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SUSTAINABLE FISHERIES MANAGEMENT PROJECT (SFMP)

Fuel Wood Value Chain Report

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ACRONYMS

CCM	Centre for Coastal Management
CDCS	Country Development Cooperation Strategy
CEWEFIA	Central and Western Region Fishmongers Improvement Association
COMFISH	Collaborative Management for A Sustainable Fisheries Future
COP	Chief of Party
CR	Central Region
CRC	Coastal Resources Center at the Graduate School Of Oceanography, University Of Rhode Island
CSLP	Coastal Sustainable Landscapes Project
DA	District Authorities
DAA	Development Action Association
DAASGIFT	Daasgift Quality Foundation
DFAS	Department of Fisheries and Aquatic Sciences
EG	Economic Growth
EPA	Environmental Protection Agency
FAO	Food and Agricultural Organization Of The United Nations
FASDP	Fisheries and Aquaculture Sector Development Program
FC	Fisheries Commision
FON	Friends of Nation
FSD	Forestry Service Division
FTF	Feed the Future
HM	Hen Mpoano
GIS	Geographic Information System
GOG	Government Of Ghana
GSA	Ghana Standards Authority
GSS	Ghana Statistical Survey
GSO	Graduate School Of Oceanography, University Of Rhode Island
IFAD	International Fund for Agriculture Development
LPG	Liquefied Petroleum Gas
MOFA	Ministry Of Food and Agriculture
MOFAD	Ministry Of Fisheries and Aquaculture Development
NADMO	National Disaster Management Organization
NGO	Non-Governmental Organization
NRM	Natural Resources Management
PPP	Public Private Partnerships
REDD	Reduced Deforestation And Degradation
RCC	Regional Coordinating Council
RWE	Round Wood Equivalent
SFMP	Sustainable Fisheries Management Program
SMES	Small and Medium Enterprises
SNV	Netherlands Development Organization
SS	Spatial Solutions
SSG	Ssg Advisors
UCC	University of Cape Coast
UN	United Nations
URI	University Of Rhode Island
USAID	United States Agency for International Development
USG	United States Government
WA	West Africa
WARFP	West Africa Regional Fisheries Development Program
WASH	Water, Sanitation and Hygiene
WR	Western Region

EXECUTIVE SUMMARY

This study analysed the fuelwood value chain for the fish smoking industry in 4 coastal regions of Ghana namely Volta, Greater Accra, Central and Western Regions as well as fuelwood producing areas in the moist semi-deciduous forest zone in the Eastern Region of Ghana. The objective was to analyze the nature of economic agents, transactions and constraints along the value chain to propose policy, development and research actions to enhance the chain. Literature was first consulted for general information on fuelwood use and management as well as policies and programs related to fuelwood across the globe and then specifically for fish smoking in Ghana. This helped in the preparation of the background to the study, the framework for analysing the fuelwood value chain and design of data instruments for gathering the requisite information for preparing this report. A total of 1400 actors were interviewed in 27 districts across the five regions for primary data. A cross section assessment of the status of the fuelwood resources and quantity of fuelwood flows along the chain in the five regions was also undertaken. The actors interviewed include fuelwood resource owners and producers, transporters and middlemen, traders and consumers/fish smokers as well as traditional authorities, government departments namely, the EPA, FSD, Wildlife Division, NADMO and District Assembly. Some NGOs working in the coastal areas were also consulted. The data has been analysed descriptively and quantitatively.

Results indicate that fuelwood is the primary source of fuel used by 98% of fish smokers along the coast. It is largely produced from natural sources from dead and standing trees on farmlands including fallows (49%) as well as dead trees and logging residues from government forest reserves (22%). However, production from mangroves cassia, neem and other plantations (29%) in the Volta estuaries and Central Region respectively on private lands are also key resources for fish smoking along the coast. For commercial purposes, there are distinct ownership and use rights for fuelwood resources. Fuelwood resources or land may be owned by a family, community or an individual and may be purchased outright or rented. Seventy fuelwood species are harvested for supply across the five regions, although the majority of the species have not been botanically identified. Twenty of these are most frequently harvested. The principal fuelwood species for coastal fish smoking based on preference and availability across the regions are as follows:

1. Volta
    - **Mangrove in Keta and Ketu within the Volta estuary in local areas**
    - **Supplementary supplies of other species from the transition and semi-deciduous forests in Mid-Volta areas**
2. Greater Accra
    - **Neem mainly from the districts in the Accra plains for the Ada, LEKMA and Tema areas**
    - **Mangrove from Volta delta for particularly Ada areas**
    - **Celtis mildbraedii (Esa), Albizia zygia (Okoro), Terminalia ivorensis (Emire), Milicia excelsa (Odum), cocoa, and other species from the forests in the Eastern Region for the Accra Metropolitan area**
3. Central
    - *Celtis mildbraedii, Albizia zygia, Terminalia ivorensis* and other species from the forests in the Eastern Region
    - A variety of species from clearings in the local farming areas
    - Plantations of *Senna siamea* (Cassia), Neem, *Acacia sp*. and old citrus stands within the local areas
4. Western
    - *Funtumia elastica* and other species from farmlands in adjacent forests
    - Cocoa from old stands on farms in the local area
    - Rubber from old stands in the local area

Results also indicate that approximately 90% of the fuelwood supplied and traded in the coastal regions is used for fish smoking. It was also observed that the fuelwood value chain for fish smoking

is well developed. Although largely an informal sector, the economic agents involved in production, transporting, trading and consumption and their enterprises operate within some regulatory framework as follows:

- Permit is required and a fee is paid for access to the wood material from reserves, farmlands and plantations for commercial extraction
- A waybill is required for transporting fuelwood especially from government forest reserves, which is checked by security officials i.e. Police, Customs, en-route to market
- Traders require permit in some cases to operate in a location
- Traders, transporters and fish smokers are also required to pay income tax
- Resource owners, government and traditional authorities earn some revenue from the fuelwood commodity and to some extent influence extraction from natural forest stands to ensure sustainability of the resource.

Fuelwood is delivered by producers and transporters in bundles or cylindrical block pieces. The bundles may consist of splits of wood or smaller diameter logs or saplings tied, while the blocks are larger diameter pieces of wood purchased for further splitting by the trader before sales or by the fish smoker for use. The bundle is the most common unit of sale. The mean farm gate price per bundle of variable weight and quantity of pieces is GHC2.50 (range: GHC2 in Central – GHC 3.5 in Western) while the retail price is GHC 8 on average (range: GHC5 in Central-GHC12 in Volta). The value addition is the transformation process from the standing tree to the splits or pieces of wood used by the consumer or fish smoker. This entails mainly labour for harvesting, cleaning, sizing into shorter length, splitting, bundling and packing. Overall, producers earned the least price (15.4%) and profit (20%) share across regions while traders earned the highest shares of 49% of the price spread and 50% profit along the chain for a bundle of fuelwood. Transporters may earn the least profit per bundle in some cases hence tend to overload trucks to maximize profit.

Although fuelwood may be pursued as a secondary income source by producers and traders, the fuelwood enterprise for fish smoking provide a vital source of income and livelihood option for households all year round. A wide range of people with various social status including educated or illiterate, employed or unemployed, native or migrant or settler, men or women, married or un-married including single headed households as well as the youth or aged are involved in the production, transportation, trading and consumption of fuelwood. However, at least 50% of the actors are of middle age and have had basic formal education with the majority of the uneducated being women. Generally men dominate the production and transportation in the chain while women are mostly involved in trading and consumption of the fuelwood.

Approximately 50% of actors are dependent mainly on fuelwood for fish smoking industry for survival. Seventy percent of producers do not own fuelwood resources and may be required to pay for harvesting and pay for access when necessary. Except in Volta and Central regions fuelwood is harvested mainly from the wild with hardly any coppice management measures. Seasonal fuelwood scarcity during the rainy season and fish bumper harvest control demand and supply. Scarcity of preferred fuelwood species was reported but on a limited scale.

With respect to mangroves, it was observed that the fishery economy in the Volta Region and adjacent communities in the Greater Accra Region thrive on mangrove wood along the estuary and islands. Mangroves in Greater Accra, Central and Western Region are also exploited for fish smoking but comparatively not well managed as done in the Volta Region. The mangrove ecosystem is also an important wood source for building as well as crab production. Three mangrove species were identified along the Volta Delta as follows:

- **Red mangrove (Rhizophora spp.) - found along the river/lake shores**
- **White (Langaculaia spp.) and Black (Avicennia spp.) mangroves often referred to as white mangrove found further on islands.**
- **Mangrove is extensively harvested with nearly all parts comprising roots, stems and branches used for smoking fish depending of fish type and size. Mangrove in the Volta Region and some parts of the Western Regions is somehow managed through natural regeneration and enrichment planting. Maturity for fuelwood is attained between 6-12 years. The extent and rate of cutting appears to outstrip**

the slow rate of regeneration. Mangrove silviculture needs to be understood to enhance regeneration and to reduce the long regeneration period to less than 12 years.

Generally, a number of constraints were reported by the actors along the fuelwood value chain. Overall, inadequate financial resources for business operations and expansion as well as the lack of business management skills leading to high levels of crediting of supplies on delivery to clients i.e. traders and fish smokers and thereby reducing profits among producers, transporters and fish smokers in some cases were the principal constraint across the actors and regions. Scarcity and unavailability of suitable hard and heavy density wood species that burn longer were also mentioned. Owing to the decline in quality wood resources for fuelwood production, producers indicated that there have been decline in the quantity of fuelwood they produce now compared to what was being produced a decade ago, although the product is somehow available for extraction. As a result, long distances up to 20km have to be traversed to access suitable material for supply. They further stated that, acquisition of official permit for harvesting fuelwood from government production forest reserves is cumbersome and may be associated with high transaction costs. It was also observed that producers, transporters, traders and fish smokers as consumers in many of the areas surveyed were not properly organized into functional associations for business purposes.

Major challenges encountered by the transporters are the unavailability of reliable transport systems and the poor road network which causes delays in hauling fuelwood to final destinations as well as motor accidents. Moreover, harassment from law enforcement agencies including the police, FSD task force, customs officials among others during haulage is also a challenge to transporters and middlemen.

Generally, drudgery i.e. the laborious nature of the fuelwood production-to-consumption process was commonly reported across the economic agents along the chain in addition to high risks or occupational hazards associated with the activities along the chain. While producers encounter animal attacks, injuries and sometimes death, transporters encounter motor accidents, traction problems and confrontations with security officials. Traders mostly experience drudgery and injuries from handling wood during splitting and packing and also wood rot and theft in storage. Fish smokers encounter drudgery, poor working environment as most of them operate at the mercy of the weather but most importantly is the health related problems with smoke and heat from smoking fish. Forty to eighty nine percent of fish smokers reported health problems resulting from smoke across regions.

Actors are generally suggesting the provision of financial and material support to enhance activities along the chain. These include the following:

- Loans to support business operations
- Sheds and other enclosures to preserve wood and enhance working environment
- Creation of wood depots for traders in fishing communities to help in the organization of the trade
- Community cold rooms for fish preservation to reduce drudgery as a result of the perishability of fish they purchase for smoking
- Promotion of woodlots to ensure availability of wood all year round
- Education to reduce health related problems
- Capacity building in business management skills
- Review of policies to reduce FSD permit and access problems
- Improved fish smoking stoves to reduce health problems related to wood smoke among fish smokers
- Formation of actor associations for business and welfare purposes
- **During the stakeholder workshop held on the 3rd September 2015, participants suggested the development of fuelwood plantations among other interventions. They recommended that species preferences for plantation must tally with local preferences. For instance, neem is the most suitable species for the Greater Accra and coastal savannah plains for fuelwood. It is the only species available with prolific vegetative growth. In addition neem enhances aesthetics of smoked fish and prolong shelve life even in storage for long periods. A study on PAH of principal species used in fish smoking has been completed by the SNV. SNV**

needs to share the findings of this study to ensure that species promoted for fish smoking have acceptable or recommended levels of PAH to avoid gradual poisoning of consumers

To reduce drudgery and injury in fuelwood processing, appropriate wood splitters would be required to be introduced and promoted. Local artisans could be supported to fabricate, test these splitters for wider promotion among fuelwood producers, traders and fish smokers. A number of possible research activities have been proposed. The details are presented in the recommendation section of this report.

Mangrove vegetation and resources is urgently needed as a hedge against strong tidal waves particularly, in the phase of distortions in climatic parameters. Mangroves will be required to moderate the coast line against denudation from harsh incidental tides and productivity of aquatic resources required for healthy fish development. To protect the mangrove ecosystem as fish nurseries community based management of mangrove areas using appropriate approaches to be agreed with land or resource owners, local authorities and other institutions with a stake in the resource is proposed. Up scaling mangrove planting and techniques for tending to enhance maturity over a shorter duration is also recommended.

TABLE OF CONTENTS

ACRONYMS III
EXECUTIVE SUMMARY IV
1.0 INTRODUCTION AND BACKGROUND 1
1.1 FUELWOOD, LIVELIHOODS AND ECONOMIES 1
1.2 THE EFFECT OF FUELWOOD PRODUCTION ON THE ENVIRONMENT 3
1.3 EFFECT OF FUELWOOD USE ON HUMAN HEALTH 3
1.4 FUELWOOD AND DEVELOPMENT POLICIES 4
1.4.1 International policies 4
1.4.2 Ghana sectoral policies 8
1.4.3 Energy sector policies 8
1.4.5 Forest sector polices, programs and strategies 9
1.4.6 Other policies related to fuelwood 11
2.0 OBJECTIVE OF THE STUDY AND TERMS OF REFERENCE 13
2.1 EXPECTED RESULTS 13
3.0 METHODOLOGY 14
3.1 CONCEPTUAL FRAMEWORK FOR THE STUDY 14
3.2. STUDY AREAS AND RESPONDENTS 16
3.3. DATA COLLECTION AND ANALYSIS 27
3.3.1 Study strategy or approach 27
3.3.2 Data collected 27
3.3.3 Data analysis and presentation of the information 28
4.0 FINDINGS 28
4.1 OVERVIEW OF THE FUELWOOD VALUE CHAIN 28
4.2. FUELWOOD PRODUCTION SYSTEM 29
4.2.1 Socio-demographic profile of fuelwood producers 29
4.2.2 Fuelwood production enterprise operations 34
4.2.3 Type of fuel wood produced 36
4.2.4 Management of the fuelwood resource base 39
4.2.5 Access to fuelwood resources 42
4.2.6 HARVESTING/collection frequency and quantity harvested 43
4.2.7 Land use systems exploited for fuelwood 45
4.2.8 Regulations/controls on accessing fuelwood for harvesting and passage to market 46
4.2.9 Fuelwood species harvested and preferences 46
4.2.10 FUELWOOD harvesting, processing, packaging and distribution 51
4.2.11 Constraints in fuelwood production and remedial measures 52
4.3 FUELWOOD TRANSPORT SYSTEM 55
4.3.1. Socio-demographic profile of fuelwood transporters 55
4.3.2 Fuelwood transport business operations 61
4.3.3 Fuelwood transported, clientele and demand 64
4.3.4 Constraints in fuelwood transportation and distribution and remedial measures 66
4.4 FUELWOOD TRADING SYSTEM 69
4.4.1 Socio-demographic profile of fuelwood traders 69
4.4.2 The fuelwood trading enterprise 74
4.4.3 Constraints in trading of fuelwood and remedial measures 78
4.5 FUELWOOD CONSUMPTION 77
4.5.1. Socio-demographic profile of fuelwood consumers in fish smoking industry 77
4.5.2 The fish smoking business/enterprise 81

4.5.3 Forms of fish smoked and fuel type used *83*
4.5.4 Fuelwood species used, reasons for preferences supply sources *86*
4.5.5 Constraints in the use of fuelwood for fish smoking and remedial measures *92*
4.6 PROFIT ALONG THE FUELWOOD VALUE CHAIN 95
4.7 FISH SMOKING AND MANGROVE ECOSYSTEM: IMPLICATIONS FOR SUSTAINABLE CONSERVATION OF FISH NURSERIES 98
4.7.1 INTRODUCTION *98*
4.7.2 Mangrove resources in the coastal regions of Ghana *99*
4.7.3 Harvesting and stand management *101*
4.7.4 Dependency on mangroves for livelihood *103*
4.7.5 Threats or challenges to sustainability *104*
4.7.6 Options for sustainable utilization and conservation of mangroves as fish nurseries *105*
5.0 CONCLUSIONS 106
6.0 RECOMMENDATIONS: OPTIONS FOR ENHANCING THE FUELWOOD VALUE CHAIN 107
EVERY SEGMENT OF THE VALUE CHAIN 107
6.1 RESOURCE GOVERNANCE 107
6.2 BUILDING CAPACITY AND PROMOTING WOODLOTS FOR FUELWOOD PRODUCTION 107
6.3 PROMOTION OF APPROPRIATE END-USE DEVICE FOR EFFICIENT USE OF FUELWOOD AMONG FISH SMOKERS 108
6.4 IMPROVING WOOD PRESERVATION/STORAGE, WORKING ENVIRONMENT AND HEALTH SAFETY FOR FUELWOOD TRADERS AND FISH SMOKERS 108
6.5 RESEARCH 108
6.6 INTERVENTIONS TO PROTECT MANGROVES AND FISH NURSERY SITES 109
REFERENCES 110
ANNEXES 112

LIST OF TABLES

Table 1 Employment generated by different types of energy 1
Table 2 Species recommended for fuelwood plantation development in Ghana 10
Table 3 Proportion of respondents/actor categories interviewed in 27 districts and data collected 16
Table 4 Biophysical and economic features of coastal and forest regions surveyed 20
Table 5 Age of fuelwood producers across regions 30
Table 6 Household sizes of fuelwood producers 33
Table 7 Number of years experience in fuelwood production business 34
Table 8 Number of assistants engaged by fuelwood producers 36
Table 9 Number of years species regenerate for harvesting 40
Table 10 Distance travelled to harvest fuelwood 41
Table 11 Frequency of harvest during the major fish season 43
Table 12 Frequency of fuelwood harvest during the minor fish season 45
Table 13Mean size of fuelwood plantation owned for all regions combined 46
Table 14 Species harvested for sale by fuelwood producers 47
Table 15 Constraints in fuelwood production 53
Table 16 Measures suggested for alleviating fuelwood production constraints 55
Table 17 Age of fuelwood transporters 56
Table 18 Number of years of residency in community among fuelwood transporters 58
Table 19 Household size for fuelwood transporters 58
Table 20 Number of spouses for fuelwood transporters 60

Table 21 Number of dependents in transporter households (i.e.<15 and >65 years old) 60
Table 22 Number of years experience in fuelwood transportation.....61
Table 23 Frequency of trips made transporting fuelwood to clients 63
Table 24 Constraints in fuelwood transportation.....67
Table 25 Measures suggested for alleviating fuelwood transport constraints 68
Table 26 Age of fuelwood traders 69
Table 27 Mean number of years lived in community-all regions combined 71
Table 28 Mean household size for fuelwood traders-all regions combined 72
Table 29 Number of years experience in fuelwood trading.....78
Table 30 Membership strength of fuelwood consumer association.....82
Table 31 Distribution of membership strength of fuelwood consumer/fish smoker association 82
Table 32 Species used in fish smoking in the Volta Region.....87
Table 33 Species used in fish smoking in the Central Region.....88
Table 34 Species used in fish smoking in the Greater Accra Region.....89
Table 35 Species used in fish smoking in the Western Region 91
Table 36 Constraints encountered in fuelwood consumption for fish smoking 93
Table 37 Measures suggested by fuelwood consumers to alleviate constraints 94

LIST OF FIGURES

Figure 1 Ghana Woodfuel (i.e. Firewood and charcoal) supply – demand balance.....2
Figure 2 PAH levels on sardinella from five fuelwood species.....4
Figure 3 A map of a typical fuelwood value chain. 15
Figure 4 Framework for analysing costs and returns for estimating profit along the fuelwood value chain 16
Figure 5 Map of Ghana showing districts surveyed 19
Figure 6 Ecological map of Ghana showing fuelwood production, trading and consumption areas surveyed.....20
Figure 7 Map of the fuelwood value chain for fish smoking in Ghana 28
Figure 8 Gender of fuelwood producers across regions 30
Figure 9 Age distribution among fuelwood producers 31
Figure 10 Residential status of fuelwood producers.....31
Figure 11 Educational status of men and women fuelwood producers in survey regions.....32
Figure 12 Marital status of fuelwood producers 32
Figure 13 Dependency on fuelwood production for income 34
Figure 14 Other major income sources for fuelwood producers 34
Figure 15 Number of years experience in fuelwood production 35
Figure 16 Initiator of producer into fuelwood business.....35
Figure 17 Employing others in fuelwood production business 36
Figure 18 Membership of fuelwood producer association 36
Figure 19 Proportion of producers supplying the different fuelwood types.....37
Figure 20 Clients producers supply with fuelwood 38
Figure 21 Producers perception of the status of demand for fuelwood throughout the year...39
Figure 22 Producers claims on their knowledge on regeneration of fuelwood species.....39
Figure 23 Producer perception of fuelwood availability 41
Figure 24 Producer claims on distance travelled to harvest fuelwood for sale 41
Figure 25 Producer perception of causes of decline in fuelwood resources.....42
Figure 26 Ownership of fuelwood resource among producers.....43
Figure 27 Proportion of producers indicating sources of fuelwood harvested 45

Figure 28 Fuelwood plantation sizes owned....46
Figure 29 Requisition for permit to harvest fuelwood for sale....47
Figure 30 Who grants permit for fuelwood harvesting....47
Figure 31 Fuelwood species harvested for sale across regions....46
Figure 32 Percent distribution of producers processing fuelwood before sale....52
Figure 33 Producer fuelwood sale/delivery points....52
Figure 34 Constraints encountered in fuelwood production....53
Figure 35 Measures fuelwood producers suggested for alleviating production constraints....54
Figure 36 Gender of fuelwood transporters....56
Figure 37 Age distribution among fuelwood transporters....56
Figure 38 Educational status of fuelwood transporters....57
Figure 39 Residential status of fuelwood transporters....57
Figure 40 Marital status of fuelwood transporters....59
Figure 41 Dependency on fuelwood transportation for income....61
Figure 42 Transport systems operated....62
Figure 43 Vehicle ownership among fuelwood transporters....63
Figure 44 Transporters claims of record keeping on business....64
Figure 45 Membership of fuelwood transporters association....64
Figure 46 proportion of transporters indicating their clients for fuelwood delivery....65
Figure 47 Proportion of transporters indicating forms of fuelwood delivered to clients....65
Figure 48 Proportion of fuelwood transporters indicating nature of demand for their services....66
Figure 49 Constraints in fuelwood transportation....67
Figure 50 Measures proposed by transporters to alleviate constraints....68
Figure 51 Gender of fuelwood traders for the coastal fish smoking industry....70
Figure 52 Formal educational status of male and female fuelwood traders....70
Figure 53 Residential status of fuelwood traders....71
Figure 54 Number of years traders have lived in their community....71
Figure 55 Marital status of fuelwood traders....72
Figure 56: Household size distribution for fuelwood traders....73
Figure 57 Reliance on fuelwood trading as main economic activity/income source....73
Figure 58 Other economic activities undertaken by fuelwood traders for income....74
Figure 59 Fuelwood trader categories....75
Figure 60 Fuelwood type sold among traders....76
Figure 61 Clientele of fuelwood traders....77
Figure 62 Availability of fuelwood trader association in regions surveyed....77
Figure 63 Membership of fuelwood trader association....78
Figure 64 Constraints in fuelwood trading....76
Figure 65 Measures suggested by traders to alleviate constraints in fuelwood trading....77
Figure 66 Age distribution among fuelwood consumers....78
Figure 67 Gender of fuelwood consumers/fish smokers....78
Figure 68: Educational status of fuelwood consumers/fish smokers....79
Figure 69: Residential status of fuelwood smokers....79
Figure 70 Number of years fuelwood consumers/fish smokers have lived in their communities....80
Figure 71 Size of fuelwood consumer/fish smoker households....80
Figure 72 Number of years of experience in fish smoking....81
Figure 73 Membership of fish smoker/Consumer association....82
Figure 74 Reasons for the formation of fish smokers association....83
Figure 75 Proportion of fish smokers processing main forms of fish smoked....83

Figure 76 Distribution of quantities of frozen fish smoked per day 84
Figure 77 Fuel types used for fish smoking 84
Figure 78 Other fuels used in addition to wood for fish smoking 85
Figure 79 Proportion of fish smokers owning stoves used for fish smoking 85
Figure 80 Distribution of the number of stoves owned by fish smokers 86
Figure 81 Proportion of consumers/fish smokers indicating clients from who they secure their fuelwood 87
Figure 82 Constraints encountered by fuelwood consumers/fish smokers 92
Figure 83 Measures suggested for alleviating constraints in fuelwood consumption for fish smoking 94
Figure 84 Costs, gains and worth of value added per bundle of fuelwood along the chain - All regions 95
Figure 85 Costs, gains and worth of value added per bundle of fuelwood along the chain - Volta 96
Figure 86 Costs, gains and worth of value added per bundle of fuelwood along the chain - Greater Accra 97
Figure 87 Costs, gains and worth of value added per bundle of fuelwood along the chain – Central 97
Figure 88 Costs, gains and worth of value added per bundle of fuelwood along the chain- Western 98
Figure 89 Tenure to mangrove land in Ghana 100

LIST OF PLATES

Plate 1 Female fuelwood producer –Eastern Region 30
Plate 2 A couple and household engaged in fuelwood production-Eastern Region 33
Plate 3 Types/forms of fuelwood produced-assembled at production site for haulage 37
Plate 4 Unmanaged coppice growth and natural regeneration in forest and mangrove stands 40
Plate 5 (above): Key fuelwood species and regions used for the fish smoking 51
Plate 6 (below): Sources of fuelwood in various land use types 51
Plate 7 Vehicles used in transporting fuelwood 63
Plate 8 Wholesale/retail fuelwood trading at Chokor fishing community-Greater Accra 75
Plate 9 Types of fuelwood for sale 76
Plate 10: Smoke pollution from fish smoking 93
Plate 11 Vehicles loaded with fuelwood for delivery in fishing communities in the Central Region 96
Plate 12 Some mangrove sites visited in the Volta and Central Regions 99
Plate 13 Estimating mangrove wood volumes in the Keta District of the Volta Region 100
Plate 14 Identifying mangrove species in the Keta District of the Volta Region 101
Plate 15 Three mangrove species along the Volta Estuaries 101
Plate 16 Harvesting of mangrove for sale 102
Plate 17 Mangrove natural regeneration at the Volta estuaries 102
Plate 18 Livelihood options associated with the mangrove in the Volta estuaries 103
Plate 19 Mangrove as fish nursery, landscape scenic beauty and barrier to erosion and pollutants -Keta District 104
Plate 20 Trading mangrove fuelwood: Units of sale at the harvesting point and on the market 104
Plate 21 Potential threats to mangrove ecosystem sustainability 105

1.0 INTRODUCTION AND BACKGROUND

Wood has been used as fuel for millennia in both developed and under developed countries worldwide. Burning of wood is the largest use of energy derived from a solid fuel biomass. Wood is used for cooking and heating in many places around the world in a stove or an open fire. It is also used as a fuel in many industrial processes and occasionally for fuelling steam engines and steam turbines that generate electricity. Global interest in fuelwood as a renewable biomass energy resource has soared in recent times because it can be developed and used sustainably. As a sustainable energy source, fuel wood is viable for generating electricity in areas with easy access to forest products and by-products (Wikipedia, 2015). Fuelwood[1] is consumed by more than two billion people globally (FAO, 2005). Global fuelwood consumption is estimated at 1.8 billion m^3. This comprises 7% of the world's total primary energy consumption with 76% of it being used in developing countries particularly in Africa (Trossero, 2002).

1.1 Fuelwood, livelihoods and economies

Fuelwood production has been an age-old activity in most parts of the developing world for subsistence and commercial purposes. Studies in India, Pakistan and Kenya have shown that wood and other biomass resources generate at least 20 times more local employment within the national economy than other forms of energy, per unit consumed. This is due to the huge amount of unskilled manpower or labour required for harvesting, processing, transporting and trading of this fuel (ESDA, 2005). In the Democratic Republic of Congo (DRC), firewood contributes 12% to producers' household income, for fuelwood producers around Kisangani and supports basic needs of 65% of them, thereby helping to reduce poverty (Schure *et al.*, 2014).

Table 1 Employment generated by different types of energy

Fuel	Amount of fuel per Terajoule (TJ)	Employment per TJ energy in person days
Fuelwood	62	100-700
Charcoal	33	200-350
Coal	43	20-40
Kerosene	29	10
LPG	22	10-20
Electricity(MWh)	228	80-100

Source: Trossero, 2002

Generally, Fuelwood production and marketing in most parts of Africa requires only minimal financial and human resources. The raw material which is the wood is often obtained for free. The fuelwood business is thus suitable for the socio economically rural poor, contributing to their household income as well as providing a safeguard against food-shortages, unemployment and other similar poverty-related risks. For instance in Kenya fuelwood collection is pursued by the poorest members of the community who, in general, have a low

[1] Fuelwood in this report is used synonymously as firewood and defined as any wooden material that is gathered and used for fuel. Generally, firewood is not highly processed and is in some sort of recognizable log or branch form.

social profile (Kituyi, 2001). In Ghana fuelwood gathering and sale coupled with fuel-based income generating activities are very important livelihoods in forest fringe rural communities (Amuah, 2011). Poverty levels are generally high in Ghana with 30 percent of the population living on less than $1 a day and 54 percent living on less than $2 a day (World Vision USA, 2015). Forty-nine percent of the Ghanaian population live in rural areas (GSS, 2010) with 39.2% of them being poor or living at the poverty line (IFAD, 2015). Many of the rural population rely of adjacent forest resources particularly, fuelwood as secondary income source to supplement farm income (Obiri *et al*., 2014).

In Ghana like in many parts of Africa, fuelwood constitutes about 70% of energy consumed (Ghana Energy Commission, 2006). It is a major source of domestic energy in rural areas used for cooking, heating and lighting as well as energy for rural and cottage industries (Aabeyir, 2011; Anang, *et al*., 2011; Somuah *et al*, 2010). Seventy-three percent and 25% of the population use firewood for cooking in rural and urban areas respectively (GSS, 2010). In urban areas, fuelwood is the main source of energy for commercial activities particularly for processing enterprises as well as service industries and institutions with some domestic consumption. According to FAO (2000) more than 2.2 million households depend on fuelwood or charcoal for cooking and heating in Ghana, and at least 280,000 of them use it for small-scale processing activities, such as fish smoking, gari making, pito brewing, akpeteshi distillation, pottery making, oil extraction (from palm fruits, coconut, groundnut, shea butter. Fuelwood thus makes a significant contribution to food preservation, food security and cash earnings for rural and urban people. In addition, there are also about 600, 000 small-scale enterprises in commercial activities, such as chop bars, street food and grills, which depend on fuelwood or charcoal as their main source of energy (Broadhead *et al*, 2001).

For centuries fuelwood production and marketing in Ghana has been done by subsistence and commercial entities whose activities have remained largely informal with scarcely any management procedures to ensure sustainability (Aabeyir, 2011). This has resulted in extensive exploitation of fuelwood resources with increasing demand over the years. Ghana is one of the countries with high per capita fuelwood demand in West Africa (Anang *et al.*, 2011). However, supply-consumption trends from 2006-2012 show a mean surplus of 4.1kilotonnes of fuelwood not consumed after extraction (Figure 1a) (Ghana Energy Commission, 2013). This means fuelwood supply often exceeds demand. The excess possibly goes to waste from decomposition of the wood. The annual per capita fuelwood consumption is estimated to be 1.0 m^3 round wood equivalent (FAO, 2010)

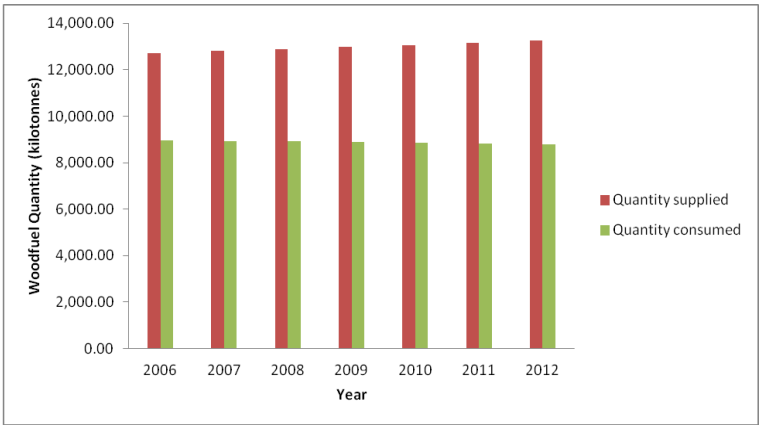


Figure 1 Ghana Woodfuel (i.e. Firewood and charcoal) supply – demand balance

Source: Ghana Energy Commission, 2013

1.2 The effect of fuelwood production on the environment

Fuelwood or firewood is the cheapest form of wood fuel in Africa because its production usually requires no complex expensive equipment and often procured at no greater cost than labour for collecting and processing (Arnold *et al.,* 2003). For this reason fuelwood is extensively exploited for income and for subsistence in both rural and urban areas across the region. Thus, fuelwood production across Africa has generally been criticized as a driver of deforestation (Parrotta *et al.,* 2015).

The burning of wood for heat for household and industrial purposes also contributes to environmental decline. The environmental impact of using wood as a fuel depends on how it is burnt. Higher temperatures result in more complete combustion and less noxious gases as a result of pyrolysis. Some may regard the burning of wood from a sustainable source as carbon neutral. However, a tree, over the course of its lifetime, absorbs as much carbon (or carbon dioxide) as it releases when burnt. (Wikipedia, 2015). Burning wood creates numerous by-products, some of which may be useful (heat and steam), and others that are undesirable, irritating or dangerous. One by-product of wood burning is wood ash, which in moderate amounts is a fertilizer (mainly potash), contributing minerals, but is strongly alkaline as it contains potassium hydroxide (lye). Wood ash is also used to manufacture soap. Some irritating and potentially dangerous by-products from the partial burning of wood include smoke containing water vapour, carbon dioxide and other chemicals and aerosol particulates, including caustic alkali (flyash). A major component of wood smoke is fine particles that may account for a large portion of particulate air pollution in some regions. During cooler months, wood heating accounts for as much as 60% of fine particles in air in Melbourne, Australia (Wikipedia, 2015).

It is reported that slow combustion stoves increase efficiency of wood heaters burning logs, but also increase particulate production. Low pollution from slow combustion stoves are a current area of research. An alternative approach is to use pyrolysis to produce several useful biochemical by-products, and clean burning charcoal, or to burn fuel extremely quickly inside a large thermal mass, such as a masonry heater. This has the effect of allowing the fuel to burn completely without producing particulates while maintaining the efficiency of the system. In some of the most efficient burners, the temperature of the smoke is raised to a much higher temperature where the smoke will itself burn (e.g. 609 °C) for igniting carbon monoxide gas). This may result in significant reduction of smoke hazards while also providing additional heat from the process. By using a catalytic converter, the temperature for obtaining cleaner smoke can be reduced. Some U.S. jurisdictions prohibit sale or installation of stoves that do not incorporate catalytic converters (Wikipedia, 2015).

1.3 Effect of fuelwood use on human health

Depending on population density, topography, climatic conditions and combustion equipment used, wood heating may substantially contribute to air pollution, particularly particulates. The conditions in which wood is burnt will greatly influence the content of the emission. Particulate air pollution can contribute to human health problems and increased hospital admissions for asthma & heart diseases. The technique of compressing wood pulp into pellets or artificial logs can reduce emissions. The combustion is cleaner, and the increased wood density and reduced water content can eliminate some of the harmful substances. Wood combustion products can include toxic and carcinogenic substances. Generally, the

heartwood of a tree contains the highest amounts of toxic substances, but precautions should be taken if one is burning wood of an unknown nature, since some trees' wood smoke can be highly toxic (Wikipedia, 2015).

Generally, men and women have different demands on energy due to the existing socio-cultural and traditional roles. Women do most of the cooking. They are also heavily involved in fuelwood collection. Traditional use of firewood has negative effects on women's health such as respiratory diseases, eye irritation, etc. Gender division of labour and environmental degradation are increasing women's time burdens (Neequaye Tetteh, 1985). A report in the Ghanaian Daily Guide news paper indicates possible inhalation of poisonous substances into the respiratory tracts of women who use charcoal in enclosures for cooking (Daily Guide, 2015).

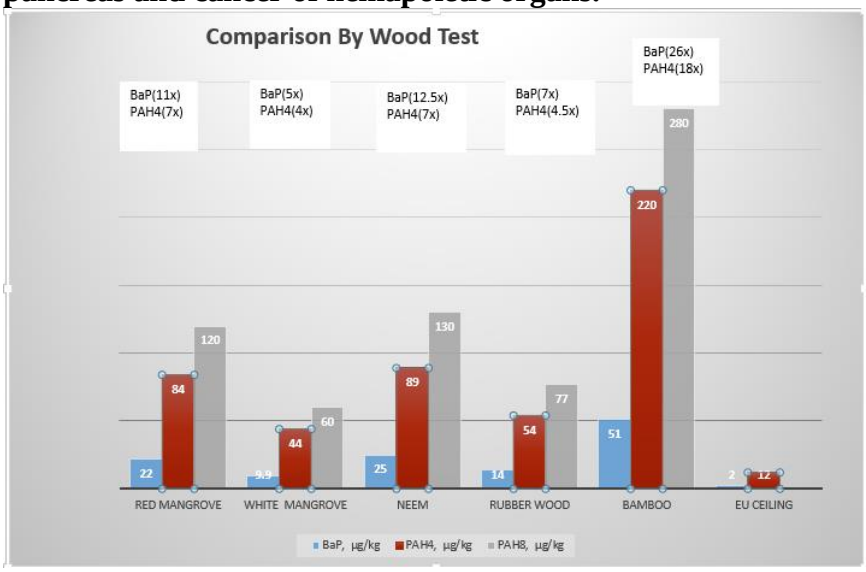
- **Studies conducted by SNV Ghana indicates that, some of the key traditionals wood species used for smoking fish in Ghana have various levels of Policyclic Aromatic Hydrocarbons (PAH). Using five wood species, neem, red mangroves, white mangroves, rubber and bamboo to smoke sardinella on common stove (Chorkor smoker), the PAH levels measured on the fish far exceeded the EU PAH standard for safe consumption (Figure 1b). Higher levels of PAH on smoked fish has potential health hazards. This is because the high PAH has carcinogenic potential causing breast cancer, cervical cancer, liver, prostate, pancreas and cancer of hemapoietic organs.**
- 

Figure 2 PAH levels on sardinella from five fuelwood species

1.4 Fuelwood and development policies

1.4.1 International policies

One of the major international development policies that is related to sustainable production and utilization of fuelwood resources in recent times is the Sustainable Development Goals (SDGs). The **Sustainable Development Goals** (**SDGs**) are a proposed set of targets that are to replace the Millennium Development Goals when they expire at the end of 2015. There are 17 SDG goals. The specific ones and actions that may directly or indirectly concern the fuelwood value chain are as follows:

- **Goal 1: End poverty in all its forms everywhere**

1.1 Eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.25 a day

1.4 Ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance

1.5 Build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters

1.a Ensure significant mobilization of resources from a variety of sources, including through enhanced development cooperation, in order to provide adequate and predictable means for developing countries, in particular least developed countries, to implement programmes and policies to end poverty in all its dimensions

1.b Create sound policy frameworks at the national, regional and international levels, based on pro-poor and gender-sensitive development strategies, to support accelerated investment in poverty eradication actions

- **Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture**

2.3 Double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment

2.4 Ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality

2.5 Maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels, and promote access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed

2.a Increase investment, including through enhanced international cooperation, in rural infrastructure, agricultural research and extension services, technology development and plant and livestock gene banks in order to enhance agricultural productive capacity in developing countries, in particular least developed countries

- **Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all**

7.2 Increase substantially the share of renewable energy in the global energy mix

7.3 Double the global rate of improvement in energy efficiency

7a. Enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology

7.b Expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries

- **Goal 12: Ensure sustainable consumption and production patterns**

12.1 Implement the 10-year framework of programmes on sustainable consumption and production, all countries taking action, with developed countries taking the lead, taking into account the development and capabilities of developing countries

12.2 Achieve the sustainable management and efficient use of natural resources

12.3 Halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses

12.4 Achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment

- **Goal 13: Take urgent action to combat climate change and its impacts**

13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries

13.2 Integrate climate change measures into national policies, strategies and planning

13.3 Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning

13.a Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly $100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible

13.b Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities

- **Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development**

14.2 Sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their

restoration in order to achieve healthy and productive oceans
14.5 Conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information

14.7 Increase the economic benefits to Small Island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism

- **Goal 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss**

15.1 Ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements

15.2 Promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally

15.3 Combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral

15.5 Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species

15.6 Promote fair and equitable sharing of the benefits arising from the utilization of genetic resources and promote appropriate access to such resources, as internationally agreed

15.9 Integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts

15.a Mobilize and significantly increase financial resources from all sources to conserve and sustainably use biodiversity and ecosystems

15.b Mobilize significant resources from all sources and at all levels to finance sustainable forest management and provide adequate incentives to developing countries to advance such management, including for conservation and reforestation

Generally, in implementing the agenda it is anticipated that each country will be responsible for its own economic and social development. However, there will be need to mobilize financial resources as well as build capacities and transfer environmentally sound technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed. Public finance, both domestic and international, will play a vital role in providing essential services and public goods and in catalyzing other sources of finance. It is also expected that the private sector, ranging from micro-enterprises to cooperatives to multi-nationals, and civil society and philanthropic organizations will play a role in the implementation of the new Agenda. For Africa the African Union's Agenda 2063 and the programme of the New Partnership for Africa's Development (NEPAD), all of which are integral to the new Agenda will be supported (UN, 2015).

1.4.2 Ghana sectoral policies

Policies, regulatory, legislative frameworks and institutional arrangements in place to provide direction for development and sustainable management of woodfuel resources in Ghana include:

1. National Energy Policy
2. Bio-energy policy
3. Renewable Energy Act, 2011 (Act 832)
4. Ghana Forest and Wildlife Policy (2012)
5. The Ghana REDD+ strategy
6. Forest Investment Plan (FIP)
7. Ghana forest plantation development strategy (2015-2040)
8. National Land Policy (1999, with revision in 2002)
9. National Wildfire Policy

1.4.3 Energy sector policies

In general Ghana Energy Policy, Bio-energy Policy and the Renewable Energy Act seek to create the enabling environment for the sustainable development and utilization of woodfuel in the country.

- **National Energy Policy:**
- **The overall national energy policy target is to attain 10% Renewable Energy (RE) in national energy mix by 2020.**
- **Bio-energy Policy**

In 2010, the Energy Commission of Ghana developed a Bio-energy Policy with sections on the development of the wood fuel sub-sector. The overall goal of the Bio-energy Policy is "to develop and promote the sustainable supply and utilization of bio-energy to ensure energy security for Ghana whilst maintaining adequate food security**.** The Bio-energy Policy also considers the supply and demand side of wood fuels and proposes strategies such as the promotion of woodlot cultivation, improved carbonisation technology and the promotion of efficient end use devices that will ensure the sustainable management of the woodfuel resources.

The key policy issues addressed under woodfuel thematic area are to promote and ensure sound management as well as expansion of the country's natural forest for sustainable supply of wood fuel. These include:

I. Sustainability of woodfuel supply
II. Development of efficient supply and end-use technologies for woodfuel production and use,
III. Efficiency in packaging, marketing and transportation of woodfuel, and strengthening of institutional and regulatory framework

The policy strategies include:

- Support for Non-Governmental Organizations (NGOs) and Community-Based Organizations (CBOs) to create awareness for the development and management of suitable wood fuel species.

- Identification and provision of incentives (financial and non-financial) for the development of woodlots in savannah and transitional zones under international funding protocols such as the Desertification Fund and Clean Development Mechanism (CDM) Fund
- It also seeks to encourage the collaboration between the District Assemblies and Traditional Authorities to educate and release land to prospective individuals (especially women) and groups for wood fuel woodlots and plantation establishment.

The key challenges to be addressed by the policy include:

- Sustainability of sources of supply
- Production of efficient technologies for wood fuel production and use
- Substitution of traditional wood fuels with more modern fuels like LPG
- Efficiency in the transportation of wood fuel
- Improved packaging and marketing
- Strong coordination in institutional and regulatory arrangements

- Renewable Energy Act, 2011 (Act 832**)**

The Renewable Energy Act (Act 832) was passed in 2011. The objective of the ACT is to ensure the development, management and utilization of renewable energy sources (including biomass) for the production of heat and power in an efficient and environmental friendly sustainable manner. The Renewable energy Act is aimed at the following:

- **Stimulate massive investment into the renewable energy sector.**
- **Ensure the development and implementation of programmes to sustain woodfuel production and consumption**

The Energy Commission is mandated to collaborate with relevant institutions to ensure the development and implementation of programmes to sustain woodfuel production and consumption including:

- **Woodlot plantations**
- **Improved kilns**
- **Improved charcoal stove promotion**

The strategic directions include the following:

- A framework to support the development and utilization of renewable energy sources
- An enabling environment to attract investment in renewable energy sources
- The promotion and use of renewable energy
- The building of indigenous capacity in technology for renewable energy sources
- The diversification of supplies to safeguard energy security
- Public education on renewable energy production and utilisation
- The regulation of the production and supply of woodfuel and bio-fuel

1.4.5 Forest sector polices, programs and strategies

- **Ghana Forest and Wildlife Policy (2012)**

This policy provides strategic directions and actions to be pursued in achieving sustainable management and development of commercial woodfuel supplies; and to develop systems and structures to support the sustainable establishment of commercial woodfuel plantations.

The Forest sector investment program (FIP)

The strategies under FIP for the wood fuel sector concerns enhancement of carbon stocks to provide an alternative opportunity for clean wood fuel production. Improved management of 'fuel wood' landscapes and maintenance of NTFPs are an important source of livelihood for women. Component 3 of the Forest Investment Plan is focused on sustainable woodfuel production in the savannah transition zone. This seeks to ensure the following:

- Support options for increased efficiency in charcoal production
- Support sustainable fuelwood harvesting and fuelwood production systems to produce emissions reductions/removals and other benefits, (potentially including investment in woodlots, establishment/engagement with CREMAs, charcoal producer "guilds" and community land use and natural resource planning)
- Leverage co-financing and private sector investment in woodfuel plantations

- **Ghana National REDD+ Strategy**

The Ghana National REDD+ Strategy document acknowledges that one of the principal drivers of deforestation and degradation in Ghana is fuelwood harvesting or exploitation as it is a major source of energy. One of the strategies for addressing environmental decline associated with wood harvesting in particularly the transition and savannah zones is to improve sustainability of fuelwood harvest & use. It is recommended in the document that the Ministry of Energy (MOE) with a core mandate on securing sustainable energy, assist in both providing complementary policies and implementation of REDD interventions (FC, 2015).

- **Ghana forest plantation development strategy 2015-2040**

A national forest plantation development strategy has been drafted for Ghana for 2015-2040. It is reported in this document that 90% of woodfuel needs of the country is obtained directly from the natural forest estate. The remaining 10% is from wood waste i.e. logging and sawmill residue, and planted forests. The continuous use of woodfuel obtained from the natural forests if not managed sustainably would lead to the depletion of the country's forests. It is imperative that measures are put in place to ensure the sustainable supply of woodfuel to meet the growing demand of woodfuels in the country. One major measure outlined in the plantation development strategy is to plant woodlots for fuelwood production. It is estimated that the annual demand for fuelwood in 2013 was 16,800,000 (m^3RWE). Supply from existing forests is 15,960,000 (m^3RWE). The deficit to be met from plantations is 840, 000 9 (m^3RWE). It is estimated that 56,000 ha of land would need to be planted at rate of 2,240 per annum to satisfy this deficit (FC & MLNR, 2013). Specific species have been recommended for planting woodfuel woodlots based on their suitability to the growing conditions across the broad ecological zones of Ghana (Table 2).

Table 2 Species recommended for fuelwood plantation development in Ghana

VEGETATION ZONE	SCIENTIFC NAME	COMMON/TRADE NAME	KEY USES
Coastal Savannah	*Senna siamea*	Cassia	Fuel wood
	Millettia thonningii	Millettia	Fuel wood
	Acacia mangium	Acacia	Fuel wood
	Acacia auriculiformis	Acacia	Fuel wood
	Azadirachta indica	Neem	Fuel wood
	Eucalyptus spp.	Eucalyptus	Fuel wood
Transitional Zone	*Acacia mangium*	Acacia	Charcoal
	Senna siamea	Cassia	Fuel wood
Northern Zone	*Acacia mangium*	Acacia	Fuel wood
	Millettia thonningii	Millettia	Fuel wood
	Azadirachta indica	Neem	Fuel wood
	Eucalyptus spp.	Eucalyptus	Fuel wood

Source: Forest Plantation Development Strategy 2015-2040

1.4.6 Other policies related to fuelwood

- **National Land Policy (1999, with revision in 2002)**

The land policy provides a framework for addressing the problems and constraints associated with sustainable land use and security of tenure to maintain a stable environment for the country's sustainable social economic development

- **National Wildfire Policy**

The wildfire policy is to promote the effective management of wildfires to guarantee the sustainable management of natural resources.

Generally, policies and programs in Ghana have not adequately paid due recognition to efficiently exploiting the potential of Small and Medium Forest Enterprises (SMFEs) for socio-economic development in the country. Consequently, although national land use policies acknowledge the sustainability and effective utilization of wood resources, there have not been any concerted efforts to develop and manage forest or vegetation resources for wood fuel purposes, neither has there been adequate attention paid to programs for the development and regulation of the associated firewood and charcoal enterprises. Thus, despite the economic contribution derived from fuelwood production and associated threat to the environment, little attention has been paid to the manner in which fuelwood is produced and sold due to the lack of coherent sector policies. Fuelwood production, transportation and distribution remain; above all, informal and unregulated therefore rendering them inefficient and risky (World Resource Institute, 2005).

- **The fuelwood value chain study**

Despite its contribution to deforestation, fuelwood plays a major role in food security and livelihoods of many forest dependent communities as well as incomes and employment for small and medium enterprises and industries in the Ghanaian economy. It has been the major source of fuel for the fishery sub-sector particularly for commercial fish smoking and frying. Hence its availability and management plays a key role in the sustenance of the fishery economy. Nevertheless, there is limited empirical information to aid in the understanding of

the interplay between the operations of the economic agents and resources in the Ghanaian fuelwood value chain, particularly for the fish smoking industry.

