

**KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY,
KUMASI**

COLLEGE OF AGRICULTURE AND NATURAL RESOURCES

FACULTY OF RENEWABLE NATURAL RESOURCES

DEPARTMENT OF SILVICULTURE AND FOREST MANAGEMENT

**THE LIVELIHOOD AND POLITICAL ECONOMY OF
CHARCOAL PRODUCTION AND TRADE IN GHANA**

LAWRENCE KWABENA BROBBEY

JUNE 2019

**THE LIVELIHOOD AND POLITICAL ECONOMY OF CHARCOAL
PRODUCTION AND TRADE IN GHANA**

By

Lawrence Kwabena Brobbey

(BSc. Natural Resources Management, MBA. Banking and Finance, MPhil.
Silviculture and Forest Management)

A thesis submitted to the Department of Silviculture and Forest Management,
Kwame Nkrumah University of Science and Technology, Kumasi,
in partial fulfilment of the requirements for the award of degree of

**DOCTOR OF PHILOSOPHY IN SILVICULTURE AND FOREST
MANAGEMENT**

June 2019

DECLARATION

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma at the Kwame Nkrumah University of Science and Technology, Kumasi, or any other educational institution, except where due acknowledgment is made in the thesis.

Lawrence Kwabena Brobbey (20386593)

Student

Signature

Date

Certified by:

Prof. Boateng Kyereh

.....

(Supervisor)

Signature

Date

Co-Supervisors

Associate Prof. Christian Pilegaard Hansen

Associate Prof. Mariève Pouliot

Certified by:

Dr. Emmanuel Acheampong

.....

(Head of Department)

Signature

Date

DEDICATION

I dedicate this work to my lovely parents, Mr. James Obiri Yeboah and the late Mrs. Anna Obiri Yeboah (née Anna Marfowaah), who had to sacrifice a lot for my education. Dad and Mum, your labour has not been in vain.

ACKNOWLEDGEMENTS

I give thanks to the Almighty God for giving me the strength and guidance to complete the PhD programme. I am very grateful to the Danish Research Council for Development Research (DANIDA) for funding the PhD studies as part of the project, “Access and eXclusion along the charcoal commodity chain in Ghana (AX Project)”. I extend my appreciation to the many people who have in diverse ways helped me to complete the PhD programme. Prominent among the people who helped and encouraged me to complete this work have been my supervisors, Prof. Boateng Kyereh, Associate Prof. Christian Pilegaard Hansen and Associate Prof. Mariève Pouliot. They guided and supervised all the stages of the work. I acknowledge their supports in the articles they co-authored with me.

I thank the lecturers at the Departments of Silviculture and Forest and Management of the Kwame Nkrumah University of Science and Technology, and the Food and Resource Economics of the University of Copenhagen for their insightful comments and critiques at my seminars. I also acknowledge the assistance I received from Marlene Lundgren Kiel, Eugene Kwabena Abu, Augustine Antwi, Prince Atta Obeng, Akosua Nyantakyiwaah and Issah Mohammed during the collection of data for the study. I am grateful to Mr. Edward Opoku-Antwi, the District Manager of the Kintampo Forest District, the Planning Officers at the Kintampo North, Kintampo South and Nkoransa North District Assemblies, the Ashanti Regional Statistician of the Ghana Statistical Service, chiefs, opinion leaders, respondents and people of the 10 study communities for their cooperation and support in making this study possible. I also appreciate the assistance I received from my colleague, Frank Kwaku Agyei.

I am very much indebted to my wife, Leticia Bentum, for her daily moral support and prayers. To my children, Maame Marfoaa, Nana Adwoa, Nana Kwame and Nhyira Boatemaa, I thank you for your cooperation in enduring the inconveniences of my physical absence from home during some periods in the PhD programme. I thank my parents, Mr. James Obiri Yeboah and the late Mrs. Anna Obiri Yeboah (née Anna Marfowaah), for the numerous sacrifices they made in order to educate me.

ACRONYMS

| | |
|--------|---|
| BoG | Bank of Ghana |
| CIFOR | Centre for International Forestry Research |
| DRC | Democratic Republic of Congo |
| ELCIR+ | Engaging Local Communities in REDD+ |
| EPA | Environmental Protection Agency |
| FAO | Food and Agriculture Organisation |
| GLSS | Ghana Living Standards Survey |
| GSS | Ghana Statistical Service |
| ICRAF | International Centre for Research in Agroforestry |
| IDS | Institute of Development Studies |
| IEA | International Energy Agency |
| KN | Kintampo North |
| KS | Kintampo South |
| LPG | Liquefied petroleum gas |
| MESTI | Ministry of Environment, Science, Technology and Innovation |
| MLNR | Ministry of Lands and Natural Resources |
| NAMA | Nationally Appropriate Mitigation Action |
| NN | Nkoransa North |
| NTFP | Non-timber forest product |
| OECD | Organisation for Economic Cooperation and Development |
| PEN | Poverty Environment Network |
| PRA | Participatory Rural Appraisal |
| REDD+ | Reduced Emissions from Deforestation and Degradation |
| SLA | Sustainable Livelihood Approach |
| SLF | Sustainable Livelihood Framework |
| SRID | Statistics, Research and Information Directorate |
| SSA | Sub-Saharan Africa |

ABSTRACT

Charcoal is an important source of energy for cooking in urban households and constitutes a major source of income for rural households in many sub-Saharan Africa countries. Rigorous and comprehensive studies on the livelihood and political economy of the charcoal sector are however, lacking in Ghana and many other charcoal-producing countries. This study applies an analytical framework that combines the Sustainable Livelihood Framework with the Revised Property Rights Scheme and “A Theory of Access” to investigate the role of charcoal in the livelihoods of rural households, and the social, economic and political contexts within which its production and trade take place in a key charcoal-producing area in Ghana. Mixed method approaches involving a quantitative survey of 400 randomly selected charcoal- and non-charcoal-producing households, participatory rural appraisal techniques, interviews of stakeholders along the charcoal commodity chain (charcoal producers, merchants, transporters, chainsaw operators, chiefs and staff of relevant statutory institutions), stakeholder meetings and document reviews were used to collect data for the study at the Kintampo Forest District. The findings empirically demonstrate that charcoal is the second-most important source of household income after agricultural crops. Charcoal production and trade are not associated with any income group, but contrarily to previous studies, high-income households gain higher income from both charcoal production and trade than low-income households. The findings also show that charcoal production is the dominant strategy used by rural households to mitigate economic shocks. Charcoal production is also used to fill seasonal income shortfalls during lean agriculture seasons, but the motivation to use charcoal to fill income-gaps depends on the income status of households. The results further reveal that charcoal production is dominated by young and male-headed households, while young and female-headed households dominate charcoal trade. Participation and income from charcoal production and trade are associated with membership in charcoal associations, ethnicity, payment of traditional charcoal levies and owning physical assets such as bicycle, motor bikes and chainsaw. The results further illustrate that property is the main mechanism social actors along the charcoal commodity chain use to benefit from charcoal, and both customary and statutory institutions are involved in mediating access to charcoal in the study area. Charcoal production and trade have been largely informal in Ghana, but the state has initiated policies to formalise the charcoal sector. The dynamics of access in the charcoal sub-sector have been driven by the realisation of economic benefits of the commodity and scarcity and concerns over sustainability of its resource base. The study shows that charcoal production is an important rural livelihood strategy for a majority of households in the study area as same may hold true for similar charcoal-producing hotspots in the country. Therefore the government’s attempt to formalise the charcoal sector should be devoid of directives that would make charcoal production and trade prohibitive for low-income households, but should rather promote the livelihood aspects of these economic activities. Further studies should investigate the factors that make charcoal trade attractive to women in Ghana, and policy makers should use this as a possible pathway to reduce rural poverty among women.

TABLE OF CONTENTS

| | |
|---|------|
| DECLARATION | ii |
| DEDICATION..... | iii |
| ACKNOWLEDGEMENTS..... | iv |
| ACRONYMS..... | v |
| ABSTRACT..... | vi |
| TABLE OF CONTENTS..... | vii |
| LIST OF TABLES | xi |
| LIST OF FIGURES | xiii |
| CHAPTER ONE..... | 1 |
| 1.0 INTRODUCTION..... | 1 |
| 1.1 Problem Statement | 1 |
| 1.2 Justification | 3 |
| 1.3 Aim, Objectives and Research Questions | 4 |
| 1.4 Hypotheses | 5 |
| 1.5 Research Design..... | 6 |
| 1.5.1 Philosophical Worldview | 6 |
| 1.5.2 Research Strategies..... | 6 |
| 1.5.3 Study Area | 8 |
| 1.6 Organisation of Study..... | 11 |
| CHAPTER TWO..... | 12 |
| 2.0 THEORETICAL AND LITERATURE REVIEW..... | 12 |
| 2.1 Theoretical Review | 12 |
| 2.1.1 Property Rights Scheme | 12 |
| 2.1.2 Entitlement Framework | 16 |
| 2.1.3 Capitals and Capability Framework | 18 |
| 2.1.4 Sustainable Livelihood Framework..... | 20 |
| 2.1.5 A Theory of Access | 28 |
| 2.2 Conceptual Framework: Linking Sustainable Livelihood Approach, Revised Property Rights Scheme and A Theory of Access | 30 |
| 2.3 Definition of Livelihood..... | 33 |
| 2.4 Literature Review..... | 35 |
| 2.4.1 Environmental Resources-related Livelihood Studies in Developing Countries | 36 |

| | |
|--|----|
| 2.4.2 Environmental Resources-related Livelihood Studies Conducted in Ghana | 41 |
| 2.4.3 Comparison of Environmental Resources-related Livelihood Studies Conducted in Ghana with other Developing Countries..... | 43 |
| 2.4.4 Charcoal and Livelihood Studies in Developing Countries | 44 |
| 2.4.5 Charcoal and Livelihood Studies in Ghana | 47 |
| 2.4.6 Comparison of Charcoal Studies Conducted in Ghana and other Developing Countries | 50 |
| 2.4.7 Charcoal and Related Policies | 51 |
| 2.5 Heckman Model | 52 |
| CHAPTER THREE | 53 |
| 3.0 THE ECONOMIC IMPORTANCE OF CHARCOAL TO RURAL LIVELIHOODS: EVIDENCE FROM A KEY CHARCOAL-PRODUCING AREA IN GHANA..... | 53 |
| Abstract | 53 |
| 3.1. Introduction | 54 |
| 3.2 Methods..... | 56 |
| 3.2.1 Study Area | 56 |
| 3.2.2 Sources and Methods of Data Collection | 59 |
| 3.2.3 Data Analysis..... | 62 |
| 3.3 Results | 63 |
| 3.3.1 Socioeconomic Characteristics of sampled households | 63 |
| 3.3.2 Sources of Household Income | 65 |
| 3.3.2.1 Overall Household Income | 65 |
| 3.3.2.2 Charcoal Income..... | 67 |
| 3.3.3 Comparison of Income of Charcoal- and Non-charcoal-producing Households | 69 |
| 3.3.4 Charcoal Income and Accessibility | 70 |
| 3.3.5 Contribution of Charcoal to Subsistence and Cash Household Income | 71 |
| 3.3.6 Gap-filling and Safety-net Functions of Charcoal..... | 74 |
| 3.4. Discussion | 78 |
| 3.4.1 Discussion of Results vis-à-vis other Studies..... | 78 |
| 3.4.2 Methods and Reliability of Results | 82 |
| 3.4.3 Impacts of Charcoal Production on Vegetation Cover and Interventions by the State | 83 |
| 3.5 Conclusions and Recommendations..... | 84 |
| Supplementary Information | 86 |

| | |
|--|-----|
| 5.4 Discussion | 143 |
| 5.4.1 Discussion of key Findings..... | 143 |
| 5.4.2 Policy Implications | 146 |
| 5.5 Conclusions | 149 |
| CHAPTER SIX | 150 |
| 6.0 GENERAL DISCUSSION AND SYNTHESIS | 150 |
| 6.1 Charcoal as an Important Rural Livelihood Option | 153 |
| 6.2 Political Economy of Charcoal Production and Trade..... | 155 |
| 6.3 Reflection on analytical and methodological issues | 158 |
| CHAPTER SEVEN | 161 |
| 7.0 CONCLUSIONS AND RECOMMENDATIONS..... | 161 |
| 7.1 Conclusions | 161 |
| 7.2 Recommendations | 162 |
| 7.2.1 Inclusive Charcoal Formalisation Policies | 162 |
| 7.2.2 Development of sustainable raw material for charcoal | 163 |
| 7.2.3 Capacity building for sustainable charcoal production and trade..... | 163 |
| 7.2.4 Institutional collaboration..... | 163 |
| 7.2.5 Further research | 163 |
| REFERENCES | 165 |
| APPENDIXES..... | 176 |
| Appendix A: Village survey (questionnaire) | 176 |
| Appendix B: Household survey (questionnaire and product list) | 177 |
| Appendix C: Interview guide for focus group meetings | 192 |
| Appendix D: Interview guide for semi-structured interviews..... | 196 |

LIST OF TABLES

| | |
|--|-----|
| Table 1. 1 List and basic characteristics of survey communities in Kintampo Forest District in Ghana | 10 |
| Table 2. 1 Bundles of rights associated with positions..... | 13 |
| Table 2. 2 Explanation of capitals in the capital and capability framework..... | 20 |
| Table 3. 1 List and basic characteristics of survey communities..... | 58 |
| Table 3. 2 Socioeconomic characteristics of sampled households | 64 |
| Table 3. 3 Relative economic importance of mean household income sources, by income quartile..... | 66 |
| Table 3. 4 Number of households participating in charcoal-related activities, by income quartile..... | 67 |
| Table 3. 5 Livelihood strategies of households with income from charcoal businesses | 69 |
| Table 3. 6 Comparison of sources of income of charcoal- and non-charcoal-producing households..... | 70 |
| Table 3. 7 Relative economic importance of mean sources of household income, by accessibility..... | 71 |
| Table 3. 8 Contribution of household income sources to subsistence and cash income, by income quartiles | 73 |
| Table 3. 9 Reasons for the seasonal importance of charcoal, by income quartiles..... | 75 |
| Table 3. 10 Types and perceived severity of shocks experienced by sampled households in 2016 | 76 |
| Table 3. 11 Coping strategies by households that faced economic shocks | 77 |
| Table 3. 12 Results of logistic regression on effect of income from charcoal production on producing charcoal to mitigate economic shock | 77 |
| Table 4. 1 List of independent variables in the model of participation and income from charcoal production and trade | 94 |
| Table 4. 2 Descriptive statistics of socioeconomic characteristics and income of sampled households in charcoal production and trade | 101 |
| Table 4. 3 Results of Heckman model for selection into and outcome of charcoal production and trade | 104 |
| Table 4. 4 Mean household income in US\$ from charcoal production and trade, by community | 106 |
| Table 4. 5 Perception of trend of tree populations in communities | 109 |

| | |
|--|-----|
| Table 5. 1 List of survey communities with administrative units, traditional areas and stool lands | 125 |
| Table 5. 2 Overview of the contemporary rights to produce charcoal and the arrangement/payment for doing so in the study area..... | 133 |

LIST OF FIGURES

| | |
|---|-----|
| Figure 1. 1 Map of Ghana showing Kintampo Forest District and the study communities..... | 9 |
| Figure 2. 1 Revised property rights scheme..... | 15 |
| Figure 2. 2 Environmental Entitlement Framework | 18 |
| Figure 2. 3 The Capital and Capabilities Framework | 20 |
| Figure 2. 4 The Sustainable Livelihood Framework | 21 |
| Figure 2. 5 Conceptual framework | 32 |
| Figure 3. 1 Sampling procedure in communities | 60 |
| Figure 3. 2 Contribution of income sources to mean subsistence and cash household income | 72 |
| Figure 4. 1 Conceptual framework of sustainable livelihoods | 93 |
| Figure 5. 1 Analytical framework on mechanisms social actors use to benefit from charcoal | 124 |

CHAPTER ONE

1.0 INTRODUCTION

This chapter begins with a description of the overall research problem addressed by this thesis and is followed by the relevance and purpose of the study. The research design and description of the study area follows with a final section that presents the organisation of the thesis.

1.1 Problem Statement

Charcoal serves as the main source of energy for heating and cooking for more than 80% of urban households in sub-Sahara African (SSA) countries (Arnold *et al.*, 2006; IEA, 2014; Zulu and Richardson, 2013). It contributes significantly to the economy of developing countries through employment creation, household income generation, provision of safety-net against economic shocks, filling of income-gaps during lean or off-agricultural seasons and reduction of rural poverty (Butz, 2013; ICRAF, 2002; Jones *et al.*, 2016; Khundi *et al.*, 2011; Smith *et al.*, 2017; World Bank, 2009; Zulu, 2010). For example, more than 40 million people are globally estimated to benefit from the charcoal sector (FAO, 2017). As of 2006, three million people were estimated to be employed on both part time and full time basis in the charcoal sector in Ghana (Energy Commission, 2006). A similar three million people were also estimated to be employed in the charcoal sector in Mozambique in 2010 (equivalent to 15% of the country's total population) (Cuvilas *et al.*, 2010). Global charcoal production volume stood at 52 million tonnes (Mt) in 2015, with Africa accounting for more than half (62.1%) of this volume (FAO, 2016). Production levels in SSA countries are high and have been projected to increase by 40% in the coming decades as a result of population growth, urbanisation, poverty and relatively high prices of alternative energy (Broadhead, *et al.*, 2001; GIZ, 2014; IEA, 2014; Mwampamba *et al.*, 2013).

Notwithstanding its economic and energy benefits, charcoal production has long been associated with emerging “fuelwood crisis” (Eckholm, 1975) and narratives of environmental degradation, deforestation and climate change (Chidumayo and Gumbo, 2013; FAO, 2017). The situation has led to periodic bans on production and efforts to substitute charcoal with liquefied petroleum gas (LPG) or electricity

(Arnold *et al.*, 2006; Gumbihi, 2018; Ribot, 1999; Smith *et al.*, 2015). Previous interventions such as production and trade bans and substitution of charcoal with LPG have all failed to achieve their intended objectives (Ribot, 1999). Recent interventions which range from outright ban on production and trade (Gumbihi, 2018), to formalisation and regularisation have been introduced by statutory institutions in SSA countries to regulate the charcoal sector. The charcoal sector is however, largely informal and attempts to formalise it has been ineffective in many SSA countries (Sander *et al.*, 2013; Schure *et al.*, 2013, 2015; Smith *et al.*, 2015). The failure by some states to regularise and formalise the charcoal sector has been attributed to the political economy of the sector that causes the *de facto* governance realities to significantly deviate from the *de jure* governance (Sander *et al.*, 2013). Uncoordinated and overlapping rules and regulations by statutory institutions have also been reported as militating against effective regulation of the sector (Sander *et al.*, 2013; World Bank, 2009).

The presumed economic and energy contribution of charcoal, coupled with narratives of environmental degradation and deforestation in many SSA countries calls for a holistic analysis of the social, economic and political contexts within which charcoal production and trade take place. However, rigorous and comprehensive studies on the livelihood and political economy of the charcoal sector are lacking in Ghana and many other charcoal-producing countries in SSA. Firstly, most studies have estimated the contribution of charcoal to household income from perceived share of overall income and not actual income (e.g., Blay *et al.*, 2007; Jones *et al.*, 2016; Obiri *et al.*, 2014). This situation leads to both over- and under-estimation of the contribution of charcoal as households may face difficulties accurately estimating such a share in commonplace diverse livelihood portfolios comprising both cash and subsistence income. Studies that attempt a more precise quantification typically have very small sample sizes and sampled only charcoal producers, thereby restricting the possibility for generalisation (e.g., Coomes and Butz, 2001). Secondly, there is limited understanding of the factors that enable households to produce or trade in charcoal, or alternatively prevent them from doing so. Thirdly, no study has examined the social and political contexts (political economy) within which charcoal production and trade take place in Ghana. Very few studies (e.g., Ribot, 1998; Sander *et al.*, 2013; Schure *et al.*, 2013, 2015) have been done in this area in other SSA countries.

1.2 Justification

Existing literature shows that charcoal production and trade have not been adequately studied in Ghana and other SSA countries. Empirical information on the economic importance of charcoal to rural livelihoods and the social and political contexts within which its production and trade take place is still lacking. However, for charcoal to be promoted as a sustainable livelihood, we need to have a better understanding of the role of charcoal as an economic driver of rural livelihoods and the associated motivational factors. Equally important is an understanding of the mechanisms that social actors use to benefit from charcoal and how this is evolving with time.

This study contributes to the literature and scholarly debate on reliance and governance of environmental resources, and more specifically, the contribution of charcoal to rural livelihoods. It also adds to emerging studies that use political economy approach to investigate rural livelihoods. Its relevance lies in the linking of the revised Property Rights Scheme (Sikor *et al.*, 2017) and A Theory of Access (Ribot and Peluso, 2003) to the Sustainable Livelihood Framework (Ellis, 2000; Scoones, 1998, 2015). The conceptual framework therefore allows for an in-depth analysis of the reliance of rural households on charcoal production and trade in line with what Scoones (2015) terms the “political economy of livelihoods”. That is, a broader context of livelihood analysis that takes into consideration the long-term, historical patterns of structurally defined relations of power between social groups, of processes of economic and political control by the state and other powerful actors, and of differential patterns of production, accumulation, investment and reproduction across society. The study analytically investigates the influence of the interactions between customary and statutory institutions and the ability of other social actors to benefit from charcoal in time and space. It also draws attention to the likely implications of the planned formalisation of the charcoal sector on the livelihoods of rural households that depend on charcoal in Ghana.

The study is also relevant for practice, especially in the governance and management of natural resources. Empirical analysis of the absolute and relative income from charcoal will lead to an appreciation of the economic importance of charcoal and other environmental resources to rural livelihoods. Investigating the factors that

influence participation and income from charcoal production and trade will lead to a better understanding of the factors that motivate certain households to rely more on charcoal than other economic activities. Additionally, an understanding of the evolving mechanisms social actors use to benefit from charcoal is relevant for policy interventions in the charcoal sector. This study addresses these three areas, and is also relevant for providing inputs for targeting policy interventions in livelihood enhancement, poverty reduction and environmental conservation in relation to charcoal and other natural resources.

1.3 Aim, Objectives and Research Questions

The overall aim of this study is to provide an understanding on the role of charcoal in the livelihoods of rural households and the social, economic and political contexts within which its production and trade take place in Ghana. The specific objectives are to:

1. investigate the economic importance of charcoal to rural households through a detailed quantitative study in a key charcoal-producing area in Ghana;
2. identify and analyse factors influencing households' participation and income from charcoal production and trade in Ghana; and
3. analyse the evolving mechanisms (i.e., means, processes and relations) social actors along the production node of the charcoal commodity chain use to benefit from charcoal production and trade in the forest savannah transition zone of Ghana in time and space.

These objectives were researched under three main and seven sub-research questions as follows:

1. What is the economic importance of charcoal to rural livelihoods in a major charcoal-producing area in Ghana?
 - 1.1 What are the sources and size of rural household income and what is the relative importance of charcoal in this income?
 - 1.2 To what extent do charcoal production and trade contribute to rural households' subsistence and cash income?
 - 1.3 To what extent do rural households that face economic shocks use charcoal as safety-net and income gap-filler when they face seasonal shortfall in agriculture production?

2. What factors motivate rural households in Ghana to produce and/or trade in charcoal?
 - 2.1 What factors determine whether or not households produce and/or trade in charcoal?
 - 2.2 What factors are associated with high income from charcoal production and trade?

3. What mechanisms do social actors along the production node of the charcoal commodity chain in Ghana use to gain, maintain and control benefits from charcoal production and trade, and how have the mechanisms evolved in time and space?
 - 3.1 What mechanisms do social actors along the production node of the charcoal commodity chain use to gain, maintain and control benefits from charcoal in Ghana?
 - 3.2 How and why have the mechanisms changed in both time and space?

1.4 Hypotheses

In accordance with A Theory of Access (Ribot and Peluso, 2003) described in section 2.1.5, it is hypothesised that social actors along the charcoal commodity chain in Ghana will use rights-based, structural and relational mechanisms to benefit from charcoal. I suggest that the use of structural and relational mechanisms will contribute to differences in the ability of social actors to benefit from charcoal. In line with the theory, it is stipulated that subordinate actors will expend resources to those who control access in order to maintain their ability to benefit from charcoal. Likewise, in conformity with studies by Leach *et al.* (1999), I hypothesise that some social actors will disregard *de jure* rules, but follow *de facto* rules with reference to access to feedstock for producing charcoal. I also suggest that in accordance with the Sustainable Livelihood Framework, seasonality, shocks and trends (i.e., vulnerability) will influence reliance on charcoal by rural households.

In conformity with the property-authority contract postulated by Sikor and Lund (2009), I hypothesise that customary and statutory institutions are legitimising and consolidating their authority along the charcoal commodity chain through the granting of property to other actors (e.g., charcoal producers, merchants and transporters). I

suggest some level of contestation among social actors who control access to benefits along the charcoal commodity chain in accordance with Sikor and Lund's (2009) proposition that rights that have no value at certain points in time may become important with changing circumstances because they are enshrined in legislation or recognised by some politico-legal institutions.

1.5 Research Design

1.5.1 Philosophical Worldview

I consider my philosophical worldview¹ as largely pragmatic. I am inclined to the use of mixed (quantitative and qualitative) methods to understand problems. I am therefore not committed to any system of philosophy and reality (cf. Creswell, 2014). This worldview has been shaped by my formal training in natural science and work experience as a forester. My professional working experiences with communities, government and non-governmental organisations have taught me to look to the “what” and “how” to research based on the intended consequences (cf. Creswell, 2014).

1.5.2 Research Strategies

Two-staged sampling approach was used in selecting respondents for the study. Random sampling was first used in selecting respondents for the household survey. This was achieved by dividing houses (in the study communities) into six strata on the basis of their closeness to the main road that runs through each community. The list of charcoal-producing households in the first-staged sampling was used to conveniently sample 150 charcoal producers for the follow-up interview. Owing to the low number of merchants, transporters and chainsaw operators identified in the first-staged sampling, snowball sampling was used to sample the aforementioned social actors in the follow-up interviews. Detailed data collection methods and materials are provided at the method sections of each paper in chapters three, four and five.

A mixed method approach whereby quantitative and qualitative methods are combined was adopted for this study. Quantitative methods however, were dominant. The “what” questions are largely addressed through the use of quantitative methods

¹ “The general orientation about the world and the nature of research that a researcher brings to a study” (Creswell, 2014: 6).

and the “how” questions through a combination of quantitative and qualitative methods. The “why” questions on the other hand, were addressed with qualitative methods. The mixed method approach aptly addressed the research problem than a purely quantitative or qualitative approach would have done. For instance, the mixed method approach helped me to explain the quantitative results with a qualitative follow-up data collection and analysis. I adopted an explanatory sequential mixed method. Creswell (2014) explains explanatory sequential mixed method to be:

The situation where the researcher first conducts quantitative research, analyses the results and then builds on the results to explain them in more detail with qualitative research. It is considered explanatory because the initial quantitative data results are explained further with the qualitative data. It is considered sequential because the initial quantitative phase is followed by the qualitative phase. (Creswell, 2014, 15-16)

The PEN² questionnaire (Appendixes A and B) was adapted in the collection of quantitative data through a household survey in 400 randomly sampled charcoal- and non-charcoal-producing households between early February and end of March 2017. The questionnaire captured data on the cost and income of crops, livestock, livestock products, processed and unprocessed environmental products and own businesses undertaken by the sampled households in the year 2016. Income from wage work, remittances, gifts and compensations from the renting of machinery or equipment by sampled households were also captured by the questionnaire. The questionnaire was also used to collect data on the seasonal importance of charcoal to rural households and the reasons for its importance, the types of economic shocks households suffered and the activities they engaged in to mitigate the shocks, and welfare perceptions and social capital of households and communities. Collected income data was used to estimate the sources of income of rural households and the relative importance of charcoal in this income.

Qualitative data were collected through stakeholder meetings, participatory rural appraisal techniques, document reviews and informal interviews to explain the differences identified between households on the basis of income, gender, ethnicity, location of communities and seasonal importance of charcoal recorded in the household survey. Interview guides (Appendixes C and D) were used to interview

² PEN, an acronym for Poverty Environment Network, was a global-comparative programme on the role of forests and trees for rural livelihoods that was coordinated by the Centre for International Forestry Research (CIFOR, 2007).

charcoal producers, merchants, chiefs, staff of statutory institutions and other social actors along the charcoal commodity chain between September and December 2017. Four community and one district charcoal fora were held for stakeholders to validate research findings, provide additional inputs and seek explanations for policy interventions.

1.5.3 Study Area

The study was conducted in 10 communities in the Kintampo Forest District in the Bono East Region (formally part of Brong-Ahafo Region) of Ghana (Figure 1.1). The forest district was chosen because it is the largest charcoal producing district in Ghana (Amanor *et al.*, 2005; Nketiah and Asante, 2018). It comprises four local government units (Kintampo North Municipality, Kintampo South, Nkoransa North and Nkoransa South District Assemblies) and falls within three traditional areas³ (Drumankese, Mo and Nkoransa) (Table 1.1). It is located between latitude 7°30' and 8°45' North, and longitude 2°0' and 1°15' West. It has a bimodal rainfall regime that gives rise to major and minor agricultural seasons in September to October, and April to July, respectively (Climate.data.org, 2017), and falls within the forest savannah transition zone, whose vegetation is characterised by a mixture of trees, shrubs, and tall grasses (SRID, 2011).

The climate of the area supports a natural vegetation of fire resistant tree species with high density preferred for charcoal production (Amanor *et al.*, 2005; Obiri *et al.*, 2014). Charcoal from the area is normally sold in three major cities of Ghana – i.e., Accra, Kumasi and Takoradi (Agyei *et al.*, 2018; Obiri *et al.*, 2014).

Study communities were selected with the aim of capturing all three traditional authorities and different levels of road accessibility (i.e., good, fair and poor). Good accessibility communities are operationalised as communities located along tarmac major roads and are easily accessed by all kinds of vehicles all year round. Fair accessibility communities are located along non-tarmac feeder roads and are accessible by all types of vehicles in the dry season. Accessibility is however, fairly difficult with non-four-wheel-drive vehicles in the wet season in fair accessibility communities. Poor accessibility communities on the other hand are located along non-

³ A traditional area covers an area where a paramount chief exercises authority and differs from an administrative (or political) area.

tarmac feeder roads, but are very difficult to access with non-four-wheel-drive vehicles in the wet season, due to the absence of regular road maintenance and broken bridges.

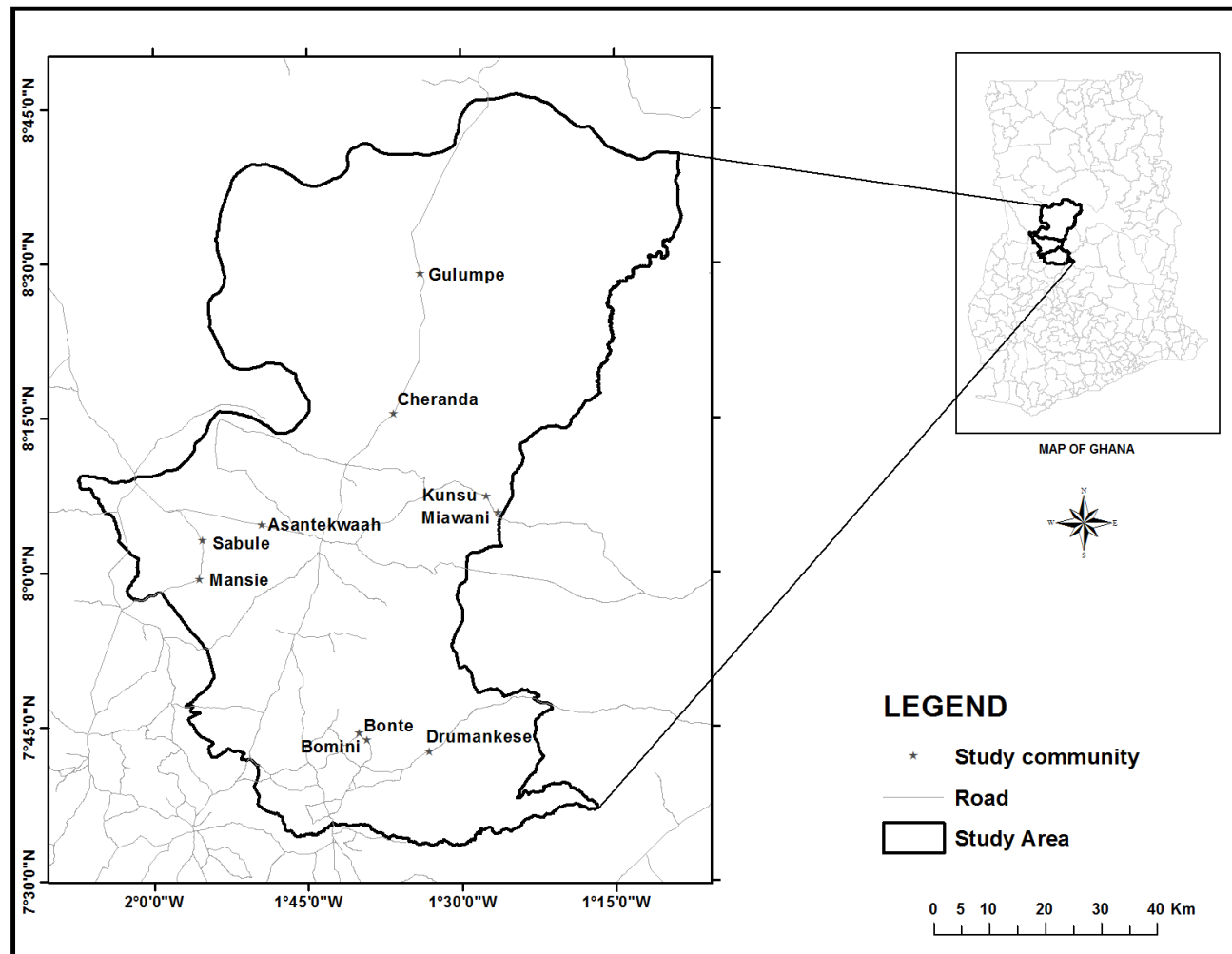


Figure 1. 1 Map of Ghana showing Kintampo Forest District and the study communities

Table 1. 1List and basic characteristics of survey communities in Kintampo Forest District in Ghana

| Community | District/Municipal Assembly | Capital town | Traditional Authority | Population | Accessibility | Formal credit institutions | Informal credit institutions | Electricity |
|-----------------------|--------------------------------|--------------|-----------------------|------------|---------------|-------------------------------|---------------------------------|-------------|
| Asantekwaah | Kintampo North | Kintampo | Mo | 1,586 | Good | - | x | x |
| Bomini | Nkoransa North | Busunya | Nkoransa | 2,656 | Fair | x | x | x |
| Bonte | Nkoransa North | Busunya | Nkoransa | 3,299 | Fair | x | x | x |
| Cheranda ⁴ | Kintampo North | Kintampo | Mo and Nkoransa | 472 | Good | - | x | x |
| Drumankese | Nkoransa North | Busunya | Drumankese | 8,179 | Fair | x | x | x |
| Gulumpe | Kintampo North | Kintampo | Nkoransa | 5,681 | Good | - | x | x |
| Kunsu | Kintampo North | Kintampo | Nkoransa | 1,306 | Poor | - | x | - |
| Mansie | Kintampo South | Jema | Mo | 1,476 | Fair | - | x | x |
| Miawani | Kintampo North | Kintampo | Nkoransa | 596 | Poor | - | - | - |
| Sabule | Kintampo South | Jema | Mo | 1,099 | Fair | - | x | x |

Notes: 1. Population data are based on 2016 data provided by the Ghana Statistical Service. 2. “x” indicates presence of facility, while “-” denotes absence of facility.

⁴ Cheranda falls under both the Mo and Nkoransa traditional areas.

1.6 Organisation of Study

The study is organised into seven chapters. Chapter one of which this section forms part provides introduction to the study. Chapter two contains a review of literature related to the topic and theories underlying the study and from which the conceptual framework used in this study has been developed. The research chapters are presented as papers in chapters three, four and five. Chapter three covers the economic importance of charcoal production and charcoal business to rural households in a detailed quantitative study in a key charcoal-producing area in Ghana. Chapter four analyses the factors that shape households' participation and income from charcoal production and trade. Chapter five explores in time and space the evolving mechanisms social actors at the production end of the charcoal commodity chain use to benefit from charcoal. The general discussion and synthesis is presented in chapter six, while the conclusions and recommendations of the study are presented in chapter seven.

CHAPTER TWO

2.0 THEORETICAL AND LITERATURE REVIEW

Introduction

This chapter clarifies and delineates the theoretical and analytical concepts underpinning the research questions for the study. It also covers literature on the contribution of environmental resources to rural livelihoods. It starts by reviewing the Property Rights schemes by Schlager and Ostrom (1992), the revised Property Rights Scheme by Sikor *et al.* (2017), the Entitlement Framework by Sen (1981), Environmental Entitlement by Leach *et al.* (1999), the Capitals and Capabilities Framework by Bebbington (1999), the Sustainable Livelihood Framework (SLF) by Ellis (2000) and Scoones (1998, 2015), and A Theory of Access by Ribot and Peluso (2003). These theoretical elements are synthesised to form the conceptual/analytical framework used in the study. The next section reviews the different definitions of livelihood, while the final section reviews empirical research on reliance on environmental resources and studies that link charcoal production and trade to livelihoods.

2.1 Theoretical Review

2.1.1 Property Rights Scheme

Schlager and Ostrom (1992), developed a conceptual scheme for analysing property rights regimes and distinguish among diverse bundles of rights, which range from authorised user, claimant to proprietor to owner (Table 2.1). They posit that rights exist as a bundle and the incentives social actors face, the type of actions they take and the outcome they achieve in the use and management of natural resources are influenced by the different “bundles of rights” they hold. That is, rights holders are given specific roles, different rights and different access to resources. Von Benda-Beckman *et al.*, (2009) note that the bundle of rights scheme conceptualises ways in which the relations between social actors with respect to valuables are given form and significance. Schlager and Ostrom (1992), posit two levels of rights with regard to the use and management of common-pool resources. The most relevant operational-level property rights with regard to common-pool resources are “access” and

“withdrawal”.⁵ Individuals that hold access rights have the authority to enter a resource (e.g. a forest or fallow land), and the requirement an individual must meet in order to exercise these rights are specified in the rules. The rights to management, exclusion and alienation are second-order rights referred to as collective-choice rights.⁶

Table 2. 1 Bundles of rights associated with positions

| | Owner | Proprietor | Claimant | Authorised user |
|-----------------------|-------|------------|----------|-----------------|
| Access and withdrawal | X | X | X | X |
| Management | X | X | X | |
| Exclusion | X | X | | |
| Alienation | X | | | |

Source: Schlager and Ostrom (1992)

Schlager and Ostrom (1992), categorise the sources of rights into *de jure*⁷ and *de facto*⁸. They posit that these rights are not usually held in isolation, but a conglomeration of *de jure* and *de facto* property rights may exist in a single common-pool resource which may overlap, complement, or even conflict with one another. North (1990), terms these rules, and classifies them into "formal and informal rules, for *de jure* and *de facto* rights respectively. Hodgson (2006), however, recommends the usage of statutory and customary rules instead of formal and informal rules so as not to hinder the influence of customary rules. This thesis adopts Hodgson’s (2006) classification of institutions since the constitution of Ghana recognises customary rules (i.e., legal pluralism).

The property rights scheme by Schlager and Ostrom (1992), relates to the role of institutions and organisations as mediators of access to natural resources in the Sustainable Livelihood Framework (SLF). Scoones (1998) posits that an understanding of the formal and informal institutional processes (i.e. land tenure, labour sharing systems, credit arrangements, and market networks) is a prerequisite

⁵ Schlager and Ostrom (1992) define access as “the right to enter a defined physical property”, while withdrawal is “the right to obtain the products of a resource”.

⁶ Management is “right to regulate internal use patterns and transform the resource by making improvements”; exclusion is “the right to determine who will have an access right, and how that right may be transferred”; and alienation is “the right to sell or lease either or both of the above collective choice rights” (Schlager and Ostrom, 1992).

⁷ *De jure* rights are “rights that have been given lawful recognition by formal and legal instruments and holders can therefore presume that their rights would most likely be sustained if it were challenged in an administrative or judicial setting” (Ibid).

⁸ *De facto* rights “originate from cooperation among resources users to define and enforce rights among themselves and they are not recognised by government authorities” (Ibid).

for designing interventions that aim at improving sustainable livelihood outcomes. Bromley (1992) also acknowledges the role of institutions in property relations. He states:

A property right is a triadic relationship between the individual who possesses the right, others that have to refrain from interfering with the right holder's exercise of those rights, and an institution to back-up the claim. (Bromley, 1992: 2)

The bundle of rights framework by Schlager and Ostrom (1992) has however, been criticised for focusing on institutions alone as mediators of access to resources. It does not take into account the multiple mechanisms besides institutions that open up, influence, obstruct and close down access to resources (Ribot and Peluso, 2003; Sikor and Lund, 2009). These include structural and relational mechanisms that will be addressed in “A Theory of Access” (section 2.1.5). The scheme also does not account for emerging multiplicity of social actors, legal pluralism and significance of indirect benefits in natural resources management (Sikor *et al.*, 2017). I concur with these criticisms against the framework.

Sikor *et al.* (2017) have proposed a revision to the property rights scheme by Schlager and Ostrom (1992) to address some of the limitations in the original scheme. Unlike the original scheme which posits five types of rights at two levels, the revised scheme by Sikor *et al.* (2017) proposes eight types of rights at three different levels that social actors can use to benefit from a resource (Figure 2.1). These are use of direct benefits, use of indirect benefits, management, exclusion, transaction, monitoring, definition, and allocation rights (Box 2.1).

In connection with Schlager and Ostrom (1992), Sikor *et al.* (2017) name all first-order rights as use rights and distinguish between the kind of benefits (i.e., direct or indirect) available to each social actor (e.g., state agencies, company, NGOs). They also expand the second-order rights in the original scheme by integrating rights of transaction and monitoring and refer to them as control rights. A third-order rights referred to as authoritative rights has also been added to the original scheme. Like the original, the revised scheme does not account for other mechanisms beyond property-rights in the use and management of natural resources.

Box 2.1: Eight types of property rights by Sikor *et al.* (2017)

Use rights are the rights to enjoy benefits, including:

1. *Use of direct benefits*: the right to obtain benefits directly derived from a resource.
2. *Use of indirect benefits*: the right to obtain indirect benefits associated with a resource.

Control rights refer to various kinds of “second-order” rights to determine the scope of use rights. They include the rights of:

3. *Management*: the right to regulate use and transform the resource.
4. *Exclusion*: the right to define who has use rights.
5. *Transaction*: the right to handle the activities required for the realisation of benefits.
6. *Monitoring*: the right to monitor the use of benefits and state of the resource.

Authoritative rights are ‘third-order’ rights to define control rights. They include the rights of:

7. *Definition*: the rights to define the discretionary space for the exercise of control rights.
8. *Allocation*: the right to assign control rights to particular actors.

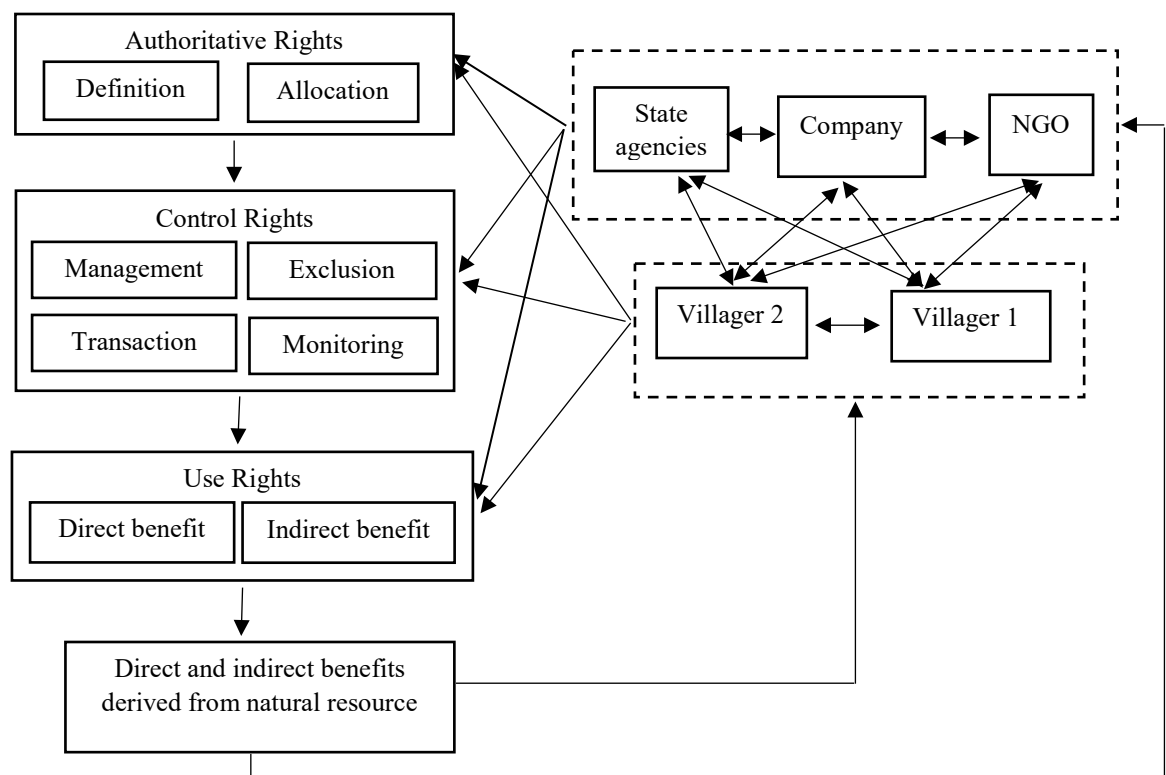


Figure 2. 1 Revised property rights scheme
Source: Sikor *et al.* (2017)

2.1.2 Entitlement Framework

Sen (1981) used the entitlement approach to demonstrate that starvation for instance results, not from lack of food (i.e. natural capital in the case of SLF), but from poorly functioning access mechanisms. In Sen's lexicon, endowments such as natural resources, can be accessed through legally or socially sanctioned means, and are critical in building entitlements (totality of means and opportunities for acquiring food). According to Sen (1984), entitlement⁹ represents "the set of alternative commodity bundles that a person can command in a society using the totality of rights and opportunities that he or she faces". Devereux (2001) however, criticises the entitlement approach as being grounded in private property regimes and is therefore incompatible with rights or claims over common pool resources like forests that are held collectively by group of people or institutions. Leach *et al.* (1999) also argue that the entitlement approach fails to recognise individuals as socially embedded members of households, communities and states, and focuses on only formal (or statutory) legal property rights as the only mediating channel over command to resources. That is, the entitlement approach does not recognise the role of customary institutions in mediating access to resources. Ribot (2014) on the other hand argues the entitlement approach does not account for moral economy – i.e., the basis of expectations that people have on those who govern (Swift, 1989). I agree with the above criticisms against the framework.

Leach *et al.* (1999) expand Sen's concept of entitlements from an individual or household basis up to the scale of any social actors. They define environmental entitlements as "alternative sets of utilities derived from environmental goods and services over which social actors have legitimate effective command and which are instrumental in achieving well-being". They posit that environmental entitlement enhances people's capabilities, which is what people can do or be with their entitlement¹⁰. The environmental entitlement framework analyses how access to and control over natural resources is mediated by a set of interacting and overlapping institutions, which are embedded in the political and social life of a locality (Figure 2.2). Leach *et al.* (1999) argue that the ability of any natural resource to function as an

⁹ Sen emphasises entitlement in the descriptive sense and not the normative sense (Leach *et al.*, 1999).

¹⁰ Leach *et al.* (1999) define entitlement as "legitimate effective command over alternative commodity bundles".

endowment or entitlement is not inherent in its nature, but depends on the empirical context and on time, within a cyclical process.

The environmental entitlement framework recognises legal pluralism in access to resources and admits that claims may be contested. These are not captured in the entitlement framework by Sen (1981). The framework also acknowledges the fact that institutions do not have the same level of influence, and different people rely on different institutions to support their claims to environmental goods and services. Hence endowments such as natural resources that are not classically owned within a household can still be accessed through social relations that may introduce cooperation, competition, or conflict mediated by systems of legitimisation other than state law. The framework therefore links both the macro and micro level institutions and situates “a disaggregated or micro analysis of the distinctive position and vulnerabilities of particular social actors in relation to the macro structural conditions of the prevailing political economy” (Leach *et al.*, 1999). Although the framework recognises the roles of statutory and customary institutions in mediating access to resources, it has a weakness of not recognising illegitimate rights or illegal mechanisms of access as is recognised in A Theory of Access. It also does not account for other mechanisms beside institutions or rights that social actors use to benefit from resources.

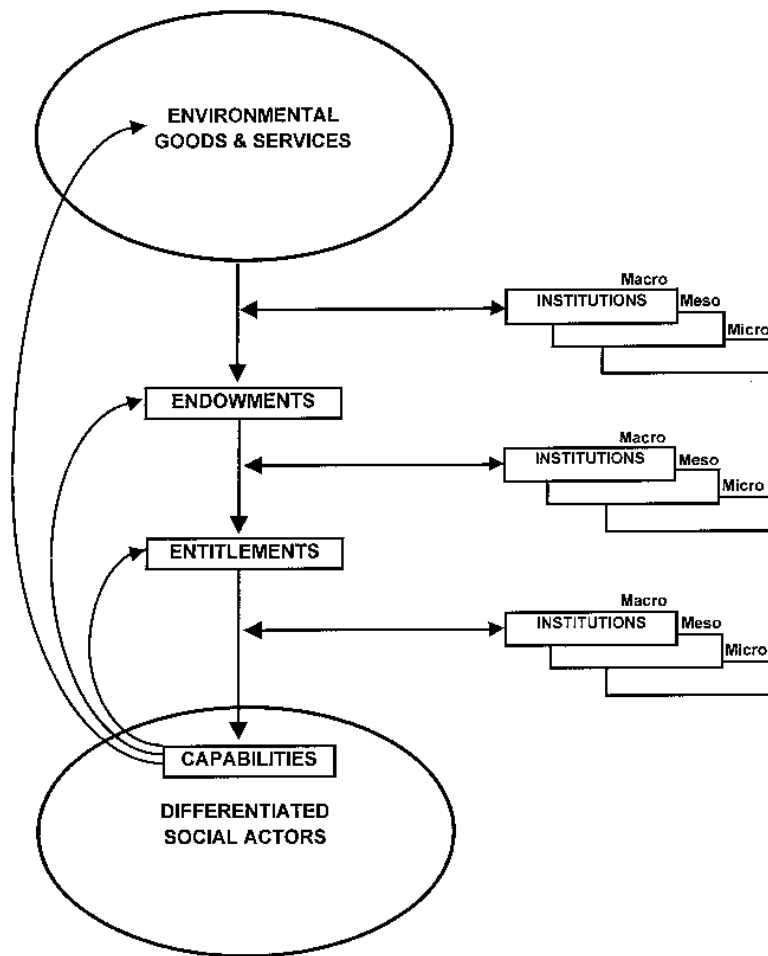


Figure 2.2 Environmental Entitlement Framework
Source: Leach *et al.* (1999)

2.1.3 Capitals and Capability Framework

Bebbington (1999), drew on the work of North's (1990) on institutional economics and Sen's (1981) entitlement approach to develop the capital and capabilities framework to study rural livelihoods in terms of their sustainability and their implications for rural poverty (Figure 2.3). He posits that assets are not only vehicles for instrumental action (making a living), but also for hermeneutic action (making life meaningful) and emancipatory action (challenging the structures under which one makes a living)". This framework is similar to the SLF and argues that access to natural, human, cultural, social and produced capitals (produced capital is equivalent to physical capital in the SLF), are the most critical resources to build sustainable poverty alleviating rural livelihoods (Table 2.2). The framework helps to understand how actors engage with other actors in the spheres of market, state and civil society in order to gain access to resources, to influence the *de jure* of access in a society, or

turn their assets into commodity bundles. It explains that the failure by rural households to improve their livelihoods stem from their inability to: defend their existing assets; identify and secure opportunities to turn assets into livelihoods; or protect existing ways of turning assets into livelihoods. Additionally, the limited ability of people to build up and draw upon networks and links with state, market or civil society actors that would otherwise have helped them access, defend and capitalise on their assets is the key cause of poverty in rural areas (Bebbington, 1999).

I find the capitals and capability framework to be similar to the SLF. I also find it useful for investigating the relationships between individuals, households and organisations, as well as the livelihood strategies and outcomes of households. The framework however, does not have a vulnerability component like the SLF, and is therefore not suitable for investigating factors that constrain or diminish livelihoods options.

