KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY,
KUMASI, GHANA

COLLEGE OF AGRICULTURE AND NATURAL RESOURCES

FACULTY OF RENEWABLE NATURAL RESOURCES

DEPARTMENT OF SILVICULTURE AND FOREST MANAGEMENT

Farmers' Willingness to Pay for Environmental Services on Farmlands and Implications for Resource Governance in Sene East District, Ghana

by

BANI, Kwasi Benjamin (BA. IDS Environment and Resource Management)

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A Thesis Submitted to the Department of Silviculture and Forest Management, College of Agriculture and Natural Resources in partial fulfillment of the requirements for the degree of

MASTER OF PHILOSOPHY

NATURAL RESOURCE AND ENVIRONMENTAL GOVERNANCE

JUNE, 2016

DECLARATION

I hereby declare that this submission is my own work towards the MPhil. in Natural Resource and Environmental Governance and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

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ABSTRACT

Farmers' ability to provide environmental services on farmlands is undermined by poor governance of agro-ecosystems. This study analyses farmers' willingness to pay for environmental services through integrating timber trees on farmlands and the required institutional structures and governance arrangements to support the integration. The study was conducted in the Sene East District of Ghana, where a total of 177 farmers were selected from six communities using stratified and simple random sampling. Informal interview was conducted using a structured questionnaire to gather information on farmers' willingness to pay for environmental services and other bio-data by means of the Contingent Valuation Method (CVM). It was found that Forest Service Division (FSD) hardly carries out its monitoring and supervisory roles in the study area and majority of farmers set fire at the roots of timber trees as opposed to weeding around fruit trees. The study identified tree ownership problems, activities of illegal chainsaw operators, lack of accountability in timber revenue disbursement and weak policies to be the major reasons why farmers destroy timber trees on farmlands. It was observed from the study that, 59% of farmers were willing to pay for provision of environmental services through integrating timber trees on farmlands. However, the multiple regression results show that gender, age, educational status, access to land and farmers' perception of climate change are significant variables influencing farmers' willingness to pay for provision of environmental services. Based on the above results, the study suggest that favourable land tenure systems, equitable benefit sharing, accountability in timber revenue disbursement, enforceable forestry laws and policies are vital to the provision of environmental services on farmlands as well as good governance of agro-ecosystems.

Keywords: Agro-ecosystem, environmental services, willingness-to-pay, institutional structures, resource governance, REDD+.

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LIST OF ABBREVIATIONS

AAC	Annual Allowable Cut
ES	Environmental Services
DA	District Assembly
FC	Forestry Commission
FSD	Forest Services Division
GSS	Ghana Statistical Service
LI	Legislative Instrument
NGOs	Non-Governmental Organizations
OASL	Office of the Administrator of Stool Lands
PES	Payment for Environmental Services
RMSC	Resource Management Support Centre
SRA	Social Responsibility Agreement
SEDA	Sene East District Assembly
TA	Traditional Authorities
TC	Traditional Council
TIDD	Timber Industry Development Division
TUC	Timber Utilization Contract
TUP	Timber Utilization Permit
WD	Wildlife Division
WTP	Willingness to Pay
WTA	Willingness to Accept

ACKNOWLEDGEMENTS

Without the help of Almighty God, this thesis would not have been successful. Glory be to Almighty God for bringing me this far. My warmest appreciation and thanks go to my supervisor, Dr. Lawrence Damnyag for diligently proof reading all the manuscripts I submitted and for all his suggestions, guidance, intelligent criticisms, inspiration and advice which have enabled me to complete this work successfully.

To my parents and siblings, I appreciate your encouragement and prayers which have resulted in this great achievement. My heartfelt gratitude goes especially to my Daddy, D. K. Bani, for ensuring that I worked consistently on my thesis. I am also grateful for the invaluable contributions of all my lecturers for their support throughout the course. I will like to specially mention the support of Dr. E. Acheampong, Dr. B. Kyereh and Mrs. Joana Beulah Uchero of the Department of Silviculture and Forest Management for their immense assistance.

I also appreciate the contribution of Boakye Emmanuel and Haruna Sumaiya for their assistance in data collection. I also value the efforts of Mr Ankomah of the Town and Country Planning Department and all other staff of Sene East District Assembly for their assistance.

I will also like to express my profound appreciation to all who made this work possible especially the moral support I received from staff of Kajaji Senior High. Without your support, I could not have completed this thesis. God richly bless you all abundantly.

CHAPTER ONE

INTRODUCTION

1.1Background

There is increase in awareness of biodiversity loss since the inception of the Millennium Ecosystem Assessment (MA 2005). Biodiversity and environmental services (ES) have benefited people the world over through contribution to material welfare, livelihoods, social relations and health (MA, 2005). In the past 50 years, anthropogenic changes in biodiversity and environmental services are deteriorating at a faster rate (MA, 2005). These changes were as a result of the rising demands for food, fibre, fodder and energy (wood fuel) in agricultural landscapes mostly in the tropics at the expense of provision of environmental services (World Resource Institute, 2007). Anthropogenic changes result in loss of biodiversity, degradation of the environment, growing scarcity of tree products, and soil fertility loss. Consequently, severe rural land-use problems have been created most especially in agricultural landscape affecting livelihoods the world over (MA, 2005; Aladi and Olujobi, 2014).

Cultivated lands are the managed ecosystem that show lots of alterations such as habitat change or land use change, overexploitation of resources, emission of carbon dioxide and pollution in the atmosphere which are reported to be the major direct drivers of biodiversity loss (MA, 2005). Agriculture has led to the depletion of the natural forests (Aladi and Olujobi, 2014). In Ghana, deforestation over the last 30 years has contributed rapidly to its forest depletion and biodiversity loss (Kusimi, 2008). The high level of deforestation can be attributed to the demand for energy. Wood fuels account for over 70% of total primary energy in Ghana (SE4ALL, 2012) and the bulk of it is sourced from the natural forest resulting in a 3% of deforestation rate per annum (FAO, 2002).

Despite the several efforts to combat deforestation in Ghana, forest loss throughout the country has been on the increase (Appiah, 2013). Consequently, environmental services such as carbon sequestration, watershed protection, landscape beauty and biodiversity conservation are not adequately provided or are made worstoff. In order to improve upon the status quo of provision of ES in agricultural landscape, understanding how farmers perceive and place value on these ES is important (Swinton et al, 2007).

There are several emerging markets for ecosystem services and among the most successful ones is Payment for Environmental Services (PES). The emergence of PES is as a result of the unsustainable land use that has caused irreversible biodiversity loss affecting 15 of the 24 ecosystem services examined by the Millennium Ecosystem Assessment (MA, 2005).

Governance of agro-ecosystems including institutional reforms, tenure, decentralization and community forest management (CFM) (Angelsen et al, 2009) can help provide a win-win solution to restore degraded biodiversity. Integrating timber trees on farmlands would help provide food, fibre and at the same time improves upon carbon sequestration, watershed protection, biodiversity and the environment at large (Chazdon et al., 2003; Bhagwat et al., 2008). Tree planting also improves agriculture through the protection from soil erosion, regulation of water flow by reducing floods and droughts and serves as a habitat for both flora and fauna (Dalle and Potvin, 2004; MA, 2005; Knoke et al., 2009).

According to Wilson, (2013 p.4) tree planting in Latin America, China, and Haiti is genuinely accepted by governments, international, NGO's and businesses who spend billions of dollars a year promoting tree planting for both economic and environmental reasons (UNEP, 2013; Wilson, 2013). However, strict regulations, weak institutions and governance structures in some way

makes it a disincentive for farmers to integrate or retain trees on their farms and fallows (Ribot, 2004; Roe et al, 2009; Sandbrook et al, 2010). Devolution of user right to forest resources is sometimes restrained by the political processes and government regimes (Ribot et al, 2006; Sandbrook et al, 2010). These lead to high prevalence of corruption, elite capture and desire to retain control over forest resources (Sandbrook et al, 2010). In the light of these challenges, farmers do not get any direct benefit for providing services like carbon sequestration, watershed protection, biodiversity among others. As a result, many studies emphasize the importance of giving financial incentives to land managers (Farmers) for sustainable use and management of forest resources in agricultural landscape (Suter et al, 2008; Patrick and Barclay, 2009; Yu and Belcher, 2011).

1.2 Problem statement

The tradition of top-down governance of agro-ecosystem is promoting deforestation in the Sene East district. Biodiversity is continually decimated as farmers' burn and destroy naturally grown trees found on their farmlands. This situation endangers the provision of environmental services such as carbon sequestration, watershed protection, biodiversity and landscape beauty on farmlands. This could partly be blamed on elite capture, lack of accountability in timber revenue disbursement, inequitable benefit sharing of timber revenue, corruption, and tree and land tenure among others in the study area. If proactive measures are not employed to solve these challenging issues, it could lead to perverse incentives for farmers to continue providing environmental services through integrating timber trees on their farmlands. This would adversely affect tree governance and sustainable management of natural resources and could further pose a challenge to global efforts to mitigate climate change as well as REDD+ implementation in Ghana.

1.3 Study objectives

The overall objective of the study is to analyze farmers' willingness to pay for provision of environmental services through the integration of trees on their farmlands and assessing institutional structures and governance arrangements required to support the integration.