Fish processing is the main economic activity for the people living in and around the coastal areas and also along the river banks of Ghana. The main employment for these people is to process and preserve fish for market. The fish processing and preservation business is dominated by women whose economic activities have become more important considering the low levels of income and high levels of energy consumption. The fish processors depend almost entirely on fuelwood for energy for their economic activities. The sustainability issues related to fuelwood supply as well as depletion of mangroves in coastal estuaries which serve as nurseries for most fish species threatens the sustainability of the fish industry, livelihoods and food security.

This study has been commissioned by SNV Ghana under the USAID funded Sustainable Fishery Management Project (SFMP) to provide a comprehensive understanding of fuelwood value chain especially for fish smoking in coastal regions of Ghana. This will guide the development of environmental friendly and livelihood centred interventions to sustain fuelwood supplies, management of costal mangrove resources to protect fish breeding sites while sustaining the fishery economy of Ghana. Specifically, the study addresses the following questions:

1. What is the nature of the fuelwood value chain for fish smoking?
2. What is the magnitude of dependency of fuelwood for fish smoking?
3. What are the governance regimes and institutional structures/arrangements that support use and development of fuelwood resources in general and specifically for the fish smoking industry?
4. How are mangrove resources in coastal estuaries exploited and managed for the fish smoking industry?
5. What management interventions can ensure sustainable use and management of the mangrove ecosystem to protect fish breeding sites?
6. What interventions will be necessary for improvement of the fuelwood value chain to ensure sustainable supply and consumption of fuelwood resources while securing fishery livelihoods?

- **Report contents and organization**

The report that follows covers a detailed analysis of the fuelwood value chain for the fish smoking industry in fishing communities along the coastal areas of Volta, Greater Accra, Central and Western Regions as well as fuelwood producing areas in the moist semi-deciduous forest zone in the Eastern Region of Ghana. The fuelwood value chain is first mapped. This is then followed by a description of actors and their activities as well as processes associated with the production through marketing to consumption of fuelwood for the Ghanaian fish smoking industry including resource governance, distribution of profits along the chain, constraints and possible alleviation measures. The report chapters thus broadly cover the following:

- Value chain concept and relevance to fuelwood production-to-consumption system in Ghana
- Description of the actors, activities and processes along the fuelwood value chain, focusing on the resource, production, transportation, distribution/supply, marketing,

consumption and utilization of fuelwood for fish smoking and income-expenditure flows along the chain
- Governance regimes for fuelwood resources (policies, access, tenure, management and sustainability)
- The extent of dependency on fuelwood i.e. nature and magnitude of supply and demand including gender perspectives
- Management of mangrove ecosystems for fuelwood production
- Constraints and challenges along the value chain
- Recommendations for enhancing sustainable environment and local economies, fuelwood value chain enterprises especially fish smoking and livelihoods in Ghana

The report is structured into five chapters. Chapter 1 covers the introduction and background to the study with the other four chapters covering the broad sections listed above. The information presented in the report was obtained from primary sources from questionnaire and inventory surveys as well as from literature including journal articles, research reports, among others.

2.0 OBJECTIVE OF THE STUDY AND TERMS OF REFERENCE

The objective of this study is to analyze the value chain of fuelwood to provide evidence-based information on the fuelwood supply chain operation and to insure that fish smokers continue to have a supply of preferred wood species while protecting mangroves as fish nurseries with focus in the 4 coastal regions of Ghana, namely Volta, Greater Accra, Central and Western Regions.

The value chain study provides an understanding of the woodfuel origin, volume, value and identifies links in the chain between wood harvesters/producers, transporters, retailers and consumers mostly associated with fish smoking and the conditions by which they gain revenues and potential economic growth. The Value Chain Analysis/study describes the status and viability of existing fuelwood business; the potential markets, employment dynamics and opportunities, value addition opportunities, problems and challenges associated and consumption volumes by the fish processing industry.

2.1 Expected Results

The following key results shall be expected upon completion of the mission:

1. A detail analysis of all the steps of the value chain and the men and women involved, including: the source (forest), timber/fuel production, transport, sale, retail, consumption, regulation/taxation/management, depletion of the resource (quantification) and its effect on the value chain.
2. Documentation of the main policies in Ghana pertaining to woodfuel and the existing institutional framework to operationalize these policies.
3. A summary of the main projects and programs surrounding fuel wood
4. Documented existing problems and challenges in the chain and proposed solutions and analysis of these solutions.
5. Identified and mapped woodfuel origin and volume used and suggested ways to reduce consumption.
6. Proposed risks and mitigation measures in the chain. Risks can include land disputes, ownership of carbon and woodlots, loss of employment for traders due to improved

management of the resource, displacement of wood extraction activities, , disappearance of endangered tree species like mangroves.

7. Documented ways to increase in the added value and supply of prefer wood species for fish smoking and also improving performance along the chain.

3.0 METHODOLOGY

3.1 Conceptual framework for the study

A value chain is a set of activities that a firm operating in a specific industry performs in order to deliver a product or service for the market. Value chain analysis (VCA) is a tool used in understanding the sequence of related business activities from production to consumption of a commodity, and the functions of the operators and supporters in the chain. The analysis helps to identify money flow, the bottlenecks in the chain and their causes, understand the relationships between businesses in the chain and other market players, the role of specific market functions and the rules that govern the chain (GTZ, 2007). This should lead to identification of capacities and incentives of the actors where intervention can be made to eliminate the bottlenecks.

Value chain analysis focuses on the actors and their relations at all levels and their often-complex networks. According to Kaplinsky and Morris (2001), VCA offers a framework to analyze the activities and processes involved in taking a product from the forest, eventual production, transformation and processing to delivery to final consumers and ultimately disposal. As a product moves from the producer to the consumer, a number of transformations and transactions take place along a chain of interrelated activities, and value is added successively at each stage. Value chains do adapt and respond to local conditions, policy and institutional environment, market power and consumer preferences, among other things. Some of these factors shaping value chain evolution may not be optimal from a social welfare standpoint. The aim of value chain analysis, therefore, is to analyze the organization and behaviour of all the participants in the value chain, to diagnose the constraints and problems that they face, and to identify public actions that may enhance the performance of the value chain and contribute to national policy objectives.

With respect to fuelwood, it involves among other issues, the sequence of related business activities from production to consumption of fuelwood; detailing the nature and functions of the operators and supporters in the chain, magnitude of resource flows, management and regulations, price and profit spread along the chain, challenges and opportunities and options for enhancement of the chain as well increased value addition to increase profits and efficiency in the use of resources and development/conservation of resources to sustainably support livelihoods along the chain. There are basic steps in a value chain analysis depending on the commodity being analysed. According to Fasse *et al.* (2009) the first step of a value chain analysis is chain mapping. At this stage the sector is illustrated in a map-like fashion tracing the product flows within the chain which leads to a multi-layered “atlas” of the woodfuel chain. Figure 2 illustrates a map of a typical fuelwood value chain.

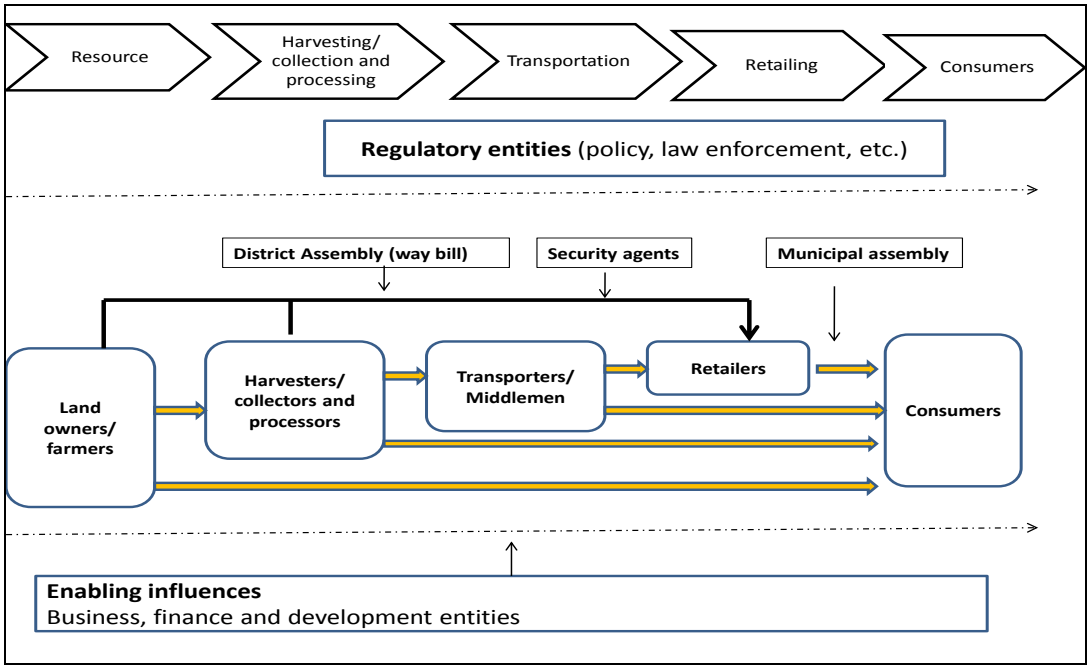


Figure 3 A map of a typical fuelwood value chain.

Source: Adapted from Obiri and Nunoo, 2014; Murererehe and Richter, 2011 and Hellin and Meijer, 2006)

The second step involves quantifying the value chain in detail. This is addition of quantifiable data about;

- **Number of operators in each category.**
- **Prices paid at each chain link between stages.**
- **Volumes and turnover in each chain stage.**
- **Shares of product flow of the different sub-chains / distribution channels.**
- **The chain supporters and suppliers**

The third step is economic analysis of value chains and it complements which deepens the quantification, with more emphasis on economic efficiency. This is a kind of partial budget analysis of expenditure and income streams along the chain (Figure 3). The flow of costs and revenues accruing at various stages of the value chain is analysed in regard to;

- **Costs, Income and profit, prices, and quantities of the goods handled by the different actors**
- **Distribution of income and profit within and among the groups along the value chain**
- **The mechanisms which determine revenue generation and revenue sharing in a given setting**

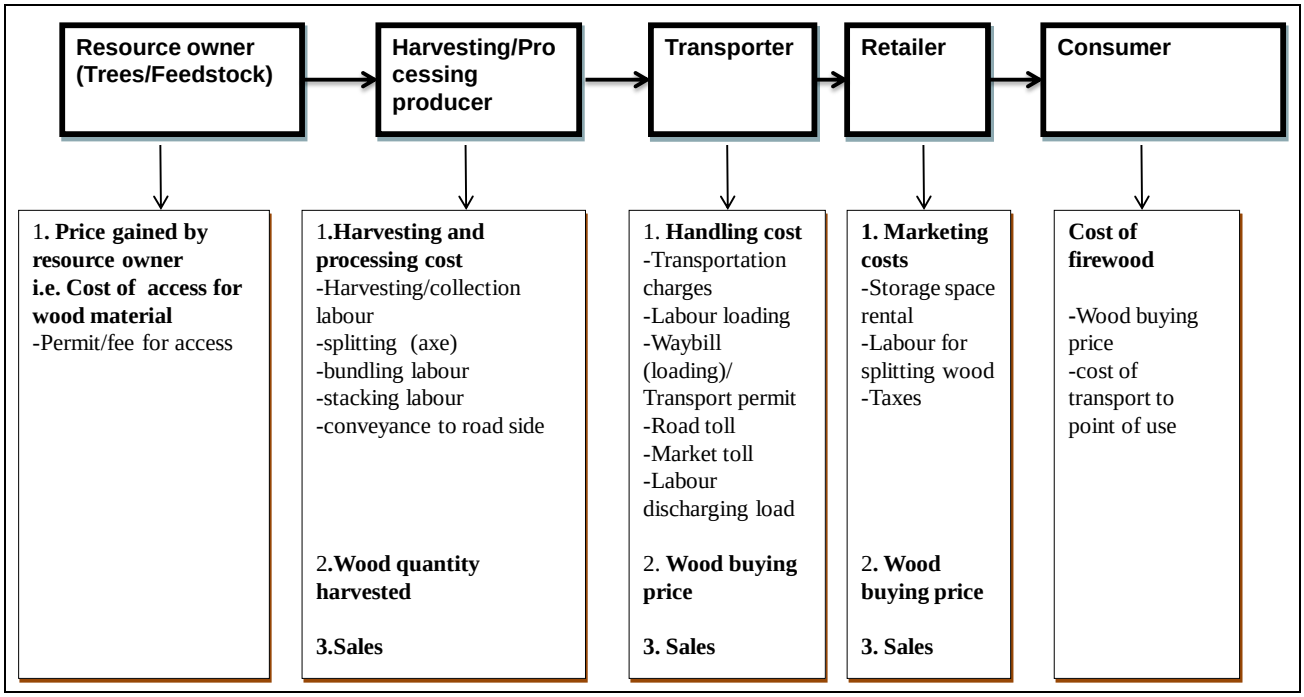


Figure 4 Framework for analysing costs and returns for estimating profit along the fuelwood value chain

At this stage the value addition is calculated. This is the new wealth created by a productive activity and is calculated by subtracting the wealth (II) which had to be consumed in the production process of the product from the gross value Y of the product (FAO, 2005). The total value added is the summation of the value added for each step of the chain as well as the overall value added of the entire chain (Fasse *et al.*, 2009).

Value added (VA) is defined by the equation:

$$VA = Y - II$$

Finally the opportunities and constraints in the value chain are analyzed through the analysis of the roles, mandates, rights and responsibilities of the concerned stakeholders, their respective capacities and weaknesses considered (GTZ, 2007).

3.2. Study areas and respondents

The study was conducted in 27 districts spread across Volta, Greater Accra, Central, Eastern and Western Regions of Ghana. Figure 4 shows districts surveyed and Table 3 shows a distribution of categories of respondents across the districts in the five regions. Figure 5 shows study sites in 3 major ecological zones (wet, moist semi-deciduous and coastal savannah thicket) surveyed in the 5 regions with fuelwood flows from producing areas to trading and consumption areas for the coastal fish smoking industry.

Table 3 Proportion of respondents/actor categories interviewed in 27 districts and data collected

Fuelwood actor category	No. interview	Per cen	Data Type	District

interviewed	ed	t (%)		
Resource owners	53	4%	Socio-demographic profile, Tenure, regulation, management, constraints, alleviation measures, etc. Acreages of land under fuelwood resources, management/regulatory strategies, etc.	**Volta**: Keta , South Tongu **Central:** Awutu Senya, Efutu, Ekumfi, Gomoa East, Gomoa West, Mfantsiman **Western:** Shama, Ahanta-West, Jomoro, Nzeman East
Producers	286	20 %	Socio-demographic profile, resource access & acquisition, labour, marketing & regulations, constraints, Inputs & outputs, alleviation measures, etc. Quantities harvested and distribution	**Volta**: Keta **Greater Accra**: Ningo Prampram, Ada East, LEKMA, **Central**: Awutu Senya, Asikuma/Odoben/ Brakwa, Effutu, Ekumfi, Gomoa West, Gomoa East, Mfantseman, Abura Asebu, Agona East, **Eastern**: New Juaben, Suhum- Kraboa, West Akim, Kwamankese, Kwaebibirem, Birim central, Akuapem north **Western**: Shama Ahanta East, Ahanta East, Ahanta West, Wassa East, Nzema East, Jomoro,
Transporters	220	15 %	Socio-demographic profile, resource access & acquisition, labour, marketing & regulations, constraints, Inputs & outputs, alleviation measures, etc. Quantities trasported and distribution	**Volta**: Keta **Greater Accra**: Ningo Prampram, Ada East, LEKMA, Accra Metropolis, **Central**: Awutu Senya, Asikuma/Odoben/ Brakwa, Effutu, Ekumfi, Gomoa West, Gomoa East, MFATSEMAN, Abura Asebu **Eastern:** New Juaben, Suhum- Kraboa, West Akim, Kwamankese, Kwaebibirem, Birim,

				Akuapem north **Western:** Shama Ahanta East, Ahanta East, Ahanta West, Wassa East, Nzema East, Jomoro,
Traders/Marketers	416	29 %	Inputs & outputs, resource constraints, alleviation measures, access & acquisition, labour, marketing & regulations, supply and demand trends, finance, species, sources and preferences, constraints, alleviation measures	**Volta**: Keta, Ketu South **Greater Accra**: Kpone Katamanso, Ada East, Ada West,Ningo-Prampram, Tema East, Ga South. Lekma, Accra Metro **Central**: Senya Breku, Effutu, Ekumfi, Gomao East, Gomoa West, Mfantseman, Abura/Asebu/Kwamankese **Western**: Shama Ahanta, Ahanta West, Nzema East, Jomoro
Consumers	408	28 %	Socio-demographic profile, consumption trends, supply, species, preferences, constraints, alleviation measures, etc	**Volta**: Keta, Ketu South **Greater Accra**: Kpone Katamanso, Ada East, Ada West, Ningo-Prampram, Tema East, Ga South. Lekma, Accra Metro **Central**: Senya Breku, Gomao East, Mfantseman **Western**: Shama Ahanta, Ahanta West,Nzema East, Jomoro
Other Actors (District authority, Forestry, EPA, Traditional Authorities	57	4%	Regulations, management, access, interventions, revenue, constraints, alleviation measures, etc..	**Volta**: Keta Municipal, Ketu South, **Central**: Awutu Senya, Ekumfi, Gomoa East, Gomoa West, Mfantsiman, **Western**: Shama, Takoradi, Ahanta-West Jomoro, Nzeman East,
Total	1440	100		

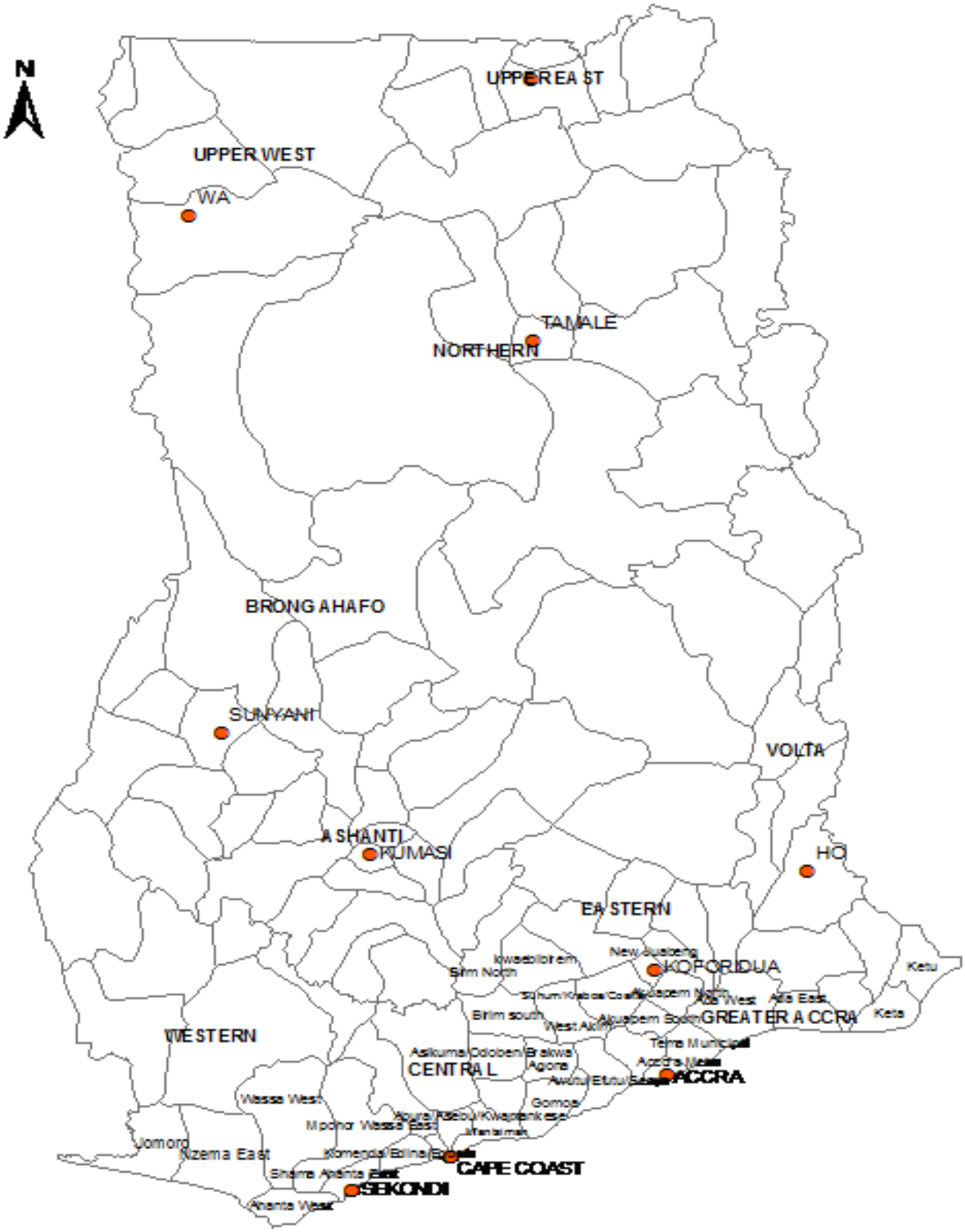


Figure 5 Map of Ghana showing districts surveyed

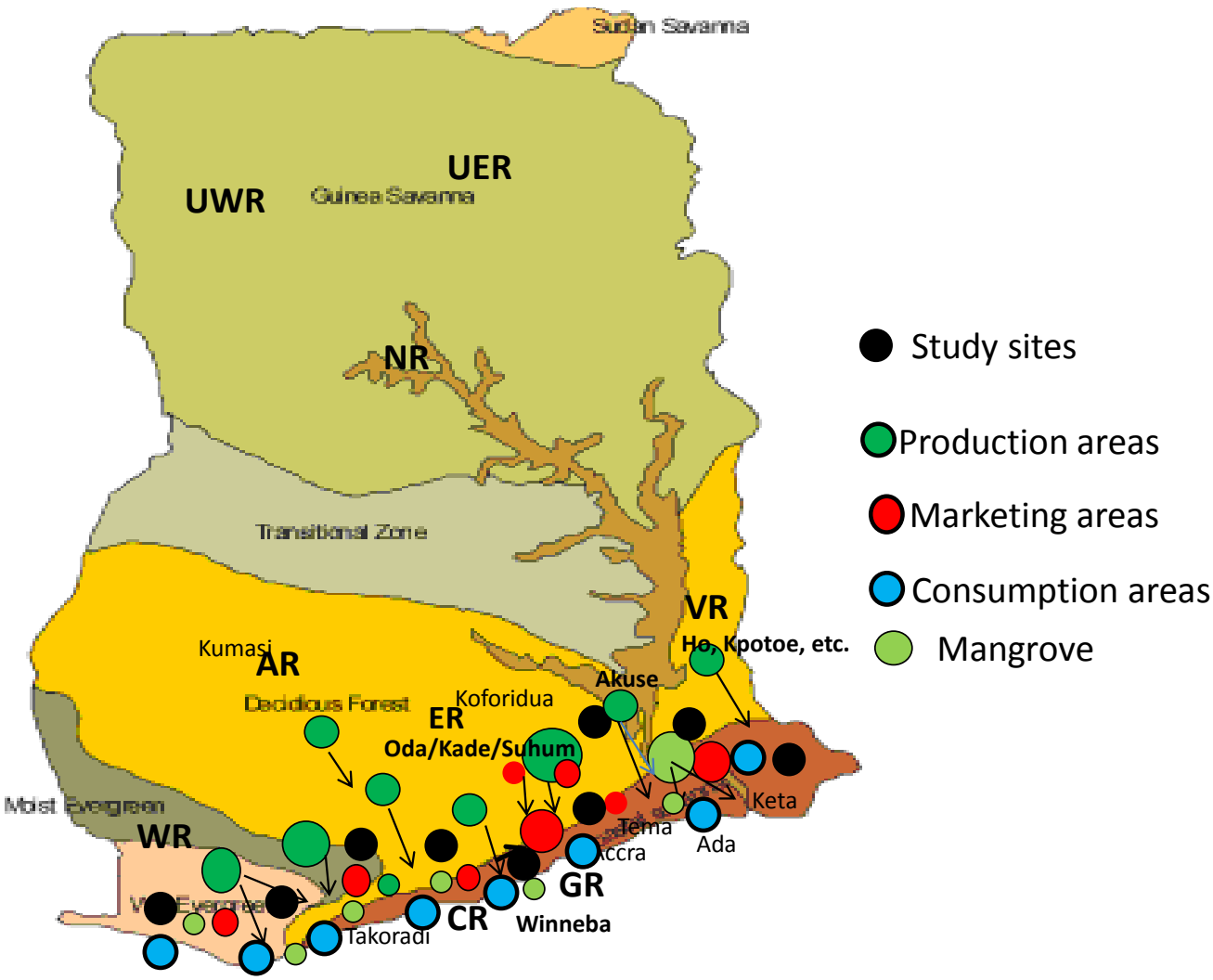


Figure 6 Ecological map of Ghana showing fuelwood production, trading and consumption areas surveyed

The bio-physical and economic features of the regions surveyed are summarised in Table 4. All districts surveyed are typically agrarian economies with agriculture engaging up to 80% of the labour force (www.ghanadistrcits.com). Agricultural crop production is largely rain-fed and practiced under slash and burn with relatively low external inputs. Artisanal fishing is predominantly practiced in the coastal communities surveyed.

Table 4 Biophysical and economic features of coastal and forest regions surveyed

Characteristics	Volta	Greater Accra	Central	Western	Eastern
Location	South East of Ghana and the Lake Volta on latitudes 6^0 03"N	Bordered on the north by the Eastern Region, on the east by	The Central Region is bordered by Ashanti and Eastern regions to	South West of Ghana, spreading from the Ivory Coast b	Bordered to the east by the Lake Volta, to the north by Brong-Ahafo region and Ashanti region, to the west by Ashanti region, to the south by Central region and Greater Accra

	and 6^0 20”N and longitudes 0^0 49’E and 1^0 05’E.	the Lake Volta, on the south by the Gulf of Guinea, and on the west by the Central Region.	the north, Western region to the west, Greater Accra region to the east, and to the south by the Gulf of Guinea.50 30’N 1000’W	order in the west to the Central region in the east. $5^0$30’N $2^0$30’W	region. $3^0$30’N $0^0$30’W
Land size	20,570 km²	3,245 km²	9,826 km²	23,921 km²	19,323 km²
Topography	Low-lying coastal plain with the highest point of only 53 meters above sea level. The lowest point is approximately between 1-3.5 meters below sea level along the coast.	Gently, undulating and almost flat. The Accra Plains descend gradually to the gulf from a height of about 150 meters. The topography is also marked by a succession of ridges and spoon shaped valleys.	Elevation lower than 60m above sea level. The land slopes gently from south to north with isolated hills on forest dissected plateau in the north and coastal plains in the south. The area is drained by a few rivers and numerous streams.	The land is generally low lying and it is underlain with rocks rich in gold, diamonds, manganese and some takes of clay.	The land is generally undulating and rises about 240 metres to 300 metres above sea level.
Vegetation	Moist semi deciduous forest in the	Coastal savannah characterized by	Two main vegetation zones, the coastal savannah	Largely falls within High Rain	Moist semi-deciduous rain forest mainly

	north with coastal savanna thickest in the south.	short savanna h grasses and intersper sed with shrubs and short tress.	thicket along the coast in the south and the moist semi-deciduous forest in the North	Forest Vegetati on Zone with wet evergre en and moist forests.	
Climate	Falls within the Dry Coastal Equatori al Climate with an annual average rainfall of less than 1,000m m. The amount of rainfall reduces as one travels from the north to the coastal parts where only about 800mm annual may be recorded . The region experien ces a double maximu m rainfall pattern.	Falls within the south-eastern coastal plains of Ghana which is one of the hottest parts of the country. Tempera tures are high througho ut the year and ranges between 23°C and 28°C. A maximu m temperat ure of 33°C is may prevail during the very hot seasons. Rainfall is	The Region experienc es two rainfall patterns - major rainy season (April - July) and minor rainy season (Septemb er - November). Mean annual rainfall ranges between 70 and 90cm. Its mean annual maximum and minimum temperatu res of29°C and 26°C occur in February to March and August respective	The Region is found within the South-Western Equatori al Climatic Zone of Ghana the highest mean tempera ture is 34°C which is recorde d between March and April, while the lowest mean tempera ture of 20°C is experie nced in August. Relative humidity is very high	A double maxima rainy season. Annual rainfall up to 1130mm; maximum monthly mean temperature is 37.2ºC and a minimum of 21.0ºC. Relative humidity is generally high upto 98% in June and low 31% in January

	The major rainy season is between March and July while the minor one begins in September and ends in November. These coincide with the main and minor cropping seasons	generally heavy during the major seasons between March and September. The average rainfall is about 750 mm. Humidity is 60% due to the proximity of the sea, the Volta River and other water bodies.	ly. The Region experiences two wind systems, the South-Western Monsoon and dry Harmattan winds	averaging between 75% to 85% in the rainy season and 70% to 80% in the dry season. It experiences a double maxima rainfall of over 1,700 mm.	

Characteristics	**Volta**	**Greater Accra**	**Central**	**Western**	**Eastern**

Soil type	Along the coastal strip are the Oyibi-Muni and Keta Associations characterized by sandy soils. The soil is generally alkaline and supports mangrove vegetation, sugar-cane, and grass for pasture.	The soils in the Region can be divided into four main groups: drift materials resulting from deposits by wind-blown erosion; alluvial and marine motted clays of comparatively recent origin derived from underlying shales; residual clays and gravels derived from weathered quartzites, gneiss and schist rocks, and lateritic sandy clay soils derived from weathered Accraian sandstone bedrock formations.	The soils in the Region are made up of four main groups namely the forest ochrosols, forest ochrosols and oxysols intergrades, tropical black earth and forest lithosols. The forest ochrosols has a high nutrient value and is suitable for both tree and food crops, i.e. cocoa, coffee, citrus, maize, cassava, pineapple and vegetables	Soils in the Region are mostly underlain by Cambrian Rocks of the Birimean formation and the Tarkwaian sandstone-Association Quartzite and Phyllites types. The soil is loamy and is good for the cultivation of palm fruit, coconut, maize, and vegetables and citrus.	The major soils in the Region are the Asikuma-Atiwa-Ansum/Oda Compound Area. Dominating this soil group is the Atiwa series which are mainly red, well drained, deep gravel-free silty loams and silty-clay loams. The soils are suitable for the cultivation of both food crops (plantain, cassava, maize and vegetable) and cash crops (cocoa, coffee, oil palm, citrus and cola).

Population	2,118,252	4,010,054	2,201,863	2,376,021	2,633,154

Local economy	Agriculture/forestry/ fishing is the largest industrial sector, employing more than 50 percent of the economically active population. The other two major industries are wholesale and retail trade	42.0% engaged in sales and service occupations, with 24.7 per cent as production, transport and equipment operators. wholesale and retail trade (30.4%) and manufacturing (16.7%) are the dominant branches of activity. About 7.9 per cent of economically active persons are engaged in agriculture, hunting, forestry and fishing industry.	Agriculture, forestry and fishery and service and sales sectors engage 42.5% and 20.3% of all employed persons. Seventeen percent of employed persons are engaged in crafts and related trades. Managers, professionals, associate professionals and technicians altogether form nine percent of employed persons.	Agriculture, forestry and fishery enage over 70% of the working population followed by service and sales workers. The region is endowed with considerable natural resources. It is the largest producer of cocoa, rubber and coconut, and one of the major producers of oil palm. The rich tropical forest makes it one of the largest producers of raw and sawn timber as well as processed wood products. A wide variety of minerals, including	Predominantly rural population with a higher proportion of the population engaged in agriculture. Also has gold and bauxite deposits that are exploited. Agro-based industries also exist.

3.3. Data collection and analysis

3.3.1 Study strategy or approach

The study was structured to cover the following:

- **Literature review for compiling background information for the study and design of interview guides**
- **Design of data collection forms/ questionnaires and interview guides**
- **Reconnaissance and pre-testing of questionnaires and interview guides**
- **Finalizing questionnaires and interview guides for survey data collection**
- **Training of 45 enumerators in sampling and data collection techniques**
- **Design matrix for data collection for enumerators**
- **Sampling of respondents for interviewing**
- **Data collection: Interview of value chain actors**
- **Monitoring of enumerators during data collection**
- **General observations and photo capture**
- **Data analysis and report preparation**

3.3.2 Data collected

Data collection was undertaken from June-July 2015. Both primary and secondary data were gathered for the study. The secondary data obtained from literature provided information for writing the introduction and background of the report as well as preparation of questionnaires and informal interview guides. Two sets of primary data were gathered from the various agent or actors of the value chain based on the structure presented in Figure 2 and 3. The figure illustrates the basic agents or actors and corresponding cost items associated with activities undertaken in the chain as the product moves in the raw material form from the source through transportation/distribution to markets/sale points and to the final consumer. The figure is adapted from a description of the charcoal value chains in Uganda and Rwanda (Sepp, undated and Murererehe *et al.*, 2011). The 2 categories of primary data collected (summarized in Table 3) are described as follows:

1. **Descriptive data used for narratives for describing the value chain actors and sequence of their activities among others along the chain. Semi-structured questionnaires were used to collect relevant primary data from 1400 respondents comprising fuelwood resource owners, producers, transporters, wholesalers, retailers and consumers based on their recall of activities and associated costs and revenues. The costs and revenues are economic data for the estimation of profits and price spread along the chain. The questions were administered in local languages Akan and Ewe as well as in the English Language where appropriate. Observations of the activities of the actors in the chain were also made. In addition, interviews were conducted of other actors or stakeholders including institutions that influence fuelwood resource access and management for the fish smoking industry such as District Assembly, National Disaster Management Organization (NADMO), Forestry Services Division, Wildlife Division, Ministry of Food and Agriculture (MoFA) and the Environmental Protection Agency (EPA) as well as traditional authorities and fuelwood resource or landowners in the 27 districts surveyed.**

2. **Assessment of fuelwood resources in study areas and quantity flows describing the status of the fuelwood resource base and estimating volumes flowing along the chain.**

3.3.3 Data analysis and presentation of the information

Data was analyzed descriptively and quantitatively using the Statistical Package for Social Sciences (SPSS) and Microsoft Excel spread sheets. The analysis involved simple descriptive statistical tools like averages, percentages. Price spread was determined by computing the differences between the prices received by the producers and prices paid by the consumer. Price spread = Pp-Pf. Where, Pp = prices paid by the consumer and Pf = prices received by the producer (Fasse *et al.*, 2009)

4.0 FINDINGS

4.1 Overview of the fuelwood value chain

Figure 6 is a value chain map illustrating an overview of the Fuelwood Value Chain for the coastal fish smoking system. It shows the various categories of actors, their activities and inter-connections. Generally, fuelwood supplies for trading and consumption in fish smoking communities along the coastal zone is acquired from natural sources from farmlands and forest reserves and to a limited extent from plantations in the Wet Evergreen Forest Zone in the Western Region and Moist Semi-deciduous Forest Zones in the Central, Eastern and Volta Regions. The forest-savannah transition vegetation in the Volta region as well as the coastal vegetation or thicket and mangroves along the estuaries and on islands of the Volta Region are exploited for smoking fish in the Volta and Greater Accra regions.

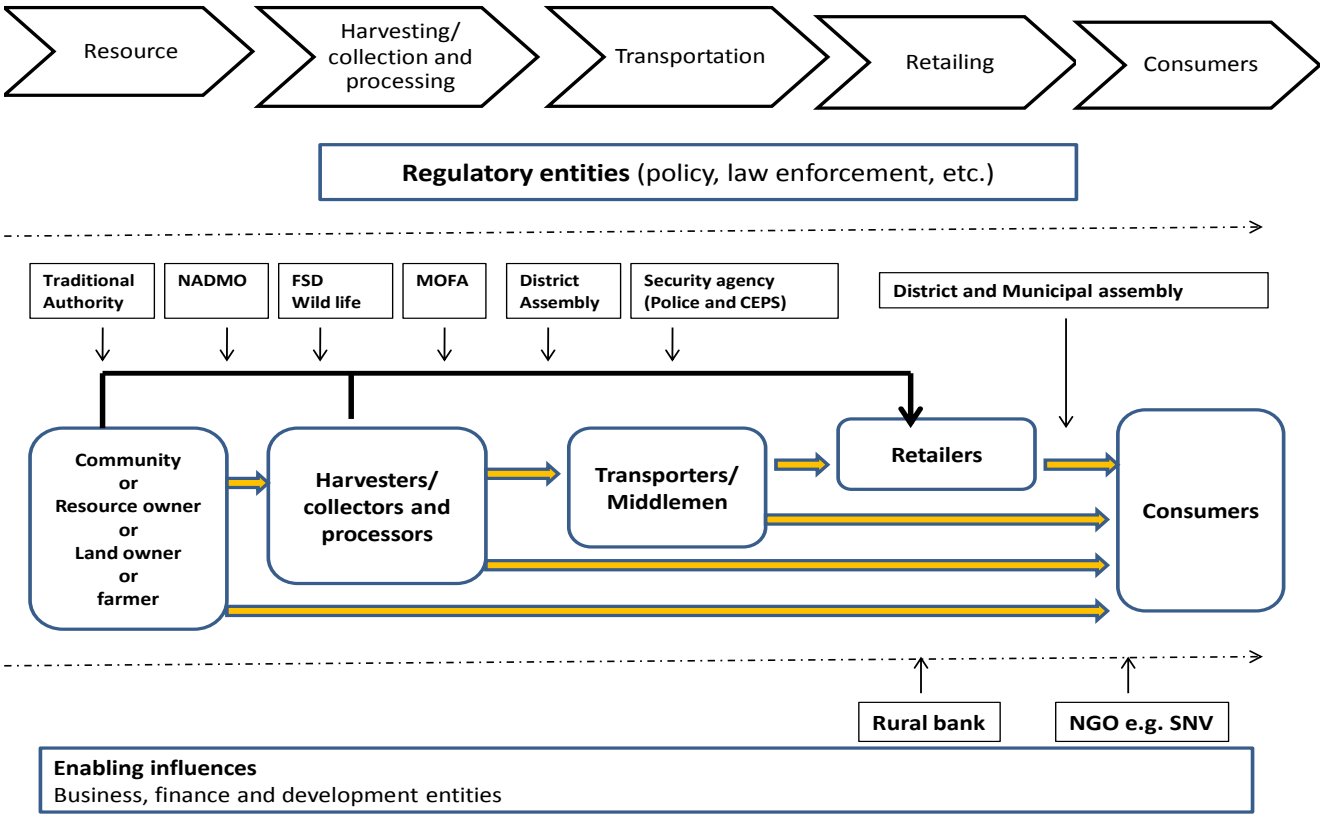


Figure 7 Map of the fuelwood value chain for fish smoking in Ghana

- **Commercial fuelwood supplies are secured from farmlands owned by individuals, families and communities and often have to be acquired at a fee except in cases where the producer or supplier owns the farmland. That from government forest reserves is acquired through a paid permit system while supplies from private plantations are purchased. Labourers including chainsaw operators are engaged in preparing the fuelwood for sale by cutting into chunks for bigger diameter logs or split into pieces and bundled. The supply/value chain involves three categories of traders i.e. the roadside dealers (usually in production areas), truck dealers/transporter middlemen and traders usually women in consuming areas. Supplies are usually collected and sold at the harvest point where there is access route or hauled from the harvest point to the road side and sold to a truck dealer or transporter/middleman. The truck dealer/transporter/middlemen may either deliver to traders in fishing communities for wholesaling/retailing to fish smokers and other clients (food processors or households) or deliver directly from the truck to the fish smoker (Figure 6). Direct supply from producer or farmer to the trader at sale points in the fishing areas or to the fish smoker also prevails. At the sale or smoking points, the trader or fish smoker engages labour to split wood chunks into pieces for retailing or use respectively. Engagement of hired labour is essential in harvesting, collection, bundling, loading in producing areas as well as off-loading and packing at delivery points in consuming communities. The harvesting and splitting are done with basic tools such as the cutlass, saw, chisel, hammer and axe making it a very tedious job.**

The activities of several regulatory entities also influence the performance of the fuelwood value chain. At the resource areas traditional authority particularly the chiefs may give out community lands to be harvested at a fee or may impose regulations on species and quantities of fuelwood to be harvested to protect the resource. Public sector institutions such as the National Disaster Management Organization (NADMO), Forest Services Division (FSD), Wildlife Division, Ministry of Food and Agriculture (MoFA), District Assembly, Unit committee, Assembly men and the church may either jointly or individually mobilize community members to plant trees for fuelwood production. These institutions as well embark on educational campaigns to enlighten communities on trees and their importance in environmental safety especially against climate change. The District Assembly collects tolls at the farm gate on each load of fuelwood being transported to the market. The FSD, Wildlife and District Assembly in addition monitor activities of fuelwood producers. The FSD in the forest areas of the Eastern, Western and Central Regions issue permits for fuelwood harvesting and conveyance certificates for transporting fuelwood produce to clients in fishing communities. The environmental management and planning units of the District and municipal assembly in addition monitor activities of fisher folks at the landing and fish smoking sites. USCOND an NGO in the Western Region promotes local governance in fishing communities, while the management of the Keta Lagon Complex Ramsar Site can potentially assist in transferring interventions to enhance the fuelwood business and protect fish resources in the Volta estuaries. With respect to women, the Women in Agricultural Development Division of MoFA monitor utilization of fuelwood for fish and gari processing to boost food production especially in the municipalities.

4.2. Fuelwood production system

4.2.1 Socio-demographic profile of fuelwood producers

Gender, Age, Education and Residential Status of fuelwood producers

Fuelwood is produced by both male and female in the five regions surveyed. Overall 53% and 47% male and female fuelwood producers were interviwed for data across the regions (Figure, 7). Both the youth aged between 20-50 years (70%) and older people over 50 years (29%) across regions and particuarly in the Volta and Central Regions actively engage in fuelwood production on commercial basis (Figure, 8). Up to 98% of fuelwood producers are permanently residents in their community of operations except in Greater Accra and Central Regions where 33% and 20% respectively are migrants that come from other areas to seek the reosurce for harvesting and sale (Figure 9). Generally, 71% of the producers interviewed across are formally educated with the majority having had basic i.e. primary, middle and junior secondary education. The greater proportion of the un-educated producers are women particuarly in Greater Accra (50%), Central (31%) and Western (29%) Regions (Figure, 10).

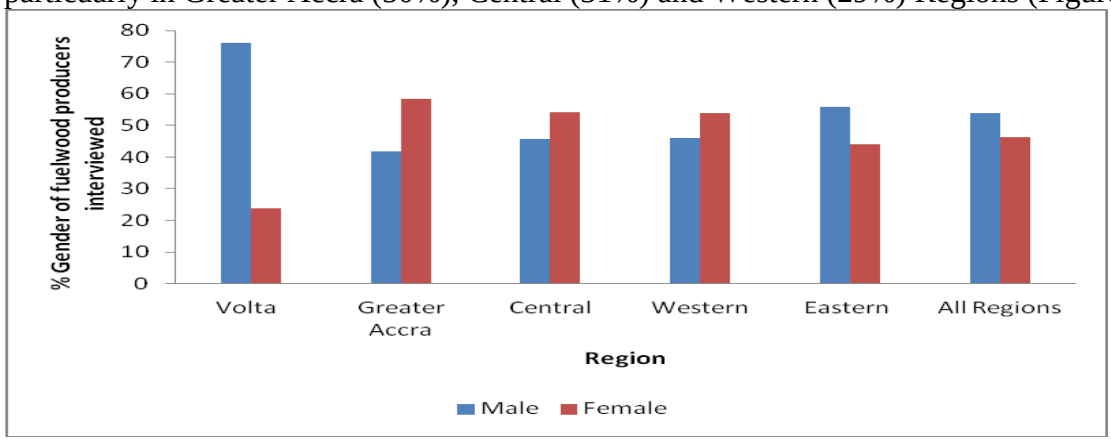


Figure 8 Gender of fuelwood producers across regions

Plate 1 Female fuelwood producer –Eastern Region

Table 5 Age of fuelwood producers across regions

Region	N	Age of fuelwood producers			Std. Deviation
		Mean	Min.	Max.	
Volta	46	50	24	70	12.1
Greater Accra	12	48	25	78	16.0
Central	48	49	27	82	12.4
Western	89	41	14	80	12.5
Eastern	91	41	19	80	11.8
All Regions	286	44	14	82	12.9

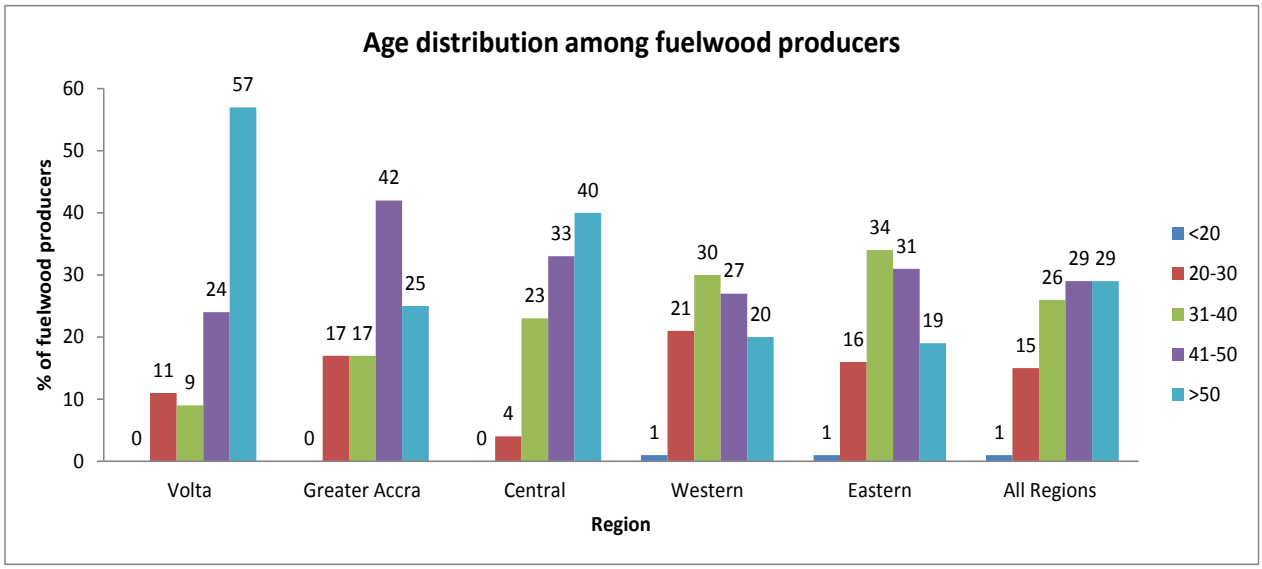


Figure 9 Age distribution among fuelwood producers

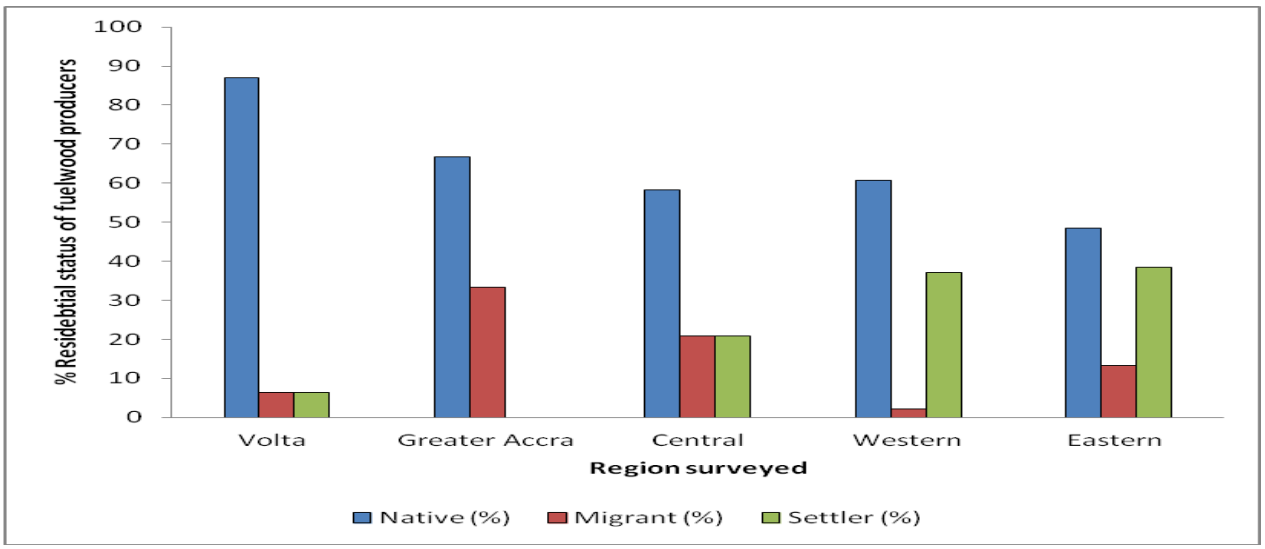


Figure 10 Residential status of fuelwood producers

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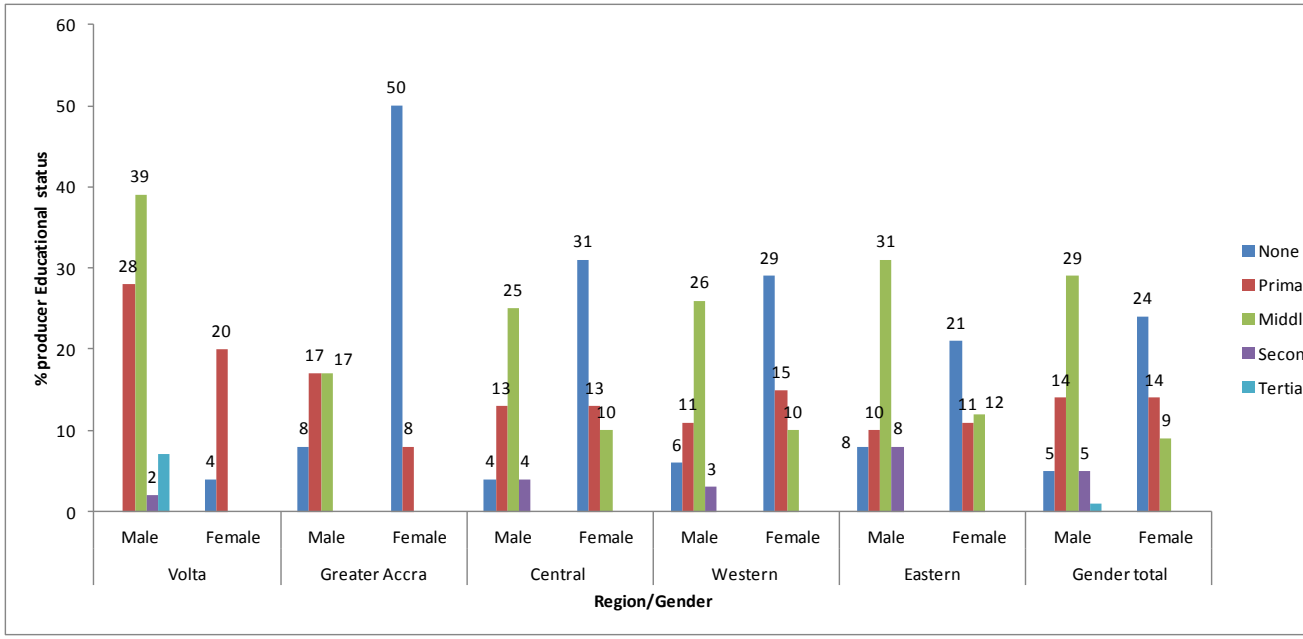


Figure 11 Educational status of men and women fuelwood producers in survey regions

Household characteristics of fuelwood producers

Majority of fuelwood producers are married ranging from 73% in Central to 87% in the Volta Region with 19% on average being single parents across regions (Figure 11). Household sizes range on the average from 7-10 people (Table 6).