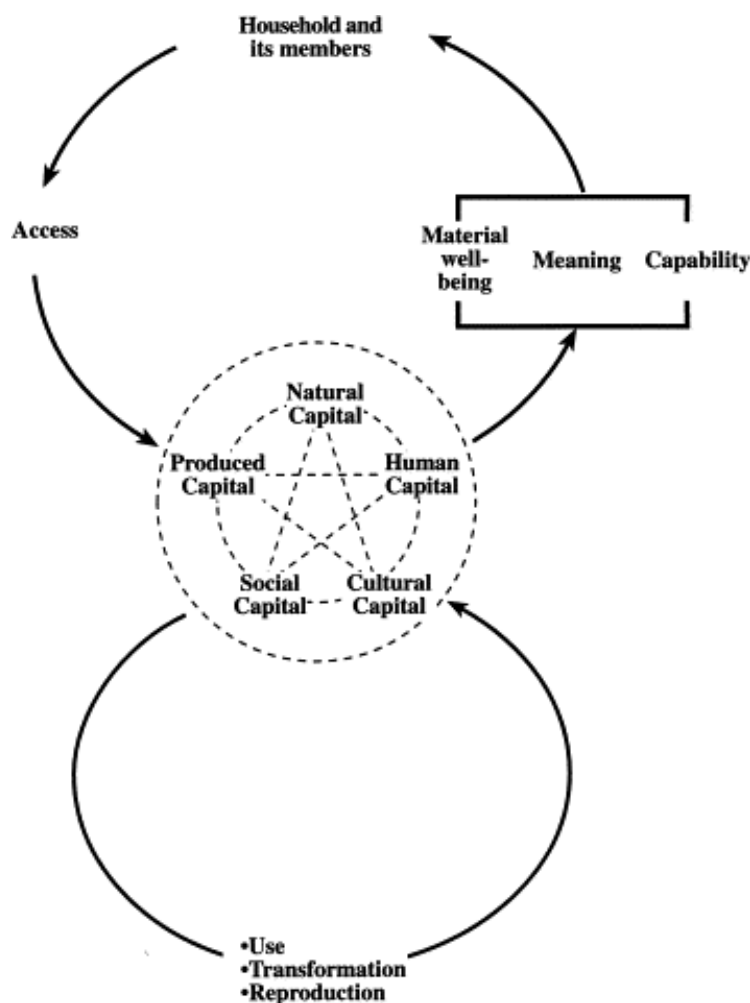


Figure 2. 3 The Capital and Capabilities Framework

Source: Bebbington (1999)

Table 2. 2 Explanation of capitals in the capital and capability framework

| Capital | Explanation |
|------------------|---|
| Cultural capital | Cultural practices made possible (or constrained) by the patterns of co-residence and absence linked to certain livelihood strategies |
| Human capital | Investment in people (e.g., education and health) |
| Natural capital | Assets obtained from nature (e.g., soils, trees) |
| Produced capital | Assets owned (e.g., financial savings, houses and vehicles) |
| Social capital | Benefits obtained from organisations, family/kin network (e.g., social structures and network) |

Source: Adapted from Bebbington (1999)

2.1.4 Sustainable Livelihood Framework

The main framework that guided this study is the Sustainable Livelihood Framework (SLF). The SLF argues that the ability to pursue a livelihood strategy (e.g. livelihood diversification and agriculture intensification) depends on the possession of or access to five capitals (i.e. financial, human, natural, physical and social) which are mediated by institutions and organisations from which livelihoods outcomes (e.g. reduced poverty, improved wellbeing) are constructed (Ellis, 2000; Scoones, 1998). It links livelihood contexts with resources, the building blocks of livelihoods, to strategies and outcomes (Figure 2.4). The framework drew substantially from the classic work of Sen (1981) on entitlement, which emphasises the role of institutions in defining access to resources, rather than simply production and abundance (Leach *et al.*, 1999). Explanations to the various components of the framework are provided below.

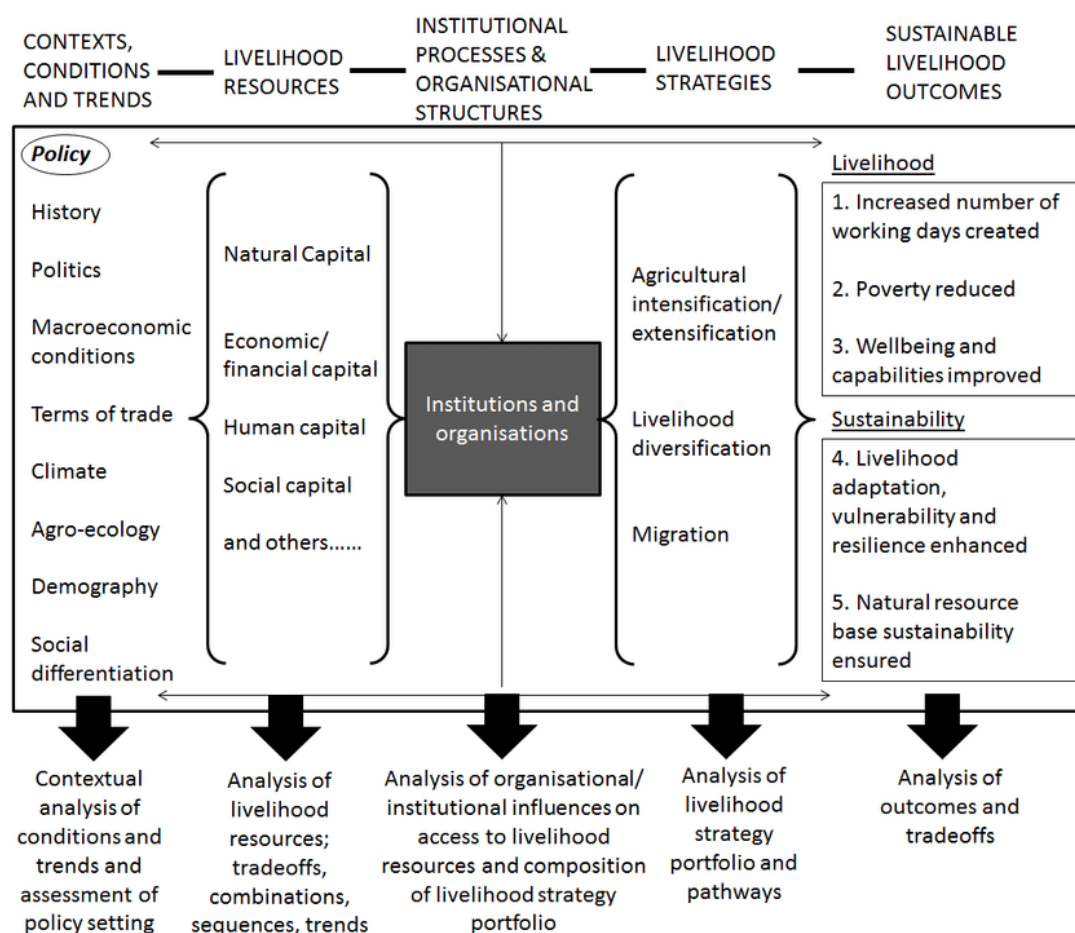


Figure 2. 4 The Sustainable Livelihood Framework
Source: Scoones (1998)

2.1.4.1 Assets or Capitals in the Sustainable Livelihood Framework

Assets owned, controlled, claimed and accessed by households form the starting point of the SLF, and the ability of a household to pursue any livelihood strategy is dependent on possession or access combinations of these assets (Scoones, 1998). Ellis (2000) posits that assets are the basic building blocks upon which households are able to undertake production, engage in labour markets, and participate in reciprocal exchanges with other households. Assets have been categorised into five – financial, human, natural, physical, and social capitals (Ellis, 2000; Scoones, 1998). DFID (2000) argues that the SLF places emphasis on improving the assets status of poor people (strength) rather than emphasising their needs or weakness of these assets. It does so by investigating the:

- levels of assets and their distribution among individuals, households, groups, neighbourhoods and communities;

- ii. changes in assets status over time (cycles within a year as well as longer-term changes);
- iii. roles assets play in livelihoods; and
- iv. asset interactions within and among households.

The five capitals or assets are explained below as follows:

Financial Capital

Financial capital refers to the stocks of money to which a household has access, and includes cash, credit and savings (Ellis, 2000; Scoones, 1998). Financial capitals can also be held in forms other than cash. For example, Dercon and Krishnan (1996) report that, the keeping of livestock in rural SSA, often plays a critical role as a store of wealth and a buffer against bad times. Financial capitals own their role in the asset portfolio of households to their convertibility into other forms of capital, or directly into consumption (Ellis, 2000).

Human Capital

Human capital refers to the labour available to the household, and includes education, skills and health (Carney, 1998). It can be increased by investment in education and training, as well as by the skills acquired through pursuing one or more occupations (Ellis, 2000). It can also decrease through ill-health and death. Human capital is not static and changes constantly due to internal demographic reasons, e.g., births, death, marriage, in/out migration (Moser, 1998). Scoones (1998) includes good health and physical capability important for the successful pursuit of different livelihood strategies to human capital.

Natural Capital

Natural capital comprises the natural resource stocks (e.g. soil, trees, land, water and genetic resources) and environmental services (e.g. hydrological cycle, pollution sinks) from which resource flows and services useful for livelihoods are derived (Scoones, 1998). Ellis (2000) distinguishes between renewable (e.g. soil, trees, fisheries) and non-renewable (e.g. metals, oils, etc.) natural capitals, and reports that in most rural development context, interest centres on renewable resources. DFID (2000) reports that access to and reliance on natural capital is affected by gender, age

and other social distinctions. Examples of how the aforementioned factors influence access to natural capital are presented in sections 2.4.1 and 2.4.4 of this thesis.

Physical Capital

Physical capital comprises assets that are created by economic production processes and include machines, tools, roads, housing, storage facilities and irrigation canals (Ellis, 2000). Physical capitals can substitute for natural capitals in many circumstances through the long-term process of technological change coupled with industrialisation and urbanisation (Ibid). Swift (1998) reports that physical capitals like road, electricity and water supplies facilitate livelihood diversification. For instance, roads facilitate the movement of people between places offering different income-earning opportunities; creates markets that otherwise would not come into existence; and plays an important role in the transfer of information between rural centres and remote settlements in countries lacking in telecommunication facilities.

Social Capital

Social capital refers to the “networks of social relationships that can be drawn upon to improve individual and collective well-being” (Katz, 2000), or “the structure of relations between actors and among actors that encourages productive activities (Coleman, 1990). It includes social resources such as networks, social claims, social relations, affiliations, associations, etc., upon which people draw when pursuing different livelihood strategies (Scoones, 1998). The basic idea behind social capital is that relationships among individuals give rise to something valuable (Katz, 2000); and social bonds and social norms are an important part of the basis for sustainable livelihoods (Pretty and Ward, 2001). Katz (2000) posits that social capital may have its foundations in shared history, ethnicity, religion or other group memberships, and is manifest in collective knowledge (including environmental knowledge), respect for group rules and norms, and the creation and maintenance of self-governing institutions. Bebbington (1999) argues that social capital is a critical precursor to access to resources. He states that “social capitals appear to be a phenomenon whose indicators are largely surrogate and indirect”.

Pretty and Ward (2001) describe four kinds of social capital – relation of trust¹¹; reciprocity and exchanges¹²; common rules, norms and sanctions¹³; and connectedness, networks and groups¹⁴ and argue that social capital lowers the cost of working together, and facilitates cooperation. They posit that in relation to property rights, social capital gives people the confidence to invest in collective activities, knowing that others will also do so. Katz (2000) argues that in the absence of well-defined property rights (i.e. formal, legal system that can guarantee resource tenure rights for either individuals or groups of users), social capital can substitute for this system by providing a non-market solution to the negative externality, information asymmetry, and moral hazard problems that can be expected to arise. According to Katz (2000), social capital can provide the foundation for people to participate in and abide by social norms governing resource use, and to care about sanctions which may be purely moral (i.e. non-material) in nature. Social capital can therefore substitute for the costly monitoring, supervision and enforcement of the rules governing property rights and resource use in both private and common property regimes.

2.1.4.2 Institutions and other Mediating Processes in the Sustainable Livelihood Framework

Ellis (2000) and Scoones (1998) note that institutions, organisations and social relations mediate access to capitals and together with policies define the opportunities and constraints of different livelihood strategies and outcomes. This thesis adopts North's (1990) definitions of institutions and organisations. North (1990) distinguishes institutions from organisations, and states:

Institutions are the rules of the game in society or, more formally, are the humanly devised constraints that shape human interaction. In consequence they structure incentives in human exchange, whether political, social, or economic. Organisations are the players of the game and are made up of groups of individuals bound together by some common purpose to achieve certain objectives. (North, 1990: 3-5)

¹¹Trust lubricates cooperation and reduces the transaction costs between people (e.g. monitoring cost). It also creates social obligation which cause us to expect the right thing from those we know and do not know (Pretty and Ward, 2001).

¹²Coleman (1990) and Putman (1993) distinguish between specific and diffuse reciprocity. Specific reciprocity refers "to simultaneous exchanges of items of roughly the same value"; and diffuse reciprocity refers to "a continuing relationship of exchange that at a given time may be unrequited, but over time is repaid and balanced".

¹³These are the mutually agreed or handed-down norms of behaviour that place group interests above those of individuals. They give individuals the confidence to invest in collective or group activities, knowing that others will do so too.

¹⁴ They are the vital aspect of social capital (Pretty and Ward, 2001).

Institutions, by North's (1990) definition, include the conventions, norms and rules that guide the use and management of natural resources. Institutions therefore define rights to natural resources. Rights, according to Schlager and Ostrom (1992), are the product of rules¹⁵, and specify both the rights and duties of social actors.

Ellis (2000) separates social relation from institutions in the SLF and defines it as “the social positioning of individuals and households within society”. It includes gender, caste, class, age, ethnicity and religion. Paying attention to social relations enable researchers to identify social groups that are more dependent and/or vulnerable to natural resources. For example, Cavendish (2000) reports that gender and age of heads of household influence the level of reliance and access to forest resources. According to him, while children, and particularly poor children, depended heavily on wild foods (natural capital) at certain times, certain foods are regarded as unfit for adult consumption. Older individuals who have difficulty carrying out arduous agricultural tasks, and also have reduced cultivated acreage and per capita food production however, depend more on wild foods. On the other hand, female headed households were mostly “cash rich” and depended less on wild foods. The social requirement for men to provide for their wives kitchen huts and bedroom huts, cause rapid surge in construction activities and associated firewood use (for brick burning) and construction poles among men than women. In order to earn cash to hire labour for firewood collection and water fetching (regarded as female activities in the study areas) divorced or widowed male headed households turn to certain forest resources and use them intensively.

2.1.4.3 Vulnerability Context

The vulnerability context of the SLF refers to seasonality, trends, and shocks that affect people's livelihoods (Ellis, 2000). DFID (2000) posits that vulnerability factors are not susceptible to control by local people themselves, at least in the short and medium term. That is, vulnerability may result from policies and institutions, and lack of assets by households. DFID (2000) however, reports that vulnerability contexts are neglected in most livelihood studies, and recommends investigations into the various forms of political and physical vulnerability and the ways that they affect, constrain or

¹⁵ Schlager and Ostrom (1992) define rules as “generally agreed upon and enforced prescriptions that require, forbid, or permit specific actions for more than a single individual”.

diminish livelihood options. These, DFID (2000) argues, are prerequisites for identifying the means through which their negative effects on households can be minimised.

2.1.4.4 Livelihood Strategies

A livelihood strategy denotes the range and combination of activities and choices that people make and undertake (Ashley and Carney, 1999). Ellis (2000) argues that the adoption and adaptation of a livelihood strategy depend on the asset status of a household, and mediated social factors and exogenous trends or shocks. He states that “livelihood strategies are dynamic, respond to changing pressures and opportunities, and are composed of activities that generate the means of household survival”. According to Scoones (1998), livelihood strategies frequently vary between individuals and households depending on differences in asset ownership, income levels, gender, age, caste and social or political status.

Scoones (1998) classifies rural livelihood strategies into three broad types – agricultural intensification or extensification; livelihood diversification; and migration. Rural households can gain more of their livelihoods from agriculture through process of intensification (more output per unit area through capital investment or increase in labour inputs) or extensification (more land under cultivation); or diversify into a range of off-farm income earning activities, or move away to seek a livelihood temporarily or permanently, elsewhere. They could also pursue a combination of all strategies together or in sequence (Ibid). Ellis (2000) on the other hand classifies livelihood strategies into natural resource and non-natural resource based activities. Natural resource based activities are sub-divided into on-farm (e.g. food cultivation, livestock keeping and pastoralism) and off-farm (e.g. fuelwood collection, collection of wild foods, and brick making). Non-natural resource based activities are also termed non-farm activities and include rural trade in farm inputs and outputs, consumer goods and remittances (Ellis, 2000).

Demissie and Workneh (2004) used the random utility maximisation theory to explain livelihood strategies. According to the theory, households’ attempt to maximise their utility and their choices of strategy is a function of factors related to household characteristics and attributes of alternative livelihood strategies (Ibid). Tesfaye *et al.*

(2011) report five livelihood strategies – forest based, crop based, livestock based, business based and diversification based – by rural households participating in participatory forest management in Ethiopia. The strategies are influenced by the area or size of crop land, distance and altitude of crop land and age of household head.

2.1.4.5 Livelihood Outcomes

Livelihood outcomes are the goals to which people aspire, and are the results of pursuing their livelihood strategies (IDS, 2016). Examples of livelihoods outcomes include: increased income; reduced vulnerability; increased well-being; improved food security; and more sustainable use of natural resources. Livelihood outcomes are important because they help researchers and policy makers to understand: the results of peoples' livelihoods strategies in a particular context; the reasons behind the choice and priorities of livelihood strategies by certain people; and predict the likely response of people to new opportunities or constraints (Ibid).

Ellis (2000) classifies livelihood outcomes on the basis of their effects on livelihood security and environmental sustainability. IDS (2016) however, notes that whilst improved access to livelihood assets and the outcome of greater livelihood security (especially higher incomes and reduce risk) are usually important objectives in rural livelihood strategies, environmental sustainability may or may not be an objective. It is for this reason that environmental sustainability is usually labelled along with livelihood security as an outcome variable rather than as an objective in the SLF.

2.1.4.6 Critiques against the Sustainable Livelihood Framework

The SLF has been described by many as people centred, participatory and use bottom-up approach to analyse rural livelihoods (e.g., Scoones, 2015; Small, 2007). The framework is however, critiqued for not linked to a broader theory and also not formally taking into account the actions and influences of wealthier “players” in the use and management of resources (Wiggins, 2002). Although I agree that the SLF is not linked to a broader theory, it can accommodate a theory when it is used as an analytical or conceptual framework. The SLF was therefore combined with A Theory of Access in the conceptual framework that guided this study (section 2.2). The influence of wealthier players are catered for in the social relations portion of the

institutions and mediating processes component of the SLF which addresses issues on caste, class, gender and ethnicity.

Small (2007) critiques the SLF on the basis of its inherent difficulty in measuring some non-income livelihood outcomes variables such as reduced vulnerability and improved wellbeing. Although I agree to this assertion, Participatory Rural Appraisal methods such as (wealth) ranking can be used to measure such non-income livelihood outcomes variables. The SLF is also critiqued for its failure to engage with economic globalisation (Sakdapolrak, 2014; Scoones, 2009). Scoones (2009) attributes this failure to the history of the framework. He states that “the SLF came from a complex disciplinary parentage that emphasised the local, and have not been very good at dealing with big shifts in the state of global markets and politics”. This notwithstanding, I agree with Scoones (2015) that a political economy perspective can be employed to rectify this limitation.

Another critique against the SLF is its lack of attention to power and politics (de Haan and Zoomers, 2005; Moser *et al.*, 2001; Sakdapolrak, 2014). Scoones (2015) debunks this critique, and I agree with him. He explains that the institutions and other mediating processes component of the SLF relates to power and politics – i.e., questions of rights, access and governance. A final critique against the SLF relates to its focus on the household as its unit of analysis and its assumption that the household is a uniform unit with common interests (Solesbury, 2003). The framework therefore fails to account for differences in interests and powers within households (Ribot, 2014). I agree to this critique.

2.1.5 A Theory of Access

The main theory underlying the study is “A Theory of Access”, by Ribot and Peluso (2003). A Theory of Access has expanded scholarly thinking about how people are able to benefit from resources beyond what property enables them. The theory brings attention to a wider range of social relations beyond property that can constrain or enable people to benefit from resources. Ribot and Peluso (2003) define “access” as “the ability to benefit from things”, and broadens it from the classical property rights’ definition as “the right to benefit from things”. The difference between “ability” and “right” is the key distinction between “access” and “property”. The theory argues that social actors can use multiple mechanisms in addition to, or independent of property to

benefit from resources. In addition to property relations, A Theory of Access also gives recognition to illicit actions, relations of production, entitlement relations, and the histories of all the aforementioned. The theory therefore postulates that social actors can use rights-based (or property) and structural and relational mechanisms to benefit from resources. Rights-based access mechanisms include those sanctioned by law, custom or convention. Rights-based mechanisms also include illegal mechanisms such as theft, coercion, or deception. The structural and relational mechanisms include authority, capital, identity, knowledge, labour, markets, social relations and technology, (Ribot and Peluso, 2003).

Myers and Hansen (2019) note that A Theory of Access is based on a synthesis of several strands of thought in human geography, political economy and political ecology based on social theory and years of research. A Theory of Access integrates property and tenure theories (e.g., Christman, 1994; Geisler and Daneker, 2000), common property resources (e.g., Schlager and Ostrom, 1992) and relations of production (e.g., Marx, 1977; Polanyi, 1944). The theory also engages with both structure and agency and expands the “bundle of rights” notion of property to a “bundle of powers” approach to access, and advocates for the location of these “powers” within the social and political-economic contexts that shape people’s abilities to benefit from resources. Ribot and Peluso (2003) explain the strands in the bundle of powers to be the means, processes and relations (together referred to as mechanisms) by which social actors are able to gain, control and maintain access to resources. Access control is “the ability to mediate others access”, while access maintenance “involves the expending of resources or powers to keep access open”. Both access control and maintenance are complementary, and are constitutive of relations among social actors in relation to resource appropriation, management or use. Access gain on the other hand is the “general process by which access is established” (Ribot and Peluso, 2003; 159).

A Theory of Access has been critiqued by Westermann (2007) for its treatment of power. According to him, the theory emphasises the importance of power relationships behind mechanisms of access, but it is rather weak on how to study the power involved in access and control relationships. He further notes that the theory is vague on its understanding of power. I do not agree to the critique of Westermann (2007) on

the description of power in A Theory of Access. My disagreement stems from the description of power by Ribot and Peluso (2003) themselves. They assert that:

Ability is akin to power, and define power in two senses – first, as the capacity of some actors to affect the practices and ideas of others (Lukes 1986, 3; Weber 1978, 53) and second, power as emergent from, though not always attached to, people. Power is inherent in certain kinds of relationships and can emerge from or flow through the intended and unintended consequences or effects of social relationships. Disciplining institutions and practices can cause people to act in certain ways without any apparent coercion (Foucault 1978; 1979). (Ribot and Peluso, 2003; 156)

The SLF and capital and capability framework are not cited in A Theory of Access, but the three frameworks are comparable. For example, social relations and identity in A Theory of Access are analogous to social capital in the SLF and capital and capability framework. Likewise, knowledge is embedded in the human capital component of the SLF and capital and capability frameworks, while rights-based mechanisms in A Theory of Access relates to institutions and other mediating processes component of the SLF. Some structural and relational access mechanisms such as capital, labour, market and technology are however, absent in the SFL and capital and capability frameworks.

2.2 Conceptual Framework: Linking Sustainable Livelihood Approach, Revised Property Rights Scheme and A Theory of Access

No single approach is suitable for analysing the complex nature of rural livelihoods. The conceptual framework for this study (Figure 2.5) links the SLF, revised property rights framework (Sikor *et al.*, 2017) and A Theory of Access (Ribot and Peluso, 2003). The conceptual framework therefore takes into consideration the influence of statutory and customary institutions in mediating access to capitals, the multiplicity of social actors and their level of rights as suggested by Sikor *et al.* (2017) and the influence of all eight structural and relational mechanisms of access stipulated by Ribot and Peluso (2003) used by social actors to gain, maintain and control benefits to charcoal, to investigate the livelihood strategies and outcomes of charcoal producers and traders in Ghana. The conceptual framework addresses the weaknesses in the SLF, capital and capability framework and the property rights framework that have been reviewed above. For example, A Theory of Access overcome the weakness in the SLF that assumes the household to be a uniform unit with a common interest.

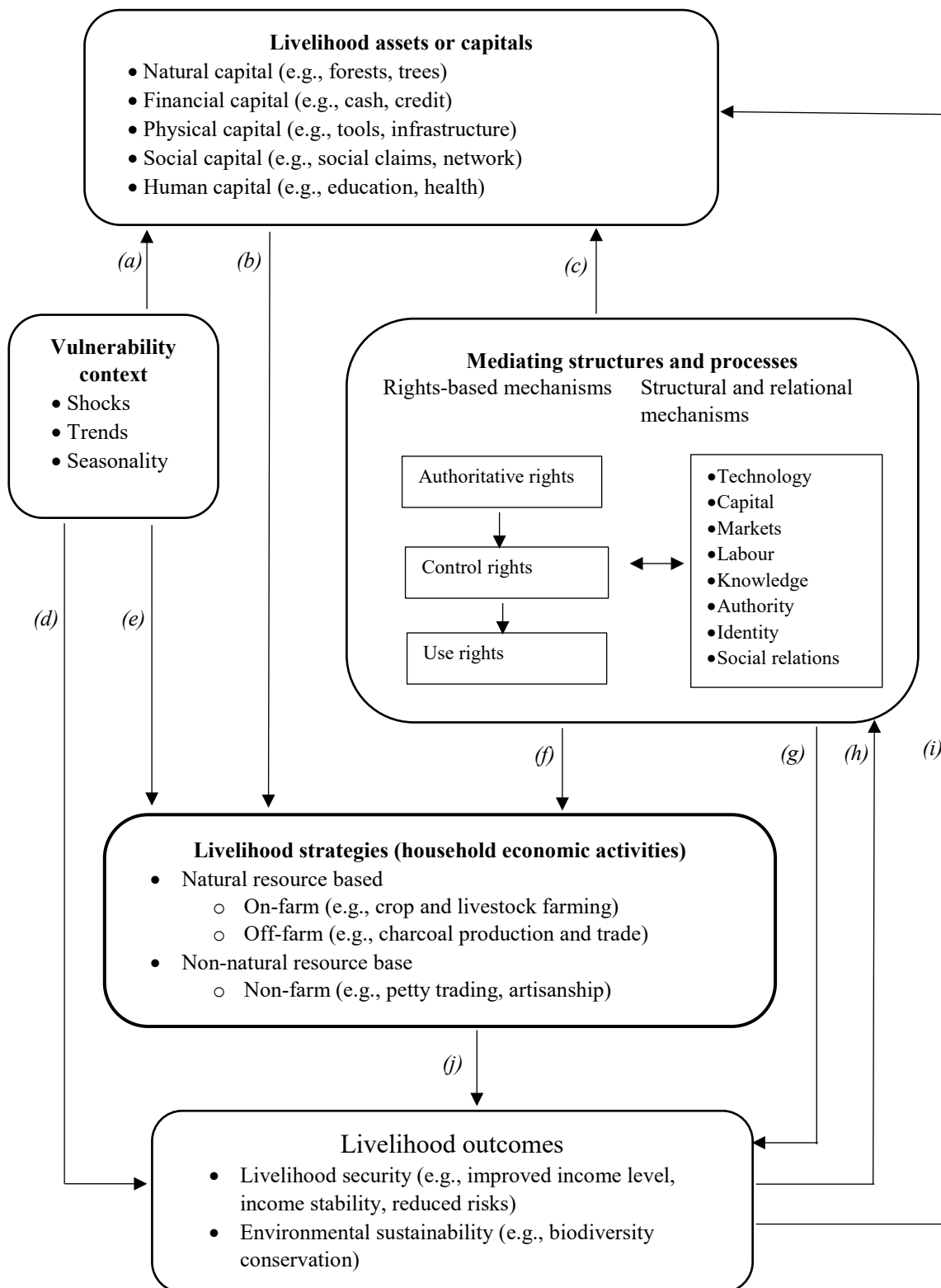


Figure 2. 5 Conceptual framework

Source: adapted from Ellis (2000), Scoones (1998, 2015), Ribot and Peluso (2003) and Sikor *et al.* (2017)

At the centre of the conceptual framework is the economic activities engaged in by rural households. These include on-farm, off-farm and non-farm activities. According to the framework, a household choice to pursue a particular economic activity is influenced by its access to five capitals in the assets section of the framework (arrow *b*), which are in turn mediated by rights-based and structural and relational mechanisms (arrow *f*). Mediating structures and processes invariably affect the capitals (arrow *c*) and livelihood outcome of households (arrow *g*). Exogenous factors such as shocks, seasonality and trends affect the livelihood strategies (arrow *e*), assets (arrow *a*) and livelihood outcome of households (arrow *d*). For example, both natural and man-made disasters such as wildfires, drought and cattle raiding can lead to crop failure which will force farmers to exploit environmental resources to meet subsistence and cash household needs. Finally, a livelihood strategy engaged in by a household also generates a livelihood outcome like livelihood security and environmental sustainability (arrow *j*). The resulting livelihood outcome of a household can consequently influence its capitals through investment in education of household members, financial savings or tree planting (arrow *i*) and the mediating structures and processes (arrow *h*).

The framework also uses a political economy approach to investigate the economic, political and social contexts within which charcoal production and trade occur in Ghana. Political economy analysis does not follow any recognised framework, but studies claiming to be “using a political economy approach” typically attempt to answer questions relating to public policies such as (Stilwell, 2002): what is happening?, why?, who gains?, who loses?, does it matter?, if so, what can be done about it, and by whom? The conceptual framework therefore allows for an in-depth analysis of livelihood. It takes into consideration the long-term, historical patterns of structurally defined relations of power between social groups, of processes of economic and political control by the state and other powerful actors, and of differential patterns of production, accumulation, investment and reproduction across society (cf. Scoones, 2015).

2.3 Definition of Livelihood

Livelihood studies date back to 1820s, to the work of William Cobbett who engaged in what he termed “actual observation of rural conditions” to inform his political campaigns in England (Cobbett, 1885; cited in Scoones, 2015). The connection of the three words “sustainable”, “rural” and “livelihoods” as a term denoting a particular approach was first introduced by the 1987 Brundtland Commission on Environment and Development as a way of linking socioeconomic and ecological considerations in a cohesive, policy-relevant structure (Krantz, 2001; Scoones, 2009). The 1992 United Nations Conference on Environment and Development (UNCED) expanded the concept, especially in the context of Agenda 21, and advocated the achievement of sustainable livelihoods as a broad goal for poverty eradication. It states that “sustainable livelihoods could serve as an integrating factor that allows policies to address development, sustainable resource management and poverty eradication simultaneously” (Krantz, 2001:6). It was however, the influential paper by Chambers and Conway (1992) that threw more light on the Sustainable Livelihood Approach (SLA). They state:

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 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: 7)

Chambers and Conway (1992) explain that the most complex of the various components of a livelihood is the portfolio of assets out of which people construct their living. This portfolio includes tangible assets such as stores (e.g., food stocks, stores of value such as gold, jewellery, cash savings) and resources (e.g., land, water, trees, livestock, farm equipment), as well as intangible assets such as claims (i.e., demands and appeals which can be made for material, moral or other practical support) and access, which is the opportunity in practice to use a resource, store or service or to obtain information, material, technology, employment, food or income. They also distinguish between “environmental sustainability”, which refers to the external impact of a livelihood on other livelihoods, that is, its effects on local and global resources and other assets; and “social sustainability”, which concerns the internal capacity of a livelihood to withstand outside pressure, that is, to cope with

stress and shocks¹⁶ and retain its ability to continue and improve over time. They therefore argue that any definition of livelihood sustainability has to include the ability to avoid, or more usually to withstand and recover from, such stresses and shocks. Scoones (2015) posits that Chambers and Conway's (1992) assertion that livelihoods "must be able to maintain and enhance capabilities and assets into the future" challenges single-sector approaches to solving complex rural development problems, and appeals for a broader perspective of problem solving and understanding from local perspectives. This requirement also directs attention to the links between assets and the options people possess in practice to pursue alternative activities that can generate the income level required for survival (Ellis, 2000).

Scoones (1998) however, finds the definition of livelihood by Chambers and Conway (1992) to be more demanding and modifies it to exclude the requirement that for livelihoods to be considered sustainable they should also "...contribute net benefits to other livelihoods". He states:

A livelihood comprises the capabilities, assets (including both material and social resources) 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, while not undermining the natural resource base. (Scoones, 1998: 5)

Scoones (1998) also develops a framework for analysing sustainable rural livelihoods (Figure 2.1). This framework will be explained in detail in the next section.

Carney (1998) on the other hand argues that livelihood activities must meet both present and future needs to be sustainable. He states:

A livelihood comprises the capabilities, assets (including both material and social resources) 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 both now and in the future, while not undermining the natural resource base. (Carney, 1998: 4)

Ellis (2000) broadens the definition of livelihood to include "access", i.e., ability to benefit from things, as defined by Ribot and Peluso (2003). He argues that the "access" that individuals or households have to the different types of assets or capitals is subsumed in the definitions of Chambers and Conway (1992), Carney (1998) and

¹⁶Stresses are defined as "pressures which are typically continuous and cumulative and therefore to some extent predictable, such as seasonal shortages, rising populations or declining resources", while shocks are "impacts which are typically sudden, unpredictable and traumatic, such as fires, floods and epidemics" (Krantz, 2001).

Scoones (1998). He also argues that the use of the term “capabilities” in the three definitions is derived from Sen (1981) which refers to “the ability of individuals to realise their potential as human beings, in the sense of being (i.e., to be adequately nourished, free of illness, etc.), and doing (i.e. to exercise choices, develop skills and experience, participate socially and so on)”. He therefore finds the use of the term “capabilities” in the three definitions confusing since its meaning overlaps assets and activities.¹⁷ That is, the term confuses process and outcomes, as capabilities as stated at point in time both influence and are influenced by household livelihood strategies as they evolve over time. He defines livelihood as:

A livelihood comprises the assets (natural, physical, human, financial and social capital), the activities and access to these (mediated by institutions and social relations) that together determine the living gained by the individual or household. (Ellis, 2000: 10)

The definition by Ellis (2000) brings out the issue of “access” more strongly than the earlier ones (i.e., Carney, 1998; Chambers and Conway, 1992; Scoones, 1998). It postulates that access to assets or capitals is mediated by institutions and social relations (gender, class, age and ethnicity). It also acknowledges the fact that livelihood construction is an on-going process, and activities may fluctuate seasonally and across years, especially in relation to larger economic trends in the national economy and beyond (Ellis, 2000). This study therefore adapts Ellis’ (2000) definition of livelihood and the definition of access by Ribot and Peluso (2003), and defines livelihood as: “comprising the assets (natural, physical, human, financial and social capitals), the activities, and access to these (mediated by institutions and other structural and relational mechanisms) that together determine the living gained by the individual or household”.

2.4 Literature Review

This section first review studies on reliance on forest and other environmental resources in general and then narrow down to studies related to charcoal. The review starts with studies in other developing countries and are followed with studies conducted in Ghana.

¹⁷ Capabilities strictly refers to “the set of alternative beings and doings that a person can achieve with his or her economic, social and personal characteristics” (Dreze and Sen, 1989).

2.4.1 Environmental Resources-related Livelihood Studies in Developing Countries

Numerous studies have documented the reliance on forest and other environmental resources by rural households in developing countries of Africa, Asia and Latin America (e.g., Cavendish, 2000; Scoones *et al.*, 1992; Shackleton and Shackleton, 2004; Vedeld *et al.*, 2007). The products collected from the forest range from fuelwood (firewood and charcoal), fruits, bushmeat, fodder, medicinal plants and building materials. These serve subsistence needs, provide cash income, serve as income gap fillers¹⁸ and safety-nets¹⁹, and pathway out of poverty (Angelsen and Wunder, 2003; Wunder *et al.*, 2014).

Scoones *et al.* (1992) used literature review and annotated bibliography of close to one thousand references to confirm the role of forest resources in the livelihoods and agricultural systems of households in developing countries of Africa and Asia. They report that the use of forest resources is not the exclusive preserve of “hunting and gathering” society, but are particularly important during major stress periods, such as droughts and famine for most households. Reliance on forest resources was also reported to be significantly important for women, children and the poor. The analysis indicates that forest resources are mostly collected from common property resources and hence access to them is important for sustaining the livelihood of the poor.

Earlier studies on the reliance on forest resources by rural households attempted a partial evaluation. It is the seminal work by Cavendish (2000) that has been credited by many researchers (e.g. Angelsen, *et al.*, 2014; Hansen *et al.*, 2015) as presenting a better data on the contribution of environmental income to rural livelihoods in developing countries. Cavendish (2000) quantitatively surveyed 197 randomly sampled households in 29 villages in Zimbabwe in two different agricultural seasons/years (August 1993 to September 1994, and August 1996 to September 1997) and reports that income from environmental resources accounts for 35% of total household income. Identical questionnaires were administered quarterly for each household for an entire agricultural year. These were supplemented by annual

¹⁸ Gap fillers are means rural household use to generate additional income during periods of low agricultural activities, seasonal food shortages, or the need to generate moderate levels of cash income for expenditures like school fees (Cavendish, 2003).

¹⁹ Safety-nets are the means rural households use to generate additional income after being hit by a shock in the form of loss of assets, income provider or incurring higher expenditures (Angelsen and Wunder, 2003).

questionnaire on household durables, assets and socio-demographics. The study reveals that the share of aggregate environmental income decreases as income rises – i.e., the poor are definitely more resource dependent than the rich. The bottom 20% of the study population generated a sizable 40% or more of their total income from environmental resources, while for the middle three quintiles of the sample (i.e. 20-40%, 40-60% and 60-80%), total environmental income generally comprised 35% of total income or more. It is only for the top quintile that the contribution of environmental income dropped significantly (29%). Socioeconomic variables such as sex and age of individuals, headship and composition of households were identified as affecting use of environmental resources across different households. Female headed households had a small proportion of their income from environmental resources. They received about 45% of their income from remittances that allowed them to purchase more products and collect less from the wild. Divorced or widowed male headed households on the other hand turned to certain environmental resources in order to earn cash to hire labour for firewood collection and water fetching which were regarded as female activities in the study areas. These households generated significant income shares (about 59%) from gold panning and environmental cash income sub-components linked to classic male environmental activities such as carpentry, hunting, fishing and thatching (Cavendish, 2000). Although Cavendish's (2000) study has been credited with providing substantial quantitative information on reliance on environmental resources by rural households, it has a weakness of using only socioeconomic variables to explain the differences between levels of reliance. The influence of institutions on reliance on environmental resources were not investigated in the study.

Fisher (2004) examined the contribution of forest resources to rural poverty alleviation in Malawi by conducting household surveys in 99 households in three villages over a one year period. She reports that forest income accounts for 30% of total rural household income and prevents poverty by reducing measured income inequality by 12%. Asset poor households were found to rely more on forest than asset rich households. Like Cavendish (2000), forest income was second to crop

income²⁰. Fisher (2004) analysed the effect of distance to forest and markets, and the assets possessed by households on forest income, but did not consider how other factors like institutions and vulnerability mediate people's access to the forest.

Babulo *et al.* (2009) conducted household survey in 360 randomly selected rural households in 12 villages in Ethiopia to investigate the role and significance of forest resources in household income, rural poverty and inequality. They report that forest income accounts for 27% of total household income, is second to crop income (which is 43%), and higher than livestock income (16%) which was hitherto thought to be next to crops. Similar to the findings of Cavendish (2000), dependence on forest income decreases with increasing income. For instance, the bottom 25% of households derived 35% of their income from the forest, while the top quartile derives only 23% income from the forests. The study further reveals that incorporating forest income in household accounts reduces rural poverty and income inequality indexes. Unlike Cavendish (2000), data for this study were collected at a single visit to the households. The factors that mediate household access to forest resources were however, not investigated in the study.

Tesfaye *et al.* (2011) used household survey, focus group discussion, principal component and cluster analysis to investigate the effect of participatory forest management on rural income in Ethiopia. They identified five diversification strategies – forest based, crop based, livestock based, business based and diversified strategies – and report that the income available to a household is determined by the type of livelihood strategy a household engages in. These strategies were influenced by access to forest resources, access to sufficient and fertile cropland, altitude and closeness to big towns. The study also reports that most poor households depend on forest resources as their main source of off-farm income and use the cash income from these resources to diversify into other strategies like livestock and business. They however report that, although forest products dependent households were more skilled, they were the poorest in terms of both household assets and total income, and were also food insecure. They collected quarterly data on household's assets and income and village level information such as access to forest resources, credits, roads

²⁰ Cavendish (2000) used environmental resources, which include forest and non-forest products in estimating environmental income, while Fisher (2004) used only forest resources to estimate forest income.

and education. However, the mechanisms households use to access forest resources and the role institutions play in mediating these mechanisms were not assessed in the study. Also, unlike the findings of Cavendish (2000), socio-economic factors like age, sex and adult labour did not influence household income resulting from diversification strategies.

The first meta-analysis on the reliance on forest income by rural households was undertaken by Vedeld *et al.* (2007). The analysis involved 51 case studies in 17 developing countries in Africa, Asia and Latin America. The cases were selected based on their focus on data on household-level forest income, other income sources, productive assets, socio-cultural information and other contextual variables that are likely to influence the use of forest as a source of income. They report that forest income accounts for 22% of total rural household income. Fuelwood and wild foods were the main sources of forest income, and the average household derived around US\$678, out of a total average income of US\$3,043 per year from forest resources. Economic conditions such as distance to markets and income level of households were reported to be the major determinants of reliance of forest income. Long distance to markets was associated with high levels of dependence. Poor households were relatively found to depend more on forests than wealthy households within the same community. Poor communities were also found to depend more on forests than less poor communities. Dependency however, decreased with increasing income.

Vedeld *et al.* (2007) admitted that their meta-analysis had a high degree of methodological pitfalls and weaknesses. They recognise that geographical, economic, socio-cultural or ecological bias within a country, and types of products under scrutiny introduced several sorts of bias in the study. The degree to which individual cases supplied information on the selected variables differed considerably as different objectives and approaches were used for individual case studies (e.g., there is the probability that only communities with high forest dependence were selected in most of the individual case studies). Moreover, unlike Cavendish (2000), who analysed the effects of four socio-economic factors (i.e. sex and age of individuals, and head and composition of household) on forest income, the only economic factor this study analysed was distance to market and its effect on household reliance on forest resources. The role institutions play in mediating access to forest resources and their

effects or outcomes on forest dependent households were also not analysed. These setbacks introduce some ambiguity in the findings and make it difficult to make meaningful policy inferences from this study.

In order to overcome these weaknesses, Angelsen *et al.* (2014) used a set of standardised village and household-level questionnaire to elicit comprehensive data about the importance and role of environmental income²¹ in rural livelihoods. They analysed the role of environmental (i.e. forest and non-forest) income from approximately 8,000 households in 24 developing countries of Africa, Asia and Latin America under the PEN programme and report that forest (or environmental) income accounts for 28% of total rural household incomes. In absolute terms, annual forest income averages US\$ 440 for the global sample, but a large systematic regional variation was observed. For example, forest income constitutes 28.6% of average household income in the 10 Latin American sites, whereas in Asia and Africa, it constituted 20.1% and 21.4%, respectively. Fuelwood was the major forest product and accounted for 35.2% of forest income, and also represented 7.8% of total household income. Asset poor households were reported to be relatively more reliant on forest income. They also report that demographic factors like household size, age, gender and education of household heads were found to affect the level of reliance on forest resources by households. Larger households tend to have lower absolute income, but have higher relative forest income per household. Increasing age of household head reduces total income as well as absolute forest income as older households had accumulated more assets and tend to have higher reliance on crop and livestock income. In addition, older people may be less able physically to access forest resources. Female headed households have lower absolute income, and also lower forest reliance. Households headed by more educated persons have higher total income and lower forest income.

Using the same PEN dataset, Jagger *et al.* (2014) investigated the relationship between forest income and forest tenure characteristics. Their study complements that of Angelsen's *et al.* (2014) by providing insight into the role of forest ownership, the

²¹ Environmental income is defined as “income obtained from extraction from non-cultivated sources”. The term includes natural forests, other non-forest wildlands such as grass, bush, wetlands, fallows and wild animals and plants. Forest income (excluding plantations) and non-forest income combine to make up total environmental income (CIFOR, 2007).

effect of varying levels of forest rule enforcement²², and the degree of overlap between use by formal owners and other resource users (i.e. congruence). They report that state-owned forests account for the majority of forest areas and provide high income than privately and community owned forests. Moderate and high enforcement are both positively associated with income from privately owned forest, but inversely associated with access of households in state-owned forest, thereby reducing forest income. Congruence are associated with lower smallholder forest income, i.e., tenure reforms that seek to eliminate overlapping claims to forest are likely to have negative implications for local people. Jagger *et al.* (2014) acknowledge that their meta-analysis focused on only property rights (i.e., rules, and sanctions), and did not include other structural and relational access mechanisms hypothesised in A Theory of Access by Ribot and Peluso (2003).

2.4.2 Environmental Resources-related Livelihood Studies Conducted in Ghana

The importance of non-timber forest products (NTFPs) in the rural economy of Ghana has been documented by Acheampong (2003) in a one-off livelihood study in three villages (n = 160) in the Western Region. He reports that about 38% of rural households gather and process some types of forest products. He further reports that 37% of the surveyed households collect wild fruits as a coping strategy during crop failure. Property rights were also reported as affecting reliance on forest resources by rural households. The study however, did not collect absolute income data resulting from the harvesting and use of forest resources, but rather asked respondents to estimate the proportion of household income from a range of income choices (e.g., less than 25%, greater than 50%, etc.).

Appiah *et al.* (2007) also investigated the dependence on forest resources by rural households in three forest districts (i.e. Dormaa, Offinso and Begoro) that lie within the high forest zone of Ghana. They collected a one-off data on household income, their sources, demographic characteristics (age, education, household size, farming practices) and off-farm activities in 431 households. They report that forest income accounts for 38% of total rural household income, and was second to agriculture (which accounted for 60% of total household income). These forest income levels are

²² Enforcement is defined as the degree to which sanctions are applied in the event that rules are not followed (Jagger *et al.*, 2014).

higher than two latter studies by Pouliot and Treue (2013) and Hansen *et al.*, (2015) in the Brong-Ahafo and Western Regions of Ghana. While fuelwood was recorded as the dominant forest product relied upon by rural households, bushmeat and wild foods were absent from the list of products unlike the two latter studies. Another surprising finding by Appiah *et al.* (2007) was the fact that although 23% of households engaged in off-farm jobs (income from environmental resources), this contributed only 2% to the total household income. The study did not investigate the factors that mediate access to forest resources by rural households.

The reliance on forests by rural households in an admitted village²³ in a Globally Significant Biodiversity Area (GSBA²⁴) has been assessed by Derkyi *et al.* (2013). They report that 73% of respondents in the community relied to a large extent on the forest for cash and subsistence income. Although the study did not indicate the level of dependence, it reports that the inhabitants have few legal livelihood options due to the restricted access to the forest. The fact that the study was undertaken in an admitted village makes it difficult to extrapolate the findings to communities that live outside or far away from forests.

Pouliot and Treue (2013) provide an income-class specific evidence of the economic importance of forest and non-forest environmental resources on the livelihood of rural households in Ghana and Burkina Faso. Their study forms part of the PEN dataset and distinguished between the role of forest and non-forest environmental income in rural households. They conducted household surveys in 1,014 randomly selected households over a one year period. They report that forest income accounts for a relatively low share of total household income (10%), and did not vary significantly between households belonging to different income quartiles, or between countries. However, non-forest environmental income contributes a significant 30% and 35% to total incomes of poorer households in Ghana and Burkina Faso respectively, and 9-10% for richer households in the two countries. On average, forest and non-forest environmental income jointly accounts for 28% of total household income in Ghana. The high reliance on non-forest versus forest resources by rural households was attributed to the restrictive and inequitable forest polities in the two countries that

²³ Admitted village is a community situated inside a forest reserve.

²⁴ GSBA is an area of forest set aside for preservation and biodiversity conservation. Forest management practices like harvesting, plantation, and NTFPs collection are not allowed in a GSBA.

make it difficult for households to access forest resources from state-owned forest (Pouliot *et al.*, 2012). Pouliot and Treue (2013) also report that reliance on forest and non-forest environmental products is affected by gender. For example, women collect few products from forests, but more products from non-forest environmental resources. Additionally, wild foods and construction materials which bring higher income to households in both countries are collected mostly by men. Resource extraction was also found to be a common way of coping with the cost of illness among rural households.

Hansen *et al.* (2015) used the PEN dataset by Pouliot and Treue (2013) to assess the implication of social safeguards in the Ghana-European Union Voluntary Partnership Agreement on rural livelihoods. The study focused mainly on the contribution from timber in the Brong-Ahafo and Western Regions of Ghana. They report that forest income accounts for 25% of total household income, and is second to crop income. They further report that forest and environmental income contribute as much as or more than crop income to total household income for the poorest income quartile. Additionally, the study did not find the use of environmental products as a coping strategy.

2.4.3 Comparison of Environmental Resources-related Livelihood Studies Conducted in Ghana with other Developing Countries

A comparison of the studies undertaken in Ghana with those from other developing countries reveals the following similarities in research designs, results and conclusions:

- i. All studies report that forest income contributes significantly to total household income (25-38%), and is second to crop income.
- ii. Most studies (exceptions being Hansen *et al.* 2015; Pouliot and Treue, 2013) report that reliance on forest income decrease with increasing income.
- iii. Fuelwood, bushmeat, wild fruits and construction materials are the dominant products collected from the forest and non-forest environmental sources.
- iv. The household was used as the unit of analysis in all studies.
- v. Random sampling was used in selecting households (primary respondents) in all studies and the representativeness ranged from 10-14%.

- vi. Most of the studies (exceptions being Cavendish, 2000; Hansen *et al.* 2015; Pouliot and Treue, 2013) collected snapshot data and did not consider the effects of seasonality on forest income.
- vii. Most of the studies (exceptions being Acheampong, 2003; Jagger *et al.*, 2014) did not investigate the role institutions play in mediating access to forest resources.
- viii. The role of forest income in rural poverty alleviation has been investigated in other developing countries (e.g., Babulo *et al.*, 2009 in Ethiopia), but not in Ghana.
- ix. None of the studies investigated other mechanisms besides property (i.e., structural and relational mechanisms) that social actors use to gain, maintain and control benefits to forest and other environmental resources.

2.4.4 Charcoal and Livelihood Studies in Developing Countries

Most of the studies on reliance of forest products in developing countries of Africa, Asia and Latin America (e.g., Angelsen *et al.*, 2014; Hansen *et al.*, 2015; Pouliot and Treue, 2013; Vedeld *et al.*, 2007) mention fuelwood (firewood and charcoal) as the dominant product relied upon by many rural households. Small volumes of fuelwood are used as firewood to meet the energy needs (cooking and heating) of rural households, while larger volumes are used to produce charcoal for sale mostly in urban areas (Zulu and Richardson, 2013). Rural households therefore rely more on income from charcoal than firewood as charcoal is the preferred fuel in urban areas due to its high calorific value per unit of weight, ease of transportation and comparatively less smoke emission during use (Arnold *et al.*, 2006; Beukering *et al.*, 2007).

The charcoal sector is also reported to contribute significantly to the macro economy of developing countries through poverty reduction, employment creation and household income generation (Angelsen and Wunder, 2003; Butz, 2013; Coomes and Butz, 2001; Fisher, 2004; Jones *et al.*, 2016; Khundi *et al.*, 2011; Ndegwa *et al.* 2016; Smith *et al.*, 2017). Opportunities in the sector are increasing and have been projected

to grow. The sector creates 200 to 350 job-days per Terajoule (TJ)²⁵ consumed, compared to 80-110 for electricity, 10-20 for LPG and 10 for kerosene (ICRAF, 2002). An estimated 92,800 people are employed by the charcoal sector in Malawi (Kambewa *et al.*, 2007). Income from these people contributes 3.5% of the country's gross domestic product (Zulu, 2010). The World Bank estimates the contribution of the charcoal sector to Tanzania's economy to be US\$650 million per annum – this is 5.8 times the country's combined value of coffee and tea production (World Bank, 2009). In Kenya, Sepp (2008, cited in World Bank, 2009) estimates the charcoal sector to provide employment to about 700,000 people from both rural and urban areas. An estimated 200,000 people depend on charcoal as a permanent source of income in Uganda (ESD, 2007, cited in World Bank, 2009), while about three million people (equivalent to 15% of the country's population) are estimated to be employed by the charcoal sector in Mozambique (Cuvilas *et al.* 2010).

Investigating the nature, role and economic importance of charcoal production among forest peasants in the Amazonian river community in Peru, Coomes and Butz (2001) report that charcoal production contributes 46% of total household income. They also report that differential access to intra- and extra-household labour explained variations in household output of charcoal. The study used household survey to collect data on household economic activities, demographic composition, and access to land, labour and capital. The study however, used a small sample size (n=36) and also interviewed only charcoal producing households.