Specifically, the study seeks:

- To determine factors influencing farmers' tree related practices in the area.
- To assess farmers' willingness to pay for provision of environmental services on farmlands.
- To determine factors influencing farmers' willingness to pay for provision of environmental services on farmlands.
- To assess institutional structures and governance arrangements required to support the provision of environmental services on farmlands.

1.4 Research questions

- What motivates farmers to keep trees on farmlands in the study area?
- Under what condition will farmers be willing to integrate timber trees on farmlands in the study area?
- What factors would influence farmers' willingness to integrate timber trees on farmlands in the study area?
- What are the institutional structures and governance arrangements required to support the integration of timber trees on farmlands in the study area?

1.5 Hypotheses

The study hypotheses are:

- Flexible Land tenure system promotes the delivery of environmental services in agricultural landscape.

- Top-down governance of agro-ecosystem negatively affects the provision of environmental services in agricultural landscape.

1.6 Justification

A variety of agro-ecosystem services are being threatened by anthropogenic factors. In view of this, there is the need for financial incentives in securing a change in land use in productive agriculture to the provision of environmental services (Lynch et al, 2001; Gengheni et la, 2002; Rodes et al, 2002; Curtis and Robertson, 2003; Shultz, 2005; Sullivan et al, 2005; Kabii and Horwitz, 2006; Patrick and Barclay, 2009; Yu and Belcher, 2011).

Integrating timber trees with food crops is considered very important for flood regulation, nutrient cycling, water regulation, carbon sequestration, and improvement of local climate conditions, biological conservation as well as other economic uses (Alardi and Olujobi, 2014). However, farmers are often unwilling to integrate trees into croplands for a number of reasons. Specific reasons need to be indentified and analyzed comprehensively to aid in determining appropriate incentives and governance arrangements for facilitating tree integration into the agricultural landscape to harness the range of benefits and services for ecosystem and livelihood sustainability.

The good forest governance and institutional gaps identified will help retain farmers' interest in conserving the natural environment. Finally, the study contributes to build-up of academic knowledge on varied issues in Natural Resource and Environmental Governance.

1.7 Limitations of the Study

There was not enough financial resource to enable full participation of several participants and facilitation of the research activities as some respondents were willing

to exchange information for money. However, the findings from this study can be used to make informed generalization about farmers' willingness to integrate timber trees on their farmlands in the district.

Government agencies and departments refused to release some important information for the fear of it being exposed to the public domain. However, some related information was sourced from the internet to augment the irretrievable information from government agencies and departments.

CHAPTER TWO
LITERATURE REVIEW

2.1 Environmental services (ES)

Environmental Services (ES) are the activities, products and processes that nature provides to enable life exist without larger cost to humanity. In other words, they are the services nature provides for the maintenance of life. Generally, these environmental services include: Watershed Conservation, Carbon Sequestration, Biodiversity Conservation and Landscape Beauty (Wunder, 2005). Environmental

services derived from forest ecosystems may include Hydrological benefits, Reduced sedimentation, Disaster prevention, Biodiversity conservation and Carbon sequestration (Pagiola and Platais, 2002).

ES are very essential to the well-being and survival of humanity since human activities depends on environmental services. For example, Hydrological benefits helps to control the timing and volume of water flows and protecting water quality for both domestic and agricultural use. Reduced sedimentation also avoids damage to downstream reservoirs and waterways and by so doing safeguarding uses such as hydroelectric power generation, irrigation, recreation, fisheries, and domestic water supplies. Disaster prevention helps to prevent floods and landslides. Biodiversity conservation and Carbon sequestration also provides reduced global warming (Pagiola and Platais, 2002; Wunder, 2005).

In developing countries, about 47% to 89% of the total sources of livelihoods of rural poor and forest fringe communities come from environmental services (FAO, 2012). According to Katoomba Group and UNEP (2008), these environmental services (ES) have an immense but underestimated economic value. The day-to-day management decisions of ES centers on quick financial returns (FAO, 2012). As such, land users do not have any economic reason to take these services into consideration when making land use choices (Pagiola and Platais, 2002).

As explained by Pagiola and Platais (2002), there have been several concerns directed to addressing these land use problems in the past. Some of these concerns are in the form of reforms or policies such as command and control to regulate pattern of land use by farmers (land managers). But this is not a holistic approach as it often results in disappointed outcomes. The continuation or maintenance of these ES essential to the survival of all Earth's species depends on environmental conservation and preservation

as well as adopting practices that minimize the impacts of human actions on the environment.

2.2 Payment for Environmental Services (PES)

In recent times, Payment for Environmental Services (PES) is an emerging market-based mechanism aimed at understanding the full economic value of ES and Biodiversity. A fairly accepted definition for PES has been put forward by Wunder, (2005). According to Wunder (2005, p. 4), "payment for environmental services scheme is: a voluntary transaction in which a well-defined environmental service (ES) or a form of land use likely to secure that service is bought by at least one ES buyer from a minimum of one ES provider if and only if the provider continues to supply that service (conditionality)"

2.3 Why PES?

Payment for environmental services (PES) aimed at providing incentives for farmers and land managers in order to address market failures in the provision of environmental services (Pagiola et al. 2002; defra, 2010). For example, the world agro-ecosystems provides environmental services such as crop pollination, stabilization of climate, enhancing soil fertility and purification of water (SanchezAzofeifa et al. 2007) for which there is no market place for such services hence they are under supplied.

The central principle of payment for environmental services (PES) is based on the premise that, environmental service providers should be compensated for providing the services and consumers or receivers of these services are to pay for their provision (Pagiola and Platais, 2002). For example, activities could include creating buffer zones along rivers for wildlife and re-flooding wetlands to improve water carrying capacity. This could lead to additional environmental service benefits in terms of biodiversity

conservation, improved water quality, watershed protection and flood risk management. However, in order to encourage the provision of these environmental services, incentive to farmers and land managers is required which could take the form of a PES. This payment would compensate the farmer for loss of income from agricultural production, the opportunity cost for not using the land for productive agriculture and the change in land management practices.

2.4 Potentials and Limitations of PES

Payment for Environmental Services (PES) has several advantages to encourage and finance conservational practices needed to protect the environment. PES has the potential of surviving where other conservational approaches have failed (Wunder, 2005). It is also a voluntary and negotiated framework which differentiates it from other approaches such as command and control. PES is regarded as a poverty alleviation strategy aimed at improving livelihoods and conserving the environment through the establishment of relations between natural and social capitals. It has the potential of co-existing with other approaches because of its flexibility.

However, setting up and running a PES scheme could over time require higher transaction cost. PES also has an obstacle of ruling out the poorest of the poor who often do not own or control land as PES service providers. PES promotes commercial conservation which may erode culturally rooted not-for-profit conservational practices carried out by land managers (Vogel, 2002; Romero and Andrade, 2004; Karsenty and Nasi, 2004; Karsenty, 2004; Wunder, 2005). Even though PES has several benefits, one of the biggest challenges is the identification of buyers (Waage et al. 2006).

2.5 Environmental services to and from agricultural landscape

Arguably, agriculture contributes to the supply of all three major categories of environmental services according to the Millennium Ecosystem Assessment's classification (MA, 2005) namely, provisioning, regulating and aesthetic services with the exception of the supporting services that also help agriculture to be more productive (Swinton et al, 2007). It is obvious that, agriculture is a provider and a recipient of environmental services as well as disservices.

There is concern about the disservices which create discomfort to humans. Land use change in agricultural landscape results mostly in habitat loss for species and increasing in the amount of carbon concentration in the atmosphere (Swinton et al, 2007). Duarte et al, (2002) argue that, water quality and quantity are essential and valuable services that can either be enhanced or degraded by agricultural practices that do not aim at conservation. From this view point, agriculture is seen as having direct and indirect effects on water consumption and quality (Dale and Polasky, 2007). Even though agriculture is capable of contributing to carbon sequestration, yet there is a growing evidence of it also resulting in the emissions of nitrogen which is a potent greenhouse gas and methane. However, these disservices can be ameliorated by adapting good management practices in agricultural landscape and promoting good governance of agro-ecosystem.

2.6 Contingent Valuation Method (CV)

There have been several valuation methods geared towards valuing ecosystem services that have no markets or are not traded in the traditional markets but are of equal importance as the marketable ones. In order to determine farmers' willingness to provide such services, contingent valuation method is considered appropriate. The contingent valuation method has been regarded as an approach that involves the direct

survey of people to elicit their willingness to pay (WTP) for a change in land use or willingness to accept (WTA) a compensation for that same changes in land use (Swinton et al, 2007). A significant aspect of the CV is its flexibility. It allows social research scientist to categorically specify the exact scenario that will be valued and also measures the passive use values of ecosystem goods and services (Mitchell and Carson, 1989; Freeman, 2003; Swinton et al, 2007).

The CV has gain importance over other methods in the field of ecosystem valuation especially when trying to restore or conserve the natural ecosystem for which farmers will not be willing to provide due to their preferences. There has been several studies conducted in this direction to elicit people's willingness to pay or accept compensation and CV was used to estimate values for various ecosystem services associated with agriculture (Ready et al, 1997), wildlife habitat (Brouwer and Slangen, 1998) and water quality impacts (Colomboa et al, 2006).

