of 400 biomass briquette producers, […] as alternative energy sources to reduce dependence on charcoal and firewood" (pp. 37-38).

The lack of acknowledgement or mention of any specific woodfuel strategy demonstrates that the Growth Development Strategy ignores the woodfuel sector completely. Having been published only two years after BEST, which advocates for an acceptance of its findings, the Growth Development Strategy appears to disregard the Biomass Strategy completely. The Growth Development strategy fails to mention any direct woodfuel strategies.

2.3.2 Implications of Malawi's formal governance structures and processes

Key documents such as the National Forest Policy, Forestry Act, BEST, National Forestry Programme and the National Environment Programme offer constructive and promising policies for an environmentally sustainable charcoal sector that deliver renewable energy to domestic users and provide opportunities for income generation and employment. These documents demonstrate a positive and encouraging environment that forms the framework for developing a

successful charcoal sector. However, conflicting documents that include the National Energy Policy, NAPA, Biodiversity Strategy and Action Plan and Growth Development Strategy are far less forthcoming.

The proactive and productive implementation of charcoal policies suffers from entrenched political views amongst politicians and law enforcement policies that charcoal should not be encouraged (MARGE 2009). Views that perpetuate a 'crisis' mentality and that continue to put woodfuels in a negative light make it difficult to enact charcoal-friendly policies. Furthermore there are clear conflicts between certain policies, such as the Forestry and Energy policies, and the Growth Development Strategy and BEST, which make it difficult to assess the strategic direction for charcoal.

Currently, both Forestry and Energy policies and laws impinge directly on woodfuels, the former Department handling the supply side and the latter Department the demand side. Both departments fall under the same ministry, however this has failed to contribute to an integrated and holistic management approach (MARGE 2009). This separation is unique to woodfuels as it is not found in other energy sectors in Malawi, where importation, distribution and supply are all controlled by single entities and sets of legislation. BEST has called for an autonomous entity that exclusively manages the woodfuel sectors (MARGE 2009). This aims to improve the capacity of woodfuel management by reducing the conflicts found between the Departments of Forestry and Energy and multiple laws that regulate woodfuels. However, the Biomass Energy Agency is yet to be formed (SEI 2013).

No amount of legislation can have any impact if enforcement mechanisms are not in place. Environmental laws in Malawi are so poorly enforced, that they are considered almost useless (Mwafongo and Kapila 1999) and charcoal regulation lacks enforcement capacity. Improved enforcement requires resources, however the significance of the Department of Forestry (for example in comparison to HIV/AIDS and infrastructure development) is insufficient to provide the necessary funds (Kerr 2005; MARGE 2009). A lack of financial and authoritative capacity in the Department of Forestry and limited capacity make it challenging to successfully execute strategies. For example in 2007 the annual budget for one district with multiple staff and vehicles was K75,000 (equivalent at the time to USD 500) (FGLG 2008).

Sibale and Banda (2004) argue that unbalanced power relations have been major causes of failure to enforce forestry law in Malawi. For example, forestry extension workers struggle to enforce laws because despite the extension workers working for the Department of Forestry, they live with the same communities that they are supposed to regulate. The result is that illegal activities continue to occur in the communities and enforcement only targets middlemen, who tend not to be village members. Due to their visibility, transport routes (thus transporters) are more

frequently targeted than production areas (Sibale and Banda 2004; Kambewa et al. 2007; Zulu 2010). This inevitably only targets one aspect of the illegal activity.

The current formal governance of charcoal creates a disabling environment for compliance. The regulations and procedures to legally produce commercial charcoal are complicated, written in English, and few extension workers understand the legal and policy language used (Sibale and Banda 2004). Time constraints are critical to vulnerable people and a lack of clarity over roles and responsibilities prolongs the time it takes to approve management plans, which acts as a disincentive to apply for one (FGLG 2008).

2.3.3 Malawi's charcoal value chain

The data presented for Malawi's charcoal value chain is based on the only study undertaken in Malawi (Kambewa et al. 2007). The study examined the charcoal value chains of the four largest urban demand centres in Malawi: Blantyre, Lilongwe, Mzuzu and Zomba. The report suggests that these four areas account for 90% of the charcoal consumption in Malawi and estimates suggest that the sector generates an income for 92,800 people. The report presents a highly commercial product that is produced almost exclusively for urban-based consumers and although unregulated, the urban areas have designated charcoal markets and sources. Over half (58%) of charcoal in Malawi is sourced from protected areas, whilst the rest is from customary lands (39%) and a remaining 2% originates from Mozambique (1% is unaccounted for).

The study identifies three channels for charcoal: Producer to consumer, producer to buyer to consumer and producer to primary buyer to secondary buyer to consumer. There are three types of producers: small scale subsistence producers who produce less than 30 bags per month and account for 42% of production; medium scale business orientated producers who do not have access to large sums of capital, produce 30-100 bags per month and account for 25% of production; and large scale business producers who have access to considerable capital and account for 33% of production. Small-scale producers tend use charcoal as coping mechanism against food and financial insecurity. Many small and medium scale producers were contracted by urban-based traders and paid upfront. On average, producers earned 20-33% of the final retail price. Wholesalers/transporters bought charcoal from producers, and transported it to wholesale or retail markets or straight to consumers by headload, bicycle or motor vehicle. Kambewa et al.'s (2007) study did not include those using public modes of transport, therefore this group of actors remain undocumented in Malawi's value chain literature. The scale of wholesalers ranged from transporting a few bags, up to 500 at one time, with larger wholesalers requiring significant capital inputs. Wholesalers were estimated to receive 20-25% of the final retail price. Charcoal vendors sell door-to-door, from their own houses and at retail markets and retain 25-33% of the

final retail price. Informal taxes in the form of bribes account for 12-20% of the final retail price, and city assemblies were recorded collecting market fees even though charcoal is an unlicensed product.

2.3.4 Charcoal-based livelihoods in Malawi

The Department of Forestry's de facto ban criminalises the charcoal market and the livelihoods of approximately 92,800-200,000 people employed by the industry, 80% of who are rural (Kambewa et al. 2007; MARGE 2009). Estimates suggest that the urban charcoal industry is worth in excess of USD $40 million, and accounts for about 3.5% of the national gross domestic product (GDP) (Kambewa et al. 2007). Zulu (2010) demonstrated that charcoal was rarely collected free of charge, government enforcement in harvesting areas was almost non-existent and the charcoal ban promotes political corruption in Malawi.

Failure to acknowledge the importance of biomass energy perpetuates demand for illegal and unsustainable energy sources. Charcoal producers in Malawi are unable to pursue their trade legally and therefore have little incentive to invest in sustainable management, for example by planting trees, as their conversion to charcoal is illegal. This does not mean that producers are unable to run successful businesses, as it is clear by the amount of revenue and people employed in the sector that this is already happening. It has been demonstrated in other countries that legalising, or rather "professionalising" the charcoal sector, by means of forming producer groups, improving infrastructure and a formal tax system may provide incentives for sustainable production (Schure et al. 2013). It is clear that Malawi's current situation is not working, given that only one management plan has been enacted. Not only does the current situation encourage non-compliance, but it also stops the government receiving any form of legal income (FGLG 2011).

In Malawi, unreliable and inefficient electricity supply has resulted in increasing dependency on charcoal in urban areas. This coincides with contradictory government policies and institutions, which fail to reflect the significance of woodfuels and leads to poor forestry enforcement capacity, conflicting and unrealistic regulations and corruption amongst officials. Comprehensive policies for woodfuels require substantial inputs of time, funds, research and inclusive consultation with all stakeholders. However, this level of investment is extremely rare (Laird, Wynberg et al. 2010). The inevitable outcomes are inconsistent and confusing legal mechanisms that lack clarity about "which laws and government departments have jurisdiction over these products and activities" (Laird, Wynberg et al. 2010, pp. 356) and fail to acknowledge the importance of charcoal as a domestic energy source.

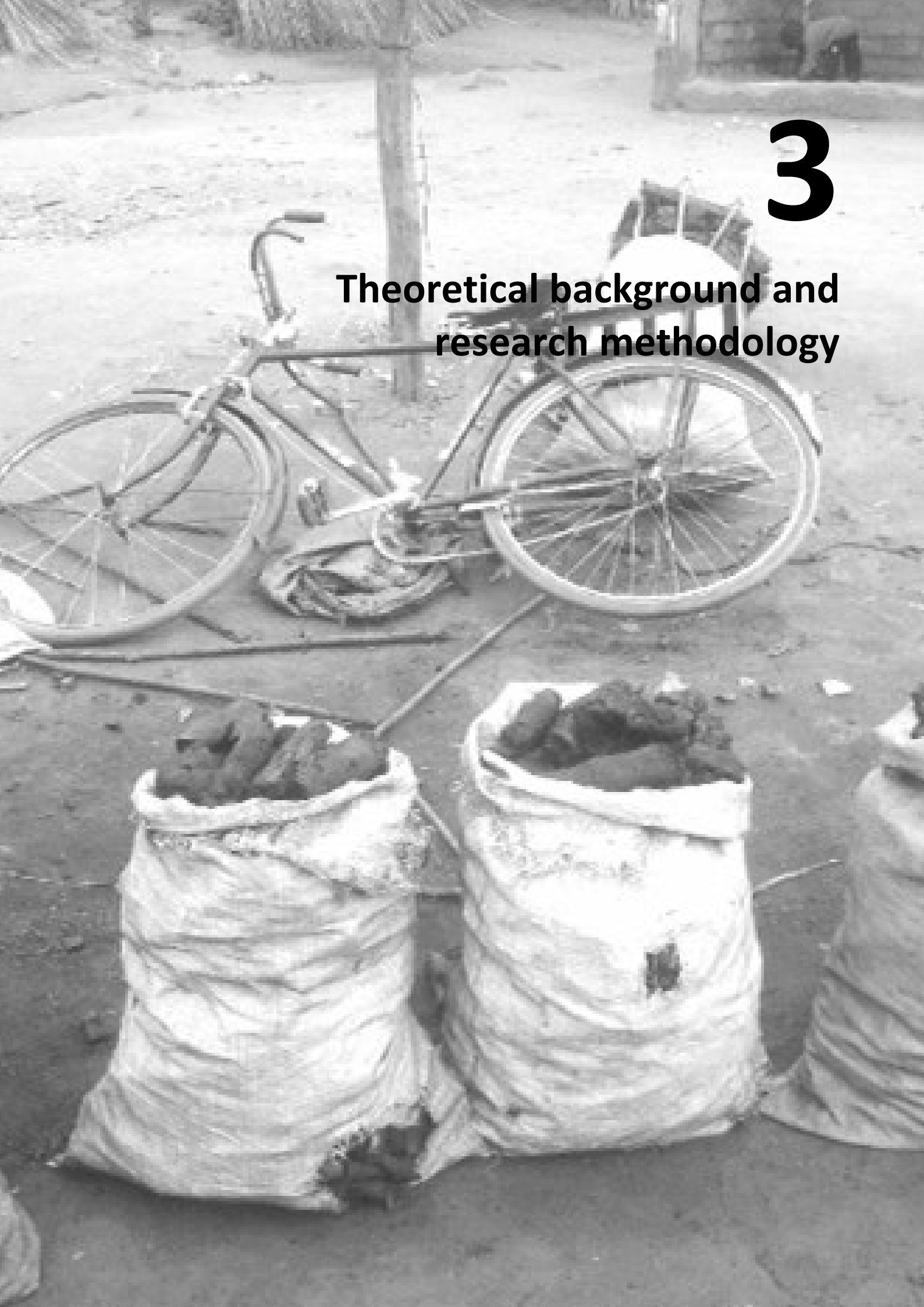
2.4 Research expectations

Based on the existing literature presented above, Table 2.1 reflects on the expected research findings, with regard to the research questions. Chapter 7 will relate back to these expectations, in order to elucidate the research's original contribution to knowledge.

Table 2.1: Research expectations

Research Question	Expected research findings
What are the rural components of the charcoal value chain, and what are the characteristics of these actors?	– Three types of producers working at a small, medium and large-scale; – Men dominate the production process; – Producers use mobile, temporary and inefficient kilns; – Producers are generally unorganised; – Small-scale transporters supplying urban markets operate by head load or on bicycles; – Large-scale transporters supplying urban markets are dominated by an urban-based elite, who typically control motorised access, are politically connected and have access to substantial capital; – Transportation of charcoal is largely dominated by men; – Market sellers are typically women and urban-based; – Vested interests and rent seeing activities (e.g. bribes) within formal structures are common within the value chain.
Why do people participate in the rural charcoal value chain?	– High demand for charcoal due to unreliable and inefficient electricity supply and increasing trends in population growth and urbanisation; – Increased opportunity for rural income generation and livelihood support; – A coping mechanism to deal with food and financial insecurity; – Lack of alternative income generating opportunities in the study region; – Minimal financial capital required to produce charcoal makes it an attractive income generating activity for those with limited assets.
What are the benefits and trade-offs from participating in the rural charcoal value chain?	– Charcoal production and transportation provide important income generating opportunities for rural populations; – Unequal power relations give rise to uneven benefit distribution, with the more power and large-scale actors accruing the highest profits; – Capital generated from charcoal production and transportation is used to afford basic needs and is invested into other livelihood activities;

	– Charcoal income may provide an important income source for women, independent of their husbands; – Time spent transporting and producing charcoal may conflict with other livelihood activities, such as farming; – Regulations are enforced more frequently along transport routes than in production areas; – Unmanaged production practices give rise to forest degradation, with areas of degraded forest expected to expand in 'waves', originating from the urban periphery; – Producers may target specific tree species due to consumer preference; – Degraded forest resources will create environmental trade-offs, negatively impacting rural livelihoods; – Punitive enforcements and corruption may undermine and marginalise rural livelihoods.
What are the constraints to charcoal-based livelihoods?	– Weak institutional capacity caused by conflicting policies that perpetuate the 'crisis' mentality; – Regulating authorities lack fiscal empowerment; – High barriers to formal production practices undermine attempts to formalise the sector; – Punitive, top-down approach to governing Malawi's charcoal sector further marginalise poor, rural stakeholders; – Existence of corruption and vested interests amongst enforcing bodies obstructs the development of policy reforms (e.g. formalisation); – Ineffective forest protection measures; – Increasing trends in forest degradation; – Lack of information on the charcoal sector, value chain actors and governance issues restricts the development of equitable and effective policies.



3

Theoretical background and research methodology

Chapter 3: Theoretical background and research methodology

Before presenting the research methods, sections 3.1 – 3.2 first provides the reader with an overview of the conceptual frameworks, the methodological approach, sampling design and a particular suite of techniques used in the methodology: Rapid rural appraisals.

3.1 Bringing a livelihoods perspective to the charcoal sector: A conceptual framework

Charcoal livelihoods are complex socio-ecological systems that require a multidisciplinary approach for analysis. Tanner et al (2015) argue that a " livelihoods perspective places people at the centre of the analysis, located within, rather than dominated by, ecosystems, technologies, governments, markets, experts, or resources" (pp. 24). In order to achieve this distinction of a people-centred analysis, this research combines a Value Chain Analysis (VCA) with the Sustainable Livelihoods Framework (SLF). Both approaches incorporate aspects of a livelihoods perspective, but neither is independently appropriate to analyse the charcoal sector from a livelihoods perspective. The initial section of this chapter presents the theory of VCA and the SLF and discusses their strengths and weaknesses for examining the livelihoods of those involved in the charcoal sector. The chapter subsequently presents a combined framework (adapted from Schure, 2014) in order to understand the scale and scope of the charcoal sector, from a livelihoods perspective.

3.1.1 Value chain analysis

Value chains are defined as "the full range of activities which are required to bring a product or service from conception, through the intermediary phases of production, involving a combination of physical transformation and the impact of various producer services, delivery to final consumers and final disposal after use" (Kaplinsky and Morris 2001, pp. 4). There are similar concepts and definitions, such as 'commodity chain' and 'supply chain', however the term 'value chain' is widely adopted because it is perceived as the most inclusive concept to describe and analyse the full range of possible activities, processes, trade routes and products (Gereffi et al. 2001).

Ribot (1998) states that VCA "is a tool for understanding who benefits from natural resources, how they benefit, and how those patterns of benefit distribution might be changed" (pp. 308).

VCA offers a framework to analyse activities and processes along the chain, allows economic processes to be mapped and categorised and aids the understanding of how, why and where actors such as individuals, institutions and households are positioned (Kaplinsky and Morris 2001; Schure et al. 2013). Non-timber forest product (NTFP) studies have used VCA and have recognised that the scale of trade extends beyond forest-based communities and includes urban, regional, national and international beneficiaries (Jensen 2009). Value chain analysis is both a descriptive and an analytical tool that can provide information to policy makers about local and national economies and opportunities that identify points of entry for policy mechanisms (Shively et al. 2010). It focuses on the vertical element of a supply chain, analysing flows of resources, finance, knowledge, power relations and information between actors (Bolwig et al. 2010)

There are however limitations to the VCA approach. Little attention has been paid to integrating the 'horizontal' (within the same actor node) and 'vertical' (between actor nodes) aspects, which results in the failure to anticipate how local level influences such as social relations, environment and local histories impact the value chain. The narrow focus only on the specified value chain also fails to incorporate external influences that can impact the value chain (Bolwig et al. 2010). Arguably, a VCA should not only focus on power relations or the direct benefits of actors, but should consider the full range of livelihood activities and networks upon which participants and their communities depend (Bolwig et al. 2010).

3.1.2 Sustainable livelihoods approach

The sustainable livelihoods approach is a hybrid of complex ideas and practices that connect different perspectives from different fields of rural development, particularly across the natural and social sciences (Scoones 2009). Although it has been around for more than 50 years, the environment and development movement in the 1980s and 1990s pushed the livelihoods approach into the limelight (Scoones 2009). The term 'livelihood' first appeared in the Brundtland Report in 1987, and was subsequently modified by Chambers and Conway (1992) which was seen as the starting point of the sustainable livelihoods approach:

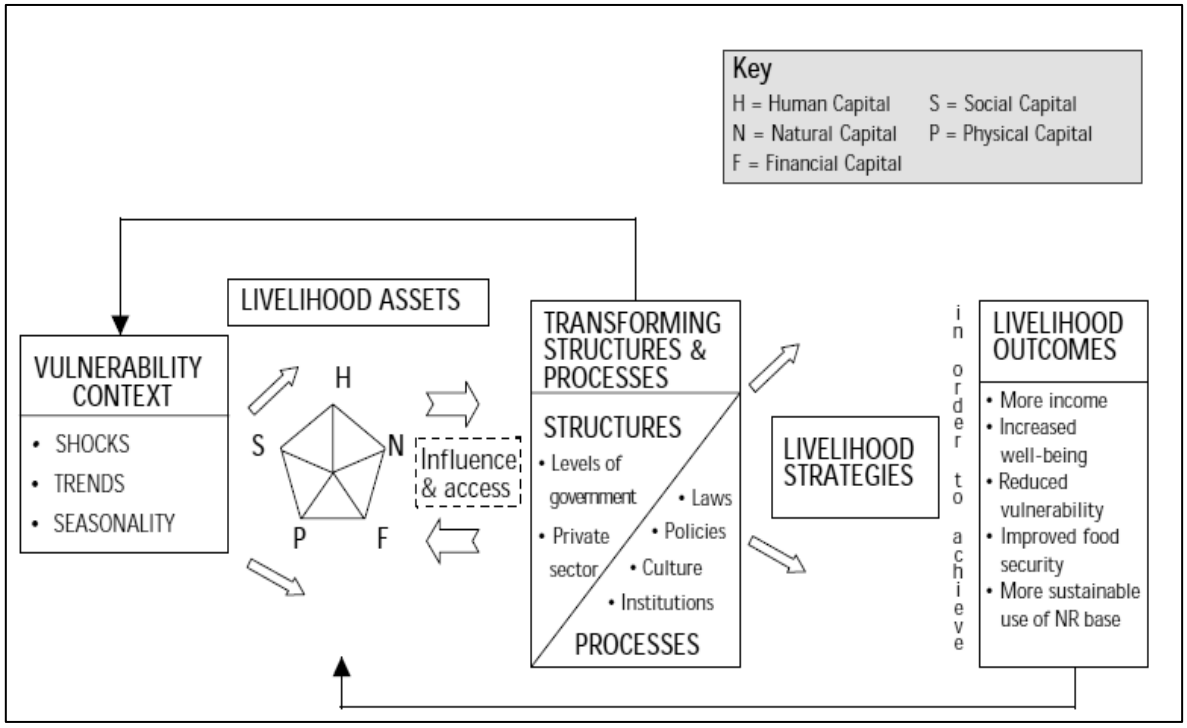
"A livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living: a livelihood is sustainable when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels in the short and long term" (pp. 7).

This interpretation of sustainability relates strongly to definitions of resilience presented in section 2.1.1 (Sallu et al. 2010), thus linking the sustainable livelihoods framework with the concept of livelihood resilience within socio-ecological systems.

In the 1990s, the Institute of Development Studies was commissioned by the British government to develop an approach to analyse livelihoods. This resulted in a diagrammatic checklist (Scoones 2009). This framework was adopted by the Department for International Development (DFID), who produced their own 'asset pentagon' framework: The Sustainable Livelihoods Framework (Figure 3.1).

Livelihoods are typically made up of a diverse combination of subsistence and income-generating activities and strategies. These depend on an individual's skill set, social relations and abilities (in terms of access and influence) and are influenced by external drivers which include an overarching context of vulnerability (seasonality, shocks and trends) and transforming structures (levels of government and private sector) and processes (institutions, culture, laws and policies). People require inputs (which the SLF describes as five 'assets': Human, Physical, Natural, Social and Financial) to generate outputs (livelihood strategies) in order to successfully achieve livelihood outcomes (aspects such as poverty, employment, wellbeing and sustainability). The cyclical nature of the framework implies that livelihood outcomes influence inputs, which reflects the feedback and interconnectedness entrenched in livelihoods.

Figure 3.1: Schematics of the Sustainable Livelihoods Framework (DFID 1999)



Although the SLF has been widely adopted, it is not without criticism. The use of language has been criticised as confusing and open to interpretation (Ambrose-Oji 2004), the framework itself has been viewed as too complex (Ashley and Hussein 2000; Ellis 2000) and issues such as social differences (e.g. gender, class, ethnicity), culture, power relations and politics are not included within the framework. There have been calls for the inclusion of political and cultural capitals into the framework (Ashley and Hussein 2000; Baumann and Subir 2001; Adato and Meinzen-Dick 2002).

When applying the SLF to examine NTFP-based livelihoods, there are additional criticisms. NTFP literature highlights the need to understand access to markets and resources in order to explain the benefits from forest products (Belcher and Schreckenberg 2007). The SLF addresses availability to resources through its focus on 'natural' assets, access to which is mediated by local institutions such as tenure arrangements and livelihood assets such as good health and the physical ability to access the resource. Schure (2014) argues that market access is less tangible, even though access to markets is a poverty dimension mentioned by Chambers (1995). A key criticism of the SLF therefore, is the unclear role of markets within it.

Scoones' (2009) paper highlights four challenges: 'the need to articulate livelihoods perspectives with concerns of knowledge, politics, scale and dynamics" (pp. 183). Under the 'scale' challenge, Scoones points out that a VCA is important "for looking at processes of change across scales" (pp. 188). He also argues that "to enrich livelihood perspectives further, there is a need to be more informed by an explicit theoretical concern with the way class, gender and capitalist relations operate, asking up-front who gains and loses and why, embedded in an analysis informed by theories of power and political economy" (pp. 187).

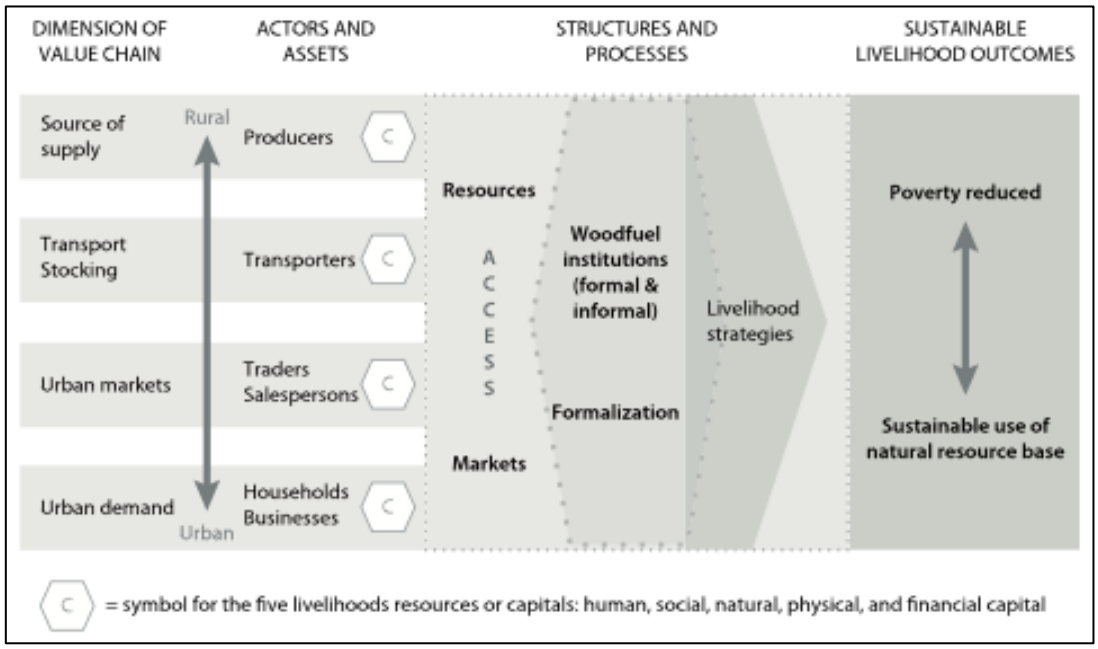
3.1.3 Combining value chain analysis and the sustainable livelihoods approach

Drawing on Scoones' (2009) challenges, combining VCA and the SLF can give a more comprehensive understanding of forest products, their market structure and how these markets interact with livelihood strategies (Kanji et al. 2005). This research draws on both a VCA and the SLF and incorporates their strengths in order to fully understand the scale, scope, benefits and trade-offs associated with charcoal-livelihoods. The SLF brings in components of governance, resources, and ecosystem services, focusing on people and production systems whereas the VCA focuses on market components, examining the role of actors and their benefits, market opportunities and power relations (Ribot 1998; Gereffi et al. 2001; Kaplinsky and Morris 2001; Humphrey and Schmitz 2004; Kanji et al. 2005). The VCA establishes the vertical aspects of the value chain, for example in terms of quantifying product flow, market pricing and distribution of benefits along the chain. The addition of the SLF integrates horizontal aspects and issues of how

power and access are influenced by other factors (e.g. gender, ethnicity etc.), how other livelihood strategies, networks and assets influence actors' participation in the value chain and their livelihood outcomes.

Combined SLF-VCA frameworks have been used by others to examine different attributes of rural livelihoods. Examples include integrating poverty, gender and environmental concerns into global value chains (Bolwig et al. 2008; Riisgaard et al. 2010), assessing the effects of trade liberalisation in the cashew sector on the livelihoods of smallholder farmers in Mozambique (Kanji et al. 2005) and the impact of adverse incorporation and social exclusion on chronic poverty (Ponte 2008). Schure (2014) adopted a combined VCA-SLF framework to examine poverty reduction outcomes, sustainable resource use and the role of institutions in market and resource access in the urban woodfuel (both firewood and charcoal) markets in the Congo Basin (Figure 3.2).

Figure 3.2: Livelihoods-Woodfuel Chain- Framework (Schure 2014).



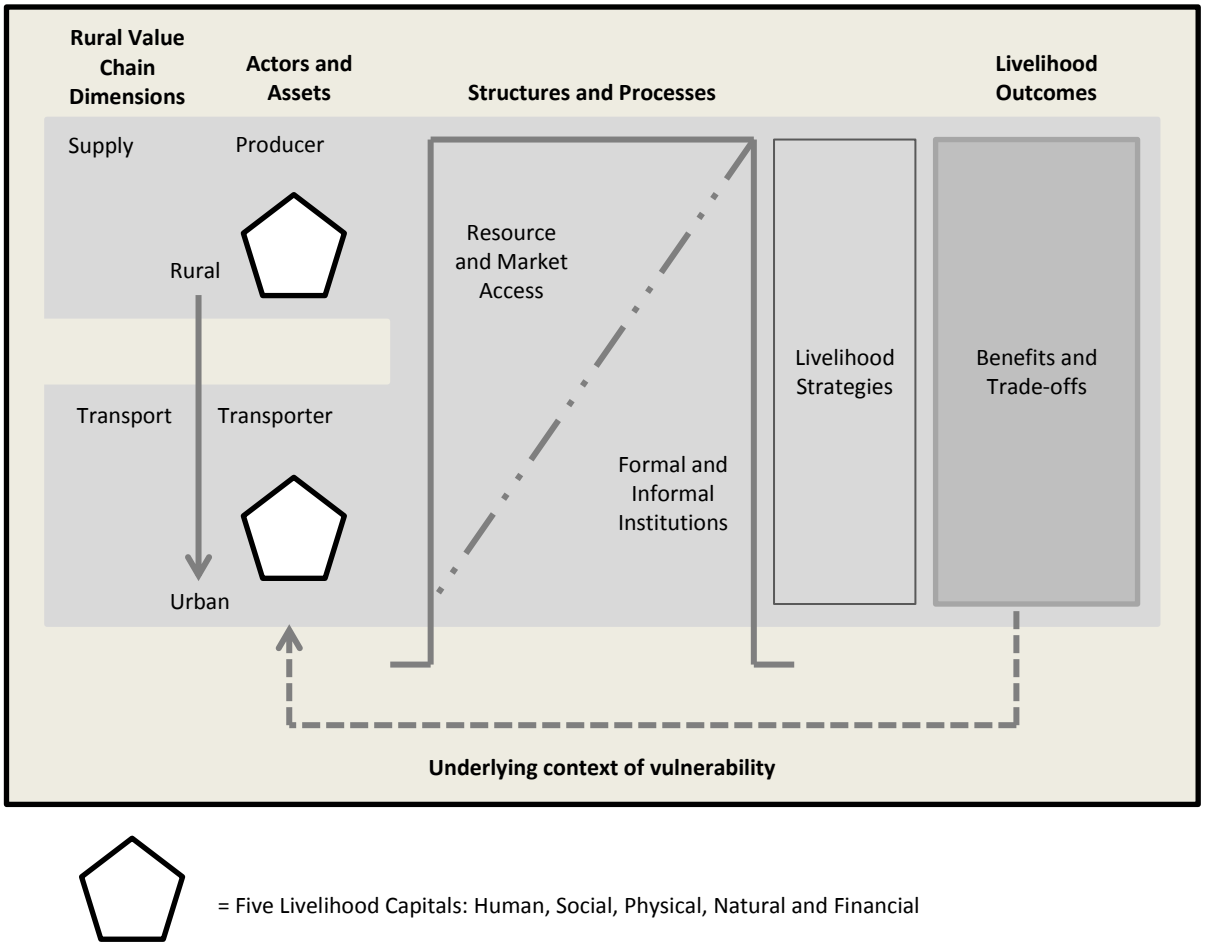
Disaggregating analyses by different factors, such as stakeholder groups, is essential in identifying how different groups use and access resources, and examining the livelihood outcomes of those involved (Dawson and Martin 2015). 80% of Malawi's charcoal value chain actors are rural (MARGE 2009). Within NTFP governance, rural stakeholders are rarely represented in formal decision-making structures (Laird, Wynberg, et al. 2010), which increases the risk of marginalising and pushing them further into poverty. The combined framework adapted for this research attempts to avoid this risk by explicitly focussing on the livelihood outcomes (with specific

emphasis on benefits and trade-offs) of the rural stakeholders of Zomba's charcoal value chain: the producers and transporters (Figure 3.3).

This research adapts Schure's (2014) Livelihoods -Woodfuel Chain- Framework to examine livelihood outcomes of Zomba's charcoal sector. Given the preponderance of rural participants in Malawi's value chain, this adaptation reduces the scale of the value chain dimensions to only focus on the rural actors. It situates charcoal-based livelihoods within a context of underlying vulnerability (represented by the outer box) and changes the livelihood outcomes to focus on benefits and trade-offs, which feed back into actors' assets via the dotted line. Following the SLF framework (DFID, 1999), the 'livelihood strategies' are separate from the 'structures and processes' dimension, which subsequently flow into (thus influence) the underlying context of vulnerability.

Linking the SLF with a VCA provides a more inclusive conceptual framework for examining producers' and transporters' livelihood benefits and trade-offs, and works as both a descriptive and analytical tool. It helps to map the charcoal value chain, in terms of actors and their trade dimension locations, their livelihood assets and the strategies they pursue. Integrating a VCA and the SLF sets the charcoal sector within the socioeconomic context of charcoal-based livelihoods. This captures the dynamics of a sector that not only traverses forest-city boundaries, but also acknowledges the influence of external drivers such as underlying vulnerability, structures and processes. Combining frameworks links resources and markets, embraces formal and informal structures and processes, which are common to forest-product markets. It allows examination of how these influence actors' access to resources and markets and in turn, how this affects their livelihood outcomes.

Figure 3.3: Charcoal livelihoods-value chain framework



3.2 Methodology

3.2.1 Mixed methods approach

Charcoal is a complex issue combining social and ecological elements, and therefore benefits from a mixed methods approach as this has greater potential than either quantitative and qualitative research methods alone to address complex questions (Hesse-Biber 2010). A mixed method approach makes use of two or more methods and generates both qualitative and quantitative data (e.g. Creswell and Plano Clark, 2007; Greene 2007; Teddlie and Tashakkori, 2003). No single method can deliver a full picture and one method can overcome the weaknesses of others (Erzberger and Prein 1997; Bryman 2006). This research employs a single paradigm stance, through the use of a pragmatist research philosophy (Teddlie and Tashakkori, 2003). When investigating the social elements of the charcoal sector, mixed methods help to address the power dynamics of traditional knowledge (Hesse-Biber 2010) by accessing different voices and interactions among social identities and advocating for marginalised social groups such as women, ethnic minorities, the poor and those with disabilities (Mertons 2003 as cited in Creswell 2009).

Furthermore, a pragmatist approach offers a "practical and outcome-orientated method of inquiry that is based on action and leads, iteratively, to further action and the elimination of doubt" (Johnson and Onwuegbuzie 2004, pp. 17).

One particular benefit of a mixed methods approach – triangulation – is important as a means of validation (Jick 1979). Its purpose is to "obtain different but complementary data on the same topic" (Morse 1991, pp. 122) and is a "strategy that will aid in the elimination of bias" where the "independence of methods and traits can be established" (Mathison 1988, pp. 13). Triangulation offers a chance to evaluate the validity of data at the collection stage, for example by clarifying responses with additional questions and cross-examining data sources (Erzberger and Prein 1997; Yauch and Steudel 2003). This research uses two types of triangulation: 1) combining methods to study the same phenomenon and 2) using multiple sources of data to examine different aspects of a phenomenon (Denzin 1978).

3.2.2 Sampling design

Rural areas can be costly to survey, both in time and resources. Target populations are scattered, access to populations is difficult, the variability of factors to study is unknown and the sample population size for one topic may not suit the size of others (Carruthers and Chambers 1981). Compromises with sampling size and scope have to be made; this results in purposive sampling procedures, as opposed to random (ibid.). Purposive sampling techniques involve selecting specified characteristics of participants as opposed to a random selection (See Teddlie and Yu 2007 for a detailed explanation of purposive sampling) and includes:

- "Sampling to achieve representativeness or comparability;
- Sampling special […] cases- employed when […] a specific group of cases is a major focus of the investigation;
- Sequential sampling, which uses the gradual selection principle of sampling when […] the sample evolves of its own accord as data are being collected" (Teddlie and Yu 2007, pp. 82). This includes snowball sampling (Marshall 1996) whereby participants recommended potential contacts for additional participants.

This research employed purposive sampling. Participants were specifically targeted based on their livelihood activity, skills or the knowledge required (Marshall 1996), and some participants were contacted through existing participants (snowballing). Snowball sampling is a technique that creates a sample, through the process of references made by participants who share characteristics particular to the research (Lopes et al 1996). It enables the researcher to approach

participants with credibility garnered from the introducing party (Denscombe 1997; Streeton et al. 2004). Snowball sampling (or chain referral sampling) is particularly applicable when "the focus of study is on a sensitive issue, possibly concerning a relatively private matter, and thus requires the knowledge of insiders to locate people for study" (Biernacki and Waldorf 1981, pp. 141). It has been widely applied when contacting 'hidden' populations or deviant groups, such as groups involved in illegal activities, for example drug abuse (e.g. Lopes et al. 1996) and homosexuality, in countries where it is illegal (Ehlers et al. 2001). It is therefore relevant for this particular study, given the illegal status of the charcoal sector in Malawi.

Rural appraisals

Gathering data in developing countries is challenging and there are many limitations with formal research methods. Interviews are time consuming, the concept of what a household survey is differs between places and postal surveys are often impossible (Loader and Amartya 1999). Certain aspects of the charcoal sector occur in rural settings and involve rural populations so in order to understand rural problems, a systems perspective with a multi-disciplinary approach to investigations is preferable (Carruthers and Chambers 1981).

Traditional social research is associated with many shortcomings. Longer in-depth studies incur high costs, delayed timeliness, inaccurate data and often policy has been determined before a survey is processed or analysed (Carruthers and Chambers 1981). 'Quick and dirty' surveys are accompanied by an 'anti-poverty' bias which results in un-representative data, emphasises the visible, neglects complex social relationships, underestimates the prevalence of poverty and only studies one point in time which fails to deliver any trend analysis (Carruthers and Chambers 1981; Chambers 1981). Chambers (1981) identifies five anti-poverty biases:

- *Spatial*- Urban, tarmac and roadside bias. Poorer people are often out of site, away from urban areas;
- *Project*- Outside links are channelled from urban areas to locations with projects. The poorest tend not to be supported by projects and are therefore neglected;
- *Personal contacts*- Contact tend to be with the more powerful, men rather than women, those who have not been forced to migrate, users of services and adopters of technologies. The bias is against perceiving the extent of deprivation;
- *Seasonal*- Wet seasons in the tropics are hardest for the poorest people (high disease prevalence, hard work, food shortages). It is also the most difficult time to travel in. The bias is against viewing the worst of times, and only studying when things are better;

- *Politeness and protocol*- Courtesy and convention can deter away from the poorest people. Short timings also mean that the poorest people are often the last in line.

Dissatisfaction with anti-poverty bias has led to the development of new methods. Rapid rural appraisals (RRAs) and their later incarnations into participatory rural appraisals (PRAs) and participatory learning and action (PLA) are similar approaches that attempt to facilitate the study and self-examination of communities.

Carruthers and Chambers (1981) explain that efficient rural appraisals are informal and a variety of methods can be chosen on the run, when and as appropriate. Combining methods helps to see the research topic in different ways and it adds dimension. Additionally, individual research problems have their own mix and sequence of methods that cannot always be foreseen. Therefore, a strength of rural appraisals is that they allow for flexibility whilst in the field. The informality of rural appraisals is key to generating good rapport with participants. Good rapport implies the trust, agreement and cooperation required to gain access to information (Mosse 1994). Visual and verbal methods have their own strengths and weaknesses and the combination of the two is always stronger than either alone (Chambers 1994b). However, sometimes neither approach can offer a reliable response, so direct observation can help resolve and confirm responses (Chambers 1981).

All three approaches (PRA, RRA, PLA) focus on visual representations, observation and sharing knowledge (Chambers 1994a; 1994b; 1994c; 2007) and they share similar techniques and principles such as triangulation and offsetting biases. However, they differ slightly in their purposes. The data gathered from RRAs are predominantly elicited, extracted and dominated by outsiders and expect no outcome (Chambers 1994b), whereas data and methods in PRA and PLA attempt to enable local people to “share, enhance and analyse their knowledge of life and conditions, to plan and to act” (Chambers 1994b, pp. 1437). PRA has become “part of everyday development practice” (Cornwall and Pratt 2010, pp. 265) and communities analyse their own situations, produce their own data, analyses and solutions in their own situations (Cornwall and Pratt 2010; Ricaurte et al. 2013; Atangana et al. 2014). Introduced by the International Institute for Environment and Development (IIED) in 1995 in their RRA Notes Issues 1–21 (1988–94), the term PLA has been used to describe PRA, but it is broader and includes similar approaches and techniques. For a detailed overview of the progression from RRA to PLA see Chambers (2007). As this study was predominantly extractive in nature and not embedded in an action process, an RRA research approach was taken.

3.3 Research methods

This final chapter section explains how the conceptual frameworks link into the research methods, outlines the study site and finally describes the methods used in the research.

3.3.1 Linking the conceptual framework to the research methods

Kanji et al. (2005) summarise the advantages of combining a VCA and the SLF and highlights that research methods for both approaches can be conducted in a participatory manner using similar research methods and demonstrates how combining the methods can provide a deeper understanding of poverty issues. The combined theoretical framework therefore has a practical application for structuring the methods.

In this thesis, the VCA composes the skeletal structure of the research and entails an analysis of the actors and vertical distribution of benefits along the value chain and mapping the governance structures and processes (both formal and informal). Incorporating the SLF implies an analysis of actors' livelihood and sustainability outcomes and allows assessment of the socioeconomic and underlying vulnerability context in which charcoal-based livelihoods operate. It incorporates actors' livelihood assets and outcomes (including how involvement in the sector and the governance structures affect livelihood outcomes), horizontal analyses of benefit distribution and participation of actors (exploring how other factors influence power and access to charcoal resources and markets). Sustainability aspects relate to how governance of the sector affects the sustainability of the resource management and extraction practices and thus the overall sustainability of charcoal-based livelihood outcomes. Details on the specific research methods are provided after a description of the study site and in each stand-alone research paper.