Khundi *et al.* (2011) investigated the relationships among income, poverty and charcoal production in Uganda and report that participation in charcoal production is influenced by household demographic characteristics – i.e., charcoal producing households were far more likely to be headed by males and have significantly younger heads than their non-producing cohorts. In terms of assets, charcoal producers owned a significantly less valuable set of productive assets than non-participants. On average, charcoal producers had slightly smaller farms than their non-producing cohorts on both an aggregate and per adult equivalent basis. However, charcoal producers had significantly higher total and per adult equivalent income than non-

²⁵ 1TJ is equivalent to 1,010 standard bags of charcoal. According to the FAO (2007) 1kg of charcoal is equivalent to 30 MJ, and a standard bag of charcoal (i.e. 50kg sugar bag) weighs 33kg. Hence 1 bag of charcoal produce 990MJ or 0.00099 TJ of energy.

producers. They also report that both absolute and income share from charcoal production increase with increasing total household income. Compared with non-producers, charcoal producers had a lower incidence of poverty²⁶, less extreme poverty and less severe poverty. Charcoal production was also reported to be higher in localities near roads, forests and woodlots. Khundi *et al.* (2011) conducted household survey (n = 284) in 12 villages in three charcoal producing districts of Western Uganda using propensity score matching²⁷ techniques.

Ainembabazi *et al.* (2013) also investigated the factors that determine participation and income from charcoal production in Uganda. Like Khundi *et al.* (2011), they report that participation in charcoal production has positive effect on household income, and younger household heads and those with few assets turn to produce charcoal than older household heads and those with more assets. They also report that charcoal production has the potential to lift households out of poverty. The study used purposive random sampling to interview 300 households in 12 villages, semi-parametric method to determine the determinants of charcoal production and a regression decomposition to measure the heterogeneous effect on household income. The contribution of other economic activities undertaken by sampled households are however, not reported in the study.

Schure *et al.* (2014) empirically analysed the contribution of fuelwood to rural livelihoods and poverty reduction among producers in the Democratic Republic of Congo (DRC) and reported that fuelwood income contributes significantly to rural household income. Although the study does not indicate the relative contribution of fuelwood income to other income sources like agriculture (which was identified to be the most important economic activity in the study areas), it reports that on average, firewood contributes 30%, while charcoal contributes 57% to household income. They also report that charcoal production offers a higher profit than firewood. Like Ainembabazi *et al.* (2013) and Khundi *et al.* (2011), reliance on charcoal is reported to increase with increasing income. In terms of poverty mitigation and reduction, the

²⁶ Khundi *et al.* (2011) classified households as “poor” if income per adult equivalent fell below Ugandan poverty line of \$1.25/day, and “not poor” if income per adult equivalent exceed this amount. Participation in charcoal production reduced the incidence of poverty by 14%.

²⁷ Propensity score is defined as the probability of treatment assignment conditioned on observed baseline covariates. Propensity score matching entails forming matched sets of treated and untreated subjects who share a similar value of the propensity score (Rosenbaum and Rubin, 1983).

study reports that producers use income from fuelwood to meet basic needs like food, education and healthcare, and also provide capital for investment in activities like agriculture, petty trading, livestock and fishing. Income from charcoal is also reported to be used as household saving account²⁸, which is mainly spent for coping with shocks (e.g. family issues, sickness and funerals), rather than for asset accumulation. The study used structured questionnaire to gather data on economic, social and environmental characteristics of 1,074 fuelwood producers who were randomly selected from 52 villages around Kinshasa (the capital) and Kisangani Provinces. Monthly records of costs, prices and production volumes were collected over a one year period. This was backed with in-depth semi-structured interviews and group interviews in 12 villages in the supply zones to collect data on saving and spending patterns of households. The contribution of other economic activities undertaken by the sampled households are however, not reported in the study.

Several studies have investigated the factors that motivate households to produce charcoal. According to Butz (2013), poverty compels pastoralist women in Tanzania to produce charcoal – they use charcoal income to buy food and clothing for their families, and also pay school fees for their children. Jones *et al.* (2016) report that some rural women in Mozambique use charcoal income as a means of working capital for farming and trading to gain financial freedom from their husbands. Additionally, the need for supplementary household income (Arnold *et al.*, 2006), working capital for other economic activities like farming or trading (Shackleton and Shackleton, 2004), means to get out of poverty (Zulu and Richardson, 2013), insurance or safety-net in times of financial hardship (Arnold *et al.*, 2006; Shackleton and Shackleton, 2004); and the higher prices and/or ready market for charcoal (Kambewa *et al.*, 2007; Mombu *et al.*, 2007; Obiri *et al.*, 2014), have all been reported as factors that motivate households in Ghana and other SSA countries to engage in charcoal production.

2.4.5 Charcoal and Livelihood Studies in Ghana

Nketiah *et al.* (1988) conducted the first nationwide baseline study on charcoal in Ghana and report that charcoal is the predominant fuel for 69% of urban households and the purchase of charcoal constitutes about 10% of the daily household budget of

²⁸ The study indicates that significant portions of charcoal income is saved by all income class (about 60% of households) in the form of buying and later reselling of telephone cards and informal money lending (Schure *et al.*, 2014).

consumers. They also report that about 79% of charcoal is supplied from the savannah ecological zone where most producers consider charcoal production as a full time business and depend entirely on it as a source of livelihood. The traditional earth mound method is reported as the main method of production and medium and heavy trucks are the main means of transporting charcoal to the urban centres. The study utilised field visits, measurement and interview of actors along the charcoal commodity chain (especially transporters and consumers), but did not quantitatively investigate the income from charcoal production and trade.

Mombu *et al.* (2007) studied the charcoal trade and economic linkages in the forest-savannah transition zone of Ghana with field surveys, stakeholder interviews and discussions in 22 communities in the Nkoransa, Kintampo North, Kintampo South, Wenchi and Tain districts of the Brong-Ahafo Region of Ghana. The study reports of three categories of charcoal producers in Ghana. The first category involves immigrants mostly from the Sissala tribe known as “gangs” who pay for trees from chiefs and land owners. They are the leading producers of charcoal and produce it on full time basis. The second category involves indigenes from communities who are farmers and often have free access to trees. Most people in this category produce charcoal as a supplementary income to their agricultural activities. The third category, the smallest in terms of volumes, consists of producers who may be indigenes or settler farmers who produce charcoal on seasonal basis. They mostly use wood resulting from land preparation for farming and yam stakes to produce charcoal and can be described as opportunistic charcoal producers. The study also reports that District Assemblies obtain substantial revenue from charcoal trade. Producers are also reported to be making little profit compared to middlemen. The study did not however, quantitatively investigate the contribution of charcoal income to the livelihoods of the three categories of producers.

Blay *et al.* (2007) corroborate the findings of Nketiah *et al.* (1988) that charcoal production is considered a full-time activity in the transition zone of Ghana in a study that assessed the role of charcoal production in the livelihood of producers. They report that 80-100% of producers depend entirely on charcoal income as their sole source of livelihoods. The youth (aged 30-39) dominates the group of people that depend entirely on charcoal income. They used face-to-face interview with 57

randomly selected respondents from six villages and focus group discussion to collect one-off data in the Kintampo and Afram Plains Districts of the Brong-Ahafo and Eastern Regions respectively. The proportion of charcoal income to the total household income in the study were however, estimated from income ranges provided by the researchers for the respondents to choose from. Such estimations, as already indicated may lead to over- or under-estimation of income.

Agyemang *et al.* (2012) assessed the role of charcoal production on household income of producers and other actors of the charcoal commodity chain in the Upper West Region of Ghana. They report that charcoal producers earn an average income of GH¢2400.00 annually (equivalent to US\$1,263.16²⁹) – this is four times the region’s mean annual household income of GH¢ 606.00 (equivalent to US\$ 318.95) and twice the national average of GH¢1217.00 (equivalent to US\$ 640.53) from employment, agriculture and non-farm activities, rents, remittances, etc. (GSS, 2008). Lurumuah (2011) using the same dataset report that producers use charcoal income to buy assets such as bicycles, motor bike, roofing sheets and livestock; and other consumable goods like foodstuffs, clothing, sanitary facilities and educational material for children. The study used interviews and focus group discussions from 500 producers, 10 transporters and 50 buyers. It did not however, consider the contribution of other economic activities like farming and livestock to the total household income. The effect of seasonality on charcoal income was also not considered as data were collected at a snapshot.

Obiri *et al.* (2014) has investigated the economic contribution of charcoal income among various actors of the charcoal commodity chain in Ghana. They report that 35% of producers depended entirely on charcoal for their livelihood, 64% combined it with agriculture, and 1% combined it with petty trading. They also report that charcoal production is one of the most remunerative forest related activities and constitutes a major source of income and employment among the respondents. They randomly selected and interviewed 204 producers, 32 transporters and 82 marketers (n = 318 actors) in the Afram Plains and Ejura-Sekyeredumasi districts of the Eastern and Ashanti Regions of Ghana respectively. Similar to Blay *et al.* (2007), the study did not use absolute income data to estimate the contribution of charcoal income to

²⁹ US\$ 1 was equivalent to GH¢ 1.90 in 2012

total household income, but asked respondents to recall economic activities they were engaged in and the associated costs and revenue.

The contribution of charcoal production to rural household income in sections of the study area of the current study (i.e., the Kintampo North District) has been assessed by Aabeyir *et al.* (2016). They report that charcoal production is considered a full time activity, and on average accounts for 93% of total household income. Farming is reported as second and accounts for the remaining 7%. Their sampling was biased towards perceived major charcoal producing households and also used a small sample size ($n = 60$). Their finding therefore contradicts an earlier study by Amanor *et al.* (2005) in the same district who report that farming is the major occupation and that charcoal producers mostly rely on harvested wood in the farming system to produce charcoal. Like the earlier studies in Ghana, Aabeyir *et al.* (2016) also did not measure actual charcoal income, but asked respondents to choose from a range of income choices.

Agyei *et al.* (2018) describe the characteristics, quantity and profits of social actors along the charcoal commodity chain in Ghana. They estimate that charcoal production and trade provide employment to 90,000 people and about US\$ 66 million is generated annually from charcoal production and trade in Ghana. The profit is highly skewed with 22% going to merchants who make up only 3% of the social actors. They also conducted their study in three communities within the study area of the current study, used commodity chain analysis, and estimated the net profit of actors by deducting their total cost from total income. The study however, does not compare charcoal income to income from other household economic activities.

2.4.6 Comparison of Charcoal Studies Conducted in Ghana and other Developing Countries

A comparison of the studies that link charcoal production to livelihoods that were conducted in Ghana with those conducted in other developing countries shows the following:

- i. All studies report that charcoal production is an important livelihood option for rural households.
- ii. Most of the studies conducted within and outside Ghana (exceptions being Ainembabazi *et al.*, 2013; Khundi *et al.*, 2011; Schure *et al.*, 2014) did not

measure actual income, but used income ranges to arrive at their conclusions. In the case of Ghana, Agyemang *et al.* (2012) is the only study that measured actual income from charcoal.

- iii. All studies conducted in Ghana sampled only charcoal producers and did not measure other economic activities households engage in. Ainembabazi *et al.* (2013) and Khundi *et al.* (2011) on the other hand included both charcoal- and non-charcoal-producing households in their sample in Uganda.

2.4.7 Charcoal and Related Policies

Charcoal production is deemed destructive to the environment. Governments in most charcoal-producing countries in SSA have therefore enacted policies that are aimed at addressing the adverse impacts of charcoal production on the environment. The policies range from substitution of charcoal with LPG, improved carbonisation techniques, formalisation and regularisation of the charcoal sector and outright ban on production and trade. Schure *et al.*, (2013) report that permits and quota systems are used to regulate the charcoal sector in Central (e.g., Cameroon, Central Africa Republic, Congo and DRC) and West Africa (e.g., Burkina Faso, Mali, Niger and Senegal). The regulations are however, weak and ineffective due to uncoordinated regulatory framework and poor implementation of the permit system (Ibid). Smith *et al.* (2015) also report that legislations introduced to regulate the charcoal sector in Malawi are effective and have led to criminalisation of charcoal-related livelihoods. Lack of political will and uncoordinated institutional arrangement within the charcoal sector in Tanzania have been reported as militating against the sector reforms in the country (Sander *et al.*, 2013; World Bank, 2009).

In Ghana, three statutory institutions, namely, the Energy Commission, Environmental Protection Agency and the Forestry Commission, have oversight responsibilities over the charcoal sub-sector. The Forest and Wildlife Policy of 2012, Climate Change Policy and the Woodfuel Policy component of the Draft Bioenergy Policy are used to address the sub-sector. The Forest and Wildlife Policy aims at making charcoal production sustainable by promoting the establishment of commercial and smallholder woodfuel plantations (or woodlots) to supplement feedstock for producing charcoal (MLNR, 2012a). The Climate Change Policy aims at improving the conversion efficiency of the carbonisation process by promoting the

use of improved kilns among charcoal producers (MESTI, 2012). The Woodfuel Policy component of the Draft Bioenergy Policy contains the most comprehensive strategies on charcoal. Its objectives include promotion of woodlots, improvement in conversion efficiency of charcoal carbonisation, improvement in transport, marketing and packaging of charcoal, and strengthening of institutional and regulatory framework within the charcoal sector (Energy Commission, 2010). Studies on the mediating roles of both customary and statutory institutions in the charcoal sub-sector are limited in Ghana.

2.5 Heckman Model

Heckman (1979) introduced the Heckman two-staged model to resolve potential biases that result from truncated samples. Truncated samples exist when the values of the independent variable(s) are unknown because the dependent variable is unobserved for part of the relevant population (Wooldridge, 2010). This normally occurs when a researcher examines a subset of a population. Analyses based on such samples are not generalised to the entire population. Heckman (1979) used the decision of women to work to develop the model. According to Heckman (1979), the sample of observed wages is biased upward when women who would have low wages may be unlikely to choose to work. That is, women choose not to work when their personal reservation wage is greater than the wage offered by employers.

The Heckman model allows simultaneous estimation of factors that influence decision of households to self-select into an economic activity (e.g., charcoal production), as well as the factors that determine the success or outcome of that activity. The model consists of an integrated two-part estimation of selection into the activity and its outcome, which overcomes common issues of endogeneity arising from sample selection in other models. Heckman (1979) notes that when observing households' income-generating activities, the observer only observes effort and outcome of those that self-selected into that activity. The potential outcome of others may not be zero, had they selected into the activities, and thus, the estimation must account for this.

CHAPTER THREE

3.0 THE ECONOMIC IMPORTANCE OF CHARCOAL TO RURAL LIVELIHOODS: EVIDENCE FROM A KEY CHARCOAL-PRODUCING AREA IN GHANA

This chapter has been published as a paper in the *Forest Policy and Economics* journal as:

Brobbey, L.K., Hansen, C.P., Kyereh, B., & Pouliot, M. 2019. The economic importance of charcoal to rural livelihoods: Evidence from a key charcoal-producing area in Ghana. *Forest Policy and Economics*, vol. 101, pp. 19-31.

Abstract

Charcoal is the main source of energy for urban households and a key source of income for rural households in many developing countries. We used survey data from 400 charcoal- and non-charcoal-producing households and results from participatory rural appraisals to demonstrate the economic importance of charcoal to rural livelihoods in a key charcoal-producing area in Ghana. Income from charcoal is the second-most important source of income, after crops. Contrary to findings of previous studies, high-income households obtain higher income from charcoal than do low-income households. We quantify charcoal's role as a cash income provider and found it to be the highest source of cash income to rural households. We find trading in charcoal to provide substantial income to rural households, albeit for a small section of our sample population. We also demonstrate the important role of charcoal as seasonal income gap-filler and as safety-net for households that face economic shocks. Low-income households use charcoal to fill seasonal income gaps because they do not have other sources of income, or their sources of income are not sufficient at certain periods of the year. High-income households on the other hand seasonally produce charcoal when it becomes more profitable. Although rural households use multiple strategies to cope with economic shocks, charcoal production appears to be a dominant strategy. Albeit an important source of income for many households in the study area, the highest income levels are obtained by the relative few members involved in charcoal business/trade. In view of this and a projected increase in charcoal consumption in Ghana and throughout sub-Saharan Africa and indications of a dwindling resource base, there is an urgent need for careful policy interventions to secure both the economic and environmental sustainability of charcoal production.

Key words: Charcoal; Ghana; Household income; Safety-net; Seasonal income gap-filler; Sub-Saharan Africa

3.1. Introduction

Charcoal is the main source of energy for heating and cooking for most urban households in many developing countries (Arnold *et al.*, 2006; IEA, 2014; Zulu and Richardson, 2013). It is preferred to firewood due to its high calorific value per unit of weight, ease of transportation, and comparatively less smoke (Beukering *et al.*, 2007), and its production continues to rise due to preferences and demands of increasing urban populations in many sub-Saharan African countries (IEA, 2014). In addition to the provision of energy, the charcoal sector contributes significantly to the economy of developing countries through poverty reduction, employment creation, and household income generation. Charcoal creates between 200 and 350 job-days per Tera joule consumed, compared to 80 to 110 for electricity, 10 to 20 for liquefied petroleum gas (LPG), and 10 for kerosene (ICRAF, 2002). It is estimated to contribute US\$650 million per annum to the Tanzanian economy, approximately six times the combined value of coffee and tea (World Bank, 2009). In Malawi, it is estimated to contribute 3.5% of the gross domestic product (Zulu, 2010).

Many narratives are associated with charcoal production and its impacts on livelihood and the environment. Charcoal production has frequently been associated with deforestation and forest degradation (FAO, 2017) and emerging “fuelwood crisis” scenarios (Eckholm, 1975), which has led to (temporary) bans on production and efforts to substitute charcoal with LPG or electricity (Arnold *et al.*, 2006; Ribot, 1998, 1999; Smith *et al.*, 2015). With regard to its livelihood impacts, charcoal production has been portrayed as a business for the poor; the producers are depicted as uneducated and lacking access to alternative income (Vos and Vis, 2010), productive land, assets, and markets (Zulu and Richardson, 2013).

Recent studies have, however, portrayed charcoal production as an important livelihood option for rural households (Agyemang *et al.*, 2012; Ainembabazi *et al.*, 2013; Butz, 2013; Coomes and Butz, 2001; Jones *et al.*, 2016; Khundi *et al.*, 2011; Obiri *et al.*, 2014; Schure *et al.*, 2014; Smith *et al.*, 2017). For example, Obiri *et al.* (2014), report that 35% of the study population from the forest savannah transition zone of Ghana depended entirely on charcoal for household income, while 64% combined it with agriculture, and the remaining 1% combined it with petty trading. In the Democratic Republic of Congo (DRC), Schure *et al.* (2014) report that charcoal

contributed 57% of total rural household income in the study population. Similarly, 35% of charcoal producers in a study population from Mozambique relied entirely on charcoal for household income (Jones *et al.*, 2016). Charcoal income fills seasonal income gaps, provides a safety-net against economic shocks, and contributes to poverty alleviation in rural areas (Fisher, 2004; Jones *et al.*, 2016; Khundi *et al.*, 2011; Schure *et al.*, 2014; Smith *et al.*, 2017). Some rural households use charcoal income as working capital for other economic activities, such as farming or trading, while some women in Mozambique use charcoal production as a means of gaining financial freedom from their husbands (Jones *et al.*, 2016). In Tanzania, Butz (2013) reports that pastoralist women use charcoal income to purchase food and clothing for their families and also to pay school fees for their children.

Most studies (e.g., Aabeyir *et al.*, 2011; Agyemang *et al.*, 2012; Blay *et al.*, 2007; Obiri *et al.*, 2014; Schure *et al.*, 2014; Smith *et al.*, 2017) have estimated the contribution of charcoal to household income from perceived share of overall income. We suggest that this approach is inaccurate, as households may face difficulties accurately estimating such a share in commonplace diverse livelihood portfolios comprising both cash and subsistence income. It may lead to both over- and underestimation of the contribution of charcoal. The studies noted also did not consider all other sources of household income. Finally, those studies that attempt a more precise quantification typically have very small sample sizes ($n < 100$) and sampled only charcoal producers, thereby restricting the possibility for generalisation (e.g., Coomes and Butz, 2001).

The aim of our study is to contribute towards the investigation on the economic importance of charcoal to rural households in developing countries through a detailed, quantitative study in a key charcoal-producing area in Ghana. The specific objectives are to empirically: (i) ascertain the sources of rural household income and their relative importance in a key charcoal-producing area; (ii) ascertain the role and importance of charcoal to subsistence and cash income, respectively; and (iii) investigate the seasonal income gap-filling and safety-net functions of charcoal to rural households. Data for the study were collected through household survey involving 400 randomly selected charcoal- and non-charcoal-producing households and participatory rural appraisal methods, seasonal calendar and resource map.

3.2 Methods

3.2.1 Study Area

The study was conducted in the Kintampo Forest District (Figure 1.1). This site was chosen because it is the largest charcoal-producing area (“hotspot”) in the country, estimated to account for 22% of the total volume of charcoal produced in Ghana (Nketiah and Asante, 2018). Production of charcoal takes place in almost all communities in the district (Aabeyir *et al.*, 2011; Amanor *et al.*, 2005). The forest district comprises four local government units: Kintampo North Municipality, Kintampo South District, Nkoransa North District and Nkoransa South Municipality. Moreover, the study area falls under three traditional (customary rule) areas; these are Nkoransa, Drumankese and Mo traditional areas. Agriculture is the major economic activity, with yam, maize, rice, ground nut, beans and mango being the dominant crops planted in the area (GSS, 2014).

Located between latitude 7°30' and 8°45' North, and longitude 2°0' and 1°15' West, the district falls within the forest savannah transition zone, whose vegetation is characterised by a mixture of trees, shrubs, and tall grasses (SRID, 2011). The area supports a natural vegetation of tree species with high wood densities preferred for charcoal production because of high calorific values (Korang *et al.*, 2015, Obiri *et al.*, 2014). The zone has a bimodal rainfall regime that gives rise to major and minor agricultural seasons. The minor rains fall between April and July, with major rains in September and October. The average temperature and rainfall are 26.1°C and 1,345 mm, respectively (Climate.data.org, 2017). Most tree species in the area are fire resistant and regenerate vigorously through coppicing (Amanor *et al.*, 2005).

Three categories of charcoal producers have been identified in the forest savannah transition zone: (i) full time producers who are largely migrants who move from community to community in search of wood for charcoal production; (ii) part time producers who may be indigenes or settler farmers who combine charcoal production with farming; and (iii) occasional producers who may be either indigenes or settler farmers who produce charcoal on seasonal basis, especially during the off-agricultural season (Amanor *et al.*, 2005; Mombu *et al.*, 2007). The third group may be described as opportunistic producers. The producers normally source trees from farm and fallow

lands (Aabeyir *et al.*, 2016; Amanor *et al.*, 2005). Charcoal from the area is normally sold in three major cities of Ghana: Accra, Kumasi and Takoradi (Agyei *et al.*, 2018; Obiri *et al.*, 2014).

Ten communities within the district were purposefully selected for the study. They were selected with the aim of having communities with different levels of accessibility (good, fair and poor), statutory and traditional authority, facilities and infrastructure in the sample (Table 3.1). Good accessibility was operationalised as communities located along major roads with tarmac and which are easily accessible by all types of vehicles at all times of the year. Fair accessibility communities are located along non-tarmac feeder roads and are accessible by all types of vehicles in the dry season. Accessibility is, however, fairly difficult with non-four-wheel-drive vehicles in the wet season in fair accessibility communities. Finally, poor accessibility communities are located along non-tarmac feeder roads, but are very difficult to access with non-four-wheel-drive vehicles in the wet season, due to the absence of maintenance and broken bridges. Communities that, to our knowledge, had engaged in previous charcoal-related research were excluded, to avoid the risk of research fatigue and biases this might cause. The number of sampled households within each community was determined with the aim of sampling approximately 30% of houses based on the 2010 population and housing census provided by the Ghana Statistical Service (cf. Angelsen *et al.*, 2011; Neuman, 1991).

Table 3. 1 List and basic characteristics of survey communities

| Community | District/Municipal Assembly | Traditional Authority | Population | Accessibility | Charcoal-producing households | | Total no. of sampled households |
|-------------|-----------------------------|-----------------------|------------|---------------|-------------------------------|-----|---------------------------------|
| | | | | | Yes | No | |
| Asantekwaah | Kintampo North | Mo | 1,586 | Good | 26 | 19 | 45 |
| Bomini | Nkoransa North | Nkoransa | 2,656 | Fair | 18 | 24 | 42 |
| Bonte | Nkoransa North | Nkoransa | 3,299 | Fair | 15 | 26 | 41 |
| Cheranda | Kintampo North | Mo and Nkoransa | 472 | Good | 26 | 7 | 33 |
| Drumankese | Nkoransa North | Drumankese | 8,179 | Fair | 38 | 24 | 62 |
| Gulumpe | Kintampo North | Gonja ³⁰ | 5,681 | Good | 50 | 10 | 60 |
| Kunsu | Kintampo North | Nkoransa | 1,306 | Poor | 21 | 10 | 31 |
| Mansie | Kintampo South | Mo | 1,476 | Fair | 17 | 12 | 29 |
| Miawani | Kintampo North | Nkoransa | 596 | Poor | 26 | 4 | 30 |
| Sabule | Kintampo South | Mo | 1,099 | Fair | 13 | 14 | 27 |
| Total | | | | | 250 | 150 | 400 |

Source: Population data are based on 2016 data provided by the Ghana Statistical Service

³⁰ Gulumpe is officially under the Nkoransa Stool (GSS, 2014), but the inhabitants pledge allegiance to the Gonja chief and therefore have different customary practices.

3.2.2 Sources and Methods of Data Collection

We adapted the PEN questionnaire (CIFOR, 2008) for the study. Definition of household³¹ followed prescriptions in the PEN technical guidelines (CIFOR, 2007). Lists of unprocessed and processed environmental products and agricultural crops in the area were initially generated from literature and key informants in December 2016. These lists were pretested in two charcoal-producing communities in the district (i.e., Nante and Kawumpe) through a household survey in January 2017. The list was adjusted to include products that were not in the initial list and the units of measurement revised accordingly.

Village meetings were held with chiefs and other village officials (e.g., assembly and unit committee members),³² in all 10 communities, to explain the purpose of the study and to seek their permission to carry out the research within the communities. Two participatory rural appraisal (PRA) methods namely, seasonal calendar and resource map, were used to obtain first-hand information on the lists of all income-generating products cultivated and collected from the wild, and employment and migration opportunities in each community (Chambers and Conway, 1992). Information on the changing pattern of natural resources in the communities; the times/seasons community members engage in farm and off-farm activities; the risks, shocks and vulnerabilities communities are exposed to; and the daily wages for unskilled labour were also collected through the PRAs. On average, 11 people, comprising two elderly (age 40+) males, two elderly females, two young (age 18-40) males, two young females, two unit committee/assembly members, and the local chief or his representative were involved in the PRAs.

The sample drawn for quantitative data collection comprised 400 randomly selected households. Due to lack of reliable (up-to-date) lists of households in the study communities, random selection was ensured by dividing each community into six sections/strata (Figure 3.1). The main road running through each community was used first to divide the community into two parts. Each half was further stratified into three

³¹A household is defined as a group of people (normally family members) living under the same roof and pooling resources (labour and income). Labour pooling means that household members exchange labour time without any payment, for example, on the farm. Income pooling means that they “eat from the same pot,” although some income may be kept by the household member who earns it (CIFOR, 2007).

³²Elected representatives of local government.

on the basis of distances to the dividing road, – houses near to the road, houses in the middle of the community, and houses far from the road. The number of households interviewed ranged between 30 households in small communities and 60 in large; see Table 3.1. The number was equally distributed across strata. Within each stratum, households were identified by randomly selecting a first house for interview, then skipping the next two or three houses before the next household was selected to ensure better coverage. The interviews were conducted in early mornings (6-9am) and late afternoons (4-6pm), when most community members were in their homes, and were restricted to one household per house.³³

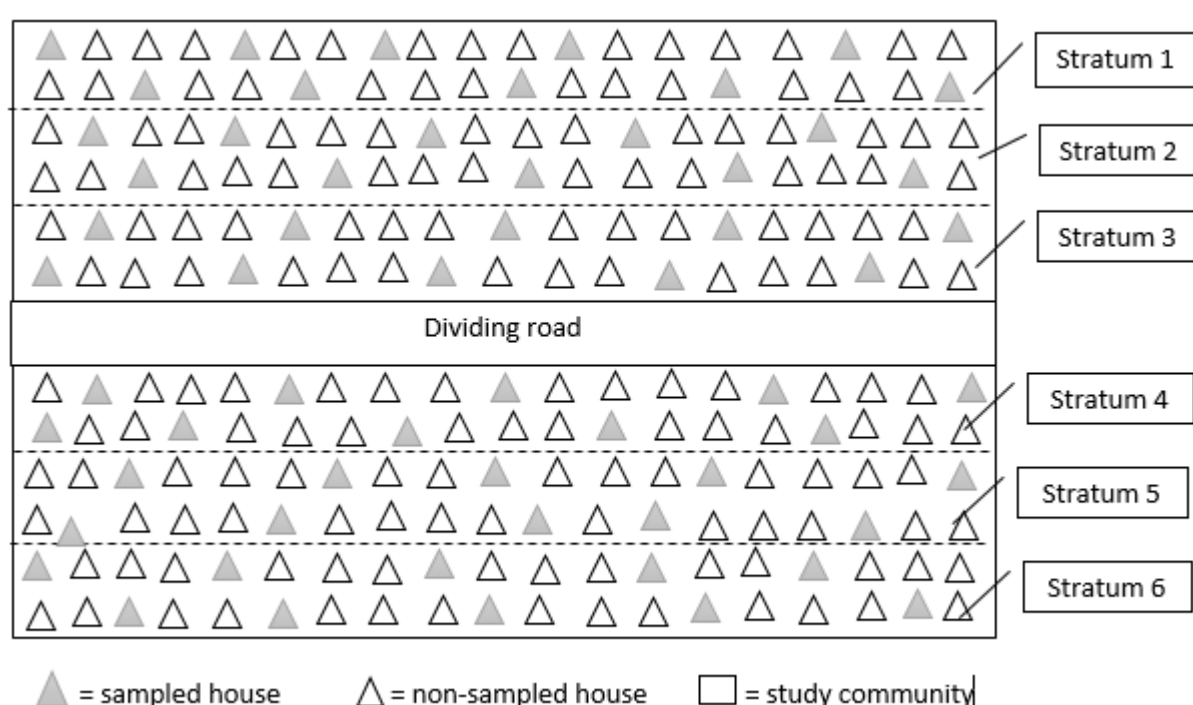


Figure 3. 1 Sampling procedure in communities

Prior to the start of the interview, the purpose of the study was explained to the respondents and their consent sought. Respondents were assured of anonymity and confidentiality of all information provided. The questionnaire was administered in a local language (Asante Twi) by the first author with assistance from five enumerators.³⁴ The survey lasted between 90 and 120 minutes per household.

³³It is a common practice in Ghana for several households to stay together in a single larger or compound house.

³⁴ We used external enumerators with bachelor degrees. They were trained in the objectives of the study, research ethics, and the use of a tablet for data collection. They also took part in the pretesting of the questionnaire.

Interviews with married couples were done in the presence of both husband and wife to ensure a better recall of the sources and amount of household income.

We collected household income data for the 2016 calendar year (one-year recall period) through a household survey³⁵ conducted over the months of February and March 2017. The questionnaire captured the costs and income of all crops cultivated by the household, products collected and processed from the wild, income from businesses and all wage work engaged in by all members of the household in the year 2016. Data were also collected on the seasonal importance of charcoal production and the use of charcoal income to mitigate economic shocks.

The following data on cost in relation to crop production were collected: land preparation, seeds, fertilizer, pesticides, weedicides, hired labour, machinery, transportation, and land rental. Income from food crops was estimated by initially making a list of all crops cultivated by a household in the major and minor farming seasons, the acreage planted, volume of crops harvested, quantity consumed and/or given out as gifts, quantity sold, the unit price at which the product was sold, and the time it was sold. Data collected on environmental resources³⁶ comprised the types of products collected and/or processed, quantity collected and/or processed, the unit for measuring these products, selling price, cost of labour in collection and/or processing, cost of transportation, quantities consumed or given out as gifts and quantity sold. The recall periods for environmental products ranged from weekly, to monthly, to yearly depending on the frequency of collection and seasonal nature of the products. Data were also collected on livestock, livestock products, and other income from wage work, remittances, gifts, compensation and renting of machinery or equipment by household members. These data were used to estimate subsistence³⁷ and cash income from businesses, charcoal production, crops, fish, livestock and livestock products,

³⁵ Diverging from the PEN technical guidelines, we did not undertake four quarterly household surveys, but rather collected snapshot income data through household survey. We also combined village surveys 1 and 2, and annual household surveys 1 and 2, in the PEN questionnaire into a single questionnaire for the survey.

³⁶ Environmental resources are resources from non-cultivated sources – natural forests and other non-forest wildlands such as grass, bush, wetlands, and fallows. It excludes resources from plantations (CIFOR, 2007).

³⁷ Subsistence income refers to the value of products consumed directly by the household or given away to friends and relatives (CIFOR, 2007).

processed and unprocessed environmental products,³⁸ wage work, rent, remittances, gifts, compensation and renting of machinery or equipment.

The data were collected digitally with ODK Collect³⁹ on tablets to reduce the time and errors associated with data recording and entry from a paper-based questionnaire. The ODK Collect further ensured data accuracy and consistency. For instance, the “constraint column” in the digitised questionnaire (i.e., XLSForm design) ensured that the sum of different age groups in a household always added up to the total number of household members. Additionally, the response to the question on severity of a crisis depended on an earlier response to whether the household had faced a crisis or not. Finally, data were scrutinised and cleaned of all errors before upload unto a Google Cloud platform.

3.2.3 Data Analysis

Net household income (subsistence and cash) was calculated as gross income less the total costs of all purchased inputs, payments to chiefs, hired labour and transportation cost. Family or one’s own labour was not included in the cost calculation.⁴⁰ All income values were converted to per capita income using the modified Organisation for Economic Cooperation and Development (OECD) adult equivalent scale, which assigns a value of one to the head of household, 0.5 to each additional adult and 0.3 to each child (below 15 years of age) (OECD, 2017). All income measures were converted to US dollars using an exchange rate of 3.925 Ghana Cedis to the dollar (BoG, 2017). Households were then divided into four income quartiles (categorised as low to high income) based on their adjusted per capita income.

One-way analysis of variance (ANOVA) and Bonferroni’s post hoc tests were undertaken to determine whether means of the different income sources were

³⁸ Processed environmental products are products that undergo complete transformation with some efforts from the households. Environmental resources that are simply boiled and consumed were not considered processed, but rather as unprocessed products in the study. For instance, the collection and sale of unprocessed dawadawa (*Parkia biglobosa*) and shea (*Vitellaria paradoxa*) seeds are considered to be of unprocessed products, while the processed seeds are considered processed products. Unprocessed products that were consumed by the households were not included in the processed category to prevent double counting.

³⁹ ODK Collect is an application designed for digitalising questionnaires.

⁴⁰ In line with PEN guidelines, family labour was not included because we used value added, instead of rent, in estimating the income. The opportunity costs of labour and capital are difficult to ascertain in many rural areas of developing countries, as local economies might fail to absorb the available labour if the entire natural resource (and thus environmental income) disappears (cf. Sjaastad *et al.*, 2005).

significantly different between pairs of identified groups: that is, between income quartiles, and between households that consider charcoal income to be of seasonal importance and those that do not. Chi-square contingency tests were used to test the effect of gender, education, marital status and ethnicity of heads of households on household income. Logistical regressions were used to test the relationship between income and use of charcoal to fill seasonal income and as a safety-net. All statistical analyses were performed with absolute income, and not income shares at a *p*-value of 0.05. Shapiro-Wilk test was used to test for normality of income data.

3.3 Results

3.3.1 Socioeconomic Characteristics of sampled households

Table 3.2 presents the socioeconomic characteristics of the sampled households. The mean age of the heads of households was 50 (\pm 14) years. There was a significant difference in average age across income quartiles, with a declining mean age with increasing income. The average household size was 7.0 (\pm 3.5), and again there are significant differences between income quartiles and a trend of declining household size with increasing income. There were also significant differences in education levels between income quartiles, with a trend of lower illiteracy rate and higher level of education among the high-income households. Most of the household heads belonged to dominant ethnic groups in the communities.

Table 3. 2 Socioeconomic characteristics of sampled households

| Socioeconomic characteristics | | Income quartiles | | | | Total | p-value |
|---|---------------------------------------|------------------------|------------------------|--|-----------|-------------|---------|
| | 1: Lowest-income households (n = 100) | 2 (n = 100) | 3 (n = 100) | 4: Highest-income households (n = 100) | | | |
| Mean age of heads of households (years) | 53.3 (14.0) | 51.4 (13.3) | 49.2 (13.3) | 46.5 (14.7) | | 50.1 (14.0) | 0.004 |
| No. of household members (mean) | 7.6 (3.0) | 7.3 (3.1) | 7.1 (4.2) | 5.9 (3.4) | | 7.0 (3.5) | 0.002 |
| | < 15 | 2.8 (1.9) | 3.0(2.3) | 2.8 (2.7) | 2.4 (1.8) | 2.7 (2.2) | |
| | 15–65 | 4.4 ^a (2.4) | 4.0 ^a (1.9) | 4.1 ^a (2.8) | 3.3 (2.3) | 4.0 (2.4) | |
| | > 65 | 0.4 (0.8) | 0.3 (0.5) | 0.2 (0.4) | 0.3 (0.5) | 0.3 (0.6) | |
| Gender of heads of households | | | | | | | 0.278 |
| | male headed | 82 | 88 | 85 | 91 | 346 (86.5%) | |
| | female headed | 18 | 12 | 15 | 9 | 54 (13.5%) | |
| Education of heads of households | | | | | | | 0.043 |
| | illiterate | 63 | 55 | 66 | 50 | 234 (58.5%) | |
| | informal | 2 | 0 | 0 | 0 | 2 (0.5%) | |
| | basic | 30 | 34 | 22 | 34 | 120 (30.0%) | |
| | secondary | 5 | 11 | 11 | 13 | 40 (10.0%) | |
| | tertiary | 0 | 0 | 1 | 3 | 4 (1.0%) | |
| Ethnic groupings of heads of households | | | | | | | 0.136 |
| | dominant group | 47 | 60 | 62 | 54 | 223 (55.8%) | |
| | minor group | 53 | 40 | 38 | 46 | 177 (44.3%) | |

Notes: 1. Standard deviation in parenthesis without percentage sign (%); 2. Age: ANOVA; 3. Others: Chi-square test

3.3.2 Sources of Household Income

First we present the overall results in terms of household income and subsequently focus on charcoal income.

3.3.2.1 Overall Household Income

Table 3.3 presents the relative economic importance of the sources of income for the sampled households, by income quartiles. The sources of income have been categorised into charcoal business, charcoal production, charcoal wage, crops, fish, livestock, livestock products, other rural businesses besides charcoal, processed environmental products excluding charcoal, unprocessed environmental products and other wages besides charcoal. Income from compensation, gift, government support, remittance and rent have been grouped together as other income.

Crops are the primary source of income and on average account for 46% of the total rural household income. Charcoal – that is, the combined production, business, and wage income – is second, at 17% of total household income. Rural business income is third, at 11.6%, closely followed by unprocessed environmental products, for example, firewood, bushmeat, wild fruits, wild leaves, grass, poles, and medicinal plants, at 9.8% of total income. Remaining sources each provide less than 6% of total income (Table 3.3).

There are significant differences between the absolute income and relative income shares across income quartiles. First, reliance on crop income is lower for households in the highest income quartile than for those belonging to middle- and low-income quartiles, while crop income in absolute terms increases with income quartile (Table 3.3). This lower reliance on crops is countered by a higher reliance on rural business income (and charcoal income, as will be discussed below). There is also a declining importance (in relative terms) of unprocessed environmental products from the lowest-income households to the highest-income households.

Table 3. 3 Relative economic importance of mean household income sources, by income quartile

| Income source | Average income | 1: Lowest-income households (n = 100) | 2 (n = 100) | 3 (n = 100) | 4: Highest-income households (n = 100) | p-value |
|------------------------------------|-------------------|---------------------------------------|--------------------------------|--------------------------------|--|--------------|
| <i>Total income</i> | <i>1366.34</i> | <i>286.76^a</i> | <i>605.67^a</i> | <i>1145.04</i> | <i>3427.90</i> | <i>0.000</i> |
| Charcoal business | 125.90 (4.3%) | 1.91 ^a (0.7%) | 0.85 ^a (0.1%) | 33.39 ^a (2.9%) | 467.45 (13.6%) | 0.000 |
| Charcoal production | 188.26 (12.4%) | 32.39 ^a (11.3%) | 71.05 ^a (11.7%) | 134.38 ^a (11.7%) | 515.24 (15.0%) | 0.000 |
| Charcoal wage | 3.35 (0.3%) | 0.55 (0.2%) | 0.78 (0.1%) | 7.07 (0.6%) | 5.00 (0.1%) | 0.280 |
| Crops | 511.09 (46.1%) | 147.80 ^a (51.5%) | 332.29 ^a (54.9%) | 554.69 (48.4%) | 1,009.59 (29.5%) | 0.000 |
| Fish | 4.08 (0.4%) | 0.92 (0.3%) | 0.82 (0.1%) | 11.43 (1.0%) | 3.17 (0.1%) | 0.080 |
| Livestock | 58.70 (4.2%) | 13.41 (4.7%) | 22.67 (3.7%) | 46.58 (4.1%) | 152.15 (4.4%) | 0.074 |
| Livestock products | 4.53 (0.5%) | 2.12 (0.7%) | 3.53 (0.6%) | 6.20 (0.5%) | 6.26 (0.2%) | 0.052 |
| Processed environmental products | 44.98 (2.7%) | 5.87 ^a (2.0%) | 13.10 ^a (2.2%) | 34.29 ^{ab} (3.0%) | 126.68 ^b (3.7%) | 0.009 |
| Rural businesses | 254.34 (11.6%) | 12.78 ^a (4.5%) | 26.27 ^a (4.3%) | 156.41 ^a (13.7%) | 821.93 (24.0%) | 0.000 |
| Unprocessed environmental products | 84.25 (9.8%) | 46.09 ^a (16.1%) | 72.35 ^a (11.9%) | 83.37 ^a (7.3%) | 135.21 (3.9%) | 0.000 |
| Wage work | 60.75 (5.0%) | 10.52 ^a (3.7%) | 46.35 ^a (7.7%) | 53.78 ^{ab} (4.7%) | 132.35 ^b (3.9%) | 0.001 |
| Other income | 26.09 (2.6%) | 12.39 ^a (4.3%) | 15.62 ^a (2.6%) | 23.46 ^{ab} (2.0%) | 52.89 ^b (1.5%) | 0.008 |

Notes: 1. All income values are in US\$ adult equivalent; 2. Superscripted letters represent Bonferroni's means – the difference between them is not significant at the 5% level when they are followed by a common superscripted letter.

3.3.2.2 Charcoal Income

Charcoal income originates from three sources: charcoal production, charcoal business, and charcoal wages. The first category involves income from household members' own production of charcoal that is predominantly sold to merchants and middlemen. Second, charcoal business income comprises income from trading in charcoal, provision of transport services, and renting out and operating chainsaws used to process trees into billets for other households' charcoal production. There are three kinds of charcoal traders: (i) merchants who live in the communities and buy, transport, and sell charcoal in urban areas; (ii) middlemen who also live in the communities but buy and resell charcoal to merchants coming from the cities; and (iii) roadside charcoal traders, local people who buy and sell charcoal along major roads. Finally, charcoal wages include income from employment in the arrangement of billets, covering billets with grasses and soil, carbonisation, bagging of charcoal and loading of charcoal unto trucks.

Charcoal wage income does not contribute significantly to household income – this holds for all income quartiles (Table 3.3). In what follows, we therefore concentrate on income from charcoal production and charcoal business. Charcoal production income provides a similar share of overall household income for the first three income quartiles, at around 11–12%, while the highest income quartile has a higher contribution from charcoal production (15%) (Table 3.3). Two hundred fifty of the 400 sampled households (i.e., 63%) were engaged in charcoal production, and the producers are approximately equally distributed across income quartiles (Table 3.4).

Table 3. 4 Number of households participating in charcoal-related activities, by income quartile

| Activity | <u>Income quartile</u> | | | | Total |
|----------------------|---------------------------------------|-------------|-------------|--|-------------|
| | 1: Lowest-income households (n = 100) | 2 (n = 100) | 3 (n = 100) | 4: Highest-income households (n = 100) | |
| Charcoal business | 6 | 3 | 9 | 18 | 36 (9.0%) |
| Charcoal production | 59 | 65 | 62 | 64 | 250 (62.5%) |
| Charcoal wage | 8 | 4 | 7 | 8 | 27 (6.8%) |
| No charcoal activity | 36 | 35 | 35 | 30 | 136 (34.0%) |

Note: Some households were engaged in more than one charcoal-related activity.

In terms of charcoal business, the results reveal that charcoal business income is important for households in the highest income quartile but contributes low shares in the other quartiles (Table 3.3). Thirty of the households that did charcoal business were merchants, one was a middleman, and the others were three chainsaw machine operators, one charcoal transporter, and one person who sold trees on his farm to a charcoal producer. Half of these households belong to the highest income quartile (Table 3.4). Division of these 36 households into four quartiles based on their total income from charcoal businesses (Table 3.5) reveals that households in the highest income quartile, and to a lesser extent income quartile three, specialise in charcoal business as a livelihood strategy.

Interviewed charcoal-producing households mentioned that trees for producing charcoal are mostly obtained from their farm and fallow lands. None of them recounted using trees from state designated forest reserves to produce charcoal. They explained that the reserves are planted with teak (*Tectona grandis*), which is not suitable for producing charcoal. Charcoal merchants in the sample mentioned Accra and Kumasi (two major cities of Ghana) as the main destinations for the charcoal.

Table 3. 5 Livelihood strategies of households with income from charcoal businesses

| Source of income | Income quartiles from charcoal business | | | | <i>p</i> -value |
|---------------------------|---|--------------------------------|--------------------------------|----------------------------------|-----------------|
| | 1: Lowest (n = 9) | 2: (n = 9) | 3: (n = 9) | 4: Highest (n = 9) | |
| <i>Total income</i> | 678.79 ^a | 1552.58 ^a | 2021.21 ^a | 6202.16 ^b | 0.000 |
| Charcoal business | 16.50 ^a (2.4%) | 178.57 ^a (11.5%) | 885.60 ^a (43.8%) | 4,514.76 ^b (72.8%) | 0.000 |
| Charcoal production | 109.15 (16.1%) | 181.29 (11.7%) | 100.20 (5.0%) | 497.94 (8.0%) | 0.477 |
| Charcoal wage | 2.11 (0.3%) | 9.87 (0.6%) | 9.99 (0.5%) | 8.09 (0.1%) | 0.815 |
| Crop | 348.66 (51.4%) | 507.26 (32.7%) | 515.22 (25.5%) | 458.23 (7.4%) | 0.894 |
| Fish | 0.09 (0.0%) | 6.16 (0.0%) | 0.19 (0.0%) | 0.40 (0.0%) | 0.174 |
| Livestock | 8.13 (1.2%) | 30.93 (2.0%) | 37.60 (1.9%) | 74.60 (1.2%) | 0.065 |
| Livestock products | 3.33 (0.5%) | 7.04 (0.5%) | 8.78 (0.4%) | 4.07 (0.1%) | 0.602 |
| Processed env. products | 7.07 (1.0%) | 405.92 (26.1%) | 1.61 (0.1%) | 6.07 (0.1%) | 0.268 |
| Rural businesses | 27.03 (4.0%) | 133.73 (8.6%) | 380.08 (18.8%) | 489.88 (7.9%) | 0.035 |
| Unprocessed env. products | 137.66 (20.3%) | 74.70 (4.8%) | 57.07 (2.8%) | 132.59 (2.1%) | 0.660 |
| Wage work | 9.98 (1.5%) | 9.85 (0.6%) | 13.90 (0.7%) | 9.12 (0.1%) | 0.985 |
| Other income | 9.06 (1.3%) | 7.25 (0.5%) | 10.96 (0.5%) | 6.45 (0.1%) | 0.931 |

Notes: 1. All income values are in US\$ adult equivalent. 2. Superscripted letters represent Bonferroni's means – the difference between them is not significant at the 5% level when they are followed by a common superscripted letter. 3. Relative income share in parenthesis. 4. env. = environmental

3.3.3 Comparison of Income of Charcoal- and Non-charcoal-producing Households

The 250 charcoal-producing households in our sample obtained 28% of their total income from charcoal business, charcoal production, and wages from charcoal-related activities (Table 3.6). Crops contributed similar income shares (37%) and constituted the highest income source for both charcoal- and non-charcoal-producing households. Interestingly, non-charcoal-producing households obtained higher income share from charcoal business (15%) than their cohorts from charcoal-producing households (6%). The difference, however, is not statistically significant.

Table 3. 6 Comparison of sources of income of charcoal- and non-charcoal-producing households

| Source of income | Charcoal-producing households (n = 250) | Non-charcoal-producing households (n = 150) | <i>p</i> -value |
|---------------------------|---|---|-----------------|
| <i>Total income</i> | <i>1,396.74</i> | <i>1,315.67</i> | <i>0.665</i> |
| Charcoal business | 79.87 (5.7%) | 202.61 (15.4%) | 0.107 |
| Charcoal production | 301.22 (21.6%) | - | 0.000 |
| Charcoal wage | 5.34 (0.4%) | 0.03 (0.0%) | 0.071 |
| Crops | 524.84 (37.6%) | 488.19 (37.1%) | 0.583 |
| Fish | 3.77 (0.3%) | 4.61 (0.4%) | 0.807 |
| Livestock | 64.59 (4.6%) | 48.89 (3.7%) | 0.718 |
| Livestock products | 5.01 (0.4%) | 3.71 (0.3%) | 0.326 |
| Processed env. products | 33.39 (2.4%) | 64.31 (4.9%) | 0.295 |
| Rural business | 214.23 (15.3%) | 321.2 (24.4%) | 0.382 |
| Wage work | 60.45 (4.3%) | 61.25 (4.7%) | 0.973 |
| Unprocessed env. products | 91.64 (6.6%) | 71.95 (5.5%) | 0.098 |
| Other income | 12.39 (0.9%) | 48.92 (3.7%) | 0.000 |

Notes: 1. All income values are in US\$ adult equivalent. 2. Income shares are in parenthesis. 3. env. = environmental.

3.3.4 Charcoal Income and Accessibility

Community accessibility does not significantly influence total income and income from charcoal-related activities (Table 3.7). However, there appears to be a trend of a higher relative income from charcoal production from well-connected to poorly connected communities. Income from processed environmental products significantly increases from well-connected to poorly connected communities. Income from other sources of income (remittances, etc.) was also significantly higher in fairly connected communities, but lower in well-connected communities.

Table 3. 7 Relative economic importance of mean sources of household income, by accessibility

| Source of household income | <u>Accessibility</u> | | | <i>p</i> -value |
|----------------------------|---------------------------------|---------------------------------|--------------------------------|-----------------|
| | Good (n = 138 households) | Fair (n = 201 households) | Poor (n = 61 households) | |
| <i>Total income</i> | <i>1,365.42</i> | <i>1,403.17</i> | <i>1,247.05</i> | <i>0.841</i> |
| Charcoal business | 183.24 (13.4%) | 63.84 (4.5%) | 200.65 (16.1%) | 0.236 |
| Charcoal production | 148.98 (10.9%) | 204.03 (14.5%) | 225.20 (18.1%) | 0.648 |
| Charcoal wage | 1.40 (0.1%) | 5.41 (0.4%) | 0.97 (0.1%) | 0.344 |
| Crop | 460.68 (33.7%) | 574.77 (41.0%) | 415.32 (33.3%) | 0.125 |
| Fish | 9.62 (0.7%) | 1.38 (0.1%) | 0.45 (0.0%) | 0.055 |
| Livestock | 111.67 (8.2%) | 33.66 (2.4%) | 21.39 (1.7%) | 0.185 |
| Livestock products | 2.97 (0.2%) | 5.98 (0.4%) | 3.28 (0.3%) | 0.074 |
| Rural business | 255.40 (18.7%) | 295.33 (21.0%) | 116.90 (9.4%) | 0.588 |
| Processed env. products | 13.15 ^a (1.0%) | 34.39 ^a (2.5%) | 151.90 (12.2%) | 0.005 |
| Unprocessed env. pdt | 74.32 (5.4%) | 92.45 (6.6%) | 79.49 (6.4%) | 0.344 |
| Wage work | 90.61 (6.6%) | 53.75 (3.8%) | 16.28 (1.3%) | 0.085 |
| Other income | 13.38 ^a (1.0%) | 38.18 ^b (2.7%) | 14.99 (1.2%) | 0.033 |

Notes: 1. All income values are in US\$ adult equivalent. 2. Superscripted letters represent Bonferroni's means – the difference between them is not significant at the 5% level when they are followed by a common superscripted letter. 3. env. pdt. = environmental products.