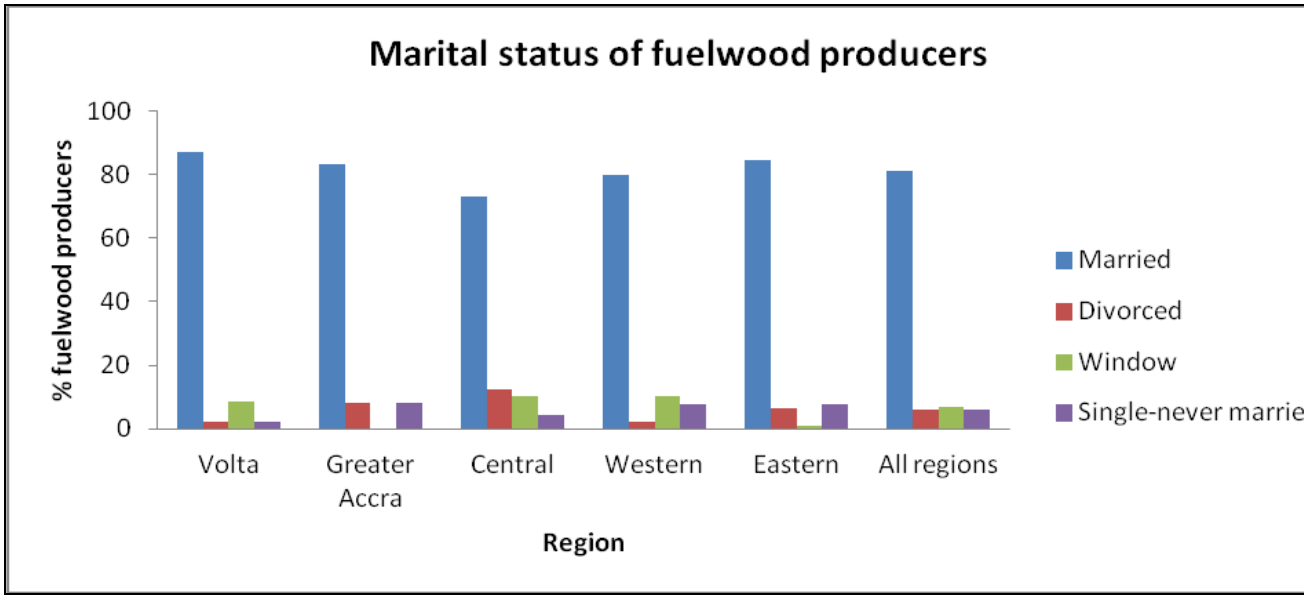


Figure 12 Marital status of fuelwood producers

Table 6 Household sizes of fuelwood producers

• Region	• Mean household Size	• Standard Deviation
• Volta	• 7	• 2.81
• Greater Accra	• 10	• 8.35
• Central	• 9	• 5.27
• Western	• 8	• 4.49
• Eastern	• 7	• 3.54
• Combine	• 8	• 4.89

Plate 2 A couple and household engaged in fuelwood production-Eastern Region

- **Sources of livelihood for fuelwood producers**

Fuelwood production is frequently undertaken as a secondary activity by most households in producing communities on subsistence basis to supplement income from agriculture. Usually agriculture is the major economic activity in these areas. However, there are other producers who engage in the activity as their major source of income on commercial basis (Figures 12 and Figure 13).

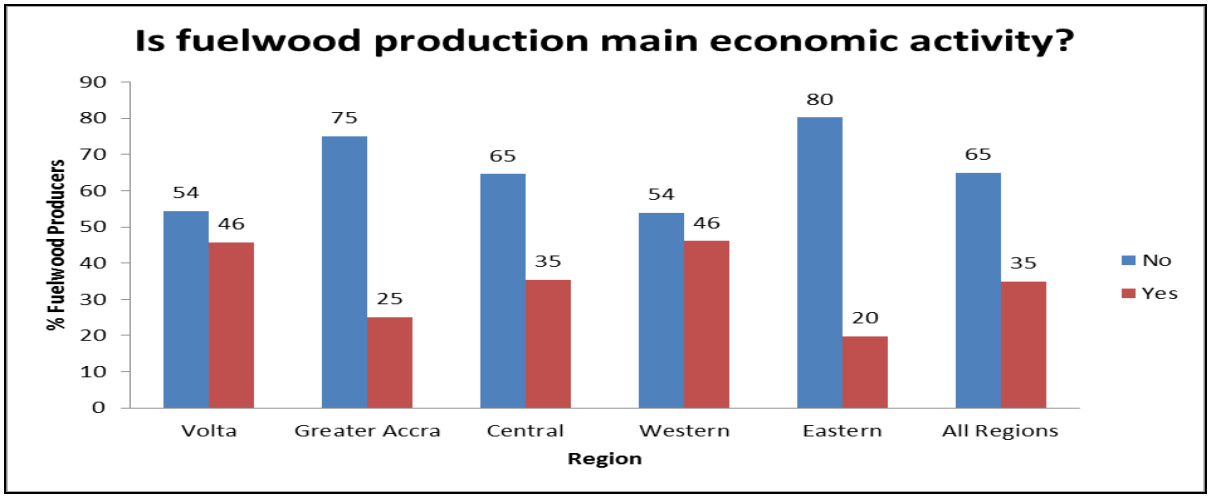


Figure 13 Dependency on fuelwood production for income

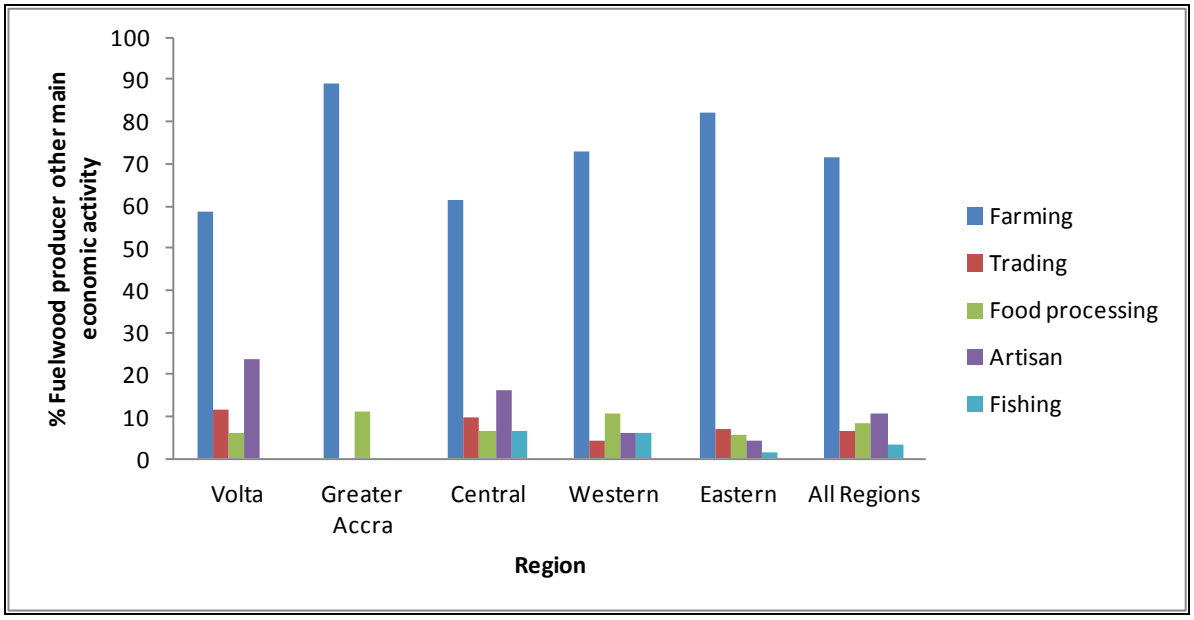


Figure 14 Other major income sources for fuelwood producers

4.2.2 Fuelwood production enterprise operations

- **Fuelwood production could be a households' life time job. Nearly 50% of fuelwood producers have been engaged in this enterprise for over 10 years (Figure 14). Overall, the number of years of experience is 13 across regions with the maximum of 50years in the Volta Region. Eighty percent of the producers were initiated into the business by their parents (Figure 15). With exception of the Greater Accra Region 27-96% of producers often engage from 3-6 people to assist in harvesting and processing of fuelwood for sale (Figure 16 and Table 8).**

Table 7 Number of years experience in fuelwood production business

Region	Mean	Min	Max	Std. Deviation	N
Volta	23	4	50	12.81	46

Greater Accra	10	1	30	10.40	12
Central	10	0.5	45	9.84	48
Western	11	0.2	46	10.18	89
Eastern	12	2	40	8.71	91
All Regions	**13**	**0.2**	**50**	**11.05**	**286**

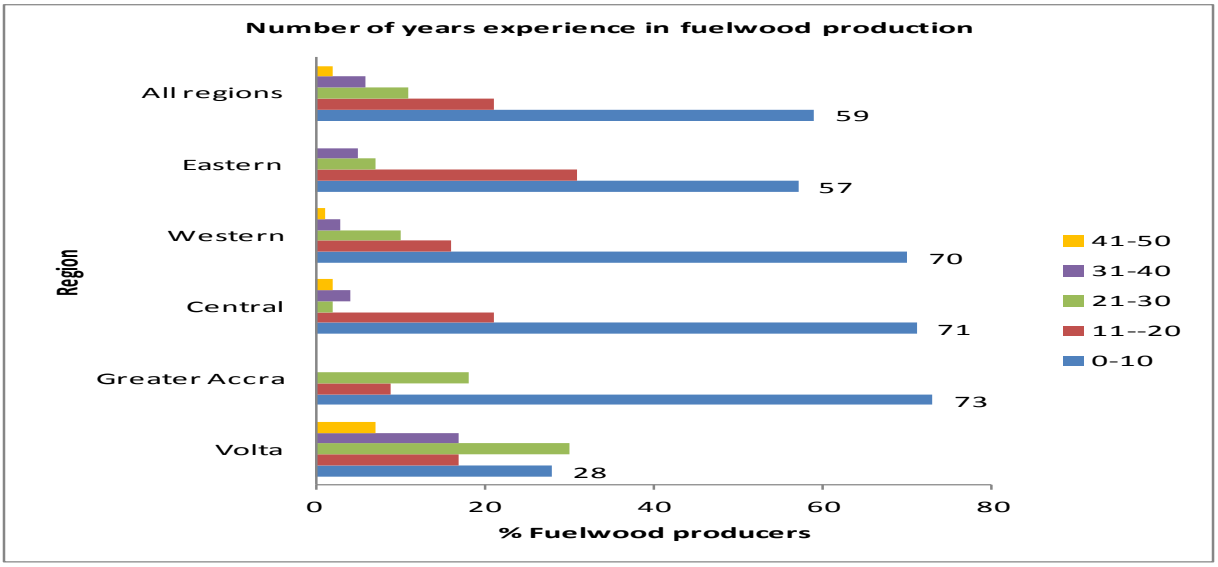


Figure 15 Number of years experience in fuelwood production

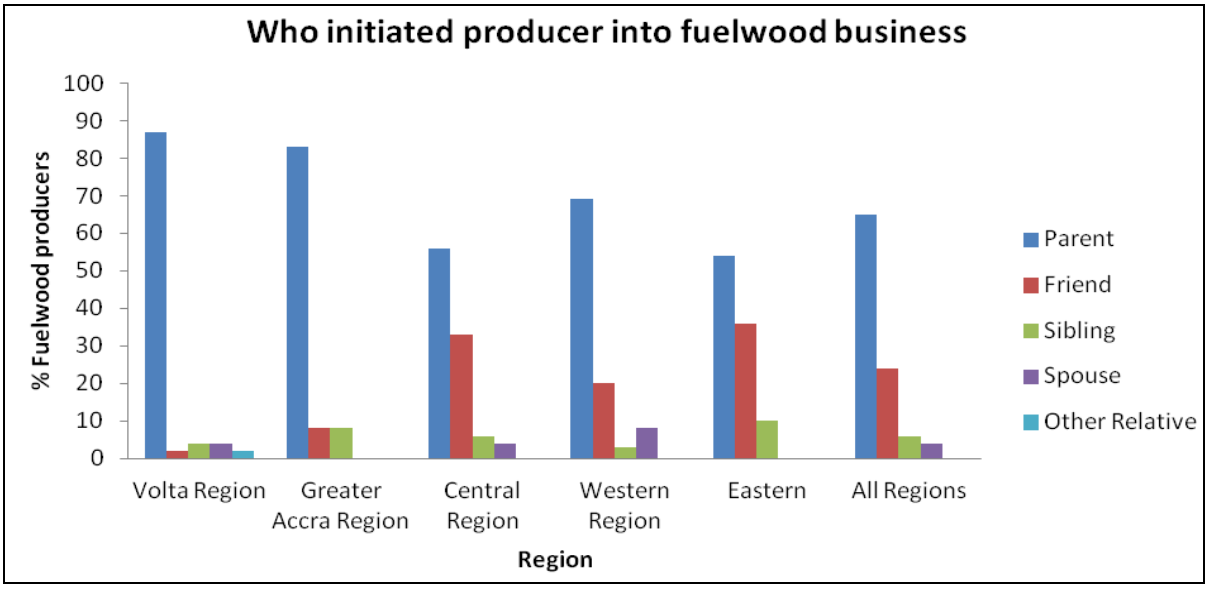
- 

Figure 16 Initiator of producer into fuelwood business

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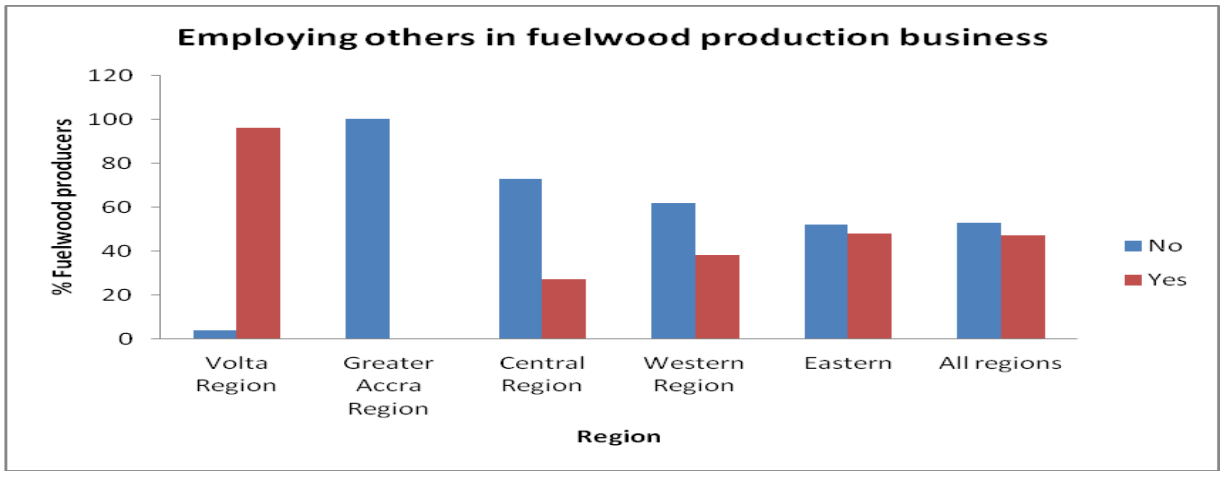

Figure 17 Employing others in fuelwood production business

Table 8 Number of assistants engaged by fuelwood producers

Region	Mean	Std. Deviation
Volta	5	2.95
Central	6	5.25
Western	3	2.07
Eastern	3	2.30

- **There are some producer associations in producing area particularly in Volta, Central, Western and Eastern Regions. However, over 80% of producers interviewed do not belong to any association.**

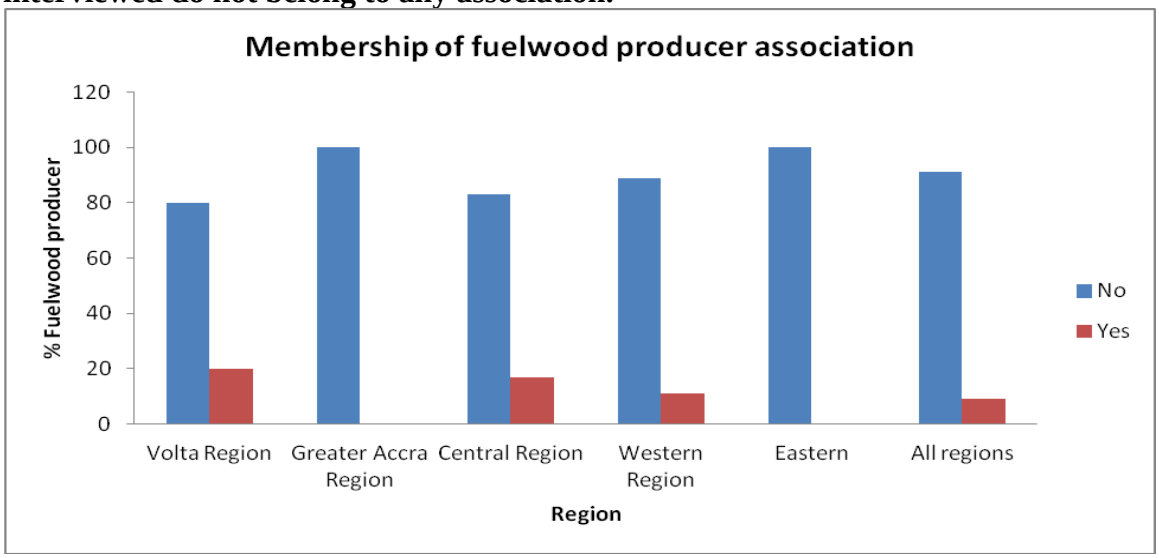

Figure 18 Membership of fuelwood producer association

4.2.3 Type of fuel wood produced

Two forms of fuelwood are produced for sale. It is either smaller diameter whole or split pieces tied in bundles or larger diameter cylindrical chunks often referred to as blocks (Plate 3). Overall, approximately 60% of fuelwood producers supply bundles particularly in Volta (91%), Greater Accra (67%) and Central (79%) Regions. Over 50% of the producers in the wet evergreen and moist semi-deciduous forests of the Western (52%) and Eastern (63%) regions produce both blocks and bundles (Figure 18).

Plate 3 Types/forms of fuelwood produced-assembled at production site for haulage

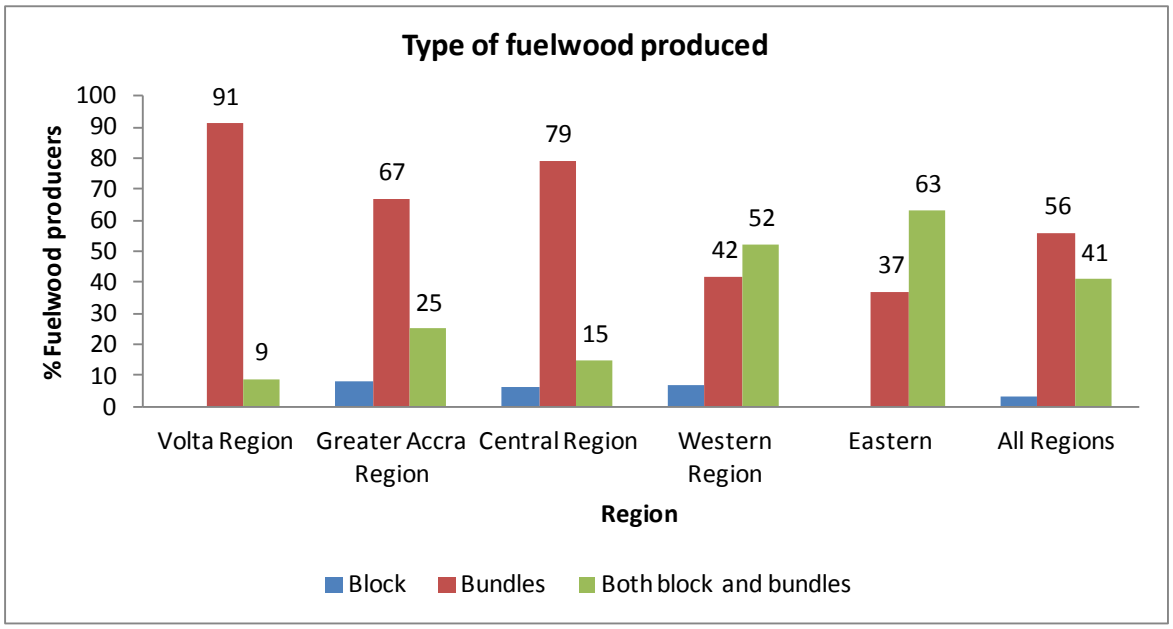

Figure 19 Proportion of producers supplying the different fuelwood types

Producers commonly supply fuelwood directly to clients from the areas of production. Direct supplies to fish smokers is common in all regions (60%), ranging from 65% in Volta to 85% in the Greater Accra Region. However, producers in the Eastern Region in 70% of the cases sell directly to transporters who act as middlemen delivering to traders or fish smokers in fishing communities (Figure 19). Thirty-five to 83% of producers indicated demand for fuelwood supplies may be high throughout the year particularly for those in the Greater Accra Region (Figure 20). On the contrary, 17% - 64% of producers from Greater Accra to Western Regions indicated that demand was rather seasonal and contingent upon availability of fish throughout the year. It is high during periods of abundance in fish catch during the major season and declines in the lean season.

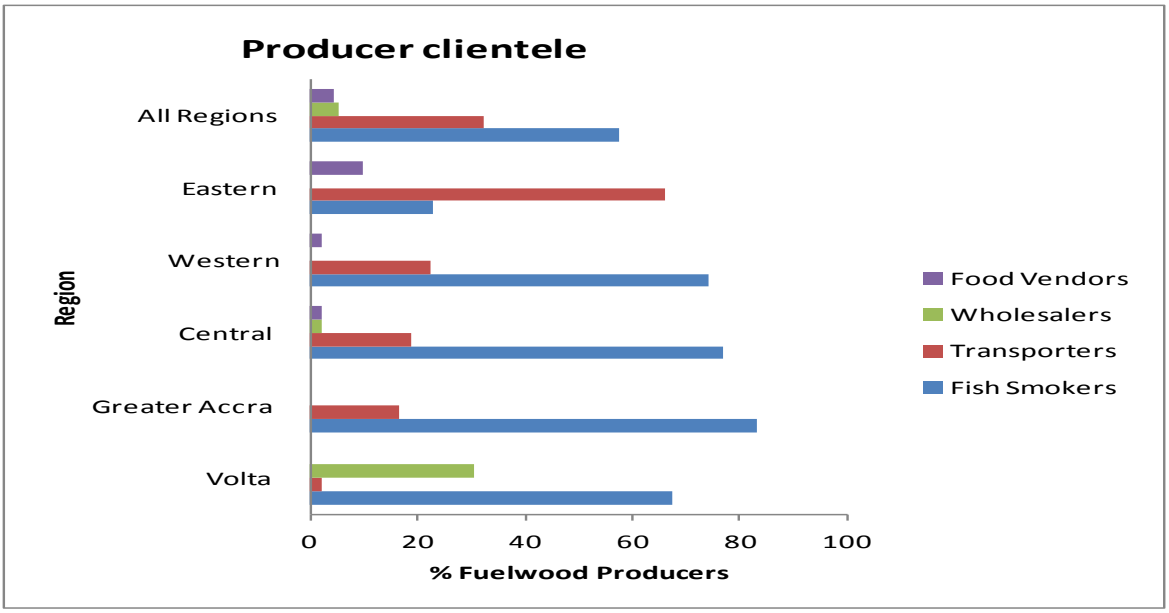

Figure 20 Clients producers supply with fuelwood

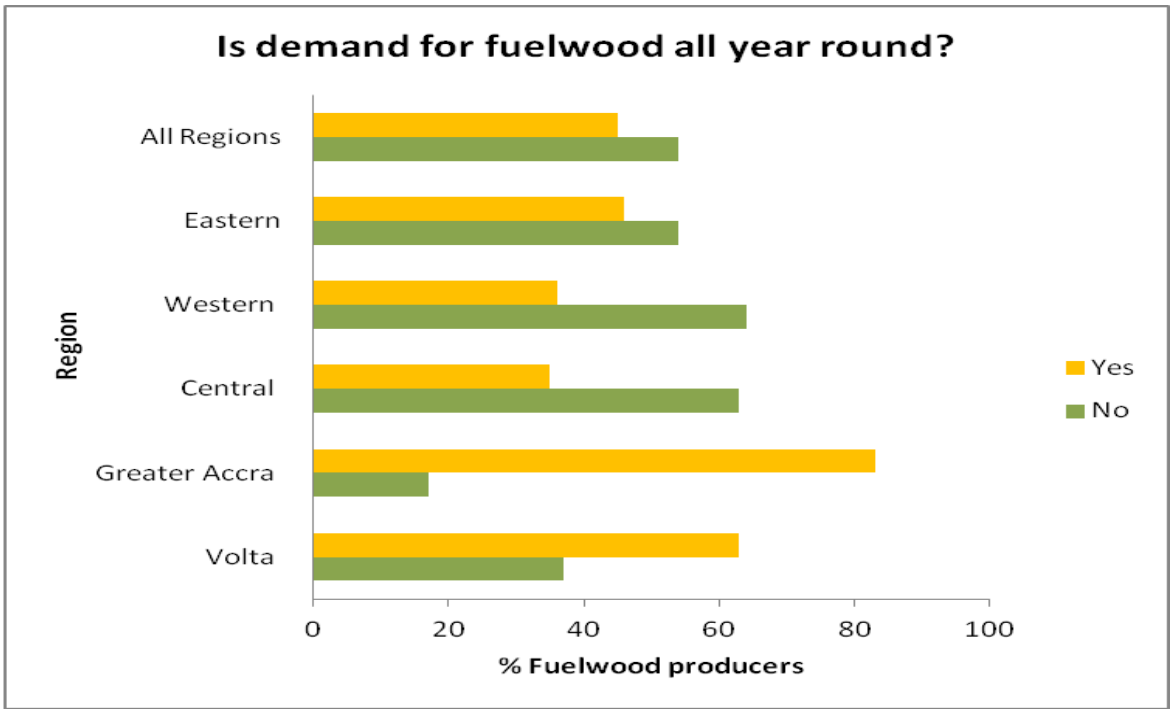

Figure 21 Producers perception of the status of demand for fuelwood throughout the year

4.2.4 Management of the fuelwood resource base

In developing countries, wood is collected for free and comes with no cost. The collection is mostly done from government and trust land which never reflect in government statistics (Mugo and Ong, 2006). Consequently, fuelwood resources were hardly sustainably managed especially in most parts of Africa.

In Ghana is collected from public and private forest lands in both reserved and off-reserve areas. While the management of reserved forests is strictly under the jurisdiction of the Forestry Commission, the management of forests in the off-reserve areas is by traditional land owning authorities and private landowners. The forestry commission has responsibility for monitoring and enforcing rules related to charcoal production on private lands, and plays a large role in regulating the transport of fuelwood beyond boundaries of every district. Taxes are collected at various stages in the value chain. Officially, the FC issues a permit at a fee for the collection of Non Timber Forest Products including fuelwood from reserved forest areas for commercial purposes. The conveyance of fuelwood beyond the boundaries of production areas is also taxed by the District Assembly at the forest gate on issuing of a waybill. Police and Customs officials at various check points and borders inspect waybills to ensure the authenticity of source of products during transportation en-route to market. Local district and metropolitan assemblies also collect tolls/levies on respective markets as well as at the retailing points but hardly ensure that resources are not over exploited.

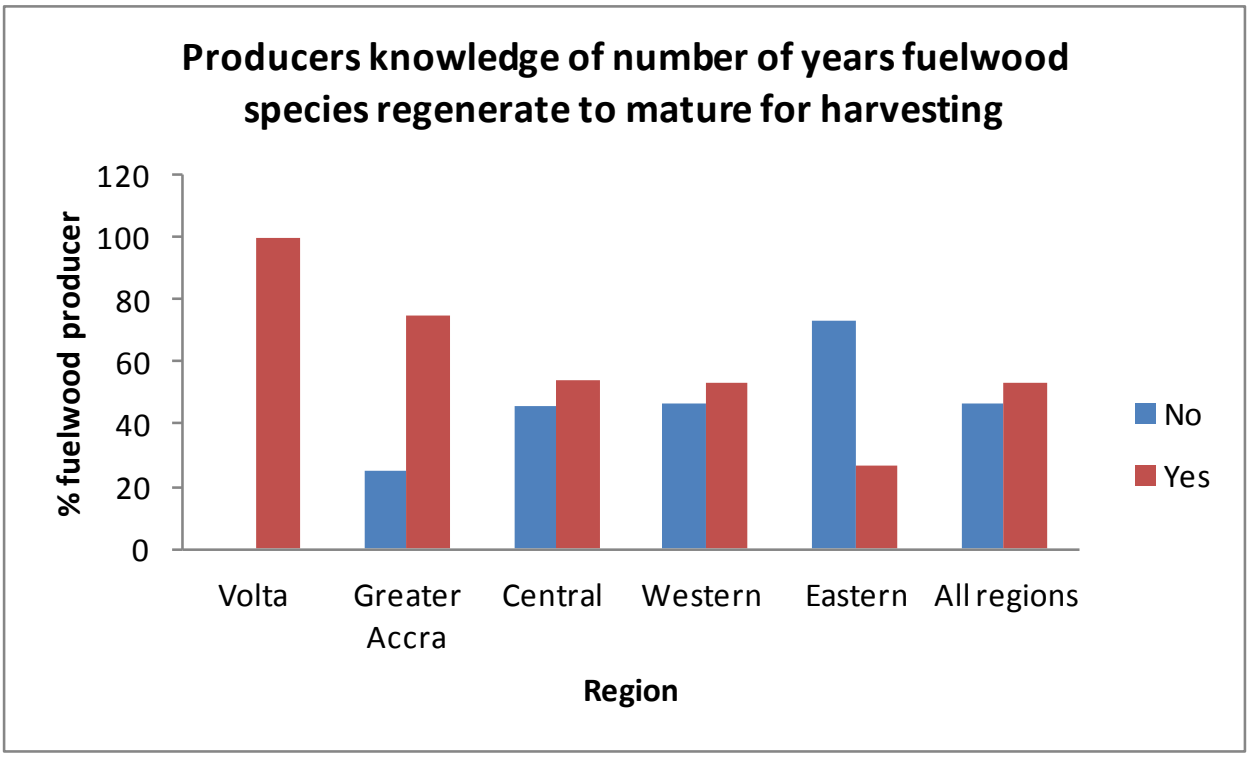

Figure 22 Producers claims on their knowledge on regeneration of fuelwood species

With exception of the Eastern Region, most producers are knowledgeable of the regeneration period for the fuelwood species they harvest for sale. Natural regeneration period of trees vary with species across regions. In Mangrove species in the Volta Region may take between 6-12 years to mature for harvest as fuelwood. In the Accra plains, coppice growth of neem

and that of Cassia in the Central coastal forest areas may take up to 2 years or more to mature for fuelwood (Table 9). However, natural regeneration is often not managed. This together with inappropriate methods for cutting of trees and wildfire incidence hamper coppice growth in stumps and ultimately reduce fuelwood availability.

Plate 4 Unmanaged coppice growth and natural regeneration in forest and mangrove stands

Table 9 Number of years species regenerate for harvesting

Region	Mean	Min	Max	Std Deviation	N
Volta	12	5	25	4.4	46
Greater Accra	2	1	2	0.5	9
Central	2	0.3	10	2.2	26
Western	4	0.2	50	7.4	45
Eastern	8	0.8	16	3.2	25
All regions	7	0.2	50	7.4	151

Overall 80% of producers interviewed acknowledged that fuelwood is readily available for harvesting (Figure 22). However, they might travel variable distances on average 5.3km (0.8-20km) across regions to harvest matured wood for fuelwood (Figure 23 and Table 10).

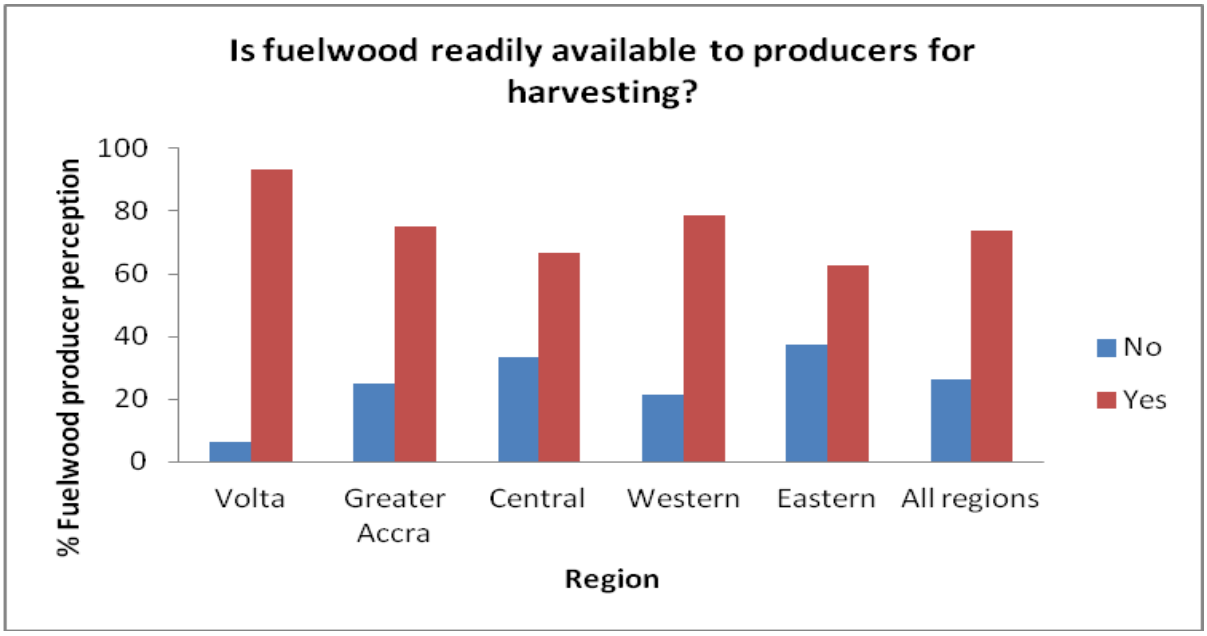

Figure 23 Producer perception of fuelwood availability

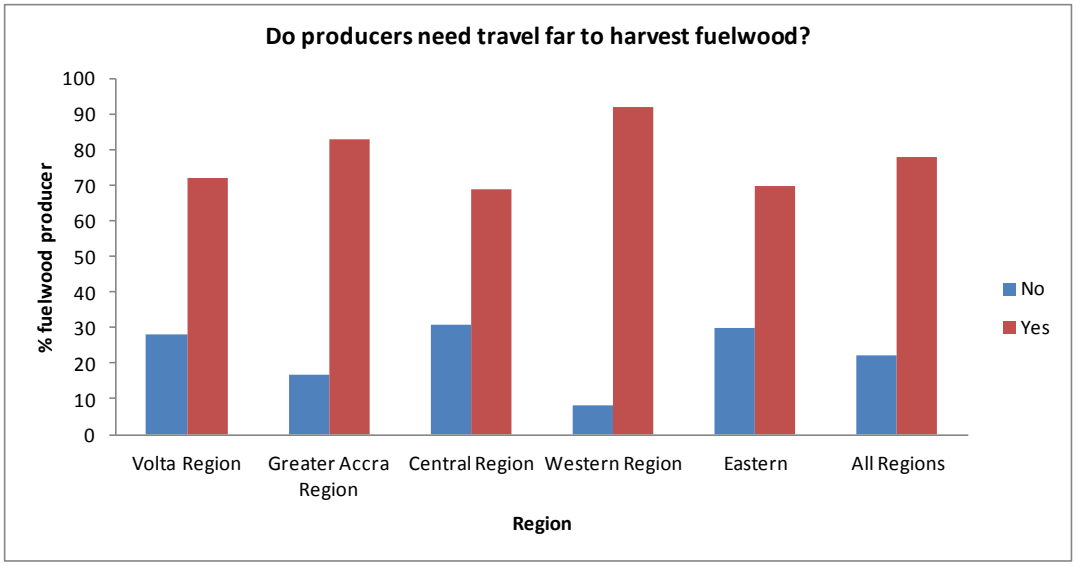

Figure 24 Producer claims on distance travelled to harvest fuelwood for sale

Table 10 Distance travelled to harvest fuelwood

Region	Mean (Km)	Min	Max	Std Deviation	N
Volta	4.9	1.60	20	3.5	32
Greater Accra	2.5	1.50	4	0.9	8
Central	3.9	0.80	16	3.0	31
Western	6.7	1.00	20	3.8	78
Eastern	4.8	0.80	16	3.2	60
All regions	5.3	0.80	20	3.6	209

In some cases fuelwood may not be readily available for harvesting. The principal cause may be declined stocks in natural stands especially in the Eastern and Central Regions (Figure 24).

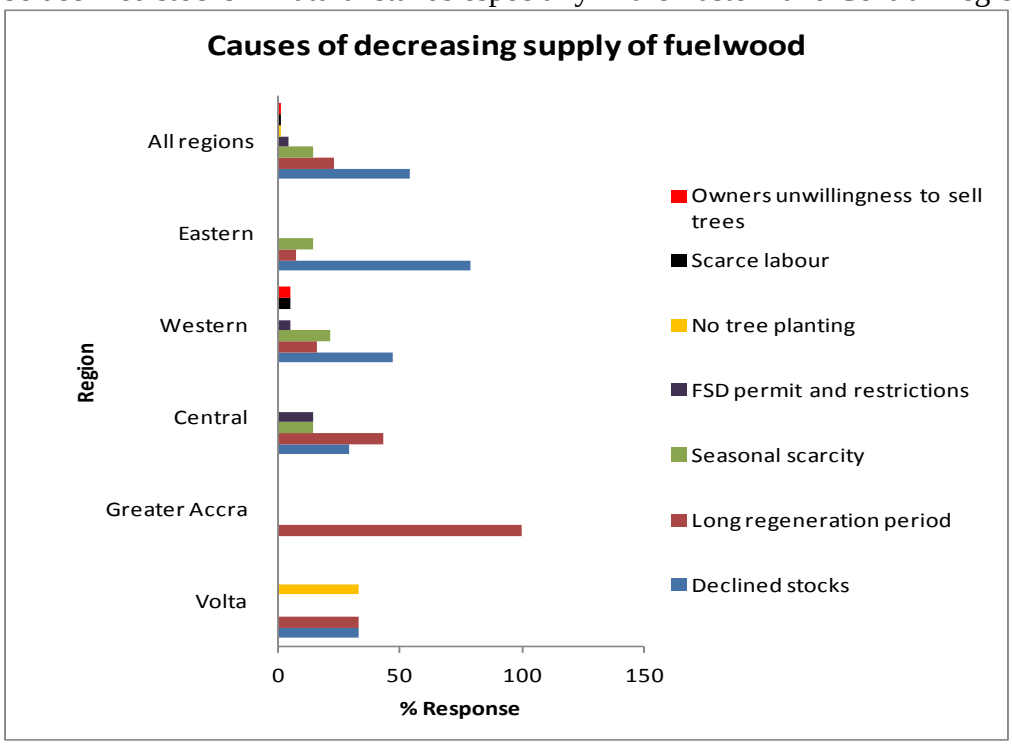

Figure 25 Producer perception of causes of decline in fuelwood resources

The long regeneration period of coppice growth especially for mangrove species in the Volta Region also reduce fuelwood availability. Obviously the frequency of cutting or harvesting is higher than regeneration rate in most areas. Fuelwood is harvested daily without replanting in natural stand. Other causes of fuelwood unavailability include seasonal deterioration of roads in harvesting sites during the rainy season that reduce frequency of harvesting and bureaucratic nature of permit acquisition for harvesting from the FSD.

4.2.5 Access to fuelwood resources

Seventy percent of producers interviewed do not own the fuelwood resource they harvest for sale particularly in the Western and Central Regions (Figure 25).

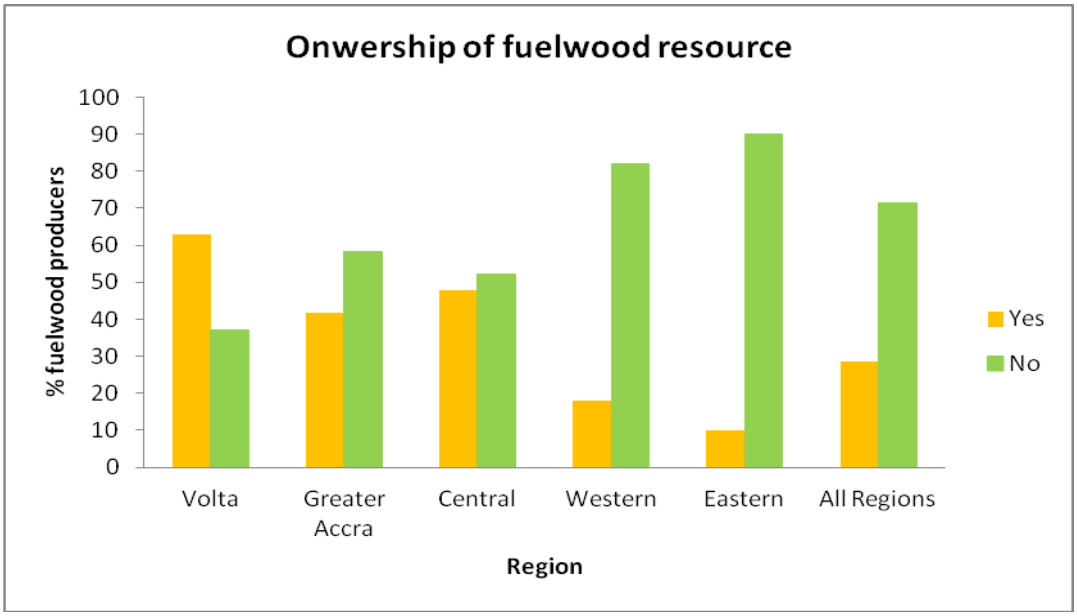

Figure 26 Ownership of fuelwood resource among producers

Individual harvesters with their own financial and labour resources engage in harvesting, collection and supply of fuelwood to the market or clients. Sometimes, the activity may be pre-financed by traders or fish smokers. Access to the resource is essentially by paying a fee to the landowner or the FSD.

4.2.6 HARVESTING/collection frequency and quantity harvested

During the major fishing season, usually from June/July to September/October when demand for fuelwood is high, producers harvest fuelwood for sale for an average of eight times across regions with a minimum of 1 to maximum of 90 times during the period (Table 11).

Table 11 Frequency of harvest during the major fish season

• Region	• Mean	• Minimum	• Maximum	• Std. Deviation
• Volta	• 8	• 3	• 20	• 5.3
• Greater Accra	• 4	• 2	• 6	• 2.0
• Central	• 16	• 1	• 90	• 27.0
• Western	• 16	• 7	• 80	• 15.0
• Eastern	• 10	• 1	• 28	• 7.3
• Combine	• 8	• 1	• 90	• 12.8

Fuelwood production/harvesting is most frequent in the Central and Western Regions. Frequency of harvesting for sale obviously reduces during the minor fish season, however, this could be 4-7 times in the Eastern and Western Regions on average to a maximum of 30 times in the Western Region (Table 12). The reason for the disparity in the intensity of

harvesting among the regions is not clear. However, since the demand for fuelwood is dictated by fish availability, it may be due to higher quantities of fish smoked, particularly frozen fish in the Western Region during the lean season than the other 3 regions.

Table 12 Frequency of fuelwood harvest during the minor fish season

• Region	• Mean	• Minimum	• Maximum	• Std. Deviation
• Volta	• 2	• 1	• 6	• 1.86
• Greater Accra	• 2	• 1	• 2	• 0.71
• Central	• 2	• 1	• 3	• 0.79
• Western	• 7	• 1	• 30	• 7.18
• Eastern	• 4	• 1	• 13	• 3.15
• Combine	• 4	• 1	• 30	• 4.98

4.2.7 Land use systems exploited for fuelwood

Generally, fuelwood used for smoking fish and for other food enterprises in the coastal and forest districts surveyed are secured from four main land use systems as follows:

- Plantations –Mangrove, cassia, neem, acacia
- Natural forests – on and off reserves
- Farmlands (including fallow lands)
- Natural mangrove stands

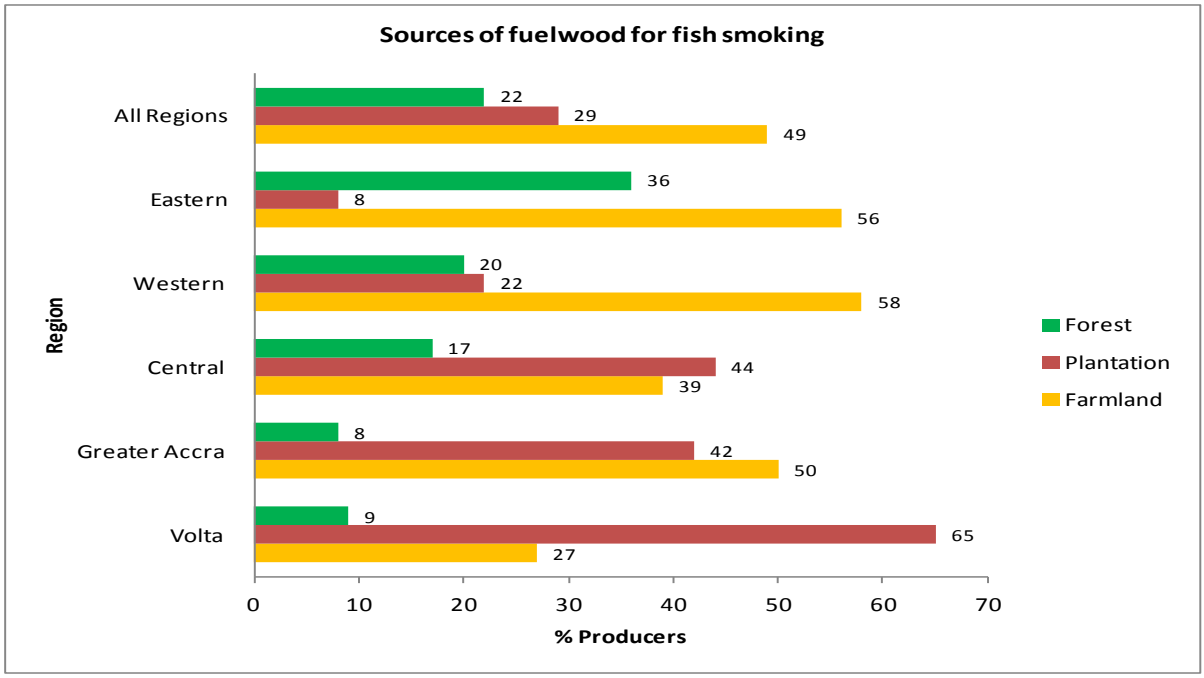

Figure 27 Proportion of producers indicating sources of fuelwood harvested

The major source of fuelwood for fish smoking is farmland, usually consisting of wood from clearing agricultural land as well as standing trees on fallows lands. Overall, 49% of the producers acquire fuelwood from farmlands, 29% from plantations and 22% from natural forests stands on or off reserves. The 65% plantation source in the Volta Region is mainly

from mangroves while the 42% source in the Greater Accra is largely from neem and the 44% in the Central /Region from Cassia, neem and acacia plantations. The main plantation sources for the Western Region are from spent/old rubber trees particularly from the farms of the Ghana Rubber Estates Company, while the 8% plantation source in the Eastern Region is from spent cocoa and orange/citrus plantations (Figure 26). The mean size of plantation is 10 acres, ranging from 0.5 -100 acres (Table 13). Western and Eastern Regions abounds in natural forests, hence, these are also significant sources (i.e. 22% and 36% respectively) of fuelwood for fish smoking.

Table 13Mean size of fuelwood plantation owned for all regions combined

All regions		Size of Fuelwood plantation owned (acres)			Std. Deviation
	N	Mean	Minimum	Maximum	
	85	9.56	0.5	100	16.2

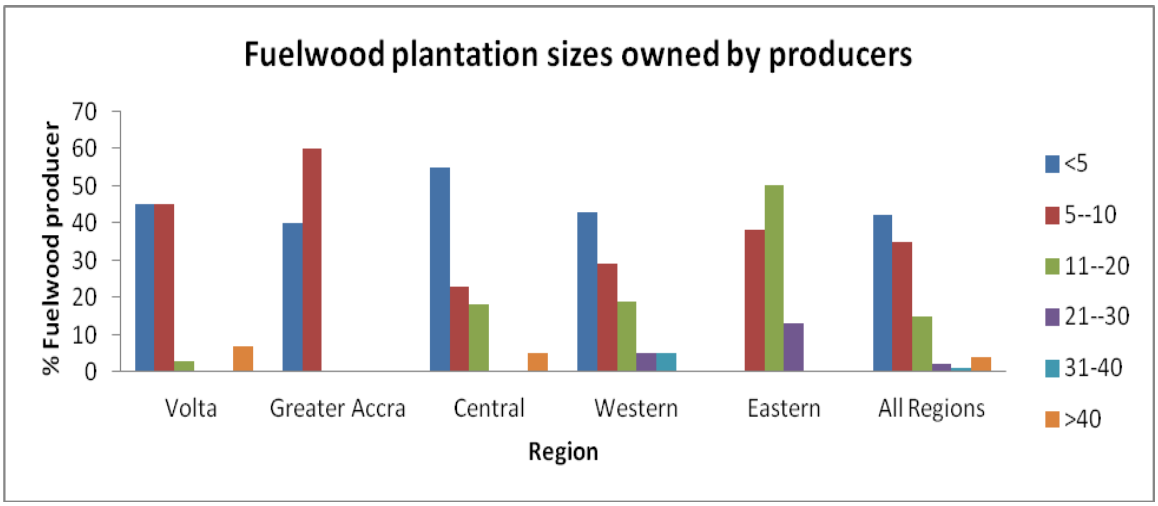

Figure 28 Fuelwood plantation sizes owned

4.2.8 Regulations/controls on accessing fuelwood for harvesting and passage to market

Usually, a permit has to be acquired from the Forest Service Division's forest district offices located in appropriate district capitals in the Western, Central and Eastern Regions before harvesting/collection of firewood for commercial purposes in particularly forest reserves. Officially although harvesting of fuelwood is mainly from farmlands including fallows in the off-reserve areas or private lands, a permit is also required from the FSD for commercial extraction. However, Figure 29 indicates that permit is hardly sought for harvesting. This is either because producers lack knowledge on this procedure for off-reserve areas or it might be due the cumbersome procedure and cost involved in permit acquisition. Variable sums are paid for an acre of fuelwood purchased from land and farm owners. GHC250-550 for mangrove in the Volta Region; GHC 40-2000 in the Western Region and GHC 100-300 per acre in the Eastern Region. Indeed there are times that landowners request for fuelwood on their farmlands to be harvested to make room for farming. In these cases the harvester or

collector may seek permission and engage paid labour to collect and process the fuelwood for the market. According to producers transporting of fuelwood to the market or clients in consuming areas could be tedious and goods could be impounded without a permit. In some cases some fees may be paid for a way bill at District Assembly revenue points situated at exit points of villages/towns at the farm gate where the fuelwood is being transported.