3.3.2 Study site

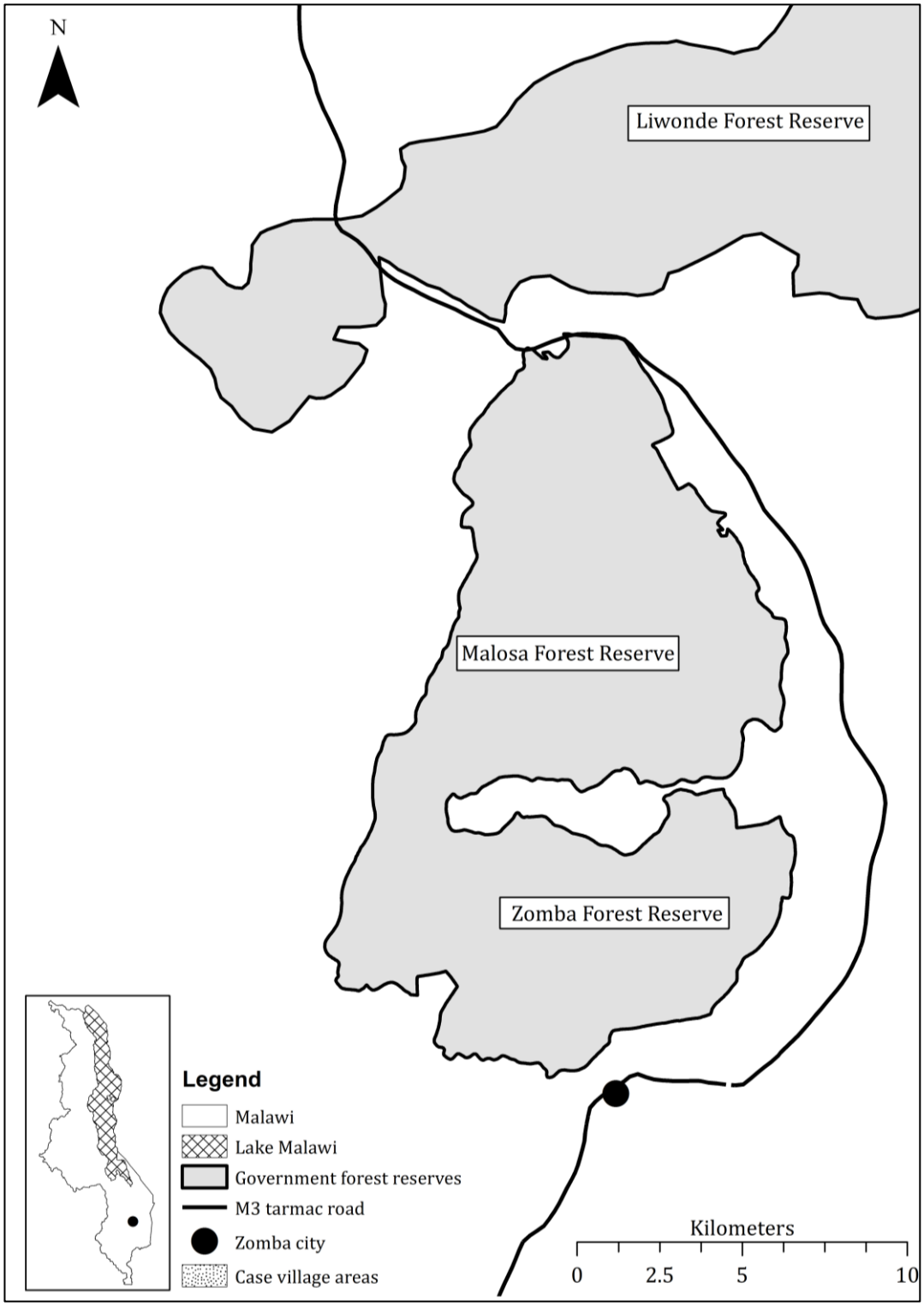
The study focuses on the rural components of Zomba city's charcoal sector, which includes the production areas and trade routes. The extent of the market landscape covers two districts in Southern Malawi: Zomba district, which surrounds Zomba city, the fourth largest urban area in Malawi and the administrative capital of Zomba district, and Machinga district (Figure 3.4). Situated in the southern region, between Lake Chilwa and Lake Malombe, Zomba city lies at the foot of Zomba plateau. National population projections estimate the urban population exceeded 164,000 in 2015 and is increasing at a rate of 4.21% (NSO 2013). The major production sites that supply Zomba city are Zomba forest reserve, Malosa forest reserve and Liwonde forest reserve (Kambewa et al. 2007). Zomba and Malosa forest reserve consist of indigenous slow-growing

miombo woodlands and government-owned pine and eucalyptus timber plantations, Liwonde forest reserve is predominantly miombo woodland (Makungwa and Kayambazinthu 1999; Zomba District Assembly 2009). As the numbers of trees in Zomba and Malosa forest reserves have decreased, Liwonde forest reserve is increasingly being used as a charcoal source to supply Zomba city. Zomba, Malosa and Liwonde forest reserves are classified as public land and fall under the regulatory control of the central government and the authority of the Department of Forestry (Europe Aid n.d.; MALGA 2012).

According to projections, combined populations of Machinga and Zomba districts were over 1,200,000 in 2013, with growth rates of 1.83% and 3.04% respectively (NSO 2009) and respective population densities of 130 people km^{-2} and 230 people km^{-2}. The two districts are the second and third poorest districts in Malawi, 73% of the population in Machinga and 70% of the population in Zomba district fall below the national poverty line (Zomba District Assembly 2009). Within both districts there is a heavy reliance on seasonal and casual income and the local economy is dominated by subsistence agriculture, predominantly maize production (Zomba District Assembly 2009).

In accordance to the Forestry Act (1997), a commercial charcoal production license is granted if the production of charcoal adheres to either a forest management plan, a forest management agreement or a forest plantation agreement. However, difficulties in acquiring a license are associated with having secure tenure arrangements and access to forest inputs and extension services. For example, in February 2015 the Government rejected 50 applications for charcoal licenses, because applicants failed to meet the following three criteria: production on private land, access to tree seedlings, and extension support from the Department of Forestry (Nation Online 2016). High population densities, high levels of poverty and high demand for agricultural land in the study region mean that suitable charcoal resources (forested areas) in the Zomba study region are restricted to the government-owned forest reserves: Zomba, Malosa and Liwonde. Legal charcoal production does not exist in the study region, due to the lack of suitable charcoal resources on private land and difficulties in accessing the financial capacities required for forest inputs.

Figure 3.4: Zomba, Malawi and its main charcoal production areas



Data supplied by the National Statistics Office of Malawi

3.3.3 Data collection

Transporter survey

The aim of the survey was to collect data on the horizontal distribution of benefits amongst charcoal transporters, locations of the charcoal resources and producer communities, map the supply routes and selling points and obtain information on charcoal value chain governance. The transporter sample comprised of 201 individuals who were engaged in transporting charcoal. Two sets of data were collected in September-October 2013 (n=92) and June-July 2014 (n=109) (data collection was carried out during these periods due to limitations of the PhD candidate's ability to travel to Malawi). Transporters were surveyed at six sites identified and selected through observation and confirmation with local stakeholders. The sites included main market areas, the main road (M3) into Zomba and smaller arterial dirt roads. Data were collected using a semi-structured questionnaire that was designed to gather information on transporter characteristics, earnings and costs incurred and to allow for further discussion on particular topics. See Appendix A for a copy of the transporter questionnaire and Chapter 5 for further details on the methods.

Producer community survey

The aim of the producer community survey was to understand the type of villages that produced charcoal, how charcoal was governed at village level and how different factors influenced village-level charcoal production participation dynamics.

Sampling strategy

The population of producer communities had to first be identified with a baseline survey. Data on the locations of producer communities ascertained from the transporter survey was triangulated against information from Local Agricultural Extension Development Coordinators (AEDC), Forestry Extension Officers and Traditional Authorities. Producer village locations were mapped on a base map showing the villages surrounding Zomba, Malosa and Liwonde forest reserve.[4] A total population of 123 producer villages were identified in the study area. Over the course of two data collection periods in September-November 2013 and August-October 2014, a sample of 28 villages (23% of the identified producer community population) participated in the survey. The aim of the sample design was to gather data that covered the spatial scale of the production

[4] At the time of data collection, we used the most up-to-date base map available supplied by the National Statistics Office of Malawi, based on 2008 census data. Villages created after the map's publication were not recorded so, where necessary, we used key informants from the AEDC to add the locations of new villages to the base map.

areas, therefore villages were selected purposefully based upon their location and willingness to participate. Due to the illicit nature of the sector, there was the risk that respondents may mistrust the research and researcher, which may have affected participation and data quality. Therefore, in an attempt to build good rapport (Mosse 1994) the Department of Agriculture (as opposed to the Department of Forestry) was deliberately chosen as a neutral intermediary party to organise introductions with villages on behalf of the researcher (see discussion for a reflection on this decision).

Different people have different types of knowledge, therefore a group of key informants was selected using purposive sampling (Teddlie and Yu 2007) in order to access the range of information required (Marshall 1996). Key informants are useful in rural appraisals as they tend to be better educated, more powerful and better off (Chambers 1981). The use of local knowledge is important and can, for example, be applied to identify local wellbeing and poverty indicators (Chambers 1981). In wellbeing exercises, informant groups give a wider and more accurate range of considerations such as housing standards (Chambers 1981) and the possession of assets (Takasaki et al. 2000). Participants in each village were selected by village chiefs and each informant group comprised the following:

- *Village chief*- For their knowledge of village level information such as village population, infrastructure and village committees;
- *The chair (if available) or a member of the Village Development Committee (VDC)*- For their knowledge of village level information such as village infrastructure and village committees;
- *The chair (if available) or a member of the Village Natural Resource Management Committee (VNRMC)*- For their knowledge of the use and management of the village's natural resources;
- *A young, ordinary village member between the ages of 18-25*- To represent the knowledge of and perspective of recent information and events on the younger generation;
- *An elderly, ordinary village member over 60 years of age*- To represent the knowledge of and perspective on historic information and events on the elderly population;
- *Two village members who, at the time of the focus group, were producing charcoal*- To represent the knowledge and perspective of charcoal producers in the village. Two producers (as opposed to one) were chosen to attend the focus group. This was a

deliberate attempt to increase confidence and comfort levels of these particular participants in order to reduce the possibility of response bias.

In total, 196 respondents participated in the producer community survey. The genders of participants were not specified for two reasons. Firstly, gender-specified responses were not necessary at this scale of research and secondly there was no certainty, prior knowledge or control over the gender of individual participants.

Data collection

Each group of key informants was asked about the following (see Appendix B for a copy of the survey and Chapter 4 for further details on the methods):

- *Village characteristics*: Village demographics (e.g. population, education, ethnicity), infrastructure (e.g. access to healthcare services, places of worship, education etc.), institutions (e.g. existence and functionality of village organisations), and income generating activities pursued in the village, ranked in order of contribution to the village economy (10=most income contributed, 1= least income contributed);
- *Village-level charcoal production*: perceived past and current trends of producer populations, charcoal production processes and resources accessed by charcoal producers in the community;
- *Village-level charcoal governance*: perceptions of how charcoal production and resources were controlled, the roles and responsibilities of formal and informal institutions, and the level of understanding of formal governance regulating charcoal production and transportation.

Case study villages: Rural Appraisals

Many of the rural appraisals used in this research incorporated the use of visual tools. In visual exercises, the researcher takes a step back and plays a facilitating role. The respondents are in control, outsider awareness is lower and both literate and non-literate participants can engage with the information (Chambers 1994b). When data are visual, marginalised participants are empowered as visual literacy is independent of alphabetical literacy and participants can express "preferences and priorities in a physical form which does not entail personal confrontation with otherwise dominating [people]" (Chambers 1994a, pp. 1263). Visual aids encourage discussions further and interviewing a map or a matrix for example, rather than a person, can improve data quality. Information is verified, checked and owned by participants and comparisons, as opposed to measurements, are easier to reveal and less threatening to participants then giving actual

figures (Chambers 1994b). This study employed several approaches to using visual data, the details and analysis of which are described below

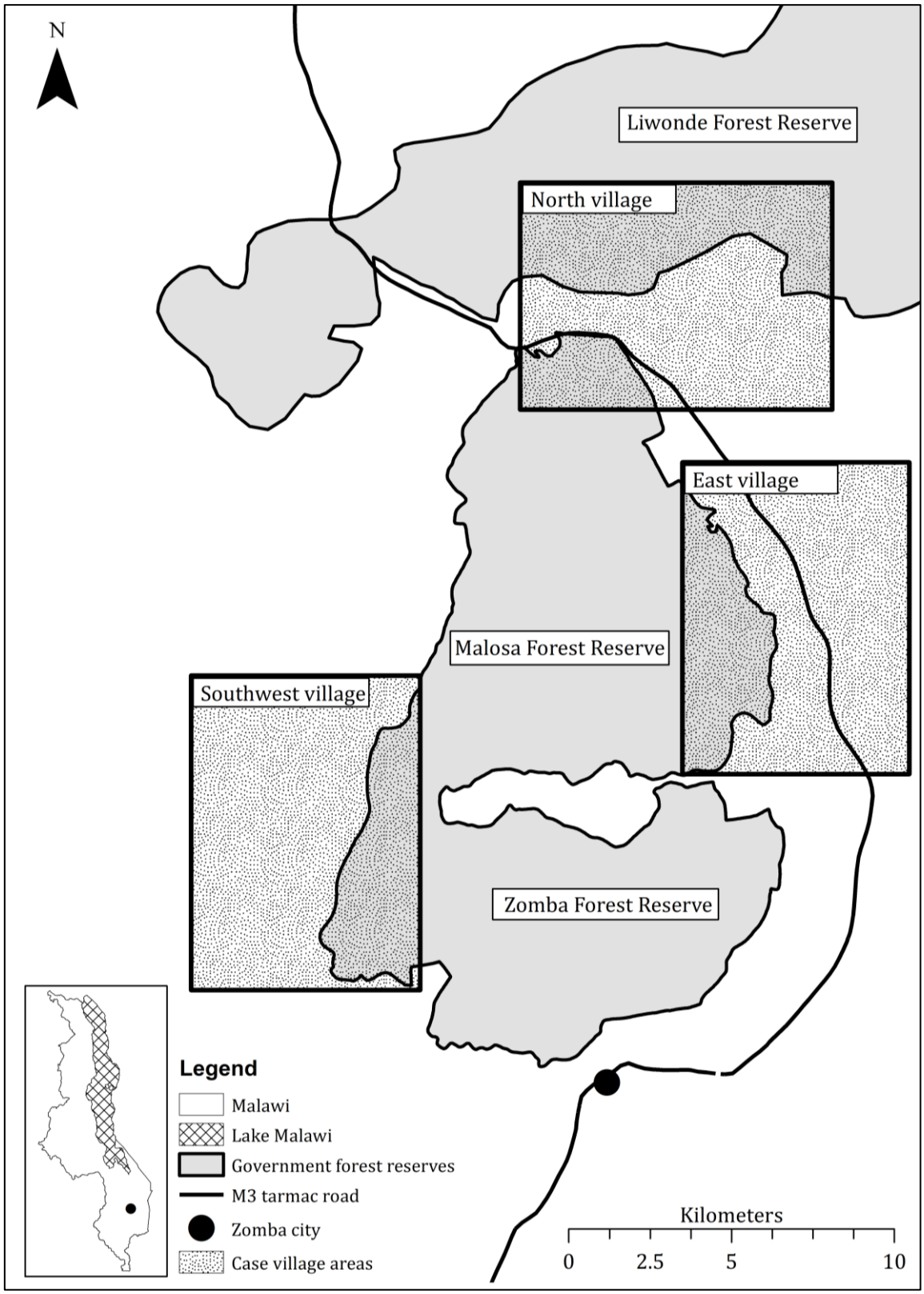
Sampling strategy: Case study villages

Case studies empirically investigate contemporary phenomena in real life contexts, and although they have been criticised as having limited scientific reliability, they provide a rounded picture through the use of multiple sources (Noor 2008). Three case study villages were selected from the communities sampled during the producer community survey. The sampling design followed a purposive sampling strategy "to achieve representativeness" (Teddlie and Yu 2007, pp. 80). Analysing data from the producer community survey, five criteria were used to identify the 'most representative' village from the three main charcoal production areas. The criteria were chosen to determine the stage of charcoal production within villages at the time of the research. The criteria were as follows:

- Size of the village;
- Proportion of households perceived to be actively engaged in charcoal production at the time of data collection;
- Perceived amount of time charcoal production had existed in the village;
- Distance of the village to the forest boundary;
- Perceived contribution from charcoal income to the village economy.

Analysis of the mode and mean for each criterion was employed to identify the 'most representative' village in each of the three production areas. Analysis showed no village represented the mean or mode for all criteria, so instead three villages with the closest responses to the modes and means were selected and were located in the north, east and southwest of the supply shed (Figure 3.5).

Figure 3.5: Approximate locations of the three case study villages within Zomba's charcoal supply shed



Data supplied by the National Statistics Office of Malawi[5]

[5] Precise location withheld to honour confidentiality agreements.

Sampling strategy: Participant groups

Group interviews gain access to a larger pool of knowledge and as such, are specifically useful for natural resource data (a group has knowledge on a wider subject matter and larger geographical area than any one respondent) (Chambers 1981). Sensitive subjects are sometimes more freely discussed, groups build collective enthusiasm, have mutual cross checking amongst participants (thus triangulation is instant and observable) and guided interviews are informal, structured by a list of questions allowing for flexibility (ibid.). Gendered roles are not uncommon in rural livelihoods (Ellis 1999) and differences in the way that men and women value, access and use NTFPs, resources and markets is well documented in the literature (Paumgarten and Shackleton 2011; Ingram, Schure et al. 2014; Ingram, Levang et al. 2014; Sunderland et al. 2014). Therefore women and men were separated in the data collection to form three participant groups: male charcoal producers, female charcoal producers and a key informant group. The key informant group followed the same structure as the producer community survey. A core set of questions was followed, which were addressed with all participant groups. However, as is often the case with participatory research, the interests and experiences of the participants of specific groups were followed, which resulted in some data being collected only from certain groups (Desai and Potter 2006).

Village chiefs initially selected participants; subsequent participant selection was carried out through snowball sequential sampling (Marshall 1996). Each rural appraisal was performed with a participant group comprising 6-8 individuals (Table 3.1). Data were collected in two phases, in October-November 2013 and September-October 2014. Although under-18s may have produced charcoal, only over-18s participated due to ethical considerations.

Table 3.1: Participant groups involved in each rural appraisal exercise

Rural appraisal exercise	Participant group	Sample size per exercise		
		East	Southwest	North
Village timeline	Key informant group	7	7	7
Value chain governance analysis	Male charcoal producer group	7	7	7
	Female charcoal producer group	6	-	6
Seasonal income and expenditure calendars	Male charcoal producer group	6	8	7
	Female charcoal producer group	7	-	7
Livelihood assets focus group discussion	Male charcoal producer group	7	7	6
	Female charcoal producer group	8	-	7
Production recall calendar	Male charcoal producer group	-	-	25
	Female charcoal producer group	-	-	32
Tree species change trend analysis	Male charcoal producer group	6	8	8
	Female charcoal producer group	7	-	6
Semi-structured interviews	Individual male charcoal producers	7	14	7
	Individual female charcoal producers	7	-	7

Village timeline

The aim of the village timeline was to understand the degree to which charcoal production was a coping and/or adaptive strategy to changes experienced by the village and to understand how internal and external events affected charcoal production in the village. The village timeline was deliberately chosen as the first activity to orientate the researcher, so village-specific events and information could be discussed in subsequent exercises. The group was asked to give dates (as accurate as possible) of events that happened in the surrounding area and in the village. For example: creation of the village, large construction projects in the area, changes in political parties and famine years. The researcher and participants jointly created a visual representation of the timeline and the group discussed relationships between events and their influence on (or lack of) perceived participation in charcoal production within the village. See Chapter 4 for further details on the method.

Value chain governance analysis

The value chain governance analysis RRA was designed to elicit data on how formal and informal structures affected producers' access to charcoal resources and the market. The researcher and participants jointly constructed a diagram of the charcoal value chain. Participants identified the roles and responsibilities of different actors and institutions along the value chain, indicated the challenges associated with obstructing[6] processes and the coping or supporting mechanisms

[6] Obstructive processes were identified by participants as those that hindered their involvement in charcoal production.

producers implemented in response. The aim of the RRA was to investigate the governance, actors, barriers and costs involved in the charcoal value chain. Further details on the method are outlined in Chapter 6.

Seasonal income and expenditure calendars

The aim of these exercises was to understand the income generating activities charcoal producers engage in, the significance of charcoal as an income generating activity and to understand the differences of spending demands and patterns between participant groups. By cross-examining responses between income and expenditures the intention was also to determine whether charcoal income was used for particular expenditures.

For the income generating activities, participants constructed a list of income generating activities that they had engaged in during the previous 12 months. The expenditure exercise started with a discussion about the main expenditure items that participants have, including the roles and decision making at household level. Following the discussion, a list was constructed of the expenditures participants had had during the previous 12 months.

In both exercises the income generating activities and expenditures were scored using counters, based on how much money was either earned or spent, and a monthly calendar was then drawn up to create a matrix system (Table 3.2). Respondents then distributed, adjusted, explained and justified the distribution of counters. Further details on the method are outlined in Chapter 6.

Table 3.2: Example matrix used for the seasonal income generation activity

	January	February	March	April	May	June	July	August	September	October	November	December
Activity/Expenditure 1												
Activity/Expenditure 2												
Activity/Expenditure 3												

Livelihood asset focus group discussion

The aim of this exercise was to understand how charcoal production affects livelihood activities, environmental and household characteristics, and how significant the repercussions of these effects were to the household. The group discussion was guided by the five livelihood assets as outlined in the SLF (DFID 1999). Participants discussed how and why charcoal production affected

natural, physical, financial, human and socio-cultural assets, and what impact this had for household livelihood strategies. Further details on the method are outlined in Chapter 6.

Production recall calendar

Participants recalled the number of charcoal bags they had personally produced each month, over the previous 12 months and the group discussed reasons for unusually high or low levels of production. Further details on the method are outlined in Chapter 6.

Tree species change trend analysis

The purpose of this exercise was to investigate how charcoal resources, in terms of tree species preference and availability changed over time. Participants discussed and constructed a list of all the tree species (in local languages) that they used for charcoal production. A matrix was constructed (Table 3.3) crossing tree species with five-year intervals. For each year, counters were distributed amongst the tree species. More counters indicated higher use of the tree species for charcoal production. On completion, participants gave explanations for the changes in use of tree species. Further details on the method are outlined in Chapter 4.

Table 3.3: Example matrix used for the tree-use change trend analysis

	Year X	Year Y	Year Z
Species 1			
Species 2			
Species 3			

Semi-structured interviews

During group interviews, there is the risk of a consensus view and a loss of detail on the extreme values (Cooke and Kothari 2001). To overcome this particular issue, 42 semi-structured interviews were carried out on an individual basis with 28 men and 14 women from the three case-study villages.[7] Semi-structured interviews are useful for talking through issues and triangulation (McCracken and Conway 1988), and their informality can offer "hints of hidden information that can be revealing" (Mitchell and Slim 1991, pp. 71). The interviews lasted between 15 and 30 minutes and were designed to elicit detailed information about producers' personal histories, thematic reasons for engaging in production and their experience with the sector. See Chapters 4

[7] We interviewed 14 participants in each village: 7 men and 7 women. However, in the Southwest village, only men participated in charcoal production, therefore we interviewed 14 men.

and 6 for further details on the method and Appendix C for a copy of the semi-structured interview questions.

3.3.4 Data management

Where participant consent was given, all surveys and rural appraisals were recorded digitally using a dictaphone. To ensure a standardised technique in asking questions, field assistants were trained for each method. For the surveys, the rational of each question was explained to research assistants, and translated in advance of the data collection. During data collection, the researcher initially asked questions in English, field assistants translated the questions to participants in Chichewa using the prescribed translation, participants responded in Chichewa and field assistants relayed responses to the researcher in English. Short responses were interpreted *verbatim*. Practically, longer discourses were challenging to translate in real time; instead, the general sense of the response was interpreted and written in note form.

Participatory research often follows the interest and experiences of participants, therefore the rural appraisals allowed flexibility in discussions. Unlike the surveys, pre-translations were not required. Instead, the rational and motivations of each rural appraisal were explained to research assistants, the researcher demonstrated and explained the techniques to research assistants (e.g. order of actions), and the researcher and assistants ran through each rural appraisal in advance. During the data collection the researcher led each session, asking the questions in English, and field assistants translated the questions to participants in Chichewa. The rural appraisals included elements of group discussions and some required collective answers. Field assistants relayed the components of the discussion to the researcher and interpreted participants' responses as accurately as possible. The researcher recorded discussion elements and collective responses in note-form and relevant lines of discussions were subsequently followed upon the researcher's instruction. Where visual methods were used (e.g. seasonal calendars), the researcher gave instructions in English, which field assistants translated to Chichewa. Visual responses were photographed and subsequently digitised (e.g. matrices were transformed into tables and figures, using Microsoft Excel). Research assistants relayed participants' discussions to the researcher, which were recorded in note form and relevant lines of discussions (e.g. asking for further explanations for responses) were subsequently followed upon the researcher's instruction. For examples of the rural appraisals, see Figures 3.6-3.7.

During data collection, the researcher noted any elements of uncertainty (e.g. discussion that may not have been recorded in note form) and described physical responses that may not have been recorded by the voice recorder (e.g. body language). After data collection all written notes were

digitised and where necessary, the digital sound recordings were re-examined by the research assistants and researcher.

3.3.5 Ethical considerations

Ethical approval was obtained from both the University of Southampton and Chancellor College, University of Malawi and formal consent (either written or verbal) was obtained from all participants. Due to the nature of interviewing people involved in illegal activities, ethical consideration was given to minimize potential stress or harm to participants and build rapport. During data collection, the researcher ensured that only participating individuals were present, for example if uninvited individuals joined a group discussion, the session would be paused and they would be instructed to leave before the session recommenced. All participants had given consent and were aware they could withdraw from the research process at any time. The researcher and research assistant explained their autonomy (e.g. not linked to any regulatory bodies) and explained that data were anonymous (see Appendix D for the consent script). Participants' identities were not recorded during data collection. Names were recorded in written consent forms, but were not recorded digitally or stored alongside the data. Where compensation was given, it followed the prescribed compensation policy (Appendix E).

3.3.6 Data analysis

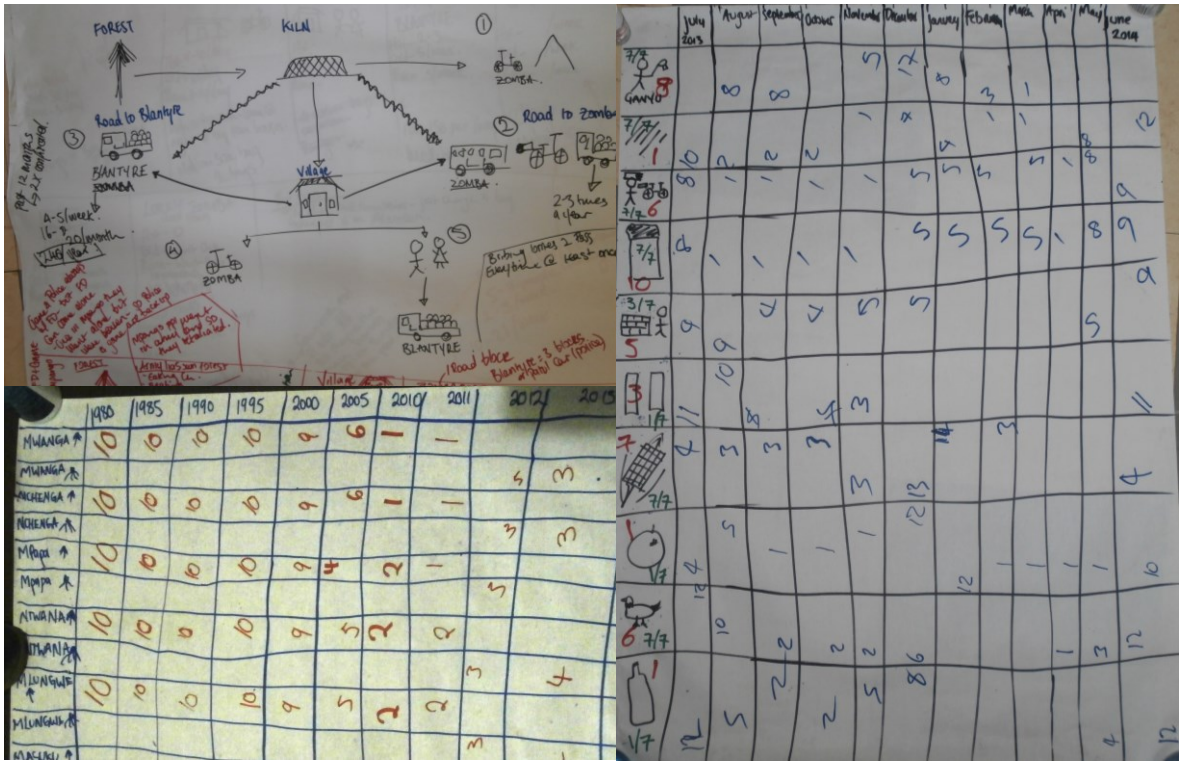
Table 3.4 summarises the data collection methods applied to each research question. Quantitative data were analysed statistically using SPSS and Microsoft Excel, qualitative data were analysed thematically, and visual data from the rural appraisals (e.g. seasonal calendars) were digitised and presented in graphical or tabular form. Several data sets underwent multiple analyses, therefore the individual data chapters give details on the specific data analyses used.

Table 3.4: Data collection methods applied to each research question

Research method	Research Questions			
	Who participates in the production and transportation of charcoal?	**Why do people participate in the production and transportation of charcoal?**	**What are the livelihood outcomes obtained from participating in the production and transportation of charcoal?**	**What are the constraints to charcoal-based livelihoods?**
Transporter survey				
Producer community survey				
Case Study Villages: Rural Appraisals				
Village timeline				
Value chain governance analysis				
Seasonal income calendar				
Seasonal expenditure calendar				
Livelihood asset focus group discussion				
Production recall calendar				
Tree species change trend analysis				
Semi-structured interviews				

Figure 3.6: Examples of rural appraisals undertaken during the data collection. Images have been blurred to safeguard participant anonymity.

Figure 3.7: Examples of outputs from visual rural appraisals for a) joint value chain diagram, b) tree species change trend analysis c) seasonal income calendar



4

Spatial-temporal dynamics of charcoal extraction

Chapter 4: Spatial-temporal dynamics of charcoal extraction

This chapter has been submitted for publishing in the *Journal of Rural Studies*:

Harriet Elizabeth Smith, Felix Eigenbrod, Malcolm D. Hudson and Kate Schreckenberg (2016). Socio-economic factors affecting the spatial-temporal dynamics of charcoal extraction in Zomba, Malawi. Submitted to the *Journal of Rural Studies*.

Data from this chapter were also presented at the *Ecosystem Services for Poverty Alleviation (ESPA) funded Pre- Poverty Environment Partnership (PEP) Landscape Forum* in Edinburgh, May 2015

and at the *First Annual FLARE Network Conference* in Paris, November 2015.

Abstract

Much of the charcoal production across sub-Saharan Africa is an illegal activity of high economic importance, with significant environmental and social consequences. Understanding why communities engage in charcoal production and how these decisions vary spatially and temporally is critical for more targeted and effective policy interventions for both forest management and sustainable rural development. This paper examines the supply shed of Zomba, a medium-sized city in southern Malawi. We explore how different factors influenced communities' decisions to engage in charcoal production and how these affected the spatial-temporal production dynamics across the supply shed. Drawing on a survey of 28 villages (representing 23% of producing communities) and rapid rural appraisals in three case-study villages, we identified four factors that influenced how villages engaged in charcoal production: resource access; market access; financial security and food insecurity. The location of charcoal resources that villages accessed and the heterogeneity of factors resulted in spatial and temporal production clusters scattered throughout Zomba's supply shed. Producers began by using species with high charcoal production value; perceived peak production coincided with a diversification of harvested species to include those of lower value and the use of tree roots. This study shows that both locally specific and national analyses of trends and events are important to assess the outcomes of policy changes or plan interventions to manage charcoal production.

4.1 Introduction

Across sub-Saharan Africa, charcoal consumption is projected to increase at higher rates than in any other region in the world (Zulu and Richardson 2013), doubling from 23 million tons in 2000 to 46.1 million tons by 2030 (Broadhead et al. 2001, as cited in Arnold et al. 2006). Africa is predicted to be the fastest urbanising continent between 2020-2050, with urban populations increasing from 40% of the total population in 2014 to 56% by 2050 (UN 2015a). A 1% rise in urbanisation can lead to a 14% increase in charcoal consumption (Hosier and Kipondya 1993). As long as alternative options fail to provide reliable and affordable energy sources to urban populations, urban charcoal consumption is going to increase and remain irreplaceable for the foreseeable future (MARGE 2009).

Changes in the economy, environment and population are changing the priorities and aspirations of rural African communities, leading to a growing dependence on non-farm activities (Barrett et al. 2001) such as charcoal production (Arnold and Towson 1994). By 2030, sub-Saharan Africa's charcoal sector will be a livelihood source for an estimated 12 million people (Mwampamba et al. 2013). Increasing rates of urbanisation and subsequent growing demand for energy are putting forests located near demand centres at increasing risk of overexploitation and degradation (Krutilla et al. 1995; Ahrends et al. 2010; Chidumayo and Gumbo 2013; Zulu and Richardson 2013). Africa already accounts for nearly 80% of charcoal-based deforestation in tropical areas (Chidumayo and Gumbo 2013). Currently, much of sub-Saharan Africa's charcoal sector is ineffectively governed and there are rarely explicit policies that promote sustainable charcoal production (Mugo and Ong 2006). Furthermore, promoting sustainable charcoal production requires an in-depth understanding of the production cycle that is lacking in most instances. Therefore to safeguard forest resources and meet energy needs, further research to understand the dynamics of wood extraction is needed to support effective policy decisions (ICRAF 2015).

Charcoal production is an important driver of land use change across sub-Saharan Africa. Drivers of land use change are scale dependent, mediated by decisions made at the individual, household and village level (Kissinger et al. 2012). Yet, analysing drivers of land use change is often made at coarse scales, such as global (DeFries et al., 2010, Rademaekers et al. 2010) and regional case studies (Geist and Lambin, 2002; Olson et al. 2004; Wood et al. 2004), with limited focus at the national level (Kissinger et al. 2012) and even less at local level. Knowledge about charcoal market participation is highly contextual (Ros-Tonen and Wiersum, 2005; Kambewa et al. 2007; Schure et al., 2014). Most studies assess the motivations and actions of producers at the household and individual level (e.g. Kambewa et al. 2007; Minten et al. 2013; Baumert et al. 2016; Jones et al. 2016; Ndegwa et al. 2016; Smith et al. 2016). These findings suggest that at this scale, producers

are heterogeneous with factors such as shocks, seasonality, education, gender and poverty influencing their participation in charcoal production. However, there is limited focus on factors influencing village-scale participation in charcoal production, and insufficient evidence to indicate whether heterogeneity at the individual level is scalable to the village and supply shed level.

Large research gaps in the charcoal literature have led to a lack of evidence-based decision-making and a failure of basic, formal approaches to regulate the sector (ICRAF 2015). Seventy-five per cent of urban growth in Africa will occur in small and medium-sized cities with populations of less than 1 million (UN-Habitat 2014). However, there is little evidence to establish whether the charcoal markets and value chains of these smaller cities are comparable to their larger counterparts (Smith et al. 2015).[8] Arguably, charcoal governance should be addressed at local scales, "to ensure that policies match the realities on the ground" (Mwampamba et al. 2013, p. 83). However, due to unknown interactions between different market landscapes, large-scale studies and interventions struggle to effectively recognise locally relevant spatial and temporal factors.

4.1.1 Current understanding of spatial determinants of charcoal extraction

Research into "spatially-specific patterns of forest-extractive incomes" is becoming increasingly necessary (Wunder, Angelsen et al. 2014, p. S8). A lack of spatial assessment of the extraction of non-timber forest products (NTFPs), which include charcoal, reduces policy effectiveness because of a failure to target enforcement in the right forest areas and acknowledgement of extractors' reactions to infrastructure (e.g. market or road access, buffer zones) (Robinson et al. 2002; Albers and Robinson 2013). At large spatial scales, Von Thünen's theory of land use applies to spatial patterns of charcoal extraction. This predicts general patterns of land degradation and highlights the importance of transport routes (von Thünen 1966). When applied to forests, this translates to a prediction that waves of forest degradation emanate from major demand centres, targeting high to low valued species in sequence (Ahrends et al. 2010). However, at smaller scales, forest loss is spatially heterogeneous, varying widely on a local contextual basis (e.g. Ryan et al. 2014; Tadesse et al. 2014; Butsic et al. 2015).

Although charcoal demand is principally an urban phenomenon, the value-chain transects the rural-urban landscape and charcoal production is predominantly a rural livelihood activity (e.g. Ribot 1998; Kambewa et al. 2007; Shively et al. 2010; Zulu 2010; Schaafsma, Morse-Jones et al.

[8] References for Smith et al. (2015) refer to the article published from Chapter 5. The reference is included in Chapters 4 and 6 because the data chapters are written as stand-alone journal articles and have been submitted for publishing as such. Chapter 5 was the first article published and was written prior to Chapters 4 and 6.

2014; Schure et al. 2014; Dons et al. 2015). Pressure from NTFP collection is greatest in high population density areas (Schaafsma, Morse-Jones et al. 2014). However, misrepresentation of the link between charcoal production and forest loss has led to punitive, conflicting and often corrupt formal management approaches forcing many small-scale entrepreneurs to work informally (Zulu 2010; Mwampamba et al. 2013). The illicit nature of the informal charcoal sector motivates producers to work in a disjointed, individual manner, scattered in rural and often remote areas (Mwampamba et al. 2013).

Forests in areas of mid-elevation with flat topography are likely to suffer higher intensity charcoal production than forests at higher elevation (Castillo-Santiago et al. 2013; Green et al. 2013). This is because the traditional earth-mound charcoal kilns common throughout sub-Saharan Africa (Malimbwi and Zahabu 2008) are more easily constructed on relatively flat, rock-free terrain. It may also be less worthwhile investing in charcoal production at higher elevation as trees tend to be smaller (smaller trees are less desirable) and more sparsely distributed and mountain topography makes transporting charcoal bags to lowland markets very challenging (Green et al. 2013). Furthermore, distance costs protect a forest whereby areas of forest far enough from extraction zones form a 'natural core' of pristine, un-degraded forest (Albers and Robinson 2013) and forest areas on the edge of protected areas experience higher degradation (Green et al. 2013).

4.1.2 Current understanding of temporal determinants of charcoal extraction

A boom-bust pattern of unregulated charcoal production may provide significant employment opportunities for rural communities in the short term. However, it is disruptive in the long run particularly when relatively high returns encourage a movement away from more diversified and less-risky agricultural-based livelihoods and increases the prevalence of resource degradation (Arnold and Perez 2001; Chidumayo and Gumbo 2013). The distance between households and resource locations is positively correlated with opportunity cost of labour and time spent harvesting (Schaafsma et al. 2012). Households' variability with respect to their labour opportunity costs leads to spatial heterogeneity of NTFP extraction (Albers and Robinson 2013). In the case of charcoal, differences in access to labour and land contribute to heterogeneity amongst households in their reasons for engaging in charcoal production and their dependence on it (Coomes and Burt 2001).

The duration, combination and impact of other factors may also influence communities' engagement with the charcoal sector. For example, trends in population growth and urbanisation increase demand and strengthen the charcoal market (Zulu 2010; Mwampamba et al. 2013). Local events such as the opening or closure of a business can lead to an increase or decrease in

employment opportunities and famines may cause households to seek additional income seasonally and/or in response to unexpected shocks (Corbett 1988; Ellis 1998; Wunder, Börner et al. 2014). A change in natural resource policy may reduce or increase resource access, leading to a change in resource extraction patterns (Robinson and Lokina 2011).

4.1.3 Research questions

Deforestation policy responses are compromised if spatial and temporal dimensions become disconnected (Vance and Geoghegan 2002). Whilst there is some evidence to predict the location of charcoal extraction activities (e.g. Green et al. 2013), there is little detailed empirical investigation into how villages engage in the charcoal sector and what factors affect their decision-making. Understanding these factors is critical to ensure more targeted and effective policy interventions for both natural resource management and sustainable rural development.

This paper is one component of a larger study that examines charcoal-related livelihoods in and around Zomba, a medium-sized city in southern Malawi (see Smith et al. 2015; 2016). The novelty of this study lies in the identification of local-level factors that influence villages' decisions to engage with charcoal production. Our aim is to understand how factors influencing village-level production shape the spatial-temporal dynamics of charcoal extraction across Zomba's supply shed. The specific objectives are as follows:

- Identify the perceived spatial-temporal patterns of Zomba's charcoal supply shed;
- Identify the perceived temporal patterns of species extracted for charcoal production;
- Determine what factors influence communities' engagement with charcoal production.

4.2 Materials and methods

4.2.1 Study site

This study focuses on charcoal production around Zomba, a city located in Southern Malawi, with an urban population projected to exceed 164,000 in 2015, increasing at an annual rate of 4.21% (NSO 2013). The major production sites are Zomba forest reserve, the adjacent Malosa forest reserve and Liwonde forest reserve, located in Machinga and Zomba Districts (Kambewa et al. 2007). The Zomba and Malosa forest reserve complex consists of indigenous slow-growing miombo woodlands and government-owned pine and eucalyptus timber plantations, while Liwonde forest reserve is predominantly miombo woodland (Makungwa and Kayambazinthu 1999; Zomba District Assembly 2009).

4.2.2 Malawian charcoal sector

Malawi presents a good example of a sub-Saharan African country experiencing growing urban demand for charcoal. Charcoal can be produced legally in Malawi, if the producer has an approved management plan and an authorised licence. However, although the law was enacted in 1997 the first licence wasn't authorised until September 2015 and took eight years to obtain (personal comm. Tanya Clarke, Kawandama Hills Plantation Director). Aside from the one licence, all other charcoal production and transportation in Malawi is illegal and informally regulated (or not at all). Unfortunately, Malawi's informal charcoal sector creates space for corruption (Kambewa et al. 2007), increases the vulnerability of charcoal-based livelihoods to poverty (Smith et al. 2015), frustrates attempts to develop effective and progressive policies to regulate the sector and means that there is little incentive to invest in the sustainable management of charcoal resources.

Charcoal consumption in Malawi increased substantially around 2003/04. Until 1998, charcoal accounted for less than 20% of energy consumed in urban areas. By 2004, charcoal consumption superseded that of firewood in urban areas, becoming the most commonly consumed fuel and accounting for almost 50% of consumption (Zulu 2010).

Urban markets and supply routes are well established and the sector generates an income for an estimated 92,800-200,000 people across Malawi (Kambewa et al. 2007; MARGE 2009). Most producers (42%) work on a small-scale level, making less than 30 bags (typically 50kg in size)[9] per month. A quarter of producers are business oriented with limited capital, making between 30-100 bags per month. The remaining 33% have access to considerable capital and produce over 100 bags per month (Kambewa et al. 2007). Estimates suggest that Malawi's charcoal industry is very important for the national economy and for alleviation of rural poverty, being worth in excess of USD $40 million and accounting for about 0.5% of gross domestic product (GDP). For comparison, this figure falls between Malawi's second and third largest exports, tobacco and sugar (Kambewa et al. 2007).

4.2.3 Data collection

Research on forest product extraction is challenging due to the illicit nature of the sector. A significant methodological challenge is the reliability of the data collected (Gavin et al. 2009, as cited in Schaafsma, Burgess et al. 2014). Respondents may be disinclined to respond openly for

[9] 50kg is the average weight of a regular charcoal bag (Kambewa et al. 2007).

fear of criminalising themselves (Schaafsma, Burgess et al. 2014). To overcome these issues, we used a mixed-methods approach to triangulate information using three scales of data acquisition: 1) A baseline landscape survey to identify the producer community population; 2) A village sample survey to understand village-level phenomena; and 3) in-depth exploration in three case study villages to examine village and sub-village phenomena.

Baseline survey

We first conducted a survey of charcoal transporters entering Zomba (see Smith et al. 2015 for a detailed methodology) to identify the location of production areas and the population of producer communities. Local Agricultural Extension Development Coordinators (AEDC), Forestry Extension Officers and Traditional Authorities corroborated the production locations. All producer village locations were mapped on a base map showing the villages in Machinga and Zomba districts.[10] In this way a total of 123 producer villages were identified in the study area.

Village sample survey

We then surveyed 28 (23% of the total) producer villages. The sample was designed to gather data that covered the spatial scale of the supply shed, so villages were selected purposefully (Teddlie and Yu 2007) based upon their location and their willingness to participate. In order to protect village identity, the locations of the villages we surveyed are not disclosed.