3.3.5 Contribution of Charcoal to Subsistence and Cash Household Income

Charcoal mainly provides cash income. Rural households on average use only 1% of the charcoal they produce themselves, and sell the remaining 99% (Figure 3.2). This makes charcoal income unique among other income sources, and charcoal production on average the single most important source of cash income. Also, charcoal business provides very significant cash income, but this is restricted to a few households (cf. Tables 3.4 and 3.5). Livestock products and unprocessed environmental products are mainly used to meet subsistence needs, while livestock and processed environmental products (other than charcoal) provide more cash than subsistence income. Mean crop income is equally divided between cash and subsistence income (Figure 3.2).

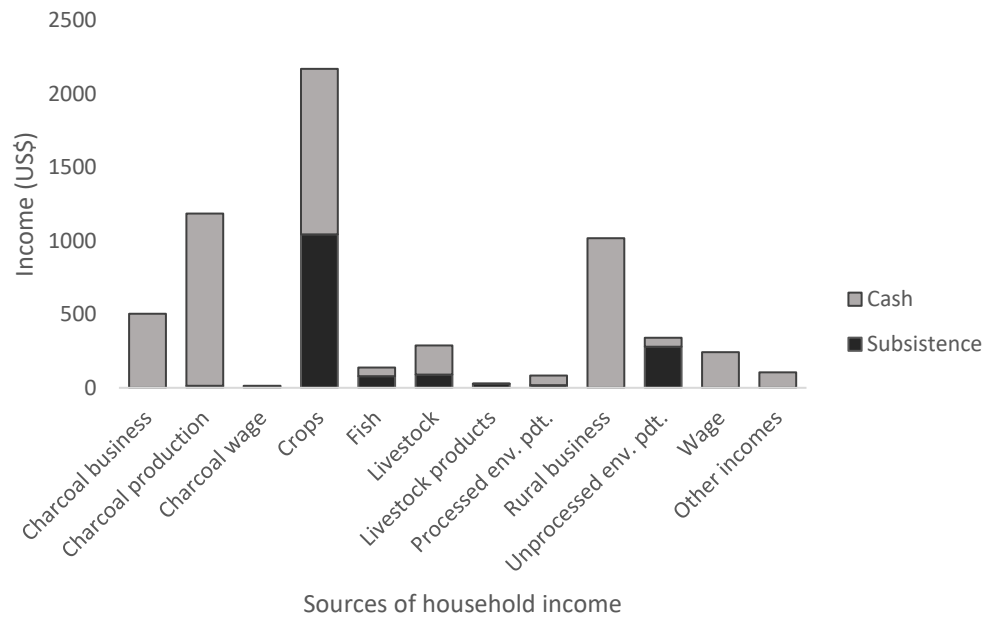


Figure 3. 2 Contribution of income sources to mean subsistence and cash household income

Charcoal production is an important source of cash income for all income quartiles; for the first three income quartiles, it is the second-most important cash earner, at about 1/6 of total cash income (Table 3.8). For the highest income group, charcoal production constitutes 21% of total cash income, comparable to income from rural business and exceeding the contribution from crops. In addition, charcoal business provides significant cash income to the highest income quartile; for this group, the combined cash income from charcoal business and production is more than double the cash income share from crops (Table 3.8).

Table 3. 8 Contribution of household income sources to subsistence and cash income, by income quartiles

| Income source | 1: Lowest-income households (n = 100) | | 2: (n = 100) | | 3: (n = 100) | | 4: Highest-income households (n = 100) | |
|-----------------------|---------------------------------------|---------------|----------------|----------------|----------------|----------------|--|----------------|
| | Subsistence | Cash | Subsistence | Cash | Subsistence | Cash | Subsistence | Cash |
| <i>Total income</i> | <i>155.00</i> | <i>177.49</i> | <i>276.29</i> | <i>386.74</i> | <i>460.45</i> | <i>861.87</i> | <i>657.83</i> | <i>3124.65</i> |
| Charcoal business | 0 | 1.91 (1.1%) | 0 | 0.85 (0.2%) | 0 | 33.39 (3.9%) | 0 | 467.45 (14.9%) |
| Charcoal production | 1.51 (1.0%) | 53.39 (30.1%) | 2.39 (0.9%) | 106.91 (27.6%) | 3.2 (0.7%) | 213.55 (24.8%) | 7.06 (1.1%) | 798 (25.4%) |
| Charcoal wage | 0 | 0.55 (0.3%) | 0 | 0.78 (0.2%) | 0 | 7.07 (0.8%) | 0 | 5 (0.2%) |
| Crop | 86.12 (55.6%) | 68.17 (38.4%) | 178.07 (64.5%) | 161.38 (41.7%) | 309.58 (67.2%) | 268.42 (31.1%) | 470.10 (71.5%) | 629.39 (20.0%) |
| Fish | 6.42 (4.1%) | 1.95 (1.1%) | 9.08 (3.3%) | 0 | 41.84 (9.1%) | 53.42 (6.2%) | 21.3 (3.2%) | 3.06 (0.1%) |
| Livestock | 9.23 (6.0%) | 9.84 (5.5%) | 12.63 (4.6%) | 17.14 (4.4%) | 19 (4.1%) | 37.27 (4.3%) | 49.32 (7.5%) | 134.25 (4.3%) |
| Livestock product | 3.97 (2.6%) | 0.19 (0.1%) | 5.9 (2.1%) | 0.15 (0.0%) | 6.76 (1.5%) | 3.08 (0.4%) | 9.27 (1.4%) | 0.35 (0.0%) |
| Processed env. pdt. | 2.58 (1.7%) | 2.82 (1.6%) | 5.28 (1.9%) | 1.13 (0.3%) | 5.89 (1.3%) | 2.82 (0.3%) | 3.61 (0.5%) | 58.59 (1.9%) |
| Rural business | 0 | 12.77 (7.2%) | 0 | 26.27 (6.8%) | 0 | 156.41 (18.1%) | 0 | 821.93 (26.2%) |
| Unprocessed env. pdt. | 45.17 (29.1%) | 2.98 (1.7%) | 62.94 (22.8%) | 10.15 (2.6%) | 74.18 (16.1%) | 9.2 (1.1%) | 97.17 (14.8%) | 39.39 (1.3%) |
| Wage work | 0 | 10.53 (5.9%) | 0 | 46.36 (12.0%) | 0 | 53.78 (6.2%) | 0 | 132.35 (4.2%) |
| Other income | 0 | 12.39 (7.0%) | 0 | 15.62 (4.0.0%) | 0 | 23.46 (2.7%) | 0 | 52.89 (1.7%) |

Notes: 1. All income values are in US\$ adult equivalent. 2. env. pdt. = environmental products

3.3.6 Gap-filling and Safety-net Functions of Charcoal

Gap fillers are activities rural households pursue to generate additional income during periods of low agricultural activities, seasonal food shortages, or the need to generate moderate levels of cash income for expenditures such as school fees (Cavendish, 2003). Safety-nets are the activities rural households pursue to generate additional income after being hit by a shock in the form of loss of assets, or income provider or incurring higher expenditures (Angelsen and Wunder, 2003).

3.3.6.1 Gap-filling Function of Charcoal

One hundred eighty-three out of the 250 charcoal-producing households in our sample (73%) indicated that income from charcoal is of seasonal importance to them.⁴¹ Correspondingly, these households had higher per capita mean income from charcoal production (US\$367.94) than those who indicated otherwise (US\$36.74) ($p = 0.000$). When probed further about the seasonal importance of charcoal (Table 3.9), 51 households (28%) indicated that they do not have access to other sources of income at specific periods of the year, especially June and July, while 70 households (38%) indicated that other sources of income exist but are not sufficient to meet the needs of their households. We gathered through PRA that most households sell larger portions of the previous year's harvested crops to finance the cultivation of new farms from February to May. New crops are also not ready for harvest during this period. The remaining 62 households (34%) indicated that while they have access to other sources of income, charcoal is more profitable than other rural economic activities at certain periods of the year, especially during the major rainy season (September and October), when the price of charcoal rises. Charcoal production therefore fills income gaps of 121 out of the 250 charcoal-producing households (48%), that is, households that do not have any other source of income and those whose income is not sufficient to meet their needs at certain times of the year (51 and 70 respectively). The gap-filling function of charcoal appears to vary with household income (Table 3.9) – a higher share of the households in the lowest income quartile has no other income sources available at certain times of the year compared to more well-off households. On the other hand, a higher share of households with higher income produce charcoal

⁴¹ This question was restricted to only charcoal producing households and did not include households with income from charcoal business and wage. This is due to the fact that income from both charcoal business and wage depend on charcoal production, and merchants mostly trade all year round.

to supplement their households' income when prices are high. Although not a common practice, few well-off households store charcoal until price rises to get higher profit. Result of the logistic regression indicates that total household income, income from charcoal production and the income level of households have no effect on the seasonal importance of charcoal to rural households (p -values = 0.253, 0.169 and 0.666 respectively).⁴²

Table 3. 9 Reasons for the seasonal importance of charcoal, by income quartiles

| Reason | <u>Income quartiles</u> | | | | Total | p -value |
|--|--------------------------------------|-------------|-------------|---------------------------------------|------------|------------|
| | 1: Lowest-income households (n = 41) | 2: (n = 48) | 3: (n = 46) | 4: Highest-income households (n = 53) | | |
| No other source of income | 17 (41.5%) | 14 (29.2%) | 12 (26.7%) | 8 (16.3%) | 51 (27.9%) | 0.083 |
| Other sources of income not sufficient | 17 (41.5%) | 18 (37.5%) | 17 (37.7%) | 18 (36.7%) | 70 (38.3%) | |
| Charcoal income more profitable | 7 (17.1%) | 16 (33.3%) | 16 (35.6%) | 23 (46.9%) | 62 (33.9%) | |
| Total | 41 (22.4 %) | 48 (26.2%) | 45 (24.6%) | 49 (26.8%) | 183 | |

3.3.6.2 Safety-net Function of Charcoal

Households were asked if they had experienced any form of shock in the year 2016. Three hundred twelve households in our sample (78%) reported facing one or more types of shocks during the year. The most frequently reported shocks were crop failure, illness, and cattle damage experienced by 52%, 35%, and 12% of the sample in 2016, respectively (Table 3.10). The problem of cattle invasion was reported in the Kintampo North Municipality and Kintampo South District, but less so in Nkoransa North District.

⁴² Detailed results presented as Annex 1 under supplementary information.

Table 3. 10 Types and perceived severity of shocks experienced by sampled households in 2016

| Shock type | Total | % |
|-----------------|-------|------|
| Asset loss | 14 | 3.5 |
| Cattle invasion | 49 | 12.3 |
| Crop failure | 209 | 52.3 |
| Death | 57 | 14.3 |
| Illness | 142 | 35.5 |
| Livestock loss | 28 | 7.0 |
| Wedding | 11 | 2.8 |
| Other shocks | 10 | 2.5 |

Note: Households could report multiple shocks.

Households were also asked to indicate the three most important mechanisms used to cope with the shocks. Interestingly, charcoal production features as the most frequently mentioned coping strategy, followed closely by agriculture (Table 3.11). When the per capita mean income from charcoal production of households that experienced crop failure, illness, and cattle invasion (the three most important shocks) were compared with cohorts that did not experience these shocks, we find that charcoal production income was higher only in the case of cattle invasion; \$265.00 for those who had farms destroyed, against \$177.55 for those not facing cattle invasion (but this difference is not statistically significant, $p = 0.927$). For crop failure and illness, the figures are \$163.30 and \$176.23, respectively, for those that mentioned charcoal as a safety-net, against \$215.59 and \$194.89, respectively, for those that did not (p values = 0.712 and 0.800 for crop failure and illness, respectively). Result of the logistic regression indicates that total household income and level of income (i.e. income quartile) did not influence decision by households to produce more charcoal to mitigate economic shocks ($p = 0.667$ and 0.843 respectively).⁴³ However, households with higher charcoal income used charcoal production as a safety-net to a higher extent than other households ($p = 0.001$, Table 3.12).

⁴³ Detail results presented as Annex 2 under supplementary information.

Table 3. 11 Coping strategies by households that faced economic shocks

| Coping strategy | Crop failure | Asset loss | Livestock loss | Cattle invasion | Death | Illness | Wedding | Other crisis | Total |
|---|--------------|------------|----------------|-----------------|-------|---------|---------|--------------|-------|
| Borrowed against future earnings | 0 | 1 | 1 | 0 | 4 | 9 | 3 | 0 | 18 |
| Changed to different livestock | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 3 |
| Did other casual work not related to charcoal | 25 | 1 | 2 | 7 | 4 | 14 | 3 | 2 | 58 |
| Engaged in the sale/transport of charcoal | 3 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 6 |
| Fought for compensation | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 3 |
| Got assistance from friends and relatives | 29 | 3 | 4 | 5 | 7 | 35 | 0 | 0 | 83 |
| Harvested more products from the wild | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| Produced more agricultural products | 77 | 8 | 9 | 12 | 12 | 39 | 2 | 3 | 162 |
| Produced more charcoal | 70 | 1 | 7 | 18 | 20 | 44 | 6 | 2 | 168 |
| Reduced number of meals taken | 15 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 17 |
| Sold/spent cash assets/savings | 16 | 1 | 2 | 5 | 15 | 23 | 1 | 2 | 65 |
| Took loan from money lender, bank, etc. | 7 | 0 | 1 | 1 | 8 | 10 | 0 | 2 | 29 |
| Tried to reduce household spending | 14 | 1 | 0 | 3 | 2 | 3 | 0 | 0 | 23 |

Note: Households could report multiple coping strategies.

Table 3. 12 Results of logistic regression on effect of income from charcoal production on producing charcoal to mitigate economic shock

| Explanatory variable | Odds ratio | Std. Err. | P > z | 95% conf. interval |
|----------------------------|-------------|-------------|--------------|--------------------|
| Charcoal production income | 1.00 | 2.44E-04 | 0.007 | 1.000 1.000 |
| <i>Constant</i> | <i>0.35</i> | <i>0.04</i> | <i>0.000</i> | <i>0.278 0.445</i> |

3.4. Discussion

3.4.1 Discussion of Results vis-à-vis other Studies

3.4.1.1 Income from Charcoal

We found charcoal to be the second-most important household income source, after crops, and the primary contributor to environmental income in our study. The 17% average household income from charcoal in our study is higher than the 4.5% reported by Angelsen *et al.* (2014) for Africa in their global study under the PEN studies. We attribute the difference between their study and ours to the fact that our study was conducted in a charcoal hotspot, while theirs is a continental average, which also includes sites with no, or very little, charcoal production. The 28% reliance on charcoal by the 250 charcoal-producing households in our sample alone is lower than the 57% reported by Schure *et al.* (2014) in the DRC, and the 36% reported by Smith *et al.* (2017) in Malawi. The differences are likely attributable to site-level economic factors and methodological differences. Schure *et al.* (2014), report that opportunities for salaried employment were rare and that few households benefited from paid seasonal jobs in their study area. This situation might influence reliance on charcoal and other environmental products (cf, Angelsen *et al.*, 2014). Schure *et al.* (2014), also compared the contribution of charcoal against only five income-earning activities of sampled households, while Smith *et al.* (2017), estimated the contribution of charcoal from perceived income share from economic activities engaged in by sampled households. These approaches may lead to under- or overestimation of income, as rural households may have difficulty correctly estimating the income share of charcoal from diverse income portfolios. Our study and that of Angelsen *et al.* (2014), however, estimated the contribution of charcoal from both charcoal- and non-charcoal-producing households (randomly) and also used actual income of all economic activities engaged in by rural households. We suggest that this approach gives a better estimate of household reliance on charcoal income.

Comparing our results to those of previous studies in Ghana, Agyemang *et al.* (2012) estimated the contribution of charcoal to household income from the volume of production and the corresponding income and expenditures. They however, did not collect information on other household income activities and hence were not able to compare and put results in perspective of total household income. Obiri *et al.* (2014)

estimated the contribution of charcoal to household income from perceived income share relative to other economic activities and, like Agyemang *et al.* (2012), sampled only charcoal producers. Aabeyir *et al.* (2011), estimated the contribution of charcoal to household income from perceived income share and reported that charcoal production is a full-time activity for many households, accounting for 93% of household income. The latter study had a small sample size ($n = 60$) and purposefully sampled only charcoal producers. We suggest that the results of the present study provide a more realistic and reliable estimate of the reliance on charcoal, both overall and within those households that produce charcoal, as a consequence of the larger sample size and a more robust methodology.

Our results are unique in that they differentiate charcoal income by income quartiles. Categorising producers into income quartiles enabled us to assess the differences in the level of reliance among income groups. Our results indicate that charcoal production is important for all income quartiles, but the importance increases with increasing income quartile. Hence, our results do not support the oft-reported claim that charcoal is mainly a source of livelihood for the poorest of the poor (Vos and Vis, 2010). They also contradict the more general finding that reliance on non-timber-forest products (NTFPs⁴⁴) in Ghana decreases with increasing income (Falconer, 1992). Our findings corroborate those of Ainembabazi *et al.* (2013), Khundi *et al.* (2011), and Schure *et al.* (2014), that charcoal production is not exclusively a domain of the poor or low-income households. It further corroborates the report by Fisher (2004) that reliance on high-value NTFPs, like charcoal, increases with increasing income. Our findings resonate with Arnold and Pérez (2001), who observed that wealthier households frequently capture higher income from trade in forest products because poorer households mostly lack the skills and funds required for start-up and to access markets.

Our results are also unique in quantifying the importance of charcoal business income. We show that it is primarily those (relatively few) households engaged in trading of charcoal as merchants that generate substantial business income, a finding that corroborates, and provides quantitative evidence of, what Ribot (1998) has

⁴⁴ Consistent with the PEN guidelines, environmental products in our study comprise timber and non-timber products collected from non-cultivated sources (natural forest and non-forest wild lands). More products are therefore captured under environmental products than NTFPs used in other studies.

reported on charcoal production in Senegal. We attribute this ability to generate very substantial income from charcoal business primarily to the capacity of the merchants to provide credit to the producers. The knowledge of merchants of the urban charcoal markets, price structures, and their connections to charcoal transporters propel them to generate higher income from charcoal (Agyei *et al.*, 2018; Ribot and Peluso, 2003), but again, this is an area we intend to investigate further.

Our results indicate that charcoal is mainly sold for cash income. This is consistent with the findings of Anang *et al.* (2011) and Schure *et al.* (2014) that charcoal and firewood are sold by rural households in Ghana and the DRC, respectively, for cash income. In the case of Ghana, rural households consider charcoal unaffordable and instead use firewood as their source of energy (Anang *et al.*, 2011). Consistent with Angelsen *et al.* (2014), cash income shares from charcoal production and business in our study increase with increasing income, while subsistence income share from charcoal production decreases with increasing income. We attribute these differences to the low volumes of charcoal produced by low-income households, and the diminishing marginal utility in the use of charcoal for subsistence.

3.4.1.2 Overall Rural Household Income

As has already been shown in different parts of Africa and Asia, our findings show that crops are the primary source of rural household income. Our finding that absolute income from crops increases with increasing income confirms that of Pouliot and Treue (2013). Unlike Pouliot and Treue (2013), however, we did not find a corresponding increase in income share of crops with increasing income. The second income quartile in our sample has the highest income share from crops, while the fourth quartile has the lowest income share from crops. Although our result also coincides with the Ghana Living Standards Survey (GLSS) report that agriculture is the major rural activity in Ghana, the total income share from agriculture (i.e., crops, livestock, and livestock products) in our study (i.e., 51%) is higher than the average 28% for rural savannah and 12% for the Brong-Ahafo Region (GSS, 2014). The difference might be attributed to differences in categorisation of agriculture and non-farm income in this study and the GLSS – income from firewood is included in agricultural income, while income from charcoal trading is included in non-farm income under the GLSS. The GLSS also covers a wider area.

Contrary to the findings on the reliance on processed environmental products, our results indicate that reliance on unprocessed environmental products decreases with increasing income. This corroborates the findings of Babulo *et al.* (2009), Cavendish (2000), Fisher (2004), Hansen *et al.* (2015), Pouliot and Treue (2013) and Thondhlana *et al.* (2012). We attribute this mainly to the importance of fuelwood (subsistence income), which is needed by all households in similar quantities. The differences in the level of reliance on processed and unprocessed environmental products between low- and high-income households can be attributed to the investment costs in processing or adding value to environmental products. For instance, it was realised through the PRA exercises that households get about four times higher income from shea butter processing than from selling the raw shea seeds. However, most low-income households do not have the facilities for processing the shea seeds into butter, and they therefore sell the raw kernels.

3.4.1.3 Gap-filling and Safety-net Functions of Charcoal

Forty-eight percent of the charcoal-producing households in our sample use charcoal to fill seasonal income gaps. The majority of low-income households use charcoal to fill seasonal income gaps, because they do not have access to alternative sources of income at certain times of the year, especially the off-agricultural season. This coincides with the findings of Shackleton and Shackleton (2004) that poorer households that lack alternative cash income sell NTFPs to cope with shocks. On the other hand, high-income households have alternative sources of income but produce charcoal seasonally to supplement their household income. Paumgarten and Shackleton (2009) have reported that wealthy households predominantly respond to opportunities in higher-return environmental products, while poorer households diversify in response to vulnerability. Statistically, we did not find evidence to support the claim that income from charcoal production serves as a primary seasonal gap-filler for rural households, especially during off-agricultural seasons. Wunder *et al.* (2014) made a similar observation in their global comparative assessment of the role of environmental products on gap-filling. This is explained by the high contribution of charcoal to household cash income and supports the assertion by Angelsen *et al.* (2014) that forest income contributes more to regular household income than is often recognised.

Seventy-eight percent of the sampled households experienced at least one form of shock in the year 2016. A comparable figure provided by Pouliot and Treue (2013) from households sampled in Ghana and Burkina Faso was somewhat lower (67%). Our results on the use of charcoal to mitigate economic shocks from farm raiding by cattle, crop failure, and illness do not support the assertion by Wunder *et al.* (2014) that the frequency and/or amount of environmental resource use as safety-net increases with shocks' severity. We attribute the non-proportionate increase in income from coping strategies to the multiple strategies adopted by households to cope with economic shocks. It could also be explained by the inability of households to clearly differentiate between usage of charcoal income as regular household income or emergency income (Angelsen *et al.*, 2014). Similar observations have been made by McSweeney (2004) and Pouliot and Treue (2013). Wunder *et al.* (2014) also did not find evidence on the use of environmental products as safety-net in their global study and recommended a careful case-by-case analysis to understand the kind of shocks that trigger the use of forest as safety-net.

Our results suggest that charcoal production is used both as an *ex ante* and *ex post* coping strategy against cattle invasion. Some households whose fields had been raided by cattle in the past indicated that the incident forced them to enter into charcoal production (*ex post*), while others indicated that the frequent destruction of their fields by cattle forced them to produce more charcoal to ensure a stable source of income (*ex ante*). Our results also corroborate the findings of Jones *et al.* (2016) that households produce charcoal in bulk to respond to one-off shock events, or they turn to charcoal production as a longer-term response to deprivation.

3.4.2 Methods and Reliability of Results

Our results on charcoal income are likely to be underestimated, because we might not have fully captured the production and wage income from charcoal of all household members, in particular young members. In all cases where charcoal production and wage work by younger household members were mentioned in the interview, separate interviews were held with them to capture and add their income to that of their household. There might have been cases, however, where this production was not mentioned (or known) by the household head. As mentioned in the methods section, we involved both the husband and wife in the interview to account also for income

generated and earned separately, but we cannot discount situations where, for strategic reasons, individuals may not have wanted to report their income, be it from charcoal or other activities, to the enumerator and/or their partner.

The breaking down of income into 12 major sources provided a useful framework that allowed us to probe into all possible sources of household income. We had previous knowledge of the seasonal nature of most crops and environmental products, and this, coupled with the PRA exercises that preceded the household surveys, also ensured better capture of crop and environmental income. We however, acknowledge that the one year recall period applied in this study might have introduced some errors as some households might not have correctly recalled all income sources and figures. Although most household members could easily recall the income from agriculture, environmental resources, business income, and wage work, a few had difficulty recalling exact amounts of remittances. We therefore believe income from remittances could be underestimated.⁴⁵

Information received from the PRA exercises and confirmed by rainfall data from the Ghana Meteorological Agency indicates that the district experienced erratic rainfall in 2016. As agriculture is rain-fed in the study area, this is likely to have had an adverse impact on crop production that year. The results on crop income could therefore be higher than in years with high rainfall, and charcoal income, including the role of charcoal as a safety-net against income shocks, might have played a larger role than in other years. This suggests that a longitudinal study could be relevant.

3.4.3 Impacts of Charcoal Production on Vegetation Cover and Interventions by the State

The results show that charcoal provides a significant source of income for many households in the study area and also plays an important role as income-gap filler and safety-net for some households. At the same time, charcoal is expected to continue to constitute a central element of urban energy consumption in years to come, and consumption is on the rise (IEA, 2014). This raises concerns about the environmental sustainability of charcoal production. This is an important topic but falls outside the

⁴⁵ Other studies (e.g., Cavendish, 2000) and the Ghana Living Standards Survey report (GSS, 2014) indicate that households in developing countries receive substantial financial assistance in the form of remittances from abroad and urban areas.

scope of this paper. However, we would like to comment that the link between charcoal production and environmental sustainability is not as straightforward (i.e., increased charcoal production leading to severe environmental degradation) as has been suggested (e.g., EPA 2016). Charcoal production in the study area is typically intimately integrated into the agricultural production system and the number of trees removed dictated more by the requirements of agricultural production than by charcoal production per se (Amanor *et al.*, 2005). This said, PRA participants all mentioned that the number of trees and tree sizes are lower now compared to the recent past, and attributed this reduction, to increased human population resulting in larger areas under cultivation at any given point in time and reduced fallow periods. Both legal and illegal timber harvesting, wildfires and charcoal production were also mentioned as causes for the perceived reduction in tree number and sizes in the area. Further studies on the impact of charcoal and other land uses, and changes in land uses, on tree vegetation (overall cover, species distribution and sizes) are needed, considering the importance of the production and projected future increase.

Charcoal production has been identified as an important activity under the Nationally Appropriate Mitigation Action (NAMA) against climate change in Ghana and the government has initiated programmes to make its production environmentally and economically sustainable (EPA, 2016). Charcoal producers in the study area are being provided with free seedlings to establish woodlot under the Forest Investment Program (MLNR, 2012a). Their capacities are also being built under the Dedicated Grant Mechanism, a project under the United Nations Framework Convention on Climate Change (Solidaridad, 2018). Government and some non-governmental organisations are also promoting the use of improved kilns to increase the conversion efficiencies of trees used for charcoal.

3.5 Conclusions and Recommendations

The paper has demonstrated the economic importance of charcoal production and charcoal business to rural livelihoods in an area in Ghana generally known for its high production of charcoal. The results are thus mainly representative for such high-producing areas and not readily generalised to areas with lower intensities of production. We showed that charcoal is the second-highest source of rural income after crops. Second, contrary to previous studies, high-income households obtain

higher income from charcoal production than do low-income households. Third, we illustrate that charcoal business, especially trading, provides very substantial income, albeit for a small section of our sample population. Fourth, charcoal fills seasonal income gaps by providing an alternative source of income to low-income households and supplementary income to high-income households. Finally, although rural households use multiple coping strategies to mitigate economic shocks, charcoal production appears to be a dominant coping strategy.

Our results show that charcoal production is a very important rural livelihood strategy for a majority of households in charcoal producing “hotspots” like the Kintampo Forest District while the largest income are being captured by those involved in charcoal business/trade. The demand for charcoal, in Ghana and in other sub-Saharan African countries is on the rise, and there are indications that the resource base (vegetation cover) is dwindling. There is therefore the need for policy frameworks and interventions that ensure that charcoal production is sustainable both in an economic and environmental sense. More research on both aspects are required.

Supplementary Information

Annex 1: Results of logistic regression on effect of total household income, income quartile and income from charcoal production on seasonal importance of charcoal

| Explanatory variable | Odds Ratio | Std. Err. | z | P>z | 95% Conf. Interval | |
|----------------------------|-------------|-------------|--------------|--------------|--------------------|--------------|
| Total household income | 1.00 | 0.00 | -1.39 | 0.164 | 1.000 | 1.000 |
| <i>Constant</i> | <i>0.49</i> | <i>0.07</i> | <i>-4.98</i> | <i>0.000</i> | <i>0.375</i> | <i>0.652</i> |
| Income quartile | 0.88 | 0.09 | -1.31 | 0.189 | 0.726 | 1.065 |
| <i>Constant</i> | <i>0.60</i> | <i>0.16</i> | <i>-1.98</i> | <i>0.048</i> | <i>0.356</i> | <i>0.995</i> |
| Charcoal production income | 1.00 | 0.00 | 0.61 | 0.543 | 1.000 | 1.000 |
| <i>Constant</i> | <i>0.43</i> | <i>0.05</i> | <i>-7.52</i> | <i>0.000</i> | <i>0.340</i> | <i>0.532</i> |

Annex 2: Results of logistic regression on effect of total household income to mitigate economic shock

| Explanatory variable | Odds Ratio | Std. Err. | z | P>z | 95% Conf. Interval | |
|------------------------|--------------|-------------|--------------|--------------|--------------------|--------------|
| Total household income | 1.00 | 0.00 | 0.43 | 0.664 | 1.000 | 1.000 |
| <i>Constant</i> | <i>0.385</i> | <i>0.05</i> | <i>-6.90</i> | <i>0.000</i> | <i>0.293</i> | <i>0.505</i> |
| Income quartile | 1.02 | 0.10 | 0.20 | 0.843 | 0.840 | 1.238 |
| <i>Constant</i> | <i>0.38</i> | <i>0.10</i> | <i>-3.56</i> | <i>0.000</i> | <i>0.222</i> | <i>0.647</i> |

CHAPTER FOUR

4.0 FACTORS INFLUENCING PARTICIPATION AND INCOME FROM CHARCOAL PRODUCTION AND TRADE IN GHANA

This chapter has been published as a paper in the Energy for Sustainable Development journal as:

Brobbey, L.K., Pouliot, M., Hansen, C.P., and Kyereh, B. 2019. Factors influencing participation and income from charcoal production and trade in Ghana, *Energy for Sustainable Development*, vol. 50, pp. 69-81

Abstract

Policy makers in the charcoal sector of developing countries are constrained by lack of insight into factors that enhance the livelihood aspects of charcoal production and trade. This study therefore examined the contextual factors that influence rural households' participation and income from charcoal production and trade in the Kintampo Forest District, a major charcoal-producing area in the forest savannah transition zone of Ghana. We used the Heckman selection and outcome model to examine the factors that influence participation and income from charcoal production and trade based on survey data from 400 randomly selected charcoal- and non-charcoal-producing households. We also undertook participatory rural appraisal methods and follow-up interviews to understand the results of the Heckman model from the perspective of charcoal producers, merchants and other key actors along the charcoal commodity chain. We found out that participation in charcoal production and trade is not associated with any specific income group, but high-income households use financial and physical capitals to get higher income from both charcoal production and trade than low-income households. Charcoal production is dominated by young and male-headed households, while charcoal trade is dominated by young and female-headed households and offers an opportunity for reducing rural poverty and raising the status of rural women. Income from charcoal production and trade is also influenced by membership in charcoal associations, ethnicity and payment of traditional charcoal levy. Our results suggest that low-income households and female-headed households will be able to reap higher profits from charcoal production and trade respectively if given financial support. We also observed good prospects for policy engagement with traditional authorities and charcoal associations for sustainable charcoal production due to the mutual benefits the two stakeholders derive from charcoal production and trade.

Key words: Ghana; Livelihood strategies; Reliance on charcoal; Rural livelihoods; Sub-Saharan Africa

4.1 Introduction

Charcoal production is at a crossroads in many sub-Saharan African (SSA) countries due to its economic importance, and yet it is deemed destructive in nature. On one hand, charcoal contributes to the economy and energy needs of many SSA countries (Arnold *et al.*, 2006; Zulu and Richardson, 2013), and its production continues to rise due to preferences and demands of increasing urban populations (IEA, 2014). Globally, more than 40 million people are estimated to benefit from charcoal (FAO, 2017). Charcoal provides regular household income and seasonal income during lean agricultural seasons, serves as a safety-net against economic shocks and helps lift households out of poverty (Agyemang *et al.*, 2012; Brobbey *et al.*, 2019a; Fisher, 2004; Jones *et al.*, 2016; Khundi *et al.*, 2011; Ndegwa *et al.* 2016; Obiri *et al.*, 2014; Smith *et al.*, 2017). On the other hand, charcoal production is associated with narratives of environmental degradation, deforestation and climate change (Chidumayo and Gumbo, 2013; FAO, 2017). For instance, Chidumayo and Gumbo (2013), estimated the emissions of greenhouse gases from charcoal production in tropical ecosystems to be 71.2 million tons for carbon dioxide and 1.3 million tons for methane in 2009. This is equivalent to 7% of tropical deforestation (Chidumayo and Gumbo, 2013).

Previous attempts to ban charcoal production and trade, or to substitute charcoal with liquefied petroleum gas (LPG), in some SSA countries because of environmental concerns have been unsuccessful (Arnold *et al.*, 2006; Ribot, 1999; Sander *et al.*, 2013; Smith *et al.*, 2015). Recent policy interventions apply an array of measures, and the interventions vary among countries in SSA. For example, Kenya has recently reintroduced a ban on charcoal production and trade (Gumbihi, 2018), while Ghana has initiated programmes to formalise and regularise the charcoal industry to make it economically and environmentally sustainable (Ameyaw, 2016; Energy Commission, 2010; EPA, 2016; MLNR, 2012a, 2012b). In Ghana attempts to develop the charcoal sub-sector to make it sustainable are addressed in three state policies, namely, the Forest and Wildlife Policy of 2012, the Climate Change Policy and the Woodfuel Policy component of the Draft Bioenergy Policy.

The Forest and Wildlife Policy recognises the important role of charcoal in rural livelihoods and its impact on the integrity of forests and woodlands. The policy

therefore aims at developing criteria and indicators and a chain of custody to ensure sustainable production of charcoal in all types of forests in the country. It promotes the establishment of commercial and smallholder woodfuel plantations or woodlots to augment fuelwood supplies from natural forests and woodlands (MLNR, 2012a). For the Climate Change Policy, the role of charcoal production in greenhouse gases emission is its main concern and it consequently considers charcoal production an important activity under the country's Nationally Appropriate Mitigation Action (NAMA) against climate change (EPA, 2016; MESTI, 2012). Under the NAMA programme, the Environmental Protection Agency, one of the state agencies with oversight responsibility for charcoal production, plans to promote the use of improved kilns among charcoal producers to boost the conversion efficiency of the carbonisation process. The Woodfuel Policy component of the Draft Bioenergy Policy is the most comprehensive of the three policies guiding the charcoal sub-sector. It has six policy objectives: (i) sustainable supply and production of feedstock for producing charcoal; (ii) improving conversion efficiency of the carbonisation process; (iii) improving efficiency in charcoal transport; (iv) improving packaging and marketing of charcoal; (v) promoting the use of LPG as a substitute for charcoal; and (vi) strengthening institutional and regulatory arrangements in the charcoal sub-sector (Energy Commission, 2010). These policies are yet to have full effect on charcoal production and trade but it is expected that state interventions for the subsector will derive their directions from them.

Charcoal is mainly produced from naturally occurring trees outside state designated forest reserves in Ghana (Amanor *et al.*, 2005; Obiri *et al.*, 2014). There is legal pluralism in the regulation of the charcoal sector in the country, because different legal systems overlap. Lands in Ghana are owned by chiefs, but the state Forestry Commission has the constitutional mandate (*de jure*) to manage and regulate naturally occurring trees, including trees used for producing charcoal (Kotey *et al.*, 1998; Marfo, 2009). This is, however, not the case in practice, as chiefs sell trees, and in some cases charge levies on trees used for producing charcoal in some communities.

Few households produce charcoal as their sole source of income; for most households, charcoal production forms part of a diversified livelihood strategy (Brobby *et al.*, 2019a; Ndegwa, *et al.*, 2016; Obiri *et al.*, 2014; Schure *et al.*, 2014;

Smith *et al.*, 2017). For instance, charcoal served as the sole source of household income for 35% of the population in a study from the forest savannah transition zone of Ghana, while 64% combined it with agriculture, and the remaining 1% combined it with petty trading (Obiri *et al.*, 2014). The motivations for engaging in charcoal production are varied and are influenced by the socio-economic characteristics at the household level and availability of alternative economic activities. It has been shown that charcoal production in Uganda is higher among households with limited human and physical capitals (Khundi *et al.*, 2011), those headed by young males and those who possess few productive assets (Ainembabazi *et al.*, 2013). Population growth, drought, social and economic marginalisation, and lack of alternative economic activities drive pastoralist women (mostly widows or divorcees) to produce charcoal in Mozambique (Butz, 2013). Charcoal producers in Malawi do not consider charcoal production as a desirable livelihood strategy, but lack of alternative employment opportunities, loss of previous employment, need for money for specific expenditures like school fees and economic shocks necessitate that they to produce it (Smith *et al.*, 2017). A different situation, however, exists in Ghana where in some localities charcoal production constitutes an important and sometimes specialised livelihood. For instance, charcoal producers in the Upper West Region of the country obtain twice the national and four times the region's mean household income, and use income from charcoal to buy assets such as bicycles, motorbikes, roofing sheets, livestock, and other consumable goods, like foodstuffs, clothing, sanitary facilities and educational materials for their children (Agyemang *et al.*, 2012; Lurumuah, 2011).

An understanding of the factors that enable households to produce or trade in charcoal, or, alternatively, prevent them from doing so is a prerequisite for any successful policy intervention in the charcoal sector. Such an understanding is essential for targeting policy interventions in livelihood enhancement, poverty reduction and environmental conservation in relation to charcoal and other natural resources. It is particularly essential in the design and implementation of policies and programmes aimed at making charcoal production and trade economically and environmentally sustainable in Ghana and other SSA countries. Moreover, no study has used comprehensive household income data to examine the factors influencing charcoal income in Ghana. Relatively few studies have investigated the factors that

drive rural households in other developing countries to engage in charcoal production or not, and fewer studies yet have been based on actual income data, exceptions being Ainembabazi *et al.* (2013) and Khundi *et al.* (2011) in Uganda, and Coomes and Butz (2001) in Peru. Furthermore, recent research has illustrated that apart from engaging in charcoal production, some rural households also engage in, and earn significant income from, charcoal trade (Brobbey *et al.*, 2019a).

The overall aim of this paper is thus to contribute to the understanding of the factors that shape households' participation and income from charcoal production and trade. Specifically, we address the following two questions: (i) what factors determine whether or not households produce and/or trade charcoal? and (ii) what factors are associated with high income from charcoal production and trade?

4.2. Methods

4.2.1 Study Area

The study was conducted in 10 communities in the Kintampo Forest District of the Brong-Ahafo Region of Ghana (Figure 1.1). The district was chosen because it is the largest charcoal-producing district in the country, accounting for 22% of estimated charcoal produced in Ghana (Amanor *et al.*, 2005; Nketiah and Asante, 2018). The district is located between latitude 7°30' and 8°45' North, and longitude 2°0' and 1°15' West. It lies within the forest savannah transition zone, with a natural vegetation characterised by a mixture of trees, shrubs, and tall grasses (SRID, 2011). The zone experiences a bimodal rainfall regime that gives rise to major and minor agricultural seasons. The minor rains fall between April and July, while the major rains fall between September and October. The area supports the growth of fire resistant tree species with high wood density preferred for charcoal (Amanor *et al.*, 2005; Korang *et al.*, 2015; Obiri *et al.*, 2014). The average temperature and rainfall are 26.1°C and 1,345 mm, respectively (Climate-data.org, 2017). Crop farming is the major economic activity in the area (GSS, 2014).

Research communities were selected with the aim of having all four traditional authorities (chiefs) and different levels of accessibility (good, fair, and poor) in the sample (Table 3.1). Chiefs in Ghana collect levies from charcoal producers, but the levies vary from one traditional area to the other. The state, on the other hand collects

levies from charcoal merchants, which are uniform across the country (Agyei *et al.*, 2018). We categorise good accessibility as communities located along tarmac major roads and which are easily accessible by all types of vehicles at all times of the year. Fair-accessibility communities are located along non-tarmac feeder roads and are accessible by all types of vehicles in the dry season. However, accessibility is fairly difficult with non-four-wheel-drive vehicles in the wet season in fair-accessibility communities. Poor-accessibility communities, on the other hand, are located along non-tarmac feeder roads but are very difficult to access with non-four-wheel-drive vehicles in the wet season, due to broken bridges and the absence of maintenance.

4.2.2 Conceptual Framework

We developed our conceptual framework for the study from the Sustainable Livelihood Framework (Ellis, 2000; Scoones, 1998, 2015) to identify the potential variables that influence decisions by rural households to produce or trade in charcoal (Figure 4.1). At the centre of the conceptual framework are the economic activities engaged in by rural households. Examples include crop farming, charcoal production, and trade. According to the framework, a household's choice to pursue a particular economic activity (i.e., livelihood strategies) is influenced by its access to five capitals in the assets or capitals section of the framework (arrow *b*), which are in turn mediated by institutions and other mediating structures (arrow *f*). Mediating structures and institutions invariably affect the capitals (arrow *c*) and livelihood outcome of households (arrow *g*). Exogenous factors such as shocks, seasonality and trends affect the livelihood strategies (arrow *e*), assets (arrow *a*), and livelihood outcome of households (arrow *d*). Finally, a livelihood strategy engaged in by a household also generates a livelihood outcome such as improved household income, reduced poverty and environmental sustainability (arrow *j*). The resulting livelihood outcome of a household can consequently influence its capitals through investment in education of household members, financial savings or tree planting (arrow *i*), and the mediating structures and institutions (arrow *h*).

Adapting the Sustainable Livelihood Framework and previous research, we developed a list of relevant independent variables (Table 4.1).

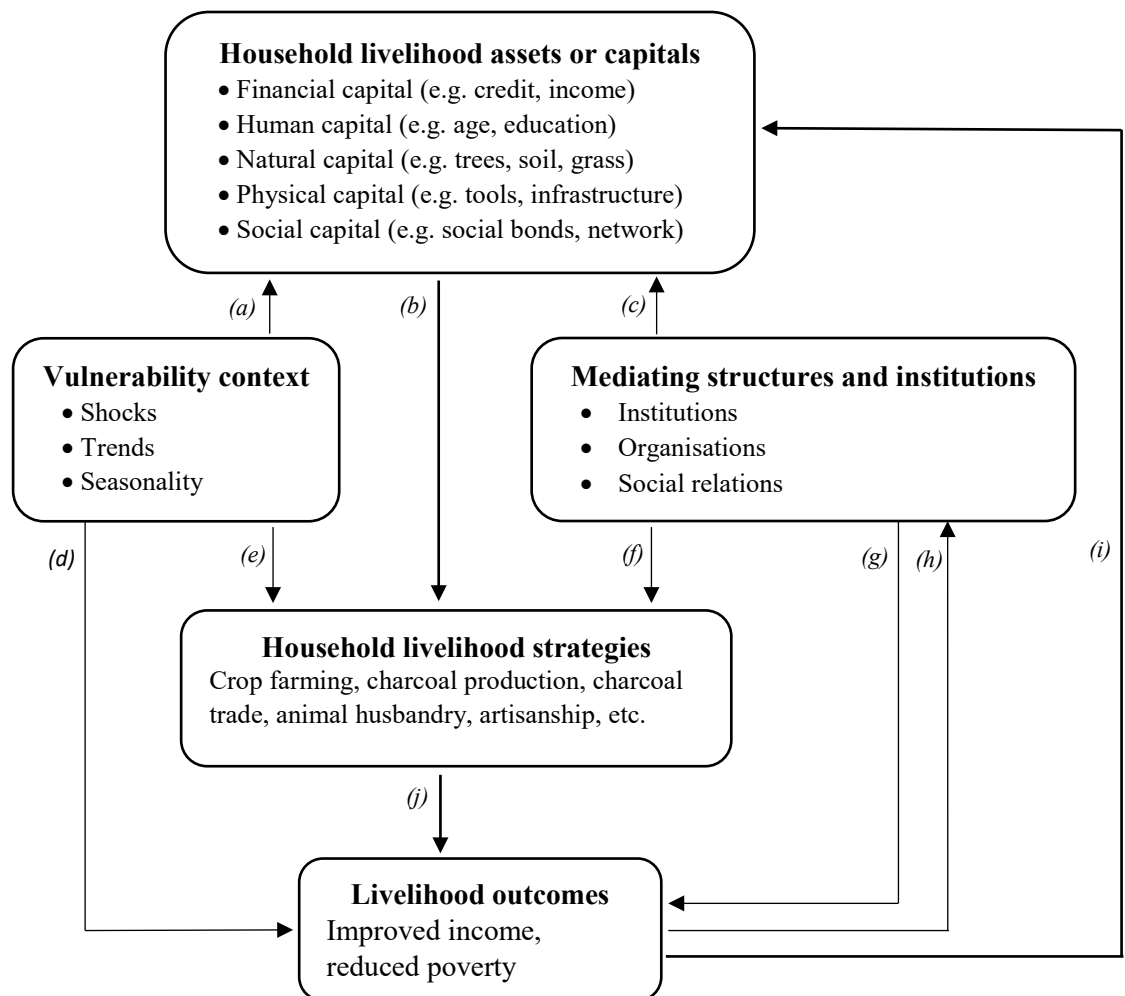


Figure 4. 1 Conceptual framework of sustainable livelihoods
Source: Adapted from Ellis (2000) and Scoones (1998, 2015)

Table 4. 1 List of independent variables in the model of participation and income from charcoal production and trade

| Variable | Type of data | Explanation | Expected sign | | Source of literature |
|------------------------------|--------------|---|---------------------|------------------|--|
| | | | Charcoal production | Charcoal trading | |
| <i>Financial capital</i> | | | | | |
| Total income | Continuous | Overall household income (US\$) | + | + | Brobbey <i>et al.</i> (2019); Fisher (2004)*; Khundi <i>et al.</i> (2011); Schure <i>et al.</i> (2014) |
| Crop income | Continuous | Household income from crops (US\$) | + | - | Brobbey <i>et al.</i> (2019) |
| <i>Human capital</i> | | | | | |
| Age | Discrete | Age of household head (years) | - | - | Angelsen <i>et al.</i> (2014)*; Khundi <i>et al.</i> (2011); Pouliot and Elias (2013)* |
| Education | Categorical | Highest education attained by household head (illiterate = 0; informal = 1; basic = 2; secondary = 3; tertiary = 4) | - | + | Khundi <i>et al.</i> (2011); Shively <i>et al.</i> (2010) |
| Gender | Categorical | Sex of household head (male = 1, female = 0) | + | - | Agyei <i>et al.</i> (2018); Khundi <i>et al.</i> (2011) |
| No. household members | Discrete | Total number of household members | + | + | Coomes and Butz (2001); Khundi <i>et al.</i> (2011) |
| No. active household members | Discrete | Labour available to households, that is, household members aged 15-65 years | + | + | Bakkegaard <i>et al.</i> (2017)*; Coomes and Butz (2001) |
| <i>Natural capital</i> | | | | | |
| Tree availability | Ordinal | Perception of trees available for producing charcoal in communities ranked on a scale of 1-10 | + | + | |
| <i>Physical capital</i> | | | | | |
| Accessibility | Ordinal | Quality of road linking community to district capital (operationalised as poor = 0; fair = 1; good = 2) | + | + | Charlery <i>et al.</i> (2016)*; Olsson (2009)* |

Table 4.1 continuation

| Variable | Type of data | Explanation | Expected sign | | Source of literature |
|--|--------------|--|---------------------|------------------|--|
| | | | Charcoal production | Charcoal trading | |
| Market distance | Continuous | Distance from community to urban charcoal market (meters). Kumasi used as proxy market. | - | - | Bakkegaard <i>et al.</i> (2017)* |
| Bicycles | Discrete | Number of bicycles owned by a household | + | + | Ainembabazi <i>et al.</i> (2013); Shively <i>et al.</i> (2010) |
| Motorbikes | Discrete | Number of motor bikes owned by a household | + | + | Ainembabazi <i>et al.</i> (2013) |
| Chainsaw | Discrete | Number of chainsaws owned by a household | + | + | Ainembabazi <i>et al.</i> (2013) |
| <i>Social capital</i> Assistance | Categorical | Level of assistance a household gets from other community members (no = 0; partly = 1; yes = 2) | + | + | Katz (2000)* |
| Charcoal association | Dummy | Membership of household members in an association of charcoal producers and merchants (non-member = 0; member = 1) | + | + | Katz (2000)*; Pouliot and Elias (2013)* |
| Ethnicity | Dummy | Ethnicity of household head (Sissala ethnic group used as proxy: non-Sissala = 0; Sissala = 1) | + | + | Amanor (2005); Mombu <i>et al.</i> , 2007; Ribot (1998) |
| Trust | Categorical | Level at which household trust other community members (no = 0; partly = 1; yes = 2) | + | + | Katz (2000)*; Pretty and Ward (2001)* |
| Residential status | Dummy | Residential status of household head (migrant = 0; indigene = 1) | + | + | Ainembabazi <i>et al.</i> (2013) |
| <i>Institutions</i> Traditional charcoal levy | Ordinal | Percentage of traditional levy charged on charcoal (no levy = 0; 10% = 1; 20% = 2) | - | - | Amanor <i>et al.</i> (2005); Schure <i>et al.</i> , (2015) |

Table 4.1 continuation

| Variable | Type of data | Explanation | Expected sign | | Source of literature |
|------------------------------|--------------|--|---------------------|------------------|---|
| | | | Charcoal production | Charcoal trading | |
| <i>Vulnerability context</i> | | | | | |
| Seasonal production | Dummy | Household seasonally produce charcoal (no = 0 ; yes = 1) | + | | Brobbey <i>et al.</i> (2019); Khundi <i>et al.</i> (2011) |
| Economic shock | Dummy | Household suffered one or more forms of economic shock (no = 0; yes = 1) | + | | Angelsen <i>et al.</i> (2014)*; Pouliot and Elias (2013)* |

Notes: 1. References marked with asterisks (*) are not charcoal studies, but general studies on environmental products; 2. Vulnerability in this study refers to the general trend and shocks that affect the total livelihood strategies of respondents; 3. “+” = positive relationship, “-” = negative relationship

4.2.3 Data Collection and Analysis

Participatory rural appraisal (PRA) methods and interviews were used to collect qualitative data, while a household survey was used to collect quantitative data for the study. Village meetings were initially held with chiefs and other community officials to explain the purpose of the study and also to seek their permission to conduct the study in their communities. Four PRA methods – resource map, seasonal calendar, trend analysis and focus group discussion, were conducted in all 10 communities to collect information on: (i) the changing pattern of natural resources; (ii) times/seasons community members engage in farm and off-farm activities; and (iii) risks, shocks, and other vulnerabilities communities are exposed to. The resource map and seasonal calendar were conducted before the household survey, while the focus group discussion and trend analysis were conducted afterward to explain the findings of the survey. On average, 11 people, comprising two elderly (age 40+) males, two elderly females, two young (age 18-40) males, two young females, two unit committee/assembly members, and the local chief or his representative were involved in the PRAs.

We adapted the PEN questionnaire (CIFOR, 2008) to collect data on the sources of household income through a household survey⁴⁶ in 400 randomly selected households. In the absence of up-to-date lists of households in the study communities, random selection was ensured, by dividing each community into six sections/strata. The main road running through each community was used first to divide the community into two parts. Each half was further stratified into three based on distances to the dividing road: houses near to the road, houses in the middle of the community, and houses far from the road. The number of households interviewed ranged between 30 households in small communities and 60 in large (Table 1). Households were sampled with the aim of sampling approximately 30% of houses based on the 2010 population and housing census provided by the Ghana Statistical Service (cf. Angelsen *et al.*, 2011; Neuman, 1991), and the number was equally distributed across strata. Within the stratum, households were identified by randomly selecting a first house for interview, then skipping the next two or three houses before

⁴⁶We diverted from the PEN technical guidelines on quarterly surveys and collected snapshot income data for the household survey. We also combined village surveys 1 and 2, and annual household surveys 1 and 2, in the PEN questionnaire into a single questionnaire for the survey.

selecting the next household. The interviews were restricted to one household per house⁴⁷ and were conducted in early mornings and late afternoons, when most community members were in their homes.

Income data for the 2016 calendar year (one-year recall period) was collected over the months of February and March 2017. The questionnaire for the survey captured the costs and income of all crops cultivated by the household, products collected and processed from the wild, income from businesses and all wage work engaged in by all members of the household in the year 2016. Data were also collected on livestock, livestock products, and other income from wage work, rent, remittances, gifts, compensation, and renting of machinery or equipment by household members. Net household income (subsistence and cash) was calculated as gross income minus the costs of all purchased inputs, transportation, hired labour and payment to chiefs. Local market prices were used to estimate the gross value of products used for subsistence or given out as gifts. Family or one's own labour was not included in the cost calculation, due to the fact that we used value added, instead of rent, in estimating the income. The opportunity costs of labour and capital are difficult to ascertain in many rural areas of developing countries, as local economies might fail to absorb the available labour if the entire natural resource (and thus environmental income) disappears (Sjaastad *et al.*, 2005). Income measures were converted to US dollars using an exchange rate of 3.925 Ghana cedis to the dollar (BoG, 2017). Data were also collected on the seasonal importance of charcoal production and the shocks suffered by households. The household survey data were collected digitally with ODK Collect on tablets to reduce the time and errors associated with data recording and entry from a paper-based questionnaire.