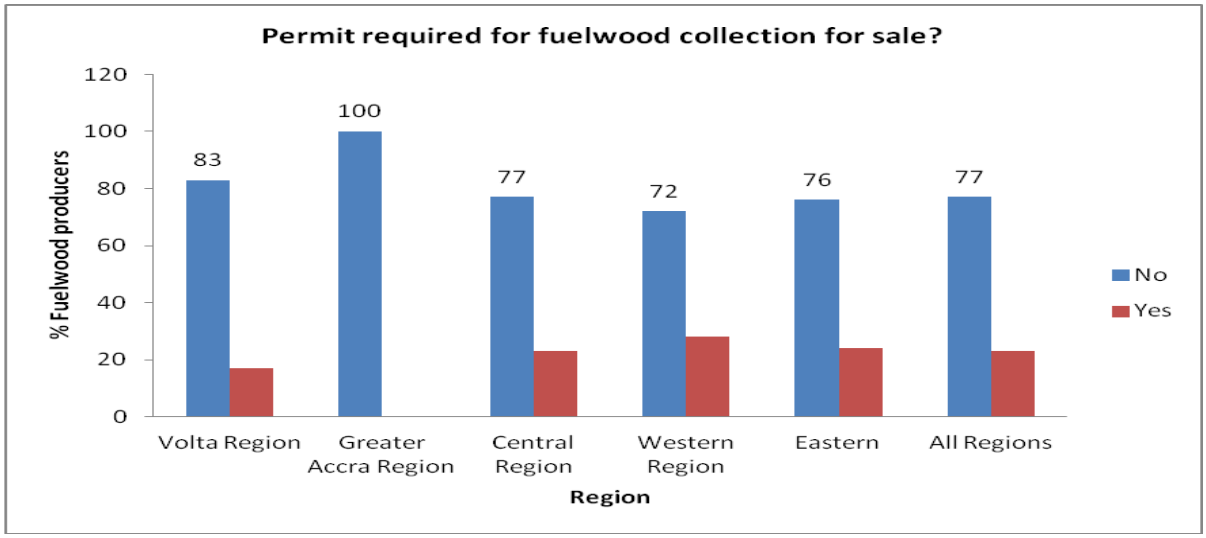

Figure 29 Requisition for permit to harvest fuelwood for sale

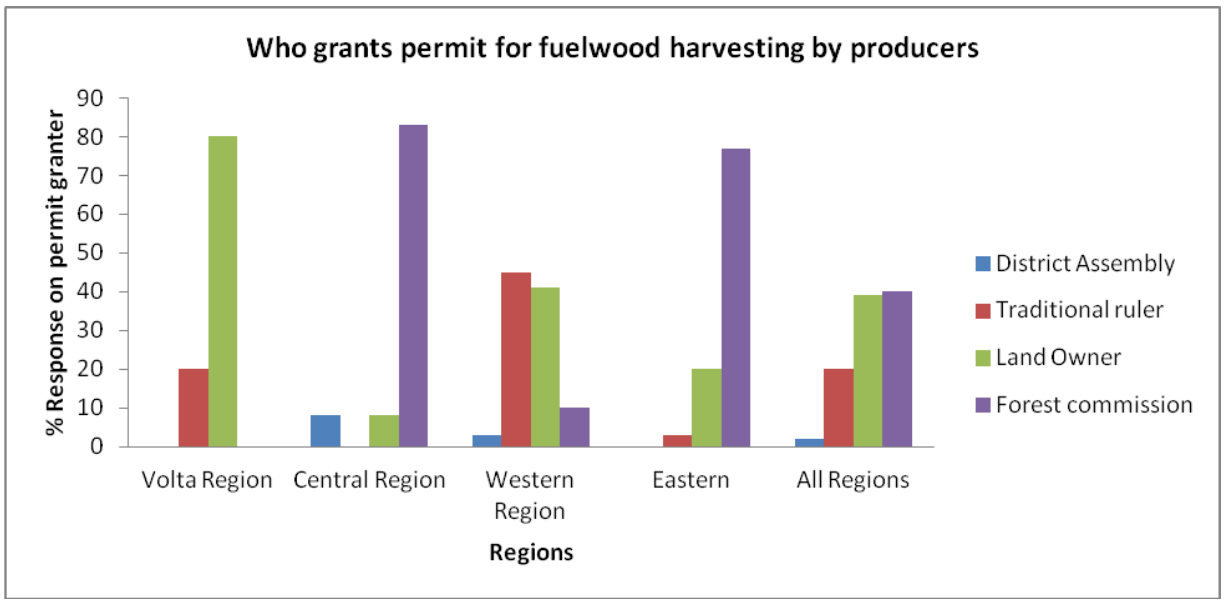

Figure 30 Who grants permit for fuelwood harvesting

The standard procedure issued by the FSD for acquiring legal access for harvesting/collecting commercial quantities of rattan from the Government forest reserves is as follows:

I. Prospective collector/harvester first identifies the area for collection
II. Application for permit addressed to the District Forest Officer is filed
III. Verification of availability of fuelwood at the proposed area/site by Forestry Department (FSD) staff

IV. Request approved upon satisfactory report from inspection of site
V. Payment of royalty/permit fee by successful applicant.
VI. Permit with a validity period of a day per specified quantity is issued after payment of royalty fee
VII. Firewood collection or harvesting is done under supervision of FSD staff
VIII. Conveyance certificate (waybill) is issued at a cost of GH¢25 with a validity period of three days before transporting collected fuelwood to its destination

4.2.9 Fuelwood species harvested and preferences

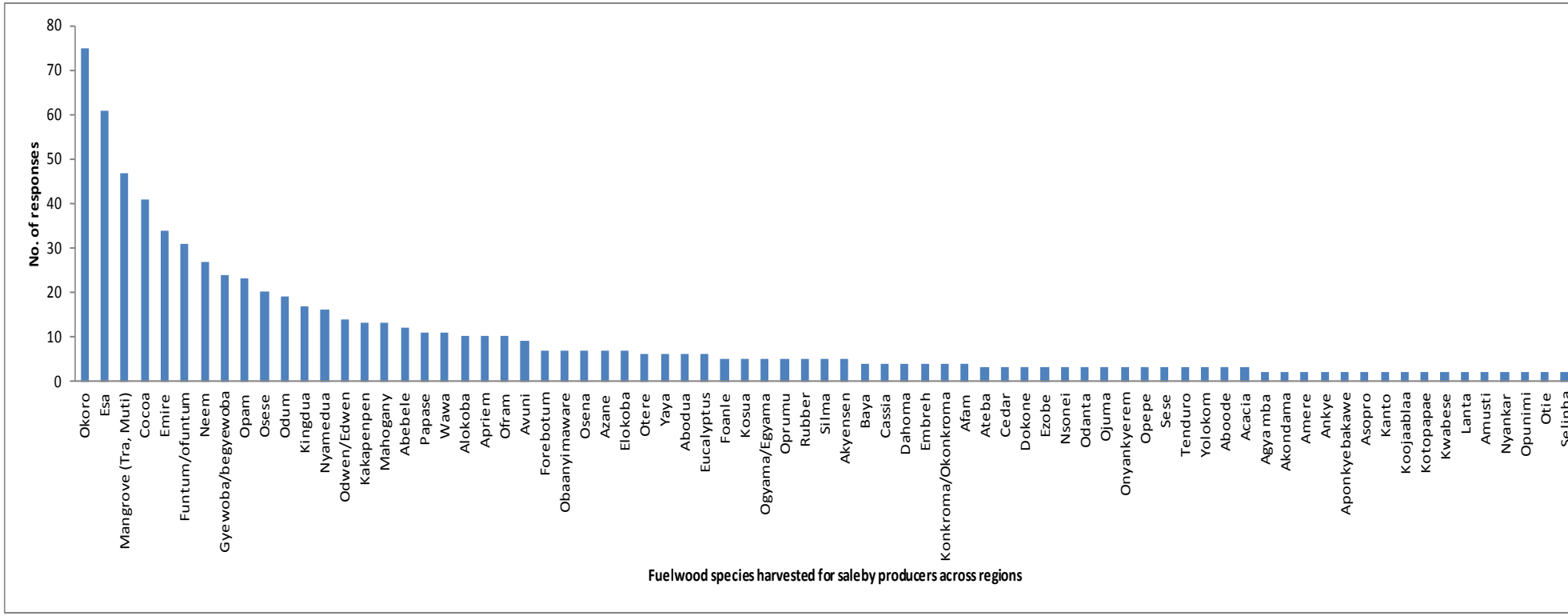

Figure 31 Fuelwood species harvested for sale across regions

Fuelwood producers usually harvest more than one tree species for sale except those in the Volta Region where mangrove is the dominant species harvested. Figure 30 shows the range of fuelwood species generally harvested for sale. Seventy species (most not indentified) are harvested with 20 most frequently harvested. Table 14 shows the regional variation in preferences of the species produced for the fish smoking industry. Overall Albizia zygia (Okoro), Celtis mildbraedii (Esa), cocoa, and Termianlia ivorensis (Emire) are the most frequently harvested species particularly from the moist semi-deciduous forest in the Eastern Region. Celtis mildbraedii (Esa) is also commonly harvested)in the Central Region, Funtumia elastica (Funtum) in the Western Region, while Azadirachta indica (Neem) is the most available in the Accra plains harvested for supply and fish smoking.

Table 14 Species harvested for sale by fuelwood producers

No.	Species		Frequency of response on species harvested for sale by producer					
	Local name	**Scientific name**	Volta	Greater Accra	Central	Western	Eastern	Total
1	Okoro	*Albizia zygia*	-	-	7	5	63	75
2	Esa	*Celtis mildbraedii*	-	-	16	9	36	61
3	Mangrove (Tra, Amuti)	*Mangrove spp.*	48	2	-	-	-	50
4	Cocoa	*Theobroma cacao*	-	-	6	4	31	41
5	Emire	*Terminalia ivorensis*	-	-	-	5	29	34
6	Funtum/ofuntum	*Funtumia elastica*	-	-	4	19	8	31
7	Neem	*Azadirachta indica*	-	11	9	-	7	27
8	Gyewoba/begyewoba	-	-	-	8	-	16	24
9	Opam	-	-	-	-	15	8	23
10	Osese	-	-	-	-	-	20	20
11	Odum	*Milicia excelsa*	-	-	-	3	16	19
12	Kingdua	-	-	-	2	-	15	17
13	Odwen/Edwen	-	-	-	10	2	4	16
14	Nyamedua	*Alstonia boonei*	-	-	-	-	14	14
15	Kakapenpen	*Rauvolfia vomitoria*	-	-	-	-	13	13
16	Mahogany	*Khaya spp*	-	-	-	-	13	13

17	Abebele	-	-	-	-	12	-	12
18	Papase	-	-	-	-	11	-	11
19	Wawa	*Triplochiton scleroxylon*	-	-	-	3	8	11
20	Alokoba	-	-	-	-	10	-	10
21	Apriem	-	-	-	-	10	-	10
22	Ofram	*Terminalia superba*	-	-	3	2	5	10
23	Avuni	-	-	-	-	9	-	9
24	Forebotum	-	-	-	-	7	-	7
25	Obaanyima ware	-	-	-	-	3	4	7
26	Osena	-	-	-	7	-	-	7
27	Ogyama/Egyama	-	-	-	2	2	3	7
28	Opunimi	*Radophyllum caloph*	-	-	-	7	-	7
29	Azane	-	-	-	-	6	-	6
30	Elokoba	-	-	-	-	6	-	6
31	Otere	-	-	-	-	-	6	6
32	Yaya	*Amphimas pterocarpoides*	-	-	-	3	3	6
33	Abodua	-	-	-	5	-	-	5
34	Eucalyptus	-	-	-	5	-	-	5
35	Foanle	-	-	-	-	5	-	5
36	Kosua	-	-	-	-	5	-	5
37	Oprumu	-	-	-	-	5	-	5
38	Rubber	*Hevea brasiliensis*	-	-	-	5	-	5

39	Silma	-	-	-	-	5	-	5
40	Akyensen	-	-	-	4	-	-	4
41	Baya	-	-	-	-	4	-	4
42	Cassia	-	-	-	4	-	-	4
43	Dahoma	-	-	-	-	4	-	4
44	Embreh	-	-	-	4	-	-	4
45	Konkroma/ Okonkroma	*Morida lucida*	-	-	-	-	4	4
46	Afam	-	-	-	-	3	-	3
47	Ateba	-	-	-	-	3	-	3
48	Cedar	*Cedrela odorata*	-	-	-	-	3	3
49	Dokone	-	-	-	-	3	-	3
50	Ezobe	-	-	-	-	3	-	3
51	Nsonei	-	-	-	-	3	-	3
52	Odanta	*Nesigordina papaverifera*	-	-	-	-	3	3
53	Ojuma	-	-	-	-	3	-	3
54	Onyankyerem	*Ficus spp.*	-	-	-	3	-	3
55	Opepe	-	-	-	-	3	-	3
56	Sese	*Holarrhena floribunda*	-	-	3	-	-	3
57	Tenduro	*Trichilia manadelpha*	-	-	-	3	-	3
58	Yolokom	-	-	-	-	3	-	3
59	Aboode	-	-	-	2	-	-	2
60	Acacia	*Acacia spp.*	-	-	2	-	-	2
6	Agya mba	-	-	-	-	2	-	2

1								
62	Akondama	-	-	-	-	2	-	2
63	Amere	-	-	-	-	-	2	2
64	Ankye	*Blighia sapida*	-	-	-	-	2	2
65	Aponkyeba kawe	-	-	-	2	-	-	2
66	Asopro	-	-	-	-	2	-	2
67	Kanto	-	-	-	2	-	-	2
68	Koojaablaa	-	-	-	-	2	-	2
69	Kotopapae	-	-	-	-	2	-	2
70	Kwabese	-	-	-	-	-	2	2
71	Lanta	-	-	-	-	-	2	2
72	Nyankar	-	-	-	-	2	-	2
73	Otie	*Pycnanthus angolensis*	-	-	-	2	-	2
74	Selinha	-	-	-	-	2	-	2
75	Mutuku	-	-	1	-	-	-	1

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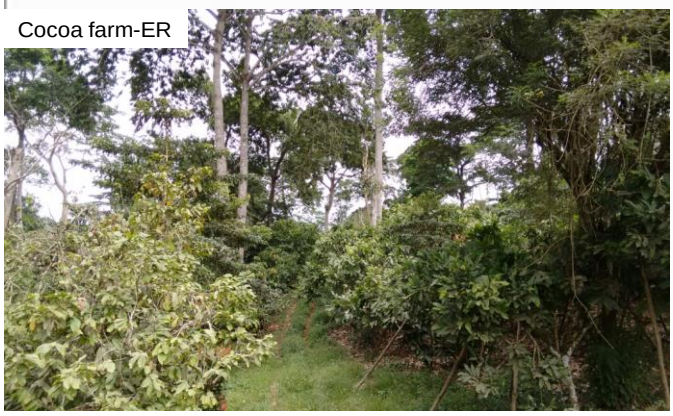

Plate 5 (above): Key fuelwood species and regions used for the fish smoking

Plate 6 (below): Sources of fuelwood in various land use types

4.2.10 FUELWOOD harvesting, processing, packaging and distribution

Harvesting of fuelwood is done manually with the machete or cutlass of chainsaw. Trunks or stems of bigger diameter trees as well as saplings are cut or felled and sized by cutting into pieces. Smaller diameter stems are packed into bundles/head loads of variable numbers for transport to market and fish processing centres. The number of stems in a bundle varies with species. The bigger log pieces are further split using an axe or chainsaw, bundled for delivery of delivered in chunks to clients.

Due to problems of vehicle inaccessibility, the bundles are carried by the head first to an assembly point, usually near an access road or major routes before they are loaded onto trucks for their destinations (Figure 32). Where access is relatively good, the bundles or pieces of logs are heaped at an appropriate point in the forest for direct loading by trucks. In some cases the bundles are assembled at the homes of the producer or harvester/collector before transporting to points of sale.

Most producers engage in primary processing of the standing trees or off-cuts they harvest before selling to clients (Figure 31). The primary processing usually entails cutting and sizing of the wood into shorter stems for bundling into units/pieces using a cutlass. In the case of large tree trunks, chainsaw may be used to saw the trunk into units usually called blocks. In the Eastern region the blocks are splits into smaller units and tied into bundles for sale or delivery to clients.

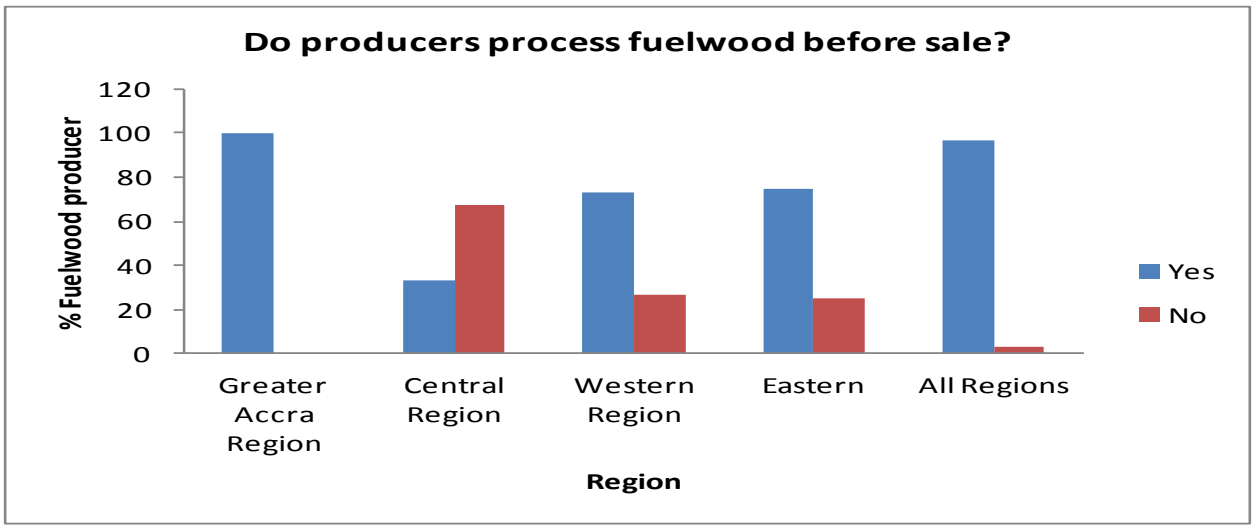

Figure 32 Percent distribution of producers processing fuelwood before sale

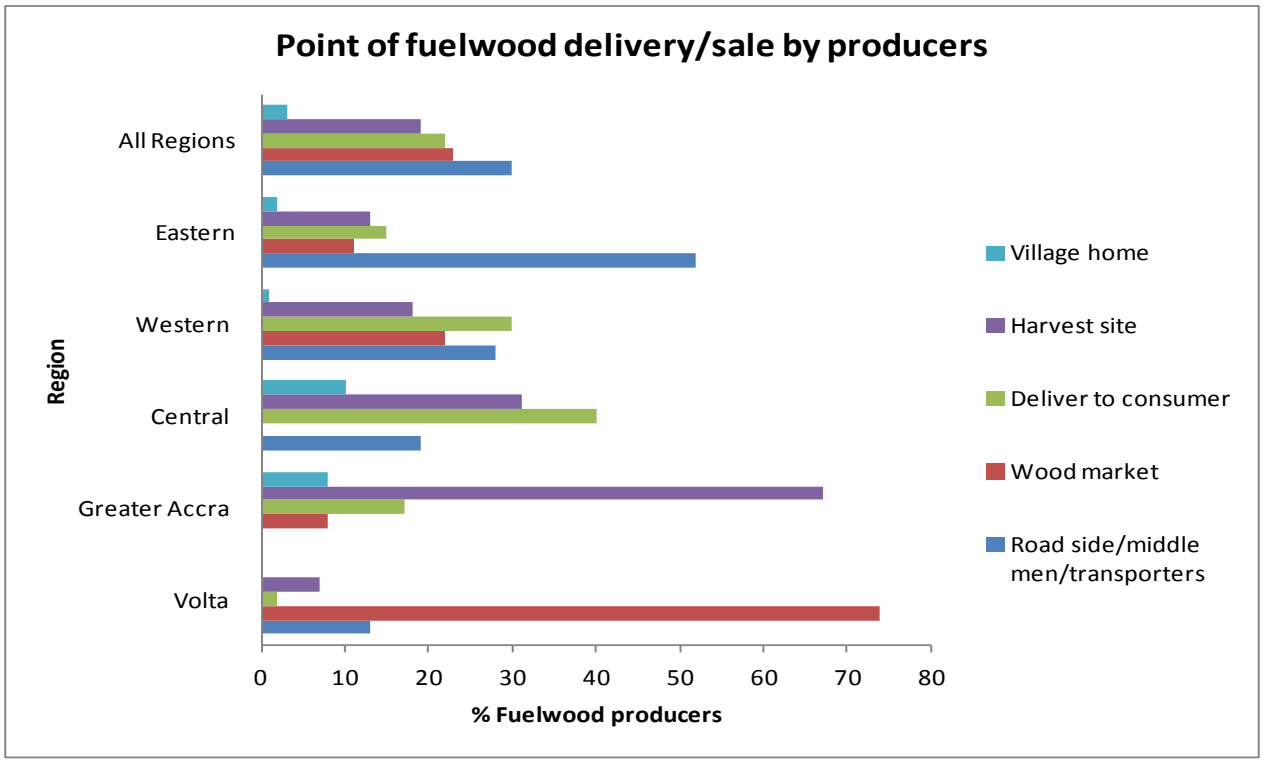

Figure 33 Producer fuelwood sale/delivery points

4.2.11 Constraints in fuelwood production and remedial measures

Twenty problems were reported to constrain fuelwood production (Figure 33 and Table 15). The most frequently reported constraints include inadequate capital to finance production operations and the highly risky nature of the fuelwood harvesting process with attacks from insects, snakes, bees as well as injuries and accidents incurred in the production process.
Fuelwood producers suggest provisions of loans and a range of material incentive for alleviating fuelwood production constraints (Figure 34 and Table 16).

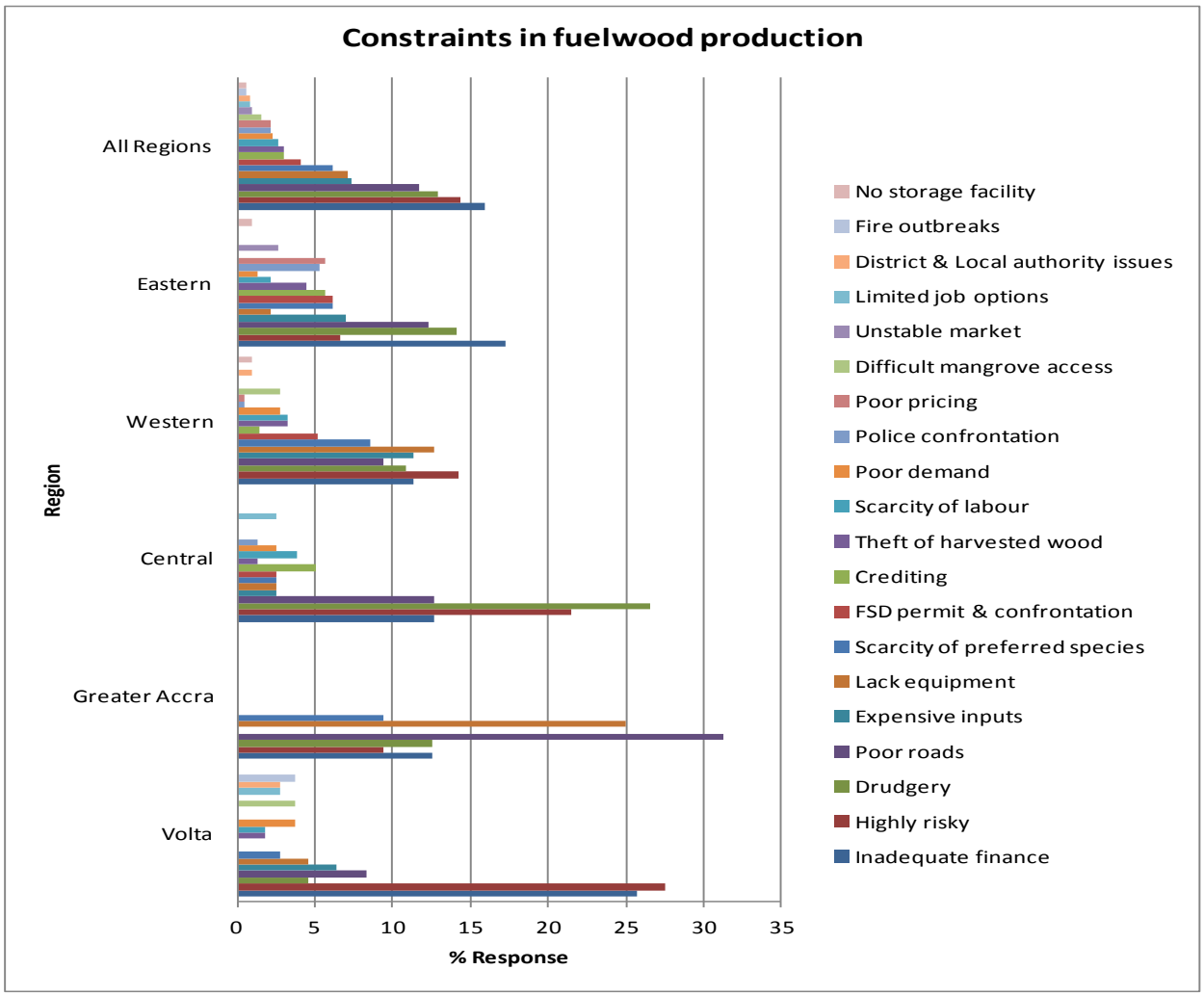

Figure 34 Constraints encountered in fuelwood production

Table 15 Constraints in fuelwood production

No.	Problem	Volta	Greater Accra	Central	Western	Eastern	All Regions
1	Inadequate finance	25.7	12.5	12.7	11.3	17.2	15.9
2	Highly risky job	27.5	9.4	21.5	14.2	6.6	14.4
3	Drudgery	4.6	12.5	26.6	10.8	14.1	12.9
4	Poor roads	8.3	31.3	12.7	9.4	12.3	11.7
5	Expensive inputs	6.4	-	2.5	11.3	7.0	7.4
6	Lack of equipment	4.6	25	2.5	12.7	2.2	7.1
7	Scarcity of preferred fuelwood species	2.8	9.4	2.5	8.5	6.2	6.1
8	FSD permit & confrontation	-	-	2.5	5.2	6.2	4.1
9	Crediting of fuelwood supplied	-	-	5.1	1.4	5.7	3.0

10	Theft of harvested wood	1.8	-	1.3	3.3	4.4	3.0
11	Scarcity of labour	1.8	-	3.8	3.3	2.2	2.6
12	Poor seasonal demand	3.7	-	2.5	2.8	1.3	2.3
13	Police confrontation	-	-	1.3	0.5	5.3	2.1
14	Poor pricing	-	-	-	0.5	5.7	2.1
15	Difficult mangrove access	3.7	-	-	2.8	-	1.5
16	Unstable market	0	-	-	-	2.6	0.9
17	Limited job options in producing communities	2.8	-	2.5	-	-	0.8
18	District & Local authority confrontations	2.8	-	-	0.9	-	0.8
19	Wildfire fire outbreaks	3.7	-	-	-	-	0.6
20	No storage facility	-	-	-	0.9	0.9	0.6

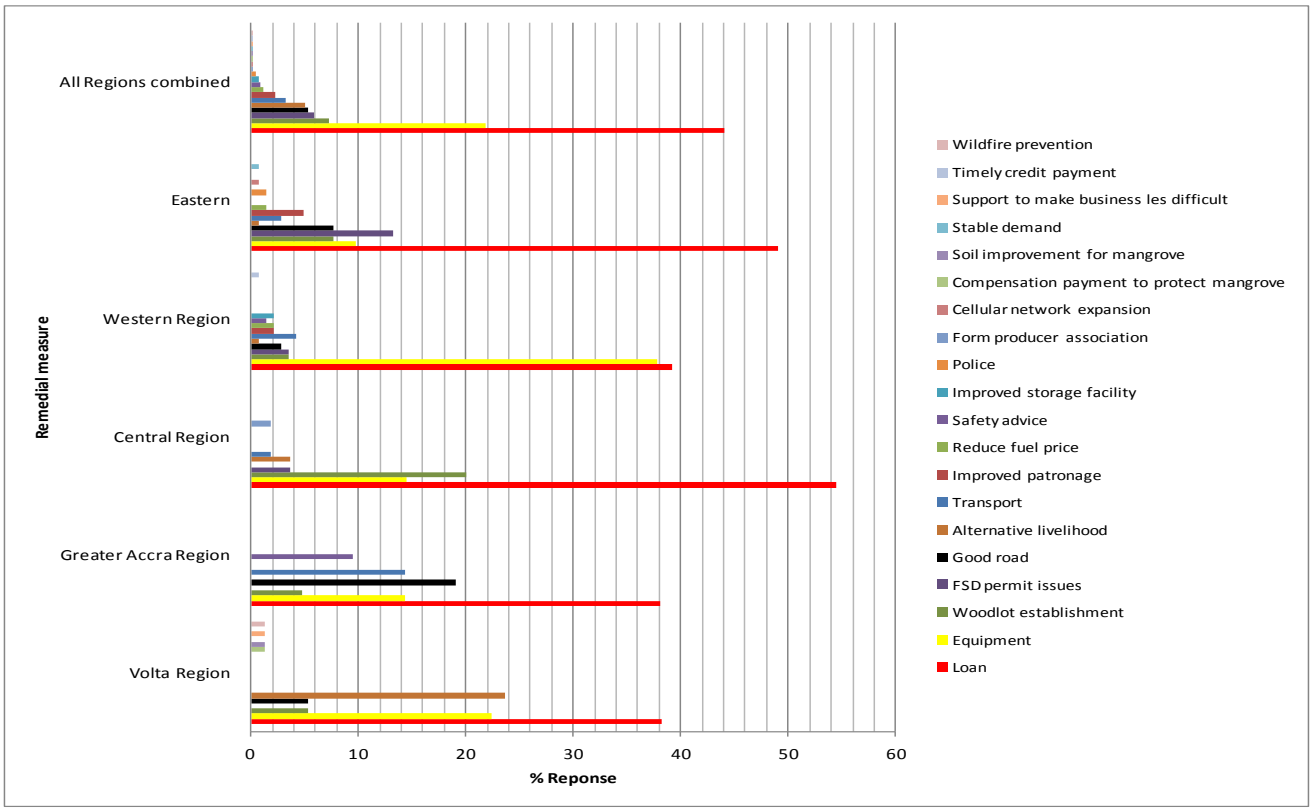

Figure 35 Measures fuelwood producers suggested for alleviating production constraints

Table 16 Measures suggested for alleviating fuelwood production constraints

No.	Remedial measure	% Response					
		Volta Region	Greater Accra Region	Central Region	Western Region	Eastern	All Regions combined
1	Loan	38.2	38.1	54.5	39.2	49	44.1
2	Equipment	22.4	14.3	14.5	37.8	9.8	21.9
3	Woodlot establishment	5.3	4.8	20	3.5	7.7	7.3
4	FSD permit issues	-	-	3.6	3.5	13.3	5.9
5	Good road	5.3	19		2.8	7.7	5.3
6	Alternative livelihoods	23.7	-	3.6	0.7	0.7	5.0
7	Transport	-	14.3	1.8	4.2	2.8	3.2
8	Improved patronage	-	-	-	2.1	4.9	2.3
9	Reduce fuel price	-	-	-	2.1	1.4	1.1
10	Safety advice	-	9.5	-	1.4	-	0.9
11	provide storage facility	-	-	-	2.1	-	0.7
12	Police advised to stop extortion	-	-		-	1.4	0.5
13	Form producer association	-	-	1.8	-		0.2
14	Cellular network expansion	-	-	-	-	0.7	0.2
15	Compensation payment to protect mangrove	1.3	-	-	-	-	0.2
16	Soil improvement for mangrove	1.3	-	-	-		0.2
17	Stable demand		-	-	-	0.7	0.2
18	Support to make business les difficult	1.3	-	-	-	-	0.2
19	Timely credit payment	-	-	-	0.7	-	0.2
20	Wildfire prevention	1.3	-	-	-	-	0.2

4.3 Fuelwood transport system

4.3.1. Socio-demographic profile of fuelwood transporters

Gender, Age, education and residential status of fuelwood transporters

Fuelwood is transported by both male and female in the five regions surveyed but up to 90% are male. Overall 80% and 20% male and female fuelwood transporters were interviwed across the regions (Figure, 35). Fuelwood is predominantly transported by the youth aged between 20-50 years (76%) with an average age of 38 years as well as older people over 50 years (23%) across regions (Table 17 and Figure 36). More than 80% of the transporters are formally educated. The majority have had basic and secondary education (Figure 37). The majority (70%-95%) of the fuelwood transporters are permanent residents in their community of operations and have lived in these areas for a mean of 20-30 years across regions. However, in Greater Accra and Central Regions 25% are migrants that come from other areas to provide transport services usually as middlemen purchasing fuelwood for delivery to traders and fish smokers (Figure 38).

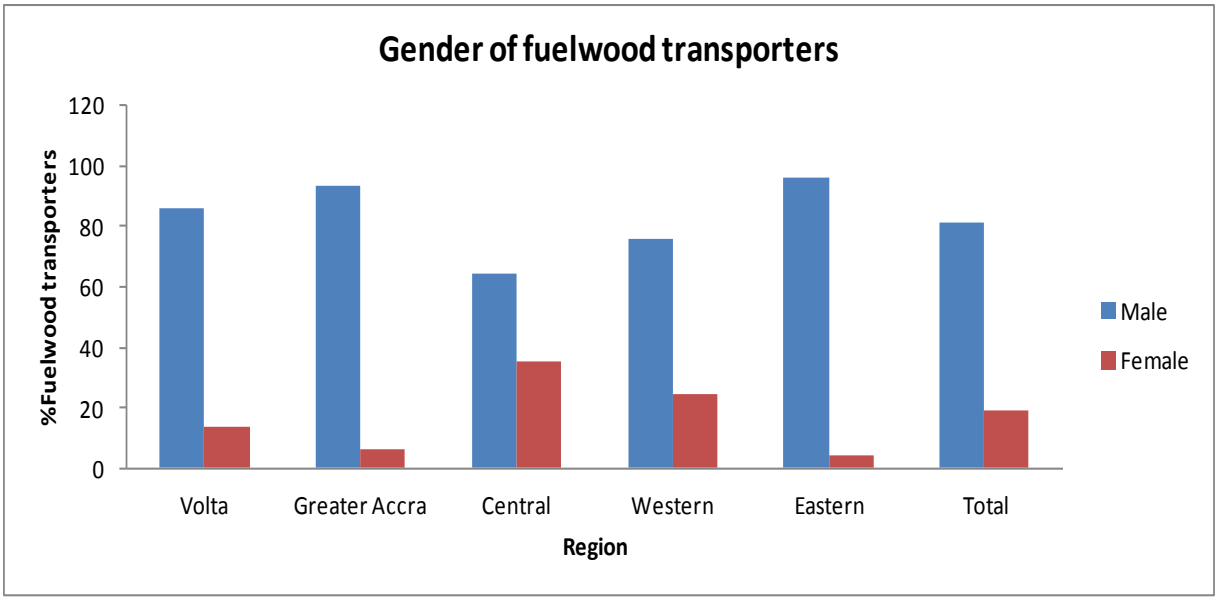

Figure 36 Gender of fuelwood transporters

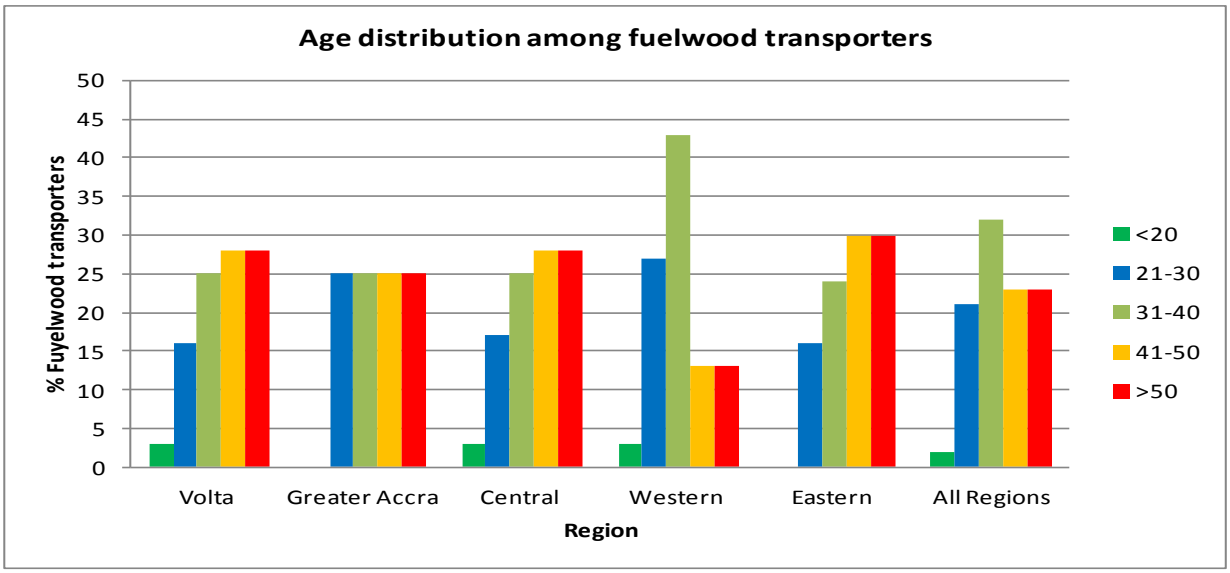

Figure 37 Age distribution among fuelwood transporters

Table 17 Age of fuelwood transporters

Region	Mean	Std. Deviation
Volta	41	11.9
Greater Accra	36	10.5
Central	41	11.4
Western	36	10.3
Eastern	39	7.7

• All Region	• 38	• 10.4

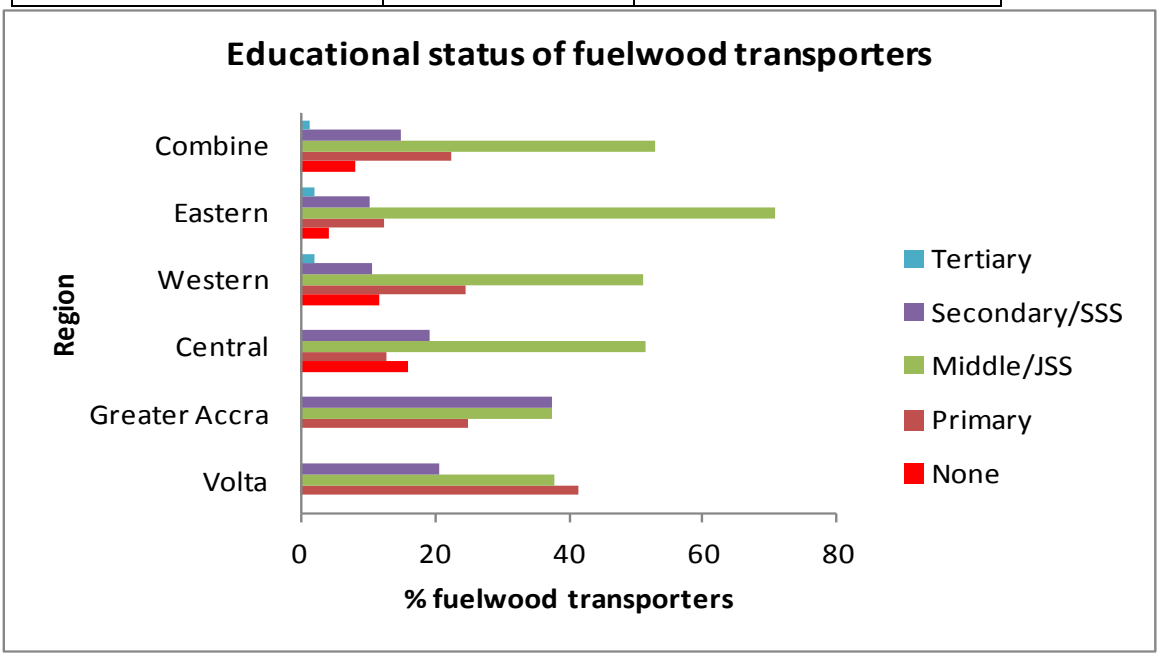

Figure 38 Educational status of fuelwood transporters

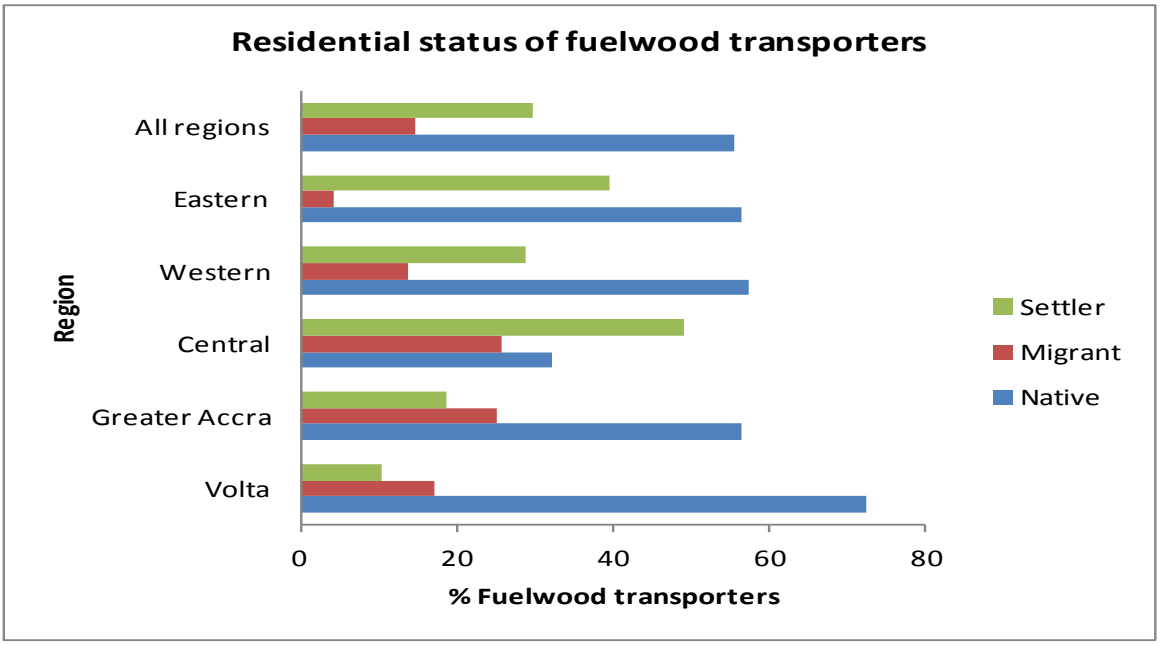

Figure 39 Residential status of fuelwood transporters

Table 18 Number of years of residency in community among fuelwood transporters

• Region	• Mean	• Std. Deviation
• Volta	• 30	• 16.11
• Greater Accra	• 27	• 14.96
• Central	• 20	• 18.27
• Western	• 24	• 15.96
• Eastern	• 29	• 13.02
• All Region	• 25	• 15.88

Household characteristics of fuelwood transporters

Over 80% of fuelwood transporters are married. 8% on average are single parents across regions (Figure 11). The mean household sizes range 5-7 people (Table 19). Male transporters an average of two spouses or wives with 3 at least 3 members of their households being dependents less than 15 years and or more than 65 years old (Tables 20 and 21).

Table 19 Household size for fuelwood transporters

• Region	• Mean	• Std. Deviation
• Volta	• 6	• 3.3
• Greater Accra	• 7	• 2.67
• Central	• 6	• 2.39
• Western	• 6	• 3.51
• Eastern	• 5	• 3.01
• All Region	• 6	• 3.21

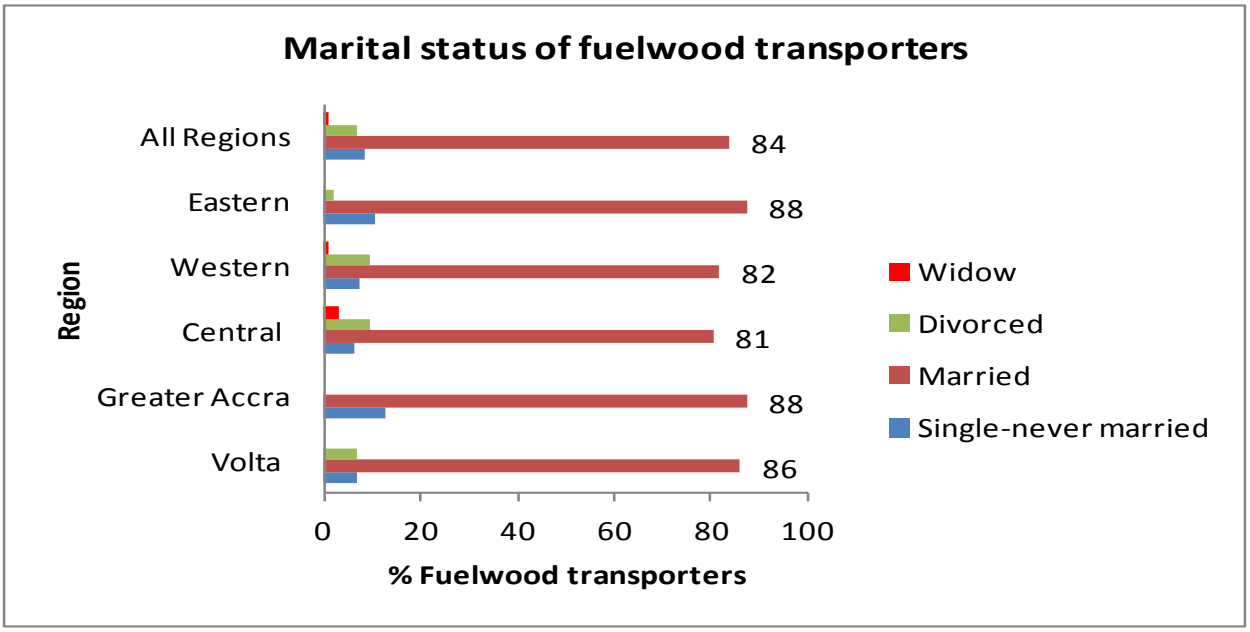

Figure 40 Marital status of fuelwood transporters

Table 20 Number of spouses for fuelwood transporters

• Region	• Mean	• Std. Deviation
• Volta	• 2	• 1.83
• Greater Accra	• 3	• 2.73
• Central	• 3	• 1.82
• Western	• 2	• 2.23
• Eastern	• 2	• 1.63
• All Region	• 2	• 2.11

Table 21 Number of dependents in transporter households (i.e.<15 and >65 years old)

•	• Mean	• Std. Deviation
• Volta	• 3	• 2.28
• Greater Accra	• 4	• 1.83
• Central	• 3	• 2.03
• Western	• 3	• 1.91
• Eastern	• 3	• 1.83
• All Region	• 3	• 1.98

- **Dependency of fuelwood transportation for livelihood**

Generally, fuelwood transportation is the main income earning activity for approximately 50% of the transporters across the regions with highest proportion in the Eastern Region (Figure 39). Media reports indicates that this enterprise has been pursued by some transporters in the Eastern region for over 2 decades and has been the major source of income used in educating children and catering to other major household expenses (Mensah, 2011).

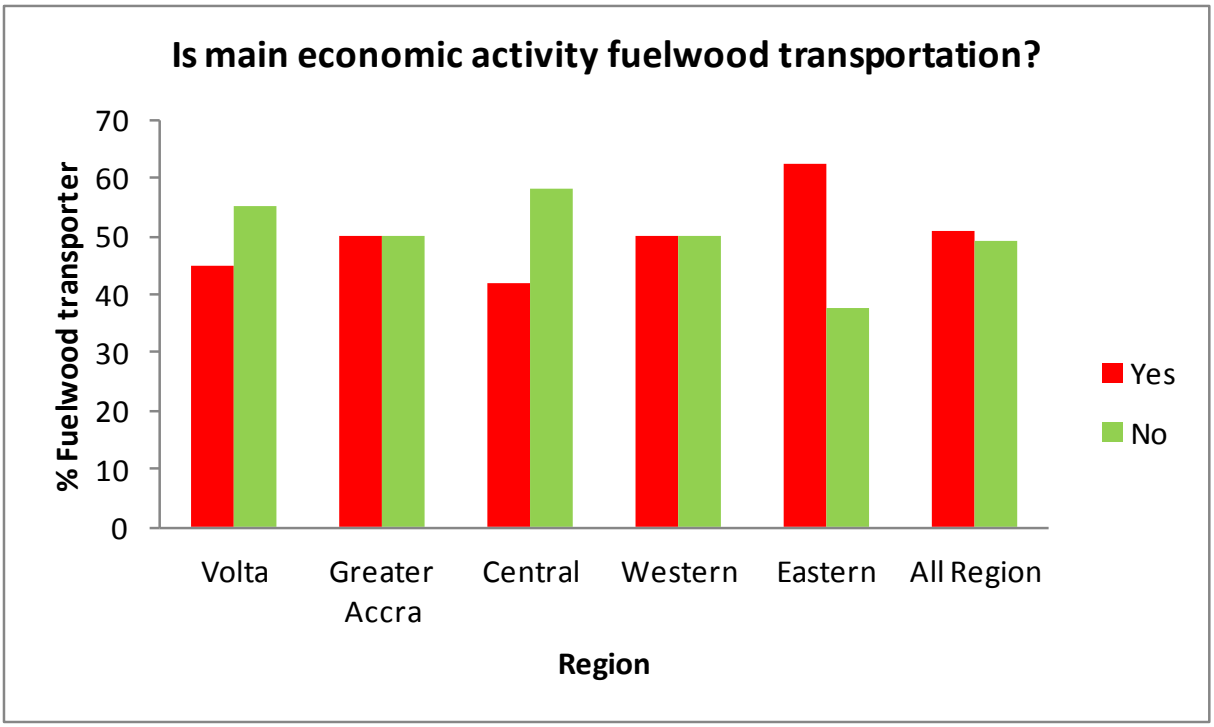

Figure 41 Dependency on fuelwood transportation for income

4.3.2 Fuelwood transport business operations

Fuelwood transporters could have been engaged in this enterprise for from a mean of 6-15 years (Table 22). Overall, the mean number of years of experience is 9 across regions with the maximum in the Volta Region. Sixty percent of the transporters were initiated into the business by their family members. Transporters often engage 3 people to assist in loading and off loading of fuelwood for sale.