Data were collected in two sets, in September-November 2013 and August-October 2014, with the help of a trained interpreter. In each village, surveys were held with a group of seven key informants. These were selected purposively in order to access the range of information required (Marshall 1996) and comprised: the Village Chief, a member of the village development committee, a member of the village natural resource management committee, a young (aged 18-25) non-charcoal producer, an elderly (over 60) non-charcoal producer and two village members actively engaged in charcoal production. In total, 196 respondents participated in the producer community survey and group sessions lasted between two and three hours.

We collected information on village-level charcoal production trends: when production started, how many households were engaged in production, how this number changed over time and the location of the charcoal resources the village accessed. Peak production was defined as the most number of people actively engaged in charcoal production. The group listed reasons for why

[10] At the time of data collection, we used the most up-to-date base map available supplied by the National Statistics Office of Malawi, based on 2008 census data. Villages created after the map's publication were not recorded so, where necessary, we used key informants from the AEDC to add the locations of new villages to the base map.

production changed in the village and described the type of people engaged in production. Qualitative elements, were interpreted in-situ, recorded in the form of notes and were analysed thematically in order to identify reasons for villages' engagement in production. We identified alternative income generating activities pursued in the village and ranked the top 10 village-level income generating activities from 1-10, in order of contribution to the village economy (10=most income contributed, 1= least income contributed). We also collected village population data recorded in the Village Chief's register.[11] As villages' population data did not meet the assumptions of parametric testing, Kruskal-Wallis tests were used to assess differences between the population sizes of sampled villages. Statistical analyses were carried out using IBM SPSS version 22.

Case study producer villages

The third method used was an in-depth case-study of three villages. These were selected to research village-level phenomena in greater depth and represent forest use patterns in different areas of the forest reserves. To protect village anonymity and the identity of participants, the locations and names of villages are not given, but each of the case-study villages accessed a different production area.

We performed three rapid rural appraisal (RRA) exercises (see Schreckenberg et al. 2012 and Marshall, Rushton et al. 2006) in the case study villages. Each RRA individually lasted between 2-3 hours. Using a matrix, with years on one axis and tree species on the other (see FAO 1999), groups of 6-8 charcoal producers (in gender separated groups)[12] recorded how the tree species they harvested for charcoal had changed over time. We conducted a village timeline with a key informant group from each case study village[13] and explored how past trends and events had affected charcoal extraction local to the forested area accessed by the village. We then discussed the identified trends and events with gender-separate groups of 6-8 charcoal producers for a detailed exploration of how and why specific socio-economic factors affected village, household, individual and gender specific engagement with charcoal production.

[11] Please refer to Appendix B for a copy of the village survey, and to Section 3.3.3 for further details of the methods.
[12] In one case study village, no women were known to actively produce charcoal. Therefore in this village, only groups of male producers participated.
[13] The key informant group in the case study villages followed the same structure as that of the producer village survey.

4.3 Results

4.3.1 Patterns of charcoal extraction

This first section presents the perceived spatial and temporal pattern of resource extraction based on data from the baseline survey and the village sample survey.

Spatial-temporal extraction patterns

Zomba's charcoal comes from three production areas: Access Area 1 runs along the southeastern forest areas of Zomba and Malosa forest reserve, cutting west behind Malosa Peak; Area 2 runs along the western flank of Zomba and Malosa forest reserve, cutting east of Zomba Peak; and Area 3 is located on the northern tip of Malosa forest reserve and the southern edge of Liwonde forest reserve (Figure 4.1). Based on the charcoal production areas that villages accessed, Zomba's producing villages were categorised into six village groupings (Table 4.1).

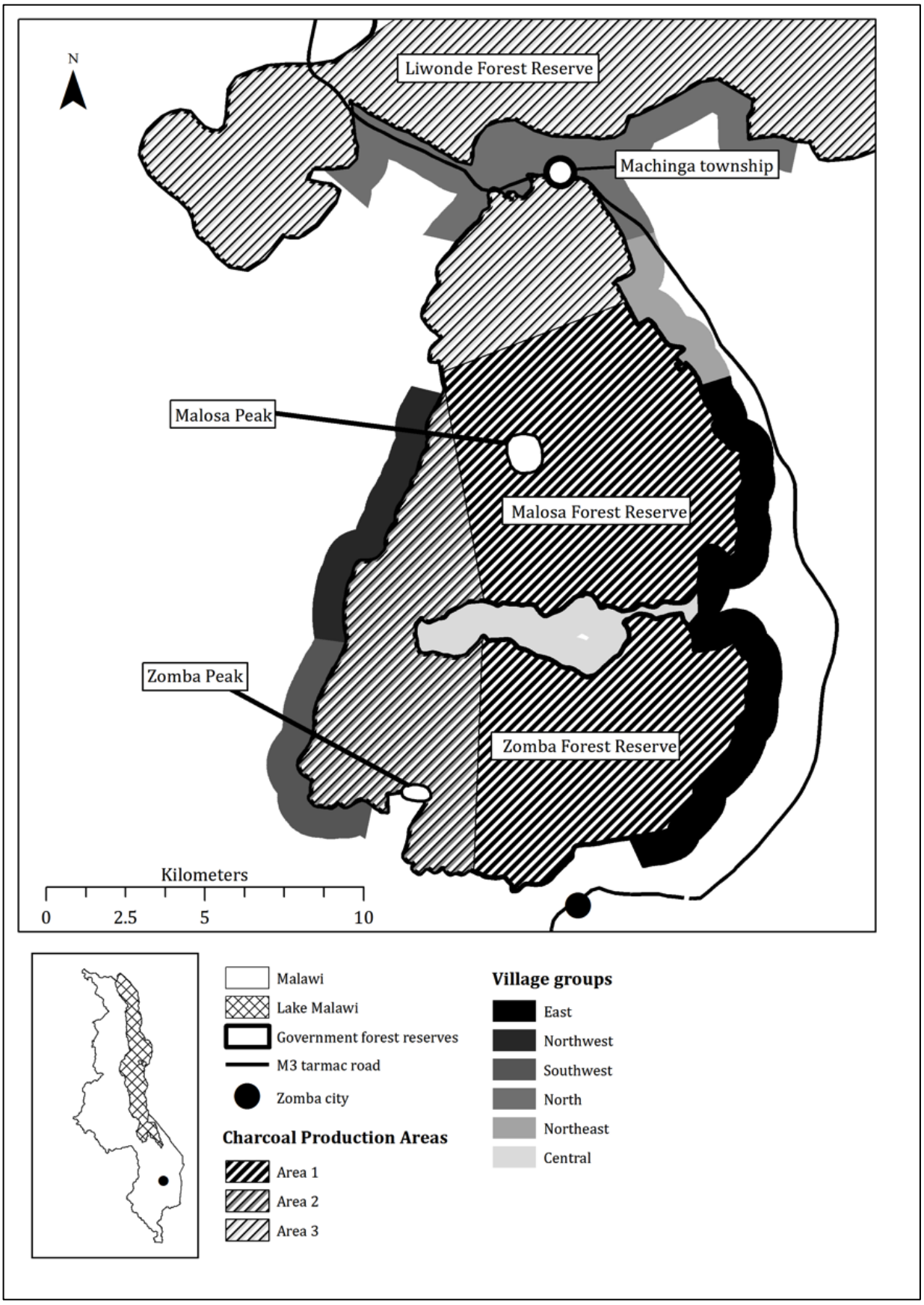
According to respondents, charcoal production had never occurred in the northwest border of Malosa forest reserve and the southern edge of Zomba forest reserve. Agricultural extension officers working in these villages suggested that charcoal production did not occur in these areas because of low availability of forest resources to the south, low access to markets to the north and availability of alternative income-generating activities in both areas. We did not survey villages in these areas.

Table 4.1: Zomba's charcoal village groupings, the forest resource area they accessed and sample size

Village group	Charcoal Production Access Area	Total number of villages in production zone	Number of villages sampled	Percentage (%) of villages sampled
East	1 only	41	4	10
Northwest	2 only	16	4	25
Southwest	2 only	21	5	24
North	3 only	23	9	40
Northeast	1 and 3	12	4	30
Central	1 and 2	9	2	22
Total		123	28	23

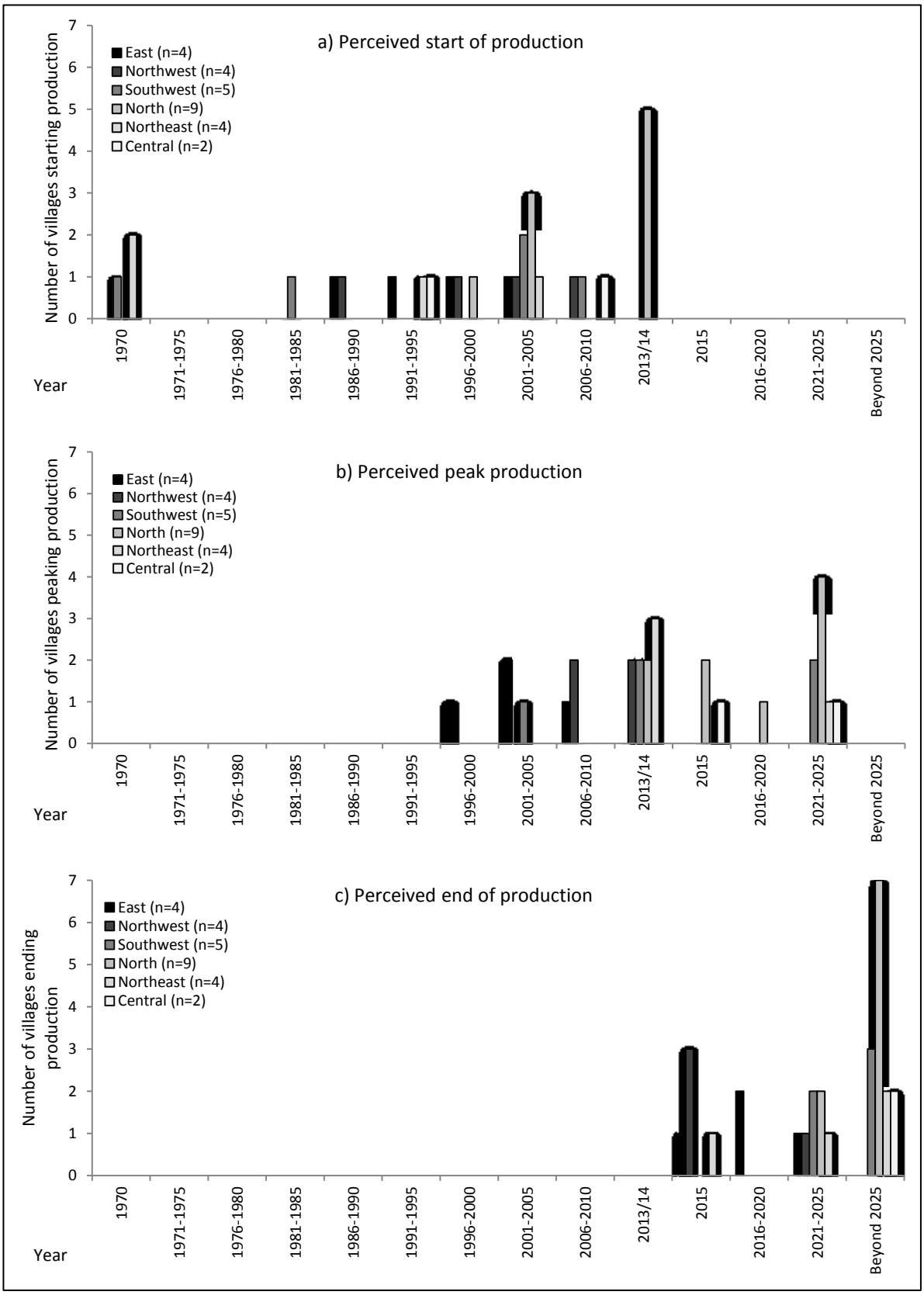
Perceived charcoal production had existed in the region since the 1970s, however most villages remembered starting production between 1991 and 2005, with the most recent uptake of production in the Northern group (Figure 4.2). Peak-production was not confined to any specific time period, starting in 1996/2000 and forecast to end in all villages by 2025. Charcoal production was perceived to have already peaked in 57% of villages by 2013/14. The Southwest, North, Northeast and Central groups believed that peak production was still a future prospect. The East and Northwest groups predicted that all village-level production would finish by 2025, whereas the Southwest, North, Northeast and Central groups predicted that some production would continue beyond 2025.

Figure 4.1: Village groups and production areas in Zomba's charcoal supply shed



Data supplied by the National Statistics Office of Malawi

Figure 4.2: Periods when villages in each production group perceived their charcoal production (a) started, (b) peaked and (c) ended



Village-level household engagement and production periods

Village population sizes were similar across most village groupings (Kruskal-Wallis =3.888, df=4, p=0.421), but were smaller in the Central group (Table 4.2). On average at least 50% of households per village in the North, Central and Northeast groups were actively engaged in charcoal production. On average at most 20% of households per village in the Northwest, Southwest and East groups were actively engaged in charcoal production.

Table 4.2: Mean perceived numbers of households and proportions of charcoal-producing households in the six village groupings, data from the village sample survey

Village group	Mean number of households per village 2013/14 ± SD	Mean proportion of households per village actively engaged in production in 2013/14 period
East (n=4)	126 ± 55	16% ± 12%
Northwest (n=4)	192 ±156	5% ± 6%
Southwest (n=5)	238 ± 204	23% ± 30%
North (n=9)	308 ± 242	65% ± 27%
Northeast (n=4)	327 ± 192	59% ± 25%
Central (n=2)	43 ± 5	52% ± 53%

Each village group perceived different production patterns (Figure 4.3). Accessing only Production Area 1, villages in the East group had a mean of 47 producers at peak period. They perceived a 20-year start-to-peak duration, starting in 1986/90 and peaking in 2001/05, the earliest of all the groups.

Accessing only Production Area 2, the Northwest group had a mean of 8 producers per village at peak period; this was the lowest number of all village groups. They perceived a 25-year start-to-peak period from 1986/90 to 2013/14. The Southwest group experienced one of the longest start-to-peak periods, lasting approximately 45 years from 1970 to 2013/14 and had a mean of 32 producers per village at peak period.

Accessing only Production Area 3, the North group had the shortest and most recent start-to-peak duration from 1996/00 to 2015 and had the most producers on average per village, with 228 producers at peak period.

Villages accessing more than one production area did not follow the same pattern as those accessing single production areas. Production in these villages was categorised by both a long production period and large numbers of active charcoal producers. The Northeast group perceived a start-to-peak duration lasting 44 years from 1970 to 2013/14 and had a mean of 166

producers per village at peak period. The Central group perceived a start-to-peak period lasting 24 years from 1991/95 to 2015, with 33 producers at peak period. However, the village population sizes were the smallest in the Central group, therefore the proportion of households actively engaged in production was the second highest.

Peak production and tree species extraction

Perceived peak production coincided with a diversification of harvested species and the use of tree roots in Production Areas 1 and 2; tree species diversification was not yet apparent in Area 3 (Figure 4.4). Across the entire supply shed miombo trees (*Brachystegia bussei; Brachystegia speciformis; Brachystegia stipulata)* and other indigenous trees such as Afromosia (*Pericopsis angolensis)* and Dalbergia *(Dalbergia nitidula)* were initially targeted for charcoal production. Due to their high wood densities, these species were considered to produce the highest quality charcoal.

In the years approaching peak production in Area 1 (1996/00 – 2001/05) and Area 2 (2006/10 – 2013/14), producers began diversifying targeted species to include a wider range of other indigenous trees such as Forest Newtonia (*Newtonia buchananii*) and Bleedwood (*Pterocarpus angolensis*)*,* indigenous fruit trees such as Mahobohobo (*Uapaca kirkiana*) and domestic fruit trees such as Avocado (*Persea americana*)*.* Once peak production had been reached, producers harvested remaining available trees including planted village trees such as Acacia (*Faidherbia albida*), Mango (*Mangifera indica*), Eucalyptus (*Eucalyptus camaldulensis*) and introduced trees such as Red Cedar (*Toona ciliata*)*.* Producers in both areas also reported digging up the roots of more favoured species in addition to cutting live species.[14]

In contrast, Area 3 reported harvesting a few predominantly miombo species. Participants envisaged travelling further into the forest in future years and predicted a continued availability of miombo species.

[14] See Appendix F for a full list of species harvested for charcoal.

Figure 4.3: Change over time of the mean number of households actively producing charcoal within different village group

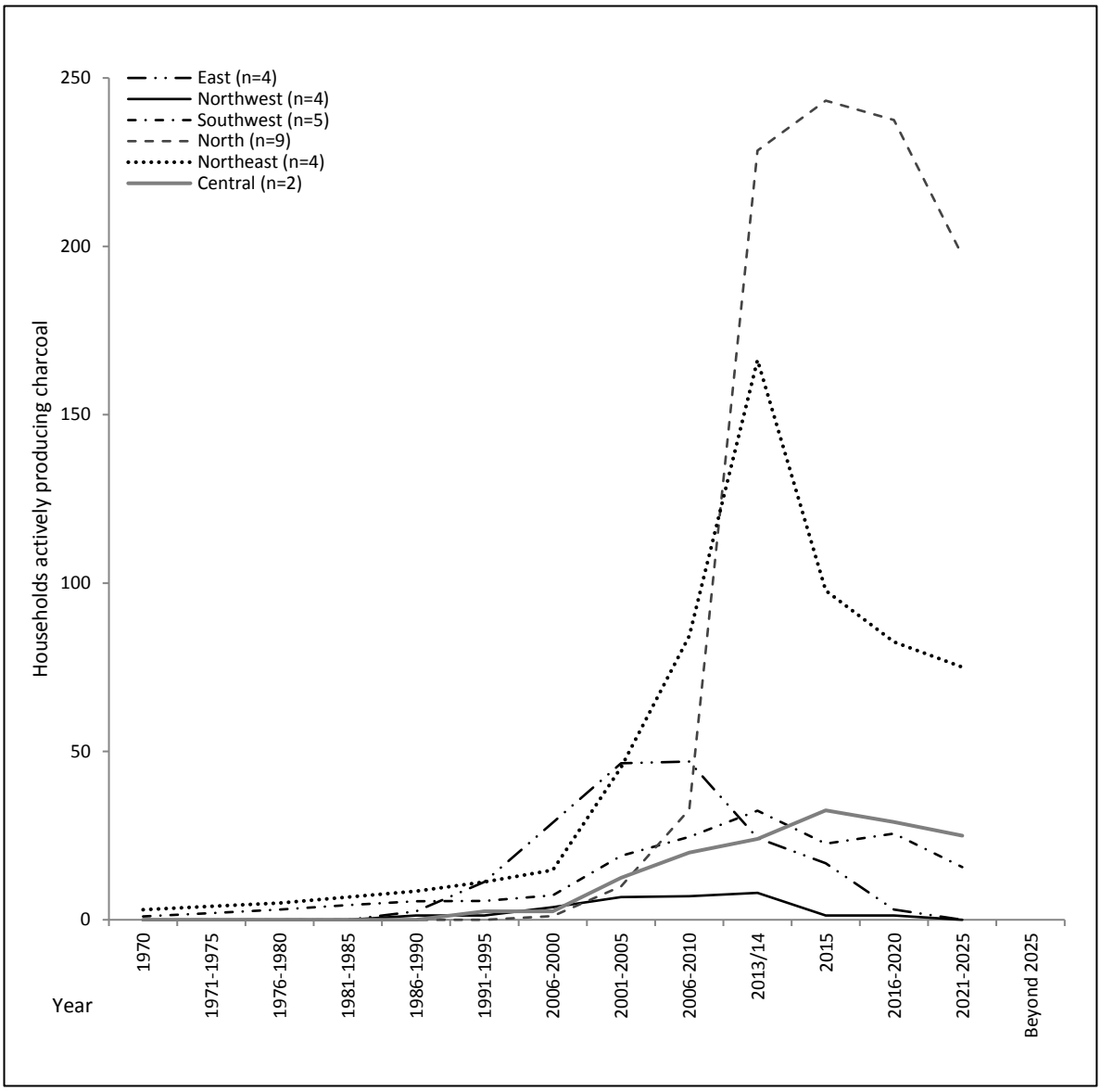
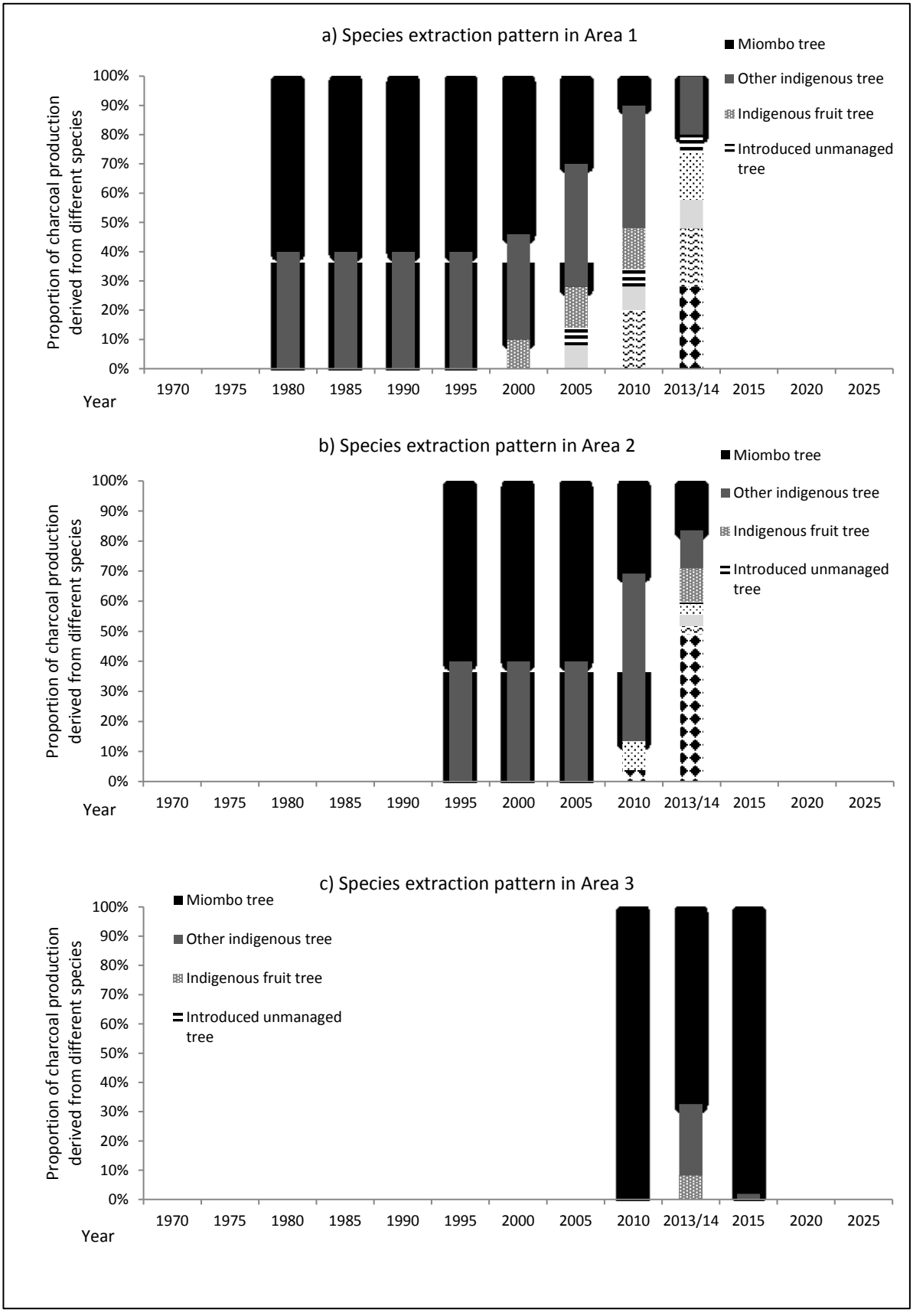


Figure 4.4: Tree species extraction patterns over time in Access Areas a) 1, b) 2 and c) 3



4.3.2 Factors influencing charcoal production

This second section triangulates information from both the village sample survey and the three case study villages, to narrate how various factors affected the spatial-temporal dynamics of charcoal production. Participants identified 4 key factors influencing communities' level of engagement with charcoal production: resource access, market access, financial insecurity and food security.

Resource Access

Institutional access

During the post-colonial one-party presidency between 1970-1994, the Department of Forestry employed local village members as forest guards in the forest reserves. However with the arrival of multi-party politics and democracy in 1994, local forest guard positions were discontinued and institutional resource restrictions were no longer locally enforced. Encouraged by traditional leaders to utilise the forest resources, villages interpreted democracy as the freedom to do as they wished, leading to high local-levels of forest resource extraction. Eleven villages identified the arrival of multi-party politics and as a factor influencing their engagement in charcoal production. However, this did not equate to immediate widespread production in the Zomba supply area in 1994. The Central group stipulated that migrant charcoal producers initially introduced the idea, knowledge and skills to the local area. The time lag amongst village residents was attributed to uncertainty with the trade's success, with residents producing once they had observed migrant producers generating substantial incomes.

Zomba, Malosa and Liwonde forest reserve were largely de facto open access resources due lacking enforcement capacities in the Forest Department. However, at the time of data collection the study period was midway through a transition phase establishing forest management in the forest reserves. All villages adjacent to Zomba, Malosa and Liwonde forest reserves were participating in a six-year, two-phase improved forest management for sustainable livelihoods programme (IFMSLP), a European Union (EU) funded programme which was running from 2007-2016. The programme aimed to "improve the livelihoods of forest dependent communities through the participatory management of forests both in forest reserves and on customary land" (IFMSLP II 2009, p. 2). All surveyed villages had a Village Natural Resource Management Committee (VNRMC), and most villages mentioned the existence of the IFMSLP through the

presence of a block committee.[15] The Department of Forestry, VNRMCs and block committees were all reported to patrol the forest reserves and enforce regulations (e.g. confiscations and fines) at the kiln site, in the villages and en-route to the market. Despite the prevalence of VNRMCs and block committees, no village perceived that the IFMSLP had yet affected their involvement in charcoal production. However, villages anticipated that future reduction in producers would in part be due to increased enforcement capacities.

Physical access

The eastern edge of Zomba and Malosa forest reserves sits on a plateau at approximately 1000m above the western plain. The slope gradient on the western side was consequently more severe than in the east. Furthermore, the hills in Liwonde forest reserve and the northern tip of Malosa forest reserve were much lower in elevation than Zomba and Malosa forest reserves. Distance to the resources and the contrast in elevation and gradient created spatial heterogeneity in physical resource access, which in turn contributed gendered characteristics in village-level production (Table 4.3). Area 2 was the most challenging to access; consequently production in the Southwest and Northwest villages was dominated by men. Production Area 1 was the furthest from the East group, taking up to 6 hours for a one-way trip; few women who produced in the East were described as desperate, likely to be poor and single. In contrast, Area 3 was the easiest to access and both men and women produced charcoal. In the North villages, only those too young, old or sick did not produce charcoal as physical access and distance to the resources was considered achievable for anyone.

Much of the early forest degradation in Production Area 1 was driven by the market demand for building materials in expanding urban areas of Zomba and smaller trading centres along the M3 tarmac road. Prior to the rise of charcoal demand, forests on the external perimeter of Area 1 were heavily utilised and degraded, thus remaining forest stock was located deeper in the forest reserve interior and was increasingly challenging for charcoal producers to reach. Consequently, the preceding forest product markets contributed to a shorter charcoal production period in the East group.

[15] Part IV, section 25 of the Forestry Act 1997 stipulates “the director of Forestry may enter into agreement with local communities for implementation of the management plan”. Under this agreement, the block committees were local-level community structures, charged with the coordination of community participation in forest resource management. Block committees were formed of representatives from multiple villages within the same block area.

Table 4.3: Reported genders of active charcoal producers in different village groupings, and walking distances (hours) to resources

Village group	Men only	Women only	Both men and women	Estimated hours walking one-way to resources
East (n=4)	2	0	2	5-6
Northwest (n=4)	3	0	1	3-4
Southwest (n=5)	4	0	1	3-4
Central (n=2)	0	0	2	2-3
Northeast (n=4)	1	0	3	1-2
North (n=9)	1	1	7	0-1
Total	11	1	16	-

Market access

Villages on the eastern side of Zomba and Malosa forest reserves had reliable road access via the M3 tarmacked road. In contrast, villages on the western side accessed Zomba via compacted and mountainous dirt roads, which were prone to flooding and deterioration during periods of intense rainfall. The difference in road access contributed to lower levels of production on the western side, compared to the eastern side.

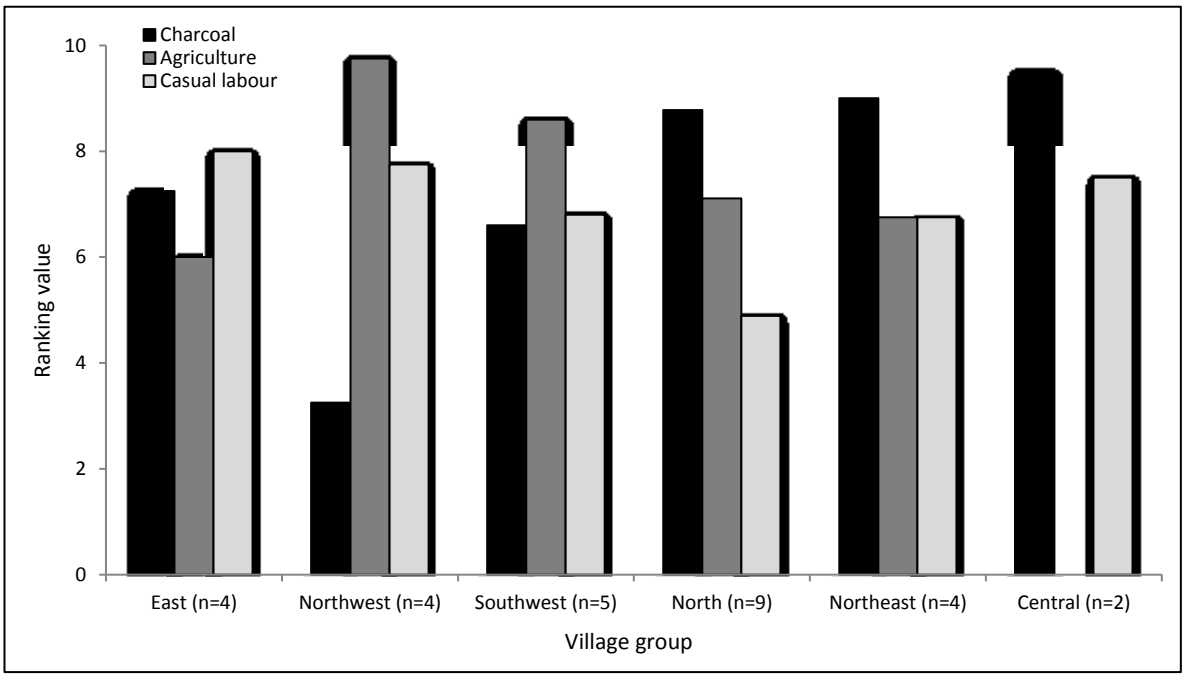
Due to higher market prices in Blantyre (a much larger city approximately 60km south of Zomba), there was no record of forested areas south of Zomba supplying the Zomba charcoal market. Market access for villages between the southern edge of Liwonde forest reserve and the northern tip of Malosa forest reserve was either via organised lorries delivering charcoal to Blantyre, or consumers buying directly from producers in private vehicles. Here, the eastern plateau drops down to meet the Western lower plain and at the time of data collection, the only permanent Department of Forestry roadblock in the study site was located at the top of this hill in Machinga town. No village located downhill sold to bicycle transporters (conversely no bicycle transporters travelled downhill to purchase charcoal from these villages), thus access to Zomba's market for these villages was uncommon. In comparison, nearby villages to the east of Machinga town had market access to both Zomba and Blantyre, via organised lorries travelling directly to Blantyre and small-scale transporters using bicycles and public transport travelling to Zomba.

Financial insecurity

The term *umphawi*, meaning poverty in Chichewa, Malawi's national language, was commonly used to describe why people produced charcoal. *Umphawi* was associated with financial insecurity, with secondary impacts associated with the inability to purchase basic assets, to afford to send their children to school, to purchase farm inputs, or to start a small business. Nineteen communities identified that *umphawi* underpinned most reasons for their involvement in charcoal production.

The contribution to the village economy from agriculture, casual labour[16] and charcoal production varied (Figure 4.5). The Northwest and Southwest groups ranked charcoal the lowest, the North, Northeast and Central groups ranked charcoal production as the most important income generating activity at the village level. All villages explained that people would stop charcoal production if there were alternative income generating opportunities. Two particular employment losses in the study region led to increases in local-level charcoal production: Six villages within the East, Southwest, North and Central groups identified the discontinuation of the forest guard positions with the arrival of democracy in 1994; Four villages in the Southwest group identified the closure of a limestone mining plant in November 2002.

Figure 4.5: Mean ranking of the importance of three income-generating activities: Charcoal production, agriculture and casual labour. A rank of 10 indicates the most important income generating activity, a rank of 1 indicates low importance



[16] We compared casual labour and agriculture against charcoal production, as they were considered the main livelihood activities in the supply shed (Zomba District Assembly 2009).

Food security

Seasonal and non-seasonal food insecurity

In 2001/02, Malawi experienced its greatest famine in recorded history.[17] Seven villages in the East, Northwest and North groups identified the famine as a key event that prompted them to engage in charcoal production. During the famine years and in the ensuing aftermath, villages entered into charcoal production as a means of generating income with which to purchase food. However, during the famine years the per-capita production rates were low, as households were making small, faster burning kilns, selling quickly and in smaller quantities. Producers recorded harvesting trees closer to their villages, as they did not have the energy or time to travel further into the forest. Participants from the Area 1 case study village described how the famine contributed to the diversification of targeted tree species for charcoal production. People had less energy to walk further into the forest reserve, so they produced closer to the villages, harvesting trees indiscriminately. In the ensuing years after the famine, charcoal production became integrated as a short-term food security strategy for households in this area. Seasonal food insecurity from December-March (due to insufficient maize reserves) contributed to household reliance on markets and the cash economy, thus stimulating engagement in charcoal production.

Agricultural support

In 2005/06 Malawi's Farm Input Subsidy Programme (FISP) was rolled out (Pauw and Thurlow 2014) in which some rural households initially received one coupon for 50 kg of fertiliser per year.[18] In the East, the FISP was perceived to have increased food security for poorer households.[19] Due to the distance to the remaining charcoal resources, the opportunity costs of labour, time allocations and food security provided by increased agricultural yields, subsistence agriculture became a preferable livelihood activity to charcoal production for some producers in

[17] Initially triggered by abnormal rainfall, localised flooding and waterlogged fields, the famine was exacerbated by grain reserve mismanagement, crop import bottlenecks and slow donor response (Devereux 2002). Although no official figures exist, estimates suggest the famine caused between 1000-3000 mortalities nation-wide, concentrated in three vulnerable groups: the elderly, young and the already ill (Devereux 2002). However, healthy adult men and women also succumbed to famine-related diseases and mortality (FEWSNET 2002 as cited in Devereux 2002).

[18] The Agricultural Subsidy programme has since developed to include various seeds.

[19] The programme's long-term economic success is criticised (Holden and Lunduka 2010; Dorward et al. 2013) and although official estimates demonstrate increased yields, good rains were likely the main contributing factor (Dorward and Chirwa 2011; Lunduka et al. 2013). Although some poorer household beneficiaries reduced their food insecurity, the FISP was not sufficient to enable these households to "'step out' or 'step up' [from food insecurity] rather […] just 'hang in'" (Dorward et al. 2013, p. ii).

this particular area. This resulted in a reduction of producers primarily using charcoal production as a short-term food security strategy.

The Northwest group perceived the lowest prevalence of charcoal production within the supply shed. This area in particular received considerable development support for irrigation agriculture practices, under the Irrigation, Rural Livelihoods and Development Project (IRLADP), which launched irrigation schemes in the area between 2005 and 2010. Villages in this group and Agricultural Extension Officers indicated that the increase in irrigation schemes contributed to the low level of charcoal production, as agriculture was a more productive livelihood strategy.

4.4 Discussion

4.4.1 Perceived spatial-temporal patterns of charcoal production and species extraction

In taking a finer-scale approach to examining Zomba's supply shed we found variability in the locations and duration of production periods. Over a 35-year period between 1990-2025, the production start, peak and end as perceived by communities were distributed unevenly throughout the supply shed. Hotspots of intense production have shifted from the East to the North, Northeast and Central, but lower intensity clusters have been maintained in the Northwest and Southwest. As the availability of trees decreased, charcoal production transitioned from perceived 'high-quality' trees such as Miombo species to remaining available trees, including the residual roots of the higher value species and domestic and fruit trees, which successively produce charcoal of lower grades. Diversifying targeted trees to those of lower value extended a community's ability to participate in the charcoal market and also was a coping mechanisms during the 2001/02 famine. However, by harvesting trees with multiple uses such as fruit and medicine, other forest products were lost.

Our findings corroborate other studies demonstrating that preferences towards particular tree species and size classes leads to selective harvesting practices in charcoal production (Hosier 1993; Sedanoet al. 2016) and with other wood products such firewood (Shackleton 1993; Pote et al. 2006) and timber (Plumptre 1996; Hall et al. 2003). Regardless of whether a forest is entirely cleared however, selective harvesting practices alters forest composition, ecosystem function (Ndangalasi et al. 2007) and the loss of certain indigenous species is an important indicator of severe biodiversity loss (Kirubi et al. 2000). The transition from selective to indiscriminate harvesting of trees demonstrated in this case study follows the theory of 'fishing down the food web', an unsustainable exploitation pattern of extraction that targets high to low valued species in sequence (Pauly et al. 1998). This type of high to low value sequential extraction has also been recorded in forests in Tanzania (Ahrends et al. 2010), whereby the spatial pattern of extraction

occurred in “predictable waves of sequential forest degradation and biodiversity loss” (p. 14556) that spread from the urban demand centre of Dar es Salaam. Whilst we find a similar high to low value trend in the sequential targeting of tree species as Ahrends et al. (2010), our study does not demonstrate comparable spatial patterns of ringed degradation expanding from the urban centre, possibly due to the difference in the scale of analysis. Instead, we found that the dynamics of resource extraction occurred in heterogeneous clusters with specific spatial hotspots; similar spatial extraction patters of NTFPs have been demonstrated in other local-scales of analyses (Mackenzie et al. 2012).

The diversification of harvested species upon reaching peak production is perhaps not a surprising find, but this type of knowledge could be useful for forest management practices to easily determine the stages of charcoal production across a supply shed. For example, knowing whether communities harvest lesser-preferred species or roots provides information the level of resource degradation and of tipping points, immediately signifying that the local situation has reached a crisis point and requires interventions.

4.4.2 Local-scale factors influencing charcoal production

Whilst household and individual-scale analyses of producers can help identify important factors motivating an individual (e.g. Minten et al. 2016; Jones et al. 2016) and larger (e.g. global) scale analyses identify broader drivers of change (e.g. Geist and Lambin 2002), there is a gap in our understanding at the intermediate level. Spatial-temporal patterns of charcoal extraction are not solely based upon the spatial distribution of available resources, broad scale drivers or an individual’s needs. Our study identified local-scale factors invisible at both the individual and broad-scale, thus contributing new knowledge to our understanding of the drivers of land use change. We demonstrate that additional, intermediate local-level events have shaped Zomba’s spatial-temporal variability of production locations and identify four local-level factors that influenced who participated, where, how long for and at what intensity production occurred in a given time and location. Forest resources must initially be available and physical and institutional market and resource access must be achievable. Under conditions of financial and food insecurity, poor, rural villages are likely to engage in charcoal production. It is important not to overlook the nuances between these factors as their heterogeneity and interconnectivity determined much of the temporal-spatial variability of production locations.

Von-Thünen’s theory on land use change requires a homogenous landscape to predict land use change. However we demonstrate the impact a heterogeneous landscape has on the supply shed dynamics, as market demand for forest resources from Blantyre severely skewed the spatial-temporal dynamics of the supply shed North of Zomba. Furthermore, the higher market costs for

communities furthest away from Zomba in the North meant that these villages accessed both Blantyre and Zomba charcoal markets. Additionally, some villages only accessed Blantyre's market due to institutional constraints and topography. These local-level factors within Zomba's supply shed influenced where charcoal production, thus forest degradation, occurred.

Producers' harvesting behaviour has been shown to be a function of the market setting (Ruiz-Pérez et al. 2004). When market costs are too high (e.g. transportation methods are too costly or the distance is too far), producers are unlikely to sell to the market. However reduced market costs (e.g. from improved roads or increased product prices) increases producers' ability to access markets (Robinson et al. 2002). When market costs decrease, the area of degraded forest is likely to expand as producers travel further into forested areas to harvest resources. Consequently, forests in close proximity to markets tend to be more degraded (Robinson et al. 2002). Our findings correspond to these market influences. The ease of access to Zomba's markets via the M3 tarmac road and the steep rise in market demand correlated with a surge of producers, particularly in the North and Northeast groups. Additionally, demand for other forest resources (e.g. building materials) resulted in the southern-forested areas of Zomba forest reserve being depleted before demand for charcoal grew and opened up deeper forest areas for more recent charcoal production.

The Northwest and Southwest groups had lower numbers of producers and men dominated production. These observations suggest that physical access, in terms of elevation and slope, not only influenced the type of producer able to access the resources but also the prevalence of production as a livelihood strategy. In contrast, producers in communities with easier access to resources, or with access to multiple production areas were more numerous and included both men and women. The need to fit income-generation around domestic chores (Jiggins 1989; Mehretu and Mutambirwa 1992) may explain the fact that women were more likely to participate in charcoal production in villages with shorter distances to the resource and only marginalised (e.g. single and poor) women were more likely to participate when resources were more challenging to access. Other authors report similar findings, suggesting that charcoal production is too labour intensive for women (Angelsen and Wunder 2003; Arnold et al. 2006).

In contrast there were limited entry barriers in the North group, resulting in a lack of distinct 'producer type' and large number of producers. Market demand was high, with corresponding high market selling prices; market costs were low, with transporters travelling to villages to purchase charcoal and with ease of transport to Zomba city along the M3 tarmac road; resource access and labour costs were low, as preferred species were numerous, at low elevations close to the forest reserve boundary. There was no dominant alternative source of income for these villages. It is therefore likely that charcoal production will continue to expand through these

villages, eastward along the southern edge of Liwonde forest reserve providing sufficient resources are available. Furthermore, unrelated events may cumulatively influence local decisions to engage in production. For example, the coincidence of the 2001/02 famine and the closure of Changalume mining plant may have exacerbated local financial stresses. The strengthening urban market for charcoal in Zomba was potentially an attractive and lucrative business for villages in the Southeast group at this time.

The Northeast group had the lowest prevalence of charcoal production per village. Poor resource access caused by high elevation and steep slopes and high market costs due to long distances and low quality road access meant that charcoal production was unlikely to become an important income generating activity in this area. The concentration of agricultural development in the Northeast may have meant that labour for, and profits from charcoal could not easily compete with those of agriculture. Thus, future engagement with production may struggle to expand in this area. Charcoal production is often considered a secondary and profitable product of agricultural expansion (Chidumayo et al. 2001; Bailis 2005; Hofstad et al. 2009) yet our study shows no evidence of this type of production in the supply shed. Although the study region is land scarce (this region has the highest population densities in Malawi), the topography of the forest reserves limits the potential for agriculture in these areas. The experience in the Northeast group highlights that agricultural development may be a potential tool to reduce people's dependence on charcoal production or a useful pre-emptive investment to prevent future charcoal expansion into a potentially high-risk area. However caution is required with certain types of agricultural development, given that charcoal is a lucrative by-product and affordable means for agricultural expansion. In this respect, investment in agricultural development would be most beneficial if it helps to intensify production from already cleared land and does not inadvertently lead to additional land cover change.