Follow-up interviews were conducted with 60% of charcoal-producing households (n = 150) and merchants (n = 18) identified in the first phase of sampling. Convenience sampling was used in selecting the respondents for the follow-up interviews. The selection was based on the interviewer meeting the respondents in their homes at the time of the second visit. Semi-structured questionnaires were used to collect data on the mechanisms households use to produce and trade in charcoal, and the challenges

⁴⁷It is a common practice in Ghana for several households to stay together in a single larger or compound house.

and opportunities in these two economic activities. Key informant interviews were held with chiefs to understand the reasons behind charcoal levies and other customary laws relating to the production and trade in charcoal in their communities. Selected staff members of the Forestry Commission and District Assemblies were also interviewed to assess the role of the state in the charcoal sector. The purpose of the study was explained to all respondents and their consent sought before every interview. They were assured of anonymity and confidentiality of all information they provided. Interviews with married couples were done in the presence of both husband and wife to ensure a better recall of the sources and amount of household income.

4.2.4 Econometric Model Specifications

Standard regression models of outcome regressed on descriptive variables are likely to suffer from selection bias when households self-select into an activity under study (Heckman, 1979). The Heckman selection and outcome model was therefore used to simultaneously examine the factors that determine a household's decision to produce or trade in charcoal, as well as the factors that determine the success or income from charcoal production and trade. This model applies a two-step estimation of participation and outcome, and thereby overcomes issues of endogeneity that may arise from sample selection in other models (Heckman, 1979). The Heckman model allows us to account for self-selection into activities based on the argument that a household will opt to select into an activity only if it is part of the household's optimal set of income generating activities, in a given context, and given particular household characteristics. That is, when observing households' income-generating activities, the observer observes effort and outcome of only of those that self-selected into that activity. The potential outcome of others may not be zero, had they selected into the activities; and thus, the estimation must account for this (Ibid).

The participation in charcoal production or trade or selection equation is defined as a probit relation:

$$w_i^* = \gamma Z_i + \mu_i \quad (1)$$

where w_i^* is the latent variable, related to a set of exogenous variables, Z_i and $w_i = 1$ if $w_i^* > 0$ and $w_i = 0$ otherwise. The probability of observing participation or selection equation is defined as a probit model:

$$\text{Prob}(w_i = 1 | Z_i) = \Phi(\gamma Z_i) \quad (2)$$

$$\text{Prob}(w_i = 0|Z_i) = 1 - \Phi(\gamma Z_i) \quad (3)$$

The outcome model will then describe the outcome of charcoal production or trading intensity in terms of income, and its relation to a subset of variables x :

$$y_i = x_i \beta + \varepsilon_i \text{ only if } w_i = 1 \text{ and} \quad (4)$$

$$(\mu_i, \varepsilon_i) \sim \text{bivariate normal } [0, 0, 1, \sigma_\varepsilon, \rho]$$

The role of community in participation and income from charcoal production and trade could not be analysed with the Heckman model due to the problem of multicollinearity. Analysis of variance (ANOVA) was therefore used to test the difference in the mean income that sampled households got from producing and trading in charcoal ($\alpha = 0.05$). Stata/IC 15.0 was used to run the Heckman model and ANOVA.

4.3 Results

4.3.1 Basic Descriptive Statistics

The basic descriptive statistics of the sampled households and their sources of income are presented in Table 4.2. Two hundred and fifty out of the 400 sampled households (63%) produced charcoal, while 30 households (8%) traded in charcoal. Eighteen out of the 30 charcoal merchants (60%) were also into charcoal production. On average, charcoal production accounted for US\$ 591 of total annual household income, while charcoal trade accounted for US\$ 389 for the 400 sampled households. A high variation in income was observed among the 250 charcoal-producing households (US\$ 6 minimum and US\$ 20995 maximum) and the 30 households involved in charcoal trade (US\$ 36 minimum and US\$ 23725 maximum). Most of the 400 sampled households were headed by males (90%), the average age of the household head was 50 years and half of them had primary education. The average household size was seven. About half of the entire sampled households considered charcoal to be seasonally important to them, while 80% had suffered one or more forms of economic shocks during the one-year recall period.

Table 4. 2 Descriptive statistics of socioeconomic characteristics and income of sampled households in charcoal production and trade

| Variables | All sampled HH (n = 400) | | | | Charcoal-producing HH only (n = 250) | | | | Charcoal-trading HH only (n = 30) | | | |
|---|--------------------------|---------|--------|----------|--------------------------------------|---------|--------|----------|-----------------------------------|---------|--------|----------|
| | Mean | SD | Min | Max | Mean | SD | Min | Max | Mean | SD | Min | Max |
| <i>Financial capital</i> | | | | | | | | | | | | |
| Charcoal production income (US\$) | 591.8 | 1889.9 | 0 | 20994.7 | 946.9 | 2320.8 | 6.1 | 20994.7 | 828.3 | 2209.4 | 0 | 11535.3 |
| Charcoal trade income (US\$) | 388.9 | 2383.8 | 0 | 23724.8 | 238.8 | 1726.2 | 0 | 23724.8 | 5184.8 | 7243.1 | 35.7 | 23724.8 |
| Crop income (US\$) | 1681.9 | 2255.3 | -208.4 | 22828.5 | 1758.7 | 2431.8 | -208.4 | 22828.5 | 1496.1 | 1900.1 | 0 | 8325.6 |
| Total income less crops and charcoal production income (US\$) | 15499.3 | 25331.4 | 283.3 | 280712.7 | 15627.0 | 25029.2 | 283.31 | 280712.7 | 33624.3 | 32864.3 | 327.3 | 128205.3 |
| Total income less crops and charcoal trade income (US\$) | 15702.2 | 25114.5 | 308.8 | 284868.2 | 16335.1 | 25545.8 | 308.8 | 284868.2 | 29267.7 | 27035.3 | 2966.6 | 105275.4 |
| <i>Human capital</i> | | | | | | | | | | | | |
| Age (years) | 50.1 | 14.0 | 22.0 | 85.0 | 48.0 | 13.3 | 23.0 | 82.0 | 45.8 | 11.6 | 30.0 | 79.0 |
| Education | 0.9 | 1.2 | 0.0 | 4.0 | 0.9 | 1.2 | 0.0 | 4.0 | 1.2 | 1.2 | 0.0 | 3.0 |
| Gender | 0.9 | 0.3 | 0.0 | 1.0 | 0.9 | 0.2 | 0.0 | 1.0 | 0.8 | 0.4 | 0.0 | 1.0 |
| No. HH members | 7.0 | 3.5 | 1.0 | 30.0 | 7.1 | 3.4 | 1.0 | 30.0 | 7.4 | 3.5 | 3.0 | 19.0 |
| No. active HH members | 3.9 | 2.4 | 0.0 | 23.0 | 4.0 | 2.2 | 0.0 | 11.0 | 4.3 | 2.5 | 1.0 | 11.0 |
| <i>Natural capital</i> | | | | | | | | | | | | |
| Perception of tree availability | 1.3 | 0.6 | 1.0 | 3.0 | 1.4 | 0.7 | 1.0 | 3.0 | 1.3 | 0.7 | 1.0 | 3.0 |
| <i>Physical capital</i> | | | | | | | | | | | | |
| Accessibility | 1.8 | 0.7 | 1.0 | 3.0 | 1.8 | 0.7 | 1.0 | 3.0 | 2.0 | 0.7 | 1.0 | 3.0 |
| Market distance (km) | 205.5 | 22.0 | 174.5 | 240.5 | 210.4 | 21.7 | 174.5 | 240.5 | 201.4 | 19.7 | 174.5 | 240.5 |
| Bicycle | 1.2 | 1.2 | 0.0 | 15.0 | 1.4 | 1.3 | 0.0 | 15.0 | 0.9 | 0.7 | 0.0 | 3.0 |
| Motorbike | 0.4 | 0.6 | 0.0 | 5.0 | 0.4 | 0.6 | 0.0 | 3.0 | 0.4 | 0.5 | 0.0 | 1.0 |
| Chainsaw | 0.1 | 0.4 | 0.0 | 2.0 | 0.2 | 0.4 | 0.0 | 2.0 | 0.4 | 0.6 | 0.0 | 2.0 |
| <i>Social capital</i> | | | | | | | | | | | | |
| Assistance | 1.4 | 0.7 | 1.0 | 3.0 | 1.4 | 0.7 | 1.0 | 3.0 | 1.5 | 0.7 | 0.0 | 2.0 |

Table 4.2 continue

| Variables | <u>All sampled HH (n = 400)</u> | | | | <u>Charcoal-producing HH only (n = 250)</u> | | | | <u>Charcoal-trading HH only (n = 30)</u> | | | |
|---------------------------|---------------------------------|-----|-----|-----|---|-----|-----|-----|--|-----|-----|-----|
| | Mean | SD | Min | Max | Mean | SD | Min | Max | Mean | SD | Min | Max |
| Charcoal association | 0.1 | 0.2 | 0.0 | 1.0 | 0.1 | 0.3 | 0.0 | 1.0 | 0.3 | 0.5 | 0.0 | 1.0 |
| Ethnicity | 0.1 | 0.2 | 0.0 | 1.0 | 0.1 | 0.3 | 0.0 | 1.0 | 0.2 | 0.4 | 0.0 | 1.0 |
| Resident status | 0.6 | 0.5 | 0.0 | 1.0 | 0.5 | 0.5 | 0.0 | 1.0 | 0.6 | 0.5 | 0.0 | 1.0 |
| Trust | 1.5 | 0.6 | 0.0 | 2.0 | 1.5 | 0.6 | 0.0 | 2.0 | 1.7 | 0.5 | 1.0 | 2.0 |
| <i>Institutions</i> | | | | | | | | | | | | |
| Traditional charcoal levy | 0.5 | 0.7 | 0.0 | 2.0 | 0.5 | 0.7 | 0.0 | 2.0 | 0.6 | 0.9 | 0.0 | 2.0 |
| <i>Vulnerability</i> | | | | | | | | | | | | |
| Seasonal production | 0.5 | 0.5 | 0.0 | 1.0 | 0.7 | 0.4 | 0.0 | 1.0 | 0.5 | 0.5 | 0.0 | 1.0 |
| Economic shock | 0.8 | 0.4 | 0.0 | 1.0 | 0.8 | 0.4 | 0.0 | 1.0 | 0.5 | 0.5 | 0.0 | 1.0 |

Notes: 1. Negative figure in crop income indicates that household suffered crop damage; 2. HH = household; 3. Explanations about other variables are available in Table 4.1.

4.3.2 Factors Influencing Participation in Charcoal Production and Trade

Results of the Heckman selection and outcome model are presented in Table 4.3. The selection function suggests that younger household heads are more likely to engage in charcoal production and trade than are older ones (both significant at the 0.01 and 0.05 levels respectively). Households headed by males are more engaged in charcoal production than are households headed by females. The opposite is the case for charcoal trade where female headed households dominate participation (significant at the 0.01 and 0.05 levels respectively). Educated household heads are more likely to participate in charcoal trade (significant at the 0.1 level), but not in production. Households from communities situated farther from urban charcoal markets are more likely (significant at the 0.01 level) to participate in charcoal production, while there is no difference for charcoal trade. Membership in a charcoal association is positively associated with participation in both charcoal production and trade (significant at the 0.05 and 0.01 levels respectively).

A household head belonging to the Sissala ethnic group is positively associated with production (significant at the 0.05 level), but not with charcoal trade. Owning a bicycle is positively associated with participation in charcoal production (significant at the 0.1 level), while owning a motor bike is positively associated with participation in charcoal trade only (significant at the 0.05 level), not production. Participation in charcoal production is also positively associated (significant at the 0.05 level) with households paying a charcoal production levy to the chief and at higher levels of this fee, while there is no difference for charcoal trade. Seasonality (seasonal production of charcoal) has a highly positive association with participation in charcoal production. Households that own a chainsaw are more likely to participate in charcoal trade (significant at the 0.01 level), but not production. However, households that suffer economic shocks are less likely to trade in charcoal (significant at the 0.05 level), while no difference was found for charcoal production.

4.3.3 Factors Influencing Income from Charcoal Production and Trade

In the outcome regression focusing on the factors influencing income (Table 4.3), it emerges that overall household income is associated with high income from both charcoal production and trade (both significant at the 0.01 level). High income from crop is, however, negatively associated with income from charcoal production and

trade (significant at the 0.05 and 0.01 levels respectively). Households with higher numbers of members and economically active members are more likely to get high income from charcoal trade (both significant at the 0.05 levels), but not production. Households from communities with a perceived higher availability of trees surrounding the village are more likely to get high income from charcoal trade (significant at the 0.1 level), while there is no effect of tree availability perception on charcoal production income. Staying in well-connected communities is associated with low income from charcoal trade, while remote communities are associated with high income from charcoal trade. No statistically significant relationships were found between accessibility and market distance with income from charcoal production. Owning a bicycle is positively associated with high income from charcoal trade (significant at the 0.05 level), but not production. However, owning a motor bike is positively associated with high income from both charcoal production and trade (both significant at the 0.1 and 0.01 levels respectively).

Membership in charcoal association is positively associated with high income from charcoal production and trade (significant at the 0.01 and 0.05 levels respectively). Ethnicity or household head being Sissala is positively associated with high income from charcoal trade (significant at 0.05 level), but not production. Payment of a traditional charcoal levy is negatively associated with high income from charcoal trade (significant at 0.05 levels), while no difference was found for charcoal production.

It is worth noting that the question on seasonal importance of charcoal was restricted to only charcoal-producing households, because merchants trade all year round.

Table 4. 3 Results of Heckman model for selection into and outcome of charcoal production and trade

| | <u>Charcoal production</u> | | <u>Charcoal trade</u> | |
|---|----------------------------|-----------|-----------------------|-----------|
| | Coef. | Std. Err. | Coef. | Std. Err. |
| <i>Selection variables</i> | | | | |
| Total income less income from crops and charcoal production | -3.42E-06 | 3.21E-06 | NA | NA |
| Total income less income from crops and charcoal trade | NA | NA | 3.71E-06 | 3.35E-06 |
| Crop income | 2.50E-05 | 4.26E-05 | -4.1E-05 | 5.92E-05 |
| Age | -0.02*** | 0.01 | -0.02** | 0.01 |
| Education | 0.10 | 0.08 | 0.19* | 0.11 |

| | | | | |
|---|----------------------------|-----------|-----------------------|-----------|
| Gender | 1.01*** | 0.29 | -0.78** | 0.35 |
| | <u>Charcoal production</u> | | <u>Charcoal trade</u> | |
| | Coef. | Std. Err. | Coef. | Std. Err. |
| No. household members | 0.00 | 0.04 | -0.01 | 0.05 |
| No. active household members | -0.01 | 0.05 | 0.07 | 0.07 |
| Perception of tree availability | 0.24 | 0.17 | 0.12 | 0.21 |
| Accessibility | -0.07 | 0.14 | 0.06 | 0.19 |
| Market distance | 0.02*** | 0.00 | 0.00 | 0.01 |
| Bicycles | 0.16* | 0.09 | -0.14 | 0.16 |
| Motorbikes | -0.19 | 0.16 | -0.06 | 0.22 |
| Chainsaws | 0.35 | 0.25 | 0.84*** | 0.26 |
| Assistance | 0.10 | 0.13 | 0.04 | 0.18 |
| Charcoal association | 0.84** | 0.40 | 0.98*** | 0.34 |
| Ethnicity | 1.29** | 0.59 | 0.42 | 0.42 |
| Residential status | -0.20 | 0.20 | 0.00 | 0.31 |
| Trust | 0.07 | 0.15 | 0.10 | 0.22 |
| Traditional charcoal levy | 0.26** | 0.11 | -0.04 | 0.16 |
| Seasonal production | 2.51*** | 0.41 | NA | NA |
| Economic shock | 0.24 | 0.20 | -0.55*** | 0.24 |
| <i>Intercept</i> | -4.40*** | 1.15 | 0.27 | 1.57 |
| <i>Outcome variables</i> | | | | |
| Total income less income from crops and charcoal production | 0.03*** | 0.01 | NA | NA |
| Total income less income from crops and charcoal trade | NA | NA | 0.21*** | 0.02 |
| Crop income | -0.13** | 0.06 | -1.23*** | 0.23 |
| Age | -14.00 | 10.69 | -10.12 | 55.32 |
| Education | -81.51 | 136.35 | 221.91 | 594.96 |
| Gender | -349.55 | 596.21 | -1780.78 | 1504.64 |
| No. household members | 16.04 | 58.43 | -490.36** | 244.80 |
| No. active household members | -14.86 | 90.37 | 867.28** | 431.99 |
| Perception of tree availability | -56.78 | 249.27 | 1728.72*** | 706.81 |
| Accessibility | 189.49 | 211.68 | -3425.34*** | 1293.45 |
| Market distance | -0.43 | 8.09 | 44.51* | 24.82 |
| Bicycles | 114.69 | 111.60 | 1861.36** | 769.89 |
| Motorbikes | 449.39* | 251.61 | 3510.85*** | 1262.30 |
| Chainsaws | -182.68 | 387.85 | -103.81 | 1886.60 |
| Assistance | -277.60 | 212.30 | 1054.53 | 918.69 |
| Charcoal association | 1720.06*** | 567.18 | 4286.10** | 1819.68 |
| Ethnicity | 732.92 | 581.55 | 4524.83*** | 1258.57 |
| Residential status | -230.05 | 338.59 | 2314.24** | 1017.68 |
| Trust | 335.30 | 248.69 | -1859.40 | 1325.53 |
| Traditional charcoal levy | -183.53 | 202.24 | -1247.42** | 532.66 |
| Seasonal production | -441.99 | 546.36 | -5898.40 | 5976.00 |
| <i>Intercept</i> | 1389.53 | 2448.66 | NA | NA |

Notes: 1. *, ** and *** signify statistical significance at 0.1, 0.05 and 0.01 levels respectively; 2. NA = non-applicable; 3. Explanations about variables are available in Table 4.1

4.3.4 Influence of Community on Income from Charcoal Production and Trade

There are no statistically significant differences between communities with reference to the mean income households obtained from charcoal production ($p = 0.555$) and trade ($p = 0.495$) (Table 4.4).

Table 4. 4 Mean household income in US\$ from charcoal production and trade, by community

| Community | Charcoal production | Charcoal trade |
|-------------|---------------------|----------------|
| Asantekwaah | 150.75 | 237.44 |
| Bomini | 155.95 | 10.92 |
| Bonte | 748.96 | 637.74 |
| Cheranda | 500.76 | 1358.97 |
| Drumankese | 766.11 | 229.03 |
| Gulumpe | 788.17 | 210.45 |
| Kunsu | 810.66 | 785.04 |
| Mansie | 495.23 | 106.74 |
| Miawani | 945.47 | 635.24 |
| Sabule | 500.15 | 3.40 |

4.3.5 Insight from the Follow-up Qualitative Interviews and PRAs

Results from the PRA sessions and follow-up interviews with charcoal producers, merchants and key informants such as chiefs and staff of the Forestry Commission and District Assemblies are presented in this section. The results capture the perspectives of these stakeholders in the selection of actors into charcoal production and trade and the income derived therefrom as explained by the Heckman model.

4.3.5.1 Financial Capital

Most charcoal producers disclosed that they take loans from charcoal merchants to finance certain activities in the production process. These include felling and crosscutting trees into billets; packing billets into woodpiles; covering woodpiles with soil and grasses; and packing charcoal into sacks. Sourcing for wood and monitoring of the carbonisation process are the only activities that do not require financial capital. This information was triangulated at the PRA sessions, where the participants stated the following as conditions for a charcoal merchant to grant a loan to a charcoal

producer: (i) a producer who takes a loan is required to repay the loan in kind by selling an equivalent number of charcoal bags to the merchant from whom he/she takes a loan; and (ii) the merchant sets the buying price below the prevailing market price in the community. Interviewed merchants confirmed this arrangement and explained that their buying of charcoal below the prevailing market price is to enable them to cover their cost of credit. For example, a charcoal merchant at Bomini mentioned:

I take loans from my bank to pre-finance charcoal-producing activities, pay levies and transport fares. Although the bank from which I take loans charges interests, I do not charge interest on the loans I give to charcoal producers who borrow from me. Additionally, it takes a month or two before I get back my money in the form of charcoal from a producer who has taken a loan from me. Buying charcoal below the prevailing market price is a means of offsetting the interests on the bank loan. (interview note # CM05Bom)

Interviewed charcoal producers also recounted that they make higher profits when they finance the production process themselves. They attributed this to the fact that they are able to sell charcoal at the prevailing market price or even bargain for a higher price. This explains the results of the Heckman outcome regression that indicates that high overall household income is associated with high income from charcoal production.

Results of the Heckman outcome regression also show that high overall household income is associated with high income from charcoal trade. Interviewed charcoal merchants explained that high income affords them the opportunity to benefit from economies of scale. That is, they are able to provide loans to many producers and in effect make profit from charcoal that is bought at lower prices, and also buy more charcoal to sell in the cities. They further explained that merchants must buy charcoal from several producers, cart it from production sites, and get a truck filled before transporting charcoal from villages to cities to sell. Moreover, it takes between five and seven days for a merchant to completely sell a truck-load of charcoal to wholesalers in the cities. Wholesalers buy charcoal on credit and it takes one to two weeks for merchants to be paid. These do not inure to the benefit of low-income households.

4.3.5.2 Human Capital

The interviewed charcoal producers and participants at the PRA sessions narrated that charcoal production is drudgery and labour intensive. According to them, households with a high number of active members, especially males, can produce higher volumes of charcoal themselves than their counterparts with fewer members. This claim explains the inverse association between age of households' heads and participation in charcoal production and trade in the Heckman selection regression. PRA participants revealed that older male and female charcoal producers mostly rely on young or active household members or outside labour to assist them to produce high volumes of charcoal. It is therefore not surprising that no statistically significant relationship was found between the ages of households' heads and income from charcoal production and trade in the Heckman outcome regression.

PRA participants attributed the association between households' heads being female and participation in charcoal trade to the dominance of females in commodity trading in Ghana. They stated that trading is perceived by many as a female job. PRA participants also explained that the association between ethnicity (i.e., being Sissala) and participation in charcoal production is due to the fact that charcoal production was introduced in the study area by the Sissala tribesmen who migrated from the Upper West Region of Ghana. Although all ethnic groups in the study area are now involved in charcoal production and trade, the Sissalas are still acclaimed for their specialised skills in charcoal production. Most of our respondents indicated that a Sissala is likely to obtain more charcoal than a non-Sissala for the same volume of wood used to carbonise charcoal. The PRA participants also attributed the association between ethnicity and high income from charcoal trade to the fact that the early Sissala charcoal producers used to double as charcoal merchants. They therefore know the urban charcoal market and have networks of wholesalers and retailers to sell charcoal to.

4.3.5.3 Natural Capital

Trees, soil and grasses are the three natural inputs needed to produce charcoal. Interviewed charcoal producers and PRA participants reported that soil and grasses are readily available to charcoal producers. They become scarce only in the dry season, when the soil becomes compacted and grasses get burned by wildfires. Most

charcoal producers double as farmers and stated that they use trees from their farms and fallow lands to produce charcoal.

We undertook a trend analysis to capture the perception of tree availability in the communities over time (Table 4.5). The political history of Ghana (i.e., period after independence in 1957 to 2016) was used as a proxy because it was the easiest period the participants could relate with. Ten denotes the highest number of trees, while one denotes the lowest number of trees. The table shows that trees were abundant in the communities and their population remained intact from 1957 to 1979, when it started to decline. The decline was steady from 1979 to 2000, but very sharp from 2001 to 2008. Seven communities reported that it is difficult to get trees to produce charcoal these days. The PRA participants attributed the reduction in the number of trees to timber exploitation, farming and charcoal production.

Table 4. 5 Perception of trend of tree populations in communities

| Community | Period | | | | | | | |
|-------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | 1957- 1966 | 1966- 1969 | 1969- 1972 | 1972- 1979 | 1979- 1992 | 1993- 2000 | 2001- 2008 | 2009- 2016 |
| Asantekwaah | 10 | 10 | 10 | 10 | 10 | 7 | 3 | 2 |
| Bomini | 10 | 10 | 10 | 10 | 8 | 6 | 3 | 1 |
| Bonte | 10 | 10 | 10 | 10 | 9 | 6 | 3 | 1 |
| Cheranda | 10 | 10 | 10 | 10 | 7 | 4 | 2 | 1 |
| Drumankese | 10 | 10 | 10 | 10 | 9 | 6 | 2 | 1 |
| Gulumpe | 10 | 10 | 10 | 10 | 9 | 7 | 5 | 1 |
| Kunsu | 10 | 10 | 10 | 8 | 5 | 3 | 2 | 1 |
| Mansie | 10 | 10 | 10 | 8 | 7 | 3 | 2 | 1 |
| Miawani | 10 | 10 | 10 | 10 | 10 | 10 | 7 | 3 |
| Sabule | 10 | 10 | 10 | 10 | 10 | 7 | 3 | 2 |

4.3.5.4 Physical Capital

The interviewed charcoal producers and PRA participants stated that charcoal production requires basic implements like a cutlass, hoe, rake and often, chainsaw to fell and crosscut big trees into billets. All charcoal-producing households reported that they own cutlasses and hoes as they are used in their farming activities. Although rakes are cheap (GH¢ 10.00), the majority of charcoal producers reported that they borrow them from friends or family members or rent it at a minimal fee (GH¢ 3.00). It was learned through PRA that chainsaws are expensive and are therefore owned by very few households, who rent them out to charcoal producers for a fee. The PRA participants ascribed the association between ownership of a chainsaw and

participation in charcoal trade in the Heckman selection regression to the practice whereby producers mostly request merchants who own chainsaws to fell and crosscut trees for them. Such producers normally do not pay for these services in cash, but in-kind with charcoal after the carbonisation process.

Clarifying the association between owning a bicycle and participation in charcoal production, some producers reported that they travel long distances in search of trees, so owning a bicycle or motorbike is of paramount importance in the charcoal business. A charcoal producer in Drumankese narrated that “besides searching for trees, one needs a bicycle or motorbike to effectively monitor the carbonisation process” (interview note # CP0140Dru).

Charcoal merchants attributed the association between owning a motorbike and income from charcoal production and trade to the important role the device plays in the charcoal business. For example, a charcoal merchant at Kunsu stated:

Public transport is poor in this community as a result of the bad nature of the road linking the community to the district capital. Motorbikes are the popular means by which charcoal merchants and middlemen commute between villages in search of charcoal to buy. (interview note # CM011Kun)

Although no statistically significant differences were found between accessibility (i.e., quality of road) and participation in charcoal production and trade, income from charcoal trade was found to decrease in poorly connected communities in the Heckman outcome model. Interviewed merchants reported that although charcoal prices are lower in poorly connected communities than in better connected communities, they incur high transportation costs. For example, the price of a standard bag of charcoal ranged US\$ 3.82 – US\$ 5.10 and US\$ 2.04 – US\$ 2.54 in well- and poorly-connected communities respectively. A charcoal merchant at Kunsu recounted:

I incur double transportation costs as drivers are forced to divide loads into two or more parts before they can cart charcoal from poorly connected communities. I sometimes use tractors to cart charcoal from poorly-connected communities before off-loading to trucks that are stationed at good roads. I incur additional labour costs on loading, offloading, and reloading of charcoal into trucks. (interview notes # CM011Kun)

PRA participants attributed the association between distances from communities to urban charcoal markets to the fact that most long-distance communities have more trees than communities that are closer to the markets. The association between

distance and high income from charcoal trade was also attributed to the low price at which merchants buy charcoal from long-distance communities. A charcoal merchant at Miawani disclosed:

Vehicle drivers charge high fares for charcoal carted from long distance communities. However, charcoal prices in the urban markets do not take into consideration the source of the charcoal. We (merchants) therefore pass these extra costs to producers by reducing the price at which charcoal is bought in poorly connected communities. (interview note # CM117Mia)

4.3.5.5 Social Capital

PRA participants attributed the relationship between membership in charcoal associations and participation in charcoal production and trade to the history behind the formation of these associations. They reported that the Paramount Chiefs of Nkoransa and Mo Traditional Areas imposed a ban on charcoal production and trade in the mid-1990s over concerns that charcoal production was degrading the environment. Associations of charcoal producers and merchants were therefore formed in most of the charcoal-producing communities to appeal for the lifting of the ban. The ban was later lifted, but levies were imposed on charcoal production and trade within the two traditional areas. The levies, are however, paid by charcoal merchants. No ban has been placed on charcoal production and trade again since the formation of the associations. An executive of one of the charcoal associations narrated:

Although it is not mandatory for a charcoal producer to belong to any of the associations, the executives of these associations, where they exist, are mostly charcoal merchants or large-scale charcoal producers. We collect annual fees in the form of two bags of charcoal from all producers (members and non-members alike) and present them to the Paramount Chief during the annual yam festival. (interview notes # CM018Dru)

4.3.5.6 Institutions and Mediating Structures

We learned that chiefs of three of the study communities collect levies from migrant charcoal producers – i.e., 10% in Gulumpe and 20% in Bonte and Drumankese. We also found out that District Assemblies in the study area do not regulate the charcoal sector but collect levies from charcoal transporters. Interviewed staff of the Forestry Commission explained that the Commission has not been able to regulate the charcoal sector as expected, because of the intimate nature between charcoal production and farming. They stated that the laws of Ghana permit farmers to fell and kill trees as

part of their farming activities. The Forestry Commission therefore cannot prevent producers from using dead trees to produce charcoal. They indicated that the Commission has initiated programmes to formalise and regularise the charcoal sector. It has started the formalisation process with the issuance of a charcoal conveyance certificate to transporters of charcoal. It will soon register, license and train charcoal producers and merchants in establishment of woodlots and efficient carbonisation techniques.

4.3.5.7 Vulnerability Context

The household survey revealed that 183 out of the 250 charcoal-producing households (73%) considered income from charcoal to be seasonally important to them. When respondents were asked to explain the reasons for the seasonal importance of charcoal, 51 (28%) reported that they do not have access to other income sources, while 70 (38%) recounted that they have access to other income sources, but these sources are not sufficient at certain times of the year. The rest stated that they have access to other income sources, but charcoal production becomes more profitable in the rainy season, so they tend to produce more charcoal in this period. These claims clarify the association between seasonality and participation in charcoal production in the Heckman selection regression. We got to know through the PRA sessions that the periods where households do not have other income or have insufficient income coincide with the months of June and July where households had sold most of the previous year's food crops and new crops are also not ready for harvest. We also found from the PRA sessions that charcoal prices rise in the rainy season where it becomes difficult for vehicles to cart charcoal from production sites to the cities due to the bad nature of roads linking communities to tarred roads.

Most (80%) of the interviewed charcoal producers also reported in the household survey that they produce charcoal to mitigate economic shocks such as crop failure and damage from cattle, illness, death and social events like weddings. Crop failure, illness, and cattle damage were the three most reported shocks; and, respectively, 70 (28%), 44 (18%) and 18 households (7%) mentioned that they produce more charcoal to mitigate these shocks. For example, a charcoal producer from Mansie recounted at the follow-up interview:

I borrow money from charcoal merchants when I am in need of money for school fees or hospital bills. I produce charcoal to pay back such loans. Charcoal gives a quick source of money. (interview note # CP062Man)

Another producer at Gulumpe narrated, “Cattle have been destroying my farms of late, so I have intensified my charcoal production business to cope with the crop loss. You know cattle do not eat charcoal” (interview notes # CP088Gul).

4.4 Discussion

4.4.1 Factors Influencing Participation and Income in Charcoal Production and Trade

4.4.1.1 Capitals

A number of studies (e.g., Ainembabazi *et al.*, 2013; Brobbey *et al.*, 2019a; Khundi *et al.*, 2011) have reported that charcoal production is not the preserve of the poor and have stipulated a positive link between high overall household income and income from charcoal. Likewise, we did not find statistically significant differences between the income levels of households and their participation in charcoal production and trade. This may be explained by the low entry barrier in the collection and processing of environmental resources (Cavendish, 2000). We attribute this to the low requirement of physical capital for production of charcoal. Charcoal production requires basic tools like hoes and cutlasses, which are also used as farming implements and are easily accessible to all rural households. However, we found that overall household income is positively associated with high income from both charcoal production and trade. This is consistent with the findings of Brobbey *et al.* (2019) and Khundi *et al.* (2011) and is attributed to the role financial capital plays in determining income from charcoal. High-income households can hire labour to produce more charcoal. They are also able to reap high profits when they self-finance charcoal-producing activities, unlike their counterparts in low-income households who mostly rely on credit from charcoal merchants.

Our finding that charcoal merchants make profits by buying charcoal they pre-finance below the prevailing market price corroborates the finding of Agyei *et al.* (2018) that merchants use financial capital (i.e., credit) to control and maintain benefits along the charcoal commodity chain in Ghana. Our findings that high-income households get higher income from charcoal trade than low-income households resonates with

Arnold and Pérez's (2001) hypothesis that wealthier households frequently capture high income from trade in forest products because poorer households mostly lack the funds required for start-up and to access markets. The dominance of high-income households in charcoal trade is attributed to the high entry barrier in charcoal trade. This includes the cost of providing credits to charcoal producers, buying charcoal in bulk to enjoy economies of scale, payment of customary and statutory levies, transport fares, knowledge of the urban markets and the long credit period retailers have to pay for charcoal bought on credit. Charcoal merchants also use chainsaws (physical capital) to gain high profit from the charcoal business.

Most studies have reported that charcoal production is gendered and that the need to meet pressing financial and social desires motivates females to produce charcoal (e.g., Agyei *et al.*, 2018; Ainembabazi *et al.*, 2013; Butz, 2013; Jones *et al.*, 2016; Khundi *et al.*, 2011). Our findings that young and male-headed households are more likely to produce charcoal than are old and female-headed households are consistent with the findings of both Ainembabazi *et al.* (2013) and Khundi *et al.* (2011) that charcoal-producing households in Uganda are mostly headed by young males. Smith *et al.* (2017) report that although charcoal production is dominated by males in Malawi, females get twice as much of the income from charcoal (45%) as males (26%). They attribute this to the fact that females have a limited range of income-generating activities to choose from in Malawi and therefore tend to rely more on charcoal. The gendered nature of charcoal production may therefore be site specific and determined by the motivation behind the production. Contrary to our findings on participation in charcoal production, female-headed households dominate participation in charcoal trade. This contradicts the findings of Fisher (2004) that lucrative and commercial economic activities like charcoal are the domain of men in Malawi. Charcoal trade, however, provides high income to rural households (Brobbey *et al.*, 2019a) and the involvement of females in this activity can be used to raise the status of women within rural households in developing countries who normally have fewer income-generating options (Ellis, 1999; UN, 2013).

Although we found that charcoal production and trade were introduced in the study area by the migrant Sissala tribesmen, all ethnic groups are now engaged in charcoal production and trade. However, being Sissala is associated with participation in

charcoal production and high income from charcoal trade. This can be attributed to the fact that most Sissalas possess specialised skills in producing charcoal, do forward integration, have networks and know the urban charcoal markets (Agyei *et al.*, 2018). We also found membership in charcoal associations to be related with participation and high income from charcoal production and trade. This coincides with the report by Zorrilla-Miras *et al.* (2018) that membership in forest user groups is associated with a high volume of charcoal production in Mozambique. Similar findings have been reported by Pouliot and Elias (2013) that the presence of a shea butter producer group enhances both participation and returns in the shea butter market in Burkina Faso. The most probable explanation for the observation may lie in the conjecture that it is those who produce charcoal at a high level and therefore make the most profit that are inclined to join the association. Their motivation maybe readiness to protect the industry against possible inimical policies. Low-level producers may not be too enthused about joining the associations. This is an opportunity that policy makers and natural resources managers in Ghana can exploit in their attempt to promote sustainable charcoal production.

We did not find statistically significant differences between the perception of tree availability and participation in both charcoal production and trade. Earlier studies in the study area did not also establish evidence for a clear link between charcoal production and degradation (e.g., Aabeyir *et al.*, 2016; Amanor *et al.*, 2005). Perception of tree availability was, however, found to be associated with high income from charcoal trade. This could be attributed to the fact that charcoal merchants make more profit from communities with high tree populations.

4.4.1.2 Institutions and Mediating Structures

The charcoal sector in Ghana is characterised by legal pluralism. Customary institutions led by chiefs mediate access to trees used for producing charcoal, while the state Forestry Commission and District Assemblies regulate the trade and transport of charcoal. This resonates with the findings of Schure *et al.* (2015) that customary institutions are strong and largely govern access to tree resources for charcoal and firewood in the Democratic Republic of Congo (DRC). Statutory institutions that are officially charged with the regulation of the woodfuel (charcoal and firewood) sector in the DRC were found to be weak (Ibid). We also found that

payment of traditional charcoal levies (institutions) did not influence participation and outcome in charcoal production but is associated with reduced income from charcoal trade. This is explained by the fact that charcoal merchants rather than producers pay this levy. Schure *et al.* (2015), however, report that the imposition of restrictions by customary institutions in the DRC for specific areas and seasons has not been able to promote the sustainability of the tree resource base. The roles of statutory and customary institutions in mediating access to trees for charcoal is important to the livelihood strategies and outcomes of households and the environmental impacts of charcoal, and is an area we intend to investigate further.

4.4.1.3 Vulnerability Context

Our results indicate that households that consider income from charcoal production to be seasonally important are more likely to produce charcoal, while no statistically significant relationship was observed between income from charcoal production and seasonality. The association between seasonality and participation in charcoal production is consistent with Angelsen and Wunder's (2003) assertion that households may gather certain forest products each year in the months between staple harvests. Charcoal, in addition to being a regular source of household income, serves as a "quick source of cash" and households that need cash turn to it as an instant income gap-filler and safety-net (Brobbe *et al.*, 2019a). The absence of a statistically significant relationship between seasonality and income from charcoal production could be attributed to the assertion by Angelsen *et al.* (2014) that environmental income contribute more to regular household income than is often recognised. Households may face difficulty distinguishing seasonal income from regular income (Ibib).

No statistically significant association was found between participation in charcoal production and suffering of economic shocks. This might be attributed to the use of multiple mechanisms by rural households to mitigate such shocks. Wunder *et al.* (2014) also did not find statistically significant relationship in their global study on the use of environmental resources as safety-net. The negative association between suffering economic shocks and participation in charcoal trade could be ascribed to households' inability to travel and spend more days in the cities to sell charcoal when members fall ill or die.

We also found that high income from both charcoal production and trade is associated with low income from crops. This may be attributed to the inability of households to equally allocate household labour to farming, charcoal production, and trade. Charcoal trade, for instance, is lucrative, but time demanding. Most charcoal merchants therefore specialise in charcoal trade as a livelihood strategy (Brobbe *et al.*, 2019a). Ainembabazi *et al.* (2013) and Khundi *et al.* (2011) also report that charcoal producers in Uganda have smaller farm sizes and crops income than non-producers. Ndegwa *et al.* (2016), however, found the opposite in Kenya and report that large-scale charcoal producers get higher absolute and relative income from crops than do small-scale producers. They explained that rural business and agriculture are the two most important activities that contribute to household wealth in Kenya and large-scale charcoal producers invest and diversify into these two activities.

4.4.2 Limitations and Further Research

We should point toward a number of limitations in our study, some of which also suggest further research. First, crop farming is the major economic activity in the study area (GSS, 2014) and communities suffered a long period of drought in the survey year (2016). Since farming in the area is rain-fed, we acknowledge that the factors that influence participation and income from charcoal may differ in periods of good rains. This calls for a replication of the study, or a study that covers multiple years. Second, we acknowledge that our decision to sample only one household per house could have resulted in the selection of a lower number of households in bigger communities that are characterised by more compound houses inhabited by many families or households. We nevertheless have no indications that this has introduced a systematic bias in our results. Third, we could not include communities, statutory institutions, and price of charcoal in the Heckman model because of issues of multicollinearity. It will therefore be helpful for further studies to examine the roles of customary and statutory institutions in mediating access to capitals and the livelihood outcomes of charcoal production and trade. Finally, we would like to suggest further research on the role of charcoal associations in increasing participation in charcoal production and trade, as well as studies to further understand the role of gender in charcoal production and trade.

4.5 Conclusions and Policy Implications

The study sought to provide an understanding of factors underpinning the decision by rural households to engage in charcoal production and trade, and the income from these activities. The study found that participation and income from charcoal production and trade are not associated with any specific income group. However, high-income households get higher income from charcoal production and trade than do low-income households. Participation in charcoal production is positively influenced by long distance from community to urban charcoal market, owning a bicycle, membership in charcoal associations, ethnicity, payment of a traditional charcoal levy and consideration of seasonal importance of charcoal to households. Young and male-headed households are also more likely to produce charcoal than are old and female-headed households. Participation in charcoal trade, on the other hand, is positively associated with young and female-headed households, education, owning a chainsaw and membership in a charcoal association. Furthermore, income from charcoal production is positively associated with owning a motorbike and being a member of a charcoal association, but negatively associated with income from crop production. Income from charcoal trade is also positively influenced by the number of household members, perception of a high number of trees, distance from a community to an urban charcoal market, owning assets like bicycles and motorbikes, ethnicity of heads of household and membership in a charcoal association, but negatively associated with crop income, a poor road network and payment of the traditional charcoal levy.

In terms of policy implications of the study and its findings, we would like to first point to the finding that charcoal production and trade take place across all income groups, and constitutes a significant source of income for many rural households. Governments in many SSA countries, including Ghana, are currently considering measures to formalise the charcoal sector. In doing so, it is of crucial importance to consider the impacts (intended as well as unintended) of formalisation, for example, in the form of permit regimes. Formalisation may often have (unintended) negative impacts on rural livelihoods by restricting the activity or leading to increased burdens, barriers and costs. The impacts on rural livelihoods of attempts to formalise the timber sector in Ghana testify to this challenge and risk (Hansen *et al.*, 2018). The study also documents the strong role, over decades, of customary institutions (chiefs)

in governing charcoal production and trade, a factor that also needs to be reflected on in formalisation efforts.

On the more specific level, the study points to the importance of charcoal associations, and further strengthening of these, for example, in the form of improving members' access to credit and improved kilns to increase production efficiency; this seems to be yet another important aspect to consider in formalisation processes and future government initiatives. Charcoal associations, if they could have a role in facilitating access to credit, access to market information and collective marketing of charcoal, are perhaps a way forward in terms of enhancing the profit share of producers and reducing the profit share of merchants. Other potential roles of charcoal associations could relate to the establishment of community and smallholder woodlots, organise training of trainers programmes for the adoption of improved kiln technologies, value addition of charcoal (e.g., charcoal briquette) and improved packaging – all activities envisaged in the Woodfuel Policy component of the Bioenergy Policy of Ghana (Energy Commission, 2010). Finally, the study documents a perception among producers of a sharply declining resource base, which may jeopardise future income and livelihoods. The establishment of woodlots and plantations for charcoal production may be a way forward, but is challenged by the complex tree tenure and benefit-sharing arrangements, and risks of fire and cattle damage, that may hamper the incentive of small-scale producers to engage in such activities, especially in the forest savannah transition area including Kintampo Forest District.

CHAPTER FIVE

5.0 THE DYNAMICS OF PROPERTY AND OTHER MECHANISMS OF ACCESS: THE CASE OF CHARCOAL PRODUCTION AND TRADE IN GHANA

This chapter has been submitted as a paper to the Land Use Policy journal as:

Brobbey, L.K., Hansen, C.P., and Kyereh, B. The dynamics of property and other mechanisms of access: The case of charcoal production and trade in Ghana

Abstract

An analysis of the dynamics of access to resources is important for a fuller understanding of rural livelihoods especially with changing times and technology. This paper uses benefits from charcoal production and trade in the forest savannah transition zone of Ghana as a case to explore the dynamics of access in time and space and the mechanisms various social actors apply in order to benefit. The study applies an analytical framework combining the revised property rights framework of Sikor *et al.* (2017) with “A Theory of Access”. Participatory rural appraisal methods, stakeholder meetings, document reviews and interviews were conducted with social actors along the charcoal commodity chain. The paper shows that the ability to benefit from charcoal is more dependent on property than other mechanisms of access, and both customary and statutory institutions are involved in mediating access to charcoal in the area. The realisation of economic benefits from charcoal led to a contestation between chiefs and family heads over rights to trees in some communities and changes in the mode of payment for trees used in producing charcoal. Scarcity and concern over sustainability of trees have also driven the dynamics of the access mechanisms. Chiefs have strengthened their authority in charcoal-producing communities and the low presence of statutory institutions like the Energy Commission, Environmental Protection Agency and Forestry Commission in those communities has implication on plans by the state to formalise and regularise charcoal production and trade in the country. We envisage four adverse effects from the government’s attempt to formalise the charcoal sector – elite capture, exclusion of vulnerable and marginalised people, criminalisation of livelihoods and loss of rights. We recommend that the planned formalisation should be devoid of directives that would make charcoal production and trade prohibitive for low-income households.

Key words: Authority; Contestations over property; Formalisation; Institutions; Natural resources governance

5.1 Introduction

“A Theory of Access” has expanded scholarly thinking about how people are able to benefit from resources beyond what property enables them (Ribot and Peluso, 2003). The theory argues that social actors may use rights-based (i.e., property) as well as structural and relational mechanisms to benefit from resources. Rights-based access is access sanctioned by law, custom or convention. It also includes illegal mechanisms such as theft, coercion, or deception.⁴⁸ The structural and relational mechanisms include technology, capital, markets, labour, knowledge, authority, identity and social relations. These mechanisms alone or in combination with rights-based access shape how benefits are gained, controlled and maintained (Ribot and Peluso, 2003). “Access” is defined as “the ability to benefit from things” (Ribot and Peluso, 2003: 154), while property is “a right in the sense of an enforceable claim to some use or benefit of something” (MacPherson, 1978). Property is thus concerned with legitimate claims. A claim only becomes property if it is sanctioned by a politico-legal institution (e.g., high level, decentralised or lower level state institution, traditional authority) within laws, conventions or norms (Bromley, 1992; Ribot and Peluso, 2003; Sikor and Lund, 2009). A Theory of Access has gained popularity among scholars as a useful framework for structuring and analysing empirical data precisely because of its combination of property and structural and relational mechanisms. It has been used to explain why and how social actors without property are able to gain material benefits from resources (e.g., Neimark, 2010; Ribot, 1998; Xu *et al.*, 2010). It has also been used to explain how social actors with equal *de jure* rights actually achieve highly different benefits (e.g., Ribot and Oyono, 2005; Sikor and Nguyen, 2007).

Access to resources is obviously important for building sustainable rural livelihoods (Bebbington, 1999; Ellis, 2000; Scoones, 2015). Access is rife with contestations, conflicts and ambiguities, not least in societies characterised by normative and legal pluralism (Berry, 2002; Sikor and Lund, 2009). Berry (2002) attributes the contestations and ambiguities in access to the multiplicity of institutions that compete to sanction and validate (competing) claims in attempt to gain authority. Sikor and Lund (2009) argue that competition over access can in many ways be seen as the

⁴⁸ Ribot and Peluso (2003) posit that sanctioned and unsanctioned mechanisms are rights-based in so far as rights define the bounds of illegal activities.

forerunner of property claims where people try to secure their claims as property through recognition from a politico-legal institution. They also argue that the process of recognition of claims as property simultaneously works to imbue the institutions that provide such recognition with the recognition of its authority to do so. So access is a dynamic social process in space and time, not a fixed and static process. However, empirical studies that investigate and document the dynamics of access in time and space, including the dynamics between property and other mechanisms of access, are rare.

Consequently, the aim of this study is to describe the dynamics of access in time and space and the mechanisms that various social actors apply in order to benefit. This is done by using benefits from the production and trade of charcoal in the forest savannah transition zone of Ghana. An understanding of the dynamics of access to resource is important for a fuller understanding of rural livelihoods.

We use benefits from production and trade of charcoal as our case study because charcoal is an important environmental, social and economic resource in sub-Saharan African countries. It contributes significantly to meeting energy needs, especially for cooking (Arnold *et al.*, 2006; IEA, 2014; Zulu and Richardson, 2013), poverty reduction, employment creation, household income generation, provision of safety-net against economic shocks and filling of income gaps during lean or off-agricultural seasons (Brobbey *et al.*, 2019a; Butz, 2013; Jones *et al.*, 2016; Khundi *et al.*, 2011; Smith *et al.*, 2017). The demand (sector) is booming and projected to also increase in the coming decades (IEA, 2014). Additionally, there is a dichotomy between customary and statutory institutions in the management of the charcoal sector in many sub-Saharan African countries (Sander *et al.*, 2013; Schure *et al.*, 2015; World Bank, 2009).

The paper contributes to scholarship on the relationship between access and authority. We demonstrate that the ability to benefit from charcoal is dependent more on property than structural and relational mechanisms of access, and both customary and statutory institutions in Ghana are involved in enforcing claims as property. We further describe how the realisation of economic benefits of charcoal and scarcity and concerns over sustainability of the feedstock have driven the dynamics of access

mechanisms in time and space. We argue that the authority of customary authorities (chiefs) over trees in the study area has been strengthened relative to statutory institutions (Forestry Commission and District Assemblies) as a result of the described practices in the charcoal sector.

5.2. Methods

5.2.1 Analytical Framework

We constructed our analytical framework for the study by combining the access framework by Ribot and Peluso (2003) with the revised property rights scheme by Sikor *et al.* (2017). The analytical framework specifies the right-based access in A Theory of Access (Ribot and Peluso, 2003) with the categorisation of rights proposed by Sikor *et al.* (2017) (Figure 5.1). Sikor *et al.* (2017) developed their framework from the bundle of rights framework by Schlager and Ostrom (1992). The original bundle of rights scheme by Schlager and Ostrom (1992) posits that rights exist as a bundle and the incentives social actors face, the type of actions they take and the outcome they achieve in the use and management of natural resources are influenced by the different “bundles of rights” they hold. The limitations with this scheme are that it focuses on local communities and does not account for emerging multiplicity of social actors, legal pluralism and significance of indirect benefits in natural resources management (Sikor *et al.*, 2017). For instance, local communities have internal divisions with different bundles of rights assigned to different community members (Agrawal and Gibson, 1999). The state is also made up of actors with different mandates, resources and interests (Ribot, 2004). The revised scheme by Sikor *et al.* (2017) recognises the multiplicity of social actors and pays attention to a more comprehensive set of relationships among social actors regarding direct and indirect benefits.

Unlike the Schlager and Ostrom’s (1992) framework that proposes five types of property rights at two different levels, the revised framework by Sikor *et al.* (2017) proposes eight types of property rights at three different levels that social actors can use to benefit from a resource. These are: use of direct benefits, use of indirect benefits, management, exclusion, transaction, monitoring, definition, and allocation rights (Box 2.1). The revised framework also distinguishes between the kind of benefits (i.e., direct or indirect) available to each social actor and can be used to

analyse social factors like gender and residence status that differentiate communities. It is open to consider the involvement of other kinds of social actors in resource governance such as non-governmental organisations, private companies and international organisations. It can also accommodate a variety of state actors at the local and national levels.