Table 22 Number of years experience in fuelwood transportation

Region	Mean no. of years	Std. Deviation
Volta	15	10.1
Greater Accra	6	5.0
Central	10	11.8
Western	6	5.7
Eastern	10	7.7
All Region	**9**	**8.5**

Fuelwood transportation is either done for producers who harvest within local areas close to fishing communities or over long distances and sometimes across regions, for instance from Eastern to Greater Accra or Central Regions. Transporters also sometimes act as middlemen buying from producers to deliver to traders and fish smokers. In total 60% percent of the fuelwood transporters operate both locally and over long distance while 34% operate only locally especially in the Central and Western Regions. Six percent would usually buy and/or transport over long distances only particularly for those who deliver in the Tema and LEKMA areas of Greater Accra Region (Figure 41). These often operate from remote areas of the region e.g. Dodowa and beyond or from areas in the Eastern Region including Akuse.

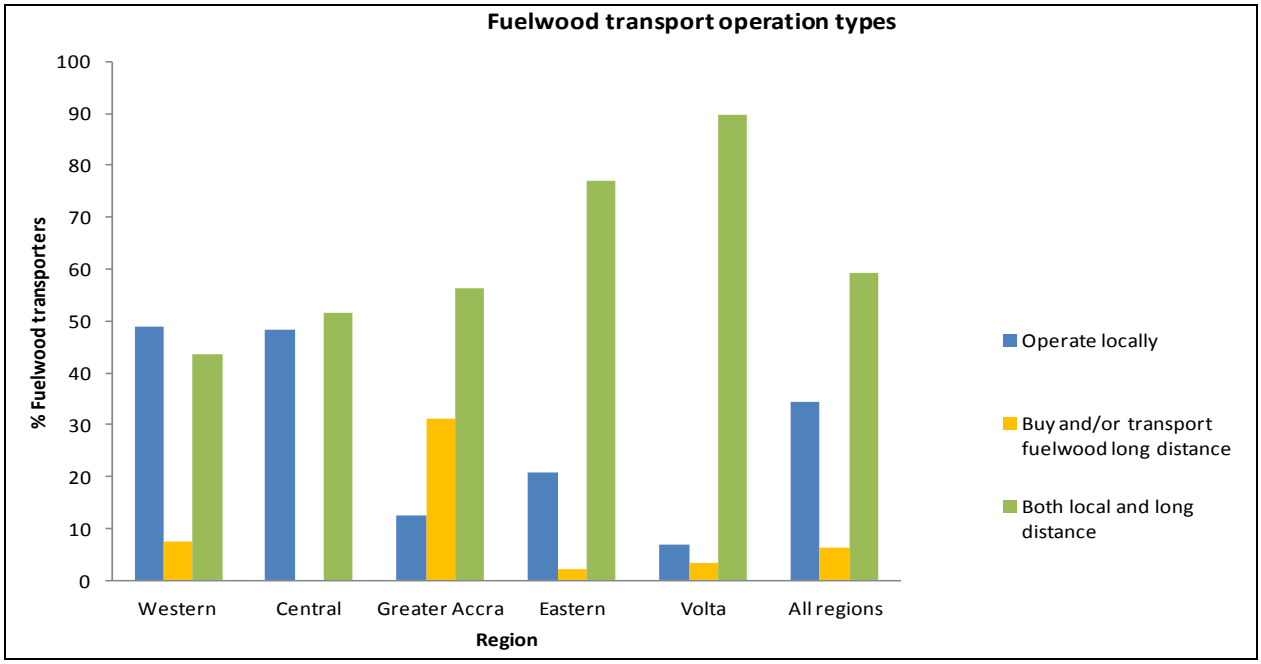

Figure 42 Transport systems operated

Sixty percent of the fuelwood transporters do not own the vehicles they operate (Figure 42). The vehicles they use range from canoes for mangrove wood on the waters in the Volta estuary to tricycles, KIA trucks of various capacities to pick-ups for overland operations (Plate 6). Tricycles and Pick-ups may be used for local deliveries while the KIA is usually used over long distances. Several trips are usually made per season. In the major fishing season, the mean frequency of trips range about 10 in the Eastern to 102 in the Western Region and an average of 56 across the regions in total (Table 23). Overall 57% of fuelwood transporters do not keep written records of their operations, especially for those in Volta, Western and Eastern whereas over 60% in Greater Accra and Central Regions do keep records on business operations (Figure 43). Further, over 80% of transporters are not members of any association, although there may an association in some communities (Figure 44).

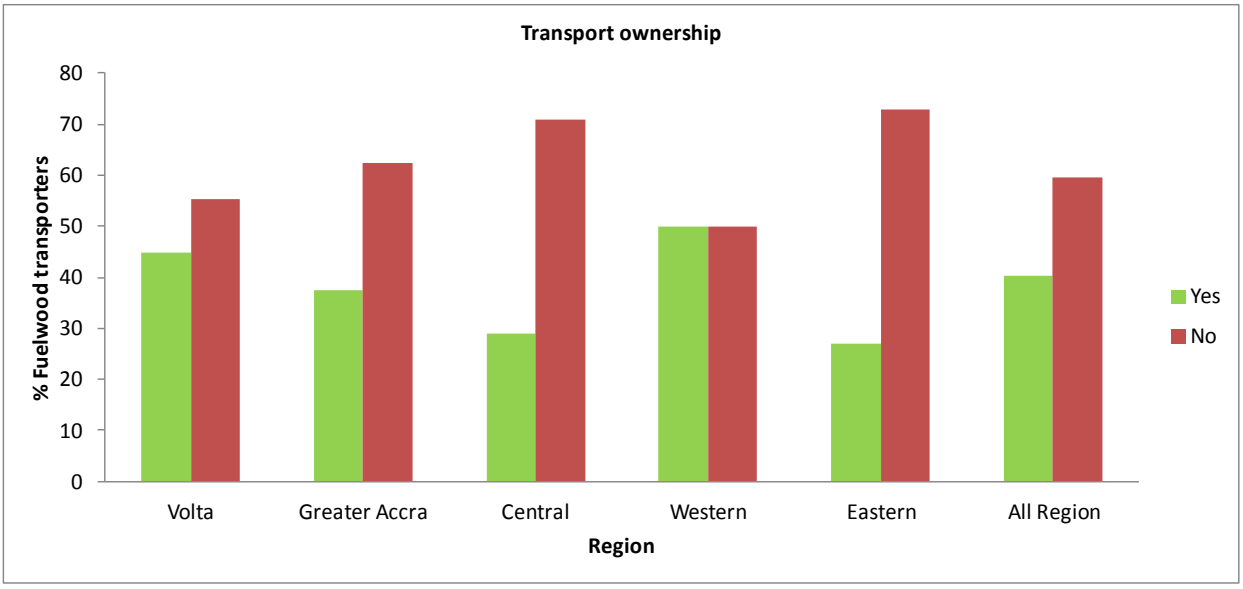

Figure 43 Vehicle ownership among fuelwood transporters

Plate 7 Vehicles used in transporting fuelwood

Table 23 Frequency of trips made transporting fuelwood to clients

Region	Major season		Minor season	
	Mean	Std. Deviation	Mean	Std. Deviation
Volta	17.69	15.82	27.87	103.57
Greater Accra	55.45	54.45	16.87	14.87
Central	29.13	32.41	19.73	21.58
Western	102.14	110.5	38.64	39.94
Eastern	9.65	7.08	3.3	2.95
All Region	**56.44**	**85.34**	**25.48**	**47.13**

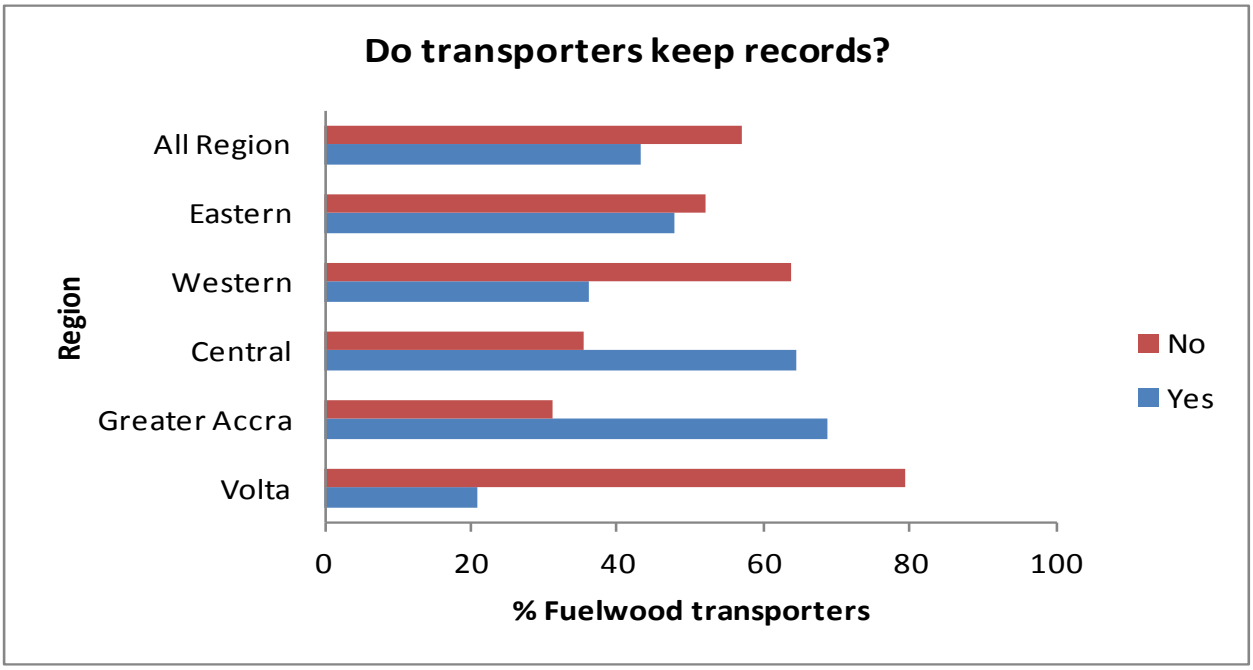

Figure 44 Transporters claims of record keeping on business

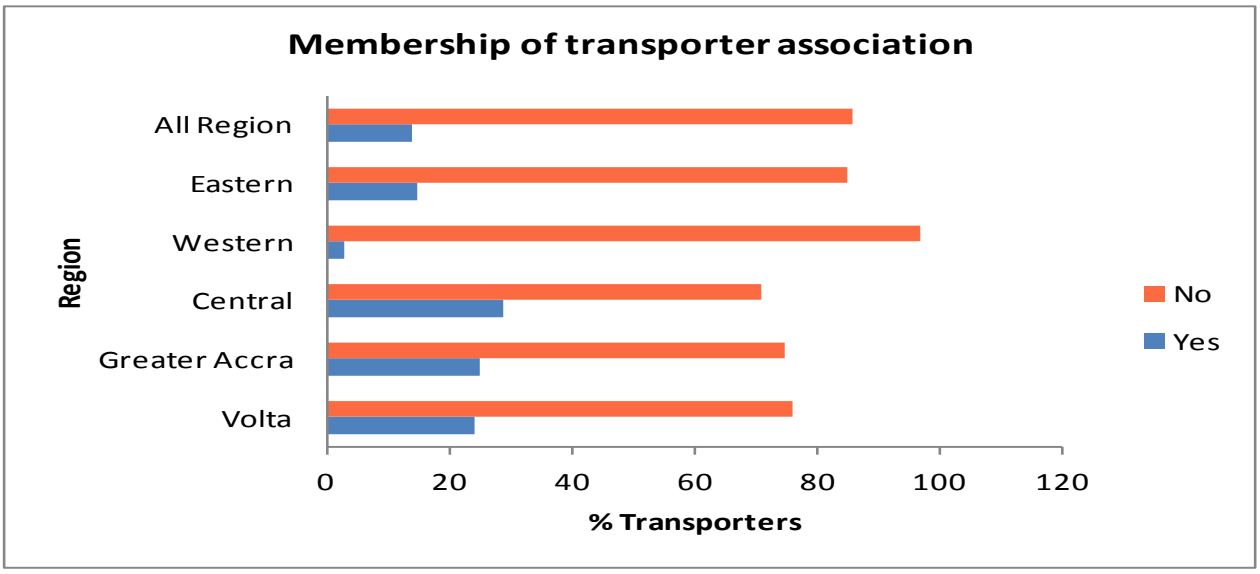

Figure 45 Membership of fuelwood transporters association

4.3.3 Fuelwood transported, clientele and demand

Transporters in Greater Accra, Western and Central would often deliver fuelwood to fish smokers and fuelwood retailers directly while those in Volta and Eastern Regions often do so to fuelwood wholesalers (Figure 45). Over 80% of the fuelwood delivered are in bundles (Figure 46).

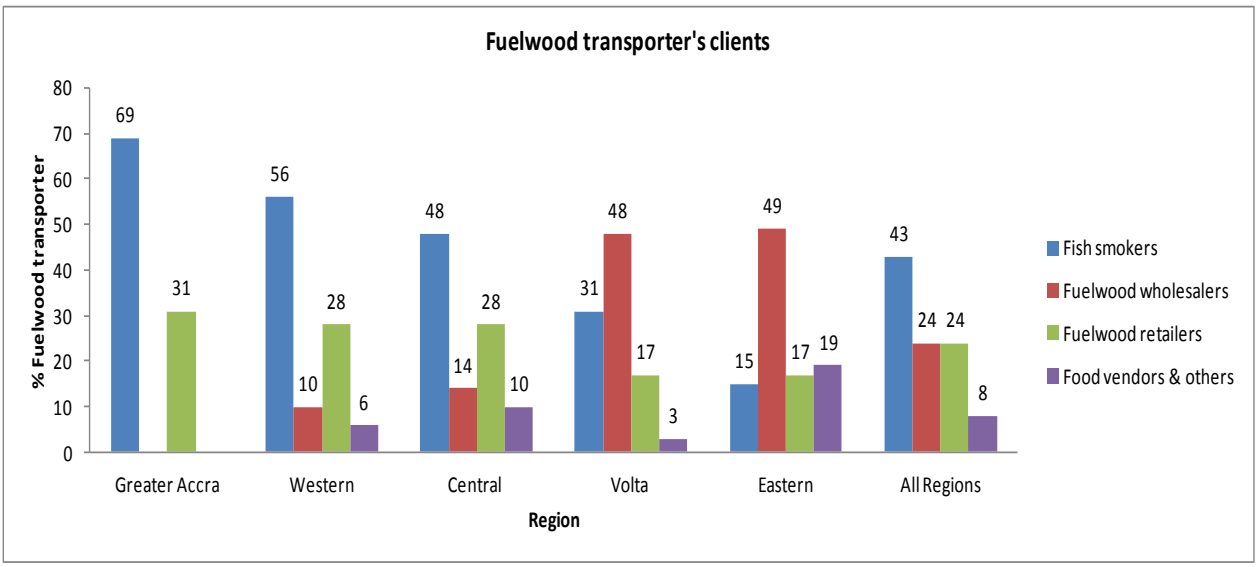

Figure 46 proportion of transporters indicating their clients for fuelwood delivery

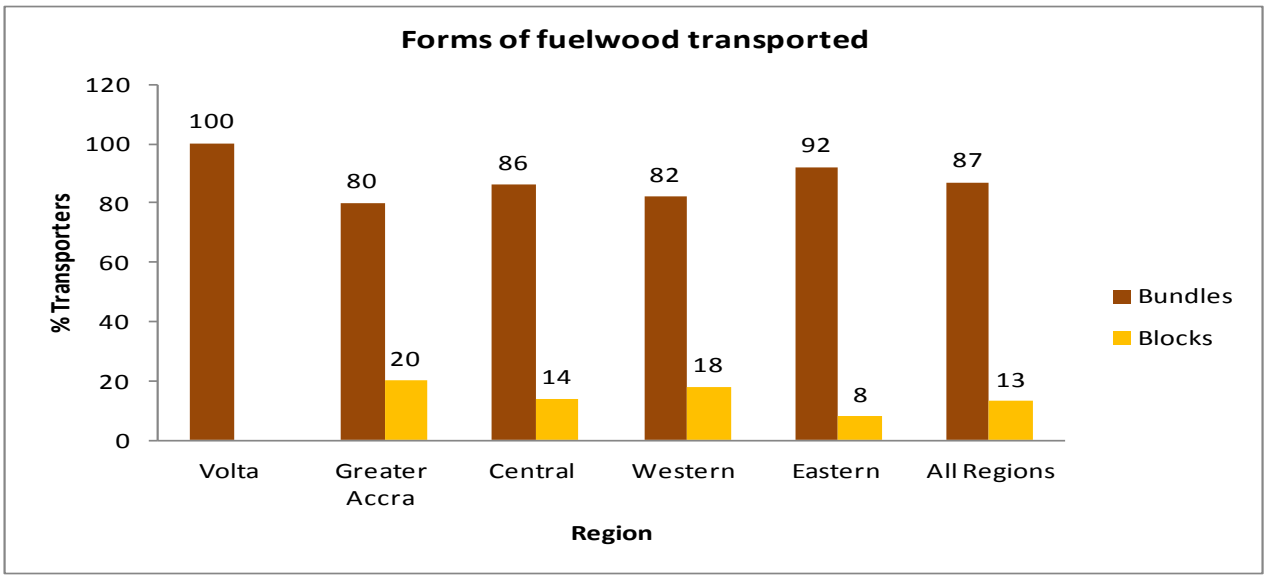

Figure 47 Proportion of transporters indicating forms of fuelwood delivered to clients

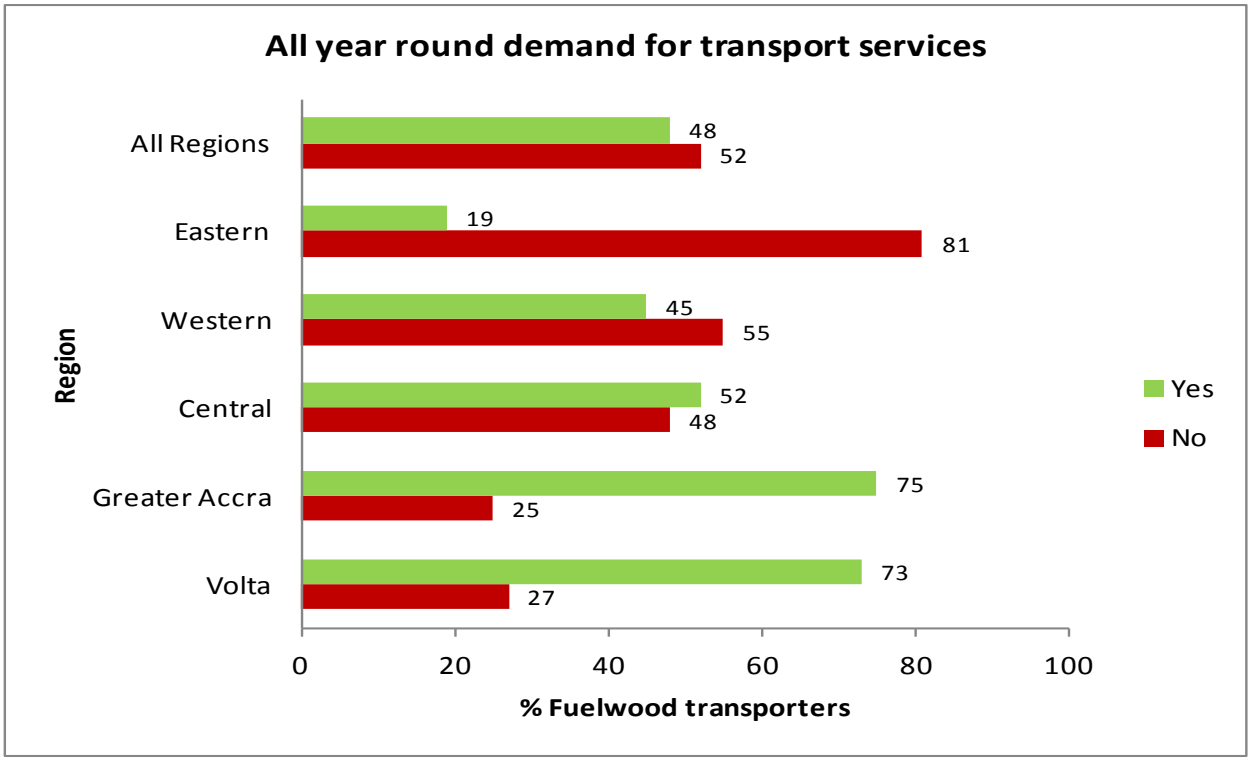

Figure 48 Proportion of fuelwood transporters indicating nature of demand for their services

4.3.4 Constraints in fuelwood transportation and distribution and remedial measures

Twelve major problems were reported to constrain fuelwood transportation (Figure 48 and Table 24). The most frequently reported constraints include poor road to harvesting sites to load fuelwood, high vehicle running and maintenance costs, inadequate capital to finance transport operations and the highly risky nature of traction often associated with motor accidents and drudgery. Confrontations with security officials, the seasonal nature of demand for fuelwood and poor price of per unit of fuelwood transported were also mentioned as setbacks to the fuelwood transport business.

Fuelwood transporters suggest provisions of loans and a range of material incentive for alleviating fuelwood transportation constraints (Figure 49 and Table 25).

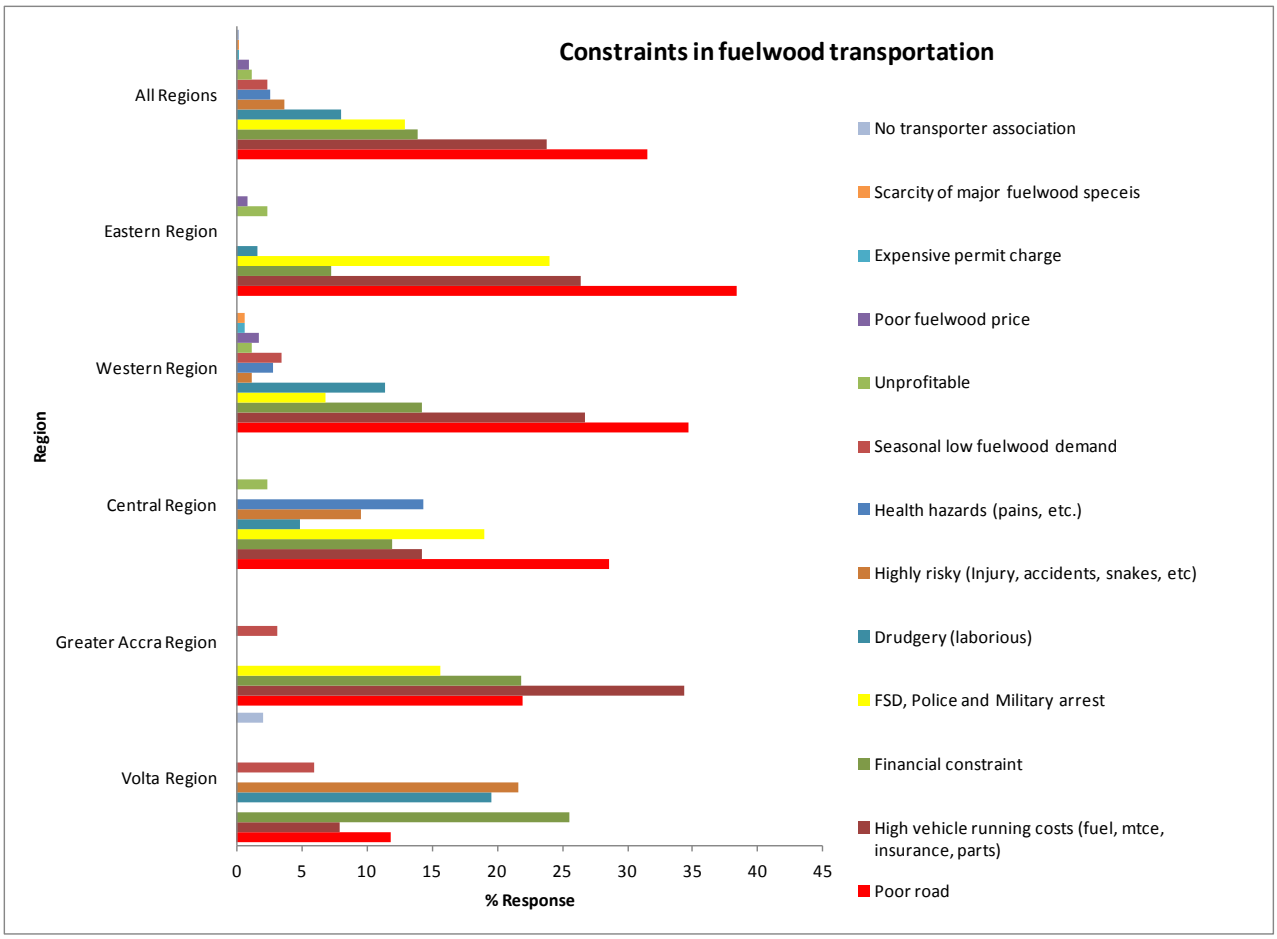

Figure 49 Constraints in fuelwood transportation

Table 24 Constraints in fuelwood transportation

No.	Fuelwood transport constraint	% Response					
		Volta	Greater Accra	Central	Western	Eastern	All Regions
1	Poor road	11.8	21.9	28.6	34.7	38.4	31.5
2	High vehicle running costs (fuel, maintenance, insurance, parts)	7.9	34.4	14.2	26.7	26.4	23.8
3	Financial constraint	25.5	21.8	11.9	14.2	7.2	13.9
4	FSD, Police and Military arrest	-	15.6	19	6.8	24	12.9
5	Drudgery (laborious)	19.6	-	4.8	11.4	1.6	8.0
6	Highly risky (Injury, accidents, snakes, etc)	21.6	-	9.5	1.2	-	3.7
7	Health hazards (pains, etc.)	-	-	14.3	2.8	-	2.6
8	Seasonal low fuelwood demand	5.	3.1	-	3.4	-	2.4

		9					
9	Unprofitable	-	-	2.4	1.1	2.4	1.2
10	Poor fuelwood price	-	-	-	1.7	0.8	0.9
11	Expensive equipment	2.0	3.1	-	-	0.8	0.7
12	Theft	-	-	-	1.1	-	0.5
13	Crediting of supplies	-	-	-	1.1	-	0.5
14	Expensive permit charge	-	-	-	0.6	-	0.2
15	Scarcity of major fuelwood species	-	-	-	0.6	-	0.2
16	No transporter association	2.0	-	-	-	-	0.2

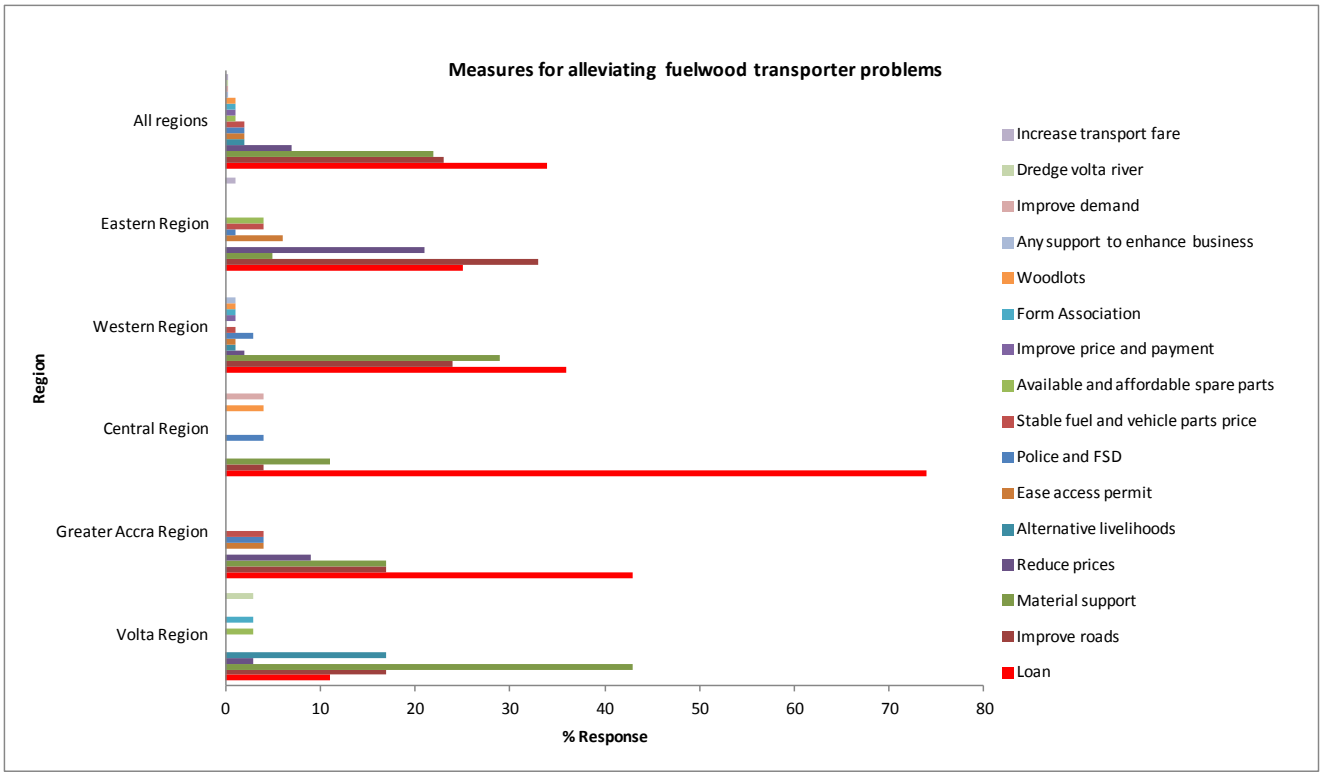

Figure 50 Measures proposed by transporters to alleviate constraints

Table 25 Measures suggested for alleviating fuelwood transport constraints

No.	Alleviation measures	Volta	Greater Accra	Central	Western	Eastern	All Regions
1	Loan	11	43	74	36	25	34
2	Improve roads	17	17	4	24	33	23

3	Material support	43	17	11	29	5	22
4	Reduce prices	3	9	-	2	21	7
5	Alternative livelihoods	17	-	-	1	-	2
6	Ease access permit	-	4	-	1	6	2
7	Police and FSD	-	4	4	3	1	2
8	Stable fuel and vehicle parts price	-	4	-	1	4	2
9	Available and affordable spare parts	3	-	-	-	4	1
10	Improve price and payment	-	-	-	1	-	1
11	Form Association	3	-	-	1	-	1
12	Woodlots	-	-	4	1	-	1
13	Any support to enhance business	-	-	-	1	-	0.3
14	Improve demand	-	-	4	-	-	0.3
15	Dredge volta river	3	-	-	-	-	0.3
16	Increase transport fare	-	-	-	-	1	0.3

4.4 Fuelwood trading system

4.4.1 Socio-demographic profile of fuelwood traders

Age, gender, educational status and resident status of fuelwood traders

Both men and women of middle age (average 49 years across regions) trade in fuelwood for fish smoking in coastal Ghana. However, the trade is dominated by women comprising 92% of the total sample of fuelwood traders interviewed across regions and approximately 100% in Greater Accra and Central Regions (Table 26 and Figure 47).

Table 26 Age of fuelwood traders

Region	Mean Age (Years)	Std. Deviation
Volta	51	16.3
Greater Accra	53	15.6
Central	50	14.4
Western	45	14.0
All regions	49	15.1

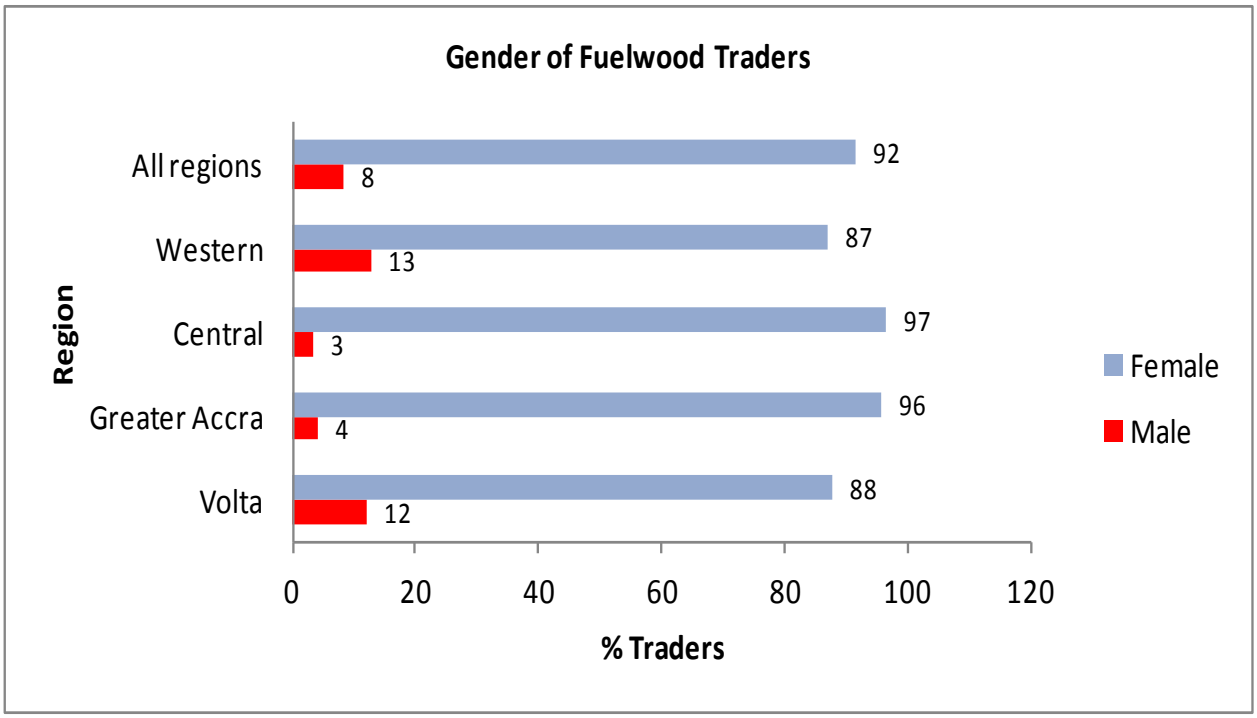

Figure 51 Gender of fuelwood traders for the coastal fish smoking industry

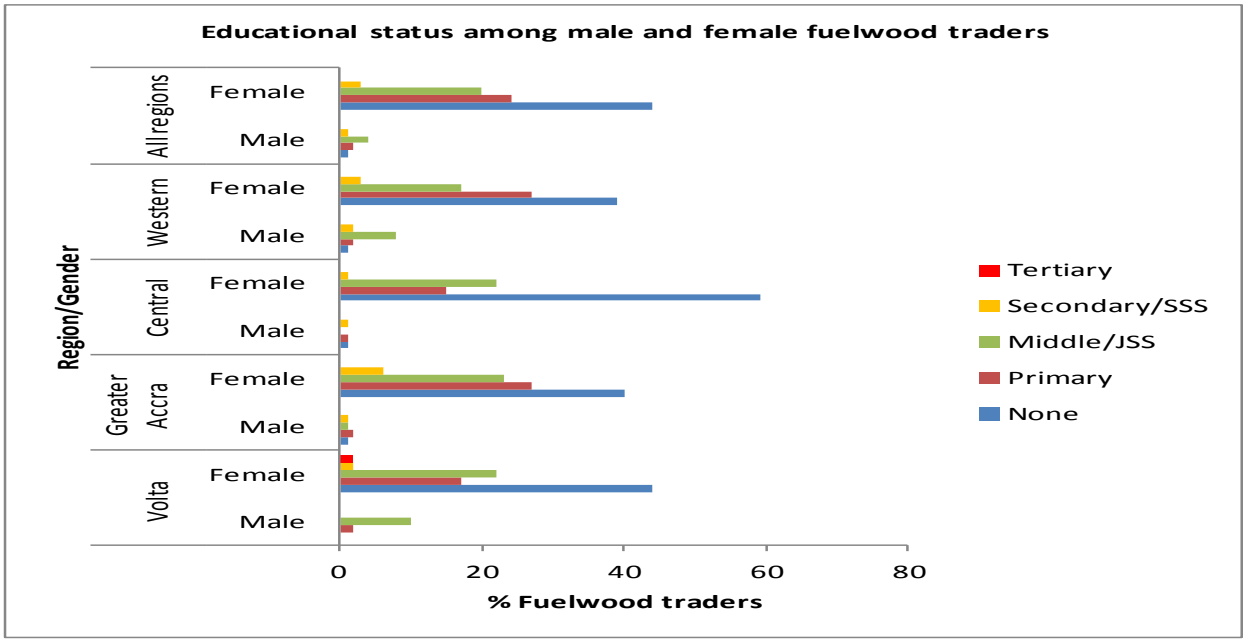

Figure 52 Formal educational status of male and female fuelwood traders

Forty to sixty percent of the female fuelwood traders have had no formal education particularly in the Central Region (Figure 48). The majority (>50%) of the educated traders have had basic education i.e. primary-middle/junior secondary. Majority (77% and 97%) of the fuelwood traders are respectively native and permanently resident in their communities across regions surveyed (Figure 49). Over 80% have been living in these communities for more than 10years i.e. 11-92 years (Figure 50) and an average of 36 years (Table 27).

Table 27 Mean number of years lived in community-all regions combined

N	Minimum	Maximum	Mean	Std. Deviation
388	0.5	92	36	21.35

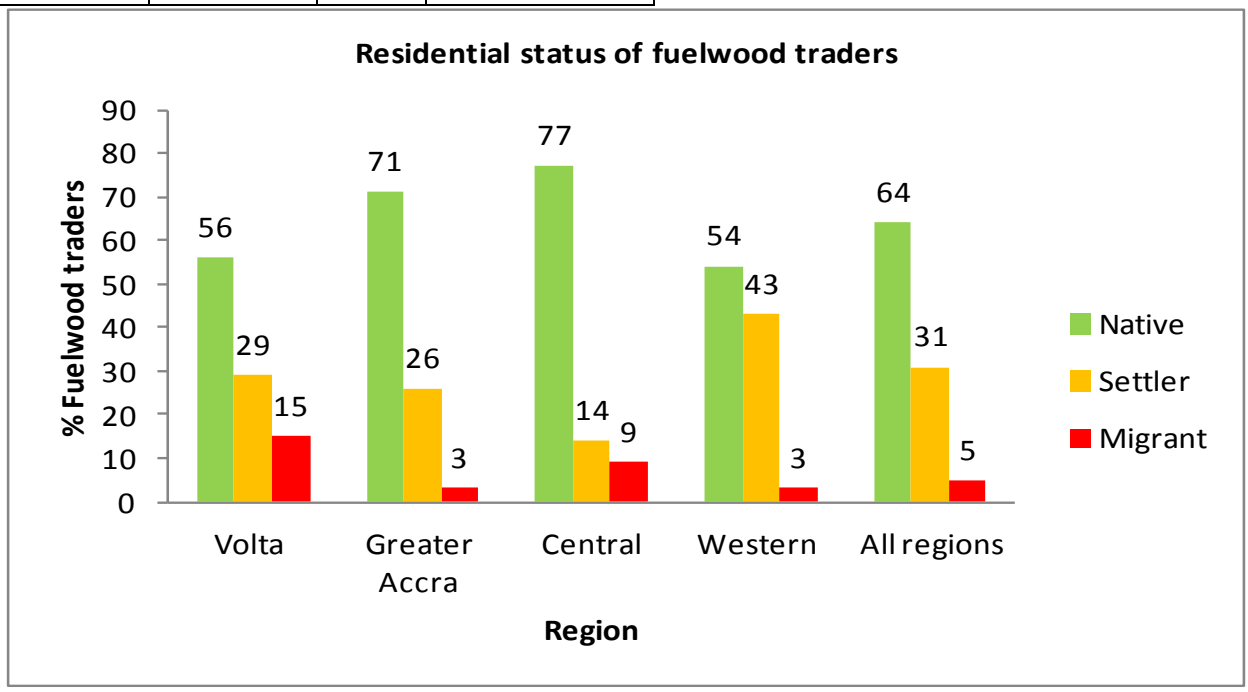

Figure 53 Residential status of fuelwood traders

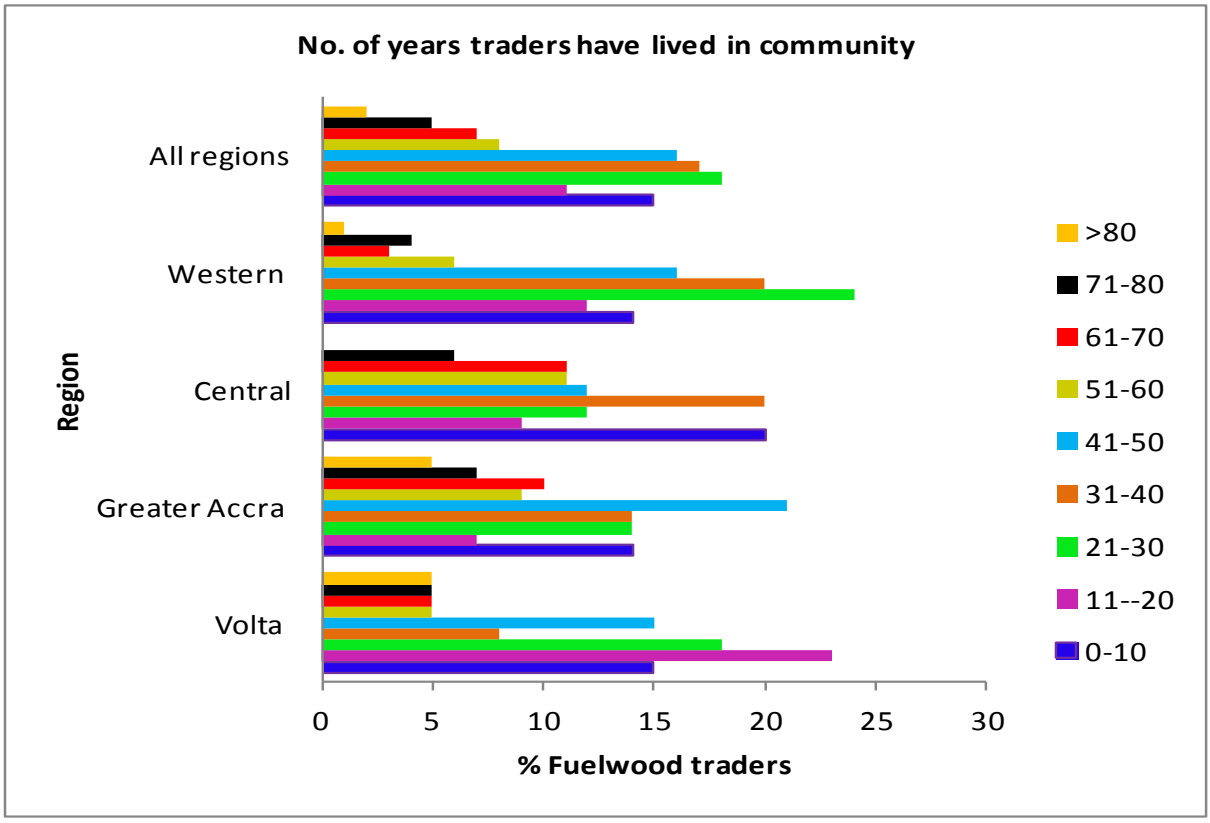

Figure 54 Number of years traders have lived in their community

- **Household characteristics of fuelwood traders**

Majority of fuelwood traders are married ranging from 57% in Central to 64% in the Western Region. On average across regions, 39% of the traders are single parents (Figure 53). Fuelwood traders are also responsible for large households. Household sizes for at least 97% of the traders range from 1-20 people with a few of them having >20-55 people (Figure 54). The average across the regions is 8 people per household (Table 28).

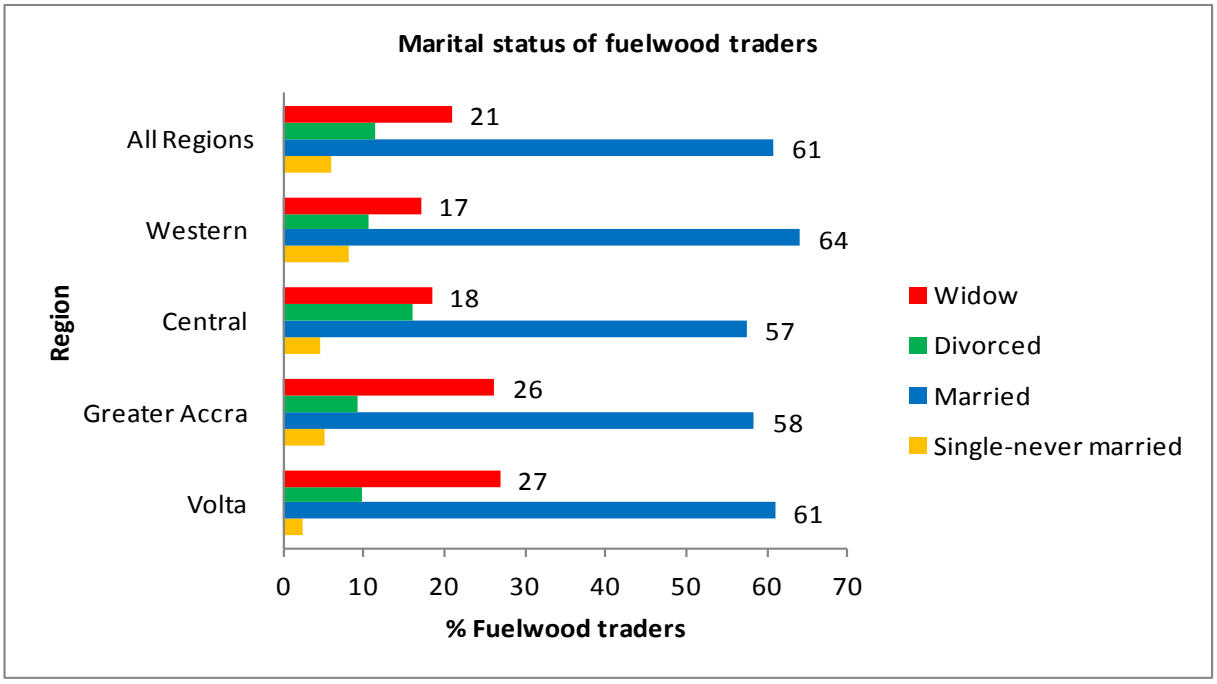

Figure 55 Marital status of fuelwood traders

Table 28 Mean household size for fuelwood traders-all regions combined

N	Minimum	Maximum	Mean	Std. Deviation
414	1	55	8	5.3

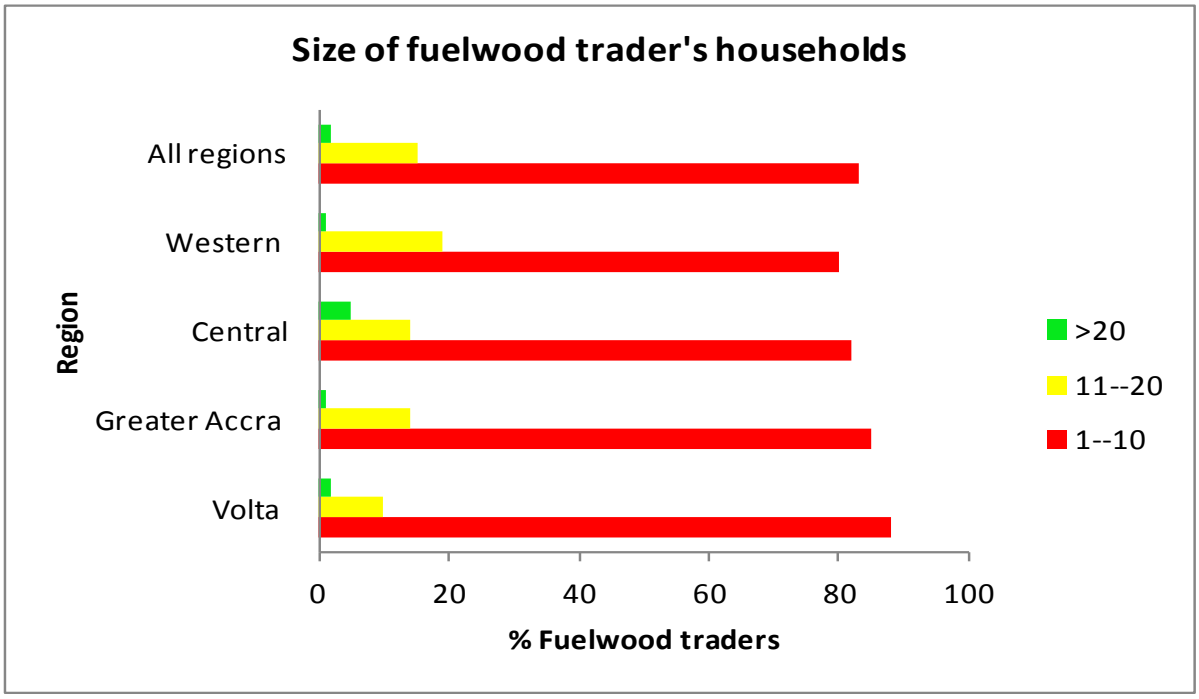

Figure 56: Household size distribution for fuelwood traders

- **Dependency on fuelwood trading for livelihood**

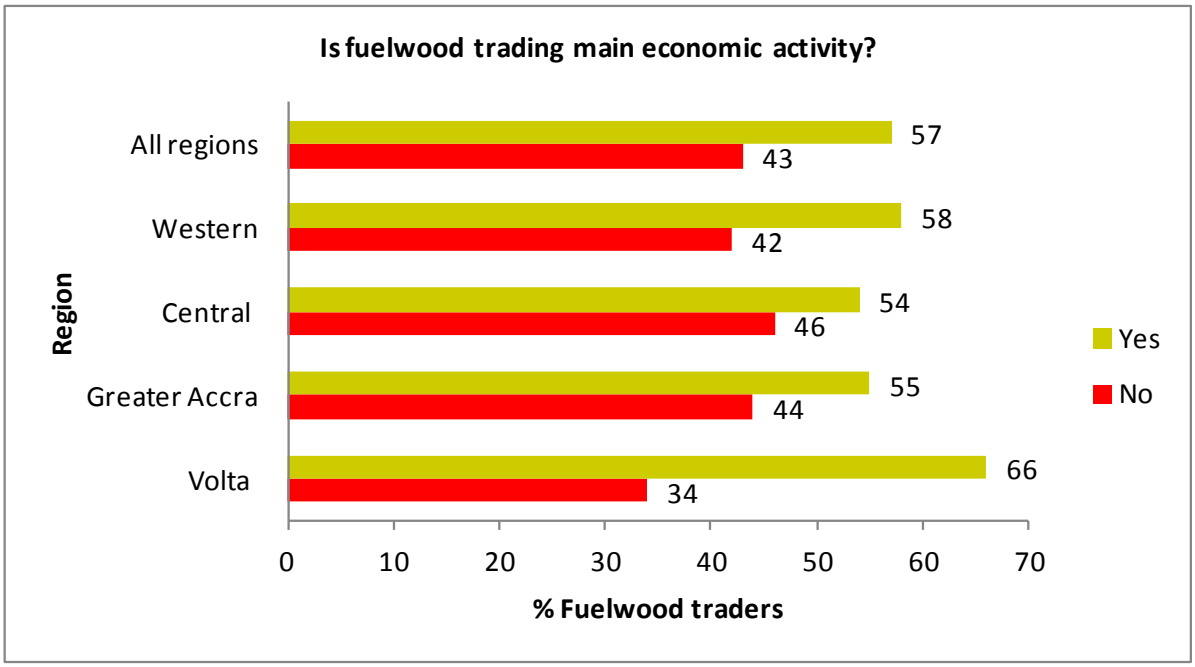

Figure 57 Reliance on fuelwood trading as main economic activity/income source

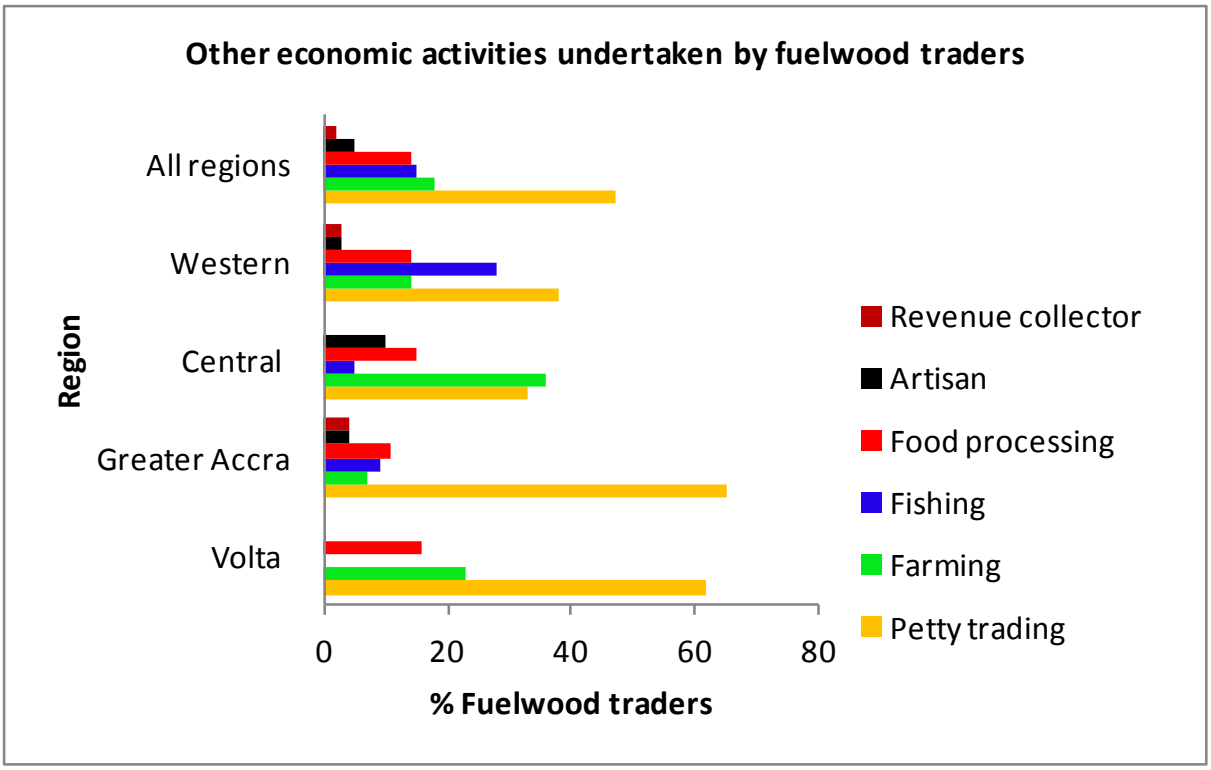

Figure 58 Other economic activities undertaken by fuelwood traders for income

4.4.2 The fuelwood trading enterprise

- **Operation permit, trader categories, fuelwood type sold and clientele**

83% of the traders do not need permit to operate their enterprises. The remaining 17% sought permit from traditional rulers (Volta and Western regions) and District Assembly (Greater Accra, Central and Western Regions).