4.4.3 Policy implications

In Malawi, local registration agreements for the Forestry Community Participation Rules (Forestry Act 1997 Section 5(k) and 31) state: "both production and sale of charcoal from indigenous wood requires a special license ONLY [sic] issued by the Director of Forestry" (p. 28). The village forest organisation "may set minimum penalties for offences" (p. 29) and "has the right to seize or detain any forest product which they reasonably suspect has been obtained or removed […] or items used in committing and offence" (p. 29). The issuance of charcoal licenses therefore remains under centralised control, while restrictions on charcoal production are enforced at local level.

Due to low enforcement capacity, the forest reserves were de facto open access resources. Open access resources are vulnerable to resource overexploitation, which can negatively impact extractors' livelihoods (Hardin 1968). As the value of such resources increase, they often become privatised (e.g. domestication of fruit trees or growing of woodlots) or subjected to new management regimes (e.g. community-based forest management or harvesting quotas) (Marshall, Schreckenberg et al. 2006). However, because the forest reserves are under government ownership, there is little opportunity for communities to independently develop sustainable management for charcoal production. Like many African countries, Malawi's charcoal demand is predicted to increase in the future, as shifts from wood-based energy to electricity are unlikely (Zulu 2010; Holmes 2015). Under a scenario of de facto open-access resources and limited alternative income generating activities, rising demand for charcoal will inevitably lead to extensive unsustainable forest resource exploitation.

The EU-funded IFMSLP is part of a global process of increasing forest devolution (Sunderlin 2011). Although a promising approach to forest conservation and community development (Charnley and Poe 2007), community forestry may also negatively impact the lives of local forest users (e.g. Edmunds and Wollenberg 2003). The capacity of the IFMSLP to protect the remaining forests from illegal charcoal extraction may substantially affect producers' future ability to access charcoal resources, a positive development for forest protection. However, the change to producers' resource access may displace extraction to more distant areas of forest, reducing the production capacity of extractors and having a negative impact on their livelihoods (Robinson and Lokina 2011), whilst not having the desired effect for forect protection. As long as there is insufficient focus on enabling sustainable production, stricter enforcement of punitive regulations simply increases vulnerability of people with charcoal-based livelihoods in this region while having no positive impact on the resource base (Smith et al. 2015).

Forest protection policies are predominantly spatially explicit (e.g. protected areas and buffer zones, targeted poverty alleviation programmes and payment for ecosystem service schemes such as REDD+). But, the success or failure of such policies depends on socio-ecological factors (which are both spatially and temporally specific) that affect how, when, how much, where and at what intensity people decide to harvest forest products (Robinson et al. 2002). Analysing the spatial distribution of socio-ecological factors is therefore important to inform natural resource planning and assist in understanding benefits and trade-offs between conservation and development concerns (Naidoo and Ricketts 2006). An understanding of the key factors causing villages to engage in charcoal production and how they are related could support more considered interventions in potential charcoal production areas. Findings from this study indicate that appropriate alternative livelihoods should be available to replace lost income from charcoal

production. Therefore, focussing on improved forest protection and encouraging more efficient and sustainable charcoal production should be combined with the development of alternative income generating activities such as agricultural intensification, to cumulatively be successful for forest protection and improved rural livelihoods.

This study has demonstrated that the spatial pattern of production shifts through time, with a range of factors affecting the intensification and duration of, and participation in the sector. The findings related to village heterogeneity challenge current debates over the outright banning of charcoal production. Rather, these findings argue for better-targeted policy interventions, which acknowledge the differences between villages within the same supply shed. Monitoring and evaluation of factors at the local charcoal market-scale may therefore provide an important tool for local policymakers, by helping to identify potential future local production locations (high-risk forest areas), and by delivering locally relevant interventions.

4.4.4 Further research

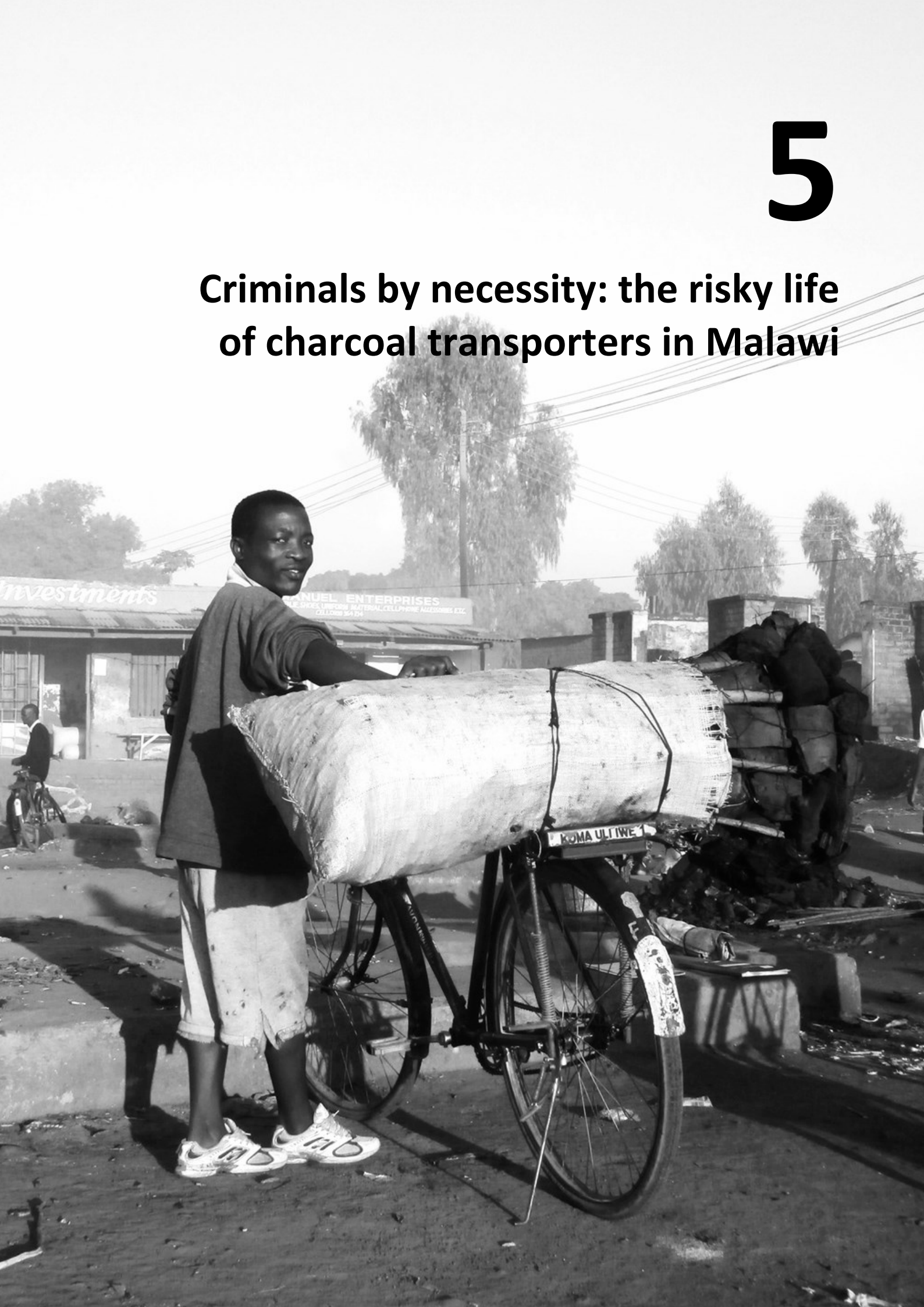
Charcoal production hot-spots are spatial indicators of forest degradation (Ryan et al. 2012) and estimations of above-ground woody biomass suitable for charcoal production is highly desirable information for forest management (Castillo-Santiago et al. 2013). Charcoal-driven land use change is frequently measured by remote sensing geographic information system (GIS) techniques, which offer snapshots of charcoal production at given moment in time, but deliver limited insights into spatial and temporal dynamics of the process (Sedano et al. 2016). Furthermore, there are consistency issues in automatic and semi-automatic methods used to identify kiln sites as proxies for charcoal production areas (Rembold et al. 2013; Bolognesi et al. 2015; Dons et al. 2015). The methodology used in this study presents a novel opportunity to indirectly monitor trends in forest use, species abundance and prevalence of charcoal production, through the use of local knowledge, a resource largely untapped by policymakers (IPCC 2014). Future research would be useful to assess how accurate (and therefore useful) this type of forest degradation data is by, for example, comparing perceived extraction trends with information from forest inventories. The findings of this study demonstrate that producers react quickly to certain policies (e.g. liberalisation of access to forests). Yet, more work is required to understand how best to integrate information about spatial-temporal production trends into policy. Thus, phasing of support for sustainable charcoal production (possibly community-based) on the one hand, and stricter enforcement of regulations on the other therefore needs careful consideration to ensure that the resource is conserved with no additional costs to local livelihoods.

4.5 Conclusion

The narrative portrayed in Zomba's supply shed highlights four intermediate local-level factors that influence communities' decisions to engage with charcoal production: market access, resource access, income and food insecurity, resulting in a spatially and temporally heterogeneous supply shed. We have demonstrated how the spatial-temporal production dynamics have changed, and indicate how future scenarios may influence communities' decisions. Given the predicted growth of the charcoal sector in sub-Saharan Africa and the current failures of forest protection measures, we propose that local-level analyses and locally-relevant interventions can support more considered interventions in high-risk forest areas of charcoal production hotspots.

5

Criminals by necessity: the risky life of charcoal transporters in Malawi



Chapter 5: Criminals by necessity: the risky life of charcoal transporters in Malawi

This chapter has been published in the Journal of *Forests, Trees and Livelihoods*:

Harriet Elizabeth Smith, Felix Eigenbrod, Dalitso Kafumbata, Malcolm D. Hudson and Kate Schreckenberg (2015). Criminals by necessity: the risky life of charcoal transporters in Malawi. *Forests, Trees and Livelihoods*, DOI: 10.1080/14728028.2015.1062808

The Journal article was presented in the form of a poster presentation by Dr Dalitso Kafumbata, on behalf of the co-authors, at the *First National Government Charcoal Forum* in Lilongwe, Malawi, in September 2015. The same poster was also presented at the *University of Malawi's Annual Research Consortium* in August 2015.

Data from this chapter were also presented as a presentation and in the proceedings of the *XIV World Forestry Conference* in Durban, South Africa, September 2015:

Smith, H. E., Eigenbrod, F., Hudson, M., Kafumbata, D., Schreckenberg, K. (2015). The impact of informal forest product trade on economic outcomes: A case study of charcoal transporters in Zomba, Malawi. Paper for XIV World Forestry Congress, Durban, South Africa.

Abstract

The charcoal industry in sub-Saharan Africa plays a substantial role providing growing urban populations with domestic energy. However, concerns about its environmental impacts have led to punitive policies, resulting in the criminalisation of charcoal-based livelihoods. One factor constraining the development of more effective policy approaches is limited data on the impacts of regulations on the socio-economic outcomes of different value chain actors. We focus on one group of actors: charcoal transporters, who supply charcoal to Zomba, a medium-sized city in Southern Malawi. Drawing on a survey of 201 transporters, we find that they are attracted by fast cash-in-hand, low capital requirements and the lack of alternative local employment opportunities. Both men and women participate, yet transport methods are gendered. Men, who typically transport charcoal on a bicycle, earn three times as much per week as those who carry charcoal on their heads, the main method used by women. However, bicycle users incur higher financial risk due to costs associated with confiscations and damage to bicycles. Unlike in larger cities, an urban elite does not dominate the supply chain in Zomba. We argue that punitive targeting of small-scale charcoal transporters serves only to push them deeper into poverty and does nothing to contribute to sustainable resource management.

5.1 Introduction

5.1.1 The charcoal dilemma

The consumption of charcoal for fuel within sub-Saharan Africa is projected to double between 2000 and 2030 and will increase at higher rates than in any other region of the world (Arnold et al. 2006; Zulu and Richardson 2013). The growing demand for charcoal has increased the opportunity for income generating activities, livelihood support, poverty alleviation and domestic market expansion (Ribot 1998; Malimbwi and Zahabu 2008; Anang et al. 2011; Khundi et al. 2011); however large uncertainty exists over the importance of charcoal as a livelihood strategy, or the risks involved (Arnold et al. 2006).

Previous studies examining charcoal-based livelihoods across sub-Saharan Africa emphasise the financial aspects of the value chain and the vertical distribution of benefits. Studies focus on the entire value chain (e.g. Kambewa et al. 2007; Shively et al. 2010) or specifically the producers (Khundi et al. 2011). Within non-timber forest product (NTFP) literature, middle-men are the most maligned actors in the value chain (Schreckenberg 2003). They are described as a powerful group of actors who have the ability to exploit others in the chain (Belcher and Schreckenberg 2007) but may also play an important entrepreneurial role, connecting producers and consumers (te Velde et al. 2006). Even though charcoal transporters have received far less focussed attention within the literature, there is a perception that they are an elite urban-based minority who earn higher revenues than other chain actors as they typically monopolise motorised transportation links and are politically connected (Ribot 1998).

Analyses of charcoal value chains in Africa have largely focussed on capital cities (Monela et al. 1993; Ribot 1993; 1995; 1998; Brouwer and Magane 1999; Knöpfle 2004; Bailis 2005; Shively et al. 2010; Khundi et al. 2011). In comparison, little research focuses specifically on value chains of smaller urban areas (Kambewa et al. 2007; Agbugba and Obi 2013). Smaller urban areas – defined as having a population of less than one million – are likely to see 75% of future urban population growth in Africa (UN-Habitat 2014). These arguably represent the most important charcoal consumption zones across Africa and a source of income for an unknown, but assumedly large number of people involved in the charcoal sector.

As the literature to date has predominantly focussed on large market landscapes, little is known about charcoal transporters in smaller urban areas. This is a major gap in the literature, as there is no evidence to suggest that the charcoal markets of small urban areas are homogenous, that they

have similar value chain actors, distributions of benefits and power, or governance structures to their larger counterparts.

Governance issues related to forest product value chains have also received limited attention in the literature (Ingram, Levang et al. 2014). The charcoal sector in sub-Saharan Africa is mostly unregulated and even when legal restrictions apply, they are frequently ignored (Biomass Technology Group 2010). Ribot (1995) examined policy implications for charcoal-based livelihoods in Senegal and found they were neither equitable nor beneficial to local forest users. Local villagers retained only 3% of the charcoal market's net profits whereas 70% went to merchants. Schure et al. (2013) examined the links between the formalisation of charcoal industries and socio-economic outcomes in Central and West Africa. They demonstrated that resource scarcity stimulated the formalisation of institutions. Although formalised institutions had the ability to distribute benefits to rural actors, the distribution favoured more powerful, predominantly urban actors. Schure et al. (2013) highlighted the lack of quantifiable knowledge about livelihood outcomes, specifically about the organisation and governance of production and trade.

Improving value chains is a potential tool to promote pro-poor development (Mitchell and Coles 2011; Ingram, Levang et al. 2014). However variations in the legality of the charcoal sector can increase corruption, exploitation and can cause voicelessness and powerlessness, particularly among poor and female value chain actors (Butz 2013; Zulu and Richardson 2013). Locally inappropriate and poorly coordinated policies may also mean that charcoal production does not fulfil its potentially positive contribution to poverty reduction but rather increases "material deprivation, poor health, and vulnerability or risk exposure" (Zulu and Richardson 2013, p. 134). The development of more effective policy approaches is hampered by limited data on the impacts of rule enforcement on livelihoods of actors in the charcoal value chain.

This paper is one component of a larger value chain study that examines charcoal-related livelihoods in Zomba, a medium-sized city located in southern Malawi. Our overarching aim is to investigate the role of the charcoal trade in the livelihoods of charcoal transporters, an under-researched group of actors who experience a high level of disciplinary enforcement within the value chain. To achieve this, we focus on three research questions:

1. What are the characteristics of charcoal transporters?
2. What income is generated from transporting charcoal and are there constraints to accessing higher earnings?
3. What are the impacts of government regulations on charcoal transporters' livelihoods?

By answering these three questions we can begin to understand the complex reasons that lead millions of people to participate in the charcoal sector and other informal trades, and continue to participate regardless of the risks associated with their illegal status. Understanding the needs and circumstances of the people who rely on informal and illegal markets can inform policies and reduce the potential for increased livelihood vulnerability that is associated with disciplinary enforcement (Canagarajah and Sethuraman 2001).

5.1.2 An overview of the Malawian charcoal sector

The charcoal sector in Malawi reflects the situation across most of sub-Saharan Africa, where people are heavily dependent on charcoal for domestic urban consumption and where the supply of charcoal is unsuccessfully regulated. In Malawi, the majority of charcoal is sourced from indigenous miombo woodlands (Zulu 2010) and an estimated 15,000 hectares of forestland is cut each year for charcoal (Kambewa et al. 2007). An over-reliance on wood-based fuels has been cited as a major cause of deforestation in Malawi (Government of Malawi 2010).

Charcoal production is permitted under the Forestry Act (1997), Part XII, Section 81 (1), which states that 'no person shall make or sell charcoal from indigenous timber or trees except pursuant to a licence issued'. There are specific offences and penalties for those who transport charcoal:

"Any person who: knowingly received forest produce illegally; or is found in possession of forest produce without a permit; trafficks in forest produce without a licence, shall be guilty of an offence. Any person who is convicted of an offence under subsection (1) shall be liable to a fine upon conviction of K20, 000 [USD $50] and to imprisonment of ten years" (Forestry Act 1997, Part X, Section 68).[20]

Despite opportunities to produce charcoal legally, there have never been any licences issued and to-date there are no recorded cases of legal production.[21] This effectively means that all charcoal production and transportation is illegal in Malawi.

Difficulties with producing and transporting charcoal in accordance with the law criminalise the livelihoods of an estimated 92,800-200,000 people employed by Malawi's charcoal industry (Kambewa et al. 2007; MARGE 2009) and put them at risk of prosecution. In the four largest urban

[20] At the time of the fieldwork in September – December 2013 and June – September 2014, the exchange rate ranged from US$1=K325 to US$1=K407 and US$1=K375 to US $1=K394 (Oanda Corporation 2015). For indicative purposes, we will use rate USD $1=K394 for the rest of the thesis.

[21] This chapter and related publication was written before the first license was given in September 2015.

settlements, estimates suggest that the charcoal industry is worth in excess of USD $40 million per year (Kambewa et al. 2007). A study by Zulu (2010) found that woodfuel for commercial use was rarely collected free of charge and government enforcement in harvesting areas was almost non-existent. He demonstrated that the charcoal ban promotes political corruption in Malawi, as bribes throughout the value chain accounted for 12–20% of the total retail value of charcoal (Kambewa et al. 2007).

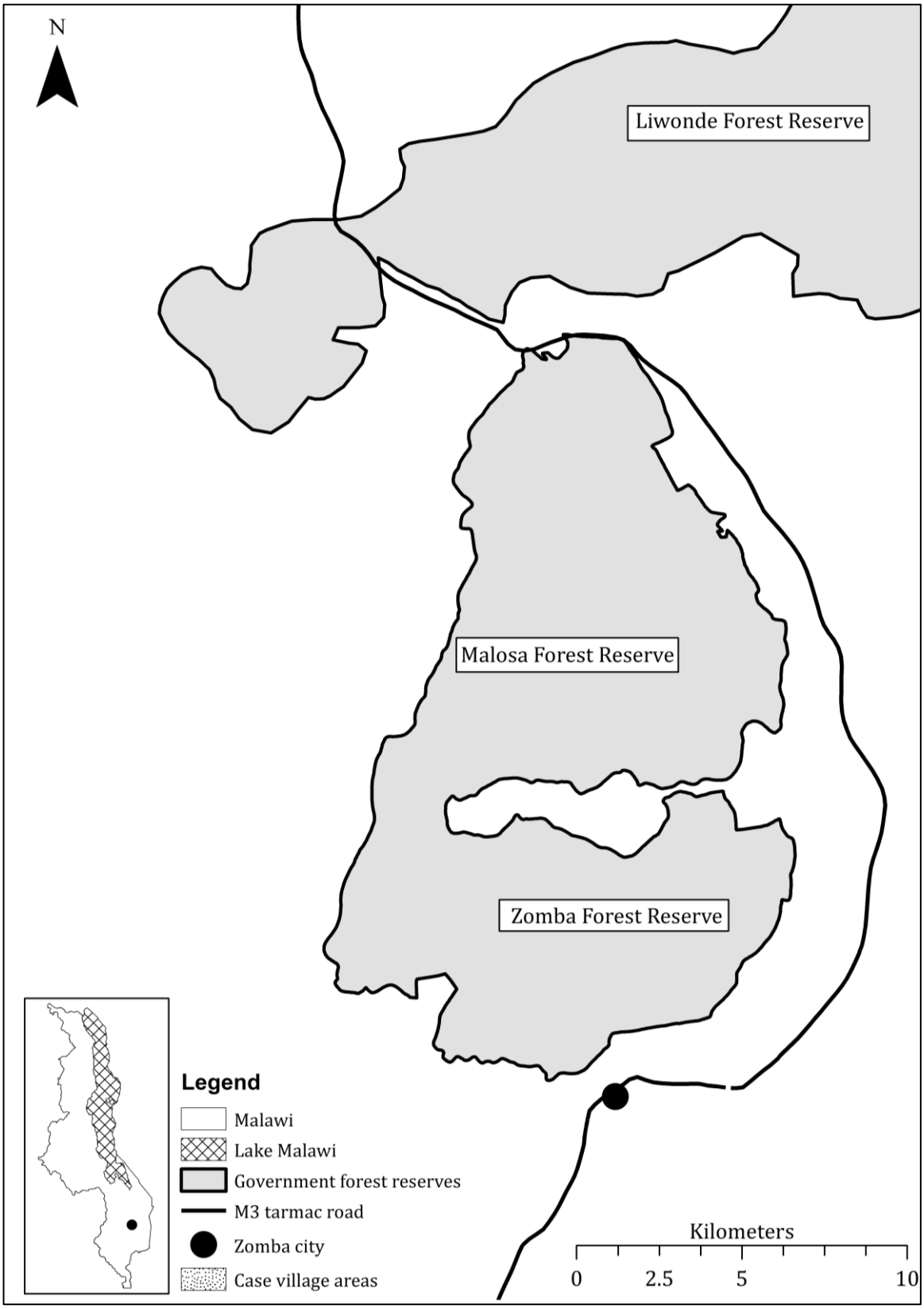
5.2 Materials and methods

5.2.1 Study area

National population projections estimate the urban population of Zomba exceeded 164,000 in 2015 and will increase at a rate of 4.21% (NSO 2013). The major charcoal production sites that supply Zomba City are Zomba forest reserve, Malosa forest reserve and Liwonde forest reserve (Kambewa et al. 2007) (Figure 5.1). There are no major supply areas south of Zomba. This is due to the scarcity of available trees and competition with Blantyre, a much larger urban area. Zomba and Malosa forest reserves consists of miombo woodlands, pine and eucalyptus timber plantations; Liwonde forest reserve is predominantly miombo woodland (Makungwa and Kayambazinthu 1999; Zomba District Assembly 2009). As the availability of trees in Zomba and Malosa forest reserves has decreased, Liwonde forest reserve is increasingly being used to supply Zomba City.

The communities surrounding the forest reserve are densely populated (NSO 2009) and some of the poorest in Malawi, with around 70% falling below the national poverty line (Zomba District Assembly 2009). There is a heavy reliance on seasonal and casual income and the local economy is dominated by subsistence agriculture, predominantly maize production (Zomba District Assembly 2009).

Figure 5.1. Zomba, Malawi and its main charcoal production areas



Data supplied by the National Statistics Office of Malawi

5.2.2 Data collection

Transporter surveys were carried out during the cool-dry season in September-October 2013 (n = 92) and June–July 2014 (n = 109). Transporters were surveyed at six sites identified and selected through observation and confirmation with key informants including consumer households and other value chain stakeholders. The sites included main market areas, the main road (M3) leading from Zomba and smaller arterial dirt roads. Surveys were carried out at varying times between 4 am and 10 am, as these were the main times transporters came to town. Transporters surveyed were those who were transporting charcoal to sell in Zomba, who were in the market selling charcoal or who were leaving Zomba, having sold charcoal.

This study does not claim that the sample is representative of the region as the sample strategy was opportunistic, targeting participants who were willing, available and observable. For example, potential participants were excluded on ethical grounds if they were in the process of selling, as the researcher did not want to interfere or jeopardise their source of income. Furthermore, due to the timings (during the night and early morning) and modes of transportation (it would have been both practically unmanageable and unethical (as the presence of the researcher may have indicated the location of the transporter to regulating authorities), to identify and survey transporters whilst they were on the bus), it is likely that there were groups of transporters who were missed in the data collection.

Information was collected using a semi-structured questionnaire. Transporter variables include information about respondents' experience in the charcoal transporting trade, their earnings and costs, experience of enforcement (e.g. number of times charcoal or bicycles were confiscated, fines paid), ownership of a few basic assets (e.g. bicycle, phone) and a range of demographic characteristics (Table 5.1).

The 2013 survey captured only bicycle and headload transporters while the 2014 survey also captured people transporting charcoal via two types of public transport (minibuses and lorries). The whole data set was used for statistical analysis of the variables of bicycle and headload transporters but only the 2014 data were used for comparisons between the four transporter groups.

People engaged in Zomba's charcoal sector operate under conditions of poverty and a lack of alternative employment opportunities. These stimulate short-term behaviour and encourage people to make decisions favouring short-term gains (Davies 1993; Chambers 1995; Wood 2003). Therefore, to capture transporters' short-term strategies we examine the range of sale

frequencies, costs and income on a weekly time-scale. Discussions with stakeholders confirmed that a week was the most appropriate time frame.

Gross per-bag profit was calculated by subtracting an individual's average buying price from their average selling price of a bag. Mean net profit per bag was calculated by further deducting costs incurred by each transporter such as transport (e.g. bicycle rental, public transport fares) and labour (e.g. hiring help). Mean weekly earnings for each individual were therefore calculated using the following equation:

Mean weekly earnings = number of trips made per week x mean number of bags carried per trip x mean net per-bag profit

Table 5.1. Transporter variables by data type

Continuous data	Bimodal categorical data	Multi-categorical data
Age (n=201)	Gender (n=201)	Education (n=201)
Number of children (n=201)	Marital status (n=201)	Ethnicity (n=201)
Experience in business (years) (n=201)	Lives in an urban area (n=201)	Method of transportation (n=109)
Number of bags per trip (n=201)	Additional income generating activity (n=201)	Intended continuation in the business (n=201)
Transportation trips per week (n=201)	Owns livestock (n=201)	Reasons for stopping transporting (n=201)
Price of a 50kg bag of charcoal bought from producers (n=109)	Owns a bicycle (n=201)	
Price of a 50kg sold to consumers (n=109)	Owns a mobile phone (n=201)	
Cost of transport per trip (n=109)	Access to agricultural land (n=201)	
Cost of labour per trip (n=109)		
Annual frequency of charcoal confiscation (n=109)		
Annual frequency of bike confiscation (n=109)		
Annual frequency of bike reclaim fee (n=109)		
Annual frequency of official fine (n=109)		
Annual frequency of unofficial monetary fee (n=109)		

5.2.3 Data analysis

As the data did not meet the assumptions of parametric tests, we used non-parametric techniques throughout. Data were both continuous and categorical, so a number of statistical tests were used. Mann–Whitney U tests and Chi-squared analyses were used to examine if there were significant differences between male and female transporters in terms of key characteristics, i.e. age, method of transportation. Differences in the distribution of weekly income across categorical variable groupings were tested with Mann–Whitney U tests, i.e. gender (male or female) and Kruskal–Wallis tests, i.e. method of transportation (bicycle, headload, lorry, minibus). Spearman's correlation analysis was used to quantify the association between weekly income and continuous variables, i.e. age, number of children. Finally, Mann–Whitney U tests, i.e. marriage and age, and Spearman's correlation, i.e. age and number of children, were used for follow-up analyses to try to identify which of the variables associated with mean weekly earnings are most likely to be causal. All statistical analyses were carried out using IBM SPSS statistical software version 22.

Qualitative information from transporters was analysed thematically and triangulated against information from informal discussions with other value chain actors and national forestry experts to provide explanations for some of the quantitative data.

5.3 Results

5.3.1 Transporter characteristics

There is considerable diversity among charcoal transporters.[22] However, the majority of transporters were married (78.1%), had primary-level education (70.6%), were from the regional ethnic group Yao (55.7%), transported twice or three times per week (49.8%) and did not live in urban areas (95.5%). Transporters tended not to have an alternative source of income (63.6%)[23] and did not own a mobile phone (62.2%). It was uncommon for transporters to work with spouses or family members. Three male respondents transported with their wives, one female respondent transported with their husband and two women transported with their parents.

Charcoal transporting was considered an intermediate activity by over half of transporters, either as a coping activity until the farming season began (9.3%), until they could upgrade to a more

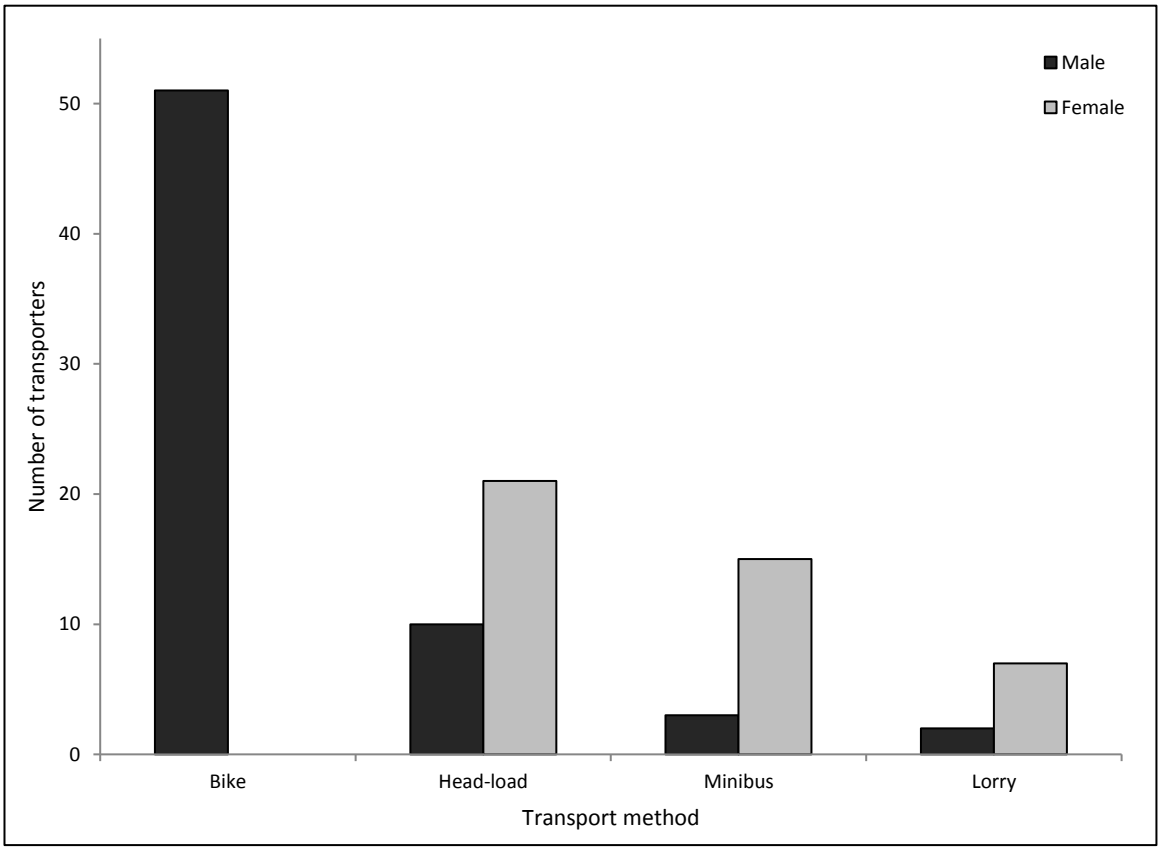
[22] Appendix G presents all the characteristic variables.

[23] Subsistence farming was not considered an income generating activity. Farming was only considered an income generating activity if transporters had sold their own produce.

profitable activity (44%) or until they no longer needed to generate as much money (11.9%). Over one third (38.2%) of transporters didn't know when they would stop, 29.4% had no intention of stopping, 30.9% were intending to stop within the following twelve months and 17.4% identified that the enforcement of regulations would cause them to stop.

Charcoal was transported as headloads, on a bicycle or by public transport (minibus or lorry) (Figure 5.2). Transport methods were highly gendered with women significantly more likely than men to transport charcoal by headload and public transport and never using bicycles (Chi-squared = 62.806, df = 3, $p < 0.01$, n = 109). Women transporters were significantly younger than men (Mann–Whitney U = 3159.5, $p < 0.01$, n = 201); they had been transporting for less time (Mann–Whitney U = 3294, $p < 0.05$, n = 201); and they transported charcoal fewer times per week (Mann–Whitney U = 2528, $p < 0.01$, n = 201). Furthermore, fewer women (13%) than men (48%) owned a mobile phone (Chi-squared = 21.8, $p < 0.01$, n = 201), only one woman owned a bicycle even though she did not use it to transport charcoal and fewer women (53%) than men (89%) were married (Chi-squared = 30.7, df = 1, $p < 0.01$, n = 201). [24]

Figure 5.2: Number of men (n = 65) and women (n = 43) transporters using different modes of transport



[24] Appendix H presents all calculations of variable differences between men and women.

The time taken and distance travelled varied between and within transporter methods. Those who travelled by headload only travelled from the villages on the southwestern edge of Zomba forest reserve to the west of Zomba city. Charcoal would be bought in advance from neighbouring villages. They would leave their villages between the hours of 11 pm and 4 am, and would walk along un-tarmacked roads and footpaths for 3-6 hours to arrive in Zomba in the early morning.

Bicycle transporters travelled from villages on the southwestern edge of Zomba forest reserve or from villages along the eastern flank of Zomba and Malosa forest reserve, north of Zomba city. Bicycle transporters from the Southwest bought from neighbouring villages, and those from the North would either buy from nearby villages, or travel further north to the southern edge of Liwonde forest reserve. They used the same access routes as headloaders if travelling from the Southwest, or would use the M3 tarmac road if travelling from the North. Bicycle transporters would leave their villages between 12 am and 4 am, cycling for 3-6 hours to arrive in Zomba early morning. Bus and lorry users either travelled from Malosa trading centre, approximately 16 km along the M3 road north of Zomba, or from the southwestern edge of Zomba forest reserve.

Bus and lorry transporters travelling from the Southwest bought charcoal from neighbouring villages and from the North would purchase from neighbouring villages, or travel further north to the southern edge of Liwonde forest reserve. Some would arrive the night before to avoid enforcements, paying to sleep at a 'rest house' in the market. Others would catch the early morning buses at around 5 am and 6 am to arrive in Zomba early morning.

5.3.2 Income generation and constraints to accessing higher earnings

Mean weekly earnings were K6423 ± K6073 (n = 109) (USD $16 ± $15). Earnings were associated with a number of factors.[25] Married transporters earned more than single transporters (Mann–Whitney U = 596, $p < 0.01$). However, confounding factors complicate the relationship between marriage and earnings. Marriage per se does not lead to higher earnings but rather it is linked to age (married transporters were older than unmarried transporters, Mann–Whitney U = 827, $p < 0.01$) and the need to support a larger family (there was a strong correlation between age and number of children, Spearman's = 0.763, $p < 0.01$). Transporters who owned a phone earned more than those who did not (Mann–Whitney U = 752, $p < 0.01$). As previously mentioned however, owning a phone is associated with gender. Therefore, we discounted owning a phone from further analysis.

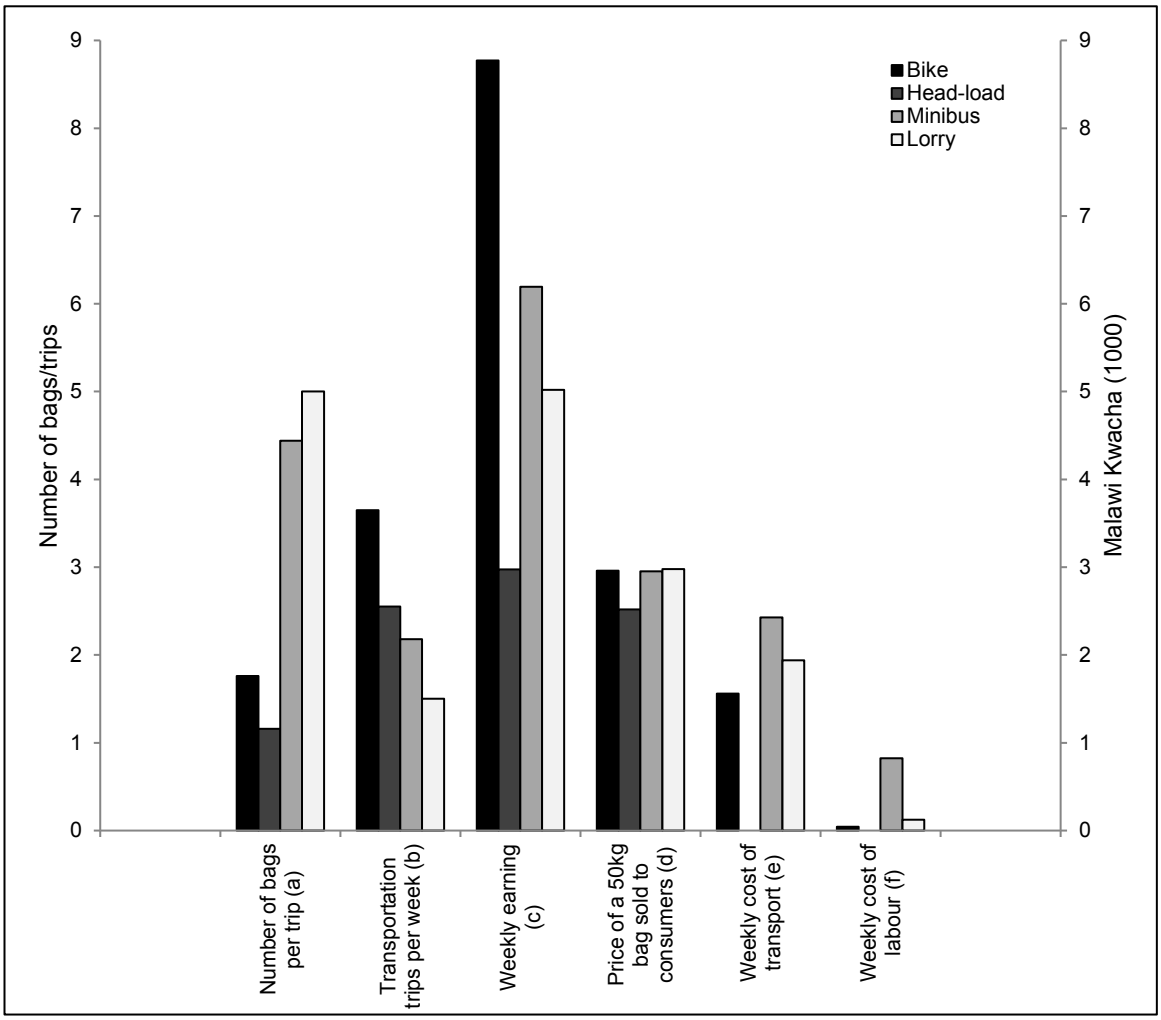
[25] Appendix I presents all calculations of differences in earnings between all transporter variables.

Mean weekly earnings were different between genders (Mann–Whitney U = 689.5, $p < 0.01$) with women earning on average only K4203 ± K4753 (USD $11 ± $12) while men earned K7748 ± K6415 (USD $20 ± $16). These differences were due to the significant differences between the weekly earnings of participants using different types of transport (Kruskal–Wallis = 19.334, df = 3, $p < 0.01$) and the fact that no women used bicycles, which was by far the most profitable mode of transport (Figure 5.3). When we compared earnings of men and women transporting by headload, minibus and lorry, no significant differences were found.

A breakdown of the mean earning inputs demonstrates where significant differences between different transport methods occurred (Figure 5.3).[26] Bicycle users transported the most frequently and had relatively low transport costs. Headloaders carried the least number of bags, travelled more frequently than those using buses or lorries, had the lowest transaction costs but also had no transport or labour costs. Minibus users had the highest labour costs, and together with lorry users had high transport costs, were able to carry more bags but also travelled less frequently.

[26] Appendix J presents all breakdowns of earnings calculations.

Figure 5.3. Differences between transporter types (n = 109) in relation to (a) number of bags per trip, (b) trips per week, (c) weekly earnings, (d) price of a 50 kg bag sold to consumers, (e) weekly transport costs incurred, (f) weekly labour costs incurred



5.3.3 Impacts of regulations

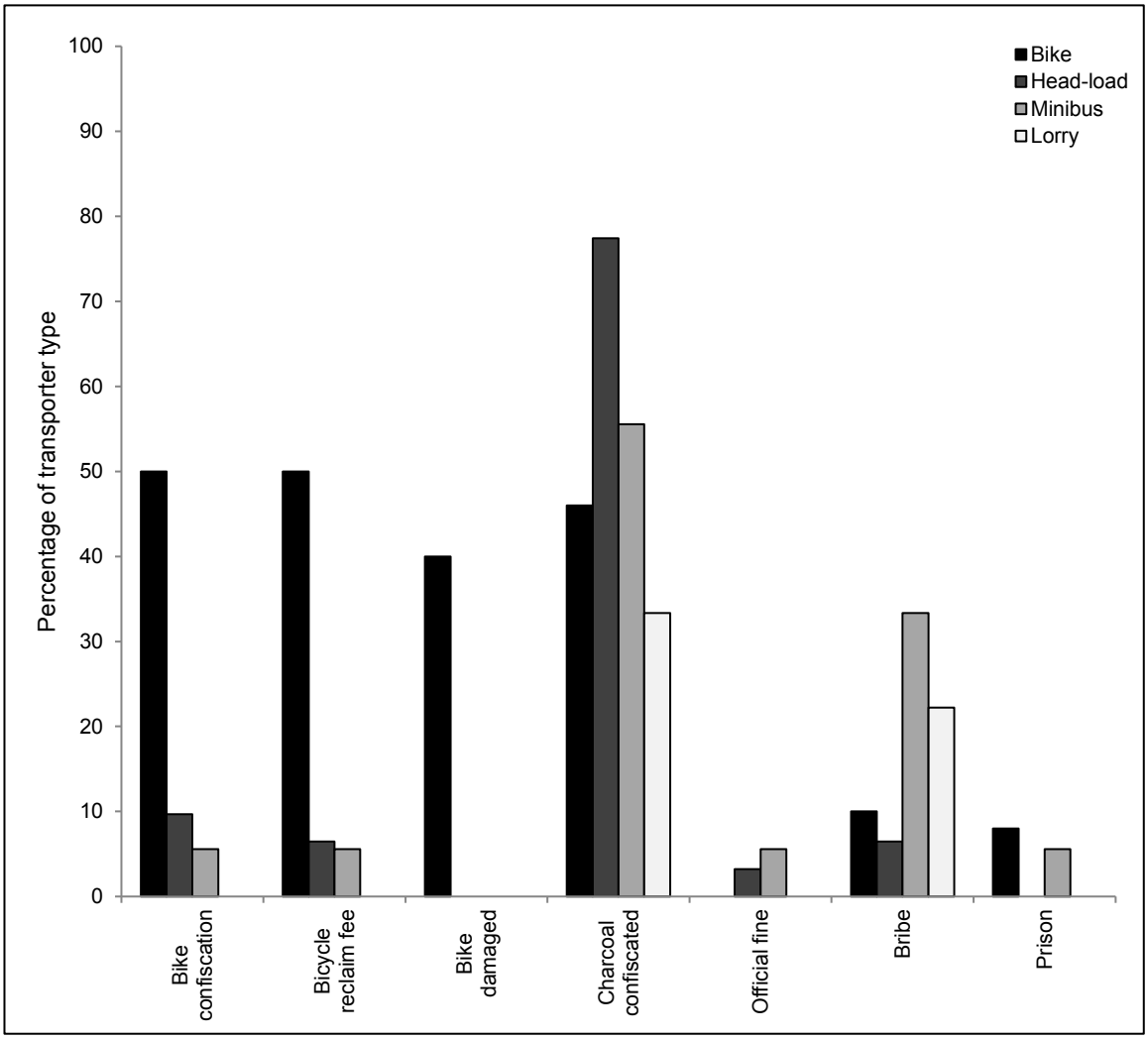
Enforcement costs[27] occurred in the form of charcoal confiscations, bicycle confiscations, bicycle reclaim fees, prison sentences, formal and informal monetary fees. The transporter types experienced different levels of enforcements (Figure 5.4). Transporters identified the Department of Forestry, Police and the National Herbarium and Botanic Gardens of Malawi[28] as the enforcing

[27] We use the term 'enforcement costs', as opposed to 'fines', because the range of enforcement was not restricted to formal monetary penalties and included non-monetary penalties such as confiscations and prison sentences.