CV has distinctive features that distinguish it from other surveys on public policy issues in several ways (Mitchell and Carson, 1989). First, a major part of CV survey is the description of the good (or goods) of interest. Second, the elicitation of preference for the good is more extensive than in a typical opinion survey. Moreover, it also involves the elicitation of monetary measure of welfare (maximum willingness-to-pay (WTP) to obtain a desired good not currently possessed or minimum compensation (WTA) to voluntarily give up a good currently possessed). CV surveys are generally organized in the following manner: (1) an introductory section identifying the sponsor and general topic, (2) a section asking questions concerning prior knowledge about the good and attitudes toward it, (3) the presentation of the CV scenario including what the project was designed to accomplish, how it would be implemented and paid for, and what will happen under the current status quo situation if the project were not

implemented, (4) question(s) asking for information about the respondent's WTP/WTA for the good, (5) de-briefing questions to help ascertain how well respondents understood the scenario, and (6) demographic questions.

One of the main problems that have been identified in literature on CV methods is the divergence between willingness-to-pay (WTP) and willingness-to-accept (WTA) (Hanneman, 1991; Diamond, 1996). From a theoretical perspective, WTP and WTA should be similar in perfectly competitive private markets (Willig, 1976, Diamond 1996). However, several studies have demonstrated that for identical environmental services, WTA amounts systematically exceed WTP (Vatn and Bromley, 1994). This discrepancy may have several causes which may include faulty questionnaire design or interviewing technique; strategic behavior by respondents and psychological effects such as loss aversion and the endowment effect (Garrod and Willis, 1999).

There is also a controversy on whether non-use values are commensurable in monetary terms (Martínez-Alier et al. 1998; Carson et al., 2001). The problem here is whether, for instance, the religious or bequest value that may be attributed to a forest can be considered within the same framework as the economic value of logging or recreation in that forest. Such an extreme range of values may not be equally relevant to all policy problems.

2.7 Factors influencing farmers' willingness to pay for environmental services on farmlands

Farmers willingness to pay for environmental services on farmlands means the value farmers place on the adoption of timber trees into their croping system which will help provide services such as disaster management, water regulation, carbon sequestration among others. However, farmers are unwilling to adopt trees on farmlands base on several reasons.

Scientific studies conducted on integrating timber trees on farmlands in Latin America, USA, Asia and Africa indentified several environmental and socioeconomic factors that influence farmers' decisions to plant or integrate trees on farmlands (Shaikh et al, 2007; Ewnetu and Bliss, 2010; Hachoofwe, 2012). For example, timber trees can die as result of drought if not properly maintained after planting. Poverty and the need for food security also influence farmers' decisions to grow more food crops than integrating timber trees. As a result, farmers tend to place more value on food production than adopting timber trees as the later may reduce crop yield and returns in the long term.

Other studies show that, farmers' decision to adopt trees on farmlands seems most consistent and appropriate to their goals or interests (Barlas et al., 2001; Rob and Burton, 2004). In view of this, farmers make choices to integrate timber trees after assessing different farm internal resources such as farm size, household composition and external conditions such as incentive policies, and market prices (Fuglie and Kascak, 2001). Pattanayak et al., (2003) explained that, demographic characteristics, intra-household homogeneity, resource assets, market incentives, biophysical factors, risk and uncertainty were major determinants farmers consider when making choices to adopt trees in agricultural landscape. Regarding external forces, the value of land for future development (opportunity cost) was found to be an important element in deciding whether to adopt trees on farmlands (Lynch and Brown, 2000).

2.8 Forest Governance in Ghana

2.8.1 Constitutional and Political context

Forest governance has been established in the 1992 constitution of Ghana but often with a dual management of forest resources. The state (statutory laws) at one end and Traditional Authorities (Customary laws) at the other end working hand in hand

but statutory laws however takes precedent over the customary laws. This at times result in legal pluralism (Marfo and Schanz, 2008). The management of forest resources was vested in the state's Ministry of Lands and Natural Resources (MLNR) and the Forestry Commission (FC) with its Forest Services Division (FSD), Wildlife Division (WD) and Resource Management Support Centre (RMSC) (Derkyi et al, 2014). According to Amanor, (2005) this management regime does not involve communities or the people in the management of natural resources. The people were excluded from the management of land that they could have used for agricultural purposes in reserves and off-reserves (Marfo and Schanz, 2008). From the foregoing discussion, it is obvious that forest governance in Ghana was a colonial heritage.

2.8.2 Forest Policies and Laws

The history of forest policies and resources management in Ghana dates back to 1906 when legislation was enacted to control the felling of commercial tree species and the creation of the Forestry Department in 1908. The demarcation and reservation of the forest estate was largely completed by 1939 and a forest policy was adopted in 1948 (Ghana Forestry Commission, 1994). Since then, a consistent policy on natural resource management and the promotion of research and public education have been vigorously pursued. However, most of the early forest policies mainly emphasized a sustained supply of timber for the wood industry and promoted over-exploitation and an eventual destruction of unreserved forests (Dappah et al, 1995; Dappah et al, 1996; Forest Watch Ghana, 2006).

Consequently, by the end of 1978, the Government placed about 3,267,250 ha of forests under permanent forest estate (Forest Watch Ghana, 2006). In addition, quite a number of policies and attempted remedies were initiated by government and its agencies between 1960 and 1998. For example Forest Commission Act of 1960; Forest

improvement fund Act of 1960; Concessions Act of 1962; Forest ordinance for the protection of forests including reserves of 1972; Trees and timber (chain saw operation) regulation of 1983; Administration of land (amendment) decree of 1984; Forest products inspection Bureau Law of 1985; Forest protection (amendment) Law of 1986; Control and prevention of bushfires Law of 1990; Trees and timber (chain saw operation) regulation of 1991, Timber Resource Management Act 1997 (Act 547) and Timber Resource Management Regulations 1998 (L.I. 1649) have been used as guides for forests resources management in the country (Forest Watch Ghana, 2006; Ghana Forestry Commission, 1994).

2.8.3 State of forest governance in Ghana

Sustainable resource management has led to a revision of the country's 1994 Forest and Wildlife Policy (Forest and Wildlife Policy, 2012). Before then, the Forestry Development Master Plan (1996-2020) was prepared as a sound basis for the attainment of the aims of the 1994 Forest and Wildlife Policy (Gyimah and Dadebo, 2010) scheduled into three time horizons: Phase I- 1996-2000; Phase II- 2001-2010 and Phase III- 2011-2020 (Table 2.1).

Table 2.1: Forestry Development Master Plan

PHASE (YEAR)	SCOPE AND EMPHASIS
Phase I 1996-2000	Consolidation of forest management systems to ensure that critical ecosystems and watersheds are protected and that extracted timber can be certified as "sourced from sustainably managed forests" by the year 2000, and implementation of a Protected Areas System Plan; development and launching of flexible schemes for investments in commercial forest plantations, tree farming and propagation of non-timber products and wildlife; creation of an enabling climate for rationalization of the timber industry and consolidation of fiscal measures for efficient utilization and increased value-added processing.
Phase II 2001-2010	Maintenance of sustainable forest management and National Parks management systems; maintenance of commercial production systems and development of product harvesting, handling and marketing facilities promotion of total value-added processing and competitive marketing

Phase III 2011-2020	Maintenance of sustainable forest and wildlife management systems; maintenance of commercial production systems and improved product harvesting and marketing; maintenance of competitive value-added processing industries.

Source: Gyimah and Dadebo, (2010)

However, the master plan has not been strictly adhered as some issues under Phase I and II are still unaddressed. For example, management of off- reserve forest resources were supposed to be under the control of the state's FSD as captured by the 1994 Forest and Wildlife Policy. Yet the FSD has not taken any effective management of these resources since the introduction of the policy almost two decades ago (Dumenu, 2010).

The 2012 Forest and Wildlife Policy was a paradigm shift from the past policies. It seeks to enhance active participation of communities and landowners in resource management and address issues on tree tenure and benefit sharing; consolidate good governance through accountability and transparency; increase biodiversity; promote sustainable management of savannah woodland and increase government commitment to degraded landscape restoration through massive plantation development schemes (Forest and Wildlife Policy, 2012).

There are several programs and initiatives on-going in the forestry sector all in an attempt to revamp the sector such as the National Forest Plantation Programs launched in 2001 to restore degraded forest and improve environmental quality (Hoogenbosch, 2010). This was followed by the Modified Taungya System (MTS) launched in 2002 after the suspension of the Taungya system in 1984 (Agyeman et al, 2003; Kalame, 2009). The MTS enable the Forestry Commission to device a new way of giving financial incentives to farmers and other stakeholders and also transfer ownership of the trees from the state (government) to multiple owners (farmers, local communities and landowners). There are other forms of benefit sharing arrangements

in Ghana's forest sector. These include commercial plantation benefit sharing, Constitutional Timber Revenue benefit sharing, Community Resource Management Area (CREMA) benefit sharing and abunu and abusa (sharecropping/land sharing) in the agricultural sector (Dumenu et al., 2014).

The forestry sector in Ghana is bedevilled with challenges such as weak institutional capacity of forestry sector institutions; high level of illegal logging and no efficient wood tracking system (WTS) in place; low level of benefit flows to communities; lack of land use right/land tenure rights of local communities; savannah resource management not given same importance as forest management and natural resource livelihood related conflicts (Marfo and Schanz, 2008; Gyimah and Dadebo, 2010; Derkyi et al, 2014)

2.8.4 Customary land tenure arrangements in Ghana

Customary land tenure systems include all land held by various stools or skins, families and clans characterised with varied tenure management systems depending on the location and leadership of a particular stool or skin, clans and families (Kassanga and Kotey, 2001). Generally, all lands in Ghana are managed and governed by customary laws (Boamah, 1986). However, in practice the state laws take precedence over customary laws (Kassanga and Kotey, 2001).