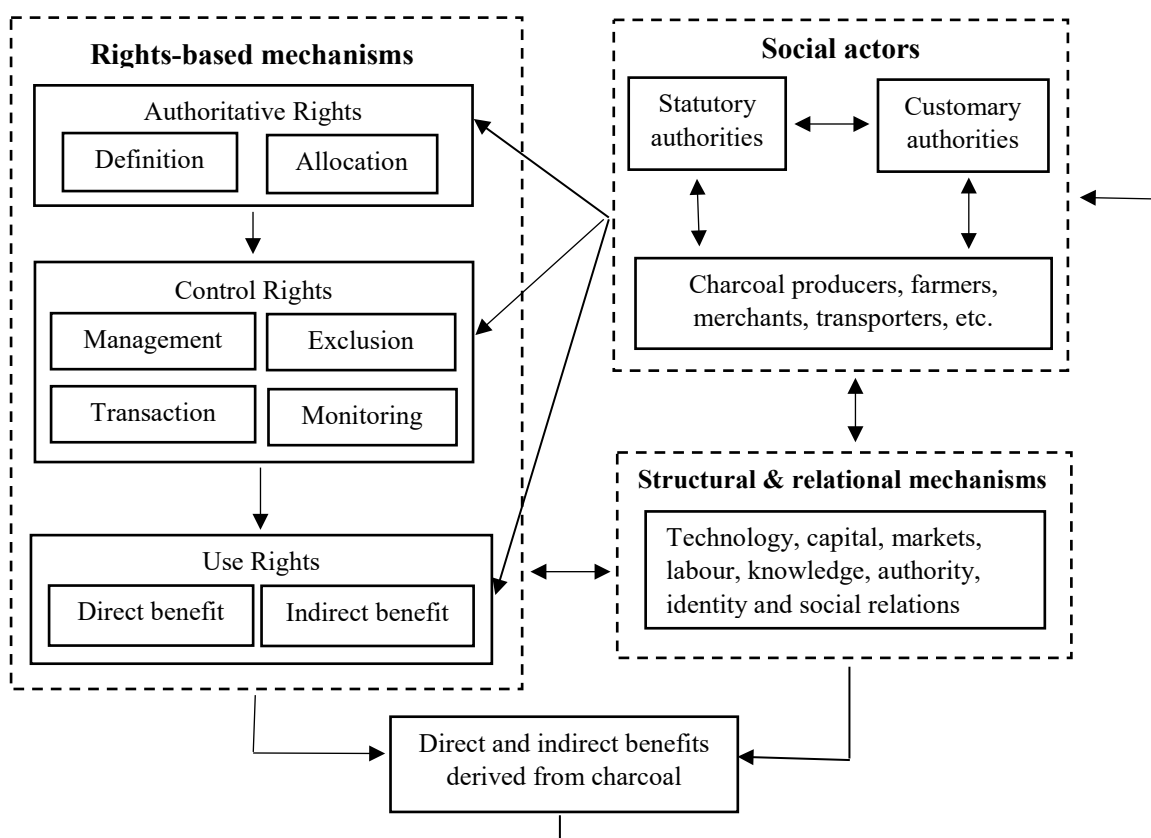


Figure 5. 1 Analytical framework on mechanisms social actors use to benefit from charcoal

Source: Adapted from Ribot and Peluso (2003) and Sikor *et al.* (2017)

5.2.2 Study Area

The study was conducted in 10 charcoal-producing communities in the Kintampo Forest District in the Brong-Ahafo Region of Ghana (Figure 1.1). The forest district was selected because it is the largest charcoal-producing district which accounts for 22% of all charcoal produced in Ghana (Nketiah and Asante, 2018). It cuts across four administrative units (districts/municipal assemblies) and three traditional areas⁴⁹.

⁴⁹ A traditional area is an area within which a paramount chief exercises jurisdiction. It is not linked with administrative boundaries of the state.

Communities were selected with the aim of having all three traditional areas in the sample (Table 5.1). Charcoal production takes place in almost all communities in the district (Aabeyir *et al.*, 2011; Amanor *et al.*, 2005). This is due to the ready availability of feedstock, a characteristic of the district due to its positioning within the forest savannah transition zone. The zone experiences a bimodal rainfall regime and the natural vegetation is characterised by a mixture of trees, shrubs and tall grasses (SRID, 2011).

Table 5. 1 List of survey communities with administrative units, traditional areas and stool lands

| Community | District/Municipal Assembly | Traditional area | Stool land |
|-------------|-----------------------------|------------------|---------------------|
| Asantekwaah | Kintampo North | Mo | Mansra |
| Bomini | Nkoransa North | Nkoransa | Buabeng |
| Bonte | Nkoransa North | Nkoransa | Buabeng |
| Cheranda | Kintampo North | Mo and Nkoransa | Dawadawa and Mansra |
| Drumankese | Nkoransa North | Drumankese | Drumankese |
| Gulumpe | Kintampo North | Nkoransa | Dawadawa |
| Kunsu | Kintampo North | Nkoransa | Dawadawa |
| Mansie | Kintampo South | Mo | Mansie |
| Miawani | Kintampo North | Nkoransa | Dawadawa |
| Sabule | Kintampo South | Mo | Sabule |

Notes: 1. Kintampo North is a municipal assembly, while Kintampo South and Nkoransa North are district assemblies; 2. Cheranda is owned by two divisional chiefs; 3. Drumankese is headed by a divisional chief who owes direct allegiance to the Asantehene (King of Asantes).

5.2.3 Data Collection

Mixed methods approach was used in collecting data for the study. Data collection commenced in June 2015, with a stakeholder analysis to broadly identify the main stakeholder groups along the charcoal commodity chain in Ghana and the relationships between them. Nine groups of social actors were identified: chiefs, charcoal producers, farmers, merchants, chainsaw operators, transporters, labourers, Forestry Commission and district assemblies. Communities were selected in December 2016, and village meetings were subsequently held with chiefs and other community leaders in January 2017, to explain the purpose of the study and to also seek their approval to conduct the study in their communities. Two-stage sampling was used in selecting the primary respondents (i.e., charcoal producers and merchants). First, random sampling was used to select 400 households who were interviewed in February and March 2017, using a structured questionnaire (Brobbe

et al., 2019a). Two hundred and fifty out of the 400 households were found to be engaged in charcoal production, while 38 were involved in charcoal related businesses like charcoal trade, transport of charcoal and renting and hiring of chainsaw machines for charcoal production. The lists of the 250 charcoal-producing households and 38 households engaged in charcoal businesses were used to interview 150 charcoal producers and 18 charcoal merchants between September and December 2017. The second-stage sampling was based on availability of respondents in their homes. Snowball sampling was used to select eight middlemen, five chainsaw operators and six charcoal transporters in the second-stage sampling.⁵⁰ The purpose of the study was explained to all respondents and their consent sought before the start of every interview. Respondents were also assured of anonymity and confidentiality of all information they provided. The questionnaire were administered in a local language (i.e., Asante Twi) by the first author and lasted between 45 to 60 minutes per person.

A semi-structured questionnaire was used in the interviews with the 150 charcoal producers to understand: (i) the processes they go through to get trees for charcoal; (ii) the kinds of rules and norms that guide the use of trees for charcoal and the reasons for complying or not complying with them; (iii) labour requirement and arrangement in the charcoal production process; (iv) access to credit; and (v) how and where they sell their charcoal. Eighteen out of the 30 charcoal merchants identified from the first-stage sampling were interviewed to understand the mechanisms they use to gain, maintain and control benefits from charcoal. In addition, key informant interviews were held with chiefs to: (i) understand their roles and responsibilities in the charcoal sector; (ii) triangulate certain information from charcoal producers and merchants; (iii) understand the reasons behind certain customary rules and norms, level of compliance and sanctions for non-compliance. Staff of statutory institutions, namely the Forestry Commission, Energy Commission and district assemblies were interviewed on their roles and programmes within the charcoal sector.

Two Participatory Rural Appraisal (PRA) methods – trend analysis and Venn diagram – were used to respectively understand: (i) the history of charcoal production

⁵⁰ There were only one middleman, one charcoal transporter and three chainsaw operators in the first-stage sampling.

and changes in natural resources within the study communities; and (ii) the relationships between and among customary and statutory institutions in relation to charcoal. On average, 11 people comprising two elderly (age 40+) males, two elderly females, two young (age 18-40) males, two young females, two local government representatives and the care-taker chief were involved in the PRAs.

Four community and one district charcoal fora were held in September 2018, to present key findings of the study to stakeholders.⁵¹ The fora also provided a platform for stakeholders to validate research findings, provide additional inputs and seek explanations for policy interventions. The participants for the fora included chiefs, charcoal producers, charcoal merchants, chainsaw operators, farmers, transporters and representatives of non-governmental organisations and local government. It also included staff of the Forestry Commission, Environmental Protection Agency, Ministry of Food and Agriculture, the Ghana Fire Service and the Ghana Police.

5.3 Results

The results are presented in three sections: first we focus on how customary institutions mediate access, then we move to statutory institutions' (Forestry Commission and district assemblies) role in access mediation. Third, we present our findings on other mechanisms besides property, that is, structural and relational mechanisms, used in combination with property or independently to derive benefits.

5.3.1 Customary Institutions

There is a hierarchy of chiefs in Ghana. Most traditional areas are ruled by a paramount chief, and under him are a number of divisional chiefs, and under these again are care-taker chiefs commonly referred to as "*Odikro*" (Berry, 2001; Marfo, 2009). Divisional chiefs operate under a paramount chief, but the former may own their lands independent of the latter (Berry, 2001). For example, the divisional chiefs in the Mo traditional area own their lands independent of the paramount chief. A care-taker chief owes allegiance to a divisional chief, and he is not a landowner.

⁵¹ Study communities were clustered into four on the basis of their closeness to each other for the community fora. Communities nominated between eight to 10 representatives for the district charcoal forum.

5.3.1.1 Authoritative Rights

In the precolonial era, trees and other natural resources were managed under customary rules. Community members could use trees for subsistence, while paramount and divisional chiefs own and could sell lands to mining companies at this period (Ubink and Amanor, 2008). Commercial rights to trees were not an issue during this period because the timber industry had not developed, neither was the charcoal industry. Statutory regulation emerged during British colonial rule (ca. 1900 to 1957). The colonial rulers however, put much greater emphasis on the control and regulation of the high forest zone to the south of the study area which held much richer timber resources and where maintenance of a significant forest cover was considered important to maintain a favourable environment for agricultural production, primarily cocoa (Amanor, 2008; Hansen and Lund, 2017). Consequently, no forest reserves were established by the colonial powers in the study area until after independence. The only forest reserve in the study area (Buru) was established in 1967 (E. Opoku-Antwi, personal communication, November 15th 2018).

After independence, rights to naturally occurring trees became vested in the President of Ghana in trust of the customary owners (Act 123; Act 124; Article 257 (1) of the 1992 Constitution). Paramount and divisional chiefs in the study area hold authoritative rights to trees used for producing charcoal. They assign control rights to themselves or to care-taker chiefs (Table 5.2).

5.3.1.2 Control Rights

Paramount and divisional chiefs grant use rights to charcoal producers and merchants. They hold and exercise all four kinds of control rights – i.e., management, exclusion, transaction and monitoring. These are explained below.

Management

Chiefs regulate the use of trees for producing charcoal in the study area. They prohibit the felling of fruit trees like *Parkia biglobosa* (dawadawa) and *Vitellaria paradoxa* (sheanut) for charcoal production. They also do not permit the felling of trees close to water bodies and in sacred grooves. The care-taker chief of Cheranda mentioned in an interview that culprits who fell fruit trees and merchantable timber trees for charcoal are tried by him and his elders, and if found guilty fined to pay two bottles of

schnapps (alcoholic drink), sheep and some amount of money determined by him in consultation with his elders (N. Asumang, personal communication, 12 September). Some charcoal producers disclosed that they used to wholly obey these norms in time past, but admitted to felling fruit trees in areas outside the “monitoring eyes” of the chief and his elders these days. Participants at all PRA sessions agreed that the number of trees for producing charcoal have reduced in recent times, and attributed the reduction to agriculture, charcoal production, human population growth and an increasing investment in cash crop (cashew, cassava and mango) establishment. When chiefs were asked about management interventions emanating from them to combat tree loss, they stated that they have made lands available for woodlot establishment by government and interested charcoal producers.

We also learned through interviews and PRA sessions that the paramount chiefs of the Mo and Nkoransa traditional areas temporarily banned charcoal production and trade within their jurisdictions in the mid-1990s. Their reason was to reduce the increasing rate of degradation attributed to charcoal production. Charcoal producers and merchants recounted that they complied with the ban, but organised themselves into associations of charcoal producers and traders to appeal for the lifting of the ban. The key condition for the lifting of the ban was for charcoal merchants to pay levies to the paramount chiefs on every truckload of charcoal purchased from their traditional areas. This arrangement persists in the Mo and Nkoransa communities with the exception of Asantekwaah and Cheranda, where the collection has stopped due to reduction in number of trees for producing charcoal. The fees range from fifteen to twenty Ghana Cedis (equivalent to US\$ 3.82 to US\$ 5.10) depending on the type of vehicle. The chief of Drumankese did not institute a ban at that time, but presently charges ten to fifteen Ghana Cedis (equivalent to US\$ 2.55 to US\$ 3.82) per truckload of charcoal depending on the type of vehicle (Table 5.2).

Exclusion and transaction

We demonstrate in this section how the ability to use property to benefit from charcoal has evolved in the study area. The changes have been driven by the realisation of the economic benefits of charcoal as well as scarcity and concern over sustainability of the feedstock. These have led to contestation between chiefs and

family heads in some communities, and a shift from the use of charcoal producers' group leaders in sourcing trees to individual sourcing of trees.

Paramount and divisional chiefs hold exclusion rights to trees for charcoal and prevent certain groups of people from accessing trees for charcoal. They also assign transaction rights to care-taker chiefs to give out trees for charcoal production. We learned through interviews and PRA sessions that charcoal production was introduced in the study area in the 1970s by Sissala tribesmen who had migrated from the Upper West Region of Ghana. Paramount and divisional chiefs, through their care-taker chiefs, used to grant use rights to the Sissalas to fell trees on forest and fallow lands by collecting minimal fees. The fees were based on the size of land to be allocated and not the volume of trees to be removed. This was the common practice in all the 10 study communities. A Sissala charcoal producer at Drumankese recounted:

We used to operate in groups of 10-20 people. A leader upon identifying a tract of land with trees suitable for producing charcoal will negotiate with the chief and pay for the land. He would then invite his fellow Sissala men to come and produce charcoal on the acquired land and collected 20% commission from each producer to offset payment to the chief and also make direct profit. (M. Tahidu, 2017, personal communication, 2 October)

Some family heads later started to sell trees on their farm and fallow lands to migrant charcoal producers themselves when charcoal gained economic importance in six of the study communities. That is, family heads started to exercise exclusion and transaction rights in Asantekwaah, Bomini, Bonte, Cheranda, Mansie and Sabule. The sharing arrangement is for the family head to take one-third, while the producer takes two-thirds of charcoal produced on a farmland. For instance, the care-taker chief of Bomini recounted instances where family heads and some indigenes prevented some Sissalas who had been given use rights to fell trees on fallow lands from felling and processing those trees with the justification that the land belonged to them. He explained that although lands in the community are owned by the Divisional Chief of Buabeng, indigenes hold usufructuary rights to both farm and fallow lands that were first cultivated by their ancestors. It was such trees that family heads started to sell to the Sissalas and other migrant charcoal producers (N. Ansah, 2017, personal communication, 8 October). An indigenous charcoal producer in Asantekwaah corroborated this assertion and justified their actions with claims of endogeneity and usufructuary rights. He stated:

We Mos own lands that were first cultivated by our ancestors, while all uncultivated lands belong to the Divisional Chief of Mansra. We originally did not know anything about charcoal production, and even used to see it as a dirty business. We learned charcoal production from the Sissalas when we recognised that it was a profitable activity. Our involvement was gradual and peaked in the early 2000s. Those who could not produce charcoal began to sell trees on their farms to the Sissalas and other migrants charcoal producers. Those who did not sell trees outright negotiated for a 10-30% stake in charcoal produced from trees on their farm and fallow lands. The selling of trees was restricted to only trees-on-farm and fallow lands, and not forest or uncultivated lands. Many people in this town prefer sharing the proceeds of charcoal to selling the trees these days. (A. Bema, 2017, personal communication, 8 September)

The Divisional Chief of Sabule mentioned in an interview that the selling of trees to migrant charcoal producers by family heads is not allowed under customary laws. He confirmed that indigenes own farm and fallow lands that were first cultivated by their ancestors, but insisted that was for farming purposes and does not extend to the selling of trees. He however, admitted that it happened some time ago, but was not widespread in his jurisdiction. He stated that all lands in his area belong to him, and indigenes do not own fallow lands as some may want to portray. He also stated that he has even banned migrants from producing charcoal on his land since January 2018, to reduce the number of trees lost to charcoal production in the area (N. Aduomi III, personal communication, 26 October). The ban on migrants from producing charcoal was confirmed by two interviewed migrant charcoal producers.

The realisation of economic benefits of charcoal coupled with selling of trees by family heads led some divisional chiefs in the study area to replace the lump-sum payment that was based on the area of land with a 10 or 20% levy on produced charcoal in the early 2000s. This levy was charged on migrant charcoal producers in all the study communities. It was however, extended to indigenes in the Mo communities (Asantekwaah, Mansie and Sabule). An ex care-taker chief of Asantekwaah under whose reign the levy was imposed narrated:

All lands in this community belong to the Mansra Divisional Chief and I used to pay homage to him with some of the royalties I was getting from the Sissala charcoal producers. The royalties declined with the involvement of indigenes in charcoal production. Some family heads and other indigenes who could not produce charcoal also started to sell trees on their farm and fallow lands to the Sissalas and other migrant producers. We could not distinguish between charcoal for a migrant and that of an indigene, and therefore came up with a 10% levy on charcoal produced by both indigenes and migrants. We used part of this money for development purposes and sent some to the divisional chief as royalties. The levy has however, been

abolished with the decline in tree population. (N. Kewa, 2017, personal communication, 4 September)

The care-taker chief of Bomini stated in an interview that he still allocates land to migrant charcoal producers on behalf of the Divisional Chief of Buabeng (his land owner), and collects 20% commission on produced charcoal as royalty (N.K. Agyei, 2017, personal communication, 10 October). The Divisional and sub-chiefs of Drumankese also still charge 20% commission from migrant charcoal producers.⁵² Indigenes who produce charcoal outside their family lands in Drumankese are also charged the 20% levy (N.D. Abiem II, 2017, personal communication, 6 October). A similar arrangement occurs at Gulumpe, where the chief charges 10% levy from non-Dagombas and non-Gonjas (K. Adams, 2017, personal communication, 12 September).⁵³ The care-taker chief of Kunsu and Miawani narrated that he still sells trees to migrant charcoal producers on the basis of land area, but has initiated plans to replace the selling with an 8% commission on produced charcoal (N. Gyamfi, 2017, personal communication, 23, September). The divisional chiefs of the three Mo communities (i.e., Asantekwaah, Cheranda and Mansie) no longer charge fees or commission on charcoal produced by migrants. They cited moral economy, i.e., the difficulty people go through to get trees for producing charcoal, as their reasons for abolition of the levy.

Monitoring

Two out of the 10 chiefs of the study communities monitor the use of trees for charcoal in their communities. The chiefs of Drumankese and Gulumpe have monitoring taskforces who ensure that migrant and unauthorised producers obtain permission from them to produce charcoal and also pay the correct levies due them. The Chief of Drumankese stated in an interview:

It is the responsibility of anyone who wants to produce charcoal on my land to seek permission from me or my elders before starting the production process. Failure to do so is considered stealing and I have a monitoring taskforce who go into the bush to ensure compliance. They reserve the right to seize all your charcoal if they find out that you are producing without my permission. (N.D. Abiem II, 2017, personal communication, 6 October)

⁵² Five sub-chiefs in Drumankese own their lands independent of the Divisional Chief.

⁵³ Gulumpe is officially under the Nkoransa Stool (GSS, 2014), but the inhabitants claim ingenuity and pledge allegiance to the Gonja chief. They therefore have different customary practices.

A member of the charcoal taskforce at Gulumpe mentioned that they have mounted barriers at the entry points in the community where they count the number of charcoal bags and collect the 10% commission due the chief. He stated that producers have the right to pay the commission in cash or in kind (K. Adams, 2017, personal communication, 15 September). These chiefs do not however, monitor the state of the tree population.

Table 5. 2 Overview of the contemporary rights to produce charcoal and the arrangement/payment for doing so in the study area

| Traditional area | Communities | Arrangement for producing charcoal |
|------------------|--|--|
| Drumankese | Drumankese | <ul style="list-style-type: none"> • Migrants and indigenes who produce charcoal outside their family lands pay 20% traditional charcoal levy. • Divisional chief collects traditional transport levy. |
| Gonja | Gulumpe | <ul style="list-style-type: none"> • Charcoal producers who do not belong to the Dagomba and Gonja ethnic groups are charged 10% traditional charcoal levy. • No traditional transport levy. |
| Mo | Asantekwaah, Mansie, Sabule | <ul style="list-style-type: none"> • The 10% charcoal levy has been abolished. • Both indigenes and migrants have rights to use trees on their farm and fallow lands to produce charcoal at Asantekwaah and Mansie. • Migrants have been banned from producing charcoal in Sabule. • Some farmers sell trees or share produced charcoal in the ratio of 1:2 between farmer and the charcoal producer. • Divisional chiefs of Mansie and Sabule collect traditional transport levy. Collection of traditional transport levy has stopped at Asantekwaah. |
| Nkoransa | Bomini, Bonte, Cheranda, Kunsu and Miawani | <ul style="list-style-type: none"> • Migrants at Kunsu and Miawani still buy trees to produce charcoal. Chief has initiated plans to replace the selling of trees with an 8% traditional charcoal levy. • The 10% charcoal levy has been abolished in Bomini and Cheranda. • Migrant charcoal producers at Bonte pay 20% traditional charcoal levy. • Some family heads and famers at Bomini and Bonte sell trees and/or share produced charcoal in the ratio of 1:2 with charcoal producers. • Paramount chief collects traditional transport levy. |

Note: Gulumpe has been separated from the Nkoransa traditional area to distinguish customary arrangements that exist in that community from the other communities under Nkoransa.

5.3.2 Statutory Institutions

5.3.2.1 Forestry Commission

All naturally occurring trees in Ghana are contemporarily vested in the President under Article 257 (1) of the 1992 Constitution. Hence, the President holds authoritative rights of definition and allocation. Control rights are granted to Parliament who through laws has put in place a framework of control rights with further control rights and powers of implementation vested in the Minister of Lands and Natural Resources and the Forestry Commission (Act 571 of 1999). The Forestry Commission grants use rights in the form of concessions and permits to timber firms to harvest trees in and outside forest reserves (LI 2254 of 2017). In principle, the Minister of Lands and Natural Resources holds the powers to define control rights for charcoal production, but focus has been on timber and consequently no specific legal framework has been prepared to govern charcoal production and trade, including the granting of use rights (permits). Furthermore, the Forestry Commission has to date made no attempt to enforce the constitutional vesting of all trees in the President under which all allocations made by chiefs, as discussed in the previous section, are illegal. Some Forestry Commission officials stated during interviews that there have been instances where the Commission has granted use rights in the form of permits to charcoal producers to use residues from timber harvesting inside forest reserves to produce charcoal, but these are scattered incidences. The officials attributed the failure of the Commission to develop a legal framework for charcoal production (outside forest reserves) to the inherent complexities in the management of trees in farming and charcoal production. An official of the Commission stated:

The rights of farmers to cut or kill trees as part of their farming activities is recognised under statutory laws and the Forestry Commission cannot stop them – farmers cut and kill trees in order to plant food crops. The Commission is aware that some chiefs sell trees to charcoal producers, this practice is illegal under the laws of Ghana. (B. Acheampong, 2017, personal communication, 26 February)

It should also be mentioned that the Forestry Commission's enforcement of its regulation on extraction of timber trees is limited and that a large share of timber extraction takes place outside the formal, legal framework (e.g., Hansen 2010; Marfo 2009).

In a recent development, the Forestry Commission has started granting use rights (i.e., the right to transport and trade in charcoal) to charcoal merchants in the form of a charcoal conveyance certificate to enable them convey charcoal from rural communities to the cities. This change in access mechanisms according to Forestry Commission officials is driven by the need for the state to regulate and support sustainable charcoal production. The Commission based its decision to grant use rights on its original mandate enshrined in Act 571 of 1999. The Commission therefore benefits from charcoal through the charcoal conveyance certificates it issues. The commission however, does not regulate or monitor the state of trees used for producing charcoal. An official of the Forestry Commission stated:

The Forestry Commission has initiated plans to formalise and regularise the charcoal sector to make it environmentally sustainable. The introduction of the charcoal conveyance certificate in December 2015, was a first step to raise funds for the formalisation process. The Commission plans to register charcoal producers and train them in efficient carbonisation techniques. Charcoal merchants will also be organised into cooperatives and licensed before they can trade in charcoal. We have been distributing seedlings to farmers and charcoal producers to establish woodlots under the Forest Investment Program”. (E. Opoku-Antwi, 2017, personal communication, 3, September)

5.3.2.2 District Assemblies

District Assemblies have a limited role in the formal governance of trees because most powers are retained at central level, that is, with the Ministry of Lands and Natural Resources and Forestry Commission, as discussed in the previous section, c.f. also the 2016 Local Government Act (Act 936). District Assemblies are thus seriously restricted in terms of their influence on the governance of trees. One activity that district assemblies do, however, mandated by the Local Government Act, is to charge a fee for transport of charcoal out of the district. This fee was instituted by the assemblies long before the Forestry Commission started charging its own fees and it was driven by a need to increase government revenue, and stood at fifty Ghana pesewas (equivalent to US\$ 0.13) per bag of charcoal at the time of data collection. It is paid by the merchants and the receipt documenting that the fee has been paid is a requirement for the merchant to transport the charcoal out of the district. Interviewed charcoal merchants mentioned that they do not have problems paying levies to district assemblies because the funds are used for development purposes in the districts.

Charcoal merchants in communities under the Nkoransa North District Assembly (Bomini, Bonte and Drumankese) have however, resisted attempts by the assembly to increase the levy recently. They stated that the planned 100% increment by the assembly, coupled with the charcoal conveyance certificate from the Forestry Commission will reduce their profit margins. Explanation by the District Chief Executive at the district charcoal forum that the district needs to increase the levy in order to increase the assembly internally generated fund was not accepted by them.

5.3.2.3 Energy Commission

The Energy Commission was established to regulate, develop and manage the utilisation of energy resources in Ghana and coordinate policies in relations to them (Act 541 of 1997). The Commission drafted the Bioenergy Policy of Ghana in 2010 with the aim of modernising the benefits of bioenergy on sustainable basis. Policy regulation of the charcoal sub-sector are prescribed under the Woodfuel component of the Draft Bioenergy Policy. The draft policy has six objectives: sustainability of feedstock for producing charcoal; promotion of efficient technologies for woodfuel production and use; substitution of traditional woodfuel with modern fuel like LPG; efficiency in the transport of charcoal; improved packaging and marketing; and strong coordination in institutional and regulatory arrangement (Energy Commission, 2010).

The Commission is also mandated under the Renewable Energy Act to issue licences for the production, transportation, storage, distribution, sale and marketing of renewable energies including charcoal (Act 832 of 2011). Licence for charcoal production is however, limited to producers who produce more than 100 tonnes of charcoal per annum (Energy Commission, 2012). An official of the Commission mentioned in an interview that the Commission issues licence for the export of charcoal (D. Adjei, 2016, personal communication, 28 April). We also learned that the Energy Commission has no presence in charcoal-producing communities, including the study area.

5.3.2.4 Environmental Protection Agency

The Environmental Protection Agency (EPA) coordinates activities of bodies concerned with the technical and practical aspect of the environment and serve as a channel of communication between such bodies and the Ministry of Environment,

Science, Technology and Innovation (MESTI). It issues environmental permits and pollution abatement notices for controlling the volume, types, constituents and effects of waste discharges, emission, deposits or other sources of pollutants and of substances which are hazardous or potentially dangerous to the quality of the environment or any segment of the environment. It additionally acts in liaison and cooperation with government agencies, District Assemblies and other bodies and institutions to control pollution and generally protect the environment (Act 490 of 1994).

The EPA considers charcoal production an important economic activity under Ghana's Nationally Appropriate Mitigation Action (NAMA) against climate change. Plans towards sustainable charcoal value chain in the NAMA include the promotion and use of improved kilns as a means of improving carbonisation efficiency of charcoal produced in the country (EPA, 2016; MESTI, 2012). An official of the Agency stated at the District Charcoal Forum that charcoal producers are required to pay two thousand four hundred Ghana Cedis (equivalent to US\$ 608) as licencing fee to produce charcoal. Surprisingly, none of the interviewed charcoal producers or participants at the forum knew about this legal requirement.

5.3.3 Mechanisms used by other Actors

We hereby present results of other mechanisms besides property that are used by non-institutional actors to benefit from charcoal. We illustrate how other actors use structural and relational mechanisms in combination with property or independent of property to benefit from charcoal. Middlemen emerged along the charcoal commodity chain following the involvement of other ethnic groups besides the Sissalas in the chain and a realisation of the economic benefits of charcoal. In one community, gender is used as an identity to benefit from charcoal tax exemption. We show also that some charcoal producers employ some illegal practices to increase benefits from charcoal.

5.3.3.1 Charcoal Producers

We learned through PRA sessions and interviews that both indigenous and migrant charcoal producers complement rights-based mechanisms with structural and

relational mechanisms. We also learned through PRA sessions that the early Sissala charcoal producers in addition to buying trees from chiefs used their specialised skills (knowledge) in tree felling to gain free trees from farmers. Axes and cutlasses were the only implements used in felling trees prior to their arrival in the study area and not all farmers could fell big trees with these implements. As such, many farmers used to kill trees with fire and therefore had many dead but standing trees on their farms. Those dead trees were given freely to the early migrant Sissalas, while some farmers also invited them to fell and use live trees on their farms free of charge to enable them (farmers) plant light demanding crops like yam and maize. The early migrant Sissalas also used their knowledge of urban charcoal market to benefit from charcoal because they were the only ethnic group who used to sell charcoal in urban areas and had relatives in the major cities (specifically Accra and Kumasi) to whom they used to send charcoal for retailing. These mechanisms are no longer the preserve of the Sissalas in contemporary times as other ethnic groups now produce and trade in charcoal (PRA Notes, 5-30 September). Thus the need to diversify household income has driven other households beside the Sissalas to partake in charcoal production.

Some migrant charcoal producers currently use identity and social relations to complement rights-based mechanism – i.e., gain access to trees for charcoal without expending resources to chiefs to maintain access. For example, a 70 year-old male charcoal producer of Kusasi origin at Gulumpe mentioned that the chief has excluded him from paying the 10% charcoal levy charged on non-Dagombas and non-Gonjas because of his age. He stated that the chief understands that he does not have the strength to produce charcoal. He only produces small volume of charcoal to pay the school fees of his children (A. Ibrahim, 2017, personal communication, 13 September). Others are also using friendship to gain access to trees without expending resources to maintain this access. For example, the Chief of Drumankese reported that although the traditional charcoal levy is pegged at 20% in his community, he sometimes reduces it for migrant charcoal producers who are close to him or faithful in their obligations to him (M. Abubakari, 2017, personal communication, 3, October).

Female migrant charcoal producers use gender as a form of identity to benefit from charcoal without expending resources to maintain their benefits. The chief of

Gulumpe explained that female migrants were originally excluded from paying the 10% traditional charcoal levy in the community until the latter part of 2016 when that dispensation was abolished. He said that charcoal production is a difficult activity for women and recounted that widows were the only class of women who used to produce charcoal at Gulumpe. It was for this reason that he and his elders decided to exempt non-Dagomba and non-Gonja migrant female charcoal producers from paying the traditional charcoal levy. They however, discovered that some unscrupulous men were using women to front for them and were evading the payment of the levy. Some women had also taken charcoal production as a business and were producing more volumes than some men. Women who produce less than 10 bags of charcoal are however, still excluded from paying the traditional levy (M. Abubakari, 2017, personal communication, 13 September). The use of gender as a form of identity to complement rights-based mechanism do not however, exist in the other two communities that still charge traditional charcoal levies (Bonte and Drumankese).

In addition to complying with customary practices to gain and maintain access, some migrant charcoal producers disclosed that they undertake certain illegal activities in order to increase the level of benefits they gain from charcoal. These are: (i) under-declaring the volume of charcoal to chiefs in order to reduce the levies paid to them; (ii) paying bribes to members of the charcoal taskforces to escape giving the required share of charcoal to chiefs in Drumankese and Gulumpe; (iii) illegally felling trees without recourse to chiefs or family heads; and (iv) illegally felling fruit and merchantable trees contrary to customary practices. For example, a charcoal producer at Gulumpe revealed that the average loading capacity of a tractor is 100 bags of charcoal. He usually pays the 10% traditional levy on the 100 bags even if the tractor can cart 110-120 bags of charcoal (I. Kyentor, 2017, personal communication, 18 September). A charcoal task force member at Gulumpe confirmed this practice and stated that the taskforce normally charges 15% as penalty (instead of 10%) when they find out that a producer is trying to outwit them. The chief of Gulumpe confirmed this assertion at the community charcoal forum and blamed some charcoal merchants for conniving with producers to cheat him of what is due him (charcoal forum notes). The chief of Drumankese also recounted some illegal activities of some charcoal producers and explained that their activities necessitated the formation of the charcoal

taskforce in his community (N.D. Abiem II, 2017, personal communication, 6, October).

Charcoal producers who can finance their own charcoal-producing activities get higher profit than those who take loans from merchants. Additionally, good relationship with merchants enable charcoal producers to benefit from charcoal. We provide examples of how charcoal producers use social relations to gain and maintain benefits from charcoal in the next section under merchants.

All interviewed charcoal producers admitted that their activities contribute to tree loss. Very few (5%) stated that they have incorporated or planted trees on their farms. They mentioned tenure conflicts with chiefs and late arrival of seedlings as their reasons for not establishing woodlots. Many recounted that they rely on natural coppicing to ensure sustainability of trees. They however, admitted that coppices are not well-managed. Moreover, PRA participants recounted that reduced fallow periods emanating from increase pressure for land has reduced the ability of trees to mature from coppice (PRA notes).

5.3.3.2 Merchants

Charcoal merchants also complement rights-based mechanisms with structural and relational mechanisms to gain, maintain and control benefits from charcoal. Interviewed merchants mentioned that they use capital, market and knowledge to gain and control access to charcoal from charcoal producers. Three categories of charcoal merchants were identified in our sample: (i) merchants who live in the communities, but buy charcoal from the communities and sell in urban areas; (ii) middlemen who also live in the communities, but buy charcoal from the communities and resell to merchants coming from the cities; and (iii) community members who buy and sell charcoal along major roads passing through communities (known as roadside charcoal traders). The first two categories of merchants use capital to gain and control the access of charcoal producers by pre-financing charcoal-producing activities. For example, a charcoal merchant at Drumankese recounted that it is most often difficult to get charcoal to buy from communities without giving loans to producers or pre-financing some charcoal-producing activities. She stated that she either gives loans to charcoal producers or pays for the labour cost of the production process. She

explained that she is able to recoup her money by having the first choice to buy the produced charcoal (J. Yeboah, 2017, personal communication, 3 October).

Merchants who sell charcoal in cities also use their knowledge of the urban charcoal markets to gain benefit and also control the access of middlemen and charcoal producers. A merchant at Bomini explained that a merchant must know and have connection with urban wholesalers and retailers in order to sell charcoal in the cities. She recounted that it usually takes four to seven days to sell a truck-load of charcoal to wholesalers and retailers in the city (A. Mansa, 2017, personal communication, 10 October). The role of middlemen in charcoal trade is a recent development. As has been mentioned in section 5.3.3.1, charcoal production and trade were the preserve of the Sissalas. They used to organise transportation together in groups. Middlemen emerged when other ethnic groups joined charcoal production and trade. Middlemen also use their knowledge of local people and information on communities that have charcoal to gain benefits from charcoal and also control access of merchants who come from cities. A middleman at Gulumpe stated:

To get a truck-load of charcoal (i.e. 200-250 standard bags depending on the type of vehicle), a merchant must buy charcoal from several producers in different houses and at times, from several cottages within a bigger community like ours. Most city merchants do not know many producers to buy from and are forced to rely on us middlemen who serve as intermediaries between them and producers. I am paid commission on charcoal I buy for merchants or resell the charcoal I have bought myself to them above the prevailing price in the community. (I. Mohammend, 2017, personal communication, 14 September)

Middlemen and merchants who live in cities originally used their knowledge of charcoal prices to gain high profits from charcoal trade. Prices of charcoal are determined by demand in the cities and merchants used to hide new prices from producers. Some charcoal producers revealed that these practices by merchants have stopped because producers these days get to know of new prices through phone calls to drivers, relatives or friends in the cities.

Road-side charcoal traders use the market provided by the location of their communities along major roads to gain high profit from charcoal trade. Prices of charcoal sold on the road-side were found to be higher than the prevailing prices in the communities. This practice does not require much capital and is done by both charcoal and non-charcoal producing households that live along trunk roads (e.g.,

Cheranda and Gulumpe). Traders normally put 10-50 bags of charcoal for sale to commuters along the Kintampo-Tamale trunk road.

5.3.3.3 Transporters, Chainsaw Operators and Labourers

Transporters⁵⁴ use social relations and technology to gain and maintain benefits from charcoal producers and merchants. These mechanisms have not changed much with time. A truck driver mentioned that the number of drivers that cart charcoal has increased over the years, but his friendship with merchants ensures that his services are in demand thus enabling him maintain his benefits from charcoal transportation (E. Appiah, 2017, personal communication, 26 October). Another truck driver disclosed that he uses his knowledge of the urban charcoal market to do forward integration. He stated:

My truck officially takes 250 standard bags of charcoal and merchants pay levies on the 250 bags. I normally buy and top this up with 20 bags. The district assembly levy and the charcoal conveyance certificates are based on the size of vehicles, so I do not pay additional fee on the extra 20 bags. (M. Seidu, 2017, 26 October)

Chainsaw operators use technology and social relations to complement rights-based mechanisms to gain and maintain benefit from charcoal. They are required by law to register their machines with their respective district assemblies in order to obtain use rights. However, all interviewed operators disclosed that they have not registered their machines with any district assembly, but are still able to render their services to charcoal producers. Axes and cutlasses were the original implements used in processing trees for charcoal. Chainsaw operators rent their services and machines to charcoal producers for a fee, which is based on the volume of fuel used in the operation. They basically depend on charcoal producers for job opportunities and mentioned in interviews that friendship with charcoal producers enables them to gain benefits from charcoal.

Labourers do not use rights-based mechanisms to benefit from charcoal – they use their labour, skills (competence) and friendship with charcoal producers and drivers to benefit. These mechanisms have not changed *per se*, but are being used by other ethnic groups besides the Sissalas. We learned from the PRA sessions and interviews that young males are mostly employed as labourers by charcoal producers to arrange

⁵⁴ We operationalised transporters as drivers of vehicles that cart charcoal.

billets, cut grasses, cover wood-piles with grass and soil, and load and off-load charcoal into vehicles, while young and elderly females are employed as labourers to pack charcoal into bags. Loading and off-loading of charcoal into tractors are done by young males from charcoal-producing communities, while truck drivers often bring their own labourers (referred to as loading boys) from district capitals to load charcoal into trucks meant for the cities. Notwithstanding the involvement of other ethnic groups in charcoal production in recent times, participants of the PRA sessions and many interviewees attested to the specialised skills of the Sissala charcoal producer or labourer. Most charcoal producers stated that they prefer employing a Sissala man as a labourer to arrange billets and cover wood piles to men from other ethnic groups. Although the entry barriers to producing charcoal is low, most producers revealed that knowledge of suitable tree species (especially high-density trees), as well as specialised skills in arranging billets and the actual carbonisation process are crucial to getting quality charcoal and making profit.

5.4 Discussion

We discuss our findings in relation to the dynamics in the ability of social actors to benefit from charcoal. Finally, we look at the policy implications of the mediating roles of customary and statutory institutions on the sustainability of the feedstock for producing charcoal.

5.4.1 Discussion of key Findings

Our empirical findings overall demonstrate that benefits from charcoal is first and foremost guided by property, enforced by both customary and statutory institutions. To obtain property, charcoal producers in turn expend resources in the form of payment of traditional charcoal levies to chiefs or give out one-third of produced charcoal to family heads, while merchants buy charcoal conveyance certificates from the Forestry Commission and also pay levies to District Assemblies. This finding supports Ribot and Peluso's (2003) argument that subordinate actors often transfer some benefits to those who control access in order to maintain their access. The findings also corroborate Sikor and Lund's (2009) argument that contestation over access is a forerunner of property; social actors along the charcoal commodity chain have always used property to access trees for charcoal.

An important finding from our study is the shift in control rights from chiefs to family heads. We found that family heads and some indigenous farmers who hitherto the emergence and realisation of the economic benefits of charcoal did not exercise control rights to trees, started exhibiting exclusion and transaction rights to trees in the study area. This shift in control rights supports Berry's (2002) assertion that property rights (in post-colonial countries) are fluid, open, ambiguous and negotiable. It also resonates with Sikor and Lund's (2009) argument that rights that may have no value at certain points in time may come in handy when circumstances change because they are somehow enshrined in legislation or recognised by some politico-legal institutions. That is, the rights of family heads and members to lands cultivated by their close relatives have all along been recognised under customary laws, but were not used until charcoal achieved economic importance in the study area. This situation however, brought an interesting and conflicting situation to the access dynamics. Some chiefs attempted to extinguish the rights of family heads by claiming that all lands and trees on the lands are under their control and family heads do not have the rights to sell trees, while some chiefs recognise the rights of the latter to family land.

We also found different customary arrangements and payment regimes for trees used for producing charcoal between communities even within the same traditional area. We attribute the variations to the variable success of members of the communities to use moral economy to appeal for the abolition of customary levies by some communities (e.g. Asantekwaah). The variations could also be attributed to differences in the rights of family heads and privileges accorded certain kinds of actors (e.g., women and elderly) in individual communities. Schure *et al.* (2015) also report of different tenure arrangements in charcoal-producing communities around the Kinshasa and Kisangani regions of the Democratic Republic of Congo.

The situation we found from our study results from legal pluralism. The selling of trees for charcoal by chiefs and family heads are not permissible under statutory laws, but is sanctioned under customary norms. Such disagreement is common in countries characterised by legal pluralism. Leach *et al.* (1999) similarly report of instances where forest fringe communities use customary rights to exploit *Marantaceae* leaves inside state designated forest reserves in Ghana instead of applying for permits from

the Forestry Commission. The inability of the Forestry Commission to regulate the harvesting of trees for charcoal outside state designated forest reserves can be likened to what Onibon *et al.* (1999) refer to as “sterile” dualism – i.e., a situation whereby the state imposes laws and regulations that are simply impracticable and incompatible with local practices, hence the rules are simply ignored, while local people’s behaviour is criminalised (Benjamin, 2008). The Environmental Protection Agency has also failed to enforce the permit requirement to produce charcoal. Schure *et al.* (2013) report that the introduction of permits and quota systems to regulate the charcoal sector in some Central and West African countries have not been successful. Similarly, the use of legislations to regulate the charcoal sector in Malawi have been unsuccessful and have rather led to criminalisation of charcoal related livelihoods (Smith *et al.*, 2015).

Albeit our study points to property as crucial for benefits, we also found that charcoal producers and merchants complement rights-based mechanisms with structural and relational mechanisms to benefit from charcoal. For instance, charcoal merchants use capital to control the access of charcoal producers, while the latter use social relations to maintain access from the former. The use of structural and relational access mechanisms separately or complementarily with rights-based mechanisms to gain, maintain or control access to charcoal agrees with the findings of Agyei *et al.* (2018) and Ribot (1998). For instance although charcoal production does not require high capital investment, many producers rely on credits or pre-financing arrangements from merchants to fund their production activities. By so doing, charcoal merchants are able to control the benefits of producers by buying charcoal below the prevailing market rates (Brobbey *et al.*, 2019b). Unlike Senegal where producers rely on social relations with merchants for permits or quotas from the state Forestry Department to produce charcoal (Ribot, 1998; Ribot and Oyono, 2005), per the existing *de facto* arrangements, producers in Ghana do not take permits from the Forestry Commission or Environmental Protection Agency to produce charcoal. They rather rely on merchants for loans to meet emergency household expenses and/or pre-financial arrangements to pay chainsaw operators and labourers (Brobbey *et al.*, 2019b).

We found out that chainsaw operators, labourers and transporters would not be able to benefit from charcoal if property was the only mechanism for benefiting. This study

thus reiterates the important role of A Theory of Access in the analysis of rural livelihoods. Data on the number and income of chainsaw operators and labourers that benefit from charcoal in the study area are not available, but other studies (e.g., Ribot, 1998) have reported the important role these actors play along the charcoal commodity chain. Agyei *et al.* (2018) estimated the number of transporters of charcoal in Ghana to be 1,085 with an annual income of US\$ 5,266. Even in Malawi where charcoal transportation is illegal, transporters use rudimentary means like bicycles, head load, minivan and trucks to illegally transport charcoal from rural areas to the cities as a livelihood strategy (Smith *et al.*, 2015). Charcoal transportation is legal in Ghana and Agyei *et al.* (2018) report that maintenance of vehicle and good working relations with merchants enable transporters to improve their benefits from charcoal.

The granting of property by customary and statutory institutions to charcoal producers and merchants also corroborates Sikor and Lund's (2009) argument of a contract between property and authority. That is, customary and statutory institutions recognise claim to property by non-institutional actors through the taxes and levies they pay to them, while these actors in turn recognise the authority of these institutions that sanction their rights. We argue that through their control over trees and their vetting of property claims, chiefs in the study area have strengthened their authority relative to the statutory institutions mandated to regulate the charcoal sub-sector. This is due to the failure of the latter to grant rights to charcoal producers. Although the Forestry Commission for instance has over the years had the constitutional mandate to manage and regulate all naturally occurring trees in the country, it has concentrated on timber without paying attention to the charcoal sub-sector. The Commission is now using the same rights that has all over the years been enshrined in the constitution, but has remained idle to exercise authority over charcoal production and trade.

5.4.2 Policy Implications

We discuss the mediating roles of customary and statutory institutions on the sustainability of trees for producing charcoal and the likely implications of measures taken by statutory institutions (i.e., Energy Commission, Environmental Protection Agency and Forestry Commission) to formalise and regularise charcoal production

and trade in Ghana. We found out that *de facto* access to trees used for producing charcoal is mediated by customary institutions, while District Assemblies and the Forestry Commission issue permits for transport and trade of charcoal. The customary institution as of now, has little consideration for the sustainability of trees; their interest is mainly about revenues and authority. Although they exclude trees in sacred grooves and fruit trees from charcoal production, these are not enough to ensure the sustainability of trees.

The existing situation presents a challenge to the sustainability of the feedstock for producing charcoal. The Energy Commission and the Environmental Protection Agency are currently not regulating the charcoal sub-sector practically, though they are mandated by law to do so. The Forestry Commission on the other hand has initiated plans to manage the charcoal sub-sector, however, one could speculate how successful it could be, based on its history with timber. The Forestry Commission has low authority and presence in the communities where trees are felled for charcoal. Besides it is now coming in as a new-comer and may face stiff opposition in trying to establish its full authority. Perhaps its decision to levy charcoal merchants rather than producers is a recognition of how difficult it will be to change the *de facto* customary rights to trees used for charcoal even though it runs contrarily to the constitutional provisions. In any case, even a strong presence of the Forestry Commission in the charcoal sector may not offer any assurance of sustainability if its history with timber is anything to go by. Elsewhere examples of sustainable charcoal production attributable to state control of resources are rare. In the Democratic Republic of Congo for instance, Schure *et al.* (2015) report that rules imposed by formal and informal institutions contribute little to the sustainability of charcoal production. In Tanzania the enormous complexity and informality of the charcoal sector and the lack of political will have been identified as major hindrances to a successful charcoal sector reform (Sander *et al.*, 2013; World Bank, 2009).

An alternative strategy would be for the Forestry Commission to go with the traditional authorities and build on their control. Chiefs are however, not often democratic and accountable to the group they represent (Marfo, 2004; Ribot *et al.*, 2008) so that is not an easy situation and may require some innovative approaches. Tree planting has been proposed as a key to sustainable charcoal production but the

limited adoption of tree planting by charcoal producers in the study area under the Engaging Local Communities in REDD+ (ELCIR+) project (Schwöppe and Wojewska, 2018) provides little hope for this option at the moment. Competitive land uses, insufficient support, uncertain tree tenure and bad reputation of the Forestry Commission have been cited as factors militating against the adoption of woodlots establishment (Ibid). The Forestry Commission could work in tandem with traditional authorities to grant tree (ownership) rights to charcoal producers or smallholder farmers who plant trees or nurture trees on their farms, or establish woodlots in their communities. Chiefs, District Assemblies and the Commission would continue to collect levies and taxes from charcoal produced from such woodlots.

The findings point to overlapping (statutory) institutional and regulatory arrangements in the charcoal sub-sector in Ghana. The Energy Commission which has the constitutional mandate to regulate renewable energy in Ghana does not regulate charcoal producers who produce less than 100 tonnes of charcoal per annum. Although the planned formalisation process of the Forestry Commission incorporates certain elements of the Woodfuel component of the Draft Bioenergy Policy, it is independent of the licencing requirement of the Environmental Protection Agency. There is therefore the need for the Energy Commission to promulgate the Draft Bioenergy Policy and use it as a mechanism to strengthen institutional coordination within the charcoal sub-sector in Ghana.

Formalisation of the charcoal sub-sector, if fully implemented, can led to criminalisation of charcoal-related livelihoods as has been reported in Malawi by Smith *et al.* (2015). It could also results in exclusion of economically vulnerable groups or loss of rights (Putzel *et al.*, 2015). Likewise, it could lead to elite capture as is the case in Senegal, where urban charcoal merchants control the access of local producers due to the inability of the latter to meet requirements for obtaining permits (Ribot, 1998; Ribot and Oyono, 2005). Very few charcoal producers can pay the two thousand four hundred Ghana Cedis (GH¢ 2400.00) required by the Environmental protection Agency as licencing fee to produce charcoal in case the Agency decides to fully enforce its rules. The Agency could develop separate licencing arrangements for small-, medium- and large-scale producers, or encourage group licences to ensure that low-income households are not driven out of charcoal production.

5.5 Conclusions

Access to natural resources is vital for building sustainable rural livelihoods, but it is dynamic in space and time. This study has first of all revealed the central role of property in benefiting from charcoal. Access to trees used for producing charcoal is mediated by customary institutions, while statutory institutions mediate access to transport and trade in charcoal. Secondly, the realisation of economic benefits of charcoal and scarcity and concern for the feedstock, have driven access dynamics for charcoal. Thirdly, actors complement rights-based mechanisms with structural and relational mechanisms, while others (i.e., chainsaw operators, labourers and transporters) would not have been able to benefit from charcoal without structural and relational mechanisms. Finally, chiefs have strengthened their authority over charcoal producers and merchants in charcoal producing communities. However, the authority of both customary and statutory institutions is yet to be deployed towards the sustainability of trees for producing charcoal.

CHAPTER SIX

6.0 GENERAL DISCUSSION AND SYNTHESIS

Introduction

Charcoal has long been recognised as an important economic, environmental and social resource in Ghana and other SSA countries. From a socio-economic perspective, the producers are often depicted as poor, uneducated and lacking assets and markets (Vos and Vis, 2010; Zulu and Richardson, 2013). Other studies however, are increasingly reporting that charcoal production is not a preserve of the poor, but an important livelihood option for rural households endowed with woodlands suitable for producing charcoal (Aabeyir, *et al.*, 2016; Agyemang *et al.*, 2012; Arnold *et al.*, 2006; Blay *et al.*, 2007; Butz, 2013; Jones *et al.*, 2016; Obiri *et al.*, 2014; Smith *et al.*, 2017). In Ghana, chiefs, local government, forestry department, merchants and retailers in urban areas also benefit from charcoal through taxes and trading (Agyei *et al.*, 2018; Amanor *et al.*, 2005; Brobbey *et al.*, 2015; Obiri *et al.*, 2018). On the environmental front, charcoal production has also been associated with climate change, deforestation and forest degradation (Chidumayo and Gumbo, 2013; FAO, 2017). This situation has led to (temporary) bans on its production and trade in some SSA countries (Arnold *et al.*, 2006; Ribot, 1999; Smith *et al.*, 2015). In terms of natural resource governance, there is a dichotomy between customary and statutory institutions in the management of the charcoal sub-sector in Ghana and other SSA countries. Charcoal production and trade therefore becomes an interesting subject from the socio-economic, environment and governance perspectives.

This study adds to the new generation of livelihood studies on environmental resources and contributes to understanding reliance on charcoal. It presents novel empirical results on the importance of charcoal to rural livelihoods and the factors that influence decisions by households to produce or trade in charcoal, as well as factors that determine high income from these two economic activities. It does so in a political economy perspective and presents findings on the evolving mechanisms social actors along the production end of the charcoal commodity chain use to benefit from charcoal in the forest savannah transition zone of Ghana. Earlier studies (Aabeyir *et al.*, 2016; Agyemang *et al.*, 2012; Blay *et al.*, 2007; Obiri *et al.*, 2014) have used income ranges to estimate the contribution of charcoal to the income of

rural households and have also interviewed only charcoal producers. Furthermore, studies that investigate the economic, social and political contexts within which charcoal production and trade take place in Ghana are rare. The current study used a holistic approach to understand the role of charcoal in the livelihoods of rural households and the social, economic and political contexts within which its production and trade take place. Seven research questions were investigated from the overall aim of the study and the main findings are highlighted below.

1. What are the sources and size of rural household income and what is the relative importance of charcoal in this income?

Analysis of survey data from 400 randomly sampled households in Kintampo Forest District, a major charcoal-producing area in Ghana, reveals that households derive income from 12 major economic activities (crops, environmental resources, livestock, rural businesses, wage work, etc.). The average annual per capita income is five thousand three hundred and sixty Ghana Cedis (equivalent to US\$ 1366). Charcoal constitutes 17% of total household income, and is second after crops. Contrary to previous studies, high-income households get higher income from charcoal than do low-income households. Charcoal business, especially trading, provides very substantial income, but for a small section of the sampled population.