[28] The National Herbarium and Botanic Gardens of Malawi is a parastatal organization and is the principal authority on botanical and related matters in Malawi.

regulatory bodies.[29] Official fines were recorded, but respondents confirmed a higher number of rent-seeking transactions in the form of bribes.

Figure 5.4: Percentage of transporters incurring different types of enforcements



In the twelve months prior to the survey, the mean bicycle reclaim fee was K7963 ± K4728 (USD $20 ± $12) (n = 27). Bicycle reclaim fees were not paid on the spot. Transporters had to invest time travelling to the Department of Forestry compound in Zomba to pay for and reclaim their bicycle. In an apparent attempt to prevent them from continuing to transport charcoal, transporters said the Department of Forestry would often return their bicycles in a damaged state. Of those who had reclaimed their bicycle, 41% were returned damaged. Additional time

[29] According to the Forestry Act, Part X, Section 75 the 'Director of Forestry may authorize any officer not below the rank of Principal Forestry Officer' to compound offences Government of Malawi 1997).

and financial costs were invested to repair the bicycles for use (mean = K1067 ± K859, (USD $3 ± $2) n = 12). Sixty-five per cent (n = 109) of respondents had had their charcoal confiscated in the previous twelve months. However, the number of times an individual experienced a charcoal confiscation was unequally distributed amongst transporter types (Kruskal–Wallis = 11.619, df = 3, $p < 0.01$). Headloaders experienced the most charcoal confiscations per person per year (2 ± 1.4), followed by bicycle transporters (1.7 ± 2.6), minibus users (0.8 ± 0.9) and lorry users (0.7 ± 1.1). Charcoal confiscations were made on the spot whereby enforcers simply took the bags, however, 14 respondents reported paying bribes in lieu of a confiscation. The mean amount paid for a bribe was K1428 ± K1727 (USD $4 ± $5) (approximately equivalent to the price transporters paid for the bag). Five respondents (out of all participants) had served prison sentences, which ranged from one to nineteen days.

In order to cope with financial losses, respondents used a variety of methods They borrowed money from friends, family and village banks, sold assets such as a radio, housing materials, livestock and food items or spent household savings. Subsequently, people's time involved in transporting charcoal was prolonged to replace the lost capital. In an attempt to avoid enforcements, many transporters travelled over night or very early in the morning, arriving in Zomba between 4 am and 10 am.

Although the use of a bicycle generated higher earnings, it incurred higher risks. For those with access to savings the time was minimal, but some individuals were not able to raise the funds to ever reclaim their bicycle. In addition to reduced incomes, respondents highlighted that losing their bicycle reduced their access to health care services, markets (for both buying and selling produce) and visiting friends and relatives. When detained in prison, transporters were unable to generate income for their household; in addition to the sentence all respondents paid the additional bicycle reclaim fee.

Given that the majority of transporters had no additional sources of income, the convictions increased transporter households' vulnerability to a number of associated issues. Fines and confiscations negatively affected education, as 10 respondents were subsequently unable to afford school fees. All respondents stated that they used income from transporting charcoal to purchase food for their household. Almost half (42%) of respondents had experienced problems providing food for their households as a direct result of fines or confiscations. Some respondents sold food items (maize and livestock) which were subsequently replaced by buying at a higher price, some borrowed money to buy food and others struggled to find food to the point where they spent up to three days with insufficient food intake.

5.4 Discussion

5.4.1 Transporter characteristics

The charcoal transporters described in this study represent a different kind of middleman (or woman) from the urban elites commonly reported in the literature. These rural-based middlemen and women bought directly from producers and sold directly to consumers and market sellers in order to generate a subsistence income. Although they weren't necessarily the poorest of the poor (some own assets such as telephones and bicycles), they were restricted by the availability of alternative employment. They were drawn to participate in charcoal transportation because it required a small amount of capital and delivered fast and substantial amounts of income. However, transporting charcoal was not perceived as a long-term employment activity for the majority of those involved. Rather, it was either a 'gap-filling' activity between other often seasonal livelihood activities, a 'stepping-stone' activity used to earn capital for a less arduous and less risky business with better long-term prospects (Marshall, Schreckenberg et al. 2006) or a 'safety net' and 'last resort' activity, when alternative sources of income had failed (Devereux 2006).

Transporters worked individually. On occasions, they would travel with others for safety when travelling during the night and for company, which could be organised in advance with friends and relatives or opportunistically with others en route to Zomba. Business transactions and price setting were carried out on an individual basis and there was no knowledge amongst transporters of any collective organised group or powerful individual transporters. The individual basis in which transporters conduct their business suggests that individual transporters had limited capacity to exploit other actors in Zomba's charcoal value chain.

Unlike the larger cities in Malawi, the charcoal resources supplying Zomba are relatively close and transporting charcoal constitutes a morning's work. Furthermore, the population in Zomba, and therefore the demand for charcoal is comparatively small. The low cost of transportation, closeness and accessibility to the resources and small size of consumer population all contribute to the low cost of charcoal in Zomba, compared with larger cities in Malawi. Whilst these conditions exist, an urban-based motorised monopoly (as opposed to individual transporters using public transport) of Zomba's charcoal value chain would struggle to compete with their abundant rural counterparts. As a result, the organised (hired or owned) motorised transport that does exist in the region merely passes through the city and continues south towards Blantyre, a much larger city than Zomba. Unlike areas where powerful urban elites with long-term vested interests block reform of the charcoal sector (Ribot 1998; Zulu 2010), their apparent absence in

Zomba's charcoal value chain suggests that there may be a real opportunity to take a different approach to the charcoal sector and provide more equitable opportunities for value chain actors.

5.4.2 Constraints to accessing higher incomes

With effect from 1, January 2014, the national minimum daily wage in Malawi was K551 (Nkawihe 2014) and in the Zomba region, the average weekly household income from agriculture (the dominant livelihood activity in the region) equates to around K416 (Zomba District Assembly 2009). Charcoal income provided immediate cash-in-hand. On a weekly average basis, transporting charcoal had the potential to earn more than the national minimum wage and also income from agriculture. Transporters' mean weekly earnings additionally exceeded the global poverty rate, which is set at USD $2 per day (World Bank 2014). However, mean weekly earnings for headloaders were less than the global poverty rate and the range of earnings suggests that there are others who also earn less than USD $2 per day.

Bicycle transporters had the highest profits and there was a strong gender component, with women unable to participate in bicycle transportation. These gender disparities are not necessarily surprising, as gendered activities and roles are not uncommon in rural livelihoods (Ellis 1999). However, further investigation is needed to fully understand women's abilities to participate in bicycle transportation. Overall, one of the biggest constraints to increased involvement in transport activity was the uncertainty and risk caused by enforcements.

5.4.3 Livelihood impacts of government regulations

Although forests provide people with a potentially sustainable source of income, in sub-Saharan Africa forest degradation is reducing the availability of marketable forest products and exposing vulnerable populations to reduced incomes (Akinnifesi et al. 2006; Shackleton, Shackleton et al. 2007). When NTFPs become commercially valuable, formal mechanisms tend to be more effective in mitigating negative environmental pressures (Laird, McLain et al. 2010). However, the formalisation of charcoal value chains can marginalise rural livelihoods, and favour urban elites instead (Ribot 1995). In the case of Malawi's charcoal sector, it would be ineffective to impose a formal system, which ignores the realities of the existing informal system (Schure et al. 2013), the importance of charcoal for rural income generation and the upward trend of charcoal demand.

Yet, the informal nature of the Malawi charcoal sector imposes a great economic and psychological burden on its participants. People employed in informal sectors are at greater risk of income loss than those in formal sectors and are more vulnerable to shocks because of their low incomes (Wiebe 1996). Informal markets partly owe their success to weak law enforcement

capacities; however enforcement, for example, through the confiscation of assets or income loss, contributes to income insecurity and vulnerability among those involved (Canagarajah and Sethuraman 2001). The variety and range of convictions and enforcement bodies reported by transporters demonstrate the tendency for regulations to be modified by informal practices due to weaknesses in formal sectors in Malawi (O'Neil and Cammack 2014).

Sibale and Banda (2004) argue that unbalanced power relations are one of the major causes of failure to enforce forestry law in Malawi. They highlight that forestry extension workers in Malawi often live in the communities that they are supposed to regulate. Rather than targeting producers – with whom they live – enforcement agents target people transporting the charcoal from the rural producers to the urban consumers, who tend not to be village members (Kambewa et al. 2007). This enforcement only targets one element of the process rather than the complex and challenging underlying causes of an over-reliance on this important forest product.

As data of natural forest cover indicate (FAO 2010), the regulations that target transporters are not succeeding in preventing further deforestation and degradation. Fines and confiscations simply stimulate reliance on charcoal because transporters prolong their time in the business to make up for their setback. As this study shows, enforcement of Malawi's current forest policy in relation to the charcoal sector not only has a negative impact on transporters' livelihoods, but also has an often-unrecognised impact on their mental well-being.

5.4.4 Caveats and further research

The income data presented in this paper are limited by the fact that they were collected in the cool-dry period in June and July, when charcoal demand and prices were assumed to be high. The impact of seasonal changes on transporters' earnings, frequency and ease of transportation would best be investigated with a year-round study to overcome issues with the reliability of recalled data, as seasonality can affect charcoal demand and access to resources and markets. The participant survey in this study was not stratified therefore it is challenging to suggest whether the findings are representative of Zomba's transporting population. Further, given the apparent differences between transporters of large and small urban areas and the lack of comparable small-city case studies, it is uncertain whether this study is representative of the wider region and of other urban markets. Further research into the value chains of small urban markets is therefore required. Further work with both transporter and non-transporter households would be needed in order to determine whether transporting charcoal is generally just a safety-net activity, a seasonal gap-filler or provides a real stepping stone out of poverty. Additional research would also be required to understand how and why charcoal producers and

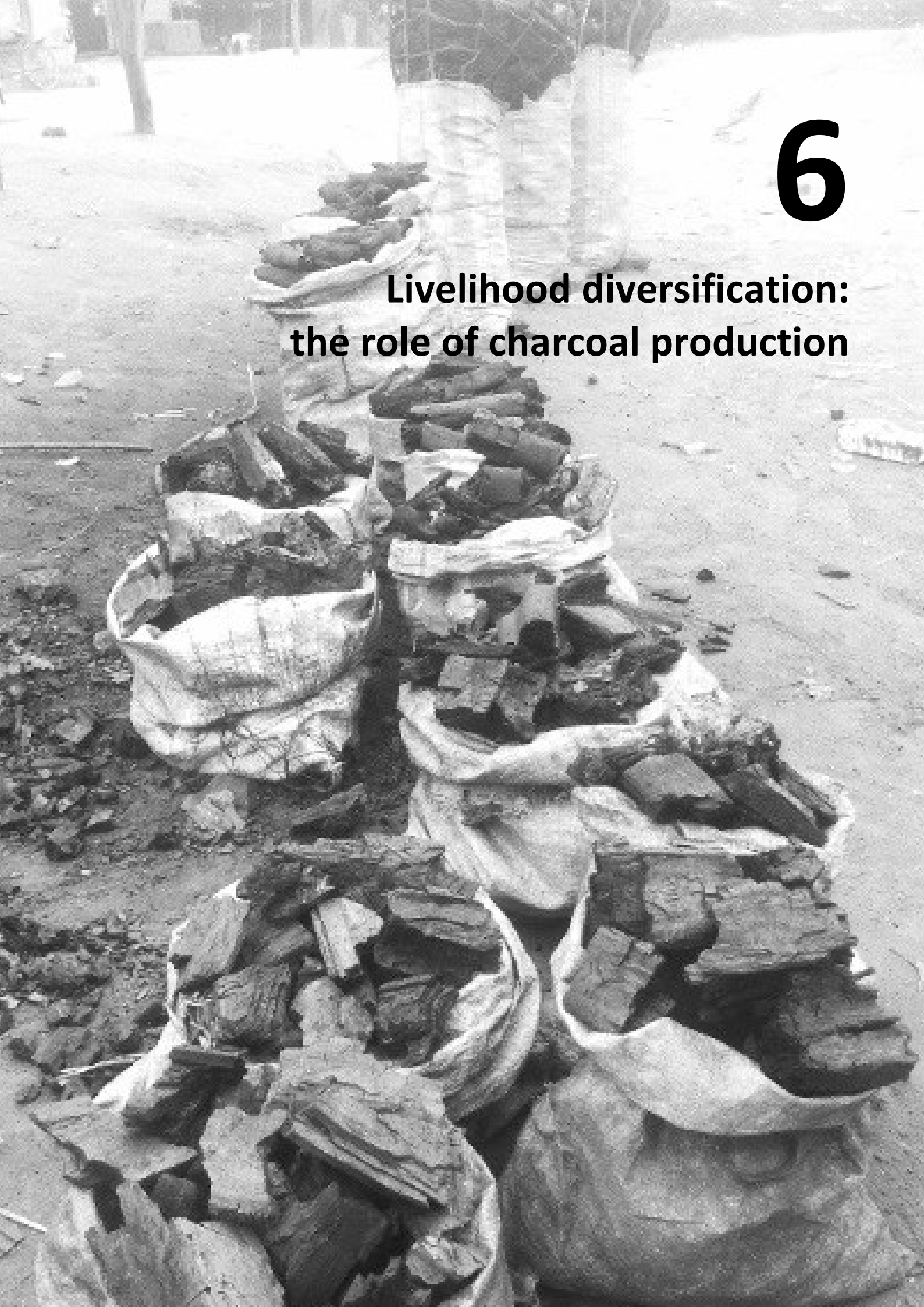
transporters are unable to produce and trade charcoal legally in Malawi, and to also understand why women do not engage in bicycle transportation.

5.5 Conclusion

Lack of employment opportunities locally, small capital requirements and substantial amounts of fast cash-in-hand are key features that encourage people to enter into transporting charcoal. However, charcoal transport is an easily targeted activity for law enforcers and penalties can be costly. The illegality and associated risks increase transporters' vulnerability to reduced income, which can subsequently have detrimental impacts on household food security, financial security, and access to education and healthcare.

Regulating authorities may benefit by appearing to be doing something to control the charcoal industry and financially from rent-seeking activities (Zulu 2010), a situation not restricted to Malawi (e.g. Jagger and Shively 2015; Schure et al. 2015). But targeting just one actor in the value chain, rather than the cause of uncontrolled charcoal production has limited scope for forest protection and unnecessarily increases the vulnerability of rural households to increased poverty. Lack of available alternative employment opportunities coupled with an increasing demand for charcoal in Zomba means that a reduction of transporting activity is unlikely to occur, regardless of the current regulations. Unless the existing approach changes, poor, rural and subsistence populations involved in the sector will remain vulnerable to falling deeper into poverty and forest degradation will continue with increasing rates of charcoal consumption.

The charcoal industry in Malawi has a critical role to play in securing urban energy provision, determining the fate of remaining forests and making important financial contributions to many rural livelihoods. It cannot simply be ignored or penalised. In conjunction with long-term plans for electrification and access to improved energy sources, forestry and energy policies must acknowledge and accept the reality of the charcoal sector and deal with it in a more constructive and coordinated manner.



6

Livelihood diversification: the role of charcoal production

Chapter 6: Livelihood diversification: the role of charcoal production in southern Malawi

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Data from this chapter were also presented at the *Regional African Ecosystem Services Partnership Conference* in Nairobi, November 2016

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Abstract

Growing urban populations in Sub-Saharan Africa are increasing demand for charcoal. This paper presents a detailed case study of three communities supplying charcoal to Zomba, a medium-sized city in Southern Malawi. Using the Sustainable Livelihoods Framework to structure our analysis, we examine individuals' motivations for producing charcoal, assess the seasonality of charcoal production, how livelihood outcomes vary between men and women, and identify sources of vulnerability for charcoal producer livelihoods. Drawing on data from four focus group exercises in each community and a total of 42 semi-structured interviews, we identify direct (e.g. financial) and indirect (e.g. strengthening of social networks, improved access to goods and services, opportunities for livelihood diversification) benefits that contribute to reducing producers' vulnerability to financial insecurity and improve their livelihoods. Irrespective of the benefits obtained and the actions (e.g. prioritising charcoal production over farming) of producers, participants did not perceive charcoal production as a desirable activity because the work was illegal, stigmatised, and hard and dangerous. Producers' primary motivations for engaging in production were to provide income to meet one-off purchases of expensive items, respond to an income shock, or to meet recurrent seasonal needs. Under certain conditions women were more dependent on income from charcoal production than men, as they had fewer alternative income generating options available to them. There was no reported management of charcoal resources in the study area, therefore the environmental sustainability of charcoal production and its associated benefits are uncertain. Trade-offs with Malawi's current de facto charcoal ban and enforcement activities exacerbate livelihood risks and increase producers' vulnerability to income insecurity.

6.1 Introduction

Forests provide a range of products and services, directly contributing to the livelihoods of an estimated 800 million people globally, living in or near tropical forests and savannahs (Chomitz et al. 2007, Naughton-Treves et al. 2007). Through the provision of timber and non-timber forest products (NTFPs) such as food, fodder, medicine, housing materials and fuel, forests contribute to livelihoods by providing access to basic materials and income generation (Ambrose-Oji 2004, Shackleton and Shackleton 2004, Sunderlin et al. 2005, Marshall et al. 2006, Heubach et al. 2011, Shackleton et al. 2011). Forest-derived incomes contribute considerably to rural livelihoods and can reduce households' vulnerability by providing a source of savings, asset building, reducing poverty levels and improving wellbeing (Sunderlin et al. 2005, Angelsen et al. 2014).

Across sub-Saharan African (SSA), charcoal has the potential to provide accessible, affordable and reliable energy to millions of households, in addition to supporting millions of rural and urban livelihoods through income generation, providing urban-rural financial flows and contributing to the national economy. For example, in Malawi, the charcoal sector contributes an estimated $40 million, roughly 0.5% of national GDP (Kambewa et al 2007). If managed effectively, charcoal is a sustainable energy source and can contribute substantially to reducing carbon emissions and greenhouse gases (Iiyama et al 2014). The sector will become an important source of income for an estimated 12 million people by 2030 (Mwampamba et al. 2013) yet there are large research gaps in the charcoal literature, which has led to a lack of evidence-based decision-making (ICRAF 2015). In Africa, 75% of urban growth is expected to occur in small and medium sized urban areas, with populations of less than 1 million (UN-Habitat 2014). Yet, the charcoal markets of smaller cities are severely under-researched and there is no evidence to suggest that their value chains, participants or governance structures are comparable to larger cities (Smith et al. 2015).

There is good evidence that involvement in the charcoal sector can generate substantial incomes for participants (Monela et al. 1993, Knöpfle 2004, Khundi et al. 2011, Schaafsma et al. 2012, Minten et al. 2013), though incomes may be unevenly distributed. Middle-men are frequently portrayed as the most exploitative actors in the value chain, yet they play essential entrepreneurial roles connecting producers and consumers (Schreckenberg 2003, te Velde et al. 2006). Highest profits often accrue to urban-based 'elite' businessmen (or women), as they typically own motorised transporting links, monopolise the trade and are politically connected (Ribot 1998, Brouwer and Magane 1999, Kambewa et al. 2007, Kwaschik 2008, Shively et al. 2010, Schure et al. 2013, Luz et al. 2015). Aside from an economic contribution however, there has been little attention to how involvement in the sector contributes to broader livelihood components.

The contribution to livelihoods of economic activities encompasses more than just income, and there is a need to consider a wider range of factors such as health, access to goods and services, social relations and food security, especially when measuring progress in development and poverty reduction (Chambers 1995, DFID 1999, Millennium Ecosystem Assessment 2003, Scoones 2009). Poverty Environment Network studies have recently taken an explicit livelihoods perspective in examining the use of forest resources (see Wunder et al. 2014); broader livelihood assessments of other NTFPs such as woodcraft have noted substantial benefits associated with engagement in natural product trade, such as strengthening of social assets, livelihood diversification and risk reduction (Shackleton et al. 2008). Broader analyses of the charcoal sector tend to focus on the trade-offs, such as the correlation of unregulated production and environmental degradation (e.g. Chidumayo and Gumbo 2013, Rembold et al. 2013), detrimental health impacts (Bautista et al. 2008, Johnson et al. 2011) and negative livelihood impacts from enforcement activities (Smith et al. 2015).

Rural livelihoods experience numerous stresses that can increase household vulnerability. One of these is seasonality, which creates variability in labour, income and food availability (Ellis 2000). Many households diversify their livelihood strategies to cope with stresses during challenging periods and diverse livelihoods tend to be less vulnerable as they allow households to adapt to change (Ellis 1999). In Mozambique, charcoal production has been found to provide a flexible source of income for rural households, making it an important seasonal diversification strategy (Jones et al 2016). However, there is still insufficient systematic analysis of the extent to which involvement in the charcoal sector contributes more widely to livelihoods, for example how it affects vulnerability and risk, capability and empowerment (Shackleton et al. 2008), its seasonal contribution, and peoples' motivations for involvement in the sector. Yet, understanding people's motivations and how various underlying factors influence them, could help deliver more effective policies (Smith et al. 2016).

Charcoal producers in SSA are often portrayed as young, poor men (Hamilton and Hamilton 2006, Bekele and Girmay 2013), who benefit least from the sector because they are unorganized, are unable to access benefits and are less visible in decision-making processes (Schure et al. 2013). However, recent evidence from East Africa indicates that women also participate (Butz 2013, Jones et al. 2016, Smith et al. 2016). Roles, responsibilities and outcomes of rural livelihoods are often considerably gendered (Ellis 1999) and differences in the way that men and women value, access and use NTFPs, resources and markets are well documented in the literature (Paumgarten and Shackleton 2011, Ingram, Levang, et al. 2014, Ingram, Schure, et al. 2014, Sunderland et al. 2014). Within the charcoal literature, male charcoal transporters typically earn higher wages than women (Smith et al. 2015). Perhaps the relatively recent presence of charcoal production within

some communities has led to non-gendered production practices (Jones et al. 2016), but there is limited data to suggest whether men and women achieve comparable outcomes from engaging in charcoal production.

Limited understanding and punitive political attitudes towards the charcoal sector, coupled with difficulties in accessing secure resource tenure, market security and start-up costs (e.g. license fees) means that SSA's charcoal status quo makes it challenging for poor communities to invest in the sector. Many charcoal-based livelihoods are thus informal, and therefore fraught with uncertainty and risk from enforcement activities, and often ignored or penalised by governments (e.g. Smith et al. 2015). Benefits to individual producers are just one of the many positive aspects of the charcoal industry that are poorly understood and often overlooked in favour of environmental arguments against the industry. A better understanding of the role charcoal production plays in producers' livelihoods is therefore required if charcoal policies are to benefit the rural poor.

6.1.1 Research objectives

This paper is one component of a larger study that examines charcoal-related livelihoods in and around Zomba, a medium-sized city in southern Malawi (see Smith et al. 2015, 2016). Here we aim to address the research gaps outlined above and examine the contribution of charcoal production to livelihoods of charcoal producers who supply to Zomba.

Our specific objectives are to:

- Identify factors that motivate an individual to be involved in charcoal production;
- Analyse gender differences in livelihood outcomes generated from charcoal production;
- Identify sources of vulnerability for charcoal producer livelihoods.

6.2 Materials and methods

6.2.1 Sustainable Livelihoods Framework

We used the Sustainable Livelihoods Framework (SLF) as a conceptual framework to structure our analysis (see Scoones 1998, DFID 1999), due to its holistic and multidimensional approach that acknowledges the complexities entrenched in rural livelihoods (Fisher et al 2013). A livelihood can be considered sustainable when it "can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long-term" (Chambers and Conway, 1992, pp. 7).

The SLF describes livelihoods as comprising a diverse combination of subsistence and income-generating activities and strategies. These depend on assets (human, physical, natural, social and financial), which are deployed within a context of vulnerability (e.g. seasonality, shocks and trends). Transforming structures and processes are important external factors that shape people's livelihood strategies. In the case of charcoal production, particularly important transforming structures are local bodies such as the Department of Forestry, police and village committees charged with the forest protection, while key processes include government policies on charcoal and resource access. When applied to charcoal production, the SLF allows assessment of the socioeconomic and underlying vulnerability context in which producers' livelihoods operate. It incorporates their livelihood assets and outcomes, including how involvement in the sector and the governance structures affect livelihood outcomes, and assists in exploring factors that influence power and access to charcoal resources and markets. Sustainability aspects relate to how governance of the sector affects the environmental sustainability of the resource management and extraction practices and thus the overall sustainability of producer-based livelihood outcomes.

6.2.2 Study site

The main charcoal resources for Zomba are located in Machinga and Zomba Districts, in mountainous outcrops located north of Zomba city within Zomba Forest Reserve, the adjacent Malosa forest reserve and Liwonde forest reserve (Kambewa et al. 2007, Smith et al. 2016). In 2015, Zomba's urban population was expected to exceed 164,000, increasing annually by 4.21% (NSO 2013). Machinga and Zomba Districts are some of the most densely populated areas of Malawi, (130 people km^{-2} and 230 people km^{-2} respectively). The two districts are also the second and third poorest in Malawi; 73% of the population in Machinga and 70% of the population in Zomba District fall below the national poverty line (Zomba District Assembly 2009). The principal livelihood activity is rain-fed subsistence agriculture, focused on maize production. Rural households do not use charcoal themselves but charcoal production for the urban and peri-urban markets of Zomba town is an important income-generating activity in many communities surrounding the forest reserves.

According to the 1997 Forestry Act, charcoal can be produced legally in Malawi subject to an agreed sustainable management plan. Although enacted in 1997, the first licence to produce charcoal was not granted until September 2015 to Kawandama Hills Plantation, a British owned company in Northern Malawi. This charcoal is produced as a by-product from stands of *Corymbia citriodora*, primarily harvested for an essential-oils business (Personal comm. Tanya Clarke,

Kawandama Hills Plantation Director). Apart from this one licence, to-date there is currently no domestic source of legally produced charcoal within Malawi.

Malawi's domestic energy market will continue to be dominated by charcoal, with demand for charcoal predicted to increase in the future regardless of whether the country's electricity expansion scenarios are achieved (MARGE 2009). Domestic urban consumers in Zomba frequently mix fuel types for cooking; an estimated 82% of urban households consume charcoal as part of their energy mix, 42% consume firewood, 29% consume electricity, and charcoal demand fluctuates seasonally corresponding with higher rainfall and lower temperatures (Holmes 2015).[30]

Malawi has three main seasons. The warm, wet season stretches from November to April, with the Zomba region experiencing an annual average rainfall of 1,433mm. A cool, dry season follows from May to August with mean national temperatures varying between 17 and 27°C, falling to between 4 and 10°C, with the coldest period occurring in June and July. The hot, dry season runs from September to October with mean national temperatures varying between 25 and 37°C (Department of Climate Change and Meteorological Services 2006). Nearly 95% of Malawi's electricity supply is provided by hydropower (ESCOM 2016) and heavy rainfall is known to disrupt electricity supplies across Malawi in the rainy season (ACAPS 2015). In response to the erratic supply of electricity and increased frequency of load-shedding, some urban households increase their consumption of charcoal during periods of high rainfall (Afriem 2015).

6.2.3 Sampling procedure

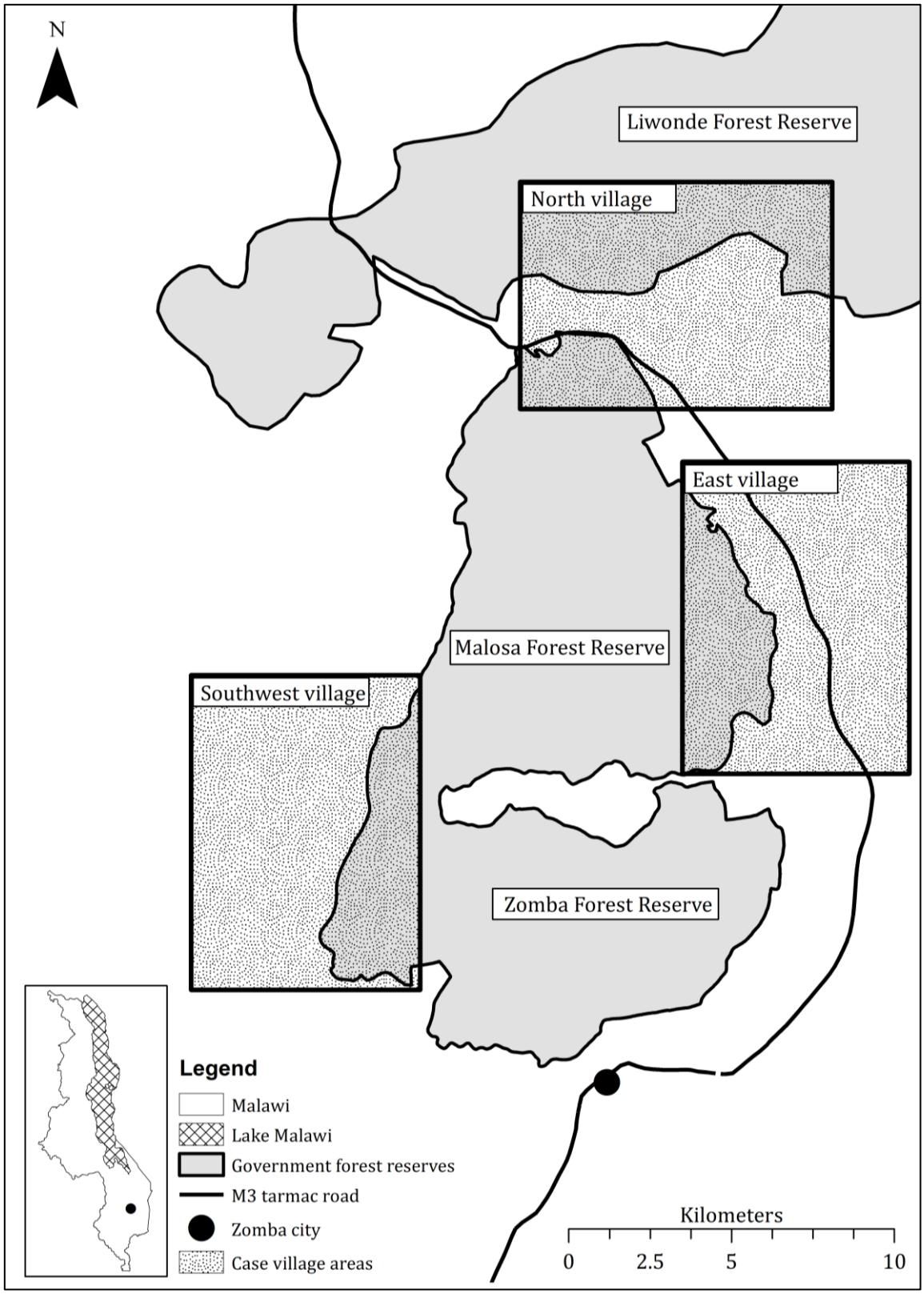
This study focuses on charcoal producers in three case-study villages that produce charcoal for Zomba city. We selected the villages from a sample of 28 charcoal-producing villages identified through a survey of charcoal transporters and discussions with agricultural extension officers (see Smith et al. 2016 for more details). From this larger set, we purposively selected the three case-study villages to be as representative as possible of the charcoal production area according to five criteria:

1. Size of the village;
2. Proportion of households perceived to be actively engaged in charcoal production at the time of data collection;
3. Perceived amount of time charcoal production had existed in the village;
4. Distance of the village to the forest reserve boundary; and
5. Perceived contribution of charcoal income to the village economy.

[30] In Holmes' (2015) study, respondents highlighted that charcoal was used for both cooking and heating purposes.

We analysed the mode and mean for each criterion to identify the 'most representative' village in each of the three production areas. As no village represented the mean or mode for all criteria, villages with the closest responses to the modes and means were selected. To protect village anonymity and participants' identities, the locations and names of villages are not given; however as described by Smith et al. (2016), the villages were located in the north, east and southwest of the production area (Figure 6.1). The three case study villages represent communities at different stages of production (Table 6.1).

Figure 6.1: Approximate locations of the three case study villages within Zomba's charcoal supply shed



Data supplied by the National Statistics Office of Malawi

Table 6.1: Stages of charcoal production and forest degradation of East, Southwest and North case study village areas

	East Village area	Southwest Village area	North Village area
Perceived start of charcoal production	1986/90	1970	1996/2000
Perceived peak of charcoal production	2001/05	2013/14	Not yet reached
State of forest resource	Heavily degraded with agricultural conversion	Degraded with some remaining patches of remaining forest	Largely undisturbed, low level of degradation
Tree species availability	High-grade species[a] scarce. Indiscriminate harvesting of trees including domestic and fruit and digging of roots.	Patches of high-grade species increasingly scarce. Indiscriminate harvesting of trees including domestic and fruit and digging of roots.	Selective harvesting of abundant high-grade species.
Hours walk to resources (one-way)	5-6	3-4	0-1
Gendered participation	Mainly men, some women	Only men	Men and women

Constructed with data from Smith et al. (2016)[31]

6.2.4 Data collection

To obtain a thorough understanding of the contribution of charcoal production to rural livelihoods, we used a mixed methods approach, combining focus-group based rapid rural appraisal tools (Carruthers and Chambers 1981, Marshall et al. 2006b) and semi-structured interviews. Between them, the methods addressed the different components of the SLF. Data were collected in two phases, in September-October 2013 and June-July 2014, with the help of trained interpreters.

Rapid rural appraisal tools

In each case-study village we undertook four focus group discussions with men and women who were actively engaged in producing charcoal. Each focus group lasted 1-3 hours and comprised 6-8 charcoal producers in gender-separated groups.[32] Village chiefs selected the initial participants;

[31] Species that are perceived to produce high-grade charcoal include *Brachystegia bussei, Brachystegia speciformis, Brachystegia stipulata, Pericopsis angolensis and Dalbergia nitidula* (Smith et al. 2016).

[32] No women were known to produce charcoal in the Southwest village, therefore we did not undertake group discussions with women in this specific village.

subsequent participant selection was carried out through snowball sequential sampling and different participants were used during each rural appraisal exercise. We addressed a core set of questions with all participant groups. However, as is often the case with participatory research, we followed the interests and experiences of the participants of specific groups, which resulted in some data being collected only from certain groups. We have indicated where this occurred within the results section. The four focus groups discussed the following topics:

1. Charcoal production calendar. Participants (n=57)[33] from all focus groups were asked to recall the number of charcoal bags they had personally produced each month, over the previous 12 months. Subsequently, focus groups discussed reasons for unusually high or low levels of production. Independent t-tests were used to examine whether there were significant differences in the number of bags men and women produced each month. Analyses were carried out using IBM SPSS statistical software, version 22.

2. Seasonal income and expenditure calendar. The income and expenditure calendars were designed to assess the seasonal importance of charcoal income. We constructed a matrix, with months on one axis and either income generating activities (IGA) or household expenditures on the other[34] (See Marshall et al. 2006b). The group used counters to indicate relative values of earnings from different activities and main expenditures over the preceding 12 months. Participants then discussed, justified and explained their distributions.

3. Livelihood assets. Participants discussed how and why charcoal production affected natural, physical, financial, human and socio-cultural assets, and what impact this had for household livelihood strategies.

4. Value chain governance. This focus group discussion was designed to elicit data on how formal and informal structures affected producers' access to charcoal resources and markets. The researcher and participants jointly constructed a diagram of the charcoal value chain. Participants identified the roles and responsibilities of different actors and institutions along the value chain, indicated the challenges to their involvement in charcoal production and the coping strategies they implemented in response.

[33] The lead author carried out other focus groups that are not detailed in this particular article. The charcoal production calendar was a final exercise at the end of session therefore. In this way, a total of 57 participants from the North village (25 men and 32 women) took part in this survey.
[34] We included IGAs or expenditures that participants identified as doing/spending within the 12 months prior to data collection.

Semi-structured interviews

We carried out 42 individual semi-structured interviews with 28 men and 14 women from the three case-study villages.[35] The interviews lasted between 15 and 30 minutes and were designed to elicit information about producers' personal histories, thematic reasons for engaging in production, their experience with the sector and to corroborate information from the value chain governance and livelihood assets focus group discussions. Quantitative data were analysed in Microsoft Excel for Mac, version 14.4.7.

6.3 Results

We first focus on the contribution of charcoal production to livelihood strategies, then outline the impact of the activity on different assets and describe the perceived role of transforming structures and processes in promoting or obstructing charcoal production. While we mention shocks, trends and seasonality in this section, we examine vulnerability in more detail in the discussion.

6.3.1 Livelihood strategies

Participants in the focus groups and semi-structured interviews never portrayed charcoal production as a desirable livelihood strategy. Engagement in production was never undertaken because an individual valued being a charcoal producer, in some circumstances lower paid jobs were preferred over charcoal production, as a 24-year-old male producer from the East village stated: "*I now own a small chip stall. I could earn more money from producing charcoal, but cooking chips gives more time to farm. I'm happier selling chips than producing* [charcoal] (see Box 6.1 for other examples).[36] Semi-structured interviews from all villages (n=42) identified six reasons for an individual's initial engagement in production. The most frequently cited reason (n=18) was a lack of alternative employment opportunities, the loss of previous employment (n=10) and the need for money for a specific expenditure (e.g. school fees, fertiliser) (n=9). Additionally, shocks in the forms of loss of a family member (n=6), birth within a household (n=3) and famine[37] (n=2) also motivated individuals to engage in production.[38]

[35] We interviewed 14 participants in each village: 7 men and 7 women. However, in the Southwest village, only men participated in charcoal production, therefore we interviewed 14 men.
[36] Interview quotes were translated from Chichewa into English by interpreters.
[37] In 2001/02, Malawi experienced its worst recorded famine, prompting individuals to start producing charcoal in order to purchase food.
[38] Participants could identify several reasons for their engagement in charcoal production as these are not mutually exclusive.

Seasonal production practices

Data on charcoal production from the North village focus groups[39] display a seasonal pattern (Figure 6.2), with highest mean levels of production occurring in July and lowest mean levels of production occurring in October. Participants did not produce consistently every month; no participant recorded producing charcoal every month, which points to the part-time nature of the work. More people were engaged in July and the least number of people were engaged in production in October.

Men and women produced similar amounts throughout most of the year, however women produced significantly more bags[40] than men in January (men mean=3.5 ± 6.7, women mean=6.1±11.8, $t(54)=1.42$, $p<0.01$), March (men mean=2.8±3.3, women mean=5.0±7.7, $t(54)=1.37$, $p<0.05$), May (men mean=5.1±5.5, women mean=8±7.7, t(54)1.66, $p<0.01$) and June (men mean=4.1±5.9, women mean=12.6±11.1, $t(54)=3.43$, $p<0.01$). There was no significant difference between the number of months men (mean=6.2±2.4) and women (mean=7.2±2.6) spent producing.

Focus groups gave a number of reasons for low levels of charcoal production:

- Sickness (could occur in any month, with the wet season a particularly high-risk period for malaria);
- Exhaustion (could occur in any month);
- Resting (could occur in any month);
- At school (term time runs from September-July);
- Living away from village (could occur in any month);
- Farming responsibilities (Field preparation in August-October; planting and weeding from December to February; maize harvest in March).

[39] In the remainder of this section we only use data from the focus groups in the North village as the Southwest village had no women producers (thus not allowing for any comparison between men and women), and we considered the data from the East village on incomes, expenditures and charcoal production to be unreliable because, at the time of data collection, charcoal production was scarce due to high levels of resource degradation.

[40] The lead author conducted a survey of bag weights in Zomba market (n=35), and found a mean weight of 32.56kg ± 7.3kg, which is comparable to Kambewa et al (2007) estimation of 38kg.

Participants attributed particularly high levels of production to:

- Food scarcity (highest in January and February);
- Paying casual (farm) labour (farming labour mirrors the months of farming responsibilities: August-October, December-February and March);
- Paying school fees (paid termly in September, January and April);
- Buying school items such as stationery and uniforms (September, January and April);
- Buying fertiliser (July-January);
- Paying for building work and materials (June-July);
- Buying clothes (could occur in any month);
- High market price for charcoal (December-February and June-July).