Customary land tenure in Ghana varied in practice and is location specific. For example, land rights vested in beneficiaries vary across the southern part of the country to the northern part (Larbi, 2006; Crook et al., 2007; Pomevor, 2014). As explained by Kassanga and Kotey (2001) and Agbosu et al. (2007), irrespective of where the land is located in Ghana, they all have similar characteristics. The land is usually governed by traditional authorities with land or earth priests, clans or family heads serving as trustees. Land rights are also established through first settlement on the land, first

clearance of land, conquest through war and also as gifts from persons. The Land Title Registration Law, 1986 (PNDCL 152) indentified four types of land rights. These include allodial title, freehold title, leasehold title and lesser interest in land (Dumenu, 2010). Among the aforementioned types of interests in land, allodial title is the highest known to customary law and is location specific. For example, in some Ghanaian traditional communities it is vested in traditional stools or skins while in others it is held by clans, families, sub stools and individuals. DaRocha and Lodoh, (1999) points out that allodial title can be acquired by a person only through transfer in the form of gift and purchasing. It could be inferred from the above that allodial title can be acquired by the rich and wealthy in society through purchasing and the poor can only do so based on their established relationship with the group owning the allodial title.

Freehold is further divided into common law freehold and customary law freehold. Common law freehold is the right to land acquired by sale or gift made by the groups owning the allodial title. In this type the holder can create a common law with the involvement of both parties coming into terms that any dispute that may arise over the land in the near future be regulated by that common law (Dumenu, 2010). As explained by Marfo, (2009), settler or migrant farmers are able to acquire land by this means and have freehold rights to their farmlands. Customary law freehold (usufructuary title) on the other hand is the rights held by sub-stools, lineage, families and individuals in land owned through succession or first clearance of land. Under the customary law freehold members enjoy usufructs rights and each member has a right to a portion of the land he is farming on for which no other member can exercise ownership over that same land (Woodman, 1996: Kassanga and Kotey, 2001; Pomevor, 2014). However, Dumenu, (2010) explained that members with usufructs can lease or grant agricultural tenancies or other arrangements such as abunu (a half share) or abusa (a third share) usually to migrants or settler

farmers for which they owe it an obligation to perform certain services to the stool owning the allodial title. Leaseholds are rights given or granted to a person to use or occupy a land for a specified term. Generally, a lease may be given or granted either by the holder of the allodial title or a customary freeholder. Under this type, the lessee pays for the right to use or occupy the land, usually in the form of an annual rent, and has oral or written agreement covering the manner in which the land is used. It can be inferred from the above that the lessees' right to use the land can be terminated and withdrawn by the holder at the end of the specified term.

Lesser interests in land for the purposes of agriculture are created by owners of the allodial titles or customary freeholds. The two major tenure arrangements used are *abunu* and *abusa,* usually in the southern part of Ghana which are sharecropping arrangements by which the tenant tills the land and at harvest gives a specified portion of the produce to the landlord.

Generally, the tenant farmer is entitled to a third of the produce from the land in the case of *abusa* and half of the produce under *abunu.* In some cases, abusa depends on the type of crop cultivated by the tenant and his/her level of investment in its cultivation. In most cases for short duration crops such as maize, the land owner takes a third and the tenant two-thirds. This often happens when the landowner only releases the land to the tenant without any other investment in labour or cash in cultivating the crop.

2.8.5 Tree tenure in Ghana

Tree tenure is explained to mean a bundle of rights (right to own, dispose, inherit, use and exclude others) a person enjoys over tree and tree products (Fortmann, 1985; Dumenu, 2010). It is explained that, these rights are categorized into use rights, control and alienation (Dumenu, 2010). A use right allows a person access, withdrawal and exploitation of tree and tree products. A control right is the right to manage and exclude

others from having access to tree and tree products and the right of alienation is the right one has to sell, rent and transfer rights over tree and tree products to others either through sale or gift.

Tree tenure in Ghana is complex and diverse in both context and types. In the case of planted trees by individuals or groups, the planter has exclusive rights (right to use, access, and manage, alienation and exclusion) over the trees which have been stated in the Timber Resources Management (Amendment) Act, 2002. Even in this regard there are exceptions. For Commercial or economic trees, the planter has to register with the state's agency responsible for managing timber resources (Forest Service Division (FSD) of the Forest Commission) and the due processes observed before the planter can have economic use of the trees in Ghana (Dumenu, 2010). In the case of naturally occurring or growing economic timber trees found either in forest reserves or off- reserves, tenure rights are vested in the President of Ghana on behalf of respective stools or skins as stated in section 16 of the Concession Act, 1962. It can be inferred from the ongoing discussion that farmers have no right over naturally growing timber trees found on their farmlands even though they continue to pass judgement over which trees to retain on their farmlands when clearing the land for farming (Amanor, 1999; Marfo and Schanz, 2008; Marfo, 2009). Non-conducive tree tenure is largely regarded as a disincentive to sustainable forest management as majority of farmers still perceive forests as places to increase agricultural productivity to support subsistence living and also destroy or sell out timber trees illegally to chainsaw operators which according to Ribot and Peluso (2003) is illicit access. If sustainable management of private and communal forests is a desired social goal, then incremental changes in tenure features (transferability,

comprehensiveness, economic compensation, and duration) would facilitate its achievement.

2.8.6 Benefit sharing arrangement for timber resources in Ghana

The distribution of revenue from timber resources in forest reserves is guided by the 1992 Constitution of Ghana. The Constitution stated that 60% of the revenue be assigned to Forestry Commission (FC), 19.8% to the District Assembly (DA), 9% to the Traditional Council (TC), 7.2% to the Stool and 4% also to the Office of Administration of Stool lands (OASL) (TBI, 2009). With regard to the distribution of outside reserve, 40% of the revenue is assigned to Forestry Commission (FC), 29.7% to the District Assembly (DA), 10.8% to the Traditional Council (TC), 13.5% to the Stool and 6% also to the Office of Administration of Stool lands (OASL) (Nketial et al, 2004; TBI, 2009). It can be inferred from the above that the farmer who tends and nurtures the timber trees on farmlands in both reserves is not considered in the distribution the benefits. This creates disparity and discrimination in the benefit sharing arrangement which has been termed not equitable. For example, Amanor, (2005) posits that existing forestry policies and laws in Ghana fail to provide equitable benefit sharing scheme but rather gave the opportunity for the rich, powerful and politically well-connected few individuals to appropriate all forest benefits.

2.9 REDD+ in Ghana

REDD+ refers to Reduced Emissions from Deforestation and forest Degradation with biodiversity conservation and carbon stocks components (Nketia et al, 2009; Cotula and Mayers, 2009; Tulyasuwan et al, 2015). It draws on the basis that about 20% of global greenhouse gas (GHG) emissions are generated mostly by deforestation and forest degradtion including bush burning. REDD+ as a mechanism seeks to assist

developing countries like Ghana to reduce their deforestation and forest degraddation in exchange of financial incentives for verified reductions (Nketia et al, 2009; Cotula and Mayers, 2009; Tulyasuwan et al, 2015).

In Ghana, REDD+ Readiness Preparation Proposal (R-PP) was developed after the approval of its REDD+ Readiness Plan Idea Note (R-PP) in July 2008 with emphasis on foest sector policy, legislation and governance focusing on tree teure security, giving incentives to off-reserve farmers to conserve and plant trees and land and carbon rights. It also focuses on agro-forestry carbon conservation activities as much of deforestation relates to agriculture in the country.

In effect, REDD+ is a new opportunity for receiving financial incentives for the fight against deforestation and forest degradation. However, inequitable benefit sharing, tree tenure insecurity, lack of law enforcement and policies, difficulty in land acquisition and tenure regimes were identified as major governance challenges facing the implementation of REDD+ in Ghana. (Cotula et al, 2004; Amelia et al, 2007;
Green Dove, 2007; Nketia et al, 2009; Cotula and Mayers, 2009; Tulyasuwan et al, 2015)

2.10 Conceptual framework of the study

Institutional structures and governance arrangements influence the provision of environmental services on farmlands. This view is supported by Angelsen et al, (2009) showing that institutional structures influence the way farmers in agricultural landscapes perceive tree and what motivates them to engage in the destructtion of timber trees on farmlands. Weak governance of agro-ecosystems on the other hand is also responsible for corruption, lack of financial transparency and accountability and perverse incentives which are the causes of mass destruction of the forest. The present study is guided by the conceptual framework in Figure 2.1. Farmers are the major decision makers in agricultural landscape concerning the provision of enivronmental

services. Therefore, laws enforcement on deforestation, bush fires and illegal logging by enforecment agencies will regulate the way farmers consume timber resources which will have positive effect on the ES provision. The implementation of equitable benefit sharing, co-management of forest resources, flexible tenure systems and incentives for farmers will encourage them to retain and integrate timber trees on farmlands.The synergy between institutional structures and governance arrangements will also have an overall positive effect on the provision of ES such as carbon sequestration, landscape beauty, nutrient cycling, watershed protection and biodiversity conservation.