Over 70% of traders retail fuelwood across the regions. Trading on wholesale is most common in the Central Region where the trader delivers directly to the consumer in bulk or supply retailers who then split into pieces for sale to consumers (Figure 57). Fuelwood is either sold in bundles usually smaller diameter wood including tree branches or split sizes of bigger wood chunks or in blocks (larger diameter wood from bigger tree trunks common with forest supplies (Plate 6). The bundle is commonly sold across regions by traders except in the Western Region where both the bundle and block are equally sold (Figure 58).

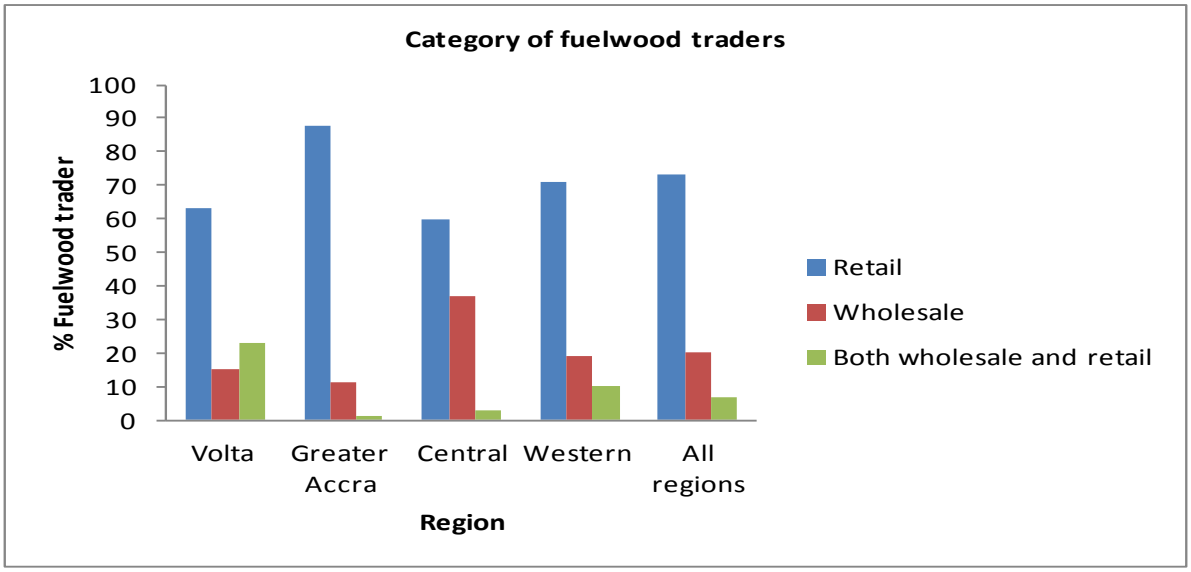

Figure 59 Fuelwood trader categories

Plate 8 Wholesale/retail fuelwood trading at Chokor fishing community-Greater Accra

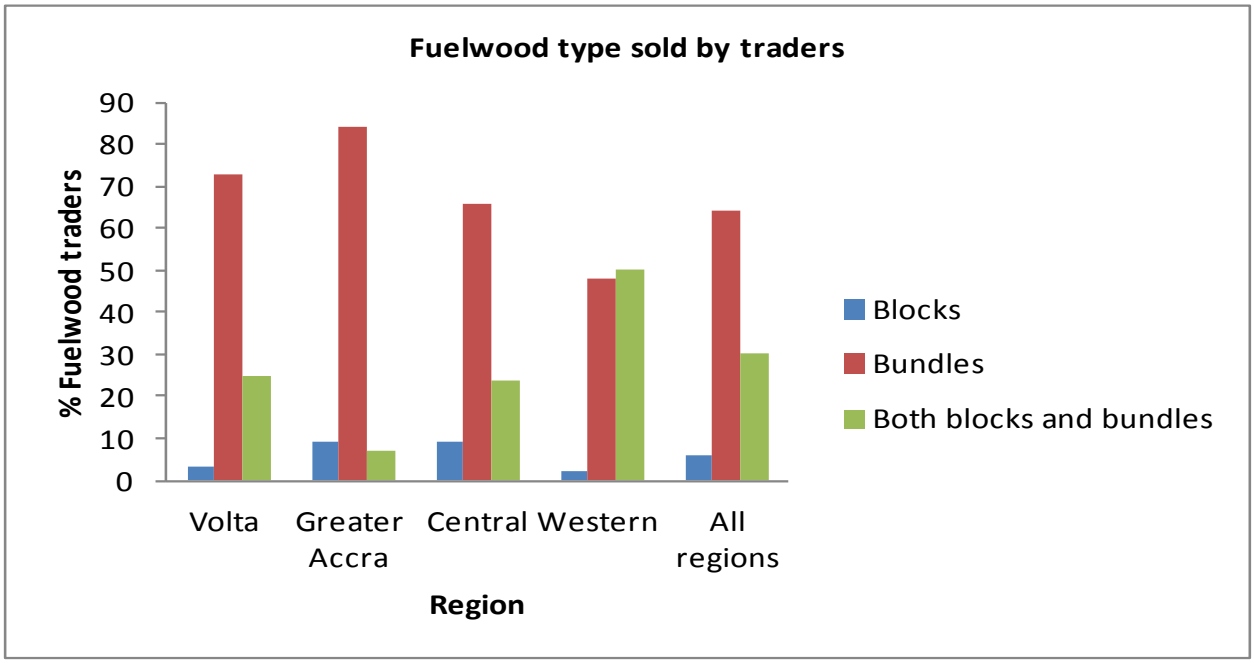

Figure 60 Fuelwood type sold among traders

Plate 9 Types of fuelwood for sale

Fish smokers comprise over 90% of the clientele for fuelwood traders. Food vendors (7%) and households (1%) also patronize fuelwood but to a lesser extent (Figure 60).

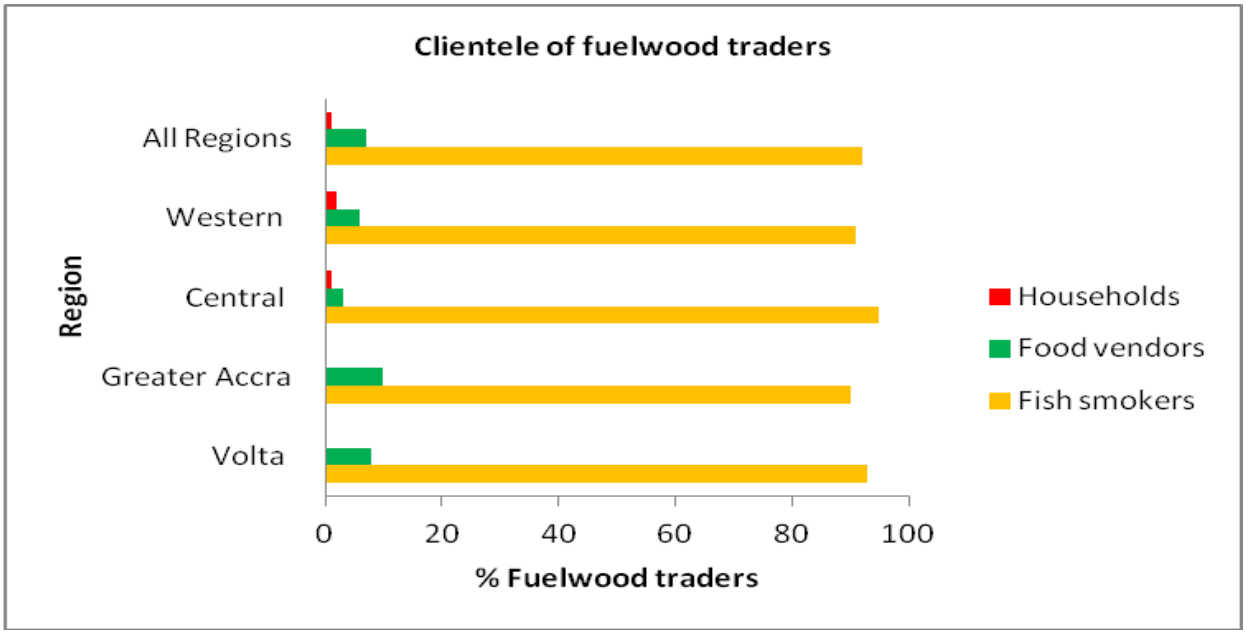

Figure 61 Clientele of fuelwood traders

- **Fuelwood trade associations**

Fuelwood trader associations are not common in most of the areas surveyed; consequently 97% of the fuelwood traders interviewed do not belong to any association (Figure 61). Only 3% of the traders in Accra Metropolis, Ada East and Tema East (Greater Accra) Gomoa East (Central), Jomoro (Western), Keta, and Ketu South (Volta) Districts indicated there was an association in their communities. Sixty-one percent of these are members of the respective associations with the majority in the Keta District of the Volta Region (Figure 62).

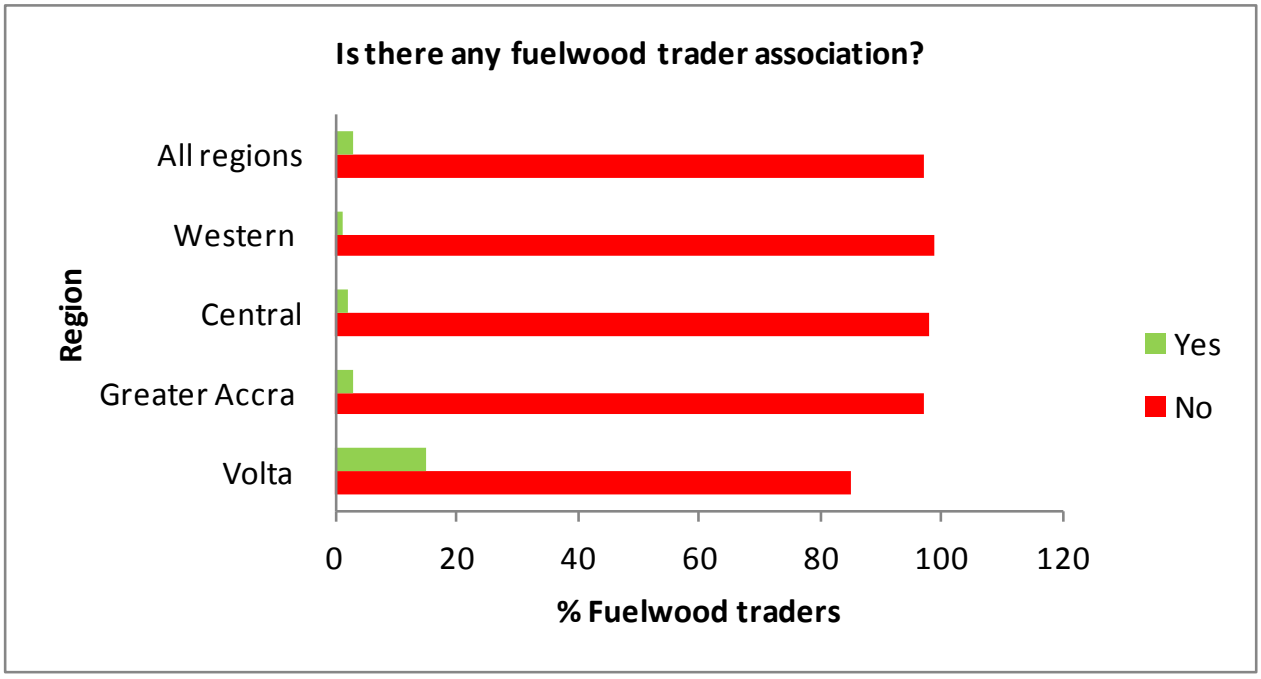

Figure 62 Availability of fuelwood trader association in regions surveyed

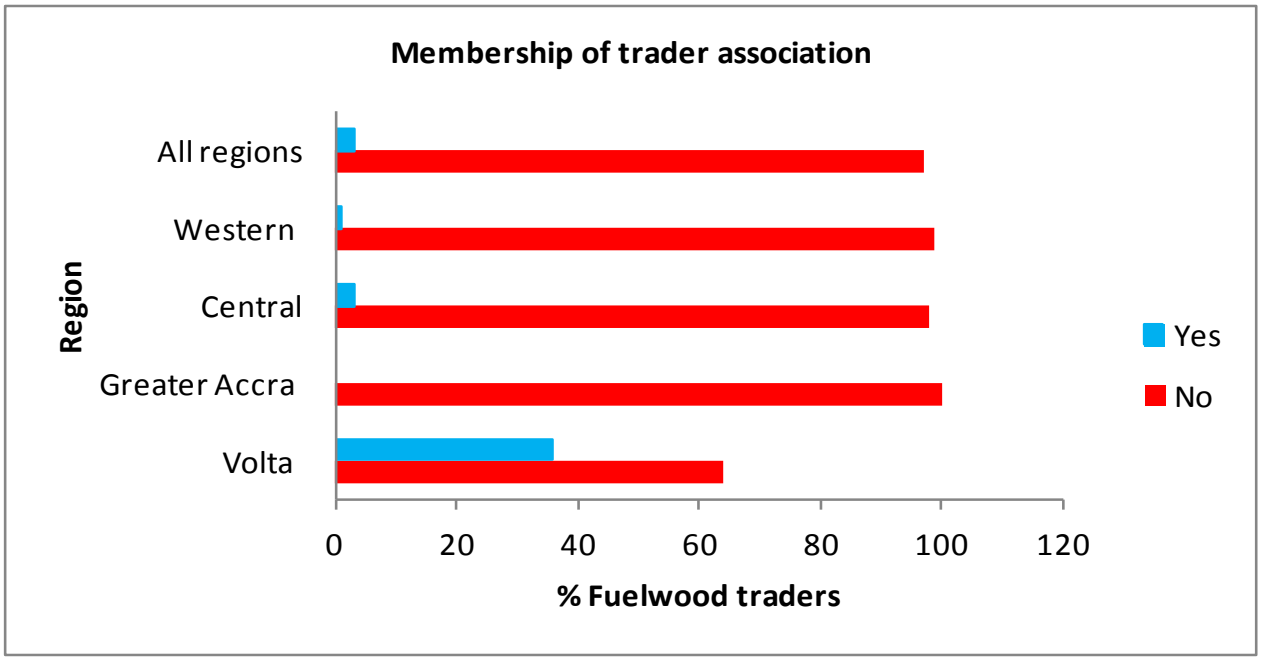

Figure 63 Membership of fuelwood trader association

- **Dependency on fuelwood trading for livelihood**

Fuelwood trading could be a household's succession job. Fuelwood traders have been engaged in this enterprise from 9 to 14 years on the average (Table 29). Overall, the number of years of experience is 11 across regions with the maximum of 14years in the Central Region. Eighty-five percent of the producers were initiated into the business by their relatives and friends. Fuelwood traders often engage 2-3 additional people to assist in splitting and packing or arranging fuelwood for sale.

Table 29 Number of years experience in fuelwood trading

Region	Mean (Yrs)	Standard Deviation
Volta Region	12	10.87
Greater Accra Region	9	8.42
Central Region	14	14.78
Western Region	11	14.78
All regions	11	11.05

4.4.3 Constraints in trading of fuelwood and remedial measures

A number of problems constrain fuelwood trading (Figure 63 and Table 24). The most frequently reported include inadequate capital to finance trading, crediting by clients who often fail to pay, theft of wood and the highly risky nature of splitting, packing wood blocks and so on. Traders encounter low demand for fuelwood during the lean fish season storage and space problems as well as health hazards in the course of their work.

Fuelwood traders suggest provisions of loans and a range of material incentive as well as woodlots for alleviating fuelwood trading constraints (Figure 64 and Table 25).

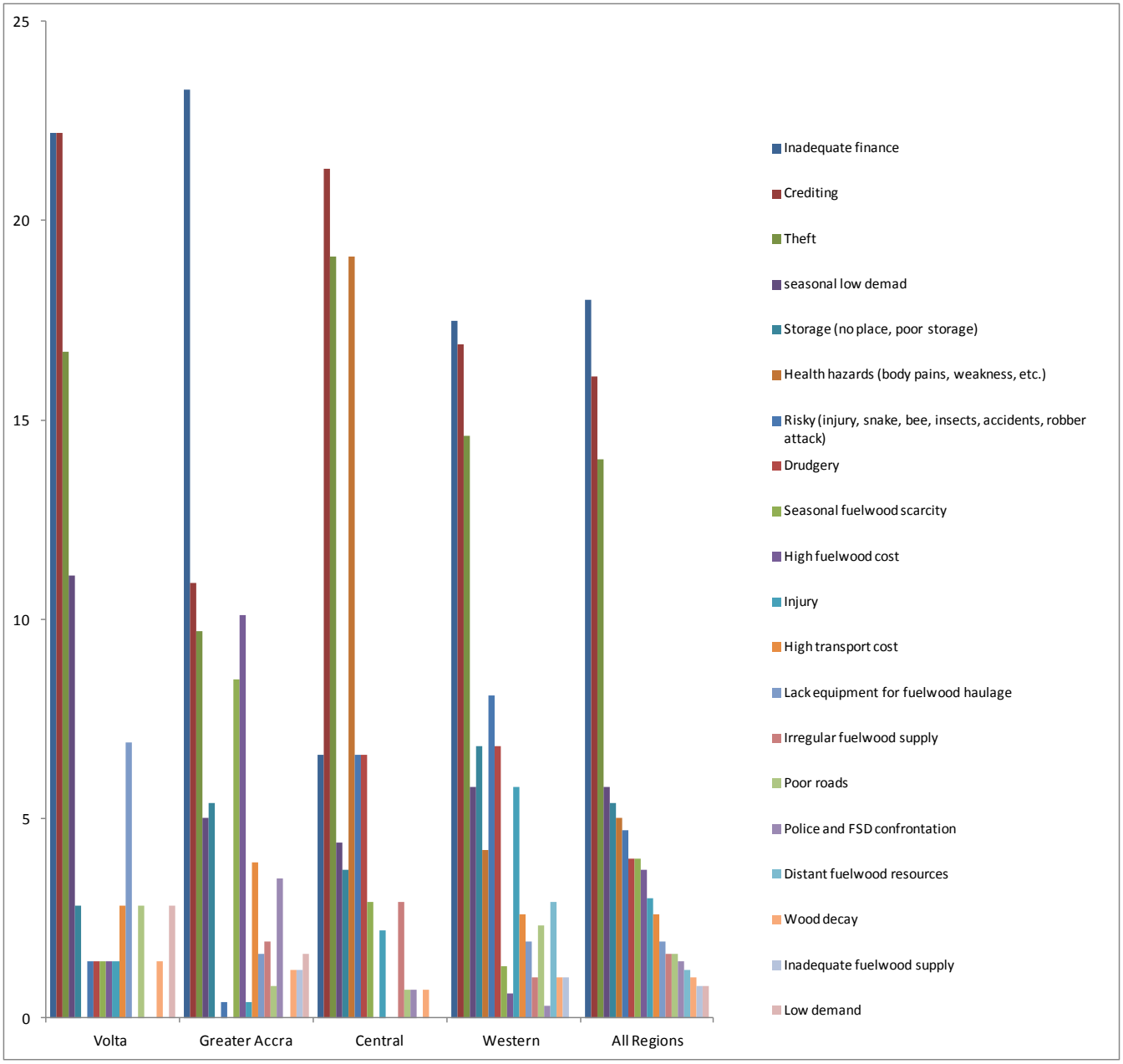

Figure 64 Constraints in fuelwood trading

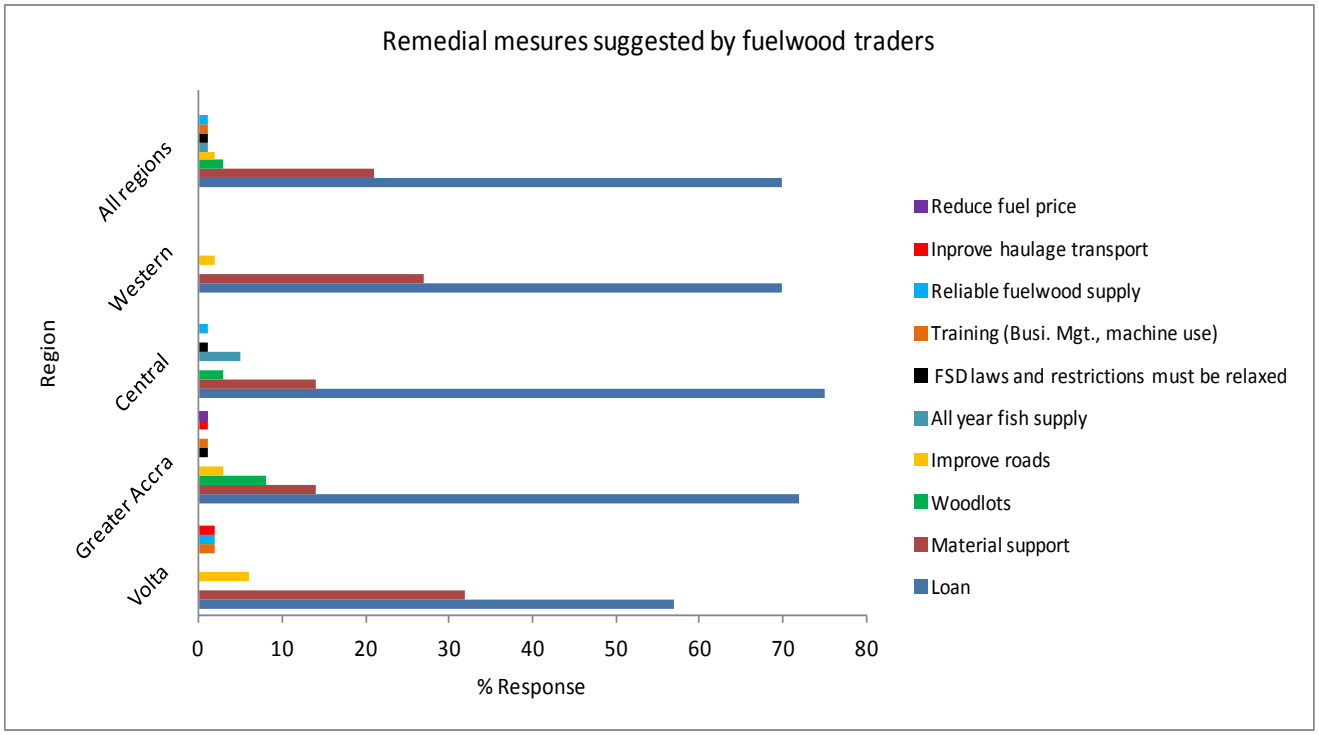

Figure 65 Measures suggested by traders to alleviate constraints in fuelwood trading

4.5 Fuelwood consumption

4.5.1. Socio-demographic profile of fuelwood consumers in fish smoking industry

Age, Gender, education and resident status of fuelwood consumers/ fish smokers

Fuelwood is consumed or used primarily by women (99.5%) for smoking fish in coastal Ghana with 0.5% being men in the Volta Region (Figure 66). Majority (75%) of them are aged between 19-50 years (Figure 65). Approximately 50% of fuelwood consumers have had no formal education particularly in the Central Region (Figure 67). The majority (50%) of the educated consumers have basic education i.e. primary-middle/junior secondary. Overall 99% of the fuelwood consumers/fish smokers permanently resident in their communities across regions surveyed (Figure 68). Over 80% have been living in these communities for more than 10years i.e. 11-80 years (Figure 69).

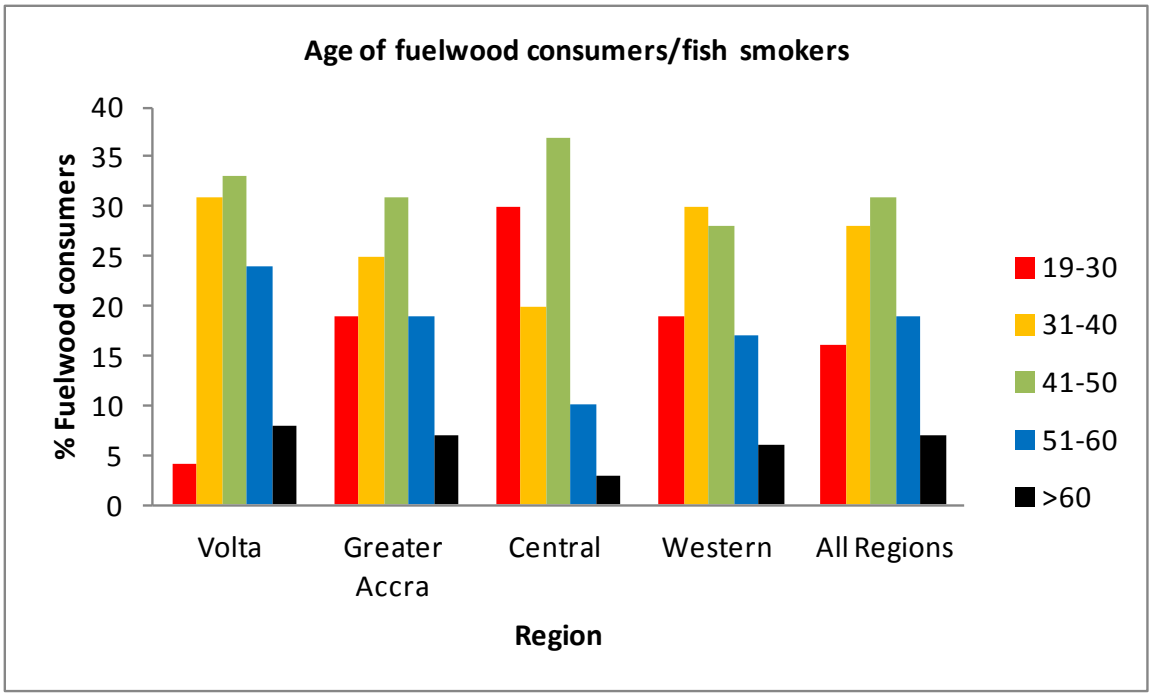

Figure 66 Age distribution among fuelwood consumers

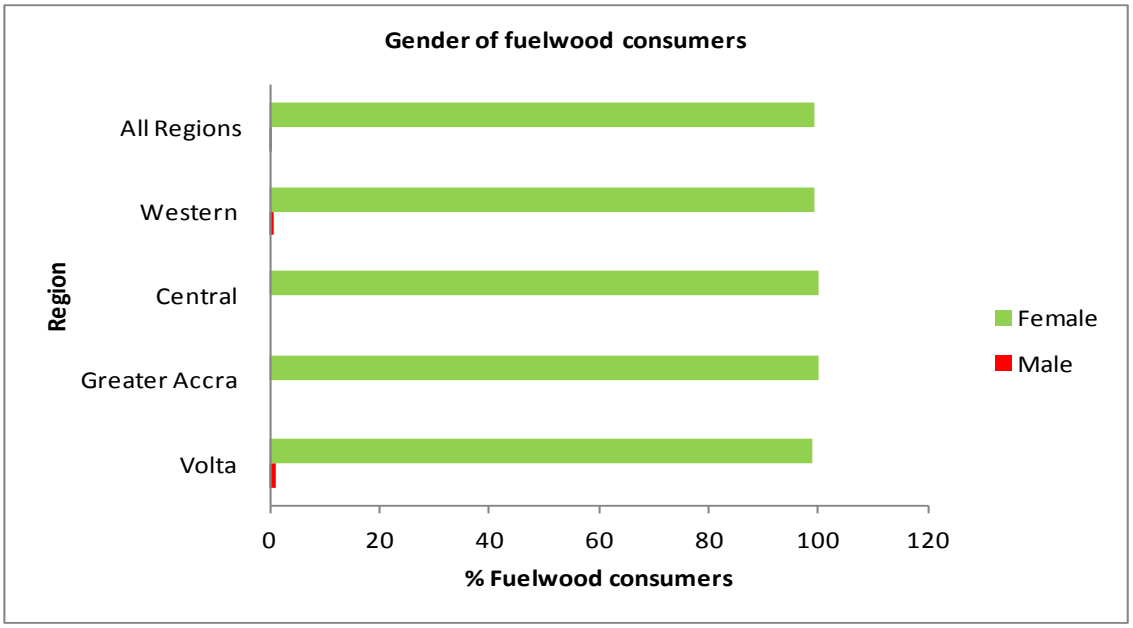

Figure 67 Gender of fuelwood consumers/fish smokers

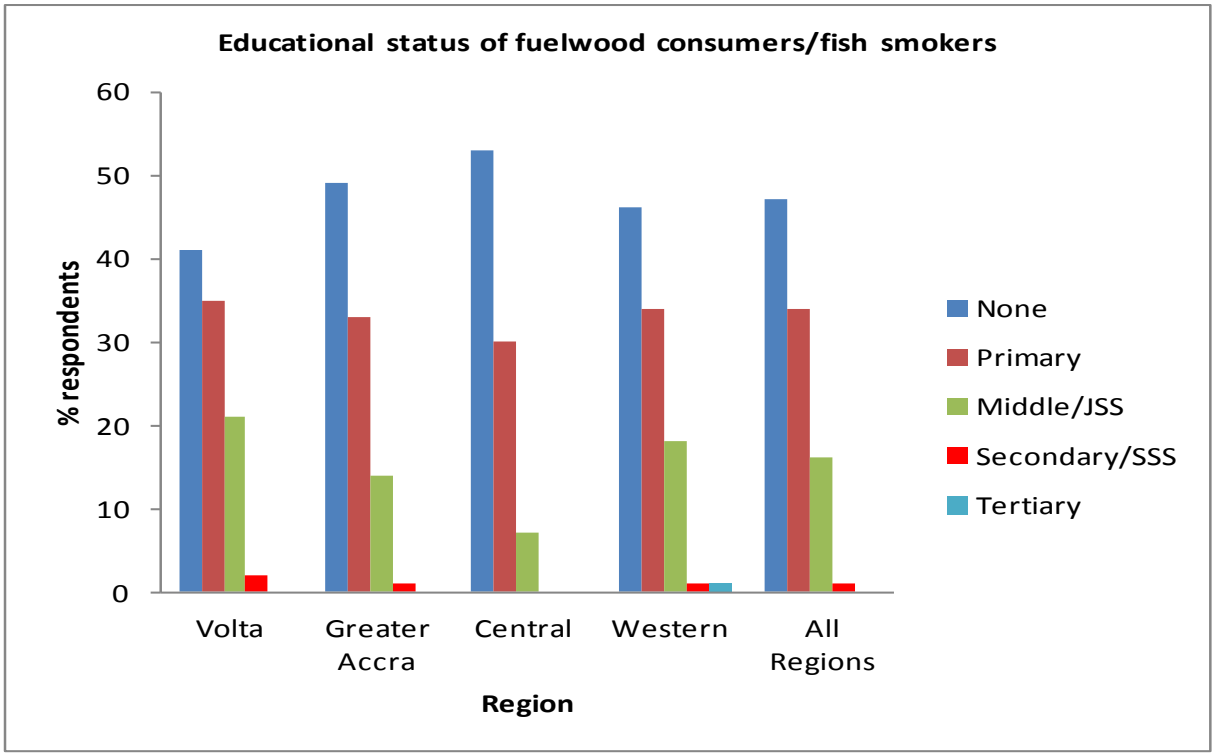

Figure 68: Educational status of fuelwood consumers/fish smokers

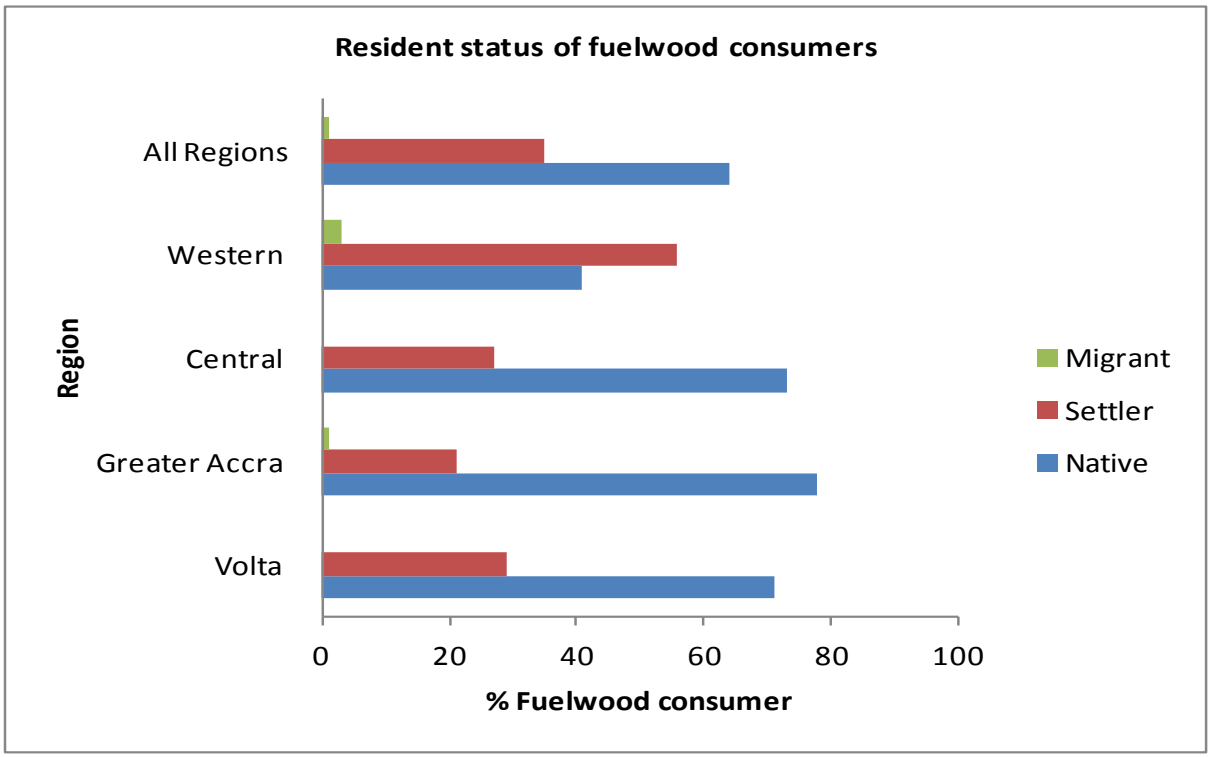

Figure 69: Residential status of fuelwood smokers

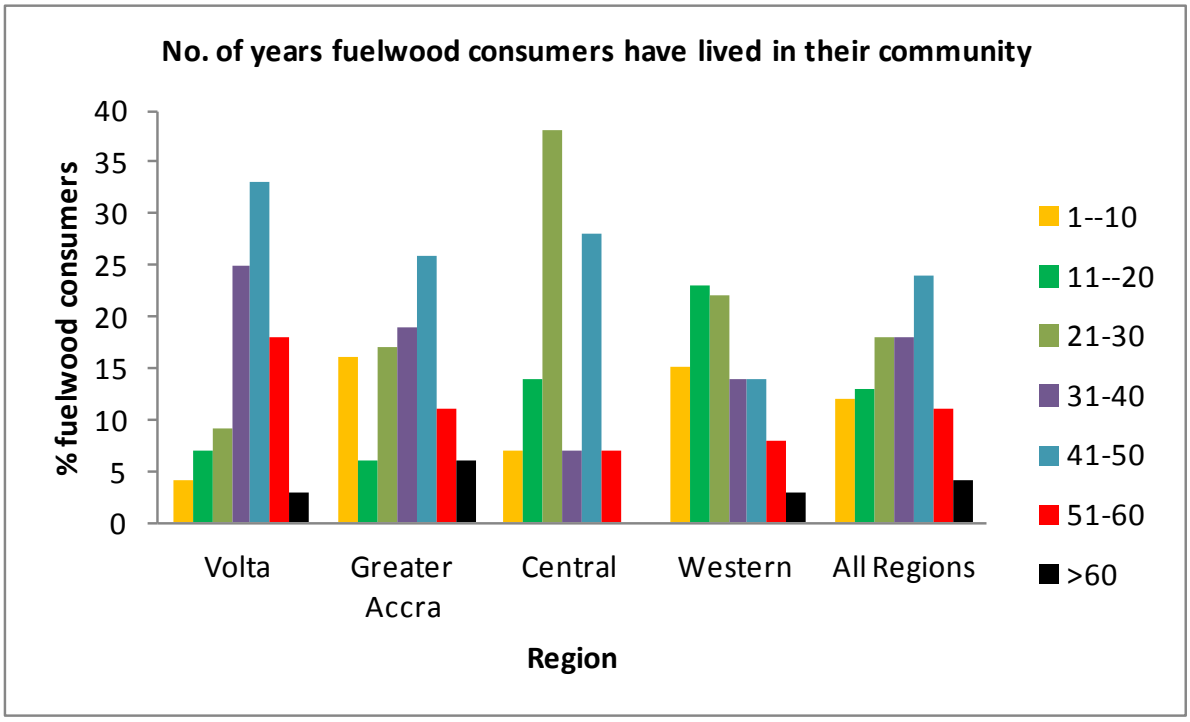

Figure 70 Number of years fuelwood consumers/fish smokers have lived in their communities

Household characteristics of fuelwood consumers/ fish smokers

Majority of fuelwood consumers are married ranging from 73% in Central to 81% in the Volta Region. On average across regions, 18% of the consumers are single parents. Household sizes for at least 80% of the traders range from 1-0 people with a few of them having >20 people (Figure 70). The average across the regions is 8 people per household.

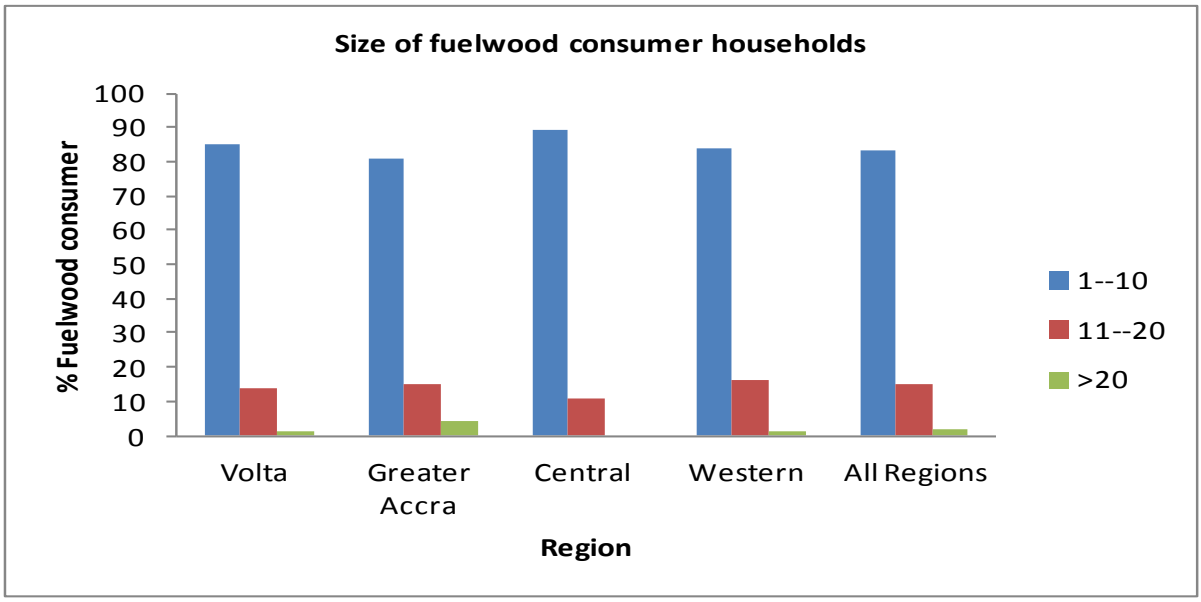

Figure 71 Size of fuelwood consumer/fish smoker households

4.5.2 The fish smoking business/enterprise

Fuelwood consumers have been in the fish smoking enterprise from less than 10 to 60 years (Figure 71). The average years of experience is 21 years across regions with a minimum of 1 occurring in Greater Accra and Western Regions and maximum of 60 years in the Greater Accra Region.

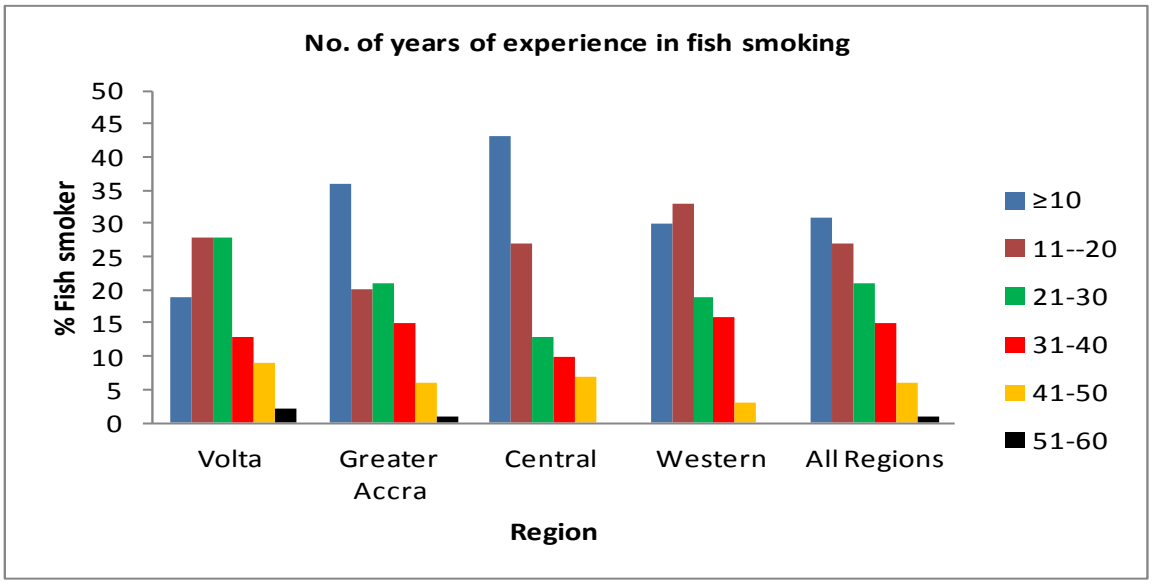

Figure 72 Number of years of experience in fish smoking

Figure 72 indicates that there are no fuelwood consumer or fish smoker associations in most communities surveyed except in few areas in the following districts:

- Volta - Keta, Ketu south,
- Greater Accra - Accra Metropolitan, Ada East, Ada West, Kpone Katamanso, LEKMA, Ningo-pramparam
- Western - Shama Ahanta, Ahanta West, Jomoro

Membership strength range from 8 in Ketu South to 200 people in Ningo-Prampram and Ahanta West Districts (Table 30). The main purpose of forming these associations is to undertake welfare activities in support of members particularly during times of bereavement. Other reasons include the potential of using group credentials as collateral in acquiring loans from banks or financial institutions and also to bargain for better prices of fuelwood and fresh fish (Figure 73).