2. To what extent do charcoal production and trade contribute to rural households' subsistence and cash income?

The result shows that charcoal mainly provides cash income to rural households and is unique among other income sources. Rural households sell 99% of the charcoal they produce for cash and use only 1%. Income from agricultural crops is shared equally between subsistence and cash income. Charcoal business provides a significant average per capita cash income of four hundred and ninety-four Ghana Cedis (equivalent to US\$ 126), but it is limited to only 9% of the sampled population.

3. To what extent do rural households that face economic shocks use charcoal as a safety-net and an income gap-filler when they face seasonal shortfall in agriculture production?

The results indicate that although rural households use multiple coping strategies to mitigate economic shocks, charcoal production appears to be a dominant coping

strategy. The use of charcoal to fill income gaps however, depends on the income level of households. That is, charcoal serves as an alternative source of income for low-income households and supplementary income for high-income households.

4. What factors determine whether or not households produce or trade in charcoal?

Participation in charcoal production and trade in the forest savannah transition zone of Ghana is not associated with any specific income group. Young and male-headed households are mostly involved in charcoal production, while young and female-headed households dominate in the trading of charcoal in Ghana. Participation in charcoal production and trade is also influenced by the socio-economic characteristics (gender, education and ethnicity) at the household and community levels.

5. What factors are associated with high income from charcoal production and trade?

High-income households use financial (e.g., savings, credits) and physical (e.g., bicycles, motor bikes and chainsaw) assets to get higher income from charcoal production and trade than do low-income households. Income from charcoal production and trade is also associated with membership of charcoal associations.

6. What mechanisms do social actors along the production end of the charcoal commodity chain use to gain, maintain and control benefits from charcoal in Ghana?

The results demonstrate that property is the main mechanism that is used by social actors to benefit from charcoal in Ghana. Both customary and statutory institutions are involved in mediating access to charcoal in Ghana, but chiefs have strengthened their authority in the charcoal sub-sector than statutory institutions (i.e., Energy Commission, Forestry Commission and Environmental Protection Agency) that have constitutional mandate to regulate the sub-sector. Some actors complement property with structural and relational mechanisms, while others use structural and relational mechanisms alone to benefit from charcoal.

7. How and why have the mechanisms changed in both space and time?

The study shows that the realisation of economic benefits from charcoal as well as scarcity and concerns over sustainability of the declining feedstock have driven the

access dynamics of charcoal. These have resulted in contestation between chiefs and family heads over the right to grant rights to charcoal producers in some communities, and influenced the decision by the state to formalise the charcoal industry as a means of promoting sustainable charcoal production.

In the following sections of this chapter, I synthesised the results of the empirical chapters by looking at the key themes of the thesis – i.e., livelihood and political economy of charcoal production and trade (6.1 and 6.2 respectively). This is followed by a reflection on the analytical and methodological issues (6.3).

6.1 Charcoal as an Important Rural Livelihood Option

It was identified in chapter three that charcoal is an important livelihood option for rural households in the study area. As demonstrated in this thesis, charcoal is the second-most important source of household income after agricultural crops. The findings that charcoal provides rural households with regular cash income, fills income-gaps during lean agricultural seasons and provides safety-net for households that face economic shocks are consistent with literature on the benefits of charcoal and other environmental resources to rural livelihoods (e.g., Angelsen and Wunder, 2003; Angelsen *et al.*, 2014; Jones *et al.*, 2016; Paumgarten and Shackleton, 2009; Shackleton and Shackleton, 2004; Wunder *et al.*, 2014). The results also confirm reports by several authors (e.g., Coomes and Butz, 2001; Ellis, 2000; Fisher, 2004; Jones *et al.*, 2016; Khundi *et al.*, 2011; Obiri *et al.*, 2014; Schure *et al.*, 2014; Smith *et al.*, 2017) that rural households rely on a diverse portfolio of economic activities and income sources. Households in the study area rely on agriculture, environmental resources, wage work, artisanship, remittances, etc. for their survival. The findings revealed that charcoal production and trade are competitive economic activities in an area known for its high agriculture production (GSS, 2014). This suggests that charcoal production and trade can be used to improve the economies of rural areas that are endowed with tree resources suitable for charcoal production.

An important feature of this thesis is the categorisation of households on the basis of income quartiles. This provided the basis to prove that although charcoal production is an important livelihood option, its importance increases with increasing household income. This finding therefore supports other studies on the fact that charcoal

production is not an exclusive domain for the rural poor (Ainembabazi *et al.*, 2013; Khundi *et al.*, 2011; Schure *et al.*, 2014). It is also in line with studies that report that reliance on high-value NTFPs increases with increasing income (Arnold and Pérez, 2001; Fisher, 2004). The current study is unique because it does not conflate the two “insurance functions” of environmental resources (Angelsen and Wunder, 2003) – i.e., it distinguishes between the use of charcoal as a safety-net from its use as an income gap-filler. As illustrated in chapter three, high-income households produce charcoal to supplement household income during the rainy season when prices are high, while low-income households produce charcoal during lean agriculture seasons because they do not have other means of income, or their income sources are not sufficient. These findings support earlier studies by Paumgarten and Shackleton (2009) and Shackleton and Shackleton (2004) on the use of environmental resources to fill income gaps by wealthier and poorer households, respectively. The study also demonstrates that charcoal production is used both as an *ex ante* and *ex post* strategy by households that suffer economic shocks.

The results from this study are also unique in quantifying the importance of income from charcoal business. It documents that it is primarily those (relatively few) households engaged in trading of charcoal as merchants who generate substantial business income. This finding corroborates and provides quantitative evidence of what Ribot (1998) reports on charcoal production in Senegal, only that in the Senegal case the merchants were not found in the local communities. It also resonates with the findings of Agyei *et al.* (2018) that the average income of charcoal merchants are much higher than that of producers in Ghana. This study also distinguishes between three types of charcoal merchants – i.e., roadside charcoal traders, middlemen and merchants that stay in the communities but sell charcoal in the cities. This distinction is absent in most studies, and points to the entrepreneurial ability of rural households to engage and progress in the charcoal trade. Unlike other commodities where merchants usually come from cities to rural areas to buy from producers, charcoal affords rural households in Ghana the opportunity to participate in charcoal trade as roadside traders, middlemen or merchants. The capacities of roadside charcoal traders and middlemen can be built to improve the packaging and storage of charcoal so as to improve the quality and standards of charcoal sold and distributed to destined markets.

Relatively few studies have investigated the factors that influence decisions by households to produce or trade in charcoal and the income associated with these activities (e.g., Ainembabazi *et al.*, 2013; Coomes and Butz, 2001; Khundi *et al.*, 2011). The results in chapter four once again reaffirm recent findings that the decision by a household to produce charcoal is not influenced by the income status of that household, but by the economic attraction of charcoal. The involvement of both low- and high-income households in charcoal production is attributed to the low entry barrier or basic tools used in producing charcoal (Cavendish, 2000). The results are consistent with the findings of Ainembabazi *et al.* (2013) and Khundi *et al.* (2011) that income from charcoal production increases with increasing household income. The findings however, contradict other general livelihood studies that report that reliance on environmental resources decreases with increasing income (Babulo *et al.*, 2009; Cavendish, 2000; Falconer *et al.*, 1992; Vedeld *et al.*, 2007), but resonate with that of Fisher (2004) that reliance on high value environmental resources like charcoal increase with increasing income.

The finding in chapter four that charcoal production and trade are gendered echoes previous studies (e.g., Agyei *et al.*, 2018; Ainembabazi *et al.*, 2013; Butz, 2013; Jones *et al.*, 2016; Khundi *et al.*, 2011). While young and male-headed households are more likely to produce charcoal, young and female-headed households dominate charcoal trade in Ghana. The involvement of more females in charcoal trade in Ghana, an activity associated with high income (Brobbeey *et al.*, 2019a), contradicts the findings of Fisher (2004) that men in Malawi dominate in lucrative and commercial economic activities like charcoal trade. It however, supports previous findings by Clark (1994) that trading in southern Ghana is mostly associated with Ashanti women. The gendered nature of charcoal production and trade are therefore site or country specific and are attributed to the motivation behind production or trade.

6.2 Political Economy of Charcoal Production and Trade

This study investigated the economic, political and social contexts within which charcoal production and trade take place in Ghana in line with what Sander *et al.* (2013), Scoones (2015) and Stilwell (2002) refer to as the “political economy of livelihoods”. Chapter five traced the history of charcoal production and trade and examined how the mechanisms social actors use to benefit from charcoal have

evolved in both space and time in the study area. The study therefore demonstrates the happenings in the charcoal sector, explains why it is happening, reveals social actors that are gaining and those losing, and recommends actions for what need to be done (cf. Stilwell, 2002). The results reveal that the realisation of the economic benefit of charcoal, and scarcity and concern over the feedstock have driven the access dynamics along the charcoal commodity chain in Ghana. The results also show the role of power and authority in the ability to benefit from charcoal. The findings expose tension between chiefs and family heads over the right to grant (use) rights to trees on farms and fallow lands to charcoal producers in some communities. While some family heads have maintained their rights to trees on farm and fallow lands, some chiefs deny those rights in some communities (e.g., Sabule). The findings reveal further that the awareness of income from charcoal led to a shift in selling of trees by chiefs on the basis of area of land to that of payment of commission.

Chapters four and five demonstrate that the emergence of charcoal production provided opportunity for indigenes and other migrants (besides the Sissalas) who were originally into crop farming to diversify into charcoal production as a source of livelihood. This brought pressure on the resource base and also resulted in a change in customary arrangements for securing land for farming and charcoal production between indigenes and migrants. As shown in chapter five, indigenes use usufructuary rights to farm and fallow lands to freely obtain trees to produce charcoal and do not pay traditional levies to chiefs. Migrants on the other hand have to buy trees from chiefs, pay commission or enter into sharing agreements with indigenous farmers before they can obtain trees to produce charcoal. Migrants in Sabule have had their rights to produce charcoal truncated by the chief over concerns over declining feedstock, while indigenes continue to produce charcoal. This demonstrates that migrants are discriminated against by customary institutions in their ability to benefit from charcoal in some communities, and contributes to literature on vulnerability of rural households to benefit from natural resources.

Chapter five reveals that middlemen and merchants of different ethnic origins later joined the charcoal commodity chain following the awareness of income from charcoal trade. This arguably led to an increase in supply and production of charcoal and a fall in its price. The situation could explain the use of credit and pre-financing

agreements by merchants to reap high income from charcoal trade in chapters three and four. This resonates with the findings of Agyei *et al.* (2018) and Ribot (1998) that charcoal merchants use credit to control high profits along the charcoal commodity chains in Ghana and Senegal respectively. This suggests that charcoal producers can only receive appreciable benefit from charcoal when the “merchants-producers chain” (loans, tools and pre-financing agreement) is broken with financial support to the producers.

Chapters four and five document the policy of the government of Ghana towards charcoal production and trade. Unlike some SSA countries where charcoal production and trade are banned and/or criminalised (e.g., Kenya and Malawi), charcoal production and trade are seen as important livelihood options, and policies in Ghana are geared towards making charcoal production economically and environmentally sustainable. The government of Ghana is using concerns over sustainability of the declining feedstock to formalise charcoal production and trade in Ghana. Two questions arise from the planned formalisation of charcoal production and trade: (i) What will be the effects of the planned formalisation on social actors along the charcoal commodity chain? (ii) Will formalisation lead to an economically and environmentally sustainable charcoal production and trade as envisaged by the government? I envisage four adverse effects from the first question – elite capture, exclusion of vulnerable and marginalised people, criminalisation of livelihoods and loss of rights. First of all, there is the likelihood that few powerful actors may use capital to obtain permits, and control prices and unjustifiably control the access of many low-income charcoal producers. This would increase their capacity to capture higher profits along the charcoal commodity chain as is the case of Senegal where urban merchants and state officials use quota system to control the access of local charcoal producers (Ribot, 1998; Ribot and Oyono, 2005). The Environmental Protection Agency requires would-be charcoal producers to pay two thousand four hundred Ghana Cedis (equivalent to US\$ 608) as a license fee to produce charcoal. With reference to the low production volumes reported by some households in chapters three and four, very few people can in fact meet this licencing requirement should the Agency decides to enforce its rules. More than half of the number of households engaged in charcoal production are likely to be knocked out (cf. Table 3.4). Additionally, as reported in chapters three and four of this thesis, charcoal trade

is the preserve of high-income households, and low-income households would not be able to meet the planned licencing requirement of the Forestry Commission. The few low-income households currently engaged in charcoal trade may subsequently be forced out of business. Secondly, as reported by Putzel *et al.* (2015), exclusion of economically vulnerable or marginalised people is a frequent outcome of most formalisation processes. Even with the existing informal governance arrangement, the Chief of Sabule has recently banned migrants from producing charcoal in his community (chapter five). Thirdly, formalisation can restrict market access and criminalised charcoal livelihoods as is the case of charcoal transport in Mozambique (Smith *et al.*, 2015). Fourthly, Putzel *et al.* (2015) further report that formalisation mostly results in the loss of rights, and some indigenous households are likely to lose their usufructuary rights to trees on farms and fallow lands in the formalisation process as found in the timber sector at present.

With reference to the second question, I am of the opinion that formalisation of charcoal production and trade alone will not lead to an economically and environmentally sustainable charcoal production. The findings of this thesis (chapter five) suggest that both customary and statutory institutions do not currently ensure the sustainability of trees used for producing charcoal, their interests lie in taxation. Statutory institutions such as the Forestry Commission and Environmental Protection Agency who have the technical abilities lack presence in charcoal-producing communities. The history of the Forestry Commission with timber does not give much hope for sustainability of the charcoal sector. The Commission has always exceeded its own annual allowable cut for timber and has not been able to control illegal logging in the timber industry (Hansen, 2010; Marfo, 2009). Statutory institutions involved in the charcoal sub-sector should recognise that formalisation alone does not guarantee sustainable charcoal production and should work on developing viable options such as a partnership between them and customary institutions.

6.3 Reflection on analytical and methodological issues

As stated in chapter one (section 1.4) and illustrated in the method sections of chapters three, four and five, this study employed qualitative approaches such as village meetings, PRA methods, interviews, document reviews and stakeholder

meetings at the outset and end of the quantitative household survey to understand the contextual factors that underlie decisions by rural households to produce and trade in charcoal. In this study, it helped in the interpretation of data, putting of results in perspective, comparison of findings across study sites and with other studies, and the generalisation of findings as reported by Angelsen *et al.* (2011) and Creswell (2014). This approach (mixed method) has the advantage of overcoming the limitations in a purely qualitative or quantitative approach. For instance, survey data (or quantitative approaches) have the advantage of recording a large sample of people's reported behaviour within a relatively short time and cost, but have the limitation of blurring the context within which livelihoods are situated, thereby making interpretation speculative (Angelsen *et al.*, 2011). They also do not show in details how people's culture and history, as well as their institutional, economic and political settings at multiple scales influence their livelihood choices (Ellis, 2000).

The analytical framework that guided data collection and analysis linked the SLF with political economy. It took into consideration the complex, diverse and dynamic nature of rural livelihoods and how statutory and customary institutions, and vulnerabilities mediate access to capitals, and the corresponding livelihood strategies and outcomes that result from these complex interactions. The framework has the benefit of linking the revised property rights scheme by Sikor *et al.* (2017) with A Theory of Access by Ribot and Peluso (2003). It therefore overcomes the limitations inherent in livelihood studies that investigate only the mediating role of institutions in access to resources or capitals. The strength of the analytical framework lies in its accounting for other mechanisms besides property that open up, influence, obstruct and close down access to resources (Ribot and Peluso, 2003; Sikor and Lund, 2009). This presents opportunity for resource managers or policy makers to strengthen the capacities of social actors that do not use property, but structural and relational mechanisms to benefit from charcoal. The framework also accounts for emerging multiplicity of social actors, legal pluralism and significance of indirect benefits along the charcoal commodity chain (cf., Sikor *et al.*, 2017). This brought to light the multiple actors along the charcoal commodity chain in Ghana and their level of rights, and has implication on the planned formalisation of the charcoal sector.

The following measures were undertaken to guarantee the reliability and validity of the study findings: (i) only enumerators with bachelor degrees assisted in data collection and were trained before the exercise; (ii) questionnaire were pretested at two different communities within the study area and corrections effected before data collection; (iii) surveyed data were digitally collected with tablets to reduce the time and errors associated with paper-based data recording and entry; (iv) surveyed households were randomly selected to enable generalisation of findings; (v) data were collected from 12 income sources to ensure that all possible sources of household income were captured; (vi) previous knowledge from literature and experts on the seasonal nature of most crops and environmental resources in the study area, coupled with the PRA methods that preceded data collection ensured a better recording of crops and environmental income.

The following limitations are however, acknowledged. First, although separate interviews were held with young household members and their income added to that of their households, there might have been cases where the household head did not mention or know of such income to enable me follow up with the young household member. Second, married couples were interviewed together to ensure that they reminded each other of sources and amount of household income; but instances where for some strategic reasons couples did not reveal correct income in the presence of each other or to the enumerators cannot be discounted. Third, the one year recall period might have introduced some errors as households might have forgotten some income sources and amount. Finally, the decision to interview only one household per house might have introduced sampling bias in large communities that are characterised by more compound houses.

CHAPTER SEVEN

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

This study has demonstrated the important functions of charcoal to rural livelihoods and has also investigated the economic, political and social contexts within which its production and trade take place in Kintampo Forest District, a major charcoal-producing area in Ghana. First of all, the results reveal that although rural households rely on diverse sources of income, charcoal is the second most-important source of household income after crops. On average, income from charcoal amounted to one thousand two hundred and sixty-four Ghana Cedis (equivalent to US\$ 317). This represented 17% of total household income. Contrary to previous studies, charcoal production is not an exclusive domain of the poor; high-income households use financial and physical capitals to obtain higher income from charcoal production and trade than do low-income households. Charcoal business, especially trading, provides substantial income, but to a few high-income households.

The findings reveal that charcoal provides the single most important source of non-agricultural cash income to rural households. On the extent to which rural households use charcoal to mitigate economic shocks, the findings show that charcoal production appears to be the dominant strategy used by rural households in charcoal-producing areas to cope with economic shocks. The findings further reveal that the motivation to use charcoal to fill seasonal income shortfalls depends on the income status of households. Households that earn between two hundred and fifty to four hundred and fifty-five Ghana Cedis (equivalent to US\$ 64-116) per annum (i.e., low-income households), are motivated to produce charcoal to fill seasonal income gaps, because they do not have other sources of income during lean agricultural seasons. On the other hand, households that earn between one thousand and fifty-nine to three thousand four hundred and sixty-eight Ghana Cedis (equivalent to US\$ 266-883) per annum, produce more charcoal during lean agricultural seasons to supplement their households' income.

On the factors that influence participation and income from charcoal production and trade, the findings demonstrate that participation in charcoal production and trade is

not associated with any specific income group, but high-income households get higher income from charcoal production (US\$ 280712 per annum) and trade (US\$ 284868 per annum) than low-income households (US\$ 283 and 309 for charcoal production and trade respectively). Participation and income from charcoal production and trade are also influenced by characteristics such as gender of households' heads, number of household members, distance from community to charcoal markets and payment of traditional charcoal levy.

Finally, answering the questions on the evolving mechanisms social actors use to benefit from charcoal and the reasons underlying the access dynamics of charcoal, the findings demonstrate that property (permission from chiefs, traditional levies and fees from statutory institutions) is the main mechanism used by social actors to benefit from charcoal. The dynamics in the ability of social actors to benefit from charcoal have been triggered by the realisation of the economic benefits of charcoal on one hand and scarcity and concerns over sustainability of feedstock for producing charcoal on the other hand. The dynamics are shaped by both rights-based and structural and relational mechanisms (i.e., authority, capital, identity, knowledge, labour, markets, social relations and technology). The government's attempt to formalise charcoal production and trade is likely to inure to the benefits of high-income households and will be unsuccessful if it ignores existing *de facto* rights and practices.

7.2 Recommendations

7.2.1 Inclusive Charcoal Formalisation Policies

In order to reduce the adverse impacts of the charcoal formalisation process, policy makers should be mindful that the ability to benefit from charcoal is location specific, and any one-sized-fits-all approach for the process is likely to fail. This is evident in the different tree tenure arrangements between and even within the same traditional areas. Policy makers should also ensure that the formalisation process is devoid of directives that will make charcoal production and trade prohibitive for low-income households. Group licenses could be issued to charcoal producers who belong to associations, or the licencing fee could take into consideration the levels of production (i.e., small-, medium- and large-scale).

7.2.2 Development of sustainable raw material for charcoal

Academics, Civil Society Organisations and policy makers should work together to develop appropriate models that will encourage the establishment of community and smallholder woodlots for charcoal. This could involve the granting of rights (security of tenure) to people who plant trees on their farms or establish woodlots in their communities. The laborious tree registration exercise should be reduced by the Forestry Commission to encourage the planting and registration of trees by smallholder farmers. The Commission could also grant tree ownership to farmers (or charcoal producers) who nurture trees on their farms to encourage natural regeneration.

7.2.3 Capacity building for sustainable charcoal production and trade

Policy makers could take advantage of the positive association between participation and income from charcoal production and trade, and membership in charcoal associations to liaise with these associations where they occur or help establish some in communities where they are non-existent to promote sustainable charcoal production. This could be done through the undertaking of training of trainers programme in agroforestry practices that incorporate trees on farms, community or individual woodlots establishment, and the provision of loans for joint purchase of improved kilns to increase conversion efficiencies as envisaged in the Woodfuel component of the Draft Bioenergy Policy.

7.2.4 Institutional collaboration

Statutory institutions involved in the charcoal sub-sector should be strengthened to work together. The Energy Commission should promulgate the Draft Bioenergy Policy and incorporate the formalisation programme of the Forestry Commission and the NAMA by the Environmental Protection Agency in its regulatory framework.

7.2.5 Further research

Further studies should be conducted to understand the role of gender in charcoal production and trade, particularly the factors that make charcoal trade attractive to women in Ghana. This can be used to lift the status of women and reduce rural poverty. Further studies should investigate the income that accrue to the three

categories of charcoal producers that have been reported in literature (full time, part time or opportunistic and seasonal producers). Finally, this study should be repeated in mid and low charcoal-producing areas (Afram Plains in the Eastern Region and Central or Western Regions respectively) to compare the level of reliance, factors that influence participation and income from charcoal production and trade, and the *de facto* mechanisms for obtaining benefits from charcoal.

REFERENCES

- Aabeyir, R., Adu-Bredu, S., Agyare, A.W., & Weir, J.C.M. 2016. Empirical evidence of the impact of commercial charcoal production on woodland in the forest savanna transition zone, Ghana. *Energy for Sustainable Development*, vol. 33, pp. 84-95.
- Aabeyir, R., Quaye-Ballard, J.A., van Leeuwen, L.M., & Oduro, W. 2011. Analysis of factors affecting sustainable commercial fuelwood collection in Dawadawa and Kunsu in Kintampo North District of Ghana. *IIOAB Journal*, vol. 2, no. 2, pp. 44-54.
- Acheampong, E. 2003. *Sustainable livelihoods of forest fringe communities: Forest, trees and household livelihood strategies in Southern Ghana*. PhD thesis, University of Hull, UK.
- Act 123 of 1962. *Administration of Lands Act*. Government of Ghana.
- Act 124 of 1962. *Concession Act*. Government of Ghana.
- Act 541 of 1997. *Energy Commission Act*. Government of Ghana.
- Act 571 of 1999. *Forestry Commission Act*. Government of Ghana.
- Act 832 of 2011. *Renewable Energy Act*. Government of Ghana.
- Act 936 of 2016. *Local Government Act*. Government of Ghana.
- Agrawal, A., & Gibson, C.C. 1999. Enchantment and disenchantment: The role of community in natural resource conservation. *World Development*, vol. 27, no. 4, pp. 629-649.
- Agyei, F.K., Hansen, C.P., & Acheampong, E. 2018. Profit and profit distribution along Ghana's charcoal commodity chain. *Energy for Sustainable Development*, vol. 47, pp. 62-74
- Agyemang, K.O., Amponsah, O., Braimah, I., & Lurumauh, S. 2012. Commercial charcoal production and sustainable community development of the Upper West Region, Ghana. *Journal of Sustainable Development*, vol. 5, no. 4, pp. 149-163.
- Ainembabazi, J.H., Shively, G., & Angelsen, A. 2013. Charcoal production and household welfare in Uganda: A quantile regression approach, *Environment and Development Economics*, vol. 18, pp. 537-558.
- Amanor, K. 2008. The changing face of customary land tenure. In Ubink, J.M., & Amanor, S.K. (eds) (2008). *Contesting land and customs in Ghana: state, chief and the citizen*. (55-80). Leiden University Press.
- Amanor, K., Osei, E., & Gyampoh, K. 2005. *Charcoal burning in the Kintampo Districts: Policies, environment and livelihood issues*. The DEAR project, University of Ghana, Legon, Accra.
- Ameyaw, K. 2016. *Rational for the promotion of a comprehensive approach for regulating and managing wood energy value chain in Ghana*. Proceedings of ECOWAS workshop on sustainable wood energy management, 9-11th May 2018, Cotonou, Benin.
- Anang, B.T., Akuriba, M.A., & Alerigesane, A.A. 2011. Charcoal production in the Gushegu District, Northern Region, Ghana: Lessons for sustainable forest management. *International Journal of Environmental Science*, vol. 1, pp. 1944-1953.

- Angelsen, A., & Wunder, S. 2003. *Exploring the forest–Poverty link: Key concepts, issues and research implications*. Occasional Paper, No. 40. Bogor, Indonesia: Centre for International Forestry Research.
- Angelsen, A., Jagger, P., Babigumira, R., Belcher, B., Hogarth, N. J., Bauch, S., Borner, J., & Smith-Hall, C. 2014. Environmental income and rural livelihoods: A global-comparative analysis. *World Development*, vol. 64, pp. S12-S28.
- Angelsen, A., Larsen, H. O., Lund, J. F., Smith-Hall, C., & Wunder, S. 2011. *Measuring rural livelihoods and environmental dependence: methods for research and fieldwork*. Earthscan, UK.
- Appiah, M., Blay, D., Damnyag, L., & Dwomoh, F.K. 2009. Dependence on forest resources and tropical deforestation in Ghana. *Environ Dev Sustain*, vol. 11, pp. 471-487. DOI 10.1007/s10668-007-9125-0
- Arnold, J.E.M., & Perez, R.M. 2001. Can non-timber forest products match tropical forest conservation and development objectives? *Ecological Economics*, vol. 39, pp. 437-447.
- Arnold, J.E.M., Kohlin, G., & Persson, R. 2006. Woodfuels, livelihoods and policy interventions: Changing perspective. *World Development*, vol. 34, pp. 596-611.
- Article 257 (1) of the 1992 Constitution of Ghana. Government of Ghana
- Ashley, C. & Carney, D., 1999. *Sustainable livelihoods: Lessons from early experience*, vol. 7, no. 1. London: Department for International Development.
- Babulo, B., Muys, B., Nega, F., Tollens, E., Nyssen, J., Deckers, J., & Mathijs, E. 2009. The economic contribution of forest use to rural livelihoods in Tigray, Northern Ethiopia. *Forest Policy and Economics*, vol. 11, pp. 109-117.
- Bakkegaard, R.K., Nielsen, M.R., & Thorsen, B.J. 2017. Household determinants of bushmeat and eru (*Gnetum africanum*) harvesting for cash in the Democratic Republic of Congo. *Environment, Development and Sustainability*, vol. 19 no. 4, pp. 1425-1443.
- Bebbington, A. 1999. Capitals and Capabilities: A Framework for Analyzing Peasant Viability, Rural Livelihoods and Poverty. *World Development*, vol. 27, no. 12, pp. 2021-2044.
- von Benda-Beckmann, F., von Benda-Beckmann, K., & Wiber, M. G., 2009. *Changing Properties of Property*. Berghahn Books
- Benjamin, C. 2008. Legal pluralism and decentralization: natural resource management in Mali. *World Development*, vol. 36, no. 9, pp. 2255-2276.
- Berry, S. 2001. *Chiefs know their boundaries: essays on property, power and the past in Asante, 1896-1996*. David Philip: Cape Town.
- Berry, S. 2002. Debating the land question in Africa. *Comparative Studies in Society and History*, vol. 44, no. 4, pp. 638-668.
- Beukering, P.J.H., Kahyarara, G., Massey, E. E., Prima, S. D., Hess, S. M., & Geoffrey, V. 2007. Optimization of the charcoal chain in Tanzania. PREM [Poverty Reduction and Environmental Management Working Paper] 07/03. Amsterdam: Institute for Environmental Studies.
- Blay, D., Dammyag, L., Twum-Ampofo, K., & Dwomoh, F. 2007. Charcoal production as sustainable source of livelihood in Afram Plains and Kintampo North Districts in Ghana. *Discovery and Innovation*, vol. 19, pp. 199-204.
- BoG, Bank of Ghana 2017. *Monthly statistical bulletin: February 2017*. Statistical Department, BoG.

- Broadhead, J., Bahdon, J., & Whiteman, A. 2001. Woodfuel consumption modelling and results. Annex 2 in *Past trends and future prospects for the utilisation of wood for energy*. Working Paper No. GFPOS/WP/05, Global Forest Products Outlook Study. Food and Agriculture Organisation of the United Nations (FAO), Rome.
- Brobbe, L.K., Asante, J., Sampong, E.K., Kumeh, E.M., & Nketiah, K. 2015. *Securing rights to wood resources for charcoal production: A case study of the Atebubu-Amantin District*. Tropenbos International Ghana
- Brobbe, L.K., Hansen, C.P., Kyereh, B., & Pouliot, M. 2019a. The economic importance of charcoal to rural livelihoods: Evidence from a key charcoal-producing area in Ghana. *Forest Policy and Economics*, vol. 101, pp. 19-31.
- Brobbe, L.K., Pouliot, M. Hansen, C.P., & Kyereh, B. 2019b. Factors influencing participation and income from charcoal production and trade in Ghana. *Energy for Sustainable Development*, vol. 50, pp. 69-81.
- Bromley, D.W. 1992. The Commons, Common Property, and Environmental Policy. *Environmental and Resource Economics*, vol. 2, pp. 1-17.
- Butz, R.J. 2013. Changing land management: A case study of charcoal production among a group of pastoral women in northern Tanzania. *Energy for Sustainable Development*, vol. 17, pp. 138-145.
- Carney, D. 1998. *Sustainable rural livelihoods: What contribution can we make?* Department for International Development (DFID).
- Cavendish, W. 2000. Empirical regularities in the poverty-environment relationship of rural households: Evidence from Zimbabwe. *World Development*, vol. 28, pp. 1979-2003.
- Cavendish, W. 2003. *How do forests support, insure and improve the livelihoods of the rural poor?* A research note. Bogor, Indonesia: Centre for International Forestry Research
- Chambers, R., & Conway, G. 1992. *Sustainable rural livelihoods: Practical concepts for the 21st century*. IDS discussion paper 296. Brighton: Institute of Development Studies.
- Charlery, L.C., Qaim, M. & Smith-Hall, C. 2016. Impact of infrastructure on rural household income and inequality in Nepal. *Journal of Development Effectiveness*, vol. 8, no. 2, pp. 266-286.
- Chidumayo, E.N., & Gumbo, D.J. 2013. The environmental impacts of charcoal production in tropical ecosystems of the world: A synthesis. *Energy for Sustainable Development*, vol. 17, pp. 86-94.
- Christman, J. 1994. *The Myth of Property: Toward an Egalitarian Theory of Ownership*. New York: Oxford University Press.
- CIFOR, Centre for International Forestry Research 2008. *PEN Prototype Questionnaire, version 4.4*. <http://www.cifor.org/pen/research-tools/the-pen-prototype-questionnaire.html>. Accessed on 29 May 2016.
- CIFOR, Centre for International Forestry Research 2007. *PEN Technical Guidelines version 4*. <http://www.cifor.org/pen/research-tools/the-pen-technical-guidelines.html>. Accessed on 29 May 2016.
- Clark, G., 1994. *Onions are my husband: Survival and accumulation by West African market women*. University of Chicago Press.
- Climate-Data.org 2017. Climate Kintampo: Temperature, climate graph, climate table for Kintampo. <https://en.climate-data.org/location/44781/>. Accessed on 15 August 2017.

- Coleman, J. 1990. *Foundations of social theory*. Boston, MA: Harvard University Press.
- Coomes, O.T., & Burt, G.J. 2001. Peasant charcoal production in the Peruvian Amazon: Rainforest use and economic reliance. *Forest Ecology and Management*, vol. 140, pp. 39-50.
- Creswell, J.W., 2014. *Research Design*. Fourth Edition. SAGE Publications, Thousand Oaks.
- Cuvilas, C.A., Jirjis, R. & Lucas, C., 2010. Energy situation in Mozambique: A review. *Renewable and Sustainable Energy Reviews*, vol. 14 no. 7, pp. 2139-2146.
- Demissie, D., Workneh, N., 2004. Determinants of rural livelihood diversification: evidence from southern Ethiopia. *Quarterly Journal of International Agriculture*, vol. 43(3), pp. 267-288.
- Dercon, S., & Krishnan, P. 1996. Income Portfolios in Rural Ethiopia and Tanzania: Choices and Constraints. *Journal of Development Studies*, vol. 32, no. 6, pp. 850-875.
- Derkyi, M., Ros-Tonem, M.A.F., Kyereh, B., & Dietz, T. 2013. Emerging forest regimes and livelihoods in the Tano Offin forest reserve, Ghana: implications for social safeguards. *Forest Policy and Economics*, vol. 32, pp. 49-56.
- Devereux, S., 2001. Livelihood insecurity and social protection: a re-emerging issue in rural development. *Development policy review*, vol. 19, no. 4, pp. 507-519.
- DFID, 2000. *Sustainable livelihoods guidance sheets*. UK DFID Department for International Development: London.
- Dreze, J., & Sen, A. 1989. *Hunger and public action*. WIDER Studies in Development Economics. Oxford: Oxford University Press.
- Eckholm, E. 1975. *The other energy crisis: Firewood*. Worldwatch Paper 1. Worldwatch Institute, Washington, DC.
- Ellis, F. 1999. *Rural livelihood diversity in developing countries: evidence and policy implications*. London, UK: Oversea Development Institute.
- Ellis, F. 2000. *Rural Livelihoods and Diversity in Developing Countries*. Oxford: Oxford University Press.
- Energy Commission, 2006; *Strategic National Energy Plan 2006-2020. Annex I of IV Energy Demand Sectors of the Economy*. Energy Commission, Ghana
- Energy Commission, 2010. *Draft Bioenergy Policy for Ghana*. Energy Commission.
- Energy Commission, 2012. *Licence Manual for Service Providers in the Renewable Energy Industry*. Energy Commission.
- EPA, Environmental Protection Agency 2016. *Renewable Charcoal Supply NAMA, Ghana*. Ghana: EPA.
- Falconer, J. 1992. A study of the non-timber forest products of Ghana's forest zone. In S. Cousell and T. Rice (Eds.), *The rainforest harvest: Sustainable strategies for saving the tropical forests?* (pp. 135-41). London: Friends of the Earth.
- FAO, 2016. *Forestry for a low-carbon future: integrating forests and wood products in climate change strategies*. FAO Forestry Paper No. 177. Rome.
- FAO, 2017. *The charcoal transition: greening the charcoal value chain to mitigate climate change and improve local livelihoods*, by J. van Dam. Rome, Food and Agriculture Organization of the United Nations
- Fisher, M. 2004. Household welfare and forest dependence in Southern Malawi. *Environment and Development Economics*, vol. 9, pp. 135-154.

- Foucault, M. 1978. "On Governmentality, Lecture at the College de France." Pp. 87–104 in *The Foucault Effect: Studies in Governmentality*, edited by Graham Burchell, Colin Gordon, and Peter Miller. Hemel Hempstead: Harvester Wheatsheaf.
- Foucault, M. 1979. *Discipline and Punish*. New York: Vintage.
- Geisler, C. and G. Daneker. 2000. *Property and Values: Alternatives to Public and Private Ownership*. Washington, DC: Island Press.
- GIZ. 2014. *Multiple-household fuel use: a balanced choice between fuelwood, charcoal and LPG*. Eschborn, Germany, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).
- GSS, Ghana Statistical Service, 2008. *Ghana Living Standards Survey Report, the Fifth Round (GLSS 5)*, Accra, Ghana Statistical Service.
- GSS, Ghana Statistical Service, 2014. *Ghana Living Standards Survey, round 6: Main report*. Accra: Ghana Statistical Service.
- Gumbihi, H. 2018, April 6. *Nairobi city residents feeling the heat of charcoal ban*, Standard Digital, Retrieved from <https://www.standardmedia.co.ke>
- de Haan, L., & Zoomers, A. 2005. Exploring the frontier of livelihoods research. *Development and change*, vol. 36, no. 1, pp. 27-47.
- Hansen, C.P. 2010. *Governance of timber resources in the high forest zone of Ghana. A positive political economy perspective*. PhD Thesis. University of Copenhagen.
- Hansen, C.P., & Lund, J.F. 2017. Imagined Forestry: The History of the Scientific Management of Ghana's High Forest Zone. *Environment and History*, vol. 23, no. 1, pp. 3-38.
- Hansen, C.P., Pouliot, M., Marfo, E., Obiri, D.B., & Treue, T. 2015. Forests, timber and rural livelihoods: Implications for social safeguards in the Ghana–EU Voluntary Partnership Agreement. *Small-Scale Forestry*, vol. 14, pp. 401-422.
- Hansen, C.P., Ruth, R., & Acheampong, E. 2018. 'Experimental' or business as usual? Implementing the European Union Forest Law Enforcement, Governance and Trade (FLEGT) Voluntary Partnership Agreement in Ghana. *Forest Policy and Economics*, vol. 96, pp. 75-82.
- Heckman, J.J. 1979. Sample selection bias as a specification error. *Econometrica*, vol. 47, no. 1, pp. 153-161.
- Hodgson, G.M. 2006. What are Institutions? *Journal of Economic Issues*, vol. XL(1), pp. 1-25
- ICRAF, International Centre for Research in Agroforestry 2002. *Wood fuel policy and legislation in Eastern and Southern Africa*. Report of Regional Workshop held at the World Agroforestry Centre, 4 March 2002, Nairobi, Kenya.
- IDS, Institute of Development Studies 2016. *Livelihood Outcomes. Eldis programme*. Available online <http://www.eldis.org/go/topics/resource-guides/livelihoods-and-social-protection/what-are-livelihoods-approaches/livelihood-outcomes#>. WBDaiiTCm9U. Accessed on 27th October, 2016.
- IEA, International Energy Agency 2014. *Africa energy outlook: A focus on energy prospects in sub-Saharan Africa*. France: International Energy Outlook/OECD.
- Jagger, P., Luckert, M. K., Duchelle, A. E., Lund, J. F., & Sunderlin, W. D. 2014. Tenure and Forest Income: Observations from a Global Study on forest and Forests and Poverty. *World Development*, vol. 64, pp. S43-S55.

- Jones, D., Ryan, C. M., & Fisher, J. 2016. Charcoal as a diversification strategy: The role of charcoal production in the livelihoods of small holders in central Mozambique. *Energy for Sustainable Development*, vol. 32, pp. 14-21.
- Kambewa, P.S., Mataya B.F., Sichinga, W.K., & Johnson, T.R. 2007. *Charcoal: the reality – a study of charcoal consumption, trade and production in Malawi. Small and Medium Forestry Enterprise Series, 21*. London, IIED.
- Katz, E.G. 2000. Social Capital and Natural Capital: A Comparative Analysis of Land Tenure and Natural Resource Management in Guatemala. *Land Economics*, vol. 76, no. 1, pp. 114-132.
- Khundi, F., Jagger, P., Shively, G., & Sserunkuuma, D. 2011. Income, poverty and charcoal production in Uganda. *Forest Policy and Economics*, vol. 13, pp. 199-205.
- Korang, J.K., Obiri, D.B., Appiah, H., and Awuku, S. 2015. Calorific values and gravimetric yield of six wood fuel species in the forest savannah transitional zone of Ghana, *Ghana Journal of Forestry*, vol. 31, pp. 51-61.
- Kotey, A.N., Francois, J., Owusu, J.G.K., Yeboah, R. Amanor, S.K. & Antwi, L. 1998. *Falling into place*. International Institute for Environment and Development, (IIED), United Kingdom.
- Krantz, L. 2001. *The Sustainable Livelihood Approach to Poverty Reduction: An introduction*. Swedish International Development Cooperation Agency. Division of Policy and Socio-economic Analysis
- Leach, M., Mearns, R., & Scoones, I. 1999. Environmental Entitlements: Dynamics and Institutions in Community-Based Natural Resource Management, *World Development*, vol. 27, no. 2, pp. 225-247.
- LI 2254, *Timber resources management and legal regulation*, 2017. Government of Ghana.
- Lukes, S. 1986. *Power*. New York: New York University Press.
- Lurumuah, S. 2011. *The Economic and Environmental Effects of Commercial Charcoal Production in the Upper West Region of Ghana*. MSc thesis, Kwame Nkrumah University of Science and Technology Kumasi.
- MacPherson, C.B. 1978. *Property: Mainstream and Critical Positions*. Toronto: University of Toronto Press.
- Marfo, E. 2004. Unpacking and repacking community representation in forest policy and management negotiations: lessons from the social responsibility agreement in Ghana. *Ghana Journal of Forestry*, vol. 15, no. 1, pp. 20-29.
- Marfo, E. 2009. *Security of tenure and community benefits under collaborative forest management arrangement in Ghana: A country report*. CIFOR/RRI Research Report.
- Marx, K. 1977. "Grundrisse." Pp. 343–87 in *Karl Marx: Selected Writings*, edited by David McLellan. Oxford: Oxford University Press.
- McSweeney, K. 2004. Forest product sale as natural insurance: The effects of household characteristics and the nature of shock in Eastern Honduras. *Society and Natural Resources*, vol. 17, pp. 39-56.
- MESTI, Ministry of Environment, Science, Technology and Innovation 2012. *Ghana National Climate Change Policy*, MEST, Ghana.
- MLNR, Ministry of Lands and Natural Resources 2012a. *Forest Investment Program*, MLNR, Ghana.
- MLNR, Ministry of Lands and Natural Resources 2012b. *Forest and Wildlife Policy of Ghana* MLNR, Ghana.

- Mombu, M.V., Mason, J.J. & Nakuku, B.B. 2007. *Understanding the local charcoal trade, stakeholders and economic linkages in the forest savannah transition zone of Ghana*. Nature Conservation Research Centre, Ghana.
- Moser, C. 1998. The asset vulnerability framework: reassessing urban poverty reduction strategies. *World Development*, vol. 26(1), pp. 1-9.
- Moser, C., Norton, A., Conway, T., Ferguson, C., & Vizard, P. 2011. *To claim our rights: livelihood security, human rights and sustainable development*. London: Overseas Development Institute (ODI).
- Mwampamba, T.H., Ghilardi, A., Sander, K. & Chaix, K.J., 2013. Dispelling common misconceptions to improve attitudes and policy outlook on charcoal in developing countries. *Energy for Sustainable Development*, vol. 17 no. 2, pp.75-85.
- Myers, R., & Hansen, C.P. 2019. Revisiting A Theory of Access: A review. *Society and Natural Resources*, 1-21, DOI: 10.1080/08941920.2018.1560522
- Ndegwa, G., Anhuf, D., Nehren, U., Ghilardi, A., & Iiyama, M. 2016. Charcoal contribution to wealth accumulation at different scales of production among the rural population of Mutomo District in Kenya. *Energy for Sustainable Development*, vol. 33, pp. 167-175.
- Neimark, B. 2010. Subverting regulatory protection of ‘natural commodities’: The *Prunus Africana* in Madagascar, *Development and Change* vol. 41, no. 5, pp. 929-954.
- Neuman, W.L. 1991. *Social Research Methods, qualitative and quantitative approaches*, Allyn and Bacon, Boston, MA
- Nketiah, S.K., & Asante, J. 2018. *Estimating national charcoal production level in Ghana*. Tropenbos Ghana.
- Nketiah, S.K., Hagan, E.B., & Addo, S.T. 1988. *The Charcoal Cycle in Ghana – a Baseline Study*. United Nations Development Programme/National Energy Board of Ghana Project, GHA/82/020. Unpublished.
- North, D. 1990. *Institutions, Institutional Change and Economic Performance*. Cambridge University Press.
- Obiri, D.B., Nunoo, I., Obeng, E., Owusu, F.W., & Marfo, E. 2014. Financial analysis of the charcoal production systems. In *The charcoal industry in Ghana: An alternative livelihood option for displaced chainsaw lumber producers*. Wageningen, The Netherlands: Tropenbos International.
- OECD, Organisation for Economic Cooperation and Development 2017. What are equivalent scales? <http://www.oecd.org/eo/growth/OECD-Note-EquivalentScales.pdf>. Accessed on 20 April 2017.
- Olsson, J. 2009. Improved road accessibility and indirect development effects: evidence from rural Philippines. *Journal of Transport Geography*, vol. 17, pp. 467-483.
- Onibon, A., Dabire, B., & Ferroukhi, L. 1999. Local practice and decentralization and devolution of natural resources management in West Africa. *Unasylva*, vol. 50, pp. 23-27.
- Paumgarten, F., & Shackleton, C.M. 2009. Wealth differentiation in household use and trade in non-timber forest products in South Africa. *Ecological Economics*, vol. 68, pp. 2950-2959.
- Polanyi, K. 1944. *The Great Transformation: The Political and Economic Origins of Our Time*. Boston: Beacon Press.

- Pouliot, M., & Elias, M. 2013. To process or not to process? Factors enabling and constraining shea butter production and income in Burkina Faso. *Geoforum*, vol. 50, pp. 211-220.
- Pouliot, M., & Treue, T. 2013. Rural people's reliance on forests and the non-forest environment in West Africa: Evidence from Ghana and Burkina Faso. *World Development*, vol. 43, pp. 180-193.
- Pouliot, M., Treue, T., Obiri D.B., & Ouedraogo, B. 2012. Deforestation and the Limited Contribution of Forests to Rural Livelihoods in West Africa: Evidence from Burkina Faso and Ghana. *AMBIO*, vol. 41, pp. 738-750, DOI 10.1007/s13280-012-0292-3
- Pretty, J., & Ward, H. 2001. Social Capital and the Environment. *World Development*, vol. 29, no. 2, pp. 209-227.
- Putnam, R.D., 1993. The prosperous community. *The American prospect*, vol.4, no. 13, pp. 35-42.
- Putzel, L., Kelly, A.B., Cerrutti, P.O. & Artati, Y. 2015. Formalization as Development in Land and Natural Resource Policy. *Society & Natural Resource*, vol. 28, no. 5, pp. 453-472
- Ribot, C.J. 1998. Theorizing access: Forest profit along Senegal's charcoal commodity chain. *Development and Change*, vol. 29, pp. 307-341.
- Ribot, C.J. 1999. A history of fear: Imagining deforestation in the West African dryland forests. *Global Ecology and Biogeography*, vol. 8, pp. 291-300.
- Ribot, C.J. 2004. *Waiting for democracy: The politics of choice in natural resource decentralization*. Washington, D.C.: World Resources Institute.
- Ribot, C.J. 2014. Cause and response: vulnerability and climate change in the Anthropocene. *Journal of Peasant Studies*, vol. 41, no. 5, pp. 667-705.
- Ribot, C.J., & Peluso, N.L. 2003. A Theory of Access. *Rural Sociology*, vol. 68, no. 2, pp. 153-181.
- Ribot, J.C., & Oyono, R. 2005. The politics of decentralization. *Toward a new map of Africa*, pp. 205-228.
- Ribot, J.C., Chhatre, A., & Lankinad, T. 2008. Introduction: Institutional choice and recognition in the formation and consolidation of local democracy. *Conservation and Society*, vol. 6, no. 1, pp. 1-11.
- Sakdapolrak, P. 2014. Livelihoods as Social Practices – Re-energising Livelihoods Research with Bourdieu's Theory of Practice. *Geographica Helvetica*, vol. 69, pp. 19-28.
- Sander, K., Gros, C. & Peter, C. 2013. Enabling reforms: Analyzing the political economy of the charcoal sector in Tanzania. *Energy for Sustainable Development*, vol. 17, pp. 116-126.
- Schlager, E. & Ostrom, E. 1992. Property-Rights Regimes and Natural Resources: A Conceptual Analysis. *Land Economics*, vol. 68, no. 3, pp. 249-262.
- Schure, J., Ingram, V., Arts, B., Levang, P., & Mvula-Mampasi, E. 2015. Institutions and access to woodfuel commerce in the Democratic Republic of Congo. *Forest Policy and Economics*, vol. 50, pp. 53-61.
- Schure, J., Ingram, V., Sakho-Jimbira, M.S., Levang, P., & Wiersum, F.K. 2013. Formalisation of charcoal value chains and livelihood outcome in Central- and West Africa. *Energy for Sustainable Development*, vol. 17, pp. 95-105.
- Schure, J., Levang, P., & Wiersum, K. F. 2014. Producing woodfuel for urban centres in the Democratic Republic of Congo: A pathway out of poverty for rural households. *World Development*, vol. 64, pp. S80-S90.

- Schwöppe, C., & Wojewska, A. 2018. *To plant or not to plant? A case study of woodlot and plantation establishment under ELCIR+ in Kintampo Forest District*. Msc Thesis, University of Copenhagen.
- Scoones, I. 1998. "Sustainable Rural Livelihoods: A Framework for Analysis", *IDS Working Paper*, No. 72
- Scoones, I. 2009. Livelihoods Perspectives and Rural Development. *Journal of Peasant Studies*, vol. 36, no. 1, pp. 171-196.
- Scoones, I. 2015. *Sustainable livelihoods and rural development*. Rugby, Warwickshire, UK: Practical Action Publishing.
- Scoones, I., Melnyk, M., & Pretty J.N. 1992. *The Hidden Harvest: wild foods and agricultural systems*. The Sustainable Agriculture Programme, IIED, UK.
- Sen, A. 1981. *Poverty and Famines: an Essay on Entitlement and Deprivation*. Oxford University Press, Oxford.
- Sen, A., 1984. *Rights and capabilities*. In: Sen, A. *Resources, Values and Development*. Basil Blackwell, Oxford, pp. 307-324.
- Shackleton, C.M., & Shackleton, S.E. 2004. The importance of non-timber forest products in rural livelihood security and as safety nets: Evidence from South Africa. *South Africa Journal of Science*, vol. 100, pp. 658-664.
- Shively, G., Jagger, P., Sserunkuuma, D., Arinaitwe, A., & Chibwana, C. 2010. Profit and margins along Uganda's charcoal value chain. *International Forestry Review*, vol. 12, pp. 270-283.
- Sikor, T., & Lund, C. 2009. "Access and Property: A Question of Power and Authority", in T. Sikor and C. Lund (eds). *The Politics of Possession: Property, Authority and Access to Natural Resources*, pp 1-22. Blackwell Publishing Limited.
- Sikor, T., & Nguyen, T.Q. 2007. Why may forest devolution not benefit the rural poor? Forest entitlements in Vietnam's central highlands. *World Development*, vol. 35, no. 11, pp. 2010-2025.
- Sikor, T., He, J., & Lestrelin, G. 2017. Property rights regimes and natural resources: a conceptual analysis revisited. *World Development*, vol. 93, pp. 337-349.
- Sjaastad, E., Angelsen, A., Vedeld, P., & Bojö, J. 2005. What is environmental income? *Ecological Economics*, vol. 55, pp. 37-46.
- Small, L.A. 2007. The sustainable rural livelihoods approach: a critical review. *Canadian Journal of Development Studies/Revue canadienne d'études du développement*, vol. 28, no. 1, pp. 27-38.
- Smith, H.E., Eigenbrod, F., Kafumbatu, D., Hudson, M.D., & Schreckenberg, K. 2015. Criminals by necessity: The risky life of charcoal transporters in Malawi. *Forest, Trees and Livelihood*, vol. 24, no. 4, pp. 259-274. DOI:1080/14728028.2015.1062808.
- Smith, H.E., Hudson, M.D., & Schreckenberg, K. 2017. Livelihood diversification: The role of charcoal production in southern Malawi. *Energy for Sustainable Development*, vol. 36, pp. 22-36.
- Solesbury, W. 2003. *Sustainable livelihoods: A case study of the evolution of DFID policy*. ODI Working Paper. Paper No. 217, Overseas Development Institute, London, England.
- Solidaridad 2018. *Ghana Dedicated Grant Mechanism for local communities, Newsletter, March 2018*, Solidaridad Ghana
- SRID, Statistics, Research and Information Directorate 2011. *Agriculture in Ghana. Facts and figures*. Accra: Ministry of Food and Agriculture.