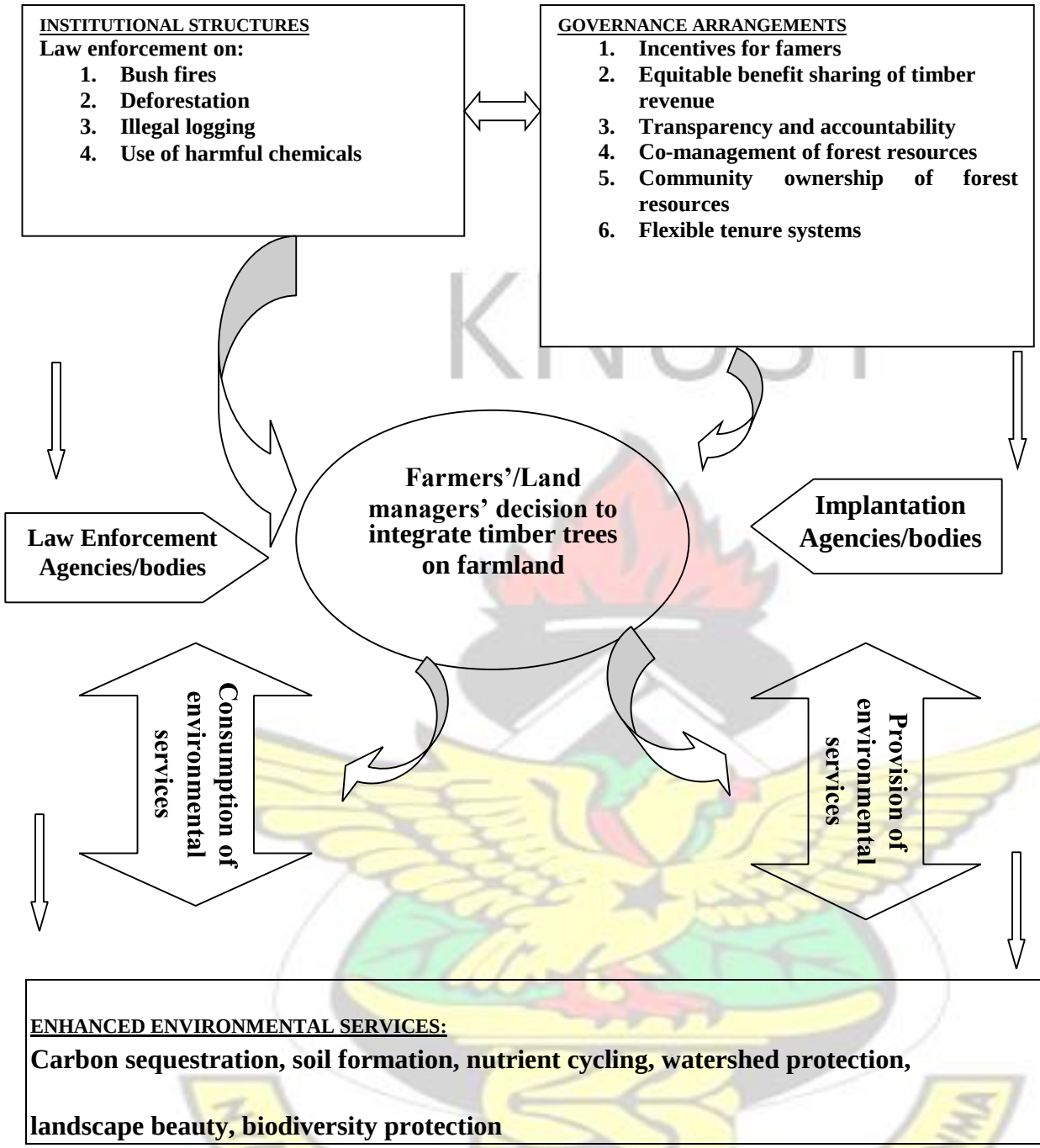


Figure 2.1: Conceptual framework for conceptualizing provision of ES on farmlands

CHAPTER THREE

METHODOLOGY

3.1 Study area

3.1.1 Location

Sene East District was created out of the then Sene District (now known as Sene West) on 9th March, 2012 with Kajaji as the District Capital (GSS, 2010). It is located in the North Eastern corner of the Brong Ahafo region of Ghana (Map .3.1). The total population of the six communities sampled was 35,838 people with 18,887 being males and 16,951 females (GSS, 2010). Majority of the population (84.6%) aged 15 years and older are economically active while 15.4% are economically not active. Agriculture is the dominate form of employment (70.3%) in the study area. Yam, rice, groundnut, maize and cassava are the common food crops grown in the study area on subsistence basis. However, there are no cash crops such as cocoa and coffee (GSS, 2010; SEDA, 2015)

3.1.2. Climate

The district falls between the Wet Semi-Equatorial and Tropical Continental Climatic Regions of Ghana and experiences two seasons; rainy and long dry seasons. The rainy season starts from April to October giving way to the dry season from November to March. The rainfall distribution varies from year to year, sometimes with intermittent droughts and floods mostly peaking in August. April to July is the period for the major rainfall while September to late October, is the minor period. The occurrence of droughts or floods affects crop growth, thus resulting in reduced crop yields every year, as optimal nutrients intake by the crops is impaired (GSS, 2010; SEDA, 2015).

3.1.3. Vegetation

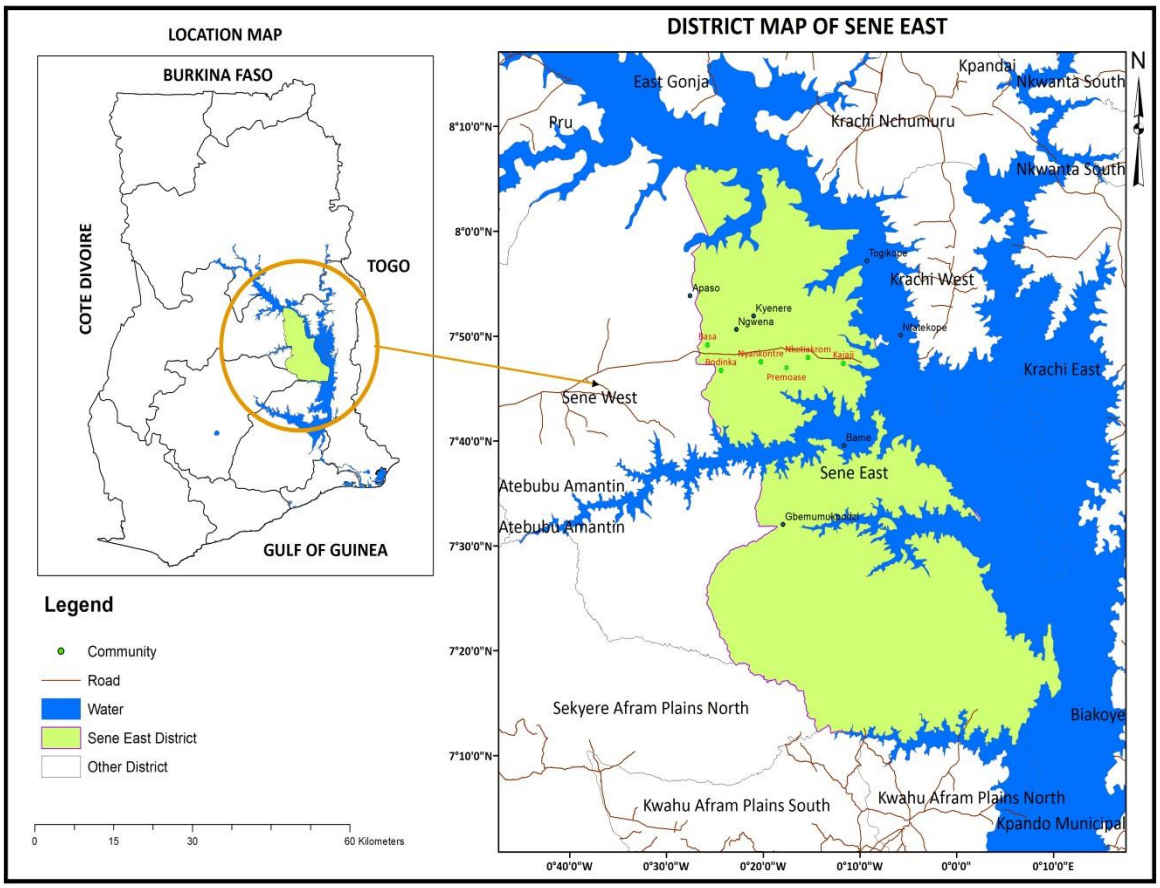
The vegetation of the district is predominantly Guinea Savanna woodland with light under growth and scattered trees. The major and economic trees are Shea, dawadawa, baobab,

mahogany, papao, senya, kane, onyina, kubre, kyenkyen, watapor, wama and neem species. Generally, tall grasses such as the elephant grasses and varieties of species mixed with these trees can be identified in the district. The vegetation opens up gradually and the trees reduce in height as one travels to the northern end of the district. Human activities such as bush burning, tree felling for fuel, poor farming practices, sand and gravel winning contribute immensely to the destruction of the vegetation and consequently the environment (GSS, 2010; SEDA, 2015).