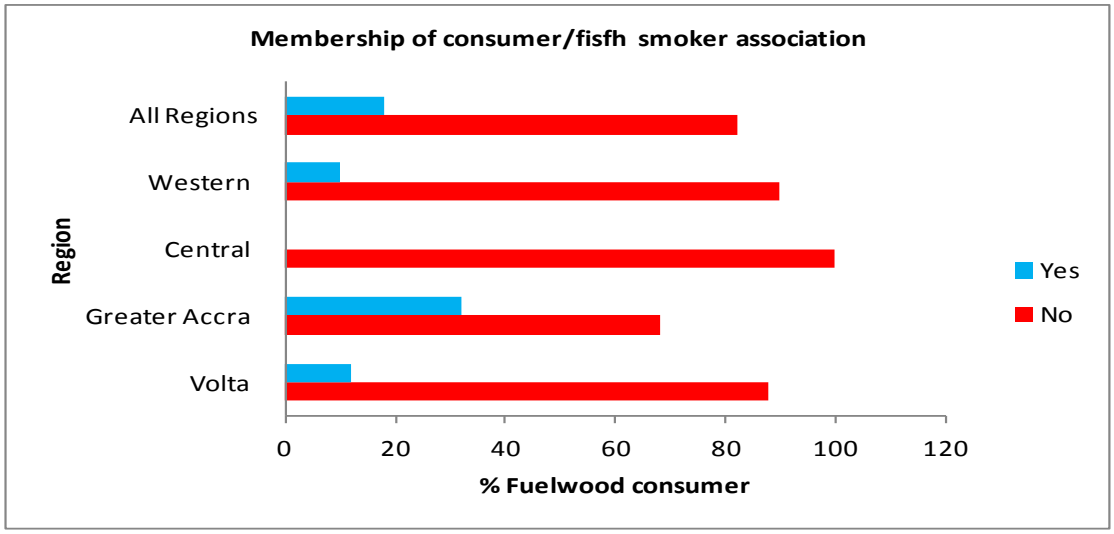

Figure 73 Membership of fish smoker/Consumer association

Table 30 Membership strength of fuelwood consumer association

District	Number of people in association
Ketu South	8-50
Keta	12-26
Ada East	26-100
Kpone-Katamanso	50-60
LEKMA	50-200
Ningo-Prampram	50-200
Ahanta West	200
Jomoro	17-135

Table 31 Distribution of membership strength of fuelwood consumer/fish smoker association

	Frequency			
	Volta	Greater Accra	Western	All Regions
≤20	8	0	2	10
21-60	4	16	5	25
61-100	0	17	1	18
>100	0	10	5	15

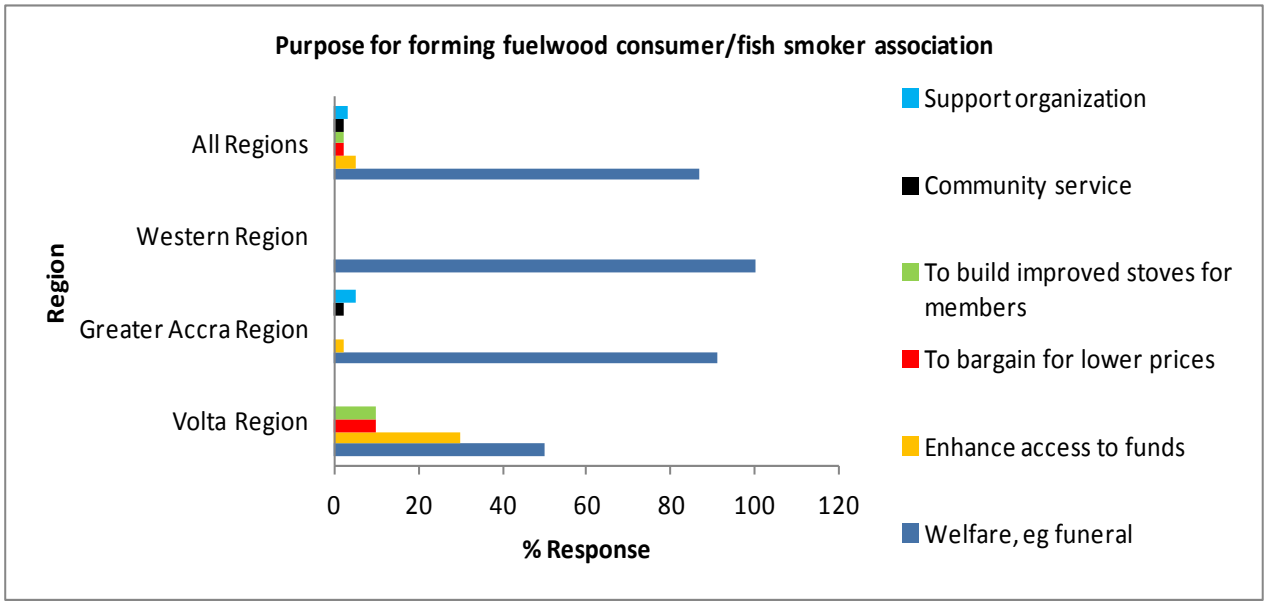

Figure 74 Reasons for the formation of fish smokers association

4.5.3 Forms of fish smoked and fuel type used

Usually fresh catch and fresh frozen fish are smoked in most fishing communities in coastal Ghana especially during the lean season when fresh supplies are low. Overall, 94% of the fish smoked is fresh catch from the sea particularly in Volta and Western Regions while is the remaining 6% is the frozen type, common smoked in Central and Greater Accra Regions (Figure 74). Variable quantities of frozen fish usually packed in paper cartons commonly called boxes are smoked per day. Eighty-six percent of the frozen fish smokers process 1-20 boxes per day (Figure 75).

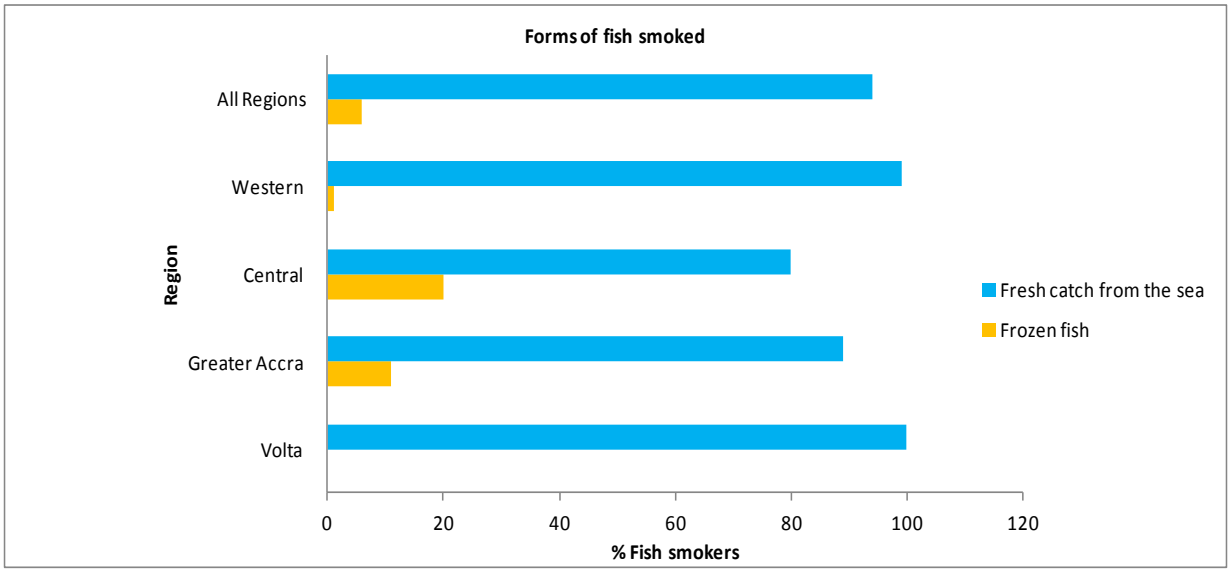

Figure 75 Proportion of fish smokers processing main forms of fish smoked

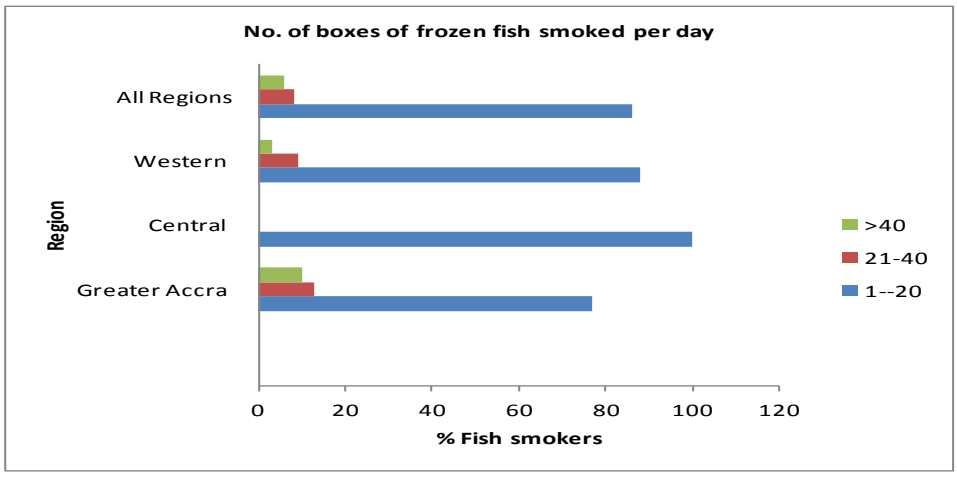

Figure 76 Distribution of quantities of frozen fish smoked per day

Usually a combination of fuel material comprising wood, coconut shell, and charcoal are used in smoking fish. However, 96% of the fish smokers use fuelwood only (Figure 76). Sugarcane husk, corn cobs and/or other materials may be added to generate smoke in addition to the heat from the wood to cure the fish. Gas and cocoanut shell may alternatively be used as the major fuel source particularly in the Volta, Greater Accra and Central Regions. Palm fronds, plastic sheet and saw dust may be used in the Western Region to compliment fuelwood in smoking while grass, cassava stick and cassava peels are used in some cases in the Greater Accra Region (Figure 77).

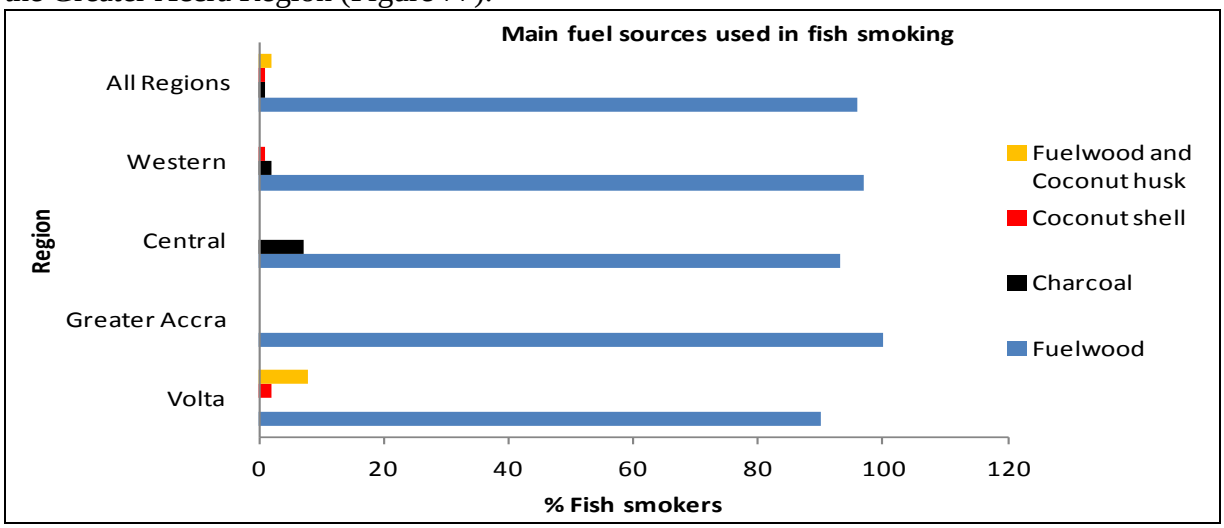

Figure 77 Fuel types used for fish smoking

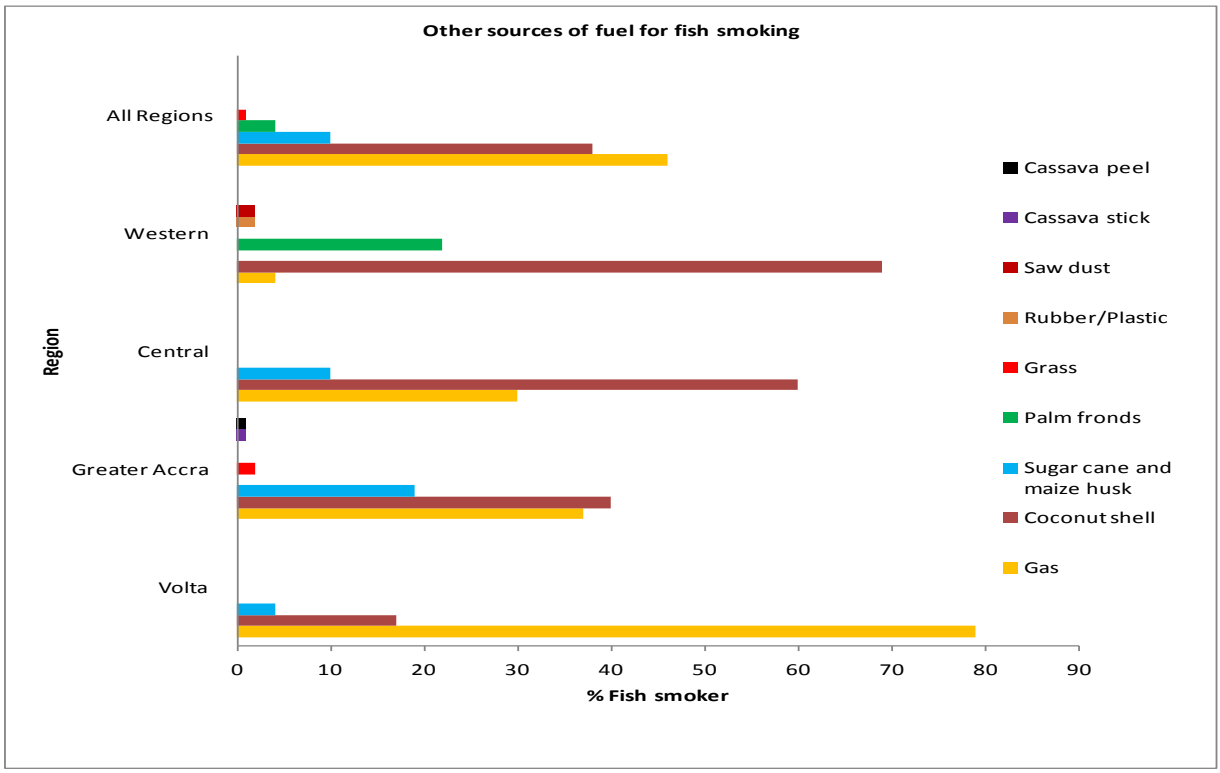

Figure 78 Other fuels used in addition to wood for fish smoking

Not all fish smokers own the stoves they use for smoking fish (Figure 78). However the majority of smokers comprising 96%, own their stoves while 4% rent or use that belonging to their family and friends. Most (78% overall) of the fish smokers own 1-5 stoves per person (Figure 79).

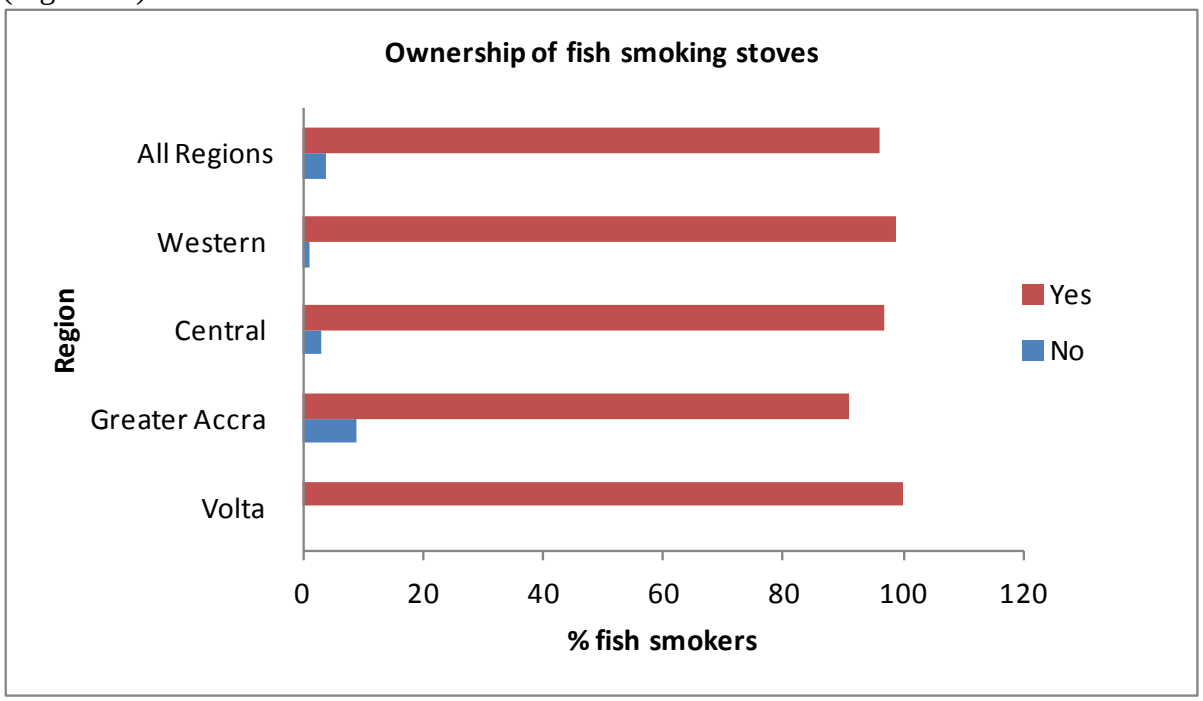

Figure 79 Proportion of fish smokers owning stoves used for fish smoking

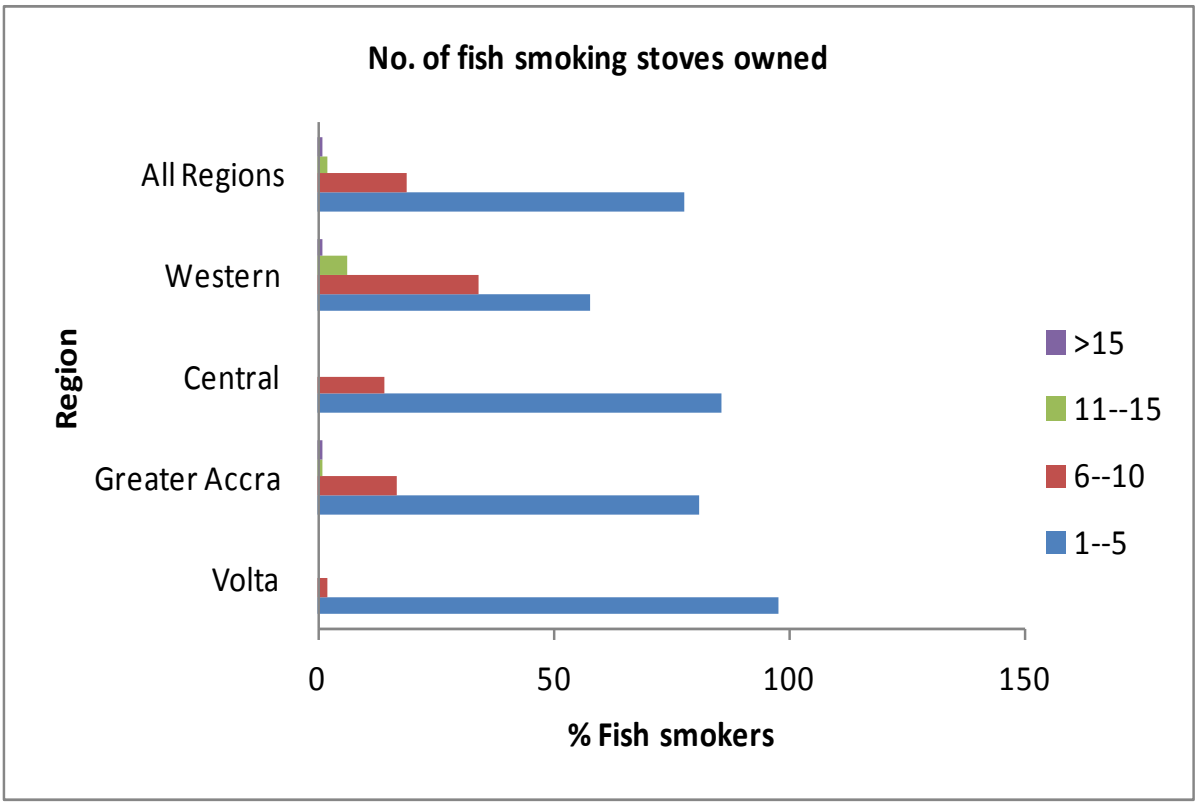

Figure 80 Distribution of the number of stoves owned by fish smokers

4.5.4 Fuelwood species used, reasons for preferences supply sources

The principal fuelwood species for coastal fish smoking based on preference and availability in the 4 coastal regions and supply sources are summarized in Tables 32 – 35. Most of the frequently used species are preferred for their denseness, hence their durability in fire. Other attributes include enhancement of fish aesthetics, i.e. colour and appearance when fish is smoked; economical to use, available and cheaper, easy to light, dry fish faster.

Volta

- Mangrove in Keta and Ketu within the Volta estuary in local areas
- Supplementary supplies of other species (Xexe, Shea, Atreti) from the transition and semi-deciduous forests in Mid-Volta areas

Greater Accra

- Neem mainly from the districts in the Accra plains for the Ada, LEKMA and Tema areas
- Mangrove from Volta delta for particularly Ada areas
- *Celtis mildbraedii (Esa), Albizia zygia (Okoro), Terminalia ivorensis (Emire), Milicia excelsa (Odum)*, cocoa, and other species from the forests in the Eastern Region for the Accra Metropolitan area e.g. Chorkor

Central

- *Celtis mildbraedii, Albizia zygia, Terminalia ivorensis* and other species from the forests in the Eastern Region
- A variety of species from clearings in the local farming areas
- Plantations of *Senna siamea* (Cassia), Neem, *Acacia sp*. and old citrus stands within the local areas

Western

- *Funtumia elastica* and other species from local farmlands and adjacent forests

- Cocoa from old stands on farms in the local area
- Rubber from old stands in the local area

Across the regions 36, 29% and 20% of consumers/fish smokers respectively take their fuelwood supplies directly from transporters, retailers and wholesalers with sale points or outlets in their communities. Direct deliveries from wholesalers and transporters is more common in the Volta Region while that from transporters and retailers common the Greater Accra, Central and Western Regions. A few others may acquire their supplies from harvesters or producers directly while others harvest the fuelwood themselves from the wild for use in the Western Region (Figure 83).

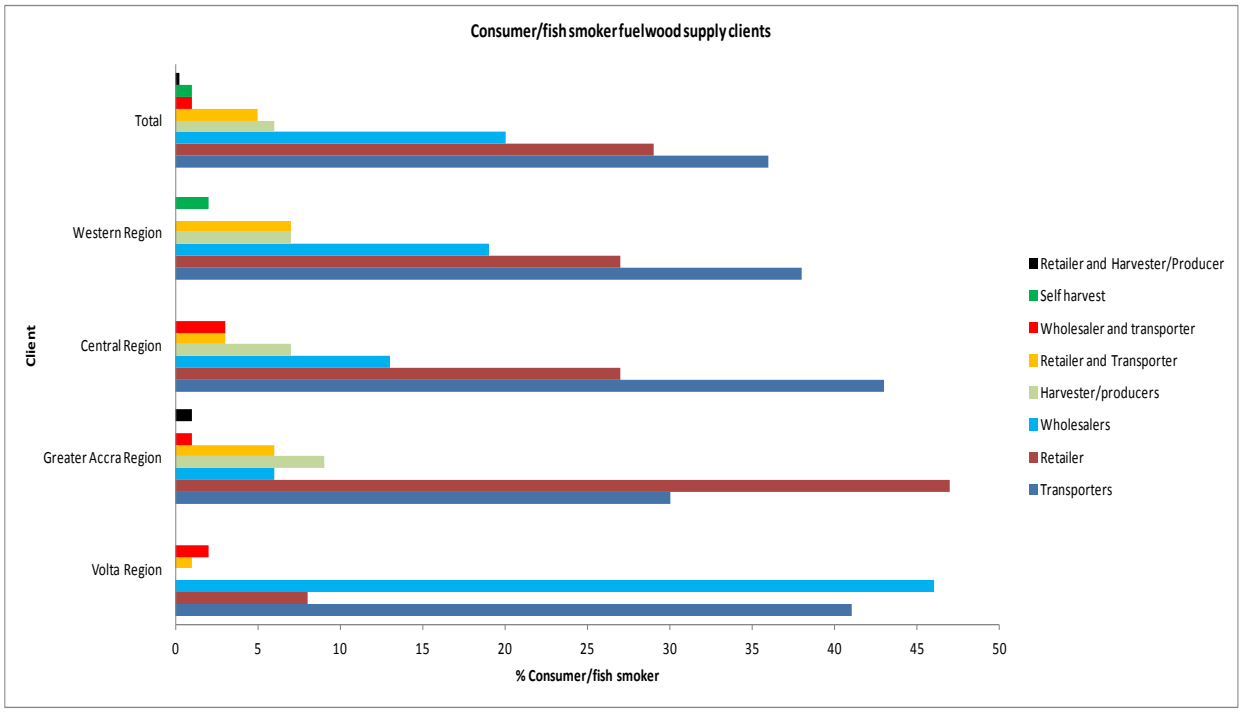

Figure 81 Proportion of consumers/fish smokers indicating clients from who they secure their fuelwood

Table 32 Species used in fish smoking in the Volta Region

Region	Species local name	% Response (Frequency of use)	Reason for use/preference in fish smoking	Source of supply
Volta	Hehe/Xexe	39	Enhance colour and taste, lasts in fire, dries and hardens fish faster, easily available, less smoky	Adaklu, Avedakpa, Dzodze, Ho, Kpetoe
	Mangrove	24	Enhance colour and taste, lasts in fire, dries and hardens fish faster, easily available, Easy to light	Anyanyui
	Shea	11	Enhance colour and taste, lasts in fire, dries and	Atidemy, Avedakpa,

			hardens fish faster	Dakpa, Ho, Kpotoe, Xevi
	Atreti	7	Enhance colour and taste, lasts in fire, dries and hardens fish faster	Avefianima, Chito, Laha, Ho, Xevi and Kpotoe
	Kinichi	6	Enhance colour and taste, lasts in fire, dries and hardens fish faster, less smoky	Ho, Kpetoe
	Neem	6	Enhance colour and taste, lasts in fire, easily available	Kpetoe, Avefianima, Afiadenyi, Ho, Xevi
	Mango	5	Enhance colour and taste, lasts in fire, easily available, dries and hardens fish faster, cheap	Ho, Avefianima, xevi and Kpotoe, Dapka
	Coconut shell	2	Enhance colour and taste, easily available	Keta and Ketu areas

Table 33 Species used in fish smoking in the Central Region

Region	Species local name	% Response (Frequency of use)	Reason for use/preference in fish smoking	Source
Central	Esa	26	Dries fish well, Easy light, lasts longer in fire	Oda
	Neem	15	Available in locally, Dries fish well, makes fish attractive, lasts longer in fire	Local farmlands
	Akutu gya	11	Dries fish well , available in locality	Fosu, Abakrampa , Kuruwa
	Begye wo ba	9	Makes fish attractive	Oda
	Emire	9	Makes fish attractive, lasts longer in fire	Oda
	Abodua	6	Less expensive, lasts longer in fire	Local farmlands
	Apasa	4	Makes fish attractive	Local farmlands
	Danta	2	Makes fish attractive	Oda
	Ofram	2	Makes fish attractive	Oda
	Ankyin	2	Makes fish attractive	-
	Ayemai	2	Lasts longer in fire	Local

				farmlands
	Bese	2	Makes fish attractive	Oda
	Kahyia	2	Makes fish attractive	Local farmlands
	Kanton	2	Makes fish attractive	Local farmlands
	Oboyono	2	Dries fish well	Local farmlands
	Okoro	2	Makes fish attractive	Oda
	Wawa	2	Dries fish well	Ayedo, Kruwe, Yamoransa

Table 34 Species used in fish smoking in the Greater Accra Region

Region	Species local name	% Response (Frequency of use)	Reason for use/preference in fish smoking	Source of supply
Greater Accra	Neem	48	Economical to use, available and cheaper, improves fish appearance, hard and lasts longer in fire, easy to light, dries fish faster	Ada, local farmlands, Ningo, Katamanso, , Akuse, Afianya, Agortor, Kpone, Tsokpoli, Aplonia, Kokompe, Dawenya, Dawa, Osudoku Akwamufi
	Esa	16	Hard and lasts long, dries fish quicker, Improves smoked fish appearance , available and cheaper	Baudwase, Asamnakese, Nkwawkwaw,
	Gyewoba	7.1	Hard and lasts long, dries fish quicker, Improves smoked fish appearance , available and cheaper	Baudwase, Asamnakese, Nkwawkwaw,
	Mangrove	7.1	Dense and lasts long in fire, dries fish quicker, Improves smoked fish appearance , available and preserves fish for	Local mangrove swamps

			long	
	Danta	5.8	Hard and lasts long, dries fish quicker, Improves smoked fish appearance , available and cheaper	Baudwase, Asamnakese, Nkwawkwaw,
	Cocoa	3.1	Available and cheaper, lasts long in fire, dries fish faster/drains fish well	Baudwase, Asamnakese, Nkwawkwaw,
	Odumakpe	3.1	Smokes fish well, Improves appearance, available, lasts long in fire	
	Wawa	2.2	Improves smoked fish appearance	Baudwase, Asamnakese, Nkwawkwaw,
	Kaatso	1.3	Available and improves smoked fish appearance	-
	Nokotso	0.9	Improves appearance of smoked fish	-
	Antsi	0.8	Available and cheaper	-
	Atotse	0.8	Lasts long in fire, adds colour to fish, drains fish well	=
	Emire	0.4	Adds colour, drains fish well	Baudwase, Asamnakese, Nkwawkwaw,
	Kaatso	0.4	Available and improves smoked fish appearance	-
	Lablaji	0.4	Available	-
	Mango	0.4	Available	=
	Odum	0.4	Lasts long in fire	Baudwase, Asamnakese, Nkwawkwaw,
	Okoro	0.4	Cheaper	Baudwase, Asamnakese, Nkwawkwaw,

	Sankaney	0.4	Less expensive	-
	Senei	0.4	Lasts long in fire	-

Table 35 Species used in fish smoking in the Western Region

Region	Species local name	% Response (Frequency of use)	Reason for use/preference in fish smoking	Source
Western	Rubber	17	Available in area, makes smoked fish attractive	Apemanin, Esuboye, Achonwa
	Alokoba	16	Hard so lasts longer in fire, makes fish attractive	Atwonwa, Ngalekyi
	Esa	10	Available, makes fish attractive	Daboase, Manso, Adanse
	Donkoni	6	Available, lasts longer in fire	Akonu, Domuni, Eghan
	Abebele	5	Dries fish faster, makes smoked fish attractive, last longer in fire, produces good frame, available in area	Ngalekyi
	Wawa	4	Available, makes fish attractive	Amakaw, Daboase, Ngalekyi
	Odum	4	Available, makes fish attractive	Daboase, Adanse
	Cocoa	4	Available, makes fish attractive	Daboase, Adanse, Boodie, Senkyem
	Dahoma	4	Available, lasts longer in fire, produce less smoke	Daboase, Adanse, Krobo, Ango
	Koodjabena	4	Available, makes fish attractive, lasts longer in fire	Daoase, Bakam
	Afam	3	Makes smoked fish attractive, lasts longer in fire	Akonu, Domuni, Eghan , Achonwa
	Apriem	3	lasts longer in fire	Aniabo
	Fanle	2	Lasts longer in fire , makes smoked fish attractive	Domuli, Akonu, Eghan

	Kako	2	Available	Daboase
	Mpoahene	2	Available fuelwood, produces less smoke, lasts longer in fire	Achonwa
	Pkunumi	2	last longer in fire	Akonu, Domuni, Eghan
	Onyina	2	Available fuelwood	Beposo, Daboase
	Edwen	2	Dries fish well	Achonwa
	Teak	2	Available fuelwood	Daboase
	Coconut tree	1	Available, lasts longer in fire	
	Mango	1	Available fuelwood	Daboase , Esuboye
	Funtum	2	Available	Adansi, Essaman
	Opepe	1	Lasts longer and produce less smoke	Daboase
	Mahogany	1	Available fuelwood	Daboase
	Nyamedua	1	Available fuelwood	Manso

4.5.5 Constraints in the use of fuelwood for fish smoking and remedial measures

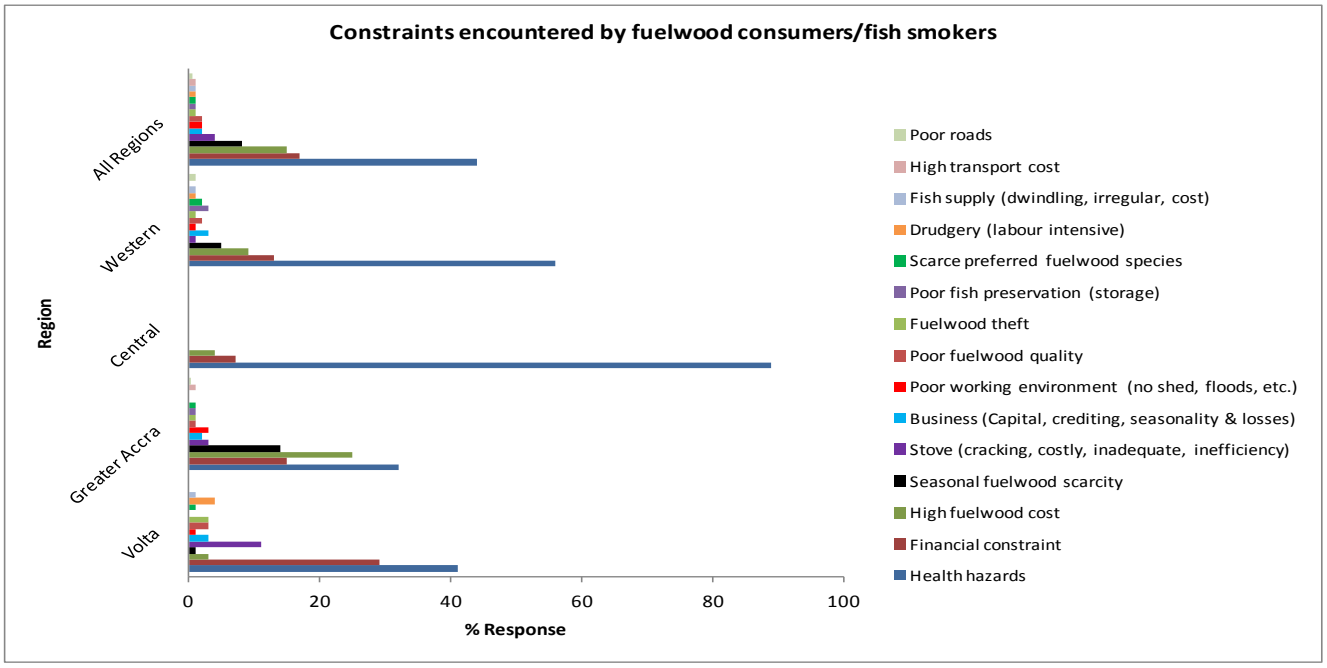

Figure 82 Constraints encountered by fuelwood consumers/fish smokers

Plate 10: Smoke pollution from fish smoking

Table 36 Constraints encountered in fuelwood consumption for fish smoking

No.	Consumer problem	Volta	Greater Accra	Central	Western	All Regions
1	Health hazards	41	32	89	56	44
2	Financial constraint	29	15	7	13	17
3	High fuelwood cost	3	25	4	9	15
4	Seasonal fuelwood scarcity	1	14	-	5	8
5	Stove (cracking, costly, inadequate, inefficiency)	11	3	-	1	4
6	Business (Capital, crediting, seasonality & losses)	3	2	-	3	2
7	Poor working environment (no shed, floods, etc.)	1	3	-	1	2
8	Poor fuelwood quality	3	1	-	2	2
9	Fuelwood theft	3	1	-	1	1
10	Poor fish preservation (storage)	-	1	-	3	1
11	Scarce preferred fuelwood species	1	1	-	2	1
12	Drudgery (labour intensive)	4	-	-	1	1
13	Fish supply (dwindling, irregular, cost)	1	-	-	1	1
14	High transport cost	-	1	-	-	1
15	Poor roads	-	0.3	-	1	0.4

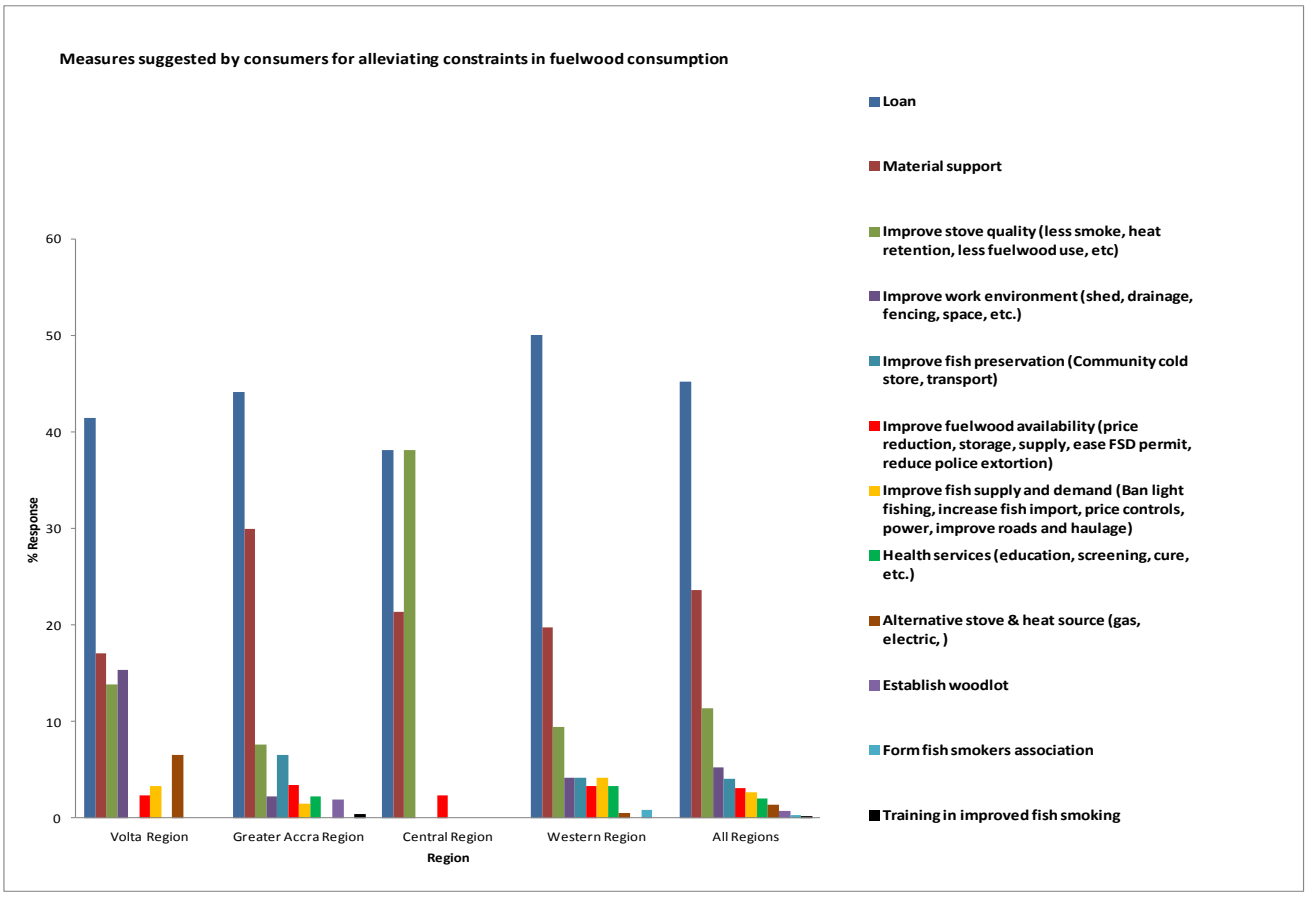

Figure 83 Measures suggested for alleviating constraints in fuelwood consumption for fish smoking

Table 37 Measures suggested by fuelwood consumers to alleviate constraints

Remedial measures for consumer problems	Volta Region	Greater Accra Region	Central Region	Western Region	All Regions
Loan	41.5	44.1	38.1	50	45.2
Material support	17.1	30	21.4	19.8	23.6
Improve stove quality (less smoke, heat retention, less fuelwood use, etc)	13.8	7.6	38.1	9.4	11.4
Improve work environment (shed, drainage, fencing, space, etc.)	15.4	2.3	-	4.2	5.3
Improve fish preservation (Community cold store, transport)	-	6.5	-	4.2	4.1
Improve fuelwood availability (price reduction, storage, supply, ease FSD permit, reduce police extortion)	2.4	3.4	2.4	3.3	3.1
Improve fish supply and demand (Ban light fishing,	3.3	1.5	-	4.2	2.7

increase fish import, price controls, power, improve roads and haulage)					
Health services (education, screening, cure, etc.)	-	2.3	-	3.3	2
Alternative stove & heat source (gas, electric,)	6.5	-	-	0.5	1.4
Establish woodlot	-	1.9	-	-	0.8
Form fish smokers association	-	-	-	0.9	0.3
Training in improved fish smoking	-	0.4	-	-	0.2

4.6 Profit along the fuelwood value chain

The price and profit as a bundle of firewood is moved in the distribution chain across regions surveyed is presented in Figure 83 and that for Volta, Greater Accra, Central and Western Regions are presented in Figure 84-87). The value addition is the transformation process from the standing tree to the splits or pieces of wood used by the consumer for fish smoking. Costs incurred by producers include permit or access fee for the resource, labour charges for harvesting and processing of firewood, loading and off-loading and District Assembly or village levy or way bill for haulage to delivery points in fishing communities. Other costs incurred by other intermediaries include transportation, labour charges, packing material cost, illegal payment, transport permit and commission charges. The mean farm gate price per bundle of variable weight and quantity of pieces is GH₵2.50 (range: GH₵2 in Central – GH₵ 3.5 in Western) while the retail price is GH₵ 8 on average (range: GH₵5 in Central-GH₵12 in Volta). Both the transporter and trader add almost the same worth of value before consumption by the fish smoker. On the whole the trader earns the highest (49.2%) of the price spread and 50% of the profit share for selling the bundle.

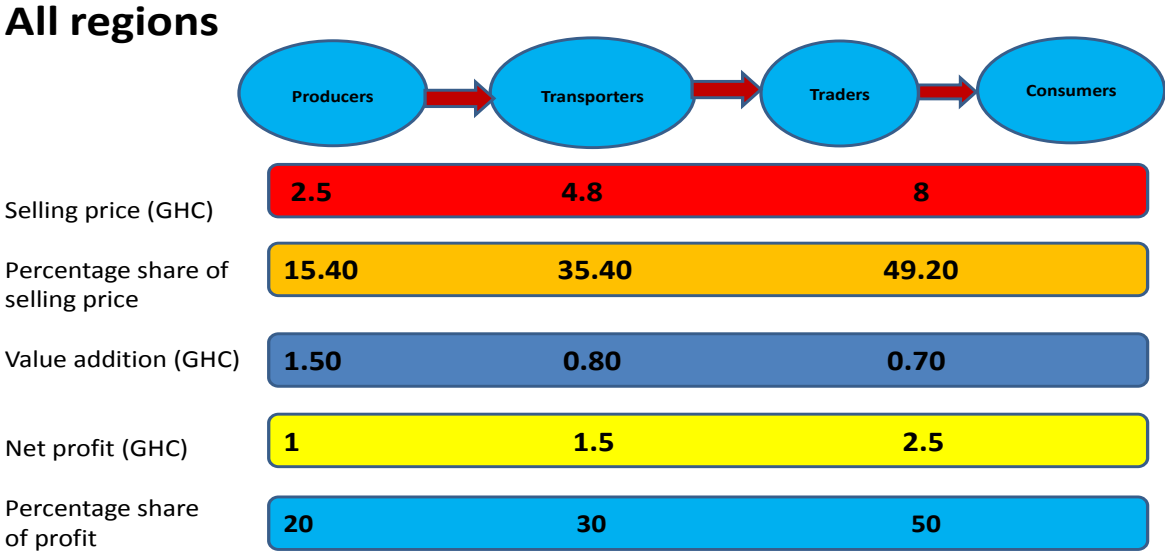

Figure 84 Costs, gains and worth of value added per bundle of fuelwood along the chain - All regions

Overall, producers earned the least price (15.4%) and profit (20%) share across regions except in the Western Region where they gained the highest profit share of 48.2% (Figure

83). Higher vehicle running costs resulted in transporters in the Volta, Central and Western Regions earning the least profit shares of 27.5%, 20.7% and 14.8% in the respective chains. This compels transporters to over load vehicles to maximize their profits often leading to breakdowns and motor accidents en-route to market.

Plate 11 Vehicles loaded with fuelwood for delivery in fishing communities in the Central Region

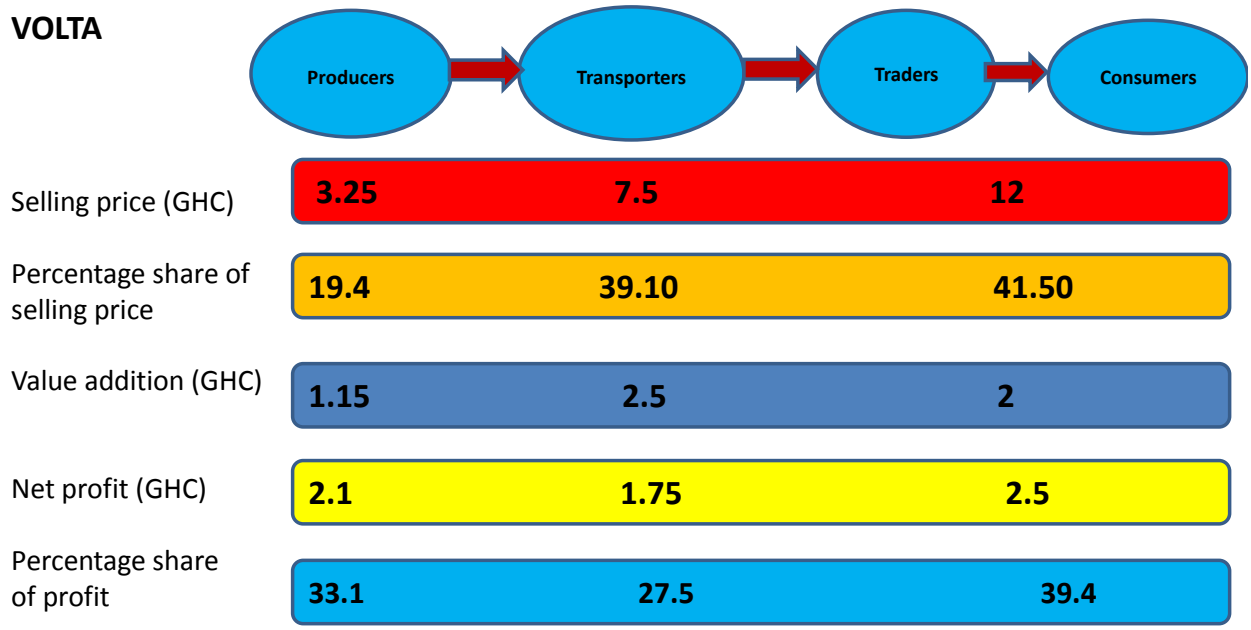

Figure 85 Costs, gains and worth of value added per bundle of fuelwood along the chain -Volta

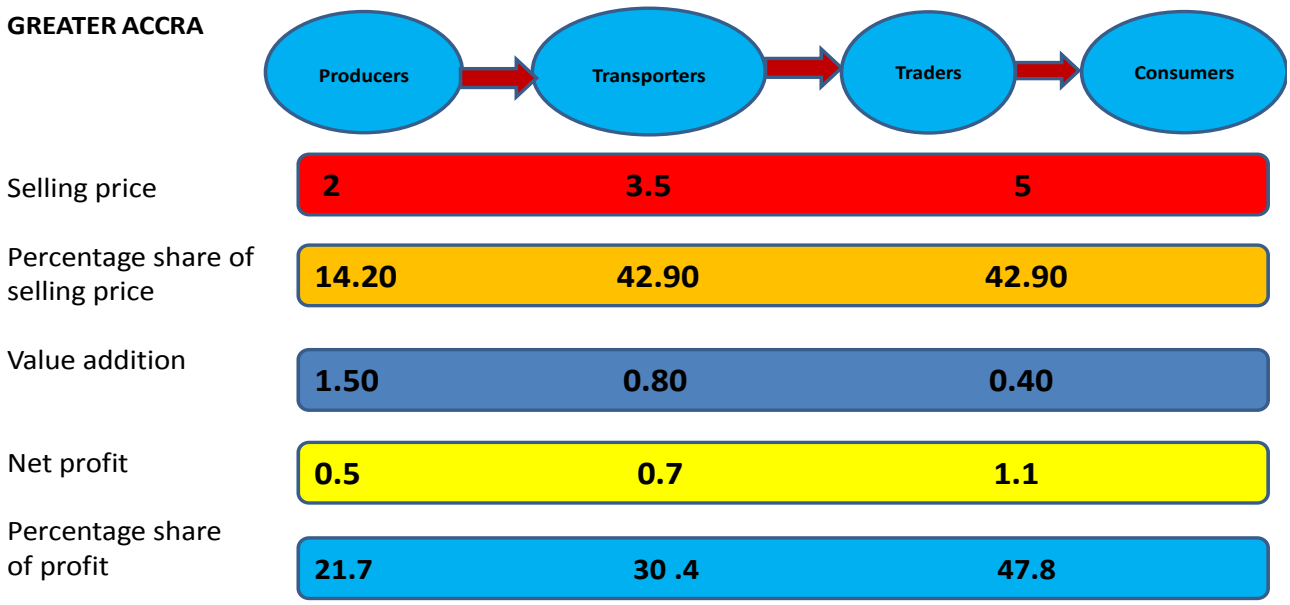

Figure 86 Costs, gains and worth of value added per bundle of fuelwood along the chain - Greater Accra

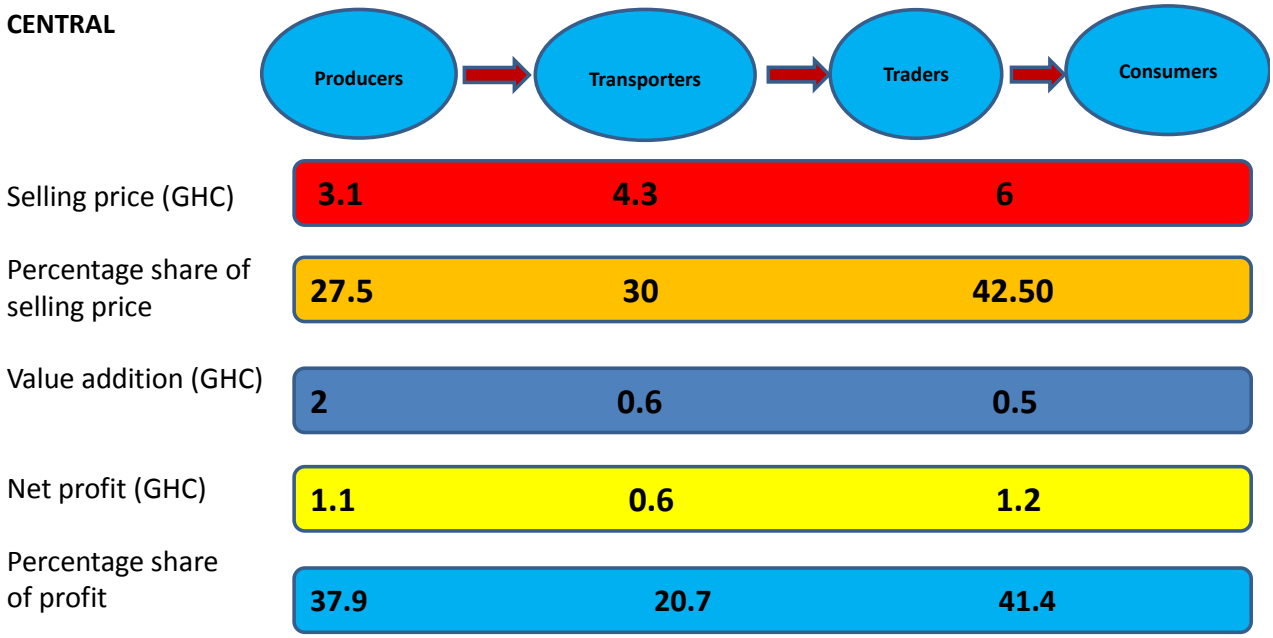

Figure 87 Costs, gains and worth of value added per bundle of fuelwood along the chain – Central

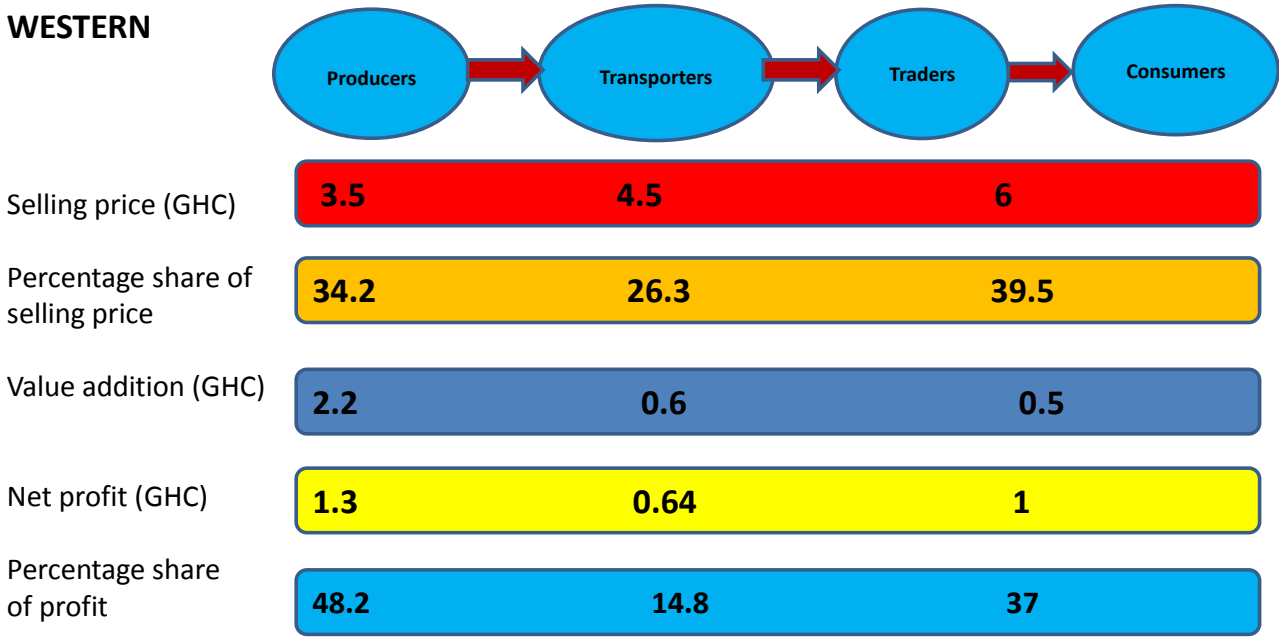

Figure 88 Costs, gains and worth of value added per bundle of fuelwood along the chain-Western

4.7 FISH SMOKING AND MANGROVE ECOSYSTEM: IMPLICATIONS FOR SUSTAINABLE CONSERVATION OF FISH NURSERIES

4.7.1 INTRODUCTION

Generally, mangroves are vital resources along coastal forest margins essentially maintaining ecological balance and providing a variety of provisioning, protection and other benefits to wildlife and communities in these ecosystems. Through photosynthesis, mangroves supply nutrients and oxygen to animals and plants in the ecosystem. It is estimated that every hectare of mangroves can feed 12 tonnes of living things. Mangroves are also foraging and living places for wildlife and serve as hiding places and shelters against adverse weather. Their root systems absorb inorganic substances and reduce water pollution. For instance nitrogen and phosphorous, metals as well as chemical oxygen are lowered. Generally mangroves serve as hedges protecting coastlines against strong tidal waves. In Guyana they have been used as sea defense material against denudation of the coastline (Allan *et al.*, 2002). Their root systems serve as barrier protecting the coastlines against erosion thus stabilizing the coastlines of the river shores and estuaries.