BOX 6.1: Charcoal producer semi-structured interview samples- Livelihood strategies

31-year-old male producer from the East village: "*Last year I worked in a shop, but now I'm producing. I only produce when I have no other source of income. I can't predict how long I will be producing for, but if I find an alternative source of income I will stop charcoal.*"

38-year-old male producer from the East village: *"Even though producing earns more money, when there is seasonal* [farm] *labour, I stop producing charcoal. Labour is easier work."*

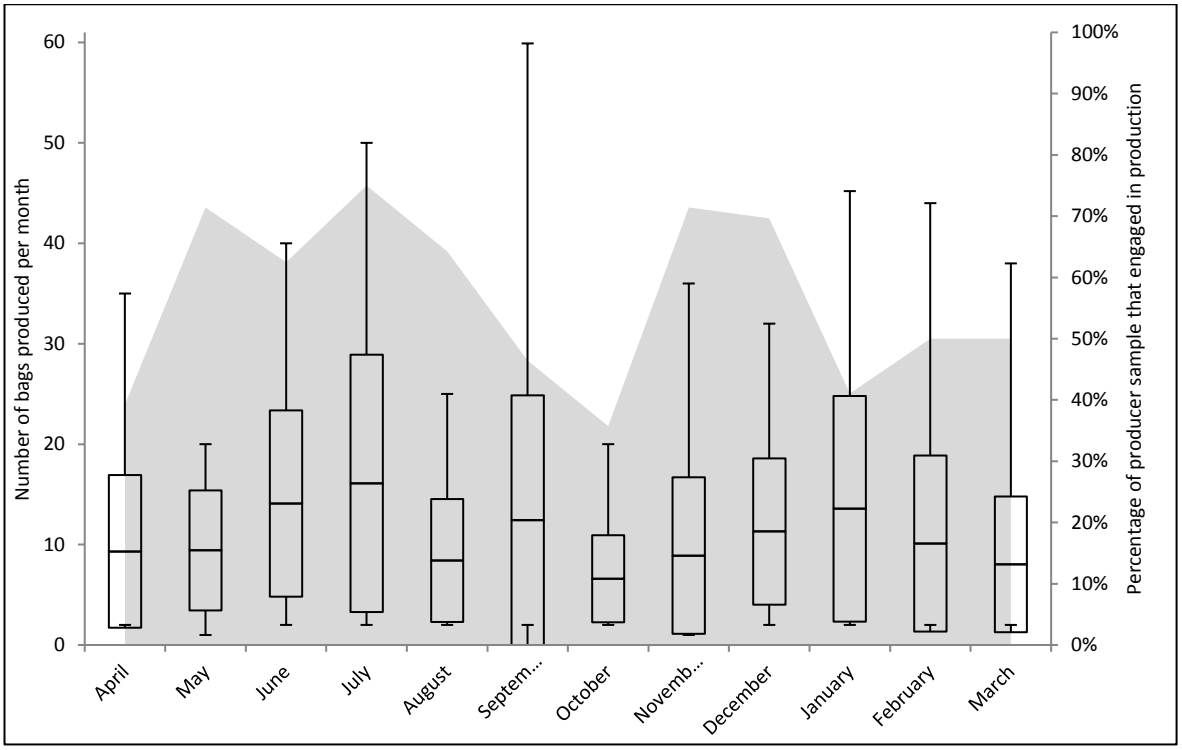
37-year-old male producer from the Southwest village: *"In two years I will stop producing because the trees will be gone. I will start farming again. I think farming is more profitable* [than charcoal], *but the money from farming comes once a year, whereas charcoal money is continuous."*

56-year-old male producer from the Southwest village: *"Charcoal money is difficult, it's not stable like farming* [income]. *Charcoal money comes in small amounts, and it's hard to save anything."*

21-year-old female producer from the North village: "*I will stop* [producing] *this year, because I have capital to start a rice* [buying and re-selling] *business with money from producing."*

33-year-old male producer from the North village: *"I think in a year I will have enough capital to change business. If there was no enforcement, it would only take me 3 months to save the money* [from production]."

Figure 6.2: Box and whiskers plots displaying the mean, standard deviation, minimum and maximum number of bags produced by individual focus group participants in the North village (n=57) in the 12 months prior to data collection (left axis); and (continuous line with shading) the percentage of sampled participants engaged in production per month (right axis).



Income generating strategies

Charcoal production provided the largest single source of annual income for both men and women, contributing to 26% of the total annual income for men, but almost twice as much (45%) for women (Figure 6.3). High levels of charcoal income were generated between March and July amongst men and in May-July and December-January amongst women.

Women engaged in a narrower range of IGAs than men as they did not generate an income from skilled labour, transporting charcoal or football,[41] and a smaller proportion of their income was generated from agriculture (Table 6.2). Women's income relied more on small enterprises and charcoal production. Discussions with the female participants indicated that start-up capital for the small enterprises predominantly came from charcoal income.

Men generated income from agriculture at different times than women, suggesting higher agricultural diversification due to various fruit and crop harvest times. Charcoal producers spent much of their time making charcoal in the forests, and were conscious of time conflicts with other

[41] Men were paid to play football in local leagues.

livelihood strategies. As one 35-year-old male charcoal producer explained: *"Charcoal delays my farming because I'm busy producing. My wife works on the farm, but two hands are better than one".* Some participants felt they generated lower agricultural yields than non-producing households as they prioritised charcoal production over farming activities.

Male charcoal producers dominated the harvesting and sale of NTFPs and harvested a wider range of NTFPs (5 types) than the women (2 types). Women did not harvest firewood for sale, which was attributed to lower potential profits (compared with those from charcoal) and lack of time available to participate due to conflicting household responsibilities.

Expenditure Patterns

The three highest expenditure items for both men and women were food (purchasing food items and maize processing fees), assets (e.g. bicycle, radio, household items) and agricultural inputs (e.g. labour, fertiliser, tools, seeds) (Table 6.3, Figure 6.4). Women proportionately spent the most on food (48%), whereas men spent the most on assets (32%).

All semi-structured interview participants were subsistence maize producers, with just 21% estimating that their maize reserves would last until the following harvest in March. Seven per cent of participants expected to run out five months before the harvest, a quarter (25%) four months before, 22% three months before, 11% two months before and 14% one month before the harvest. As a result, a principal expenditure item for participants was buying food, especially during seasonal food shortages in the pre-maize harvest period from October-February.

Spending levels were similar in both the dry (May-October) and wet (November-April) seasons for both men and women. During the dry period, men invested more income in shelter (e.g. for building materials or construction labour) [42] and in purchasing assets, and began investing in agricultural inputs and business capital towards the end of dry season. Women's spending on assets was also greater in the dry period, but they also reported higher spending on clothing and food. During the wet season, both women and men reported spending more on food, with men also increasing investments into agriculture and business capital.

Amongst men, charcoal consistently contributed at least 14% of the total income needed to meet monthly expenses, and only contributed to more than half (98%) their expenditures in March (Figure 6.4). Amongst women, the contribution of charcoal income to expenditure was much more variable across the year ranging from 4% to 99%, with charcoal contributing to at least half of their monthly expenditure in four months. Men, charcoal consistently contributed at least 14%

[42] In this region, construction work typically occurs during the dry months, as certain activities (e.g. drying bricks) are difficult to do when it rains.

of the total income needed to meet monthly expenses, and only contributed to more than half (98%) their expenditures in March (Figure 6.4). Amongst women, the contribution of charcoal income to expenditure was much more variable across the year ranging from 4% to 99%, with charcoal contributing to at least half of their monthly expenditure in four months.

Table 6.2: Men and women's reported income generating activities and their contribution to participants' total annual income

Activity group	Men		Women	
	Specific activity	**Contribution to total annual income (%) [c]**	**Specific activity**	**Contribution to total annual income (%)**
Charcoal production	-	26	-	45
Charcoal transporting	-	8	-	0
Agriculture	Selling cultivated crops Selling cultivated fruits Selling livestock	17	Selling cultivated crops Selling cultivated fruits Selling livestock	9
Small enterprises	Brick burning Hoes Mats Buying and selling vegetables	10	Beer brewing Mandasi (donuts) Buying and selling fish Buying and selling vegetables	33
Unskilled labour	Casual seasonal farm labour	12	Casual seasonal farm labour	9
Skilled labour [a]	Builder Carpenter Tailor	4	-	0
NTFP [b]	Firewood Grass Poles Sand Wild fruits	18	Grass Mushrooms	4
Misc	Football	5	-	0

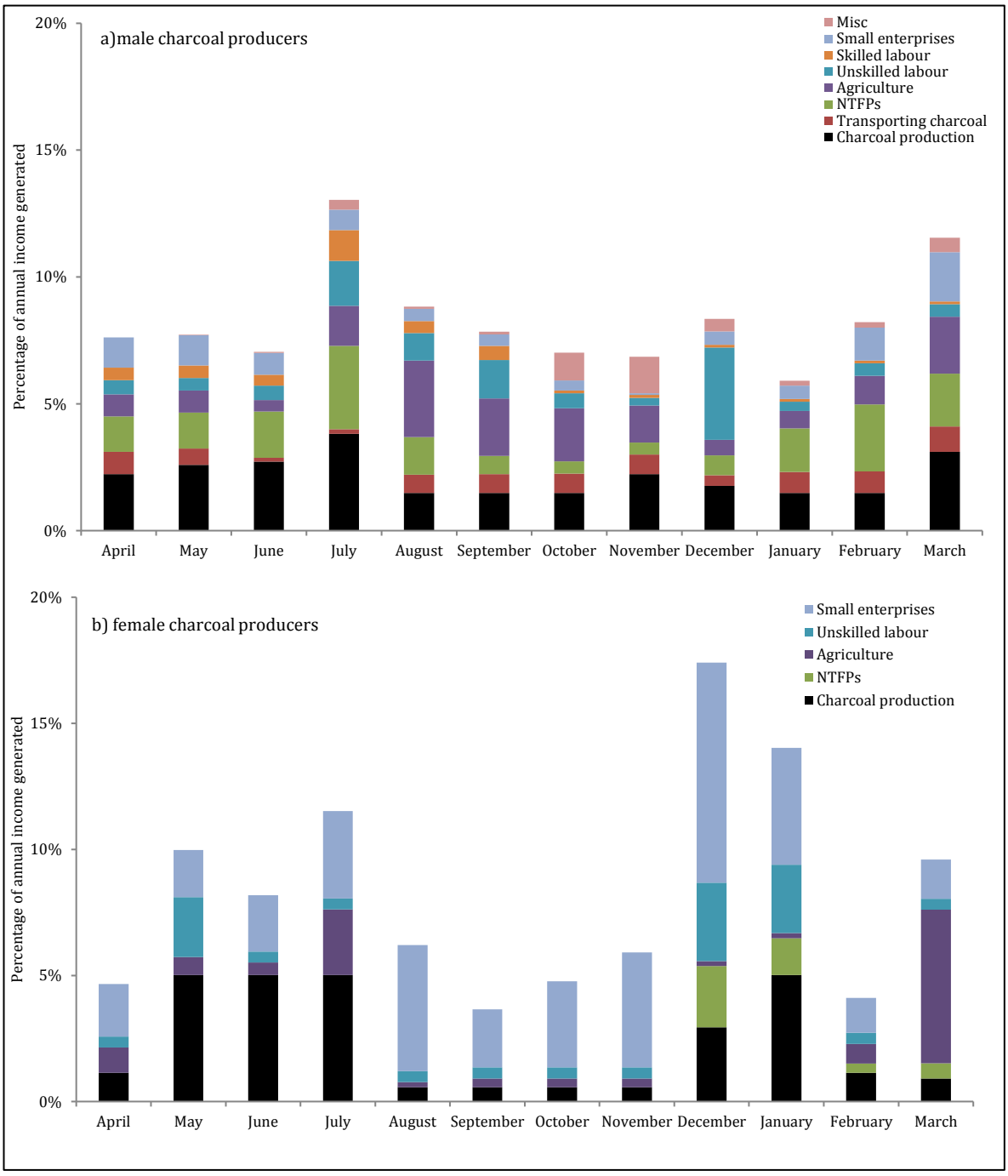
Constructed with data from the seasonal income calendar focus group in the North village

[a] Skilled labour required specialised training for the specific skill

[b] NTFPs were defined as the harvesting and selling of unprocessed NTFPs

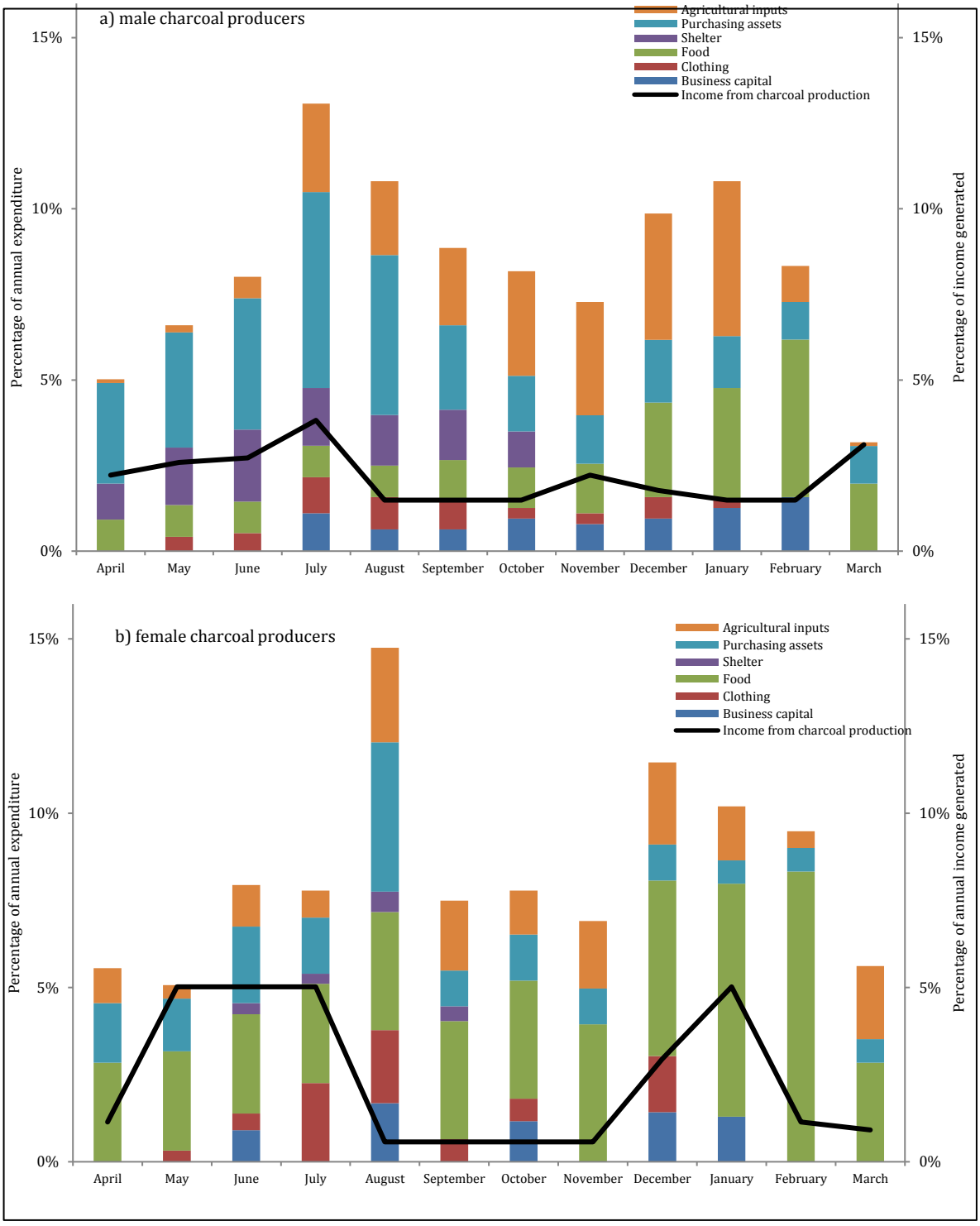
[c] Percentages calculated from the numbers of counters distributed among income generating activities

Figure 6.3: Perceived seasonal variability of income in the North village for a) male and b) female charcoal producers



Constructed with data from the seasonal income calendar focus groups in the North village

Figure 6.4: Perceived seasonal variability of expenditure in the North village for a) male and b) female charcoal producers (left axis) with charcoal income shown (black line) for comparison (right axis).



Constructed with data from the seasonal expenditure calendar focus groups in the North village

Table 6.3: Reported items of annual expenditure by men and women

Expenditure item	Proportion of total annual expenditure (%)[a]	
	Men	Women
Business investment	8	6
Clothing	5	8
Food	21	48
Shelter	11	2
Assets	32	18
Agricultural inputs	24	18

Constructed with data from the seasonal expenditure calendar focus group in the North village

[a] Percentages calculated from the numbers of counters distributed among income generating activities.

6.3.2 Livelihood assets

We summarise the livelihoods assets focus group discussions from all three case study villages, and highlight details of individuals' experiences collected from the semi-structured interviews.

Financial assets

In all villages, income from charcoal production improved participants' access to village savings and loans groups and ability to invest in other IGAs. Participants purchased farm inputs such as fertiliser, tools and seeds with charcoal income. In the North village, it was more affordable overall to focus on producing charcoal and pay for farm labour with the charcoal income. In this respect, the benefits of considerable cash income from charcoal outweighed and overcame the issues of time conflicts with farming responsibilities. In the Southwest and East villages however, available charcoal resources were limited, and thus income from charcoal was not substantial enough to hire farm labour.

Charcoal-based financial assets were vulnerable to fines and confiscations from the regulating authorities. The impact on individuals and households varied depending on the severity of the enforcement activity. Nevertheless, participants linked income loss from enforcement activities with vulnerability to increased food insecurity, debt, financial insecurity, stress and reduced access to goods and services (Box 6.2).[43]

[43] Interview quotes were translated from Chichewa into English by interpreters.
Exchange rates varied in the two periods of fieldwork: September – December 2013 (US$1 = K325 to US$1 = K407) and June – September 2014 (US$1 = K375 to US $1 = K394) (Oanda Corporation 2015). For indicative purposes, we use a rate of USD $1 = K 394 for the rest of the paper.

BOX 6.2: Charcoal producer semi-structured interview samples: Impacts of enforcement

38-year-old male producer from the East village: "*I was sent to prison* [for producing] *for one week and had to pay a fine of K5, 000. My relatives paid the fine. I was too scared to go back into the forest, so spent 6 months at home. But I needed money, and had no other choices, so I had to start producing again."*

50-year-old female producer from the East village: "*My husband was sent to prison for 1 month* [for producing] *and was fined K10, 000*. *My children had to leave school to help me produce, so we could pay the fine to release him.*"

46-year-old male producer from the Southwest village: *"I feel anxious when I produce charcoal; I'm always worried of the Department of Forestry finding me* [with charcoal]*."*

20-year-old male producer from the North village*: "I once had five bags confiscated. I was going to use the money to pay for* [farm] *labour. Another time, I couldn't afford to buy fertilizer* [due to a confiscation]*. I bought it late in the season and my* [maize] *yield reduced from 20 to 16 bags."*

22-year-old male producer from the North village*: "I had seven bags confiscated by the Department of Forestry from my home. This happened in February during the hunger period. I didn't eat for two days, and had to borrow K25,000 for the village bank, paying 20% interest."*

33-year-old male producer from the North village: *"During time in prison* [because of producing charcoal]*, my child was sick and my wife had to sell firewood to support the family. I couldn't support my family, we had less food at home. I had to take a loan and gave my bike as security."*

37-year old female producer from the North village: *"I had 15 bags confiscated. I couldn't pay* [my children's] *school fees and had to borrow from the village bank. Another time, I had 20 bags confiscated. I was using the money to pay off a debt, but instead had to take an additional loan from the village bank. I'm still only paying off the interest."*

56-year-old male producer from the North village: *"In June, I had 15 bags confiscated by the Department of Forestry. I was going to use the money to pay off an outstanding loan. Instead I had to borrow more money from the village bank. The initial loan was K34, 000 then borrowed an additional K10, 000, with 20% interest."*

Natural assets

All focus groups perceived that localised forest depletion due to the complete removal of trees (and roots in the East and Southwest villages) from charcoal production practices (e.g. not replanting cut trees) had degraded their natural assets. All focus groups perceived that localised forest loss (due to charcoal production) was linked to a change in rainfall pattern and increased frequency and intensity of run-off from the forest reserves. Focus groups from all villages perceived that forest loss was leading to lower agricultural yields due to increased prevalence of flooding and reduced soil quality in agrarian lands. They additionally stated that tree loss was responsible for the heavy siltation and subsequent drying of smaller streams in the dryer months, resulting in reduced potential for irrigated agricultural systems.

All focus groups perceived increased scarcity in NTFPs, which included firewood, edible plants (including fruits and mushrooms), wild animals, medicinal plants and construction materials such as poles and grass. Prior to their engagement with charcoal production, participants reported that all NTFPs used to be available closer to villages and were easy to source. Greater difficulty in accessing these products meant that collection of firewood, for example, had shifted from women and children to men in all three villages. However, while wild firewood resources were increasingly scarce, participants also explained that the availability of domestic alternatives (e.g. from planted eucalyptus in the village) reduced the possible impact on households. The loss of wild foods was perceived as a permanent situation; however, focus groups also felt that sufficient alternatives were available, such as cultivated fruit in the village, market vegetables and livestock, and that income from charcoal production could enable producers to access these alternatives.

Social assets

Participation in charcoal production strengthened social assets, through improved ability to support others. All focus groups described notions of camaraderie amongst charcoal producers, assisting each other to avoid enforcement activities, lending each other tools and exchanging labour. They expressed their ability to financially support family members with charcoal income, for example by paying school fees or giving financial support to elderly or infirm relatives. Non-producing community members also benefitted from the charcoal sector, as income from production would be spent within the village, thus supporting local businesses. Participants purchased gifts, expensive items (such as meat) or donated to cultural celebrations and ceremonies using charcoal income.

In the North village, following the start of charcoal production in the village, focus groups perceived lower levels of theft. Participants explained that previous incidences of theft in the village were linked to poverty and food insecurity, as people would steal crops or assets to sell for cash to buy food. The growth of charcoal production in the village, accompanied by increased incomes amongst community members had led to an apparent decline in thefts. Participants perceived increased levels of trust between community members as a result. However, participants anticipated that when the tree resource declined to a point when charcoal production was no longer possible, poverty levels and incidences of theft might increase again.

The illegality and informality of the sector weakened producers' social assets through increased risk of conflict with authorities including the Forestry and Police Departments, internal community authorities such as Village Natural Resource Management Committees (VNRMC) and traditional leaders. In the Southwest village, focus groups reported conflicts with other community members, as non-producers would threaten to report producers to the authorities. Additionally, female

focus groups in the East village perceived a stigma associated with their involvement in the sector, as non-producer women in the community were known to deride female producers for participating in a 'dirty' job.

Human assets

Income from charcoal production increased producer households' access to formal health services, however households also still relied on traditional medicines. Accompanying the degradation of natural assets, all focus groups perceived a reduction in the availability of medicinal plants due to the complete removal of trees (which were either medicinal plants or provided habitats for others) by unsustainable charcoal production practices. Focus groups in the North village had also perceived a recent reduction in the local medicinal plant market, as people were increasingly using the remaining plants for their own use rather than selling them.

All focus groups made observations of feeling exhausted after work, which affected their abilities to pursue alternate livelihood strategies and socialise. In the Southwest village specifically, group participants perceived a correlation between charcoal production and a reduction in intimate spousal relations. Producing charcoal was also associated with increased risk of respiratory illnesses from exposure to kiln smoke and dust. All group participants perceived it to be a dangerous activity, as constructing charcoal kilns in unstable, mountainous and rocky terrains increased producers' risk of accidents and serious injury. In the Southwest village for example, at the time of data collection one producer was hospitalised from a producing-related injury and one man had died the previous year after a tree he was cutting had fallen and crushed him.

The links between charcoal production and access to education and skills development were both positive and negative. The attraction of substantial incomes from production increased the risk of children dropping out of school, either to produce charcoal themselves or to look after younger siblings whilst their parents were producing charcoal. However, charcoal income could pay for school fees, uniforms, stationery and vocational skills training (e.g. drivers license, carpentry training).

Physical assets

Increased income generated from producing charcoal improved participants' ability to purchase expensive assets such as bicycles, radios, livestock, passports and farm inputs such as tools, seeds and fertiliser.

Construction and maintenance of buildings was a seasonal activity that only occurred in periods of low rainfall, from April-November. Higher charcoal production rates in the cooler months of June-July coincided with this seasonal demand for building materials and increased producers' access

to improved building materials, such as iron roofing and burnt bricks, thus strengthening producers' physical assets. Group participants in the Southwest village explained that their income had contributed to the development of community infrastructure, through funding the construction of a local religious building, which they additionally linked to the strengthening of social assets, as they were able to contribute to their community. In the North village, the recent boom in charcoal production enabled widespread purchase of solar panels, an effect not seen in the other villages where increases in charcoal production had predated technological advances in solar energy.

Group participants from all villages perceived a reduction in the availability of traditional building materials, particularly NTFPs sourced locally such as poles and grass. Although there were market substitutes for many of the lost or degraded NTFPs, some substitute products such as eucalyptus poles were considered inferior to the wild products and participants had perceived an increase in their market price.

6.3.3 Transforming structures and processes

We present information from the value chain governance focus groups and semi-structured interviews from all three case study villages to explore how formal and informal structures impact individuals' access to charcoal production, in terms of influence over and access to the resource and markets.

Formal structures and processes

In accordance with the Forestry Act (1997), VNRMC members, Forest and Police officers may seize any forest produce which they suspect has been illegally removed or obtained and must issue a certificate of seizure. Any person who, "without authority under this Act […] fells, cuts, takes, destroy [sic], removes, collects, uproots any indigenous tree or forest property in a forest reserve or protected area […] shall be guilty of an offence and liable upon conviction to a fine of K5,000 and to imprisonment for a term of two years" (Part X, 64, pp. 21). In all villages, the Department of Forestry were the primary enforcement body, implementing regulations in the forest reserves and villages. The North village indicated the widest range of institutions involved with enforcement, including the Police Department, the Department of National Parks and Wildlife and the Malawian Defence Force. In the East and Southwest villages, the VNRMC assisted the Department of Forestry by directing them towards known producers' houses.

Enforcement activities mentioned by interview respondents included bribes, confiscations, fines, prison sentences and beatings (Table 6.4). Sixty-six per cent of respondents had experienced at least one confiscation during the time they had been engaged in production and men reported

more experiences of enforcement activities than women. In the forest reserves, producers' tools and charcoal would be confiscated and kilns destroyed. Focus groups were unsure of how frequently fines were paid, or how much would be paid, but explained that a bribe could be paid in lieu of a fine. The Southwest village focus groups indicated that Forest officers sometimes abused their powers. For example, if a group of producers were found together then officers were known to make them carry the charcoal to the homes of the Forest officers. Some participants from the Southwest village reported they had personally experienced incidents when officers had used corporal punishment on producers, ordering them to beat each other with sticks. Village patrols primarily carried out by the Department of Forestry with assistance from the police occurred in all three villages, but only included the confiscation of charcoal. If producers resisted the confiscations or fines, they would be arrested and charged through the court system, with the risk of a prison sentence. Producers from the North and Southwest villages were under the impression that a fine of K60,000 and K10,000 respectively, was required to be released from prison. If this cost could not be paid then the individual would remain in custody for an unknown amount of time.

Table 6.4: Charcoal producers' experience with enforcement(n=42)

n=42	Bribe	Confiscation	Fine	Prison	Beating	Carrying charcoal	None
Female producers	2	6					7
Male producers	3	22	5	4	1	4	5
Total [a]	5	28	5	4	1	4	12

Constructed with data acquired from individual interviews with participants from all case study villages

[a] The totals add up to more than the number of participants (n=42) because some participants identified multiple experiences with enforcement.

Informal structures and processes

All recorded production processes were illegal and informal. Production was predominantly carried out as an individual activity, or jointly by household members and where both men and women participated, they performed the same roles in the production process. In the North village, there were agreed rates for casual labour in the charcoal production process.[44] Individuals involved in casual labour were not necessarily producers or from the same village. However,

[44] Neither the East nor the Southwest village confirmed the existence of a local charcoal production labour market, as the cost of labour and low availability of trees did not make it a profitable activity.

participants were not aware of the existence of an elite group (or individual) who dominated or controlled the local charcoal labour market. If an individual was looking for casual labour, they could either enquire within their immediate social network or speculatively go to the forest reserve in search of work. Due to competition with demand for casual labour in charcoal production, the price of casual labour for agricultural activities in the village had increased.

In the Southwest village, participants described a different type of organised production. Due to the scarcity of forest resources and suitable production grounds, there were specific locations within the forest reserves where production occurred, which were known and named by producers. The production locations favoured rock-free, relatively flat areas of ground near a water source and it was common for producers to organise travelling together. Unlike the North village however, only producers (as opposed to people in search of casual labour) would travel to the production sites. Producers constructed temporary shelters and cooking areas, and would transport unprocessed wood to a central kiln burning location. The sites were semi-permanent, existing for as long as there were sufficient woody resources nearby.

Other informal structures evolved around charcoal producers and their social networks to evade enforcement. For example in the three villages, traditional leaders were not directly involved in the enforcement of formal regulations, but advance warnings from village leaders were not uncommon. Village patrols would be announced during village meetings, forewarning producers not to enter the forest reserve on a particular day. Additionally, participants from all villages indicated that friends or relatives working for the Department of Forestry would informally warn them of upcoming patrols. If a patrol was seen entering, friends, relatives and other charcoal producers would signal up to producers in the forest reserves using mobile phones or by whistling. Most producers explained that they would leave their kilns in an attempt to hide from enforcers. However in the East village, producers had found a more assertive solution: if enforcers were sighted, a producer would whistle to others nearby to form a group which would then threaten the enforcers by shouting verbal abuse or even throwing stones to dissuade them from approaching. They also reported a more proactive and hostile approach to village patrols, for example by barricading enforcers' transport with rocks and logs. Participants in the North and Southwest villages conceded that there was little they could do to avoid village patrols, other than receiving warnings from the roadside, giving producers the advantage to hide their charcoal, or leave their houses. They clarified that enforcers would increase the severity of the sanctions if they became antagonised, but if houses were locked and unoccupied, regulators would usually not force entry to confiscate charcoal.

In all villages, participants reported selling to bicycle transporters either from their village or surrounding areas, or selling directly to consumers in peri-urban markets of Zomba (travelling

either by bike, using public buses or lorries and, in the Southwest village, also travelling on foot). Market access specific to each village was also reported: the East village sold ad hoc to consumers travelling in personal vehicles, the Southwest village sold to transporters travelling to Zomba on foot, both the Southwest and North villages reported selling to transporters using public transport and, in the North village, participants reported selling to staff of local authorities, who would travel in official vehicles to buy large quantities of charcoal to resell in Zomba.

6.4 Discussion

6.4.1 Motivation to engage in charcoal production

Forest resources provide safety-net, gap-filling and income-smoothing functions to meet households' everyday and seasonal requirements (Shackleton and Shackleton 2004, Sunderlin et al. 2005). Our data indicate that an individual's primary reasons for engaging in charcoal production were for one-off, large, unexpected expenses related to purchasing expensive items (e.g. school fees or fertiliser); in response to a shock, such as a birth or death in the family or unexpected loss of employment; in response to higher urban demand for charcoal; or for recurrent seasonal needs, such as purchasing food during periods of food scarcity or building materials in the dry months. Natural product trade is known to assist rural households generate some, if not all their cash income (Schreckenberg et al. 2006, Mahapatra and Shackleton 2012, Angelsen et al. 2014, Schaafsma et al. 2014) and the data from this case study demonstrate that Zomba's charcoal sector provides an important source of income for rural livelihoods.

Malawi's charcoal sector presents a much-needed opportunity for those who have access to the resources and markets to generate an income, as a key issue in the region is the lack of income generation opportunities available to rural communities (Zomba District Assembly 2009). Charcoal production generated the biggest source of income for all producers, provided start up capital required for other income generating activities and was prioritised by some over alternative livelihood strategies such as agriculture. Yet, charcoal production was not perceived as a desirable livelihood activity. These apparently conflicting views can be reconciled by the fact that unlicensed charcoal production is not only an illegal activity (subject to frequent and costly enforcement activities) but also one that is stigmatized within the village and considered much harder and more dangerous work than alternatives such as agricultural labour.

Livelihood outcomes

Natural product trades tend to generate only modest cash incomes (Schreckenberg et al. 2006). In the study region, engaging in charcoal production did not only generate financial benefits, but

also improved access to goods and services such as education and training, increased producers' ability to participate in village savings and loans associations and invest in alternative livelihood strategies such agriculture or other IGAs. These livelihood outcomes increased producers' opportunities for livelihood diversification and risk management, which are important factors for reducing vulnerability to poverty amongst rural livelihoods (Ellis 1998, Hussein and Nelson 1998). Although reporting from a very different context, our data confirm work from Mozambique that highlights the importance of charcoal production as a livelihood diversification strategy (Jones et al. 2016).

Well-functioning supporting structures (such as the alarm systems for forest patrols) relied on the development of producers' good social relations and networks. Additional livelihood outcomes included strengthened social assets through the ability to support others financially and contribute to the community and the development of new and expanded social networks, which extended beyond the immediate family relationships upon which rural households predominantly rely (Shackleton et al. 2008). The importance of social benefits generated from the harvesting and trade of other commercial natural products have also been noted by several authors (Leakey et al. 2005, Shackleton et al. 2007, 2008, Shackleton and Gumbo 2010).

Data from the seasonal income and recall calendars indicate seasonal variability in production practices, with higher levels of production in the cooler months from May to July and during the cold-wet season from November to February. Agriculture was the primary livelihood strategy in the study region, used for both income generation and subsistence food generation (Zomba District Assembly 2009). Seasonal food shortages between November and February preceded the maize harvest in March, with most participants running out of personal maize reserves before the harvest season. Cash generated from charcoal production during this period was therefore important and timely for participants' food acquisition and in reducing their vulnerability to seasonal food insecurity.

Livelihood trade-offs were related to degraded natural assets, time conflicts created by increasing scarcity and distance to remaining forest resources and vulnerability to punitive enforcement activities. The relationship between decreasing forest resources, declining availability of alternative forest-based income and increasing time commitments to travel to remaining resources restricted the ability of an individual to further diversify their livelihood strategies, and instead stimulated specialisation in, and dependence on, charcoal production as a livelihood strategy.

Livelihood benefits and trade-offs were interrelated, for example: increasing time required to travel to remaining resources reduced time available for alternative livelihood activities such as agriculture. However, the income generated from charcoal production enabled producers to hire

casual labourers to tend to their agricultural responsibilities. This scenario only existed in the North village where sufficient forest resources meant that charcoal production was much more profitable than in the other two villages, where higher levels of resource degradation meant that charcoal income was on the decline.

6.4.2 Gender differences in livelihood outcomes

Gendered participation in the charcoal production process varied between the three case study villages. In the Southwest village the production process was male-dominated with no record of any women participating. Where both men and women participated, they performed the same roles during the production process. Participation of women in charcoal production has also been observed in Mozambique (Jones et al. 2016) and in Tanzania, where women specifically engaged in the activity in order to obtain some financial independence from their husbands (Butz 2013).

Trade in natural products is sometimes one of the few accessible local IGAs available to the rural poor, particularly crucial for marginalised and vulnerable groups and especially for women (Shackleton and Shackleton 2004, Khundi et al. 2011, Schaafsma et al. 2014). In the North village, men had more opportunities than women to generate an income, perhaps due to the gendered roles and responsibilities amongst rural households (Quisumbing 2003, Blackden and Wodon 2006). Independent income is an important social benefit for women (Shackleton et al. 2008) and engagement in independent income generation may raise the status of women within a household (Ellis 1998). Data from the seasonal income and expenditure calendars from the North village indicated that female producers were considerably more dependent on charcoal production for income generation, which was especially crucial given their limited available IGA options.

There is a large focus on gender dimensions in participation in forest management and decision-making (FAO 2007, Mwangi et al. 2011, Manfre and Rubin 2012). However, there is limited information on the gender dimensions in the enforcement and conviction of forest law. Even though men and women performed the same roles in the production process, evidence from this study highlights that female participants did not suffer the same level of enforcements as their male counterparts. This was also observed by Smith et al. (2015) amongst enforcement of charcoal transporters, suggesting that perhaps gender influences the degree of forest law enforcement. In developing countries, women frequently have fewer income generating options available to them (Jiggins 1989, UN 2013). Additionally, men disproportionately control household financial decisions; women often have less opportunity to participate in decision-making and are less familiar with administration systems (ibid.). As a result, perhaps enforcers are more lenient, or may have less to gain from convicting women.

6.4.3 Sources of vulnerability for Malawi's charcoal-producer livelihoods

Livelihood trade-offs were created by insecure resource access, uncertainty in the sector's future, environmentally unsustainable production practices, increasing trends in environmental and forest resource degradation and increased vulnerability to income loss due to the risk of punitive enforcement. Charcoal production, as a broader livelihood diversification strategy may enhance an individuals' resilience. However, because the resources were not managed, specialising in charcoal production was inevitably an insecure livelihood strategy, thus specialised producers' livelihoods were vulnerable to change.

Insecure or limited resource access rights created trade-offs, undermining the potential for sustained livelihood support for communities (Ellis and Allison 2004, Angelsen et al. 2014), which is certainly the case presented in this study. Under Malawi's current de facto ban, informal charcoal production in rural communities is an important poverty mitigation strategy, but one that is limited in the long-term, thereby only preventing the deepening of poverty, as opposed to achieving real poverty reduction (Timko et al. 2010). Although resource access rights were not secure for the communities engaged in production, formal enforcement of the sector appeared to have only limited impact on an individuals' level of engagement in production. Enforcement appeared to temporarily deter producers from engaging in the production and sale of charcoal, but daily cash requirements, lack of alternative employment opportunities and limited livelihood diversification options, especially for women, undermined the desired long-term impacts of forest protection measures.

Formal sanctions associated with the protection of the government-owned forest reserves, such as fines and confiscations, increased producers' vulnerability to reduced income. Loss of income reduced producers' access to goods and services, thus increasing their vulnerability to food insecurity, financial insecurity and stress. Variability in the implementation of sanctions reported by participants, and the participation of local authorities in the commercial trade of charcoal, only serve to highlight the tendency for the regulations to be modified by informal practices due to weaknesses in the formal sector. Low capacity for policy implementation and enforcement of charcoal policies have been reported elsewhere in Africa (e.g. Shively et al. 2010, Sander et al 2013) and have also been found in the regulation of charcoal transport within the same region (Smith et al. 2015). Vested interests of illicit taxes, coercion and corruption for personal gains are deeply embedded in Malawi's charcoal value chain, which are a central source of vulnerability to charcoal-based livelihoods and may impede any changes to the sector. Addressing this particular issue is paramount to endorsing a professionalised and transparent system that delivers political confidence in the sector and encourages participation.

The study demonstrates that producers had the capacity to be self-organised, having developed groups and structures to combat enforcement, built infrastructure within the forest reserves and established a local labour market for the production process. However, informal structures and processes governing wild products are often invisible to policy makers and thus ignored, undermined or contradicted (Laird, McLain, et al. 2010). Rural stakeholders are rarely represented in formal decision-making structures (Laird, Wynberg, et al. 2010) and poor integration and coordination between formal and informal charcoal production practices can lead to ineffective resource management and risk marginalising rural livelihoods, increasing their vulnerability to falling further into poverty (Schure et al. 2013). A formalised sector, such as Malawi's current legal system, imposes barriers (e.g. costs involved in obtaining a license) to participants. Indeed, Malawi's current formal requirements are unrealistic for most people to comply with and are therefore a main source for unsustainable production. Charcoal governance should involve recognising and formalising informal institutions (Wiersum et al. 2014) and should be developed to reflect local circumstances and needs (Wynberg and Laird 2007). However, as highlighted by Jones et al. (2016) in Mozambique, formalisation of charcoal production practices must be handled carefully to ensure they do not end up restricting access to the most vulnerable households using charcoal as a flexible income source.

In developing countries across Latin America, Asia and Africa, environmental incomes contribute 28% of rural households' incomes, 77% of which comes from natural forests (Angelsen et al. 2014). This study has shown that commercial NTFPs like charcoal generate both benefits (e.g. income) and trade-offs (e.g. environmental degradation and financial loss). Supportive formal systems are crucial if charcoal is to contribute to reducing trade-offs such as vulnerability and levels of poverty (Tieguhong et al. 2015).

6.4.4 Limitations and further research

This study draws on data from just three communities in the Zomba region, thus our ability to draw generalised conclusions is limited. Indeed, the variability found between three producer communities, even within a small study region, highlights further gaps in knowledge and understanding and the need for additional empirical research on charcoal-based livelihoods. Data were only collected from participants actively engaged in production therefore further research is required to compare producer and non-producer households.

It is important that the developers of charcoal policies across SSA make efforts to recognise the presence of existing informal structures and processes and find ways of supporting them. Formalisation of the charcoal sector has been undermined by low implementation capacity of regulations and unclear and insecure resource rights elsewhere across Africa (Sander et al 2013).

There is still limited understanding of how informal charcoal structures and processes function, therefore further research is required to assist their integration into the development of formalised systems and understand the impacts of enforcement mechanisms (Shively et al 2010).

The misconception that producers are young, poor men (e.g. Hamilton and Hamilton 2006, Bekele and Girmay 2013) could be detrimental to the development of improved and equitable governance of the charcoal sector, as gender-dimensions are unlikely to incorporate the needs, motivations and outcomes of women in charcoal production policies. A more nuanced understanding of gendered participation and livelihood outcomes, for example through a disaggregated analysis of producer-groups, would help inform any new developments. Given the women's dependency on charcoal income in this study, any developments should recognise women's involvement in the sector and should include mechanisms that do not marginalise or inhibit their participation.

In examining the seasonality of charcoal production practices, this study has highlighted further nuances in charcoal production dependence, as there are temporal motivations (e.g. seasonal food scarcity or higher charcoal prices) that encourage rural producers' engagement. However, temporal relationships (e.g. between urban consumer demand and the seasonality of rural producers' livelihood requirements) are yet to be explored in great detail. Longitudinal studies would be helpful to explore seasonal variation in production and also overcome the weaknesses associated with recall data used in this study.

6.5 Conclusion

Broader definitions of poverty emphasise moving beyond an assessment of income, to also understanding wider dimensions of people's wellbeing, resilience, vulnerability and risk, capability and empowerment (Shackleton et al. 2008). An in-depth analysis of charcoal producers' livelihoods presented in this study has revealed clear direct (e.g. financial) and indirect (e.g. strengthening of social networks, improved access to goods and services, opportunities for livelihood diversification) benefits that contribute to reducing producers' vulnerability to income insecurity and poverty, and improve their livelihoods. However, livelihood trade-offs correlate with degraded natural assets, time conflicts, social stigmatisation and increased vulnerability. This study generates new insights into gendered production practices, highlighting that women were more dependent on income from charcoal production than men, as they had fewer alternative income generating options available to them. The study also demonstrates that producers are organised, having developed informal groups, structures and local labour markets. We argue that charcoal-based livelihoods should be recognised accordingly, and any developments in policy should reflect the importance of charcoal as an integral livelihood diversification strategy.

Our case study demonstrates that livelihood benefits derived from charcoal production are dependent on resource availability and their long-term sustainability is therefore uncertain given there is currently no management of charcoal resources in Malawi. Under Malawi's de facto ban, livelihood trade-offs such as risk and vulnerability are exacerbated by enforcement activities, which further undermine market security, livelihood security and the overall environmental sustainability of the sector.

7

Reflections and conclusions

Chapter 7: Reflections and conclusions

7.1 Introduction

Charcoal has become the most widely used urban source of domestic energy for cooking and heating across many countries in sub-Saharan Africa and is consumed by all tiers of urban society, ranging from the poorest to the upper class (Sander et al. 2013; Holmes 2015). Rapid urbanisation, increasing fossil fuel prices and the lack of reliable and affordable energy alternatives mean that charcoal will remain a principal urban energy source in sub-Saharan Africa for years, perhaps decades (Arnold et al. 2006; MARGE 2009).

Sub-Saharan Africa's expanding charcoal sector is predicted to be a source of income generation for over 12 million people by 2030 (Mwampamba et al. 2013) and provides opportunities for livelihood support, poverty alleviation and domestic market expansion (Monela et al. 1993; Ribot 1998; Arnold et al. 2006; Herd 2007; Kambewa et al. 2007; Malimbwi and Zahabu 2008; Openshaw 2010; Khundi et al. 2011; Agyeman et al. 2012; Jones et al. 2016). Charcoal also has the potential to be a renewable source of energy, if produced and used sustainably, significantly contributing to reducing carbon emissions (Iiyama et al. 2014). Yet, politically it is frequently disregarded as such and is instead perceived as an archaic, dirty and environmentally destructive fuel.

In an attempt to protect forest resources, current formal policies are largely punitive, inhibiting the production and transportation of charcoal. However, these policies tend to be characterised by weak enforcement capacity, insufficient funds and corruption, with limited understanding of actors' motivations and the processes involved (Zulu and Richardson 2013). Instead, much of the sector across sub-Saharan Africa tends to be dominated by informal, unregulated and unsustainable practices (Mugo and Ong 2006; Biomass Technology Group 2010; Schure et al. 2013; Neuberger 2015), criminalising the livelihoods of those involved, with the sector further becoming vilified through its correlation with illicit markets, rent-seeking activities and forest degradation.