3.1.4. Geology and Soils

The rocks underlying the district form part of the Voltaian formation which covers about two-fifths of the surface area of Ghana. The rocks belonging to this formation are mainly sedimentary and exhibit horizontal alignments. Sandstone, shales, mudstone and limestone are the principal examples of these rocks. The capability of any soil to support plant life depends on its water-holding capacity, its depth and fertility. The soil type in the Sene East district is the savannah ochrosol, which is generally well drained, friable and porous in nature.

The soils in the area are generally medium-textured ochrosols, which moderately contain organic matter. Gravel and clay deposits abound in the district providing a promising potential for construction, brick and tile, and pottery industries. There is however narrow strips of alluvial soils along the numerous dry valleys of the streams, the Volta Lake and Sene River suitable for rice farming. Generally, the soils are very fertile and enhance largescale cultivation of crops such as yam, maize, groundnuts, rice and cowpea, as well as vegetables such as tomatoes and garden eggs.



Map 3.1: Sene East District with study sites (GSS, GIS, 2010)

3.2 Research Design

Brink (2002) defines a research design as "a blueprint for conducting a study with maximum control over factors that may interfere with the validity of the findings. The research was to cover questionnaire administration, informal discussions and transect walk for field observations. Contingent Valuation Method

(CVM) was used as a method of data collection.

3.3 Data collection

Data collection was in two folds. A survey questionnaire was administered to individual farmers constituting the major source of primary data for the study (Appendix A).

Secondly, informal discussions were also held with the Director of Agriculture, the Agricultural Extension Officer, the District Planning Officer and the Forest Service Division (FSD) constituted the secondary data sources. The Traditional Authorities (Chiefs and elders) were also interviewed on management practices. Transect walk was undertaken across selected farms to validate answers respondents provided during questionnaire interviewing. It was also to observe at first hand, variations in farming practices undertaken in the area as well as attitudes and traditional socio-cultural practices.

Second, questionnaire of both open and close ended questions was administered to farmers to solicit for their willingness to pay for the provision of environmental services through integrating timber trees on farmlands by means of the Contingent Valuation Method (CVM). Mitchell and Carson, (1989) posit that CVM surveys should be carried out in a manner that will enable individual respondents understand the quality levels of the good in question and the potential improvements respondents are likely to get in order to avoid unrealistic response of willingness to pay (WTP) that may lead to omission of essential variable which can cause some bias in the estimates of coefficients in the econometric model.

To aid respondents' understanding of the services to be valued, a visual image was presented (Appendix A). These images were meant to expose respondents to the benefits and importance of providing environmental services. Respondents were made aware that in order to get image A they are to integrate trees on their farmlands as a way of paying for the environmental services.

Farmers were made aware also of the fact that, the form of payment is the energy, time, opportunity cost of use of the land and cost of obtaining seedling that would be quantified into monetary values. Information on respondents' demographic

characteristics and factors influencing their willingness to pay for provision of environmental services were also collected

3.4 Target Population / Sampling Frame

The target population for the present study was farmers who had been into farming for at least three years and above. The assumption is that; they would have more experience needed for the success of the study. The sample frame for the study constituted 320 registered farmers engaged in a five-year community sensitization program on climate change under the Ghana Social Opportunities Project (GSOP) funded by the World Bank and the Ghana Government. In consultation with the District Planning Officer and the Assistant, Community Development Officer and Agriculture Extension Officer these farmers were selected to further evaluate and monitor their progress.

3.5 Sample Size determination

In determining the sample size for the study from the sample frame, a mathematical method was adopted in order to increase the authenticity of the research outcome. Giving room for a minimal degree of error, the study operates at a 95 % level of confidence with a margin of error of 5 %. Using the mathematical sampling method: where n= sample size, N= sampling population and α= margin of error, as indicated by Miller and Brewer, (2003), the sample size was deduced from the population by the formula:

$$n = \frac{N}{1+N(\alpha)^2}$$

Where:

n = Sample size of the study population; N =Total population; α = the margin of error at 95% confidence level and error of margin of 5% (α=0.05) 1=constant.

Therefore, the sample size (n) for the study is given by

$$n = \frac{320}{1 + 320(0.05)^2}$$

$$n = \frac{320}{1.8}$$

$$n = 177$$

In order to obtain a representative sample of respondents in each section of the study area, the sample was proportionally distributed among the study communities. (Table 3.1).

Table 3.1: Sample size for the study communities

Communities	Sample size per the study area	Calculated sample	Percentage (%)
Kajaji	(58/320) *177	32	18
Bassa	(58/320) *177	32	18
Premuase	(54/320) *177	30	16.9
Bodinka	(54/320) *177	30	16.9
Nyankotreh	(51/320) *177	28	15.8
Nketiakrom	(45/320) *177	25	14.1
Total		177	100

N.B: The numerator is the total number of registered farmers in each community

3.6 Sampling Procedures

Stratified random sampling was employed. The procedure for selecting respondents for the study was done by dividing the population of each community in the study area by the stratum (males and females) and sampling within each community using simple random sampling so that respondents was selected proportionally to their representation in the total population.

Considering the calculated sample size for each community in the study area (Table 3.1), each sample size was divided into males and females according to their respective

proportions. That is, 52.7% males and 47.3% females (Table 3.2). The selection of males and females within each community was done by inviting all registered farmers who are males in each community to choose from a box containing YES and NO. YES means you would be considered for the study and NO means the otherwise. This was also carried out on the females until the required percentage of both males and females were arrived at to their representation in the population.

Table 3.2: Number of males and females selected per each community in the study area

Communities	Calculated sample	Males	Females
Kajaji	32	17	15
Bassa	32	17	15
Premuase	30	16	14
Bodinka	30	16	14
Nyankotreh	28	15	13
Nketiakrom	25	13	12
Total	177	94	83

3.7 Data Sources

The study made extensive use of both primary and secondary sources of information relevant to the study. The primary sources of information were gathered from the analysis of questionnaires that was administered to respondents. The information from primary sources is more reliable since it was gathered from questionnaires administered solely for the purpose of the study. The secondary sources of information included reports from organizations, brochures and manuals. A number of both published and unpublished information which are relevant to the study were also gathered using the internet.

3.8 Data Analysis

Data was analysed using quantitative data analysis method. Quantitative method involves proceeding from the positivist assumption that, if something exists, it exists in

some degree and can therefore be numerically measured. The survey data was coded and analyzed using Microsoft Excel and Statistical Package for Social Sciences (SPSS) version 16. An Independent Sample T- Test was run to compare the means of responses of farmers' willingness to pay for environmental services on farmlands.

A Multiple Regression Model was run to determine factors influencing farmers' willingness to pay for provision of environmental services through integrating timber trees on farmlands. Variables were inputted into the SPSS to determine means, standard deviations and test for significance of factors influencing respondents' willingness to pay for environmental services. The model used in this study was adopted from Grala et.al, (2009). The estimated model was specified as follows:

$$WTP = \alpha + \beta_1 G + \beta_2 A + \beta_3 ES + \beta_4 AL + \beta_5 FC + \beta_6 YF + \epsilon$$

Where: WTP is the dependent variable

$\alpha = \text{constant}$

$\beta(s) = \text{coefficients of explainatroy variables}$

$G = \text{Gender}$

$A = \text{Age of respondents}$

$ES = \text{Educational status of respondents}$

$AL = \text{Access to land}$

$FC = \text{Farmers}'\text{perception to climate change}$ $YF = \text{Years into farming}$ $\epsilon = \text{error term}$

CHAPTER FOUR

RESULTS

4.1 Socioeconomic characteristics of respondents

The total number surveyed was 177. As shown in Table 4.1, there were more men than women in the study area. In an informal interview with some women in the study area mentioned that, they had difficulties in acquiring land for farming.

Table 4.1: Socioeconomic Characteristics of respondents in the study area

Socioeconomic characteristics	Percentage (%)
Gender	
• Male	53.1
• Female	46.9
Age	
• 20-50	88.1
• 51-60	11.9
Educational Status	
• No formal education	63.7
• Formal education	36.3
Occupation	
• Farming	93.3
• Farming and others	6.7
Migrant Status	
• Natives	42.9
• Settlers	57.1

Source: Field Survey, 2015

4.2 Factors influencing farmers tree related practices in the study area

It was found that non- timber trees were given the utmost care and protection by weeding around them and preventing them from wild fires (Figure 4.1).

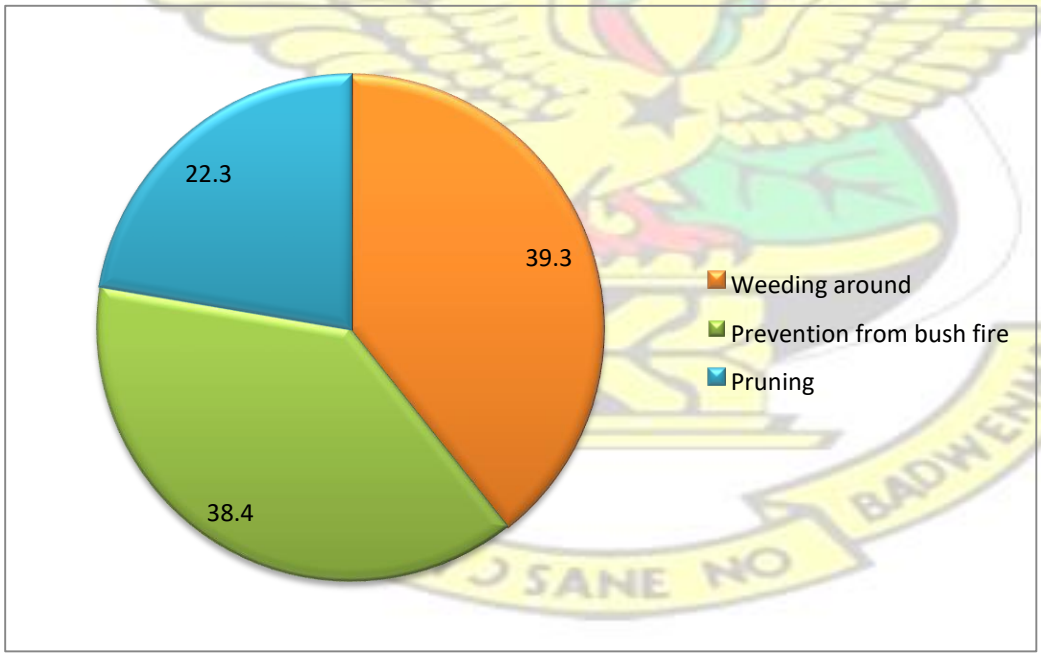


Figure 4.1: Non-timber tree related practices adopted by farmers in the study area.