Mangroves along the coastline of Ghana tend to be associated with coastal lagoons and estuaries. Its distribution is sparse with populations degraded through overcutting and conversion of mangrove areas to salt pans. The total area of mangrove land along the Ghanaian coastline was estimated in 1995 at 10,000 ha. Mangroves are more prevalent along the eastern coastal areas of Ghana especially at the Volta delta. A few stands occur along the western coastline in areas such the Amansuri River estuary and Kakum River estuary at Iture. The species of mangrove found along the Ghana coast are the red mangroves, *Rhizophora racemosa*, *Rhizophora mangle* and *Rhizophora harrisonii* (locally called Atra), the black mangrove, *Avicennia germinans* (locally called Amutsi) and white mangrove, *Laguncularia racemosa*. Mangrove habitats along the Ghana coast also tend to host a wide variety of fauna species such as oysters, gastropods, crabs, invertebrates, birds and fish. Mangrove habitats are also particularly as nursery areas for many fish species and crustaceans (Anderson, 2010).

Mangroves have been exploited decades in coastal areas of Ghana for these socio-economic benefits. Over dependency on these resources without adequate conservation measures poses a threat to wildlife, protective functions against strong tidal waves and livelihoods of and long term sustainability of the fishery industry. This section of the report briefly discuss the extent of utilization of mangrove resources as well as challenges and opportunities associated with these resources and suggest options for sustainable use and conservation particularly to protect fish nursery sites.

4.7.2 Mangrove resources in the coastal regions of Ghana

Mangroves occur in several estuaries of river deltas along the coastal wetlands of Ghana but particularly in the Volta, PRA and Ankobra Deltas. 38% of resource owners interviewed during the survey managed mangroves for fuelwood mainly for fish smoking. Both gender own and produce fuelwood from mangrove. Mangrove resources are commonly found on family land especially in the Western Region where 100% of mangrove resource owners manage family mangrove lands. In the Central region 45% of resource owners purchased mangrove land outright while about 42% of those in the Volta Region acquired their production area from a community or on hire basis (Figure 88).

Plate 12 Some mangrove sites visited in the Volta and Central Regions

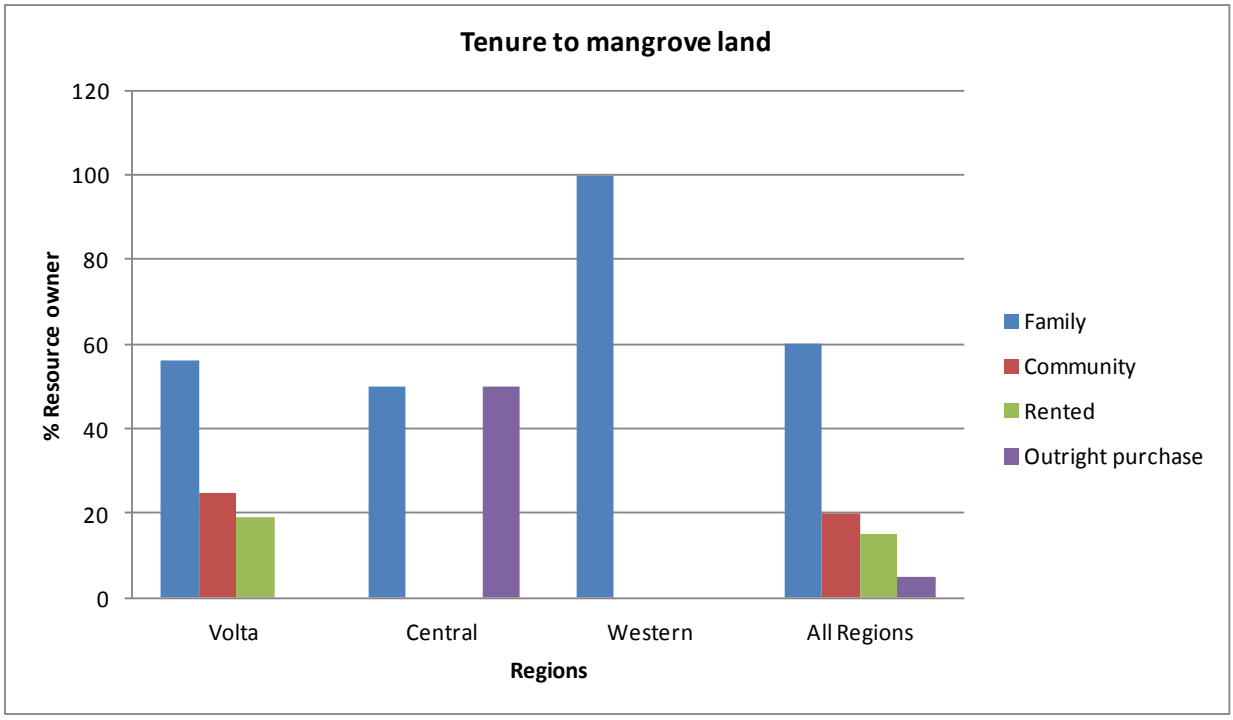

Figure 89 Tenure to mangrove land in Ghana

Mangroves either occur in natural stands or planted in the Volta, Central and Western Regions. 100% mangrove resource owners interviewed in the Volta region planted their resource. Plantation sizes range from 2-20 acres. Three mangrove species were identified during the survey i.e. Red, White and Black mangroves (Plate 13). It was observed that the red mangrove with the stilt roots occur along the margins of the estuary or river while the black and white species occur further on the islands.

Plate 13 Estimating mangrove wood volumes in the Keta District of the Volta Region

Plate 14 Identifying mangrove species in the Keta District of the Volta Region

Plate 15 Three mangrove species along the Volta Estuaries

4.7.3 Harvesting and stand management

Mangroves are extensively harvested (Plate 14) as nearly all parts of the matured tree are used for fish smoking. Resource owners pursue a range of management strategies to ensure mangrove grows to maturity. The red mangrove seeds naturally while the white and black species are established through seedlings.

Aside re-establishing a mangrove stand after harvesting some owners in the Volta and Western Regions deliberately aid natural regeneration through enrichment planting. Resource owners and fuelwood producers indicate that mangroves grow for 6-12 years or more to maturity.

Plate 16 Harvesting of mangrove for sale

Plate 17 Mangrove natural regeneration at the Volta estuaries

4.7.4 Dependency on mangroves for livelihood

The livelihood importance of mangroves in some coastal communities surveyed is illustrated in Plate 15. It was observed during the survey that in the tidal zone of all estuaries and lagoons in coastal areas of Ghana mangroves are important resources serving as a source of firewood for fish smoking and domestic cooking. Along the Volta estuary in the Keta and Ketu Districts as well as in the Pra delta in Shama Ahanta District, production and trading in mangrove fuelwood for fish smoking is an important economic activity to some households and the local economy. The entire mangrove plant i.e. the stem, roots and branches is used for fish smoking. The wood is used for charcoal production, lumber or poles for construction of houses, bridges and for wood working. The mangrove ecosystem is also a habitat for crabs, fishes and other crustaceans as well as fish nurseries. Mangroves also provide scenic beauty in the landscape particularly along the estuaries in the Volta and Ankobra deltas and are potential resources for ecotourism development.

Plate 18 Livelihood options associated with the mangrove in the Volta estuaries

Plate 19 Mangrove as fish nursery, landscape scenic beauty and barrier to erosion and pollutants -Keta District

Plate 20 Trading mangrove fuelwood: Units of sale at the harvesting point and on the market

4.7.5 Threats or challenges to sustainability

Over exploitation of the mangrove fuelwood and poor management of the mangrove stand (Plate 18) are threats to the sustainability of the resource especially for fish nursery. Further,

in some areas in the Central and Western Regions where the resource is on community wetland, exploitation is not regulated. The principal problem resource owners encounter with mangroves is its long gestation period as the wood is harvested throughout the year and the rate of regeneration is slow.

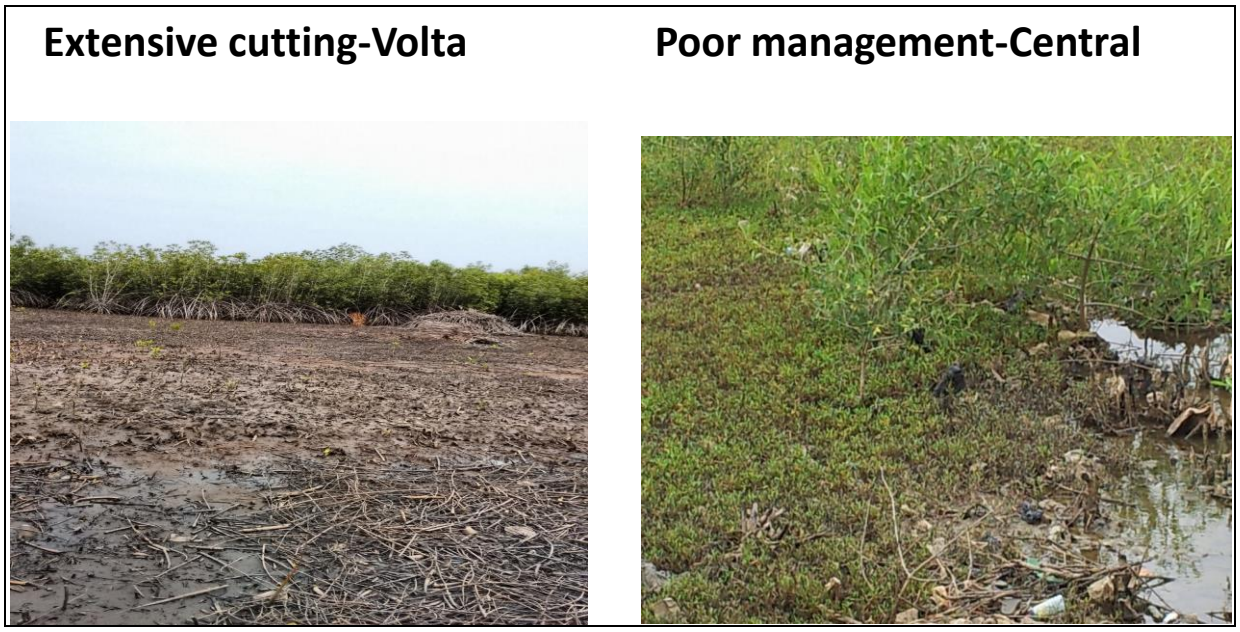

Plate 21 Potential threats to mangrove ecosystem sustainability

4.7.6 Options for sustainable utilization and conservation of mangroves as fish nurseries

The mangrove ecosystem is intertwined with the livelihoods of communities in which they occur. Along the Volta estuary, where there are limited wood resources, mangrove is the predominant resource exploited for fish smoking. The following are being recommended to augment earlier attempts or interventions executed in mangrove communities to prevent its degradation and to safeguard livelihoods and the fishery economy in general.

- Promote community based management of mangrove areas but these need to be areas of exclusive use rights by various communities
- Up-scaling planting including enriching natural regenerated sites for both community, family and privately owned lands
- Need for application of silviculture techniques to enhancing mangrove growth to reduce maturity growth of 12 years or more
- Buffer zone management (EPA, Wildlife, district Assembly, community heads, landowners must be consulted)
- Development of alternative fuelwood resources in areas outside mangrove ecosystem in mangrove dependent communities to relieve pressure and over dependence on mangrove for fuelwood and other wood needs. Advantage can be taken of the large tracts of idle land outside mangrove habitats planted with alternative short rotation fuelwood species suitable for fish smoking with landowners. There are pockets of neem, acacia, eucalyptus and cassia stands in the coastal landscape. The preferred species among these by the fish smokers can be promoted. Alternatively, the range of traditional species outside the mangroves that are preferred for fish smoking for their distinct characteristics e.g. enhancing fish colour or looks, can be screened to

recommend the most healthy species and or longer lasting when burnt in fire to smoke fish

- Study shows there are other sources of wood from forest areas in the hinterland for fish smoking even in the Volta Region. Promote woodlot in endemic fuelwood producing areas
- Promotion of alternative market based livelihoods/land use options in mangrove ecosystem (crab and shrimp culture, etc.) to reduce over dependency on mangrove resources for income
- Explore possibility of compensation payments i.e. (PES-payment for environment schemes to land to reduce mangrove cutting for fuelwood.
- In conclusion it is suggested that all relevant stakeholders concerned with the mangrove ecosystem could be engaged in consultations or in round table discussions to prioritize and agree on the most feasible options in the short, medium and long terms. Associations and traditional authorities will play a major role to facilitate these discussions and negotiations.

5.0 CONCLUSIONS

The socio-economic significance of fuelwood in the fishery economy of Ghana and particularly along the coastal belt cannot be underscored. This study has analyzed the fuelwood value chain in five regions associated with fuelwood production, transportation, trading and consumption for fish smoking in Ghana. The objective was to provide a thorough understanding of the nature of economic agents, transactions and constraints associated with the fuelwood value chain and propose policy, development and research actions to enhance the chain. A wide range of actors associated with the chain were consulted for information which has been summarized descriptively and quantitatively.

Results from the study shows that fuelwood is produced in the coastal regions as well as forest areas and supplied in fishing communities directly from the producer or through transporters and middlemen that act intermediaries for smoking fish from farmlands off-reserves (49% mainly Greater Accra, Central, Western, Eastern), government forest reserves (22% Western, Eastern) as well as from plantations (29% mainly in Volta, Greater Accra, Central) of mangrove, neem, cassia and acacia species. Spent wood from cocoa, rubber and orange plantations sourced for fuelwood. 70% of producers do not own the resource. Although 80% of producers claim all year round availability, resources are situated in distant locations. Thus at least 5km or more have to be traversed in such of fuelwood. Seasonal demand regulated by seasonal fish availability may dictate quantity flows on the market. Hard wood species with dense wood and higher calorific values that remain longer in fire are preferred for smoking bigger fishes (Tuna, etc.) while soft wood species, smaller branches and twigs used in smoking smaller fishes. Popular species preferred for smoking fish include Mangrove, Celtis (Esa), Albizia (Okoro), Funtum, Neem and Cocoa. Retail and wholesale trading of the fuelwood occur usually in unorganized locations scattered within the fish smoking areas.

Fuelwood is the major fuel for fish smoking all year round and the people or actors involved in its production, transportation, trading and consumption rely on the associated enterprises as their primary or secondary income source. Both genders are involved in the various sections of the chain although men dominate production and transportation while women dominate trading (92%) and consumption (99%). At least over 50% of the actors are literate. Up to 90% of the actors are permanent residents in their local areas of operations but often not organized into functional business associations. Overall, fuelwood producers tend to earn the

least profit (20%) and traders the highest profit (50%) along the chain. In some cases transporters may earn the least profit. This means higher volumes of fuelwood extracted and traded to meet monetary needs of households.

A number of economic, technical, physical, environmental, social and institutional constraints were reported by the actors along the chain. These range in summary from financial and material limitations; drudgery, hazards and health problems; poor roads, work environment and wood decay among others. Fuelwood scarcity was not necessarily a priority constraint to actors along the chain. However, its long term availability for the sustenance of the fish smoking industry remains a challenge due to the continuous harvesting all year without commensurate planting or regeneration. Moreover producers are travelling up to 20km to harvest fuelwood which are signs of resource decline. It was also observed that mangroves provide provisioning, protective and regulatory benefits or roles in the coastal ecosystem. Yet their current rate of exploitation for socio-economic needs particularly for fish smoking poses environmental threats and more importantly its use as fish nurseries to sustain the fishery economy.

There are opportunities for enhancing the chain. Resource owners, government departments and traditional authorities in producing and consuming areas associated with activities along the chain are particularly interested in the sustainability of the resource. These can assist in consultations for addressing value chain challenges. Promoting wide scale fuelwood plantations is feasible. Most of the actors are locally residents of their areas of operation, are at least 50% literate and knowledgeable with over 10 years of experience in their respective enterprises. Although largely unorganized in business associations they can be mobilized and their capacity built for actions targeted for reducing barriers or constraints in the value chain. Fuelwood will continue to be a vital resource for fish smoking in pending decades in Ghana. This is because it is cheaper and enhances flavour and other qualities of smoked fish. Income from the fuelwood related activities of each actor or segment of the chain is essential for household upkeep and welfare. The Appropriate recommendations to address the constraints are summarized in section 5.2.

6.0 RECOMMENDATIONS: OPTIONS FOR ENHANCING THE FUELWOOD VALUE CHAIN

Every segment of the value chain from production to consumption has peculiar technical and economic constraints that require redress to enhance the chain. Nevertheless, there are cross-cutting socio-economic issues related to drudgery, health, business associations or cooperatives that equally require redress**.** Key recommendations proposed for enhancing the fuelwood value chain are summarized under the sections that follow**.**

6.1 Resource governance

- Cross-sectoral policy for fuelwood resource development and regulation
- Policy for market/trade regulation (involving stakeholders in the value chain)
- Management of fuelwood resources including efficient harvesting (involving resource owners, harvesters, FSD, etc)

6.2 Building capacity and promoting woodlots for fuelwood production

- Fuelwood plantation program for endemic producing areas, targeting landowners and traditional authority in agroforestry systems using species preferred for fish smoking.

District Assembly, FSD and Energy Commission must be involved in this project. National Plantation Development Strategy/Program for 2015-2040 by the Forestry Commission must be consulted

- Education/awareness creation on fuelwood resources and potentials in developing them as alternative agro-based livelihood and lucrative land use options in rural communities among producers could be pursued
- Promote woodlots close to smoking areas and planting of preferred species per region among producers, fish smokers and any others interested

6.3 Promotion of appropriate end-use device for efficient use of fuelwood among fish smokers

- Promote less smoky/healthier stoves
- Upscale or intensify the promotion of efficient end-use devices to reduce wood volumes used or reduce demand to minimize wood waste (Energy commission statistics indicates that extraction of wood fuel in Ghana exceeds consumption generally)

6.4 Improving wood preservation/storage, working environment and health safety for fuelwood traders and fish smokers

- Financing for wood sheds to protect fuelwood against rot
- Financing for better wood splitters for traders, transporters/producers
- Promote less smoky/healthier stoves to reduce environmental pollution and infections
- Financing for group sheds or satellite depots for trading fuelwood and fish smoking
- Education on appropriate species and other fuel sources with less harmful chemicals for smoking fish. Ministry of Health and District Assembly health officers can be recruited to support the campaign

6.5 Research

- Appropriate silvicultural regimes for coppice management of harvesting from natural stands
- Mangrove silviculture to enhance growth or reduce maturity period
- Appropriate methods for integration of preferred species into agricultural landscape for woodlot development
- Efficient use of woody material from farm clearing, logging and milling waste to reduce over exploitation of standing trees
- Market research – statistics e.g. volume flows to various niches, etc. for policy planning (involve district assemblies – revenue collectors, transporters, toll booth operators)
- Energy and physicochemical characterization of mangrove and alternative fuelwood species in surrounding vegetation to identify other species with similar characteristics to promote for fish smoking
- Identification of environmental friendly and healthy treatments for preservation or storage of fuelwood during storage against rot
- Study to estimate amount of fuelwood being used for fish smoking annually versus proportion used for other purposes
- Study to estimate amount of fuelwood coming from sustainable sources for fish smoking

- Study to estimate amount of fuelwood and percentage used in fish smoking from mangrove wood versus other species
- Preferences of wood species per region and degree to which there seem to be sufficient supply versus demand
- Based on regional preferences, what should be recommended species per region for woodlots
- Screening for healthier fuelwood species from list of recommended species preferred for fish smoking

6.6 Interventions to protect mangroves and fish nursery sites

- Buffer zone management through characterization and zoning of mangrove habitats for appropriate management in agreement with land owners, traditional authorities, District Assembly and other wetland stakeholders. EPA, FSD, Wildlife Division of Forestry Commission must be consulted for technical inputs
- Promote community based management of mangrove areas but these areas need to have exclusive use rights by various communities
- Support extensive re-planting of degraded mangrove areas and alternative species in adjacent farmlands and fallow or idle lands
- Promote alternative livelihoods (crab and shrimp culture, etc.) as may be desirable to communities to reduce income dependency on mangrove cutting

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ANNEXES

Annex1: Questionnaire, Interview guides/Checklist
Questionnaire to the Fuelwood Traders

SNV Netherlands Development Organisation is collecting information on fuelwood business in the Coastal Regions in Ghana to help understand how the fuelwood supply chain operates; who benefits from the chain and by how much, and what are the main challenges faced by the actors with the overall aim of transforming fuelwood business into a market oriented, profitable and sustainable sector.

Any information obtained shall be treated as confidential and for the purpose of this research.

Questionnaire No.: ..... Interviewed by.....

Village/town.....Date.....

Location details: Region.....
District.....

A. Socio-demography

1. Name of respondent: .....

2. Phone number of respondent: …….....

3. Age ……

4. Gender: 0.Male [ ] 1.Female [ ]

5. Marital status: 1. Single-never married [ ] 2. Married [ ] 3. Divorced [ ]

4. Widowed [ ]

- **6. Level of formal education: 1.None [ ] 2.Primary [ ] 3.Middle/JSS [ ] 4.Secondary/SSS [ ] 5.Terciary [ ]**
- **7. Origin: 1. Native [ ] 2.Migrant [ ] 3.Settler [ ]**

8. How long have you been in this community? [ ] years

9. Counting yourself what is the size of your household? [ ]

10. Number of spouses [ ]

11. Number of dependents in your household (i.e. < 15 and >65 year olds)
……..

B. Experience in Fuelwood business and clientele

1. Is fuelwood trade your main economic activities? 1. Yes [ ] 0.No [ ]

2. If **No**, what other occupation do you have besides fuelwood trading? 1. Trading 2. Food processing 3. Baking 4.Artisan 5.Other (specify) …….

3. What was your previous occupation? 1.None 2. Trading 3. Food processing 4. Baking 5.Artisan 5.Other (specify) …….

4. What type of fuelwood trader are you: 1. Whole sale [ ] 2. Retail [ ] 3. Both whole sale and Retail [ ]

5. How many years have you been in fuelwood trade? ..... years

6. What type of fuelwood do you trade? 1. Blocks [ ] 2. Bundles [ ] 3. Both Block and Bundles [ ]

7. Who introduced you into fuelwood business? 1. Parent [ ] 2. Sibling [ ] 3. Friends [ ] 4.Other (specify)……

8. Is there a wood fuel trader association in this community? 1. Yes [ ] 0. No [ ]

9. Are you a member of fuelwood trader association? 1. Yes [ ] 0. No [ ]

10. If yes what is the size of your membership?……

11. What is the purpose of the association? 1. Welfare, e.g. funeral [ ] 2. Others……..…

12. Do you keep fuelwood trade records? 1. Yes [ ] 0. No [ ]

13. If **YES,** what is the most common way you keep the records? 1. Keep in my head [ ] 2. Book keeping [ ] 3. Write on the wall [ ] 4. Other (specify)…….

- **14. If No to 12, what is the most important reason why you do not keep records?**
- **1. No reason [ ] 2. I cannot write [ ] 3. I don't have the time [ ] 4. I don't see the importance [ ]**

15. Have you employed other people assisting you in your fuelwood business? 1. Yes [ ] 0. No [ ]

7. If **Yes** How many persons?
……
……

16. Who are your main customers? 1. Fish smokers 2. Food venders 3. Households 4. Others (specify) ……

17. Do you need to have any permit to operate as a fuelwood trader? 1. Yes [ ] 2. No [ ] 3.No idea [ ]

18. If **Yes**, who gives out the permit? 1. District Assembly [ ] 2. Traditional ruler [ ] 3. Land owner [ ] Other……..

19. Have you had any support from any organisation or government? 1. Yes [ ] 0. No [ ]

20. If **Yes**, which form of support?

a.....

b.....

c. .....

C. Fuelwood species, preferences and availability

1. What species of wood do you mostly sell (List from 1st most important)?

Fuelwood species sold	**Availability** Tick all that apply			**Supply Source**
	High	*Low*	*None*	Sources of fuelwood *(1.Mangrove swamp, 2.forest, 3.farm 4. (Other Specify……)*

2. Do you know the reason for the low or none-availability of a particular fuelwood species
……
……
……
……

3. Do the customers like the wood species you sell? 1. Yes [ ] 0. No [ ]

4. If **No**, which other species do they prefer and why?
……

5. If Yes, why do you prefer those species
……..
……
…….

6. Do you normally get the species consumers prefer 1. Yes [ ] 0. No [ ]

7. Do you have regular supply to meet your demand from suppliers? 1. Yes [ ] 0. No [ ]

8. Is demand on you fuelwood very high all year round? 1. Yes 0.No

9. If **Yes**, what factors account for the rise?
……
……
……

10. If **No**, what factors account for the fall?……
……
……

D. Fuelwood trade expenditure and income

1. Complete the table below

	Major season			**Minor season**			**Total/Month (Average)**
Activity	Day	Week	Month	Day	Week	Month	
How much fuelwood do you sell ***(GHC)***							
What quantity of wood do you sell							
Bundles							
Blocks							
Truck							
Boat\Cannon							
Motor king							
Other (specify) …….							

2. Complete the table below

How much do you pay for the fuel wood***(GHC)(Unit Cost)***	Bundle	Block

3. Complete the table below

What is the selling price of the wood ***(GHC)(Unit Cost)***	Bundle	Block

4. How do you determine the price of fuelwood? 1. Producers 2. Transporters 3. Trader association 4.Other (specify) ……..

5. Do you **mostly** process the wood in anyway before sales? 1. Yes [ ] 0. No [ ]

6a. If **Yes**, what processing activities do you undertake? Please list them and the associated costs?

Processing activity	**Unit cost (GHC)**	**Total Cost (GHC)**
1. Splitting of wood blocks		
labour		
hammer		
chisel		
2. Packing split wood		
3. Tying pieces of split wood in bundles		
4. Arranging tied pieces for sale		
5. Others ……		

6b. How long does it take to replace hammer?.....

6c. How long does it take to replace chisel?.....

7. List daily/weekly/monthly/yearly expenses related to your business activities paid

Trade expenditure	**Payment Period(Amount)**

	Daily	Weekly	Monthly	Yearly
Rent				
Transport				
Security				
Income tax				
Market toll				
Others.....				

E. Challenges/constraints/problems and opportunities in fuelwood trade

1. What are the main problems you face in the course of your business activities?

a.....

b.....

c.....

2. What changes would you like to be implemented to make your business and working environment better?

a.....

b.....

c.....

GPS Coordinates

N……, **E/W** …… Accuracy ……

Enumerators Contact ……..

Personal Field Observation and Comments

Questionnaire to the Fuelwood Transporters

SNV Netherlands Development Organisation is collecting information on fuelwood transport business in the 4 Coastal Regions in Ghana to help understand how the fuelwood supply chain operates; who benefits from the chain and by how much, and what are the main challenges faced by the actors with the overall aim of transforming fuelwood business into a market oriented profitable and sustainable sector.

Any information obtained shall be treated as confidential and for the purpose of this research.

Questionnaire No.: ..... Interviewed by.....

Village/town.....Date.....

Location details: Region.....
District.....

A. Socio-demography

1. Name of Respondent: .....

2. Phone number: …….....

3. Age ……

4. Gender: 0.Male [ ] 1.Female [ ]

5. Marital status: 1. Single-never married [ ] 2. Married [ ] 3. Divorced [ ]

4. Widowed [ ]

- **6. Level of formal education: 1.None [ ] 2.Primary [ ] 3.Middle/JSS [ ] 4.Secondary/SSS [ ] 5.Terciary [ ]**
- **7. Origin: 1. Native [ ] 2.Migrant [ ] 3.Settler [ ]**

8. How long have you been in this community? [ ] years

9. Counting yourself what is the size of your household? [ ]

10. Number of spouses [ ] No. of children: [ ]

11. Number of dependents in your household (i.e. < 15 and >65 year olds)
……..

Fuelwood transport operations

1. Is fuelwood transportation your main economic activity? 1. Yes [ ] 0.No [ ]

2. If **No**, what other occupation do you have besides fuelwood transporting? 1. Trading 2. Food processing 3. Baking 4.Artisan 5.Other (specify) …….

3. What was your previous occupation? 1.None 2. Trading 3. Food processing 4. Mechanic 5.Artisan 6.Other (specify) …….

4. How many years have you been in fuelwood transportation? ..... years

5. What type of fuelwood do you mostly transport? 1. Blocks [ ] 2. Bundles [ ] 3. Both Block and Bundles [ ]

6. Who introduced you into fuelwood transportation? 1. Parent [ ] 2. Sibling [ ] 3. Friends [ ] 4.Other (specify)……

7. Is there any fuelwood transporters association? 1. Yes [ ] 0. No [ ]

8. Are you a member of fuelwood transporters association? 1. Yes [ ] 0. No [ ]

9. If **Yes**, what is the size of your membership? ……

10. What is the purpose of the association? 1. Welfare, e.g. funeral [ ] 2. Others…….

11. Do you keep fuelwood transportation records? 1. Yes [ ] 0. No [ ]

12. If **YES,** what is the most common way you keep the records? 1. Keep in my head [ ] 2. Book keeping [ ] 3. Write on the wall [ ] 4. Other (specify)…….

- **13. If No to 12, what is the most important reason why you do not keep records?**
- **1. No reason [ ] 2. I cannot write [ ] 3. I don't have the time [ ] 4. I don't see the importance [ ]**

14. Have you employed other people assisting you in your fuelwood Transportation? 1. Yes [ ] 0. No [ ]

15. If **Yes** How many persons? …… ……

16. Who are your main customers? 1. Fuelwood retailers 2. Fuelwood wholesalers 3. Fish smokers 4. Food venders 5. Households 6. Others (specify) ……

17. Do you need to have any permit to operate as a fuelwood transporter? 1. Yes [ ] 0. No [ ]

18. If **Yes**, who gives out the permit? 1. District Assembly [ ] 2. Traditional ruler [ ] 3. Land owner [ ] Other……..

19. Have you had any support from any organisation or government? 1. Yes [ ] 0. No [ ]

20. If **Yes**, which form of support?

a.....

b.....

21. What mode of transport do you operate? 1. Operate locally 2. Buy and/or transport fuelwood long distances [ ] 3. Both locally and long distance

22. What form of transport do you operate? 1. Boat [ ] 2. Pushcart [ ] 3. Kia Track [ ] 4. Tricycle [ ] 5. Other (Specify)……

23. Do you own the transport? 1. Yes [ ] 0. No [ ]

24. If **Yes**, how many of them?
……
…….

25. Is demand on fuelwood transport services very high all year round? 1. Yes 0.No

26. If **Yes**, what factors account for the rise?
……
……
……

26. If **No**, what factors account for the fall?
……
……

C. Fuelwood species transported and availability

1. Please mention the fuelwood species or types you transport,

Fuelwood species transported	**Availability** Tick all that apply			**Supply Source** Sources of fuelwood *(1.Mangrove swamp, 2.forest, 3.farm 5. Specify others ……..)*
	High	*Low*	*None*	

D. Income and expenditure in fuelwood transport business

1. How many times (frequency) do you transport fuelwood per day/week/month

Major season	**Minor season**

2. What is the fuelwood capacity of your transport system?..... bundles/logs

3. Which are the main pick-up and destination points of the fuelwood you transport?

3a. Pick-ups.....

3b. Destinations.....

4. How much do you charge per trip (Full load)?

Long distance	**Short distance**

5. What is the unit charge for the fuelwood transported (bundle/log/kg)?
……

6. Do you own the fuelwood you transport?
….……..……....

7. Do you process the wood in any way before transporting? 1. Yes [ ] 2. No [ ]

8. If **Yes**, what processing activities do you undertake? Please list them and the associated costs?

Processing activity	**Quantity**	**Unit cost (GHC)**
1. Splitting of logs into blocks or smaller pieces		
labour		

hammer		
chisel		
2. Packing split wood		
3. Tying split pieces into bundles		
4. Others ……		
5.		

8. List daily/weekly/monthly/yearly expenses related to your business activities

Transport business expenditure	**Payment Period ,Amount (GHC)**			
	Daily	**Weekly**	**monthly**	**yearly**
Fuel				
Maintenance				
Labour				
Security				
District assembly tax at loading point				
Waybill				
Road toll				
Market toll				
Road worthiness				
Insurance				
Other (specify……)				

E. Fuelwood transport problems/challenges

1. What are the main problems you face in the course of your business activities?

a. .....

b. .....

c. ……

2. What changes would you like to be implemented to make your business and working environment better?

a. .....

b. .....

c. .....

GPS Coordinates

N……, **E/W** ……

Accuracy ……

Enumerator's Contact ……..

Questionnaire to the Fuelwood Producers

SNV Netherlands Development Organisation is collecting information on fuelwood production in the Coastal Regions of Ghana to help understand how the fuelwood supply chain operates; who benefits from the chain and by how much, and what are the main challenges faced by the actors with the overall aim of transforming the fuelwood production business into a market oriented, profitable and sustainable sector.

Questionnaire No.: ..... Interviewed by.....

Village/town.....Date.....

Location details: Region.....
District.....

A. Socio-demography

1. Name of Respondent: .....

2. Phone number: …….....

3. Age ……

4. Gender: 0.Male [ ] 1.Female [ ]

5. Marital status: 1. Single-never married [ ] 2. Married [ ] 3. Divorced [ ]

4. Widowed [ ]

- **6. Level of formal education: 1.None [ ] 2.Primary [ ] 3.Middle/JSS [ ] 4.Secondary/SSS [ ] 5.Terciary [ ]**
- **7. Origin: 1. Native [ ] 2.Migrant [ ] 3.Settler [ ]**

8. How long have you been in this community? [ ] years

9. Counting yourself what is the size of your household? [ ]

10. Number of spouses [ ] No. of children: [ ]

11. Number of dependents in your household (i.e. < 15 and >65 year olds)
……..

B. Experience in Fuelwood production business and clientele

1. Is fuelwood production your main economic activities? 1. Yes [ ] 0.No [ ]

2. If **No**, what other occupation do you have besides fuelwood trading? 1. Farming 2. Trading 3. Food processing 4. Baking 5.Artisan 6.Other (specify) …….

3. What was your previous occupation? 1. Farming 2. Trading 3. Food processing 4.Artisan 5.Other (specify) …….

4. How many years have you been in fuelwood production /harvesting business? ..... years

5. What type of fuelwood do you mostly produce? 1. Blocks [ ] 2. Bundles [ ] 3. Both Block and Bundles [ ]

6. Who introduced you into fuelwood production? 1. Parent [ ] 2. Sibling [ ] 3. Friends [ ] 4.Other (specify)……

7. Are you a member of fuelwood producers/harvesters association? 1. Yes [ ] 0. No [ ]

8. Do you keep fuelwood production/ harvesting records? 1. Yes [ ] 0. No [ ]

9. If **YES,** what is the most common way you keep the records? 1. Keep in my head [ ] 2. Book keeping [ ] 3. Write on the wall [ ] 4. Other (specify)…….

- **10. If No to 8, what is the most important reason why you do not keep records?**
- **1. No reason [ ] 2. I cannot write [ ] 3. I don't have the time [ ] 4. I don't see the importance [ ]**

11. Have you employed other people assisting you in your fuelwood production? 1.Yes [] 0. No []

7. If **Yes** How many persons? …… ……

12. Who are your main customers? 1. Transporters 2. Fish smokers 3. Food venders 4. Households 5. Others (specify) ……

13. Is demand on your fuelwood very high all year round? 1. Yes 0.No

14. If **Yes**, what factors account for the rise? …… …… ……

15. If **No**, what factors account for the fall?…… …… ……

16. Have you had any support from any organisation or government? 1. Yes [ ] 0. No [ ]

17. If **Yes**, which form of support?

a.....

b.....

C. Fuelwood resource tenure

1. Do you own a fuelwood plantation? 1. Yes [ ] 2. No [ ]

2. If **Yes**, what is the size of your plantation?
…….……. (Acres/hectares)

3. If **No**, what is the source of your fuelwood? 1. Forest [ ] 2. Own farm land [ ] 3. Other (specify)…….....……
…….

4. Do you need to have any permit to operate\ collect fuel wood from these sources? 1. Yes [ ] 0. No [ ]

5. If you do not own a wood lot do you need a permit to harvest? 1. Yes [ ] 2. No [ ]

6. If **Yes** in 4, who gives out the permit? 1. District Assembly [ ] 2. Traditional ruler [ ] 3. Land owner [ ] 4. Forestry commission 5. Other (specify) ……..

7. Do you pay for the fuelwood you harvest? 1. Yes [ ] 0. No [ ]

8. If **Yes**, how much do you pay for a truck/bundle/acre/pole?……

9. Where do you sell the fuelwood? 1. Harvest site [ ] 2. Wood market [ ] 3. Deliver to consumer [ ] 4. Sell to middle men/transporters 5. Others (specify)…….

10. How much do you pay to land/farm owner per load (specify: Bundles/truck load –Single or double axel loads)
……
……

11. Do you know how long it takes for the harvested fuelwood to regenerate? 1. Yes [ ] 0. No [ ]

12. If **Yes**, how many years?
……
……..

13. Is fuelwood readily available to you? 1. Yes 0. No

14. If **No**, what has been the course for the scarcity
…….. ……
…….

15. Do you have to travel long distance to harvest fuelwood? 1. Yes 0.No

16. If yes what is the distance you travel to harvest fuelwood…….

D. Fuelwood species and preferences

1. What species of wood do you mostly harvest and sell?

Fuelwood species harvested	**Availability** Tick all that apply			**Supply Source** Sources of fuelwood *(1.Mangrove swamp, 2.forest, 3.farm 4. Specify others ……..)*
	High	*Low*	*None*	

2. Do the customers like the wood species? 1. Yes 0. No

3. If **No**, which other species do they prefer?
……..

E. Fuelwood production income and expenditure

1. How many times (frequency) do you harvest fuelwood per day/week/month

Major season	**Minor season**	**Average Harvest/month**

2. How much wood do you harvest and sell per day/week/ month? .....
(bundle, block,……..)

3. What is the unit price of the fuelwood on the farm? .....

4. Do you process the wood you harvest in any way before sales? 1. Yes [ ] 2. No [ ]

5. 3. If **Yes**, what processing activities do you undertake? Please list them and the associated costs?

Processing activity	**Unit cost (GHC)**
1.Splitting logs into blocks	
• *Labour*	
• *Chisel*	
• *Hammer*	
2.Sizing/ cutting long stems into shorter sizes	
• *Cutlass*	
• *Saw*	
• *Labour*	
3. Sorting labour	
4. Bundling	
• *Material for tying*	
• *Labour*	
Others ……	

4. List daily/weekly/monthly/yearly expenses related to your business activities?

Harvest expenditure	**Payment Period (Amount)**			
	Daily	**Weekly**	**Monthly**	**Yearly**
Access fee (payment to owner)				
Transport				
Labour				
Security				

District assembly tax				
Others				

D. Problems/challenges in fuelwood production

1. What are the main problems you face in the course of your business activities?

a. .....

b. .....

c. .....

2. What changes would you like to be implemented to make your business and working environment better?

a. .....

b. .....

c. .....

GPS Coordinates

N……., **E/W** …… Accuracy ……

Enumerator's Contact
……
……

Questionnaire to the Fuelwood Consumer

SNV Netherlands Development Organisation is collecting information on fuelwood consumption in the Coastal Regions in Ghana to help understand how the fuelwood supply chain operates; who benefits from the chain and by how much, and what are the main challenges faced by the actors with the overall aim of transforming fuelwood business into a market oriented profitable and sustainable sector.

Questionnaire No.: ..... Interviewed by.....

Village/town.....Date.....

Location details: Region.....
District.....

A. Socio-demography

1. Name of Respondent: .....

2. Phone number: …….....

3. Age ……

4. Gender: 0.Male [ ] 1.Female [ ]

5. Marital status: 1. Single-never married [ ] 2. Married [ ] 3. Divorced [ ]

4. Widowed [ ]

- **6. Level of formal education: 1.None [ ] 2.Primary [ ] 3.Middle/JSS [ ] 4.Secondary/SSS [ ] 5.Terciary [ ]**
- **7. Origin: 1. Native [ ] 2.Migrant [ ] 3.Settler [ ]**

8. How long have you been in this community? [ ] years

9. Counting yourself what is the size of your household? [ ]

10. Number of spouses [ ] No. of children: [ ]

11. Number of dependents in your household (i.e. < 15 and >65 year olds) ……..

B. Extent of fuelwood consumption

1. **How long have you been in the fish smoking business? …….**
2. **What form of fish do you mostly smoke? 1. Fresh catch from the sea 0. Frozen fish**
3. **How many boxes of frozen fish do you smoke per day/week/month?……..**

4. **Which type of fuel do use for smoking fish: 1. Fuelwood [ ] 2. Charcoal [ ] 3. Gas [ ] Others (specify).....**
5. **Do you use any other type of fuel in smoking? 1. Coconut shell 2. Sugar cane 3.Both sugar cane and coconut shell 4.Other (specify) ……..**
6. **Do you own a fish smoking stove? 1. Yes 0. No**
7. **How many fish smoking stoves do you have? ……..**
   a. **Where do you buy the fuelwood from? 1. Retailer 2. Wholesaler 3. Transporters 4. Harvester/producers 5. Other (specify)…….**
8. **How much of the fuel do you consume in smoking fish per day/week/month (GHc/bundle)? …….....……**
9. **How much do you spend on the fuel for fish smoking per day/week/ month?**

Activity	**Major fishing season**			**Minor fishing season**			**Total/Month**
	Day	Week	Month	Day	Week	Month	
What quantity of fuelwood do you use ***(bundles/logs/ blocks/truck)***							
How much do you spend on fuelwood **(GHC)**							

11. Do you process the wood in any way before using for smoking? 1. Yes [ ] 0. No [ ]

12. If **Yes**, what processing activities do you undertake? Please list them and the associated costs?

Processing activity	**Quantity**	**Unit cost (GHC)**	**Total Cost (GHC)**
1. Splitting of blocks			
• *labour*			
• *hammer*			
• *chisel*			
2. Packing split wood			
3. Others ……			

C. Fuelwood species used, supply sources and preferences

1. **Which species of fuelwood do you mostly use? ……**
2. **Why do you use this/these wood specie(s)? ……..…… …….…… ……**
3. **Do you prefer the woodfuel available to you? 1. Yes [ ] 2. No [ ]**
4. **Why do you prefer such species. …… … …… …….**
5. **Do you know the source of your fuelwood? 1. Yes [ ] 2. No [ ]**
6. **If Yes, where do you get your fuelwood supply from? …….....…… …… ……..**
7. **What is the mode of transportation of your wood supply? 1. Boat [ ] 2. Kia truck [ ] 3.Tricycle [ ] 4. Push cart 5. Other (specify) ……**
8. **Do you belong to any fish smoker's association? 1. Yes [ ] 0. No [ ]**
9. If yes what is the size of your membership?……..……

8. What is the purpose of the association? 1. Welfare, e.g. funeral [ ] 2. Others……

- **D. Community livelihood activities**
- **1. Apart from fish smoking, what other occupation is undertaken in this community? …… ……...**
- **E. End-use devices (fish smokers used)**
- **1. Which type of stoves do you use for fish smoking business and household cooking?**

• **Type of stove (name)**	• **Improved (1) Traditional (2) Choose one**	• **Fish smoking** •	• **Fuel type used** • **(fuelwood, charcoal,**
•	•	•	•
•	•	•	•
•	•	•	•

F. Problems/challenges in fuelwood production

1. What are the main problems you face with fuelwood in the course of fish smoking business?

a. .....

b. .....

c. .....

2. What changes would you like to be implemented to make your fish smoking business and working environment better?

a. .....

b. .....

c. .....

GPS Coordinates

N……, **E/W** ……

Accuracy ……..……

Enumerators contact ……..……..

Checklist/Questionnaire for Resource Owners

SNV Netherlands Development Organisation is collecting information on fuelwood business in the Coastal Regions in Ghana to help understand how the fuelwood supply chain operates; who benefits from the chain and by how much, and what are the main challenges faced by the actors with the overall aim of transforming fuelwood business into a market oriented, profitable and sustainable sector.

Any information obtained shall be treated as confidential and for the purpose of this research.

Village/town.....Date.....

Location details: Region.....District.....

Name of respondent……Contact……

A. Socio-demography

1. Age of respondent……2. Contact……..……

3. Gender: 1.Male [ ] 2.Female [ ]

4. Marital status: 1. Single [ ] 2. Married [ ] 3. Divorced [ ]

- **5. Level of formal education: 1.None [ ] 2.Primary [ ] 3.Middle/JSS [ ] 4.Secondary/SSS [ ] 5.Tertiary [ ] Polytechnic/Training college ( ) University ( ) others…….**
- **6. Origin: 1. Native [ ] 2.Migrant [ ] 3.Settler [ ]**

7. How long have you been in this community? [ ] years

8. Counting yourself what is the size of your household? [ ]

9. Number of spouses [ ] No. of children: [ ] No. of other dependents: [ ]

10. Number of children below 15 years [ ]

11. What is your social standing in this village? Chief ( ) Linguist ( ) Elder ( ) Assembly man ( ) Unit committee chairman ( ) Unit committee member ( )Youth leader/organizer ( ) Pastor ( ) Teacher ( ) Chief farmer ( )
Others……

12. What is your occupation?

occupation	**Tick all that apply**

	Major	Minor/secondary
Labourer		
Trading		
Food processing		
Fish smoker		
Fisher man		
Artisan		
Salaried worker		
Other (specify) ……..		

B. Resource type, tenure and management

1. What type of fuelwood resource do you own? Natural [ ] Plantation [ ]

2. In which land use type is your resource located?

Land use type	Tick all that apply		Size (acres)	Tenure			
	Natural	Plantation		Community	Family	Outright purchase	Others…… ……
Mangrove swamp							
Coastal thicket							
Forest							
Coconut farm							
Planted tree farm							
Others							

] others……..

4. How do you manage the resource? .....

5. Are there any regulations to the use of the resource? Yes [ ] No [ ]

6. If yes what are these regulations and how are they implemented?.....

……
……

C. Resource transactions and income

1. Who are your main customers and where do they come from?

Main customers	**High**	**low**	**Destination** 1.community 2.outside community 3. Outside this district	**Fuelwood species patronized**
Transpoters				
Fish smokers				
Food venders				
Schools				
Bakers				
Others				

2. How do you trade the resource? i.e. Negotiations and access procedure 1. Pay cash [ ]

2. Share harvested wood [ ] Others
…….…….…

3. How much do they pay ……and over what period?.....

4. How do your clients exploit the resource? .....

……
……..

5. Do you impose any restrictions in resource exploitation by clients? 1. Yes [ ] No [ ]

6. If yes explain…….
….....

……
……

7. How much do you earn from the resource per month?.....

D. Species and availability

1. What is the status of the firewood species on your land?

Fuelwood species owned	**Source**		**Availability (Tick)**		**Reasons for scarcity or Abundance**
	Land use type *(Mangrove, thicket, forest, farm, Specify others)*	Fuelwood production sites *(Towns, etc.)*	*Abundance*	*Scarce*	

2. Which species do your clients prefer and why?.....

Species preferred	**Reason for such preference**	**Availability**		**Reasons for scarcity or Abundance**
		Abundance	*Scarce*	

E. Problems in resource ownership and remedial measures

1. Are there any constraints to the use and management of the resource?

2. How can these constraints be addressed?

Problem	**Solution**