Large research gaps in the charcoal literature have led to a lack of evidence-based decision-making and a failure of basic, formal approaches to regulate the sector (ICRAF 2015). The motivation behind this thesis has therefore been to provide evidence and examine its implications for debate surrounding emerging charcoal policies in sub-Saharan Africa. This final chapter serves to address the overarching research objective of the thesis:

Contribute to the empirical knowledge base of Malawi's charcoal sector and identify rural actors' key livelihood outcomes.

This chapter draws on the findings of the stand-alone research articles (Chapters 4-6) to answer the four research-questions:

1. What are the rural components of the charcoal value chain, and what are the characteristics of the actors?
2. Why do people participate in the rural charcoal value chain?
3. What are the benefits and trade-offs from participating in the rural charcoal value chain?
4. What are the constraints to charcoal-based livelihoods?

7.2 Components and characteristics of the charcoal value chain

Analysis of Zomba's charcoal value chain presented new information on actors and the flow of charcoal from producer to market (Figure 7.1). Chapter 4 identified a population of 123 villages actively engaged in producing charcoal for consumption in Zomba city. These villages surrounded three inter-connected Government-owned forest reserves: Zomba, Malosa and Liwonde. Production practices across the supply shed were male-dominated, a finding consistent with other studies (Herd 2007; Seidel 2008; Zulu 2010; Khundi et al. 2011). Gendered participation found in communities was linked to the differences in physical access to the resources, such as distance, elevation and gradient; in areas where resources were physically more accessible, women and men participated equally. Producers are often perceived to be generally unorganised (Schure et al. 2013), however the research generated in Chapter 6 delivered a different perspective, whereby producers had developed informal processes, structures and local charcoal labour markets.

Typically, middlemen are portrayed as the most criticised actor in non-timber forest product (NTFP) value chains, described as a powerful group, with the ability to exploit others (Schreckenberg 2003; Belcher and Schreckenberg 2007). Charcoal middlemen in particular are depicted as a politically connected elite, urban-based minority who earn the highest revenues because they monopolise the transportation links and have long-term vested interest in the sector (Ribot 1998; Brouwer and Magane 1999; Kwaschik 2008; World Bank 2009; Shively et al. 2010; Schure et al. 2013; Luz et al. 2015). Furthermore, evidence from Uganda (Shively et al. 2010) Tanzania (Ngoo et al. 2011) and Kenya (Delahunty-Pike 2012) indicates that women

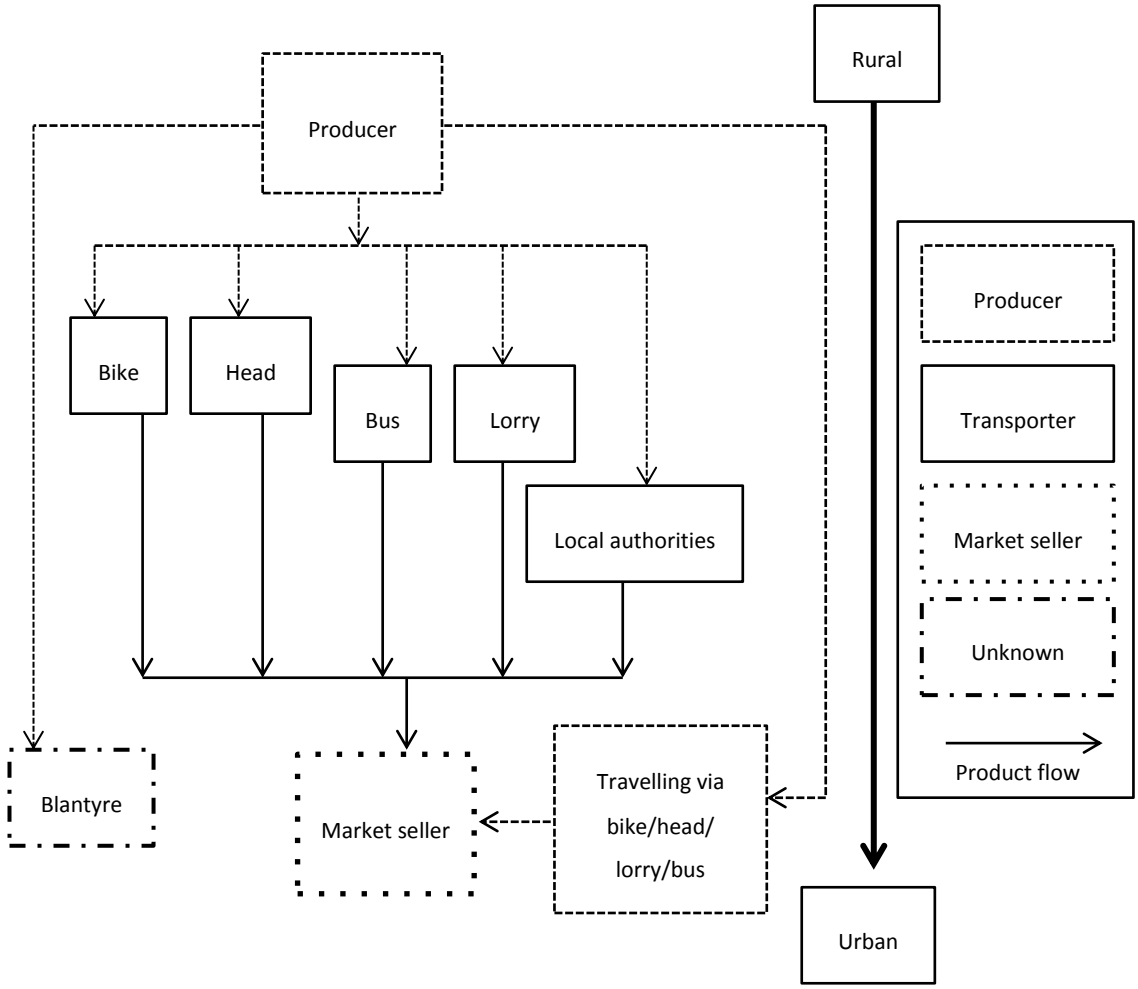
infrequently participate in the transporting stage, with the Kenyan study suggesting that the variance in gender equity "seems unlikely to change in the near future" (pp. 8).

The research reported in Chapter 5 provided an unusual description, as Zomba's transporters had none of the characteristics commonly attributed to charcoal middlemen. Both men and women participated in the transportation of charcoal. Chapter 5 identified four types of small-scale transporters supplying Zomba with charcoal: bicycle, headload, minibus, and lorry, and Chapter 6 additionally identified the involvement of local authorities. Excluding the local authority transporters, Zomba's transporters predominantly lived in rural areas, were poor (but not the poorest as they had access to land and assets such as bicycles and telephones) and the majority of transporters worked individually. Zomba's charcoal resources were relatively close to the city and the population and therefore demand for charcoal was small (for example in comparison with the nearby city of Blantyre). Because of the low cost of transportation and the abundance of small-scale rural transporters, the market price for charcoal was relatively low. Under these conditions, there was no scope for the emergence of an 'urban-elite' to dominate transport of charcoal to Zomba. As a result, all motorised charcoal transportation in the region (excluding individuals using public transport and local authorities using official vehicles) passed through Zomba, to sell to Blantyre's market.

7.3 Why do people participate?

There are two prevailing narratives for charcoal-based livelihoods in literature. The first portrays an activity of last resort, pursued by poor, marginalised households who have few alternative opportunities to generate an income. Under this narrative, charcoal-based livelihoods are depicted as short-term, responsive and often engaged in as a safety net (Zulu and Richardson 2013). The second (and more recent) narrative has begun to consider the livelihood role of charcoal as more of a long-term livelihood approach, seen as a livelihood diversification strategy (Jones et al. 2016). This second narrative describes a livelihood strategy that is pursued by people of varying income levels, has the potential to generate substantial incomes and reduce relative poverty amongst producer households (Khundi et al. 2011; Ainembabazi et al. 2013). Contributing new knowledge to the two prevailing charcoal-based livelihood narratives, the findings of this thesis demonstrate the existence of both narratives within the study site.

Figure 7.1: Value chain actors in Zomba's charcoal trade and flow of charcoal from rural to market areas, summarised from data presented in Chapters 4-6



Engaging in charcoal production was never perceived to be a desirable livelihood activity, rather participants characterised themselves as reluctant producers who engaged in production due to poverty. Similar perceptions have been reported by charcoal producers elsewhere in Malawi (Zulu 2010). A key factor that emerged throughout Chapters 4-6 was the lack of local employment opportunities available in the case study region. Where alternative livelihood strategies existed, such as irrigation agriculture in the Northwest of the study site (Chapter 4), charcoal production did not occur. This mirrors motivations of producers in Mozambique, relating charcoal production to a lack of alternative income generating opportunities (Jones et al. 2016). Zomba's charcoal sector and opportunities in its production and transportation therefore presented much-needed opportunities for rural income generation.

The apparently conflicting views of charcoal being an activity of last resort but simultaneously a lucrative business and livelihood diversification strategy can be reconciled by the fact that unlicensed charcoal production is not only an illegal activity (subject to frequent and costly

enforcement activities) but also one that is stigmatised within the villages and considered much harder and more dangerous work than alternatives such as agricultural labour. Charcoal provided a lucrative income source, yet it was interesting to note that charcoal production was never perceived as a desirable livelihood activity. Last resort activities tend to be perceived in a negative light, and perhaps charcoal was viewed as such, due to the related stigmatism and social undesirability.

It is challenging to suggest whether there was a more dominant form of engagement in the Zomba region, be it a short-term, last resort activity, or a longer-term diversification strategy, as that specific analysis was outside the scope of this research. However, an individual's primary reasons for engaging in charcoal production and transportation were for one-off, large, expenses related to purchasing expensive items, in response to a shock, in response to higher urban demand for charcoal or for recurrent seasonal needs. The ability to generate fast and substantial amounts of cash-in-hand, with low capital requirements was a key factor that encouraged actors to participate in the sector, both for short term and longer-term strategies.

7.3.1 Livelihood Resilience and Vulnerability

To state that people engage in the production and transportation of charcoal because they need money does not sufficiently explain the full complexity of why people engage in the sector. A crosscutting theme that materialised through Chapters 4-6 was the resilience, and conversely the vulnerability context of charcoal livelihoods (See also section 7.4). One facet of resilience relates to temporality of actors' actions to cope with stresses and shocks (Marschke and Berkes 2006), which incorporates induced stress from trends and seasonality (DFID 1999; Scoones 2009). The charcoal sector provides opportunities for rural livelihood strategies within the Zomba region. However, these livelihoods also comprise non-charcoal related activities. Analysis of the seasonality of producers' different livelihood activities in Chapter 6 highlighted that no single activity generated consistent income throughout the year. For example, agricultural income was primarily linked with the maize harvest season in March, income from unskilled labour corresponded with seasonal farming responsibilities from August-October and December-March and income from charcoal production was driven by increased urban demand during periods of lower temperatures in June-July and higher rainfall in November-April. In this sense, charcoal production was an additional flexible livelihood diversification strategy used by rural households with access to the forest and resources.

Chapters 4 and 6 demonstrated that both transporters and producers shared similar short-term temporal motivations. Some were coping mechanisms in response to vulnerability such as a gap-filling activity in periods of seasonal hardship (e.g. food shortage), between seasonal income

generating activities or as a safety net activity in response to a shock. Other motivations were linked to short-term financial needs, such as a stepping stone activity to generate capital with which to pursue an alternative livelihood strategy, or for one-off purchases of expensive items. Similar short-term motivations to engage in the production and transportation of commercial forest products have also been noted by several authors (Shackleton and Shackleton 2004; Mamo et al. 2007; Shackleton, Delang et al. 2011; Walelign and Nielsen 2013; Wunder, Börner et al. 2014; Jones et al. 2016)

By examining charcoal production at the village-level in Chapter 4, the research identified other temporal factors, both trends and events, giving insight into why villages participated (or did not), where, how long and at what intensity production occurred, improving our understanding of the dynamics of charcoal production. Following the growth of charcoal production in the region, locations of varying intensities of participation had shifted. These spatial patterns of extraction were influenced by a number of factors such as changes in market and resource access, linked to institutional and physical access, financial factors, linked to variations in local employment opportunities, the need to engage with a cash economy, and seasonal and non-seasonal food insecurity. The research findings suggest that some producers initially engaged in production in response to a specific shock, such as the 2001/02 famine. Under prolonged circumstances of stress and hardship, twinned with the strengthening of the local charcoal market in Zomba around 2004/05, when urban charcoal consumption exceeded urban firewood consumption (Zulu 2010), production and transportation elevated into a longer-term strategy for some actors. The transition of a commercial forest product, from a short-term coping mechanism to a longer-term livelihood strategy for supplementary income, has also been noted by other authors (Shackleton and Shackleton 2004).

7.4 Livelihood outcomes

7.4.1 Benefits

Chapters 4 and 6 identified that improved financial assets were the principal direct benefit generated from participation in Zomba's charcoal sector. Engagement in the charcoal sector was shown to reduce levels of financial poverty, as findings in Chapter 4 revealed that mean weekly earning of transporters exceeded the global poverty rate, set at USD $2/day (World Bank 2014). A detailed analysis of broader livelihood benefits in Chapter 6 demonstrated that strengthened financial assets led to other benefits, such as improved access to goods and services, strengthened social networks, reduced food insecurity and opportunities for livelihood diversification. Benefits such as these, in addition to the seasonal role of charcoal income and in

response to shocks (see also section 7.3.1), contributed to improving actors' capabilities and enhancing their overall resilience.

Whilst this thesis did not focus directly on the vertical distribution of benefits amongst producers and transporters, reviewing data presented in Chapters 5 and 6 suggests that producers achieved slightly higher per bag profits than transporters. Average per-bag profits for transporters ranged from K1203 ± K515 (for headloaders) to K1496 ± K598 (for bike men). The average price of a bag bought by transporters from producers ranged between K1419 ± K312 (for headloaders) and K1660 ± K371 (for lorry transporters), which corresponds with data in Chapter 6 reporting that producers sell a bag of charcoal for around K1500. These figures corroborate other value chain analyses from Malawi, which also suggest that producers earn higher profits (ranging from 20%-33% of the final retail value) than transporters (ranging from 20%-25% of the final retail value) (Kambewa et al. 2007). These outcomes also support findings from Nigeria (Agbugba and Obi 2013), demonstrating that smaller charcoal markets comprise actors working on smaller scales. Individual actors have little or no influence on the market price, resulting in a competitive market structure and therefore more equitable vertical distributions of profits. The small-scale engagement of producers and transporters in this study contrasts with value chain analyses of larger charcoal markets for example in Senegal, Tanzania, Uganda and Mozambique where small-scale producers generate lower profits, reflecting the different scales of activities. For example, transporters tend to be large-scale, generating higher profits, in comparison producers work on a much smaller scale, or are employed as labourers and generate comparatively smaller profits (Ribot 1998; van Beukering et al. 2007; Shively et al. 2010; Luz et al. 2015).

Horizontal analysis of production locations and case study villages presented in Chapters 4 and 6 demonstrate that depending on when and where producers engaged in charcoal production (spatial-temporal variances), they achieved different benefits. For example, Chapter 4 identified that producer communities located in the North were the most recent villages to produce charcoal. Data from the case study villages in Chapter 6 showed that producers in the North village were able to pay for farm labour with income generated from charcoal production and many had purchased solar technology. Neither outcome was reported in other production areas. Reflecting back on the framework presented in Chapter 3, these spatial-temporal variances in outcomes were linked to: actors' livelihood assets (e.g. differences in the availability and accessibility of 'high grade' charcoal tree species and associated declining financial assets obtainable from the forest resources); structures and processes (e.g. differences in market access, technological advances, institutional support and development of alternative livelihood activities); and alternative livelihood strategies (e.g. irrigation agriculture).

Women's responsibilities in commercial forest product value chains are rarely observed and frequently under-acknowledged (Shackleton, Paumgarten et al. 2011). However, the gendered disaggregation in this thesis demonstrate the integral role of women in the production and transportation of charcoal, contrasting other studies that report restricted involvement of women in these value chain positions (see section 7.2). A gendered disaggregated analysis of Zomba's rural value chain actors identified differences in the distribution of benefits. Only men transported charcoal by bike and, on an average weekly basis earned three times as much as those who transported by headload, which was the main method used by women. In areas where both men and women were involved in the production process, women reported higher rates of participation because they had less income generating opportunities available to them. These findings support claims that natural product trades are sometimes one of the few accessible income generating options available to women (Shackleton and Shackleton 2004; Schreckenberg and Marshall 2006; Kassa and Yigezu 2015). Recent sub-community studies have also identified the dominance of women in the production of charcoal in Tanzania (Butz 2013) and Mozambique (Jones et al. 2016), both demonstrating that charcoal is an important income source for women, independent of their husbands. These findings also support observations, which report the importance of financial independence for women from engaging in natural product trades (Shackleton, Shanley et al. 2007; Shackleton et al. 2008).

7.4.2 Trade-offs

Trade-offs created by management decisions need to be better understood, as the livelihoods of the most vulnerable tend to be most at risk (Daw et al 2015). Trade-offs amongst transports and producers stemmed from Malawi's current approach to managing the charcoal sector and the illicit nature of the sector imposed great economic and psychological burdens upon actors. Conflicts with authorities weakened actors' social assets and risks from enforcement increased actors' vulnerability to reduced incomes. The consequences of this income loss included reduced household food security, reduced financial security and reduced access to markets, healthcare and education services. These losses stimulated reliance on the sector, as actors prolonged their time in the sector to make up for setbacks caused by enforcements.

Chapters 5 and 6 highlighted the limited research focus on the distribution of enforcement activities in the charcoal value chain and the resultant trade-offs. Evidence from Uganda (Shively et al. 2010), Kenya (Delahunty-Pike 2012), Tanzania (Sander et al. 2013), Malawi (Sibale and Banda 2004; Kambewa et al. 2007; Zulu 2010) and Chad (Nelson 2009 as cited in Biomass Technology Group 2010) suggests that regulations (both formal and informal) are enforced more frequently along transport routes and in markets than in production areas. This is unsurprising

given that production locations are rural and often remote, and there is greater visibility of actors along transport routes and in markets. Producers were vulnerable to larger confiscations than transporters, given that enforcers confiscated everything at the kiln site, whereas transporters tended to have fewer bags to confiscate. An additional distinction between producers and transporters was the financial capital and means of transport (e.g. loss of bicycle) that transporters risked losing, in addition to loss of potential profits. Producers instead lost tools and labour and time inputs.

Disaggregating by stakeholders within the horizontal analysis of enforcement activities in Chapter 5 demonstrated that the costs were distributed unevenly amongst transporters, with those using bicycles (men) experiencing greatest risk from enforcement. Furthermore, a gendered disaggregation in Chapter 6 identified that female and male charcoal producers did not experience the same level of enforcement, as male producers were on average twice as likely to have experienced an enforcement activity as women. However, there is limited data to indicate how frequently different actors experience enforcement activities, whether socio-cultural factors such as gender, ethnicity or age influence the risk of enforcement, the differentiation of losses suffered amongst actors (e.g. whether large-scale charcoal confiscations are more detrimental than a bicycle confiscation) or the distribution of subsequent livelihood trade-offs (e.g. what groups of people are more or less vulnerable to different types of enforcement). These findings therefore serve to highlight additional unknowns and areas for further research.

Chapter 6 presented information on the livelihood trade-offs associated with local forest degradation. Forest loss had reduced actors' access to other forest ecosystem services, which included timber and NTPFs such as firewood, edible plants, wild animals, medicinal plants and construction materials. The increased scarcity of other forest products reduced opportunities for livelihood diversification due to time conflicts between livelihood strategies, which were exacerbated by increasing distances to access remaining forest resources. Results also highlighted adaptive response mechanisms, with households relying more on market substitutes, further increasing their engagement with the cash economy and need for income generation. Although not the focus of this study, Chapter 6 indicated that the degradation of broader forest ecosystem services, such as water and soil regulation produced further livelihood trade-offs. For example, perceived yield reductions and increased food insecurity, caused by an increased prevalence of flooding and reduced soil quality in arable land, heavy siltation and drying of small streams.

Causes of deforestation and forest degradation are complex, driven by a range of factors and are context specific (Geist and Lambin 2002). As highlighted in Chapter 2, there is still debate over the extent to which charcoal production contributes to deforestation and forest degradation in Africa. The findings in this thesis add to the discussion by demonstrating that where urban demand for

charcoal is high, where de facto open access resources with insecure local tenure regimes exist, unsustainable production practices prevail. This ultimately contributes to regional forest degradation. Extraction of charcoal resources in the study site followed a theorised transition of 'fishing down the food web' (Pauly et al. 1998; Ahrends et al. 2010), whereby producers initially targeted 'high quality' species for charcoal, diversifying with increasing scarcity to harvest any remaining trees (including fruit and domesticated species) and residual tree roots. The removal of residual tree roots and continued extraction of younger trees restricted the ability of natural forest regrowth to occur. Areas of degraded forest were gradually moving northward and in certain areas (such as the lower eastern slopes of Zomba and Malosa FR) where the land had been converted for agricultural purposes, complete deforestation had occurred. Whilst these findings are not surprising, as they follow a tragedy of the commons-type scenario (Hardin 1968) and mirror other reports on unsustainable charcoal production practices (Mwampamba 2007; Ahrends et al. 2010; Hosonuma et al. 2012), they are nonetheless alarming. An estimated 58% of charcoal in Malawi originates from government-owned forests with de facto open access resources due to low enforcement capacities (Kambewa et al. 2007). Under this continued scenario of de facto open access, these forest areas may be at risk of future degradation as increasing urban demand for charcoal expands the locations of production areas.

7.5 Constraints to charcoal-based livelihoods

Current governance mechanisms in Malawi do not support a formal commercial charcoal sector, given that (aside from the one licence authorised in September 2015) all production and transportation of charcoal is illegal, informal and unregulated. Chapter 6 demonstrated that sustained livelihood benefits derived from production were dependent on resource availability, but the lack of formal management of charcoal resources in Malawi means that livelihoods benefits are subsequently unsustainable in the long-term. The key constraint to charcoal-based livelihoods in Malawi is therefore the lack of a functioning sustainable charcoal sector. This section identifies four underlying constraints to the development of a sustainable charcoal sector in Malawi, details up-to-date information on Malawi's current charcoal policy reforms that have been developing during the course of this research, and draws on the findings of this study for additional implications for policy.

The first constraint concerns the lack of legal empowerment that value chain actors have. In the Zomba region, secure tenure and commercial rights to produce charcoal in the forest reserve did not exist. The issuance of commercial licences remains under central control, whilst enforcement of disciplinary regulations continues under local community and departmental control. Thus, there are no opportunities for local communities to independently develop commercial,

sustainable charcoal production practices. The research findings in Chapters 5 and 6 demonstrate that insufficient focus on promoting a sustainable sector whilst endorsing stricter enforcement of punitive regulations seems only to increase actors' vulnerability to reduced income. This undermines market and livelihood security, whilst having no positive impact on forest resource protection.

The second constraint relates to the lack of fiscal empowerment of the sector. Chronic under-funding and lack of authoritative capacity of the Department of Forestry (as highlighted in Chapter 2) makes it challenging to successfully execute strategies, or fund the development of a sustainable sector. There is no formal taxation system (of charcoal) in place. The only formal mechanism for generating revenue from charcoal is to confiscate and re-sell it (as stipulated by the Forestry Act 1997, Section 12). However, estimates suggest that less than 0.02% of Malawi's illegal charcoal is intercepted per year (Zulu 2010).

The third constraint links to low institutional capacities for implementation and enforcement of regulations. Poor integration of conflicting and confusing formal mechanisms (outlined in Chapter 2) and inadequate communication of the law generates uncertainty about which regulations apply to the production and transportation of charcoal. The collection of already limited formal revenue is further undermined by corruption amongst authorities. Reported corruption and coercion from formal structures (e.g. bribes, transporting charcoal, corporal punishment) and evasion of regulations by actors (e.g. transporters travelling at night to avoid enforcers, informal alarm systems amongst producers) in Chapters 5 and 6, undermine the ability of formal mechanisms to effectively govern the sector and protect the forest resources. Additionally, the variety and range of convictions reported by transporters and producers in Chapters 5 and 6 indicate weaknesses in the formal sector, due to the tendency for enforcing bodies to modify regulations by informal practices.

The fourth constraint to developing a sustainable charcoal sector in Malawi is the lack of available data, which stems from the informal and clandestine nature of the sector (Neufeldt et al. 2015). This has lead to a lack of evidence-based decision making relating to the charcoal sector, which has contributed to inefficient and unsuccessful approaches, such as the de facto ban on the sector (ICRAF 2015).

7.7 Further research

Chapter 2 reviewed how the sector is predominantly governed across sub-Saharan Africa and identified the environmental and socioeconomic impacts of the charcoal sector. In doing so, the chapter highlighted a number of research gaps pertaining to the charcoal-livelihood literature, which included:

- Small and medium sized urban markets;
- Actor's motivations to engage in the production and transportation of charcoal;
- Broader notions of wellbeing outcomes;
- Horizontal distribution of outcomes;
- Focused attention on specific actors;
- Informal governance and organisation of the charcoal sector;
- Spatial-temporal and socioeconomic sector dynamics.

In addressing these research gaps through Chapters 4-6, the findings of this thesis corroborate findings of others, contribute to the generation of new knowledge (summarised in Table 7.1) and expose areas for further research (Table 7.2).

Table 7.1: Summary of the generation of new knowledge and corroboration with expected findings

1. What are the rural components of the charcoal value chain, and what are the characteristics of these actors?	
Corroboration with expected findings	**Key contributions to the generation of new knowledge**
– Men dominate the production process; – Three types of producers working at a small, medium and large-scale; – Producers use mobile, temporary and inefficient kilns; – Small-scale transporters supplying urban markets operate by head load or on bicycles; – Vested interests and rent seeing activities (e.g. bribes) within formal structures are common within the value chain.	– Although men dominated the production process through the study region, this study highlights factors that affect gendered resource access (e.g. distance to the resource and topography); – Integral role of women in small-scale transporting; – In locations where resource access is high, women and men participate equally in the production practice; – Producers were organised, with informal labour markets and structures for production and to combat enforcements; – Value chain actors of small urban charcoal markets are not comparable to their larger counterparts. There was no evidence of large-scale motorised transporters supplying Zomba with charcoal. Only small-scale transporters supplied Zomba's charcoal market; – Small-scale transporters also use local transport (e.g. minibus) to transport charcoal, in addition to headload and bicycle; – Both men and women participated in the transportations of charcoal, yet transportation methods were gendered, with only men using bicycles; – Formal authorities were reported to be involved in the transportation and selling of charcoal within Zomba's market.
2. Why do people participate in the rural charcoal value chain?	
Corroboration with expected findings	**Key contributions to the generation of new knowledge**
– High demand for charcoal due to unreliable and inefficient electricity supply and increasing trends in population growth and urbanisation; – Increased opportunity for rural income generation and livelihood support; – A coping mechanism to deal with food and financial insecurity; – Lack of alternative income generating opportunities in the study region; – Minimal financial capital required to produce charcoal makes it an attractive income generating activity for those with limited assets.	– More nuanced understanding of the role that the charcoal sector plays in rural livelihoods. In the region was both an 'activity of last resource' but also an integral livelihood diversification strategy. The coexistence of these two livelihood approaches was in part linked to the social stigmatisation and undesirability of participating in an illegal activity; – More nuanced understanding of the seasonality of charcoal livelihoods, linked strongly to periods of food insecurity and increased urban demand during cool and rainy seasons; – More nuanced understanding of external

	influences on village-level engagement in production, including market and resource access and food and financial security; – Like other commercial forest products, charcoal producers may transition from short-term coping mechanism to long-term diversification approaches.

3. What are the benefits and trade-offs from participating in the rural charcoal value chain?

Corroboration with expected findings	Key contributions to the generation of new knowledge
– Charcoal production and transportation provide important income generating opportunities for rural populations; – Capital generated from charcoal production and transportation is used to afford basic needs and is invested into other livelihood activities; – Charcoal income may provide an important income source for women, independent of their husbands; – Time spent transporting and producing charcoal may conflict with other livelihood activities, such as farming; – Regulations are enforced more frequently along transport routes than in production areas; – Unmanaged production practices give rise to forest degradation, with areas of degraded forest expected to expand in 'waves', originating from the urban periphery; – Producers may target specific tree species due to consumer preference; – Degraded forest resources will create environmental trade-offs, negatively impacting rural livelihoods; – Punitive enforcements and corruption may undermine and marginalise rural livelihoods.	– Strengthened financial capacities creates indirect benefits linked to improved access to services, reduced food insecurity, opportunities for livelihood diversification and enhanced resilience to shocks and stresses; – More nuanced understanding of benefit distributions amongst small-scale transporters, with men generating higher incomes than women; – More nuanced understanding of the gendered nature of enforcement costs, with men more frequently targeted than women; – When women participate in the production process, they are more dependent on charcoal income than men, as they have few alternative income generating activities available to them; – More nuanced understanding of time conflicts, whereby substantial forest availability can outweigh the time conflicts with other livelihood strategies (e.g. agriculture), as producers can afford to pay for labour; – More nuanced understanding of the role of charcoal in forest degradation: When urban demand for charcoal is high, resources are de-facto open access and insecure tenure exists, unsustainable production practices prevail, leading to localised forest degradation.

4. What are the constraints to charcoal-based livelihoods?

Corroboration with expected findings	Key contributions to the generation of new knowledge
– Weak institutional capacity caused by conflicting policies that perpetuate the 'crisis' mentality; – Regulating authorities lack fiscal empowerment; – High barriers to formal production practices undermine attempts to formalise the sector; – Punitive, top-down approach to governing	– Variety of convictions within the sectors demonstrates authorities' tendency to modify formal practices; – Insufficient promotion of legal approaches in conjunction with strict enforcements has little impact on forest protection, as actors are forced to reengage with production and transportation to make up for the set-backs caused by enforcements.

Malawi's charcoal sector further marginalise poor, rural stakeholders; – Existence of corruption and vested interests amongst enforcing bodies obstructs the development of policy reforms; – Ineffective forest protection measures; – Increasing trends in forest degradation; – Lack of information on the charcoal sector, value chain actors and governance issues restricts the development of equitable and effective policies.	

Table 7.2: Ideas for further research

Research Gap	Insights from this study	Suggestion
There is **limited focus on the charcoal markets of smaller urban areas**. There are an unknown number of actors participating in these smaller markets and limited information on the resources they access and how they are managed.	There is insufficient information to determine whether the value chains of smaller charcoal markets are comparable to their larger counterparts. There is a need for more small-town studies, as well as an understanding of the linkages between them and large urban centre supply chains.	Conduct more charcoal value chain analyses for other small urban areas.
Women's engagement in the sector is under-reported and overlooked by the literature.	Women actively participated in the production and transportation of charcoal.	Conduct full-scale gender analysis of the charcoal value chain, focussing on understanding factors that promote women's engagement determining whether they engage out of desperation or as a positive livelihood strategy.
Further research is required to determine **how and why benefits are distributed unequally amongst actors,** and how differences in power could be addressed.	Distributions of benefits amongst transporters were gendered. Further analysis could provide insights into other influencing factors (e.g. age, ethnicity).	Conduct horizontal analyses of benefit distribution amongst actors.
There is **limited understanding on the livelihood impacts of punitive regulations**, or whether certain factors (e.g. gender, age, position in the value chain) affect actors' exposure to enforcement activities.	Actors were not equally at risk from enforcement. Enforcement activities increase actors' vulnerability to income loss, which has detrimental impacts on their livelihoods and stimulates reliance on the sector to make up for setbacks.	Research into the impacts of enforcement activities on livelihood outcomes and the vertical and horizontal distribution of enforcement within the charcoal value chain.
How does **seasonality affect the structure and governance of, and engagement in the sector**? What implications are there for policy?	Urban demand, participation in the value chain and market prices varied seasonally.	Conduct a seasonal analysis of the charcoal sector.

Table 7.2 continued

Research Gap	Insights from this study	Suggestion
The true extent of **the contribution of charcoal production to deforestation and forest degradation requires separation and further clarification**.	The effects of forest degradation are context specific and often localised. Additional studies could provide insights into the specific conditions that result in charcoal-led forest degradation.	Conduct studies that specifically examine the relationship between charcoal production, deforestation and forest degradation in a variety of contexts.
There is limited understanding into **how the informal charcoal sector is organised** and how these informal governance structures could be integrated into a formalised system.	Value chain actors were shown to self-organise, but in order to further assess possible constraints or benefits, more empirical studies are needed to fully understand variations in how informal charcoal value chains are governed and whether there are specific factors that cause value chains to shift to the 'elite dominated' model seen in larger urban areas.	Conduct more empirical studies into the informal organisation and governance of charcoal production and transportation.
How can policy decisions **integrate spatial-temporal information** effectively?	There were heterogeneous spatial-temporal factors and outcomes within Zomba's charcoal sector, with actors reacting at varying speeds to different policies.	Conduct more empirical studies into the spatial-temporal dynamics of the production and transportation of charcoal.
How can sustainable charcoal production be integrated into community forestry?	Malawi is experiencing a trend towards decentralised forest management (e.g. improved forest management for sustainable livelihoods programme (IFMSLP)), which may reduce access to charcoal resources and negatively impact charcoal-based livelihoods.	Draw on practices and lessons learnt from other commercial forest product trades (including charcoal) elsewhere in sub-Saharan Africa. Re-evaluate communities' resource access rights to support community-based, sustainable charcoal production and transportation. Promote, support and monitor community ventures into commercial charcoal trade.
How can better **coherence between energy and forestry policies** be achieved?	Contradictions between policies create a disabling environment for the development of a sustainable sector and undermine the livelihood benefits associated with the production and transportation of charcoal	Review different ways of achieving a coordinated charcoal policy (e.g. an autonomous entity to manage the charcoal sector or an inter-departmental coordination unit).

7.8 Recent and current developments in Malawi

Over the past few years, interest in charcoal has gradually increased to the point where Malawi is revisiting its charcoal policies. In order to address policy gaps, conflicts and duplications created by the development of new economic instruments, strategies and policies in the area of environment and natural resources management, Malawi's National Forest Policy is currently under review. In a draft edition from September 2014, the Policy's opening line states:

The goal of the National Forest Policy is to improve provision of forest goods and services to contribute towards sustainable development of Malawi.

In relation to charcoal, the Draft Policy identifies that "the value of non-wood forest products, processed timber or the informal trade in fuel wood and charcoal" is not fully accounted for and "as a result, the potential of the forestry sector to contribute to poverty reduction is significantly underestimated" (pp. 9). The Draft Policy stipulates a Policy Priority for Biomass Energy Development aimed at "promoting sustainable production and utilization of biomass fuels in the form of firewood and charcoal [and] improving the production and efficient use of charcoal and firewood" (pp. 15). The Draft Policy sets an enabling environment for sustainable charcoal production, trade and use. However, it does not detail any specifics into how the Policy will be implemented.

In September 2015, the Department of Forestry organised a National Charcoal Forum. The Forum brought together a wide cross-section of stakeholders to build a shared understanding of the challenge of charcoal and energy in Malawi, consensus on possible sustainable solutions and seek a framework for their implementation. The Forum had four objectives, namely to:

1. Understand the major issues surrounding the charcoal value chain (e.g. underlying drivers, the energy demand, law enforcement, etc.);
2. Appreciate the impact of illegal charcoal making as a major driver of deforestation in Malawi, including environmental degradation, human health and the economy;
3. Receive reports and updates on available alternatives and energy efficient technologies;
4. Propose feasible and practical strategies and work plans to address the charcoal/energy crisis in Malawi (Charcoal Forum Press Release, see Appendix K).

Recommendations from the Forum emphasised the need for a multi-sectoral approach through the establishment of a multi-sectoral task force to develop a National Charcoal Strategy. In a follow-up meeting to the Forum, the heads of the Department of Forestry, Department of Energy Affairs and Department of Mines proposed six pillars for the National Charcoal Strategy:

1. Effective implementation of law enforcement and putting in place effective licensing and regulatory systems for charcoal production, transport, and marketing;
2. Promotion of sustainable forest management and supply of wood and provision of pathways for legal production and marketing;
3. Sustainable charcoal production under Malawi's conditions through improved silvi-cultural practices for indigenous forests and strategies that promote private tree growing at individual, community, and industrial level;
4. Promotion of alternative sources of household cooking [fuel];
5. Adoption of fuel-efficient cookstove technologies;
6. Recognizing the role that charcoal production and trading play in supporting income generation and livelihoods (Personal Communication with Clement Chilima, Director of Forestry of Malawi).

The development of Malawi's Charcoal Strategy is running from November 2015, for adoption in July 2016. According to the Director of Forestry, the process includes stakeholder consultation to seek effective, sustainable and realistic solutions for Malawi (Personal Communication with Clement Chilima, Director of Forestry of Malawi).

7.9 Implications for policy

This research provides insights into the contribution of charcoal to rural livelihoods, focussing on the benefits and trade-offs associated with participating in the production and transportation of charcoal in Southern Malawi. This study has not only had an academic focus, but also a policy focus. A policy brief focussing on the livelihood benefits was circulated at the aforementioned Charcoal Forum in September 2015 and presentations based on the research in this thesis were made at a number of conferences and meetings[45] to share results internationally with academics and policy makers. This research has already had a number of impacts including:

- The UK Department for International Development (DFID) recognised the relevance of this case study to the wider charcoal sector across Africa. The contribution from charcoal to rural livelihoods has influenced the development of an upcoming programme that aims to "promote sustainable wood fuel energy systems that improve livelihoods and reduce deforestation rates" (LTS International 2014; personal communication with Gaia Allison, Forests and Land use adviser at DFID);

[45] Details of research findings presented at conferences have been at the beginning of each individual data chapter.

- Policy makers in Malawi have responded to the work by reviewing policies that criminalise the charcoal value chain (particularly transporters) and highlighting the significance of charcoal-based livelihoods in the development of the aforementioned Charcoal Strategy (pillar number 6) (detailed in an ESPA-ASSETS research impact report);[46]

- The work is poised to make significant contribution towards Malawi REDD+ Corruption Risk Assessment with particular focus on why corruption occurs in the charcoal value chain (detailed in an ESPA-ASSETS research impact report).

Charcoal is often considered a traditional irrelevant energy source and, as demonstrated in Chapter 2, receives marginal attention in Malawi's National Policies. This perspective needs to be reversed given the number of people involved, the associated benefits and trade-offs and the lack of realistic energy alternatives in Malawi. Fortuitously, the current developments in Malawi indicate that this shift is already underway. In addition to the impacts of this research thus far, there are additional implications from this study that may complement Malawi's current review of its charcoal policies.

Formalisation processes for charcoal value chains often exclude and marginalise the poorest participants (Ribot 1995, Schure et al. 2013) as it is often challenging for rural stakeholders to be represented during formal decision-making structures (Laird, Wynberg et al. 2010). 80% of Malawi's charcoal value chain actors are rural (MARGE 2009). The research in this thesis embodies the views from almost 600 rural stakeholders who were engaged in the production and transportation of charcoal in Zomba. The policy recommendations presented in this thesis therefore derive from these stakeholders' knowledge and represent their collective views, circumstances, requirements and experiences of Zomba's charcoal sector. However, as noted in section 7.9.2 (see below), this research did not engage directly with authorities, and therefore the policy recommendations only represent the values, opinions and knowledge of the rural actors in Zomba's charcoal value chain, thus should be considered in support of other recommendations.

Novelty can be claimed for the detailed examination of charcoal-based livelihoods in the production and transportation chains of a small African city. These recommendations are current and representative of rural stakeholders, therefore they may be particularly valuable for Malawi's revived interest in developing updated charcoal policies. However, the specificity of this case study may limit the relevance of these recommendations for larger charcoal markets, as their value chains are inherently different. Therefore these recommendations should not be used in

[46] This report will be available online at http://espa-assets.org/ from the 6th May. This thesis was submitted before the report was published.

isolation, but rather contribute to delivering a more nuanced understanding of charcoal production and transportation.

Malawi's charcoal sector provides substantial financial and non-financial benefits to rural communities involved in its production and transportation. It is imperative that charcoal-based livelihood benefits are recognised accordingly, and that any developments in policy reflect the importance of charcoal as an integral livelihood diversification strategy. The poverty reduction potential of charcoal should be incorporated into National Policies and a sustainable charcoal sector is therefore fundamental to the development of pro-poor energy policies.

Vested interests of illicit taxes, coercion and corruption for personal gains are deeply embedded in Malawi's charcoal value chain, which are a central source of vulnerability to the charcoal sector, creating livelihood trade-offs and impeding changes to the sector. Addressing this particular issue is paramount to endorsing a professionalised and transparent system that delivers political confidence in the sector and encourages participation. Political assurance in the longer-term development of a professionalised market is also required to encourage the sustainable management of resources and business investment. Information and knowledge sharing would substantially improve issues with the lack of data. Integrating research from developed and developing nations could help to not only assimilate technological advances, but also assist in fostering a constructive perspective of wood-based energy in regions where it is still seen as an archaic fuel source.

The findings of this research demonstrate the integral role that women play in the production and transportation of charcoal. Any policy developments should recognise their involvement in the sector and should include mechanisms that do not marginalise or inhibit their participation, especially given the lack of income-generating opportunities available to women. The lack of urban elites in Zomba means that there are perhaps fewer obstacles to reforming the sector, as there are no politically connected elites with long-term vested interests in the trade who may block reforms (Neufeldt et al. 2015). Therefore smaller urban markets could provide opportunities to take a different approach in professionalising their charcoal value chains that provide equitable outcomes amongst actors.

Across sub-Saharan Africa, national charcoal strategies are headed towards formalising the sector, in a bid to improve the environmental sustainability of the sector. However, formal charcoal sectors have mixed socioeconomic outcomes with regard to resource access and benefit distribution (e.g. Ribot 1998; Schure et al., 2013; Zulu and Richardson 2013). Formal systems are often unattainable for the rural poor (who in this study make up the majority of the producers and transporters), as they do not have access to the requirements (e.g. capital) needed to produce and transport legally. Thus, regulatory reforms should endeavour to make access to legal

pathways more accessible for small-scale actors, without undermining potential livelihood benefits derived from engaging in the production and transportation of charcoal. This is especially pertinent for the most marginalised actors, such as women and the poorest, given the lack of available income generating opportunities available to them.

Although there are legal pathways to produce charcoal in Malawi, current approaches do not work and in its current form, Malawi's charcoal sector is not environmentally sustainable. However, the informality of the sector allows charcoal to be a flexible diversification strategy, which is crucial for the resilience and wellbeing of rural populations. Policy reforms should endeavour to improve the environmental sustainability of the sector, without marginalising rural populations, creating tradeoffs, or reducing the positive livelihood aspects they derive. Evidence from Mozambique (Jones et al. 2016) support these findings, suggesting that formal regulations limit the flexible role of charcoal income, thus measures should be taken to protect the flexible nature of production practices, as this provides a crucial diversification strategy for many rural households.

Chapter 4 demonstrated that communities react to different policies at different speeds, therefore the timing of phased policies should aim to understand people's reactions and consider them in implementation phases. Revenue from a professionalised system is potentially great, but the rural distribution of supply areas may pose challenges to monitor sustainable practices. Interventions should therefore be locally relevant and focus on incentives to engage in a professionalised system, alternative livelihood options and the sustainable use of resources. Perhaps one of the most significant challenges will be to preserve the pro-poor and equitable qualities that the current informal system delivers. Mechanisms should therefore endeavour to support the positive livelihood benefits of the sector, whilst minimising current trade-offs by developing initiatives that deliver sustainable resource management.