Respondents gave reasons for the non-timber tree related practices in the study area. Most especially fruit trees serve as a source of food (Figure 4.2).

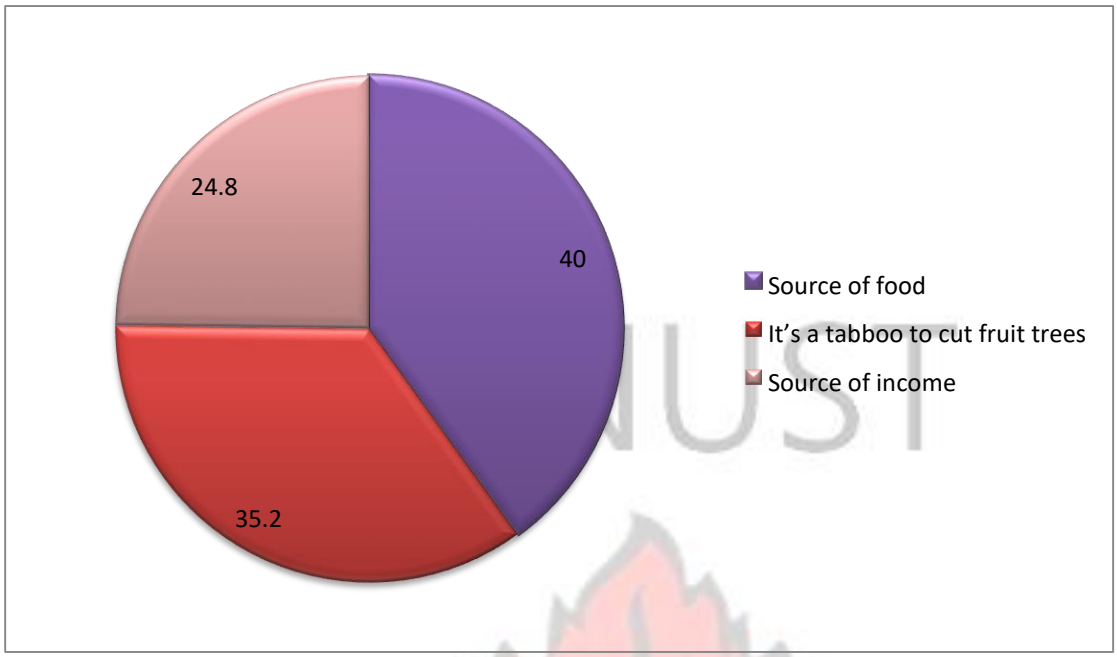


Figure 4.2: Respondents indicating reasons for non-timber tree related practices in the study area

There was no special care given to timber trees. Among the several timber tree related practices, clearing timber trees to make way for farming and setting fire at the roots of timber trees were common (Table 4.2).

Table 4.2: Percentage of respondents indicating timber tree related practices in the study area

Tree related practices	Number of responses	Percentage (%)
Setting fire at the roots of timber trees	124	25.3
Cutting timber trees to make way for farming	104	21.1
Cutting timber trees for charcoal burning	99	20.2
Killing timber trees at tender stage	97	19.8
Selling timber trees to illegal chainsaw operators	67	13.6
Total	491	100

Source: Field Survey 2015. NB (multiple response question)

It was found out that farmers engage in these practices for various reasons. Tree ownership problem was a major reason (Table 4.3).

Table 4.3: Percentage of respondents indicating reasons for timber tree related practices in the study area

Reasons for tree related practices	Number of responses	Percentage (%)
Tree ownership problems	157	21.2
Activities of illegal chainsaw operators	156	21.1
Lack of accountability in timber revenue	152	20.5
No direct benefit to farmers	146	19.7
Land tenure problems	129	17.4
Total	741	100

Source: Field Survey, 2015 NB (multiple response question)

Plate 4.1: Papao (Afzelia Africana) destroyed on a fallow in Nketiakrom in the study area.

4.3 Farmers' willingness to pay for environmental services through integrating timber trees on farmlands

Generally, respondents preferred imgae A (Timber trees integrated with food crops) as compared to B (Timber trees fell and sawn into boards illegally) (Appendix A). Respondents after comparing the images, Bassa community recorded the highest with 18% having desire for image A. Bodinka and Nyankotreh had less desire for image B. However, it was observed that the disparities in the level of choice for A in the communities were the active age group and B those in the inactive age group

(Table 4.4).

Table

4.4: Percentage of respondents desiring image A and B among study communities

Communities	Image A (%)	Image B (%)
Kajaji	16.4	1.7
Bassa	18.0	-
Premuase	14.7	2.3
Bodinka	13.0	4.0
Nyankotreh	13.0	2.8
Nketia Krom	13.6	0.5
Total	88.7	11.3

Source: Field Survey, 2015

It was found that 59% of respondents expressed willingness to pay to provide environmental services such as carbon sequestration, climate regulation, watershed regulation, flood control among others through the integration of trees on farmlands. As can be seen from Table 4.5, respondents were willing to part away with tubers of yam for obtaining seedlings.

Table 4.5: Respondents preference for WTP for environmental services through integrating timber trees on a ha per annum

No. of Tubers of yam	Amount GH₵	Frequency	Percentage (%)
25	50	51	49
30	60	12	11.5
35	70	3	2.9
40	80	5	4.8
45	90	6	5.8
50	100	4	3.8
60	120	3	2.9
70	140	4	3.8
75	150	6	5.8
200	200	10	9.6
Total		104	100

Source: Field Survey, 2015

Table

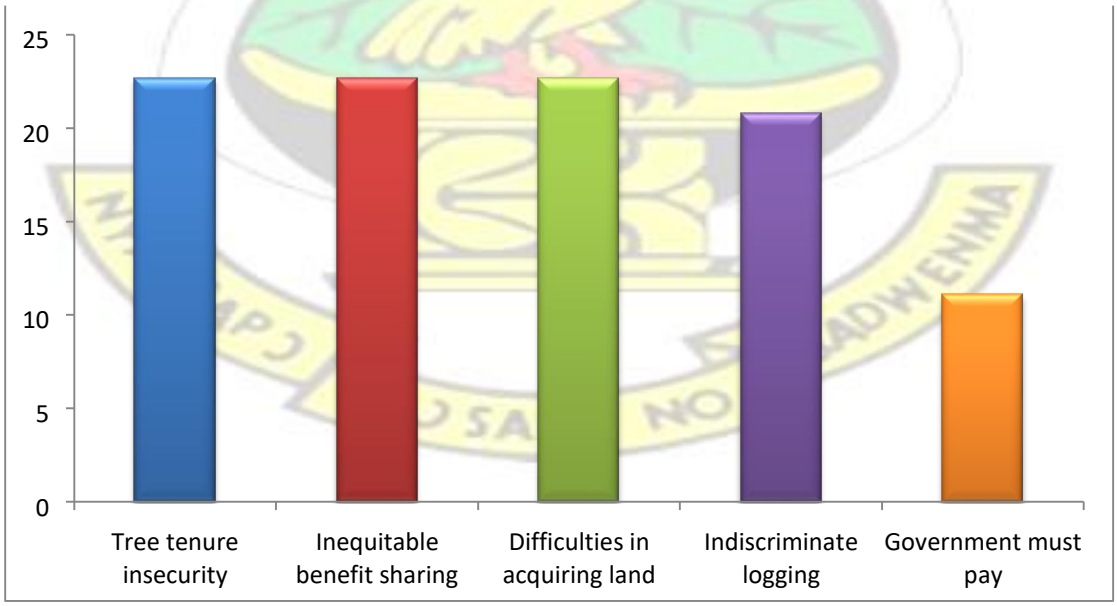
Respondents articulated several reasons for their willingness to pay for environmental services through integrating trees on farmlands (Table 4.6).

4.6: Respondents indicating reasons for willing to pay for environmental services through integrating timber trees on farmlands

Reasons for WTP	Number of responses	Percentage (%)
Income generation	104	26.9
Contributes to rainfall	97	25.2
Contribution to soil fertility	83	21.5
Erosion checking	56	14.5
Provides shade for relaxation	46	11.9
Total	386	100

Source: Field Survey, 2015 NB: Multiple response question

Some respondents were unwilling to use their time, energy as a form of payment to provide environmental services through integrating timber trees on their farmlands. Among the several reasons articulated by such respondents, difficulty in acquiring land was a major challenge (Figure 4.3).