- Stilwell, F. 2002. *Political Economy: The contest of economic ideas*. Oxford University Press.
- Swift, J. 1989. Why are rural people vulnerable to famine? IDS Bulletin, 20(2), pp. 8-15.
- Tesfaye, Y., Roos, A., Cambell, B., & Bohlin, F. 2011. Livelihood strategies and the role of forest income in participatory-managed forests of Dodola area in the bale highlands, southern Ethiopia. *Forest Policy and Economics*, vol. 13, pp. 258-265.
- Thondhlana, G., Vedeld, P., & Shackleton, S. 2012. Natural resource use, income and dependence among San and Mier communities bordering Kgalagadi Transfrontier Park, Southern Kalahari, South Africa. *International Journal of Sustainable Development and World Ecology*, vol. 19, pp. 460-470.
- Ubink, J.M., & Amanor, S.K. (eds) 2008. *Contesting land and customs in Ghana: state, chief and the citizen*. Leiden University Press.
- UN, United Nations 2013. *Millennium development goals report 2013*. New York. United Nations.
- Vedeld, P., Angelsen, A., Bojo, J., Sjaastad E., & Breg G. B. 2007. Forest environmental income and the rural poor. *Forest Policy and Economics*, vol. 9, pp. 869-879.
- Vos, J., and Vis, M. 2010. *Making charcoal production in sub-Saharan Africa sustainable*. Netherlands Agency. Ministry of Economic Affairs, Agriculture and Innovation.
- Weber, M., ed. 1978. *Economy and Society*. Berkeley: University of California Press.
- Westermann, O., 2007. *Poverty access and payment for watershed hydrological services: A social feasibility study with case in Tiquipaya Watershed Bolivia*. PhD dissertation, Danish Institute for International Studies.
- Wiggins, S., 2002, April. Sustainable Rural Livelihoods: A way, forward for the micro-economics of development. In *Development Economics Study Group Annual Conference, Nottingham, April* (pp. 18-20).
- Wooldridge JM. 2010. *Econometric Analysis of Cross Section and Panel Data*. MIT Press: Cambridge, MA.
- World Bank, 2009. *Environmental crisis or sustainable development opportunity? Transforming the charcoal sector in Tanzania*. The World Bank, Washington, DC.
- Wunder, S., Borner, J., Shively, G., & Wyman, M. 2014. Safety nets, gap filling and forests: A global-comparative perspective. *World Development*, vol. 64, pp. S29-S42.
- Xu, X., Zuo, T., Gou, T., Qi, G., & Ribot, J. 2010. *Access Matters: The little man with the big stone: A commodity chain analysis on the case of Chinese fir in P County, Hunan Province, China*. Discussion paper 62, University of Nottingham.
- Zorrilla-Miras, P., Mahamane, M., Metzger, M.J., Baumert, S., Vollmer, F., Luz, A.C., & Ryan, C.M. 2018. Environmental conservation and social benefits of charcoal production in Mozambique. *Ecological Economics*, vol. 144, pp. 100-111.
- Zulu, L. C. 2010. The forbidden fuel: Charcoal, urban woodfuel demand and supply dynamics, community forest management and woodfuel policy in Malawi. *Energy Policy*, vol. 3, pp. 3717-3730.

Zulu, L. C., & Richardson, R. B. 2013. Charcoal, livelihoods and poverty reduction: Evidence from sub-Saharan Africa. *Energy for Sustainable Development*, vol. 17, pp. 127-137.

APPENDIXES

Appendix A: Village survey (questionnaire)

| | | |
|--|--|------------|
| Name of enumerator | | |
| Date (yyyymmdd) | | |
| A. Geographic and climate variables | | |
| 1. What is the name of the village? | | |
| 2. What is the name of district? | | |
| 2. What are the GPS coordinates of the village? (UTM format) | | |
| 3. What is the latitude of the village? | | degrees |
| 4. What is the longitude of the village? | | degrees |
| 5. What is the altitude (masl) of the village? | | masl |
| 6. What has been the average annual rainfall (mm/year) in the district during the past 20 years? | | mm/year |
| 7. What is the coefficient of variation in rainfall for the past 20 years? (Note: To be filled in if data are readily available.) | | |
| 8. What was the total rainfall in the village for the past 12 months? (Note: To be filled in if data are readily available.) | | mm/year |
| B. Demographics | | |
| 1. In what year was the village established? | | |
| 2. What is the current population of the village? | | persons |
| 3. How many households live currently in this village? | | households |
| 4. What was the total population of the village 10 years ago? | | persons |
| 5. How many households lived in the village 10 years ago? | | households |
| 6. How many persons (approx.) living here now have moved to the village in the past 10 years (in-migration)? | | persons |
| 7. How many persons (approx.) have left the village over the past 10 years (outmigration)? | | persons |
| 8. How many different tribes are living in the village? (list the codes separated by a comma) Codes: 1 = Mo; 2=Dagarti; 3=Mossi; 4=Gonja; 5=Kokomba; 6=Frafra; 7=Brong; 8=Sissala; 10=Tsokosti; 11=Mamprusi; 12=Dagomba; 9=other, specify | | |
| C. Infrastructure | | |
| 1. How many households (approx.) in the village have access to electricity (from public or private suppliers)? | | households |
| 2. How many households (approx.) in the village have access to (= use) piped tap water? | | households |
| 3. How many households (approx.) in the village have access to (=use) bore hole water? | | households |
| 4. How many households (approx.) have access to formal credit (government or private bank operating in the village)? | | households |
| 5. Are informal credit institutions such as savings clubs and money lenders present in the village? Codes: 1=yes, 0=no | | (1-0) |
| 6. Is there any health centre in the village? Codes: 1=yes, 0=no | | (1-0) |
| 7. Does the village have at least one road useable by cars during all seasons? If 'yes', go to 9. Codes: 1=yes, 0=no | | (1-0) |

| | | | | |
|--|---|-------|--------|------------------------------------|
| 8. If 'no': what is the distance in kilometres to the nearest road usable during all seasons? <i>km</i> | | | | |
| 9. Is there a river within the village boundaries that is navigable during all seasons? If 'yes ', go to 11. <i>(1-0)</i> Codes: 1=yes, 0=no | | | | |
| 10. If 'no': what is the distance to the nearest river that is navigable during all seasons? <i>Km</i> | | | | |
| 11. What is the distance from the village centre to the nearest ... | | | | |
| | | 1. km | 2. min | 3. <i>transport^{>}</i> |
| | 1.district market | | | |
| | 2.market for major consumption goods | | | |
| | 3.market where agric. products are sold | | | |
| | 4.market where charcoal is sold | | | |

Codes: 1=foot, 2=bike, 3=motorbike, 4=donkey/ox cart (load on their bag), 5=tractor, 6=car/van, 7=truck/lorry, 8=bus, 10=3 wheel van, 9=other, specify

Please state here who the primary respondents are

Appendix B: Household survey (questionnaire and product list)

Enumerator _____

Name of enumerator _____

Introduction and confidential statement

My name is ..., from a research project called "Property, Access and Exclusion along the Charcoal Commodity Chain in Ghana" (AX) which is a collaboration between Kwame Nkrumah University of Science and Technology, University of Ghana, Tropenbos International Ghana and University of Copenhagen. The aim of this survey is to investigate people's economic dependence on charcoal.

The information that you give us will be treated confidentially and we assure you anonymity. Later when the data has been analysed we will make sure that the results will be given to your community.

"Do you have any questions about this research? Are you willing to take part in this interview? If you say yes, I will tick this box to indicate that I have read this information to you, that you understand and that you are willing to take part."

| | |
|--|-------|
| 1. Has this information been disseminated to the respondent and does he/she consent to participate in the interview? [Enumerators should use all means to make people understand the benefit to their community of participating in the survey.] <i>Codes: 1 = yes, 0 = no</i> If the household consent to participate then mark the household ID on your personal household ID list and proceed with the interview | (1-0) |
| 2. If "No - does NOT want to participate" What is the reason that you don't want to participate in the interview? You should then go to the next household and start a new interview | |

A. Identification

| | |
|---------------------|--|
| 1. Household ID | |
| 2. Name of village | |
| 3. Name of district | |

B. Household and contact information

[Explain to the respondent]: In the following questions we will ask about the people of the household (people living under the same roof who exchange labour time without any payment and who "eat from the same pot"). It is important that you consider all the individuals that belong to and live the majority of the year in your household.

| | |
|--|--|
| 1. Please write the name of the household head (Household head here refers to the one who is managing the entire family now) | |
| 2. Contact information of household head (mobile phone number if available) | |

Respondents

| | |
|--|-------|
| 1. Confirm that the primary respondent is household head by choosing "YES", otherwise "No" <i>Codes: 1 = yes, 0 = no</i> <i>If yes, go to 3.</i> | (1-0) |
| 2. If he/she is not the household head, please write here name of the primary respondent: | |
| 3. Please write here name of the secondary respondent: : (if none, go to next section) | |

Household head

| | |
|--|-------|
| 1. How many years is the household head? | |
| 2. Gender of household head | |
| 3. Highest education level of household head 1=illiterate, 2=informal education, 3=basic education, | |
| 4. Was the household head born in this village? <i>If 'yes', go to 6.</i> | (1-0) |
| 5. If 'no': how long has the household head lived in the village? | years |
| 6. What is the marital status of household head? <i>Codes: 1=married; 2=unmarried, 3=divorced; 4=widow/widower; 5=refuses to answer</i> | |
| 7. How long ago was this household formed (it can refer to the establishment of the first homestead - first wife)? | years |
| 8. Does the household head belong to the largest tribe in the village? | (1-0) |
| 9. Which tribe ¹⁻¹ does the household head belong to? | |

1) Codes: 1 = Mo; 2=Dagarti; 3=Mossi; 4=Gonja; 5=Kokomba; 6=Frafra; 7=Brong; 8=Sissala; 9=Tsokosti; 10=Mamprusi; 11=Dagomba; 12=other, specify

Household composition

| | |
|--|--|
| 1. How many members are there in total in your household? | |
| 2. How many members of the household are under 15 years old? | |
| 3. How many members of the household are 15-65 years old? | |
| 4. How many members of the household are over 65 years old? | |

C. Land

| | |
|---|--|
| 1. How many-area of cultivated land does your household have? | |
| 2. How many acres of fallow land does your household have? | |

D. House

| | |
|---|--|
| 1. What is the ownership of your house? ¹⁾ | |
| 2. What is the type of material of (most of) the walls? ²⁾ | |
| 3. What is the type of material of (most of) the roof? ³⁾ | |
| 4. How many rooms are in the house? | |

1) Codes: 1=own the house on their own; 2=own the house together with other household(s); 3=renting the house alone; 4=renting the house with other household(s); 5=family house; 6=other, specify:

2) Codes: 1=mud/soil; 2=wooden (boards, trunks); 3=iron (or other metal) sheets; 4=bricks or concrete; 5=reeds/straw/grass/fibres/bamboo; 6=other, specify:

3) Codes: 1=thatch; 2=wooden (boards); 3=iron (or other metal) sheets; 4=tiles; 5=other, specify:

E. Other assets

Please write how many units of the following assets the household own (if the respondent does not have the item in question then write 0).

| | |
|-----------------------------------|--|
| Car/truck | |
| Motorcycle | |
| Bicycle | |
| Tractor | |
| Plough | |
| Wooden cart or wheelbarrow | |
| Mobile phone | |
| TV | |
| Radio | |
| Cassette/CD/VHS/VSD/DVD player | |
| Camera | |
| Stove for cooking (charcoal, gas) | |
| Refrigerator/freezer | |
| Furniture | |
| Gun/rifle | |
| Chainsaw | |
| Water pump | |
| Solar panel | |
| Solar light | |
| Laptop/computer | |

F. Charcoal user groups

| | |
|---|-------|
| 1. Are you or any member of your household a member of a charcoal user group? | (1-0) |
| 2. What is the name of the user group? | |
| 3. Does someone in your household normally/regularly attend the user group meetings/activities? <i>If 'no', go to 6.</i> | (1-0) |
| 4. If 'yes': in your household, who normally attends the meetings and participates in charcoal user group activities? | |

| | | |
|--|--|-------|
| <p>Codes: 1 =only the wife; 2=both, but mainly the wife; 3=both participate about equally; 4=both , but mainly the husband; 5=only the husband; 6=mainly son(s); 7=mainly daughter(s); 8=mainly son(s); 9=mainly wife & daughter(s); 10=other arrangements not described above</p> | | |
| <p>5. How many person days (= full working days) did the household members spend in total on charcoal user group activities (meetings, policing, joint work, etc) over the past 12 months?</p> | | days |
| <p>6. Does your household make any cash payments/contributions to the charcoal user group? If 'no ', go to 8.</p> | | (1-0) |
| <p>7. If 'yes': how much did you pay in the past 12 months? (Ghanaian Cedi)</p> | | |
| <p>8. Did your household receive any cash payments from the charcoal user group (e.g., share of sales) in the past 12 months? If 'no ', go to 10.</p> | | (1-0) |
| <p>9. If 'yes': how much did you receive in the past 12 months? (Ghanaian Cedi)</p> | | |
| <p>10. What are your most important reasons for joining the charcoal user group? If several reasons, max. state the three most important.</p> | Reason | |
| | 1. Increased access to wood for charcoal | |
| | 2. Better tree management and more benefits in future | |
| | 3. Access to other benefits, e.g., government support or donor programs | |
| | 4. My duty to protect the tree resources for the community and the future | |
| | 5. Being respected and regarded as a responsible person in the village | |
| | 6. Social aspect (meeting people, working together, fear of exclusion, etc.) | |
| | 7. Forced by Government/chiefs/neighbours | |
| | 8. Higher price for charcoal | |
| | 9. Better quality of charcoal | |
| | 10. Receipt of direct payments | |
| | 11. Makes harvest of wood for charcoal production more efficient | |
| | 12. Learn new skills/information | |
| | 13. Reduce conflicts over resource | |
| | 14. Other, specify: | |
| <p>11. Overall, how would you say the existence of the charcoal user group has affected the benefits that the household gets? Codes: 1=large negative effect; 2=small negative effect; 3=no effect; 4=small positive effect; 5=large positive effect.</p> | | |
| <p>12. If you don't participate in a Charcoal user group, why? If several reasons, state the three most important.</p> | Reason | |
| | 1. No charcoal user group exists in the village | |
| | 2. I'm new in the village | |
| | 3. Charcoal user group members generally belong to other group(s) (ethnic, political party, religion, age, etc.) than I do | |
| | 4. Cannot afford to contribute the time | |
| | 5. Cannot afford to contribute the required cash | |

| | | |
|--|---|--|
| | 6. Charcoal user group membership will restrict my use of wood for charcoal production, and I want to use the wood as I need it | |
| | 7. I don't believe the charcoal user group is very effective in managing the tree stocks | |
| | 8. Not interested in the activities undertaken by existing charcoal user groups | |
| | 9. Corruption in the charcoal user groups | |
| | 10. Interested in joining but needs more information | |
| | 11. Other, specify | |

G. Forest User Groups (FUG)

| | | |
|--|---|-------|
| 1. Are you or any person from your household a member of a Forest User Group (FUG)? <i>If 'no', go to 12.</i> | | (1-0) |
| 2. What is the name of the user group? | | |
| 3. Does someone in your household normally/regularly attend the FUG meetings/activities? <i>If 'no', go to 6.</i> | | (1-0) |
| 4. If 'yes': in your household, who normally attends the meetings and participates in other FUG activities? <i>Codes: 1=only the wife; 2=both, but mainly the wife; 3=both participate about equally; 4=both, but mainly the husband; 5=only the husband; 6=mainly son(s); 7=mainly daughter(s); 8=mainly husband & son(s); 9=mainly wife & daughter(s); 10=other arrangements not described above.</i> | | |
| 5. How many person days (= full working days) did the household members spend in total on FUG activities (meetings, policing, joint work, etc.) over the past 12 months? | | days |
| 6. Does your household make any cash payments/contributions to the FUG? <i>If 'no', go to 8.</i> | | (1-0) |
| 7. If 'yes': how much did you pay in the past 12 months? (<i>Ghanaian Cedi</i>) | | |
| 8. Did your household receive any cash payments from the FUG (e.g., share of sales) in the past 12 months? <i>If 'no', go to 10.</i> | | (1-0) |
| 9. If 'yes': how much did you receive in the past 12 months? (<i>Ghanaian Cedi</i>) | | |
| 10. What are your most important reasons for joining the FUG? If several, max state the three most important. | Reason | |
| | 1. Increased access to forest products | |
| | 2. Better forest management and more benefits in future | |
| | 3. Access to other benefits, e.g., government support or donor programmes | |
| | 4. My duty to protect the forest for the community and the future | |

| | | |
|---|--|--|
| | 5. Being respected and regarded as a responsible person in the village | |
| | 6. Social aspect (meeting people, working together, fear of exclusion, etc.) | |
| | 7. Forced by Government/chiefs/neighbours | |
| | 8. Higher price for forest product | |
| | 9. Better quality of forest product | |
| | 10. Receipt of direct payments | |
| | 11. Makes harvest of forest products more efficient | |
| | 12. Learn new skills/information | |
| | 13. Reduce conflicts over resource | |
| | 14. Other, specify: | |
| 11. Overall, how would you say the existence of the FUG has affected the benefits that the household gets from the forest? <i>Codes: 1=large negative effect; 2=small negative effect; 3=no effect; 4=small positive effect; 5=large positive effect</i> | | |
| 12. If you don't participate in FUG, why? <i>If several reasons, state the three most important.</i> | Reason | |
| | 1. No FUG exists in the village | |
| | 2. I'm new in the village | |
| | 3. FUG members generally belong to other group(s) (ethnic, political party, religion, age, etc.) than I do | |
| | 4. Cannot afford to contribute the time | |
| | 5. Cannot afford to contribute the required cash payment | |
| | 6. FUG membership will restrict my use of the forest, and I want to use the forest as I need it | |
| | 7. I don't believe FUG is very effective in managing the forest | |
| | 8. Lack of forest products | |
| | 9. Not interested in the activities undertaken by existing FUGs | |
| | 10. Corruption in FUG | |
| | 11. Interested in joining but needs more information | |
| | 12. Other, specify: | |

Before proceeding, please first ask the respondent(s) which of the listed products in the "product list" the household has consumed/used or sold in the past 12 months.

H. Unprocessed products collected from the wild

1. What are the quantities and values of unprocessed products the members of your household collected for both own use and sale over the past 12 months?

Note: The quantities of unprocessed products from the wild which are used as inputs in making processed products with input from the wild should not be reported in the table below.

| 1. Product (choose product from "product list") | 2. Collected by whom? 1) | 3. Quantity collected (5+6) | 4. Unit ²⁾ | 5. Own use (incl. gifts given out) | 6. Sold (incl. barter) | 7. Price per unit ³⁾ | 8. Type of market ⁴⁾ | 9. Gross value (3*7) | 10. Transport/marketing costs | 11. Purch. inputs & hired labour | 12. Net income (9-10-11) |
|--|-----------------------------|--------------------------------|-----------------------|---------------------------------------|---------------------------|---------------------------------|---------------------------------|-------------------------|-------------------------------|----------------------------------|-----------------------------|
| | | | | | | | | | | | |

1) Codes: 1 =only/mainly by wife and adult female household members; 2=both adult males and adult females participate about equally; 3=only/mainly by the husband and adult male household members; 4=only/mainly by girls (<15 years); 5=only/mainly by boys (<15 years); 6=only/mainly by children (<15 years), and boys and girls participate about equally; 7=all members of household participate equally; 8=person employed by and living with the household, 9=none of the above alternatives.

2) Codes: 1=grams, 2=kg; 3=tonnes; 4=pound, 5=litres, 6=tin, 7= cord, 8=mini bag, 9=maxi bag, 10=jumbo bag, 11=piece, 12=crate, 13=kia rhino, 14=kia, 15=kia mini, 16=motor king, 17=bale, 18=other, specify

3) Note: It is required to enter the price even if the product is not sold by the household. Make sure it is the same unit for quantity collected.

4) Codes: 1=sold within the village, 2= sold outside the village, 3= not sold on a market (NOTE- if both for own use and sold on a market remember to separate codes with a comma)

I. Processed products (with input collected in the wild, including charcoal)

1. What are the quantities and values of processed products with input from the wild that the members of your household produced during the past 12 months?

| 1. Product (choose product from "product list") | 2. Who in the household did the work? | 3. Qty. produce (5+6) | 4. Unit ²⁾ | 5. Own use (incl. gifts given out) | 6. Sold (incl. barter) | 7. Price per unit ³⁾ | 8. Type of market ⁴⁾ | 9. Gross value (3*7) | 10. Transport/marketing costs | 11. Purch. inputs & hired labour | 12. Payments to the chief/land owner | 13. Net income excl. costs of inputs (9-10-11-12) |
|--|---------------------------------------|--------------------------|-----------------------|---------------------------------------|---------------------------|---------------------------------|---------------------------------|-------------------------|-------------------------------|----------------------------------|--------------------------------------|--|
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

1) Codes: 1 =only/mainly by wife and adult female household members; 2=both adult males and adult females participate about equally; 3=only/mainly by the husband and adult male household members; 4=only/mainly by girls (<15 years); 5=only/mainly by boys (<15 years); 6=only/mainly by children (<15 years), and boys and girls participate about equally; 7=all members of household participate equally; 8= person employed by and living with the household, 9=none of the above alternatives.

2) Codes: 1=grams, 2=kg; 3=tonnes; 4=pound, 5=litres, 6=tin, 7= cord, 8=mini bag, 9=maxi bag, 10=jumbo bag, 11=piece, 12=crate, 13=kia rhino, 14=kia, 15=kia mini, 16=motor king, 17=bale, 18=other, specify

3) Note: It is required to enter the price even if the product is not sold by the household. Make sure it is the same unit for total quantity produced.

4) Codes: 1=sold within the village, 2= sold outside the village, 3= not sold on a market (NOTE- if both for own use and sold on a market remember to separate codes with a comma)

J. Fishing and aquaculture

1. How much fish did your household catch during the past 12 months?

| 1. Which aquatic animal did your household catch ¹⁾ | 2. Total catch (pieces) (3+4) | 3. Own use (pieces) (incl. gifts given out) | 4. Sold pieces (incl. barter) | 5. Price per piece ²⁾ | 6. Gross value (2*5) | 7. Costs (inputs, hired labour, marketing) | 8. Net income (6-7) |
|--|-------------------------------|---|-------------------------------|----------------------------------|----------------------|--|---------------------|
| | | | | | | | |
| | | | | | | | |

1) Codes: 1= fish, 2= crab

2) Note: It is required to enter the price even if the product is not sold by the household.

K. Wage income

Has any member of the household had paid work the past 12 months?

Note: If the payment is (partly) in kind (e.g. helping in harvesting and get paid 10 kg of rice) you should estimate and write the monetary value of that.

| 1. Type of work ¹⁾ | 2. Paid daily, weekly, monthly or one-off | 3. Quantity (i.e. number of days, weeks, months, one-off) ²⁾ | 4. Wage rate (i.e. per day, per week, per month, or per one-off) ²⁾ | 5. Total wage income (3*4) |
|-------------------------------|---|---|--|----------------------------|
| | | | | |
| | | | | |

1) Codes: 1=Bagging charcoal, 2=Loading charcoal, 3= Charcoal production, 4= Agriculture/plantation worker, 5= Forestry (logging, processing, transport, tree planting etc.), 6= Fish farm worker/fishing, 7= Transport/driver, 8= Trade and marketing (not charcoal), 9= Construction/carpentry (bought input), 10= Repairer, 11=Mining/quarrying, 12=Manufacturing industry, 13=Service industry, 14=Government employment, 15=Tailor/shoe maker/hairdresser/similar, 16=Steelworker/goldsmith, 17=Domestic work (e.g. cook, servant, baby sitter in another home), 18=Guard/ranger, 19=Cook, 20=Road construction/maintenance, 21=Electrician, 22=Craftsman, 23=Teacher, 24=Other, specify

2) Unit must be consistent with the previous question

L. Income from own charcoal business (trade and transport, NOT production)

1. Are you involved in any such business, what are the gross income and costs related to that business?

Note: If the household produces charcoal itself and has a charcoal production business, the income should not be reported under this table, but instead in box 1 (processed products).

Note: If the household is involved in several different types of business, you should fill in one column for each business.

| | 1. Business | 2. Business | 3. Business |
|---|-------------|-------------|-------------|
| 1. What is your type of business? ⁵⁵⁻¹ | | | |
| 2. Gross income (sales, without deducting costs) [past 12 months] (Ghanaian cedi) | | | |
| Costs: | | | |
| 3. Purchased inputs (fuel for transport not included) | | | |
| 4. Hired labour | | | |
| 5. Transport/fuel for transport and marketing cost | | | |
| 6. Capital costs (repair, maintenance, etc.) | | | |
| 7. Other costs | | | |
| 8. Net income (2 -3-4-5-6-7) | | | |

1) Codes: 1=middleman (person who knows where producers are, charge commission); 2=trader (buyer and seller of charcoal in

M. Income from own business (not environmental, agriculture or related to charcoal)

1. Are you involved in such business, and if so, what are the gross income and costs related to that business the past 12 months?

Note: If the household is involved in several different types of business, you should fill in one column for each business

| | 1. Business | 2. Business | 3. Business |
|---|-------------|-------------|-------------|
| 1. What is your type of business? ¹⁻ | | | |
| 2. Gross income (sales, without deducting costs) [past 12 months] (Ghanaian cedi) | | | |
| Costs: | | | |
| 3. Purchased inputs (fuel for transport not included) | | | |
| 4. Hired labour | | | |
| 5. Transport/fuel for transport and marketing cost | | | |
| 6. Capital costs (repair, maintenance, etc.) | | | |
| 7. Other costs | | | |
| 8. Net income (2 - 3-4-5-6-7) | | | |

⁵⁵ Codes: 1=Food selling (bought input); 2=other shop/trade; 3=agric. processing (bought input); 4=lodging/restaurant 5=carpentry; 6=landlord/real estate; 7=transport/driver; 8=renting out equipment; 9=tailor/shoe maker, hairdresser or similar; 10=herbalist /native doctor/midwife, 11=repairer, 12=steelworker/goldsmith, 13=brick making(with bought input); 14=quarrying; 15= contracted work (cleaning/maintenance); 16=brewing, 17=other, specify:

N. Income from agriculture (crops, including products from plantations and agroforestry)

1. What are the quantities and values of crops that the household has harvested and consumed/sold during the past 12 months?

Note: Remember to probe for and include small quantities of crops that are continuously harvested for subsistence uses.

| 1. Crops (choose product from) | 2. Area of production (acre) | 3. Total production (5+6) | 4. Unit ¹⁾ | 5. Own use (incl. gifts given out) | 6. Sold (incl. barter) | 7. Price per Unit ²⁾ | 8. Gross income (3*7) |
|-----------------------------------|---------------------------------|------------------------------|-----------------------|---------------------------------------|---------------------------|---------------------------------|--------------------------|
| | | | | | | | |
| | | | | | | | |

1) Codes: 1=grams, 2=kg; 3=tonnes; 4=pound, 5=litres, 6=tin, 7=cord, 8=mini bag, 9=maxi bag, 10=jumbo bag, 11=piece, 12=crate, 13=kia rhino, 14=kia, 15=kia mini, 16=motor king, 17=bale, 18=other, specify

2) Note: It is required to enter the price even if the product is not sold by the household.

Note: Take into account all the crops in the previous table.

2. What are the quantities and values of inputs used in crop production for the past 12 months (this refers to agriculture cash expenditure)?

Note: Take into account all the crops in the previous table

| 1. Crops (choose product from "product list") | 2. Seeds | 3. Fertilizers | 4. Pesticides/ herbicides | 5. Manure | 6. Irrigation | 7. Hired labour | 8. Hired Machinery | 9. Transport/ marketing | 10. Payment for land rental | 11. Other, specify: |
|--|----------|----------------|------------------------------|-----------|---------------|-----------------|--------------------|----------------------------|-----------------------------|---------------------|
| | | | | | | | | | | |
| | | | | | | | | | | |

O. Income from livestock

What is the number of animals your household has now, and how many have you sold, bought, slaughtered or lost during the past 12 months?

| 1. Livestock | 2. Number of animals now | 3. Sold (incl. barter), live or slaughtered | 4. Own use (incl. gifts given out) | 5. Lost (theft, died) | 6. Price per adult animal | 10. Income (3+4)*6 |
|----------------|--------------------------|--|---------------------------------------|-----------------------|---------------------------|-----------------------|
| 1. Cattle | | | | | | |
| 2. Goats | | | | | | |
| 3. Sheep | | | | | | |
| 4. Pigs | | | | | | |
| 5. Donkeys | | | | | | |
| 6. Ducks | | | | | | |
| 7. Chicken | | | | | | |
| 8. Guinea pigs | | | | | | |
| 9. Rabbit | | | | | | |

| | | | | | | |
|------------|--|--|--|--|--|--|
| 10. Grass | | | | | | |
| 11. Turkey | | | | | | |
| 12. Guinea | | | | | | |
| 13. Other, | | | | | | |

2. What are the quantities and values of inputs used in livestock production during the past 12 months (cash expenditures)?

| 1. Livestock | 2. Medicines, vaccination and other veterinary services | 3. Costs of maintaining barns, enclosures, pens, etc. | 4. Hired labour | 5. Other, specify: |
|----------------|---|---|-----------------|--------------------|
| 1. Cattle | | | | |
| 2. Buffalos | | | | |
| 3. Goats | | | | |
| 4. Sheep | | | | |
| 5. Pigs | | | | |
| 6. Donkeys | | | | |
| 7. Ducks | | | | |
| 8. Chicken | | | | |
| 9. Guinea pigs | | | | |
| 10. Rabbit | | | | |
| 11. Turkey | | | | |
| 12. Guinea | | | | |
| 13. Other, | | | | |

P. Income from livestock products

What are the quantities and values of animal products and services that you have produced during the past 12 months?

| 1. Product/service | 2. Production (4+5) | 3. Unit ¹⁾ | 4. Own use (incl. gifts) | 5. Sold (incl. barter) | 6. Price per Unit ²⁾ | 7. Gross income 2*6 | 8. Costs related to processing of product |
|--------------------|---------------------|-----------------------|--------------------------|------------------------|---------------------------------|---------------------|---|
| 1. Milk | | | | | | | |
| 2. Eggs | | | | | | | |
| 3. Hides | | | | | | | |
| 4. | | | | | | | |
| 5. Other, specify | | | | | | | |

1) Codes: 1=grams, 2=kg; 3=tonnes; 4=pound, 5=litres, 6=tin, 7=cord, 8=mini bag, 9=maxi bag, 10=jumbo bag, 11=piece, 12=crate, 13=kia rhino, 14=kia, 15=kia mini, 16=motor king, 17=bale, 18=other, specify

2) Note: It is required to enter the price even if the product is not sold by the household.

Q. Other income sources

1. Please list any other income that the household has received during the past 12 months?

| 1. Type of income | 2. Total amount received |
|--|--------------------------|
| 1. Payment for renting out land (if in kind, state the equivalent in cash) | |
| 2. Compensation from logging or mining company (or similar) | |
| 3. Remittances | |
| 4. Support from government, NGO, organisation or similar | |
| 5. Gifts/support from friends and relatives | |
| 6. Other, specify: | |

R. Crisis and unexpected expenditures

Has the household faced any major income shortfalls or unexpectedly large expenditures during the past 12 months?

| Event | 1. How severe? ^{1*} | How did you cope with the income |
|--|------------------------------|----------------------------------|
| 1. Serious crop failure | | |
| 2. Serious illness in family (productive age-group adult unable to work for more than one month during past 12 months, due to illness, or to taking care of ill person; or high medical costs) | | |
| 3. Death of productive age-group adult | | |
| 4. Land loss (expropriation, etc.) | | |
| 5. Major livestock loss (theft, drought, etc.) | | |
| 6. Other major asset loss (fire, theft, flood, etc.) | | |
| 7. Lost wage employment | | |
| 8. Wedding or other costly social events | | |
| 9. Payment for sale of household products arrive later | | |
| 10. Cattle invasion | | |
| 11. Other, specify: | | |

- 1) Codes severity: 0=no crisis; 1=yes, moderate crisis; 2=yes, severe crisis.
2) Codes coping:
1. Produced more charcoal
2. Engaged more in charcoal business (sale, transport, bagging, loading and wage work production)
3. Did extra casual labour work (not related to charcoal)
4. Produced more agricultural products
5. Spent cash savings / sold assets (land, livestock, etc.)
6. Harvested more products from the wild (not including charcoal)
7. Got assistance from friends and relatives
8. Got assistance from NGO, community org., religious org. or similar
9. Got loan from money lender, credit association, bank etc.
10. Tried to reduce household spending
11. Reduced number of meals taken
12. Borrowed against future earnings
13. Rented out land
14. Started new business (not related to charcoal)
15. Changed to different type of livestock
16. Changed cropping patterns or types of crops planted
17. Other, specify:

S. Seasonal importance of charcoal

| | |
|---|-------|
| 1. Are there any periods of the year where income from charcoal (production/sale/transport) is the only or major income source? <i>Codes: 1=yes 0=no,</i> | (1-0) |
| 2. If yes, what is the reason for this? <i>Codes: 1= there are no other income sources, 2= there are other income sources, but they are not sufficient to make a living, 3= there are other income sources from where I can charcoal production is more profitable</i> | |

T. Welfare perceptions and social capital

| | |
|--|---|
| 1. All things considered, how satisfied are you with your life over the past 12 months? <i>Codes: 1=very unsatisfied; 2=unsatisfied; 3=neither unsatisfied or satisfied; 4=satisfied; 5=very satisfied</i> | |
| 2. Has the household's food production and income over the past 12 months been sufficient to cover what you consider to be the needs of the household? <i>Codes: 0=no; 1=reasonable (just about sufficient); 2= yes</i> | |
| 3. Compared with other households in the village (or community), how well-off is your household? <i>Codes: 1=worse-off; 2=about average; 3=better-off</i> | |
| 4. How well-off is your household today compared with the situation 5 years ago? <i>Codes: 1=less well-off now; 2=about the same; 3=better off now</i> <i>If 1 or 3, go to 5. If 2, go to 6.</i> | |
| 5. If less well-off or better-off: what is the main reason for the change? <i>If several reasons, state the three most important.</i> | Reason: Change in ... |
| | 1. income from charcoal (production, own business, wage work etc.) |
| | 2. access to wood for charcoal |
| | 3. access to other natural resources |
| | 4. land area for agric. production |
| | 5. crop failure/raiding |
| | 6. output prices (forest, agric.) |
| | 7. income from off farm employment (not charcoal) |
| | 8. started a new business/lost or less business (not related to charcoal) |
| | 9. health status |
| | 10. cost of living (e.g., high inflation) |
| | 11. material assets, incl. house (gain or loss) |
| | 12. livestock (gain or loss) |
| | 13. family situation (e.g. loss of family member) |

| | | |
|--|---|--|
| | 14. infrastructure (e.g. new road or deterioration of road) | |
| | 15. Fire destroyed everything | |
| | 16. education / increased | |
| | 17. outside support (govt., NGO,) | |
| | 18. remittances | |
| | 19. other (specify): | |
| 6. Do you consider your village (community) to be a good place to live? | | |
| 7. Do you in general trust people in the village (community)? <i>Codes: 0=no; 1=partly, trust some and not others; 2=yes</i> | | |
| 8. Can you get help from other people in the village (community) if you are in need, for example, if you need extra money because someone in your family is sick? <i>Codes: 0=no; 1 = partly, 2=yes</i> | | |

Date, time, GPS:

| | |
|-------|-------|
| Date: | Time: |
|-------|-------|

| | |
|---|--|
| GPS reference point of household (UTM format) | |
|---|--|

Enumerator assessment of the household

Note: This is to be completed by the enumerator

| | |
|---|--|
| 1. During the last interview, did the respondent smile or laugh? <i>Codes: (1) neither laughed nor smiled (somber); (2) only smiled; (3) smiled and laughed; (4) laughed openly and frequently.</i> | |
| 2. Based on your impression and what you have seen (house, assets, etc.), how well-off do you consider this household to be compared with other households in the village? <i>Codes: 1=worse-off; 2=about average; 3=better-off</i> | |
| 3. How reliable is the information generally provided by this household? <i>Codes: 1=poor; 2=reasonably reliable; 3=very reliable</i> | |
| 4. How reliable is the information on charcoal collection/use provided by this household? <i>Codes: 1=poor; 2=reasonably reliable; 3=very reliable, 4=the household had no income from charcoal</i> | |
| 5. If the charcoal information is not so reliable (code 1 above), do you think the information provided overestimate or underestimate the actual use? <i>Codes: 1=underestimate; 2=overestimate; 3= no systematic over- or underestimation; 4=don't know</i> | |

Product list

Note: The quantities of unprocessed products used as inputs in making processed products should not be reported under unprocessed products

| Unprocessed products from the wild | Processed products from the wild |
|---------------------------------------|--|
| 1. Bush meat | 1. Charcoal |
| 2. Wild nuts (incl. shea nuts) | 2. Palm wine |
| 3. Wild vegetables | 3. Baskets |
| 4. Wild leaves (rapping, spices etc.) | 4. Pottery |
| 5. Medicinal plants (tree bark etc.) | 5. Bricks |
| 6. Poles for building | 6. Wild animal hide |
| 7. Honey | 7. Sawn timber |
| 8. Firewood | 8. Musical instruments |
| 9. Bamboo | 9. Cooking utensil (mortar, pestle etc.) |
| 10. Rattan | 10. Broom |
| 11. Lianas and vines | 11. Catapult |
| 12. Wild fruits (mango, banana etc.) | 12. Furniture (wood, rattan, bamboo) |
| 13. Dyes | 13. Wood craft |
| 14. Maakube | 14. Shea butter |
| 15. Raphia palm | 15. Other: |
| 16. Spear grass | 16. Other: |
| 17. Other: | 17. Other: |
| 18. Other: | 18. Other: |

Crops and plantation products

| | | |
|--------------------|--------------------|---------------------------------|
| 1. Rice | 15. Cow pea | 29. Watermelon |
| 2. Maize | 16. Ground nut | 30. Pawpaw |
| 3. Millet | 17. Tomato | 31. Banana |
| 4. Sorghum | 18. Green pepper | 32. Apple |
| 5. Yam | 19. Pepper (chili) | 33. Sunflower |
| 6. Cassava (tuber) | 20. Cabbage | 34. Cotton |
| 7. Cassava (flour) | 21. Cucumber | 35. Pineapple |
| 8. Potatoes | 22. Okro | 36. Plantation trees (for wood) |
| 9. Plantain | 23. Carrot | 37. Other |
| 10. Cocoyam | 24. Onion | 38. Other |
| 11. Beans | 25. Lettuce | 39. Other |
| 12. Wild mango | 26. Oil palm | 40. Other |
| 13. Cashew | 27. Citrus | 41. Other |
| 14. Soybean | 28. Avocado (pea) | 42. Other |

Appendix C: Interview guide for focus group meetings

All information in this survey should be gathered during a focus group meeting in each village.

A. List: all income generating products produced or collected in the village, the ways in which villagers earn money from charcoal, and important employment/migration opportunities.

This is done in order to make sure that all important products and incomes in the village can be recorded in the household survey which will be conducted after the village survey. After the list has been made the villagers will be asked to select the most important products in a ranking exercise (see ranking section in PRA methods guide).

1. Agricultural products (crops):
2. Unprocessed products harvested from the wild:
3. Agricultural products (crops):
4. Processed products harvested from the wild:
5. Fishing/aquaculture:
6. Ways in which you earn income from charcoal:
7. Employment/migration opportunities

B. Seasonal calendar (see “PRA method guide”)

Based on the selected most important products and employment opportunities from the section above a seasonal calendar is made showing income and expenditures along with activities.

C. Environmental resource base (products harvested from the wild)

The questions should be asked for each of the categories in turn (i.e. column by column, and not row by row).

| | 1. product | 2. | 3. | 4. |
|--|-------------------|----|----|----|
| 1. What are the most important products ¹ for the livelihood of the people in the village? (record name of) | Wood for charcoal | | | |
| 2. Where do you collect the products? | | | | |
| 3. How has availability of the products changed over the past 5 years? | | | | |
| 4. If the availability has declined , what are the reasons? | | | | |
| 5. If the availability has increased , what are the reasons? | | | | |
| 6. What would be most important to increase the benefits (use or income) from the products? | | | | |

1) “Most important” is defined as the most important for the wellbeing of the village, whether it be through direct use in the home, or through sale for cash, or both.

E. Charcoal user groups

1. Existence of charcoal user groups. _____
1. How many charcoal user groups are there in the village?
2. Information about each charcoal user group (use one column per user group)

| | Group 1 | Group 2 | Group 3 |
|--|---------------------------------|---------|---------|
| 1. When was the group formed? (yyyy) | | | |
| 2. How was the group formed? <i>Codes: 1=local initiative; 2=initiative from NGO; from government, e.g., Forest Department; 4=other, specify:</i> | | | |
| 3. Is the user group's main purpose related to the management of a particular area? | (1-0) | (1-0) | (1-0) |
| 4. How many members are there in the group? | | | |
| 5. How many times per year does the user group have meetings? | | | |
| 6. Does the group have a written management plan? | (1-0) | (1-0) | (1-0) |
| 7. What are the main tasks of the charcoal user group? <i>Select as many as appropriate: 1-0 code</i> | 1. Setting rules for use | (1-0) | (1-0) |
| | 2. Monitoring and policing | (1-0) | (1-0) |
| | 3. Management | (1-0) | (1-0) |
| | 4. Harvesting wood for charcoal | (1-0) | (1-0) |
| | 5. Selling charcoal | (1-0) | (1-0) |
| | 6. Education/extension support | (1-0) | (1-0) |
| | 7. Savings and credit | (1-0) | (1-0) |
| | 8. Woodlot establishment | (1-0) | (1-0) |
| | 9. Other, specify: | (1-0) | (1-0) |
| 8. Has any development project been implemented in the village over the past 5 years using proceeds from the charcoal user group? | (1-0) | (1-0) | (1-0) |
| 9. Has anyone in the village been violating the rules of the user group over the past 12 months? <i>If 'no' go to 13.</i> | (1-0) | (1-0) | (1-0) |
| 10. If 'yes': did the user group impose any penalties on those violating the rules? | (1-0) | (1-0) | (1-0) |
| 11. If 'yes': what type of penalties? <i>Codes: 1=fee (cash payment); 2=returning collected products; 3=labour (extra work); 4=exclusion from group; 5=warning; 9=other, specify:</i> | | | |
| 12. Which group of charcoal users has most commonly violated the rules over the past 5 years? <i>Codes: 1=members of the user group; 2=non-user group members in the village; 3=people from other villages; 9=other, specify:</i> | | | |
| 13. Overall, on a scale from 1-5 (1 is highest, 5 is lowest) how effective would you say that the user group is in ensuring sustainable and equitable use of wood? | | | |

Note: Any charcoal user groups in the village should be further discussed in the village narrative

F. Forest User Groups (FUG)

1. Existence of forest user groups (FUG).
 1. How many forest user groups (FUG) are there in the village?
 2. Information about each FUG (use one column per FUG)

| | 1. FUG1 | 1. FUG2 | 1. FUG3 |
|---|--|---------|---------|
| 1. When was the group formed? (yyyy) | | | |
| 2. How was the group formed? <i>Codes: 1=local initiative; 2=initiative from NGO; 3=initiative from government, e.g., Forest Department; 4=other, specify:</i> | | | |
| 3. Is the FUG's main purpose related to the management of a particular forest area or of particular forest product(s)? <i>Codes: 1=area; 2=product(s); 3=both</i> | | | |
| 4. If for a product (code 2 or 3 above), what is the (main) product? | | | |
| 5. How many members are there in the group? | | | |
| 6. How many times per year does the FUG have meetings? | | | |
| 7. Does the group have a written management plan? | (1-0) | (1-0) | (1-0) |
| 8. What are the main tasks of the FUG? <i>Select as many as appropriate: 1-0 code</i> | 1. Setting rules for use | (1-0) | (1-0) |
| | 2. Monitoring and policing | (1-0) | (1-0) |
| | 3. Silviculture & management | (1-0) | (1-0) |
| | 4. Harvesting forest products | (1-0) | (1-0) |
| | 5. Selling forest products | (1-0) | (1-0) |
| | 6. Tree planting | (1-0) | (1-0) |
| | 7. Tourism (i.e. maintaining tourist infrastructure; guiding | (1-0) | (1-0) |
| | 8. Education/extension support | (1-0) | (1-0) |
| | 9. Other, specify: | (1-0) | (1-0) |
| | 10. Savings and credit | (1-0) | (1-0) |
| 11. Woodlot | (1-0) | (1-0) | (1-0) |
| 9. Has any development project been implemented in the village over the past 5 years using proceeds from the | (1-0) | (1-0) | (1-0) |
| 10. Has anyone in the village been violating the rules of the FUG over the past 12 months? <i>If 'no', go to 14.</i> | (1-0) | (1-0) | (1-0) |
| 11. If 'yes': did the FUG impose any penalties on those violating the rules? <i>Codes: 1=fee (cash payment); 2=returning collected products; 3=labour (extra work); 4=exclusion from group; 5=warning; 9=other, specify:</i> | (1-0) | (1-0) | (1-0) |
| 12. If 'yes': what type of penalties? <i>Codes: 1=fee (cash payment); 2=returning collected products; 3=labour (extra work); 4=exclusion from group; 5=warning; 9=other, specify:</i> | | | |
| 13. Which group of forest users have most commonly violated the rules over the past 5 years? <i>Codes: 1=members of FUG; 2=non-FUG members in the village; 3=people from other villages; 9=other, specify:</i> | | | |

| | | | |
|--|--|--|--|
| 14. Overall, on a scale from 1-5 (1 is highest, 5 is lowest) how effective would you say that the FUG is in ensuring sustainable and equitable forest use? | | | |
|--|--|--|--|

Note: Any FUGs in the village should be further discussed in the village narrative.

G. Risk

| | | |
|---|--|--|
| 1. Has the village faced any of the following crises over the past 12 months? <i>Codes: 0=no; 1=yes, moderate crisis; 2=yes, severe crisis</i> | 1. Flood and/or excess rain | |
| | 2. Drought | |
| | 3. Wild fire (in crops/ forest/grasslands etc) | |
| | 4. Widespread crop pest/disease and/or animal | |
| | 5. Human epidemics (disease) | |
| | 6. Political/civil unrest | |
| | 7. Macro-economic crisis | |
| | 8. Refugee or migration infusion | |
| | 9. Other, specify: | |
| | 10. Wildlife predation on livestock | |
| | 11. Conflicts over forest resources (theft) | |
| | 12. Land conflicts within village | |
| | 13. Bridge/road washed out | |
| | 14. Harassment from forest officials | |
| | 15. Cattle invasion | |

C. Wages and prices

| | | | |
|--|-----------|------|----------|
| 1. What was the typical daily wage rate for unskilled agricultural/casual adult male/female labour during the peak/slack season in this village over the past 12 months? <i>(Cedis/day)</i> | | Male | F |
| | Peak | 1. | 2. |
| | Slack | 3. | 4. |
| 2. What is the main staple food in the village? <i>(code-product)</i> | | | |
| 3. What was the price of a kg of the main staple food during the past 12 months before and after the main agricultural harvest? <i>(Cedis/kg)</i> | 1. Before | | 2. After |
| | | | |
| 4. What is the annual lease of one hectare of good agricultural land in the village (i.e., not degraded, not too steep, and suitable for common crops, and within 1km of the main road or settlement) <i>(Cedis/hectare)</i> | | | |

Appendix D: Interview guide for semi-structured interviews

| | Mechanisms for accessing trees for charcoal production |
|----|---|
| | Property rights |
| 1 | Where do you get trees for making charcoal? <ul style="list-style-type: none"> • Fallows • Farms • Forests • Sacred groove • Who is a resident in this community or who is an indigene in this community? |
| 2 | Who owns trees in this community? <ul style="list-style-type: none"> • Fallows • Farms • Forests • Sacred groove (prompt for Chief; family; individuals; government) Who recognises these rights? |
| 3 | Who owns land in this community? (prompt for Chief; family; individuals; government) |
| 4 | What customary rules, norms and habits regulate access to trees for charcoal production? |
| 5 | If customary rules exist, are the rules enforced/respected by people in this village? |
| 6 | Have the rules changed over the years? |
| 7 | If yes, which of these rules have changed |
| 8 | Which of these rules are respected by: <ol style="list-style-type: none"> a. you b. other people and why? |
| 9 | Are the rules or processes for obtaining trees the same or different for charcoal producers who are: <ul style="list-style-type: none"> • Farmers • Indigenes • Migrants • Men • Women • Sole charcoal producers? |
| 10 | How much do you pay for wood use in producing charcoal? How is the cost calculated or arrived at? |
| 11 | What is/are the arrangement for paying for wood? <ul style="list-style-type: none"> • Who pays? • Who collect the money? • How do you pay? • At what stage or period of production is payment made? • What place or point is the money paid? |
| 12 | What types of sanctions exist for non-payment for wood use in producing charcoal? Who enforces these sanctions? |

| | |
|----|---|
| 13 | What customary mechanisms exist for managing conflict relating to the non-payment or under payment for wood use in producing charcoal? Who is involved? How effective are these conflict management mechanisms? |
| 14 | What other charges do you pay on produced charcoal? Who pay this/these charges? Who collect these charges? How are they collected? What forms of sanction exist for non-payment of these charges? |
| | Other access mechanisms beside property rights |
| | <i>Technology</i> |
| 15 | What tools are used in producing charcoal? |
| 16 | How important is the chainsaw in charcoal production? |
| 17 | Which of the following do you use to reach the forest to harvest trees for charcoal production? – walking, bicycle, motor bike, tractor, kia truck |
| 18 | How do you cart your charcoal to the point of sale? (prompt of bicycles, motor tricycles, tractor, donkey, kia trucks, head loading) |
| 19 | Do buyers pay the same price for charcoal sold in nearby communities? (prompt for differences in relation to tarred and untarred road, i.e. difficulty in accessibility) |
| 20 | How do you get to know charges in price of charcoal? |
| 21 | How do you prevent people from stealing trees and/or charcoal that belong to you? Do you use guns or other implements to ward off people from encroaching on your wood or charcoal? |
| 22 | What type of kiln do you use in producing charcoal? |
| | <i>Capital</i> |
| 23 | How do you finance the costs of the under listed tools/items for producing charcoal? (a) trees (b) labour (c) tools and implements (d) sacks (e) carting to point of sale |
| 24 | Who owns these tools? What is preventing you (if a non-owners) from owning these tools? |
| 25 | How do non-owners get these tools/items to work with? |
| 26 | Do you have access to credit? How? What are the conditions/terms on the credit? |
| | <i>Market</i> |
| 27 | Where do you sell your charcoal? (community, district market, cities) Why? |
| 28 | If charcoal is sold at the community level, ask Why producer do not send products to the district market or regional market to sell? |

| | |
|----|--|
| 29 | Do buyers pay the same price for charcoal sold in this community as compared to other close by / far-away communities? |
| | |
| | <i>Labour</i> |
| 30 | <p>What type of labour (own labour/in-house/outside) do you use at the following stages of charcoal production?</p> <ul style="list-style-type: none"> • Scouting for trees • Felling and cross cutting of trees • Piling of logs • Site preparation • Covering with grass and soil • Monitoring the carbonisation process • Bagging • Carting to road side |
| 31 | How is access to labour during the farming season? (easy, scarce, difficult) |
| 32 | How is access to labour during the off-farming season? (easy, scarce, difficult) |
| 33 | Where do you get hired labour to produce charcoal? (same town, adjourning towns, etc.) |
| 34 | How are the charges for the stages in charcoal production listed in 30 arrived at? (cash payment, in-kind payment, working relations, communal or group support, benefit sharing) |
| | <i>Knowledge</i> |
| 35 | How do you know that trees in a particular area are matured for producing charcoal? |
| 36 | Who identify suitable trees for charcoal production? |
| 37 | What tree felling techniques do you use to promote tree regeneration (coppicing and coppicing management) |
| 38 | How do you promote tree growth or regeneration in farms? (yam staking, coppice management) |
| 39 | Where, when and how did you learn the skills for producing charcoal? |
| 40 | <p>Do possession of special skills result in more charcoal? How? Which of the charcoal making process (es) require special skills?</p> |
| | <i>Authority</i> |
| 41 | <p>Which of the following institutions do you respect the most and follow their instructions without any force? Do relationship with chief / assembly member give you advantage in accessing trees for charcoal production? What about the relationship with District Chief Executives, other officials of the District Assembly or Forest Services Division? What about relationship with District Assembly or traditional toll operator?</p> |
| | <i>Social identity</i> |
| 42 | How do the following characteristics of a charcoal producer affect his/her ability to access trees for producing charcoal? Do they make it easy, moderate or difficult for him/her? |

| | |
|----|---|
| | <ul style="list-style-type: none"> • Age (youth/adult) • Gender (male/female) • Ethnicity (tribe) • Status (indigenes/settler/migrant) • Religion (Christianity/Islam/Traditional Religion/Others) • Profession (formal/informal) • Membership in groups (Forest User Groups / fire volunteers / farm groups/etc. • Relationship with buyer / middle men / labourers |
| | <i>Social relations</i> |
| 43 | <p>How do the following social relations factors affect negotiations of a charcoal producer to benefit from trees for producing charcoal? Do they make it easy, moderate or difficult for him/her? At what stage of the charcoal production process are they needed or useful?</p> <ul style="list-style-type: none"> • Friendship – with customary and state authorities • Trust – within community members; among charcoal producers; between creditors and producers; between producers and buyers • Reciprocity – communal or group assistance • Patronage – between producers and customary or state authorities • Lobby of customary and state authorities |