7.10 Reflections on methodology

Chapters 3-6 presented a combination of research methods, which were used to examine various livelihood aspects of Zomba's rural charcoal sector and triangulate information. This mixed-methods approach follows other studies bridging qualitative and quantitative methodologies to research socio-ecological issues associated with livelihood contributions of forest-product value chains (e.g. Shackleton 2005; Ingram 2014; Schure 2014; Mayers 2015).

Obtaining reliable data was challenging in several respects. The fundamental reservation applicable to the entire study was the illegal nature of the charcoal sector in Malawi, and the issues that this may have raised in eliciting accurate and reliable data from participants. Other

difficulties related to generating a uniform understanding and approach by field assistants during data collection, challenges with interpreting from Chichewa to English, the lack of a baseline or existence of basic data on Zomba's charcoal sector and time constraints. This section describes and justifies the actions that were taken in order to minimise risk to both the researcher and participants and to improve the reliability of results, and subsequently reflects on the limitations of the study.

7.10.1 Data collection

Prior to data collection, a one-month scoping visit was undertaken in the study region to ascertain whether the topic of study was feasible and assumptions about data collection methods and participation were realistic. Researchers at the University of Malawi, Forest Research Institute of Malawi and staff at LEAD-SEA were consulted about the proposed research plan and issues surrounding Zomba's charcoal sector were discussed with local traditional authorities, local government officials in the Departments of Forestry and Agriculture in Zomba, Agricultural Extension Development Coordinators (AEDC) and community members in villages peripheral to Zomba forest reserve. Pilot studies for all methods were also carried out prior to the main phase of data collection in order to test and address any issues in the implementation of the research methods.

Alongside training enumerators, the researcher learnt key words and phrases in Chichewa so as to improve the validity of interpreted data. All surveys, rural appraisals and interviews were audio-recorded, and weekly monitoring of data entry and checking of interpretations helped to avoid anomalies in the data. In-depth discourse was challenging to translate in real time and transcripts were not created from recordings. Instead, the general sense of the response was interpreted and written in note form. Therefore, there are limitations to the depth of the data and it is likely that nuanced responses and discussions were not captured by the data recording approach used in this study. This particular limitation rose from resource (both financial and time) constraints and the researchers' limited Chichewa language skills. Given the range of methods used however, data were triangulated and uncertainties could be verified by converging multiple sources of evidence from respondents.

Aside from a survey by Kambewa et al. (2007) there was no comprehensive baseline information on Zomba's charcoal sector. Additionally, available geographic data (for example on village locations) dated from 2008, so there was no up-to-date record of the existence and location of villages in the study region (the National Statistics Office of Malawi was updating their geographic datasets, but at the time of data collection the study region had not yet been surveyed). Overcoming these issues required thorough and time-consuming field visits to traditional

authorities, agricultural extension offices and villages to collect data and corroborate the existence and locations of all villages in the study region.

The generalisability of the research findings may be limited by the specifics of the case study. Given the lack of data currently available on charcoal-based livelihoods and on charcoal sectors of small urban areas, there are limited opportunities to compare the findings of this study. In many ways, this study was a first detailed examination of charcoal-based livelihoods in Malawi and more broadly of smaller urban areas across sub-Saharan Africa, therefore perhaps this research may serve as a baseline for future work.

Despite efforts to remain neutral, this study always carried the risk of creating bias, given that the research was carried out by a foreigner (particularly a white, young female from the UK), and whilst Malawian, research assistants were educated to degree-level and in a higher economic class than respondents. Factors such as race, gender, class, marital status and culture create power gradients and preconceived ideas (both about the researcher and respondents) that influence the interactions between researchers and participants (see Desai and Porter (2006) for a detailed discussion of doing research in a developing country context). Although the influence of positionality was never underestimated during the data collection period, it is nevertheless an inherent and unavoidable bias to the research.

There are biases accompanying the tyranny of participation associated with participatory methods such as rural appraisals (Cooke and Kothari 2001). For example, the strong and elite tend to be louder, while women, young, elderly and the vulnerable are silent, seasonal activities often dictate who is available and dominant participants may overrule group exercises (Chambers 1981; 1994b; Cooke and Kothari 2001). Based on their past experiences, there is always the risk that respondents perceive outsiders as threatening or risky (Mosse 1994). Participants may also give false information about their needs, priorities and actions due to fear or opportunism (Mitchell and Slim 1991). Furthermore, respondents may have beliefs about their value and activities, which do not correspond with reality (Chambers 1981). Non- or evasive answers may be related to the sheer complexity of an answer, fear, or an emotion that makes the topic too painful to discuss (Mitchell and Slim 1991).

These biases produced limitations in the data, however where possible, measures were taken to reduce certain biases. For example, men and women were separated during group activities in the case-study villages and significant effort was made to generate rapport with participants. Data collection methods were carried out in a specific order. The research began with the transporter surveys, followed by (and overlapping with) the producer community surveys and subsequently the case study villages. It was necessary to take this order, firstly to establish the location of producer villages from the transporter survey and secondly to begin building rapport with the

case study villages. Within the case study villages, the village timeline was deliberately chosen as the first activity to orientate the researcher, so village-specific events and information could be discussed in subsequent exercises. In a bid to increase rapport with participants, the semi-structured interviews were purposefully the last exercise and all interviewees had previously participated in at least one rural appraisal exercise. Initial contact with communities was made through local agricultural extension officers (as opposed to the Department of Forestry), to minimise response bias from participants, extension officers were subsequently not present during data collection.

7.10.2 Use of authorities

When researching an illicit forest product such as charcoal, it was critical to engage with participants in ways that would not intimidate them, or lead them to assume that the research and researcher was associated with regulatory institutions or preventative forest measures, as this could have influenced the researcher-participant relationship and jeopardised the data quality. Throughout the data collection process, constant effort was made to improve and maintain rapport with participants. A key consideration was how to approach case-study villages and participants. A decision was made to initially approach communities through an intermediary who was known locally, but whose presence would not contribute to generating mistrust between the researchers and participants. Agricultural extension officers were identified as a rational and practical agent to contact villages, as they had local knowledge of village locations and land use practices (i.e. whether or not villages engaged with charcoal production). They had a level of authority and experience necessary to arrange meetings with traditional authorities and village members but importantly, had no official connection to the management of forest resources.

Indeed, there was always a risk that approaching villages via an ‘official’ body could have created mistrust, as participants may have perceived the Agricultural extension officers to have links with other departments, such as the Department of Forestry. This was perhaps an unavoidable consequence. However, great effort was made to reduce this impact, by clearly explaining the autonomy of the researcher, clearly stating the confidentiality of the research and by only engaging with participants when forest-related officials were not present, to the point of pausing the data collection if they were within earshot.

A principal aim of this research was to portray and represent the views and opinions of rural value-chain actors, therefore there was limited engagement with officials during the data collection, and no data were collected from these stakeholders. This generates limitations for the

insights and policy recommendations, as the results do not represent the views or knowledge of authorities, thus are incomplete for the entire value chain.

Expressions of power are embedded in social and cultural practices, and local knowledge (and the willingness to share it) is influenced by local power relations, authority and gender (Cooke and Kothari 2001). The participatory research in this study was particularly subject to influences of power, as they were public events taking place in public places (e.g. in open village locations). It is likely that these socio-cultural power dynamics gave rise to response bias, given that village chiefs approached some participants in the snowball sampling approach. Furthermore, some participatory activities (e.g. the village timeline) were carried out with authority figures (e.g. village chiefs) and other participants, in mixed-gender group (see section 7.9.1 for reflections on gender bias and power dynamics within groups).

7.10.3 Sampling technique

A key sampling strategy of the research was purposive, snowball sampling, whereby participants were approached through references made by participants, such as other charcoal producers or other village members such as village chiefs. This approach was a practical decision and successful in generating a large sample size, as people are more likely to participate if referred by someone they know (Streeton et al. 2004). However, there are some criticisms and experiences that require reflection.

This study acknowledges bias arising from the sampling technique. Snowballing techniques often only include members of specific networks (in this case charcoal producers and transporters). This limits the representativeness of the wider population, which can produce results that are not generalisable (Bowling, 2014). Whilst a narrow focus on charcoal producers and transporters appropriately conveys these stakeholders' viewpoints and experiences, it is neither a representative nor complete picture of the entire charcoal sector or the region as a whole, and is thus an additional limitation of the study. Inclusion of other stakeholders (e.g. market sellers, consumers, other forest users and regulatory institutions) would have reduced this particular bias, and would have improved the representativeness and generalisability of this study.

When using the snowball sampling approach, participants are enlisted to help find additional respondents and they become de-facto research assistants (Biernacki and Waldorf 1981). By using this approach, the main researcher relinquishes control to the recruiter, which requires a level of trust that the individual understands the research goals and can adequately present the study to others. It is important that the information the recruiter presents to potential new respondents is accurate, and that both the researcher and new participants trust the recruiters. This approach

carries with it a level of risk, as knowledge about the research can become distorted and rumours may develop, which can hinder the process (Biernacki and Waldorf 1981).

During the data collection period, there were incidences where both distorted knowledge and rumours did occur. For example in the East village after data collection, it became apparent that many of the participants were not actively involved in charcoal production. The researcher had, perhaps naively, assumed that the village chief fully understood the research and had assumed that all participants were actively producing charcoal. Verification of participants' involvement in the charcoal sector was not always simple, and the added fact that a financial honorarium was given to participants may have contributed to participants to pose as producers. Reflection in the field led the researcher to firstly strengthen all recruiters' knowledge of the research, and secondly directly question participants' engagement in the sector and triangulate this knowledge with other village members in order to reduce the risk of imposers. However whether or not all participants were honest in their responses remains a limitation of this study.

In the Southwest village, no women were reported to produce charcoal, therefore only male village members were engaged in the research process. Towards the end of the research period, rumours about the researcher (that she was a witch) had begun to develop, spread by female village members who had become indignant that they were excluded from the research process. Fortunately, the timing of the rumours did not affect the data collection. Upon reflection however, a more inclusive approach to explain the research to other village members would have reduced the risk of this type of incident.

Questions of bias are present in many data collection methods, but are particularly critical in the study of 'hidden populations', for example those involved in illegal activities such as the production and transportation of charcoal. Sampling and response bias are main sources of inaccuracy in data collection, but can be overcome by a larger sample size (van Meter 1990). In this study, data were collected from almost 600 participants. Upon reflection, the sample size of this study is hopefully large enough to allow for data triangulation, and minimise inaccuracies created from potential sample bias. But, the potential of sampling and response bias remains a limitation of this study, regardless the sample size.

7.10.4 Avoiding Chambers' anti-poverty bias

Using Chambers' five anti-poverty bias to reflect on the sampling strategy, there was some success in avoiding the anti-poverty bias, but also some bias which were unavoidable given the available resources and scope of the study. There was no certainty that Chambers' *politeness and protocol* bias was successfully avoided, given the short timing of the data collection, therefore this

bias is a limitation of the data. A longer field session would have helped reduce this bias, but was unfortunately not feasible given the resource limitations of the research.

Data were collected during two field seasons conducted from September-December 2013 and June-October 2014. Neither field season covered the rainy season (the rains arrived late in 2013 and began after the field season) therefore Chambers' *seasonal* bias was not avoided and is a limitation of the data. A year-round study would have been helpful to capture the seasonal fluctuations in the sector but unfortunately was not feasible within the scope of the research project. Instead, aspects of seasonality were explored through certain rural appraisals and in specific questions of the transporter questionnaire. However, recalled data is associated with data reliability issues (Nemarundwe and Richards 2002), and is thus an additional limitation of the data.

Chambers' *personal* contact bias generates bias against perceiving the extent of deprivation, as contact tends to be made with more powerful individuals (Chambers, 1981). During the village survey it is likely that this bias was not avoided, as the village chiefs selected the participants. There was no certainty that this bias was avoided in the case study villages, but by using the snowball sampling technique to broaden the sample size and break direct connections with elite individuals, this bias was hopefully reduced. This particular bias was not applicable to the transporter questionnaire, as participants were approached directly.

On the topic of *project* bias, Chambers (2006) writes "those concerned with rural development and with rural research become linked to networks of urban-rural contacts. They are then pointed to those rural places where it is known that something is being done – where money is being spent, staff are stationed, a project is in hand" (pp.20). This particular bias is not applicable to the research as the purpose of the village sampling strategy was to cover the spatial extent of the production areas and was not linked to any project (there were no projects related to the charcoal sector in existence). Villages were purposefully selected, firstly if they were engaged in the charcoal sector and secondly based on their location and willingness to participate. Charcoal-producing villages by nature were rural, and required both resource and market access. Therefore they were located near to the forest reserve boundaries and near to roads. Villages accessing Zomba and Malosa forest reserves from the east were situated along the main tarmacked road. Villages accessing Zomba and Malosa forest reserves from the west were situated near dust roads, some of which were only on accessible foot. Villages accessing Liwonde forest reserve were also located near dust roads. Disaggregating the sampled villages, 25% of all producing villages in the East were sampled, 37% of all producing villages in the North were sampled and 29% of all producing villages in the West were sampled. Therefore upon reflection, Chambers' *spatial* bias

was successfully avoided during the village survey, as the sample firstly only focused on rural villages and secondly was not restricted to only include villages located on tarmacked roads.

7.11 Conclusion

Charcoal is an essential source of energy for millions of people and one of the most commercialised forest resources in sub-Saharan Africa. However, many countries' policies are insufficient and ineffective, associated with negative perceptions of the sector and punitive regulations that condemn millions of livelihoods to illegality. Unsustainable harvesting practices prevail, creating space for widespread corruption amongst officials and environmental degradation. Nonetheless, if managed effectively "charcoal can provide a low-cost and locally available energy source that has the potential to become sustainable and contribute significantly to poverty alleviation" (Neufeldt et al. 2015). Large research gaps in the charcoal literature obstruct the development of a professionalised sector that is both environmentally and socio-economically sustainable. The motivation behind this thesis has therefore been to generate new insights into charcoal-based livelihoods and set out to examine the benefits and trade-offs associated with the production and transportation of charcoal in Malawi.

The findings in this thesis support existing literature in many ways, but also suggest nuances to what is already known. The empirical work on charcoal-based livelihoods in Zomba has contributed to the knowledge base on the charcoal sector in Malawi, more broadly on the charcoal value chains of small urban areas in sub-Saharan Africa, and provided new insights into the structure of small charcoal value chains, motivations of actors and livelihood outcomes. Combining a value chain analysis with the Sustainable Livelihoods Framework assisted in a disaggregated analysis of livelihood benefits and trade-offs for different actors along the chain and amongst actors in the same node, identifying gendered nuances in participation, livelihood outcomes and in the distribution of risk of enforcement activities amongst actors. The study confirmed the importance of the charcoal sector for income generation, provided new context-specific insights into the contribution of charcoal to forest degradation and raised concerns over the levels of corruption and rent-seeking activities by authorities.

Engaging in the production and transportation of charcoal strengthened actors' financial assets which delivered other benefits, such as improved access to goods and services and opportunities for livelihood diversification, reducing actors' overall vulnerability and improving their livelihoods. However, these livelihood benefits were dependent on resource availability. The lack of charcoal resource management in Malawi means that unsustainable harvesting practices prevail, causing localised forest degradation and charcoal-livelihoods benefits are subsequently unsustainable in the longer-term. Furthermore, the lack of a sustainable commercial sector and enforcement of

punitive regulations created trade-offs amongst actors, increasing their vulnerability to reduced income, further undermining market and livelihood security, whilst having no positive impact on forest resource protection.

References and appendices

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Appendix A Transporter questionnaire

1. **Demographic information**
    1.1. How old are you?
    1.2. What village do you live in?
    1.3. What is your ethnicity?
    1.4. Family make up
        i. Are you married?
        ii. How many children do you have?
        iii. What are their ages?
    1.5. What is your highest level of education?
    1.6. Access to agricultural land
        i. How many acres do you farm?
        ii. How many acres do you own?
        iii. How many acres do you rent?
        iv. Where is the location of the land?
    1.7. What livestock do you own?
    1.8. Do you own a phone?
    1.9. Additional household income generation
        i. Is there anyone else in your household who has earned money in the past 12 months?
        ii. Who
        iii. What have they done?
2. **Charcoal transporting**
    2.1. Transporting method
        i. How do you transport charcoal?
        ii. Do you own the transport?
        iii. How much do you pay for the transport?
    2.2. How many bags of charcoal did you carry this trip?
    2.3. Experience in business
        i. How long have you been transporting charcoal?
        ii. What were you doing before?
        iii. Why did you start transporting charcoal?
        iv. How long do you think you will continue to transport charcoal?
        v. Why will you stop?
    2.4. What activity would you be doing if you weren't transporting charcoal?

2.5. Where have you travelled from?

2.6. Where are you travelling to?

2.7. How many trips do you make in a week?

3. Charcoal value chain

3.1. How much do you buy a bag for?

3.2. Who do you buy charcoal from?

3.3. What is the price difference if you buy multiple bags?

3.2. How much do you pay for the packaging materials?

3.3. Where do you buy the charcoal from?

i. Mountain (specify)

ii. Village (specify)

iii. Market (specify)

iv. Other (specify)

3.4. Where were the trees cut?

3.5. What tree was this charcoal produced from?

3.6. How much do you sell a bag for?

3.7. Who do you sell to?

i. Repeat customer

ii. Market seller

iii. Household

iv. Anybody

v. Other (specify)

3.8. What are the price differences between customers?

3.9. How do you sell the charcoal?

i. Market (specify)

ii. Walking round houses (specify area)

iii. Pre-booked

iv. Other (specify)

3.10. What is the income from selling charcoal spent on?

3.11. In the past 12 months, what additional income have you had?

4. Charcoal regulation

4.1. Relationships with regulating authorities

i. Do you know any officials involved with regulating charcoal?

ii. How does your relationship with them impact upon your business of transporting charcoal?

4.2. Bicycle confiscation

i. In the past 12 months, how many times has you bicycle been confiscated?

ii. How much did you pay to reclaim you bicycle?
iii. How did you pay the money?
iv. How long did it take to pay the money?
v. Was your bicycle returned damaged?
vi. How much did it cost to fix the bicycle?

4.3. Charcoal confiscation
i. In the past 12 months, has your charcoal been confiscated?
ii. How many times?
iii. How many bags each time?

4.4. Additional monetary costs
i. Have you paid any other type of monetary fee in the past 12 months?
ii. Was it a fine, bribe or something else?
iii. How many times?
iv. How much did you pay each time?

4.5. Prison terms
i. Have you been to prison in the past 12 months because of transporting charcoal?
ii. How long for?

4.6. How did the penalties affect you (discussion)?

4.7. Which authorities were involved in enforcing the regulations?

4.8. If charcoal were legal, how do you think this would change your life (discussion)?

Appendix B Producer community survey

1. Village Characteristics

1.1. How many households are there in the village?

1.2. What is the average level of education in the village?

1.3. What is the dominant ethnic group in the village?

1.4. How many and what type of schools are there in village?

1.5. Is there access to electricity in the village?

1.6. What type of road is there in the village?

1.7. How many and what type of shops are there in the village?

1.8. How many and what type of health centres are there in the village?

1.9. What are the main sources of potable water in the village?

Improved source

i. Piped water into dwelling/yard/plot
ii. Public tap/standpipe
iii. Tube well or borehole
iv. Protected dug well
v. Protected spring
vi. Rainwater

Non-improved source

i. Unprotected dug well
ii. Unprotected spring
iii. Tanker truck/cart with small tank
iv. Surface water
v. Other (specify)

1.10. What are the main sanitation facilities in the village?

Improved, non shared facility

i. Flush/pour flush to piped sewer system
ii. Ventilated improved pit (VIP) latrine
iii. Pit latrine with slab

Non-improved facility

iv. Any facility shared with other households
v. Pit latrine without slab/open pit
vi. No facility/bush/field
vii. Other (specify)

1.11. What are the main sources of energy for cooking/lighting?

i. Electricity
ii. Paraffin
iii. Charcoal
iv. Candles
v. Firewood
vi. Gas
vii. Straw, shrubs, grass
viii. Dung
ix. Other (specify)

1.12. What are the main house characteristics in the village?
   i. Permanent (roof=iron/tiles/concrete – Walls=burnt brick, concrete, stone)
   ii. Semi-permanent = Mix of permanent and traditional
   iii. Traditional (unfired mud brick, thatching, rough poles for beams)

1.13. What is the average number of sleeping rooms in the village?

1.14. What is the main place for cooking in the village?
   i. Inside house,
   ii. Separate building,
   iii. Outdoors,
   iv. Other (specify)

1.15. What formal institutions (committees and CBOs) are present in the village?

1.16. Which are operational?

1.17. What village finance schemes are there in the village?

1.18. How much agricultural land is there in the village?

1.19. What are the three main uses of land in the village, ranked in order of amount?

1.20. What are the ten main livelihood activities in the village, ranked in order of contribution to the village economy?

1.21. What are the three main livestock in the village?

1.22. What proportion of the village's income comes from charcoal?

2. Charcoal production in the village

2.1. When did people start producing charcoal in the village?

2.2. What type of people produces charcoal in the community?
   i. Young/Old
   ii. Male/Female
   iii. Rich/Poor
   iv. High education/Low education

v. Married/Divorced
vi. Entire households/Individuals from households
vii. Other

2.3. How many households are involved in charcoal production and transporting?

2.4. Production change over time

i. How many households produced at the beginning?
ii. How many households produced 5 years ago?
iii. How many households produced 10 years ago?
iv. How many households will be producing next year?
v. How many households will be producing in the next 5 years?
vi. How many households will be producing in the next 10 years

2.5. What are the three main tree species used now?

2.6. What are the three tree species you would prefer to use?

2.7. What process is used to produce charcoal in the village?

2.8. What resources are used to make charcoal?

i. Government forest plantation (name)
ii. Government forest reserve (name)
iii. Village plantations
iv. Village farm land
v. Trees from people's own land
vi. Trees bought from other people's land
vii. Trees taken (not bought) from other people's land
viii. Other (specify)

2.9. How long does it take to walk from the village boundary to the resources?

2.10. Who do producers sell their charcoal to?

2.11. How much do they sell for?

2.12. Where do they sell their charcoal?

2.13. How is charcoal income shared in the village?

2.14. Why did charcoal production become an important activity?

2.15. What is the village's perception of charcoal production?

3. Charcoal management and regulation

3.1 How is charcoal production organised in the village?

i. Do people produce by themselves or with other people?
ii. How do people organise who to produce with?
iii. How do you protect yourself against patrols?
iv. If someone wants to start producing, how do they start?

v. If someone has their tools confiscated, what do they do if they want to continue producing?

vi. Why would someone stop producing?

3.1. How are community institutions involved in regulating charcoal production?

3.2. What is the role of the Department of Forestry in the village?

3.3. Are you aware of how to produce charcoal legally?

i. Can you give an explanation?

Appendix C Semi-structured interview questions

1. When did you start producing charcoal?
2. What were you doing to generate an income before you started producing charcoal?
3. Do you remember a particular event that took place, which stimulated you to start producing? What was it?
4. (If no event) What other factors motivated you to start producing charcoal?
5. How did you learn to produce charcoal?
6. Do you produce charcoal with other people? Who?
7. Does anyone help you with the business of selling charcoal? Who?
8. Who do you typically sell charcoal to?
9. What challenges have you incurred whilst producing charcoal (prompt with examples, such as accidents, enforcements)?
10. What were the repercussions of the challenges you faced?
11. Do you have access to land for farming?
12. How many (standard) bags of maize did you produce this harvest? When do you think it will run out? What will you do?
13. What additional sources of income have you had in the past 12 months?
14. When do you think you will stop producing charcoal indefinitely?
15. Why do you think you will stop?

Appendix D Consent form

[Consent form must be read out at the start of the exercise and consent recorded on a Dictaphone or witnessed by another researcher. Participant names should be recorded with signatures if participants are literate.]

Introduction to the Research:

Our names are Harriet Smith and [insert translator's name]. We are from the University of Southampton, UK and Chancellor College, Zomba.This research aims to understand the charcoal sector in Zomba, and how the charcoal trade affects people's lives. We will be carrying out a number of exercises with different groups of people to get a general understanding of these issues in the area around Zomba town. We have asked you to participate because you are involved in the charcoal trade.

The exercise will take [insert time taken] but you are free to leave at any time. Before we start we want to make sure that you understand the research we are doing and what we will do with the information we collect.

Oral Consent Script

1. I have given you some information about this research into charcoal. Did I make things clear? Do you want to ask any questions about the study?

Ndakuziwisani cholinga chakafukufuku ameneyi wa makala.Mwanvetsetsa?. Mukufuna mutafunsa funso lina lililonse pakafukufuku amenyi?

2. I will keep all the information you give us confidential as far as the law allows. Any notes or recordings I make will be kept on a password-protected computer. I will not share your personal details or personal views with anyone else. Is that okay?

Ziwani kuti chilinchonse munene chisungidwa mwachinsisi mongo malamulo anenera. Izi sizinenedwa kwa wina aliyense. Kaya mukugwilizana nazo?

3. Some of the information you give me may be published, but your real name will not be used in relation to any of the information you have provided, unless you tell me clearly that you want me to use your real name. Is that okay?

Zina zimene munene zikalembedwa m'mabuku, koma dzina lanu silikalembedwa mogwilizana ndi zimene mwanena, pokhapokha mutanena kuti dzina lanu likagwilitsidwe ntchito. Kaya mukugwilizana nazo?

4. You should know that even though I will avoid including identifying information in any publication, there is still a possibility that people will recognise you by the things you say. If at any time you feel concerned about what you are saying being disclosed, please feel free to stop and talk to me about it. If you say something that you later think should be deleted from our discussion notes, just let me know. Is that clear?

Ziwani kuti ngakhale kuti sindikalemba zina zimene mwanena , komabe ziwani kuti palikuthekera kuti anthuakhozabe kukuziwa malingana ndizimene mukunena. Nthawi ina mukaona kuti zimene mukunenazo zizaululidwa , muli ndi ufulu kuletsa komaso kundiuza nkhawa zanu, Komanso ngati mutazindikila kuti zina zimene mwanena tikuyenera kufufufuta , chonde ndiuzeni, Mwanva?

5. If you mention anything you do not want me to publish, please say so and I will follow your request. Okay?

Ngati mwatchula chinthu choti mukufuna ndikaslembe m'mabuku chonde ndiuzeni ndipo ndizachita monga mwa pempho lanu. Mwanva?

6. You can stop this discussion at any time, without giving me any reason. Okay?

Mukhoza kuletsa kuchezaku nthawi in ailiyonse popanda kupeleka chifukwa? Mwanva?

7. I would like to record this discussion with a digital audio recorder. That way I can listen to the recording afterwards and catch things you say that I might not fully understand during the discussion, or might otherwise forget. Only people in this study team will be able to listen to the recording. Do you give me permission to record?

Ndikufunanso kumatepa mawu anu pakawailesika , ch olinga choti ndikathe kunvetselanso kanthawi kena, komanso kuti ndikathe kunvetsetsa bwino bwino zinthu zina zimene sindinathe kunzinva komanso zimene ndaziyiwala. Wokhawo amene akuchita kafukufuku ameneyi ndi amene akuloledwa kunventsela. Kodi ndili olololedwa kuchita zimenezi?

8. [If appropriate] If you agree, I would like to take some photos. I might use these in presentations or publications about this project. Is this okay?

Ngati mungavomele ndikufunna kukutengani zinthunzi zoti mwina zingathe kugwilitsidwa ntchito polemba m'buku. Kaya mukugwilizana nazo?

9. Do you have any further questions? Can we start the discussion now?

Muli ndi mafunso owonjezela? tikhoza kuyamba kucheza?

Appendix E Compensation Policy

This policy concerns how I will compensate local participants who contribute their time and knowledge to the project. This policy outlines the underlying principles, which apply across the whole project. They will be adapted to align them with national and local norms in the research area.

Underlying principles

1. A fair and transparent compensation policy applied consistently by the researcher in the project is important to maintain a productive and mutually respectful relationship with local research participants.

2. Compensation should be in line with national and local norms and not undermine the willingness of people to participate in future research projects. In general, compensation should be seen as a 'thank you' gesture rather than compensation directly proportional to time spent.

3. Where possible, research activities involving community members will be organised at a place and time that is convenient to the participants.

4. For activities that require participants to travel from their usual places of residence/work, the project will either organise transport or compensate the cost of the transport.

5. In general there will be no compensation for small, one-off activities. However, for group level meetings that are longer than two hours duration, light refreshments will be provided.

6. Where individuals are employed by the project to provide research services (e.g. translation at meetings, introduction to traditional authorities and villages), they should be compensated according to the local day-wage practices.

7. Key informants interviewed in their official capacity (extension officers, local government officials) will generally not be compensated for their time, though transport expenses (if appropriate) and light refreshments may be provided.

Appendix F List of species harvested for charcoal

Latin Name	Local Name	Charcoal Production Area		
		1	2	3
Faidherbia albida	Acacia	■	■	
Afzelia quanzesis	Sambamafoumu		■	
Albizia versicolor	Ntanga Ntanga		■	
Bauhinia thonningi	Chitembe		■	
Bequaertiodendron natalense	Pimbinyolo		■	
Brachystegia boehmii	Mombo			■
Brachystegia bussei	Ntwana	■	■	■
Brachystegia spiciformis	Mpapa	■	■	
Brachystegia stipulata	Nchenga	■	■	■
Bridelia micrantha	Nsopa		■	
Burkea africana	Nkalati		■	
Combretum molle	Kadhere	■		
Dalbergia nitidula	Mlungwe	■	■	■
Diplorhynchus condylocarpon	Thombozi		■	
Eucalyptus camaldulensis	Bluegum/Eucalyptus	■	■	
Faurea speciosa	Chisese		■	
Ficus capensis	Nkuyu		■	
Gmelina arborea	Malaina		■	
Mangifera indica	Mango	■	■	
Monotes africanus	Kakathu		■	
Newtonia buchananii	Mkweranyani	■	■	
Parkia filicoidia	Nkhundi	■	■	
Pericopsis angolensis	Mwanga	■	■	■
Persea americana	Avocado	■	■	
Psidium guajava	Guava		■	
Pterocapus angolensis	Mlombwa	■	■	
Tamarindus indica	Bwemba	■		
Terminalia sericea	Naphini		■	
Toona ciliata	Sendeleya	■	■	
Uapaca kirkiana	Masuku	■	■	■
Zanha africana	Mtutumuko		■	
Unknown	Senya		■	
Unknown	Nkabanga	■		
Unknown	Nkwakwa	■		
Unknown	Mwavi		■	

Appendix G Charcoal transporter variable

	Mean ± SD	Frequency	Percentage (%)
Age (n=201)	31.82 ± 9.312		
Number of children (n=201)	3.22 ± 2.16		
Experience in business (years) (n=201)	3.834± 5.138		
Gender (n=201)			
Male		141	70.1
Female		60	29.9
Marital status (n=201)			
Not married		44	21.9
Married		157	78.1
Education (n=201)			
No education		24	12
Primary level education		142	70.6
Secondary level education		35	17.4
Ethnicity (n=201)			
Yao		112	55.7
Lomwe		47	23.4
Chewa/Nyanja		24	11.9
Mang'anja		7	3.5
Ngoni		9	4.5
Tumbouka		1	0.5
Sena		1	0.5
Lives in an urban area (n=201)			
Yes		9	4.5
No		192	95.5
Additional income generating activity (n= 201)			
Yes		73	36.4
No		128	63.6
Owns livestock (n= 201)			
Yes		84	41.8
No		104	51.7
Missing value		13	6.5
Owns a bicycle (n=201)			
Yes		106	52.7
No		95	47.3
Owns a mobile phone (n=201)			
Yes		76	37.8
No		125	62.2

	Mean ± SD	Frequency	Percentage (%)
Transportation per week (n=201)			
<1		3	1.5
1		17	8.5
2		42	20.9
3		58	28.9
4		29	14.4
5		9	4.5
6		14	6.9
7		23	11.4
n/a		6	3
Access to agricultural land (n=201)			
Yes		146	72.6
No		39	19.4
n/a		16	8
Reasons for stopping transporting (n=109)			
Seasonal		10	9.3
Due to difficulties with enforcement of regulations		19	17.4
Will stop when upgrades to an alternative income generating activity		48	44
Will stop when doesn't need to make as much money anymore		13	11.9
Will stop when business isn't profitable anymore		4	3.6
Old Age		3	2.7
Limited resources		2	1.8
Don’t know		10	9.3
Intended continuation in the business (n=201)			
1 month		11	5.5
1-6 months		41	20.4
6-12 months		10	5
Over one year		3	1.5
Indefinitely		59	29.4
Don't know		77	38.2

Appendix H Variable differences between genders

	Men (n=141)		Women (n=60)			
Variable	Mean	**Frequency**	**Mean**	**Frequency**	**Mann-Whitney U test**	**Chi squared χ^2**
Age (n=201)	33.0		29.0		U=3159.5, p<0.01	
Number of children (n=201)	3.2		3.3		U=4071, p=0.728	
Experience in business (years) (n=201)	4.4		2.4		U=3294, p<0.05	
Number of trips per week (n=201)	3.8		2.8		U=2528, p<0.01	
Marital status (n=201)						χ^2=30.707, df=1, p<0.01
Married		125		32		
Single		16		28		
Education (n=201)						χ^2=1.501, df=2, p=0.472
No education		15		9		
Primary level education		99		43		
Secondary level education		27		8		
Ethnicity (n=201)						a
Yao		81		31		
Lomwe		35		12		
Chewa/Nyanja		12		12		
Mang'anja		4		3		
Ngoni		7		2		
Tumbouka		1		0		
Sena		1		0		
Lives in an urban area (n=201)						
Yes		7		2		χ^2=0.262, df=1, p=.0609
No		134		58		
Has an additional income generating activity (n= 201)						χ^2=1.476, df=1, p=0.224
Yes		55		18		
No		86		42		
Owns livestock (n=201)						χ^2=0.084, df=1, p=0.772
Yes		58		26		
No		70		34		
Missing value		13		0		

Variable	Men (n=141) Mean	Frequency	Women (n=60) Mean	Frequency	Mann-Whitney U test	Chi squared χ^2
Owns a bicycle (n=201)						χ^2=89.499, df=1, p<0.01
Yes		105		1		
No		36		59		
Owns a mobile phone (n=201)						χ^2=21.794, df=1, p<0.01
Yes		68		8		
No		73		52		
Access to agricultural land (n=201)						χ^2=0.41, df=1, p=0.841
Yes		103		43		
No		38		17		
Reasons for stopping transporting (n=201)						a
Seasonal		8		2		
Due to difficulties with enforcement of regulations		13		6		
Will stop when upgrades to an alternative strategy		45		3		
Will stop when doesn't need to make as much money anymore		9		4		
Will stop when business isn't profitable anymore		2		2		
Old Age		3		0		
Limited resources		2		0		
Don’t know		59		43		
Intended continuation in the business (n=201)						a
1 months		8		3		
1-6 months		34		7		
6-12 months		10		0		
Over one year		1		2		
Indefinitely		31		28		
Don't know		57		20		

[a] The chi-square test for independence could not be performed for ‘ethnicity’, ‘reasons for stopping transporting’ and ‘continuation in the business’ as the data did not fit the assumption that the lowest expected frequency in any cell should be 5 or more. Seven (50%), nine (64.3%) and four cells (33.3%) had respective expected count less than 5.

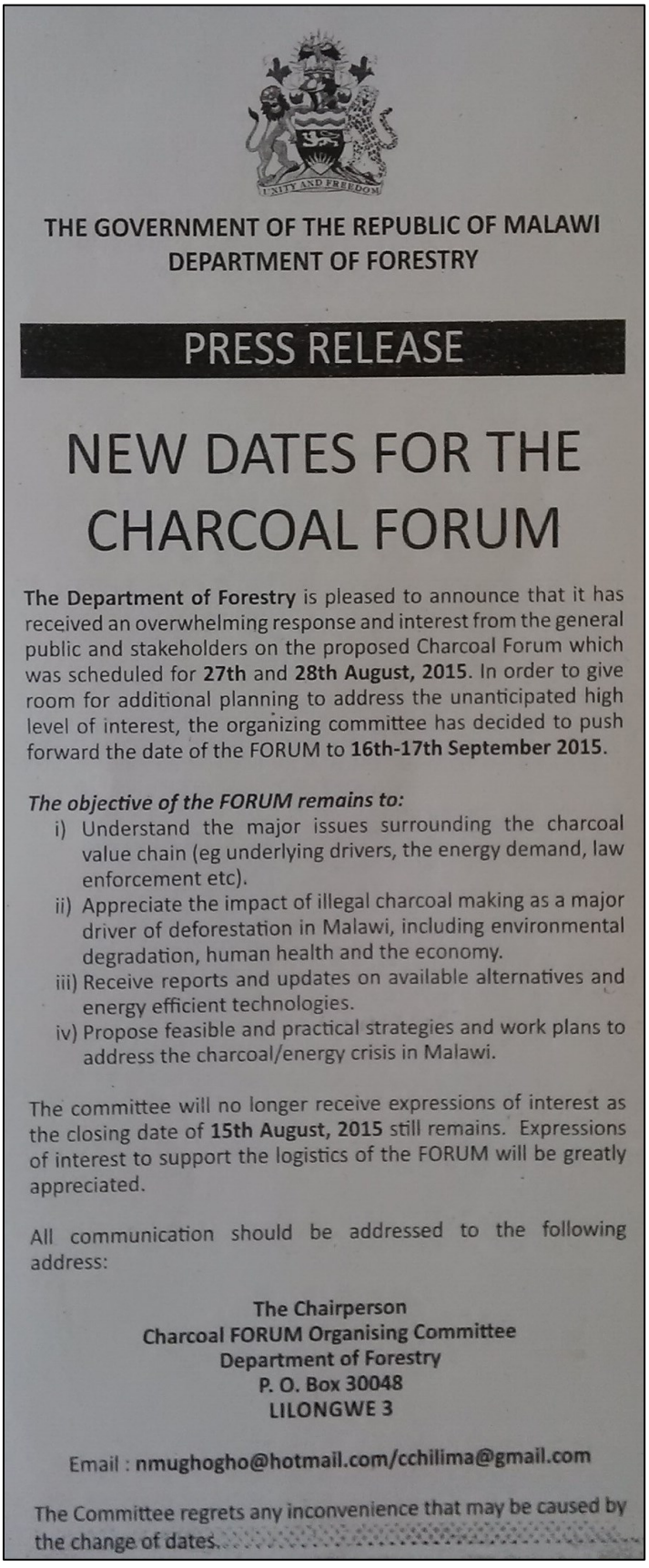
Appendix I Difference in earnings between variables

Variable (n=99)	Mean weekly earnings ± SD	Mann-Whitney U	Spearman's rho	Kruskall-Wallis
Age			Rho=-0.054 p=0.601	
Gender		U=689.5, p<0.01		
Male (n=62)	K7748 ± K6415			
Female (n=37)	K4203 ± K4753			
Marital status		U=596, p<0.01		
Married (n=70)	K7390 ± K6328			
Not married (n=29)	K4090 ± K4737			
Education				K=1.333, df=3, p=0.513
No education (n=9)	K4400 ± K4407	-		
Primary level education (n=72)	K6406 ± K5799			
Secondary level education (n=18)	K7503 ± K7722			
Ethnicity				K=5.777, df=5, p=0.328
Yao (n=58)	K6286 ± K5743			
Lomwe (n=27)	K7019 ± K6860			
Chewa/Nyanja (n=6)	K4550 ± K2897			
Mang'anja (n=2)	K8100 ± K7212			
Ngoni (n=5)	K2980 ± K2832			
Sena (n=1)	K23400 ± K0			
Has an additional income generating activity		U=1043, p=0.255		
Yes (n=43)	K5798 ± K5829			
No (n=56)	K6904 ± K6264			
Owns livestock		U=1160, p=0.679		
Yes (n=53)	K6698 ± K7031			
No (n=46)	K6116 ± K4798			
Owns a mobile phone		U=752, p<0.01		
Yes (n=36)	K8535 ± K6453			
No (n=63)	K5217 ± K5543			
Access to agricultural land		U=425, p=0.298		
Yes (n=87)	K6688 ± K6275			
No (n=12)	K4504 ± K4018			
Experience in business (years)			Rho=0.175, p=0.084	
Method of transportation				K=19.334, df=3, p<0.01
Bike (n=48)	K8733 ± K6763			
Minibus (n=17)	K6194 ± K6480			
Head (n=29)	K2976 ± K2025			
Lorry (n=5)	K5020 ± K4090			

Appendix J Differences in the breakdown of earnings between transporter types

	Bike	Head	Bus	Lorry	Kruskal Wallis (df=3)
Weekly earning	K8733 ± K6763	K2976 ± K2025	K6194 ± K6480	K5020 ± K4090	K=19.334, p<0.01
Per-bag profit	K1496 ± K598	K1203 ± K515	K1356 ± K471	K1450 ± K251	K=6.394, p=0.094
Price of a 50kg bag of charcoal bought from producers	K1568 ± K393	K1419 ± K312	K1650 ± K309	K1660 ± K371	K=6.285, p=0.099
Price of a 50kg sold to consumers	K2961 ± K690	K2519 ± K560	K2953 ± K479	K2980 ± K115	K=10.601, p<0.05
Number of bags per trip	1.76 ± 0.657	1.16 ± 0.58	4.44 ± 2.95	5 ± 2.67	K=56.226, p<0.01
Number of days a week	3.65± 1.718	2.55 ± 1.21	2.18 ± 1.51	1.5 ± 0.84	K=25.439, p<0.01
Weekly cost of transport	K156 ± K339	K0 ± K0	K2429 ± K2086	K1940 ± K2068	K=60.817, p<0.01
Weekly cost of labour	K42 ± K297	K0 ± K0	K822 ± K1362	K122 ± K299	K=36.448, p<0.01

Appendix K Press release for the Malawi charcoal forum



THE GOVERNMENT OF THE REPUBLIC OF MALAWI
DEPARTMENT OF FORESTRY

PRESS RELEASE

NEW DATES FOR THE CHARCOAL FORUM

The Department of Forestry is pleased to announce that it has received an overwhelming response and interest from the general public and stakeholders on the proposed Charcoal Forum which was scheduled for **27th** and **28th August, 2015**. In order to give room for additional planning to address the unanticipated high level of interest, the organizing committee has decided to push forward the date of the FORUM to **16th-17th September 2015**.

The objective of the FORUM remains to:

i) Understand the major issues surrounding the charcoal value chain (eg underlying drivers, the energy demand, law enforcement etc).
ii) Appreciate the impact of illegal charcoal making as a major driver of deforestation in Malawi, including environmental degradation, human health and the economy.
iii) Receive reports and updates on available alternatives and energy efficient technologies.
iv) Propose feasible and practical strategies and work plans to address the charcoal/energy crisis in Malawi.

The committee will no longer receive expressions of interest as the closing date of **15th August, 2015** still remains. Expressions of interest to support the logistics of the FORUM will be greatly appreciated.

All communication should be addressed to the following address:

The Chairperson
Charcoal FORUM Organising Committee
Department of Forestry
P. O. Box 30048
LILONGWE 3

Email : **nmughogho@hotmail.com/cchilima@gmail.com**

The Committee regrets any inconvenience that may be caused by the change of dates.