Table

Figure 4.3: Respondents preference for not willing to pay to provide ecosystem services through integration of timber trees on farmlands

Surprisingly, no native complained of the activities of illegal chainsaw operators as deterring their willingness to pay to provide environmental services through integrating trees on farmlands (Table 4.7).

4.7: Distribution of reasons for not WTP among Natives and Settlers

Reasons for not WTP	Natives		Settlers	
	N	Percentage (%)	N	Percentage (%)
Government must pay	30	9.3	6	1.8
Difficulties in acquiring land	22	6.9	51	15.8
Indiscriminate Logging	0	0	67	20.8
Inequitable benefit sharing	18	5.6	55	17.1
Tree tenure insecurity	16	5	57	17.7
Total	86	26.8	236	73.2

Source: Field Survey, 2015

4.4.1 Willingness to pay for environmental services

As can be seen in Table 4.8, Bassa community had a mean of GH₵108.40 (SD=52.42) being the highest among communities in the study area. The community with the least mean WTP value of GH₵50.91 (SD=3.02) was Nketia Krom community.

Table 4.8: Willingness to pay for environmental services in study communities

Community	N	Min. (GH₵)	Max. (GH₵)	Mean (GH₵)	Std. Deviation
Kajaji	24	50	200	87.92	56.03
Bassa	25	50	200	108.40	52.42
Premuase	20	50	200	92.50	46.67
Bodinka	14	50	200	63.57	39.54
Nyankotreh	10	50	60	52.00	4.22
NketiaKrom	11	50	60	50.91	3.02

Source: Field Survey, 2015

Table

Respondents were much concerned about the type of trees to integrate with their food crops. The survey indicates that Wawa is the most preferred species followed by Mahogany (Table 4.9). However, farmers were unwilling to integrate Kane and KyenKyen with their food crops.

4.9: Types of timber trees respondents are willing to integrate with food crops in order to provide environmental services

Type of tree			
Local Name	Scientific Name	Number of responses	Percentage (%)
Wawa	*Triplochiton scleroxylon*	104	45.4
Mahogany	*Khaya ivorensis*	58	25.3
Ofram	*Terminalia superb*	21	9.2
Papao	*Afzelia Africana*	19	8.3
Kyenkyen	*Antiaris toxicaria*	15	6.6
Kane Total	*Anogeissus leiocarpus*	12	5.2
		229	100

Source: Field Survey, 2015 (Multiple response question)

4.4.2 Payment Vehicle for tree integration

It was discovered that 99% selected donations as their payment vehicle. Surprisingly, none of the respondents selected Utility bill or increase in prices of farming inputs. However, 1% selected tax on farm products as their payment vehicle (Table 4.10).

Table 4.10: Percentage of respondents indicating their Payment Vehicle for tree integration

Payment Vehicle	Frequency	Percentage (%)
Donations	103	99
Tax on farm products	1	1
Utility bill	0	0
Increase in price of farming inputs	0	0
Total	104	100

Table

Source: Field Survey, 2015

4.4.3: Mode of payment for tree integration

It was discovered that, 92.3% of the respondents wanted the mode of payment to be annually. However, less than 3% of respondents selected weekly as the mode of payment (Figure 4.4).

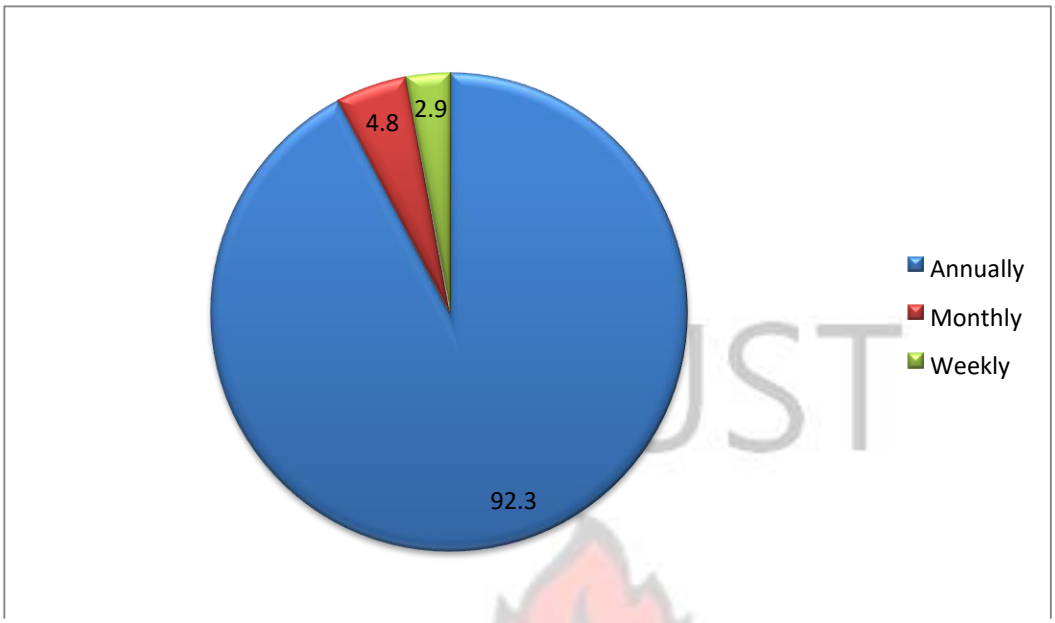


Figure 4.4: Percentage of respondents indicating their Period of payment

4.4.4 Preferred farmland for tree integration

Farmers indicated the type of farmland they will be willing to integrate timber trees on and it was discovered that 74% of respondents were willing to integrate timber trees on their food crop farmland (Figure 4.5).

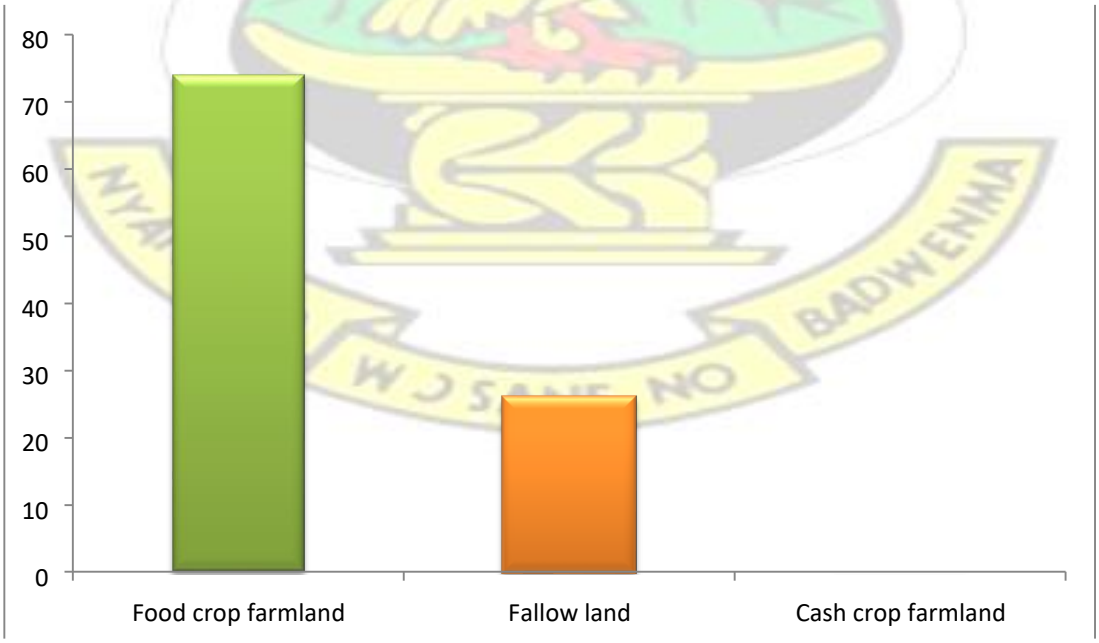


Table 4.5: Respondents indicating their preferred type of farmland for integrating timber trees

4.5 Factors influencing Farmers' willingness to pay for environmental services on farmlands

A Multiple Regression was used to determine the significance of these variations. As can be seen from Table 4.11, age, gender, educational status, farmers' perception to climate change and access to land are all significant at 5%. However, years into farming was found not significant.

Table 4.11: A Multiple Regression Model estimates of factors influencing farmers' willingness to pay (WTP) for environmental services through integrating timber trees on farmlands

Variable	N	Coefficients	t-Statistics	Sig.
Constant		11.997	0.259	0.001
Gender	177	9.347	-2.308***	0.0001
Age	177	5.040	-0.623***	0.0001
Educational status	177	6.034	5.739***	0.001
Years into farming	177	0.520	1.001	0.096
Farmers perception to climate change	177	36.073	-0.011***	0.0001
Access to land	177	7.621	1.123***	0.0001

NB: $R^2 = .753$, $F(7, 58) = 68.67$, $p < .001$

NB: *** show statistical significance at 5%.

4.6 Assessment of Institutional structures and Governance arrangements

4.6.1 Management of forest resources in the area

Respondents indicated that chiefs are the traditional forest managers in the communities surveyed. Ninety-nine percent of the respondents reported there were no Forest Services Division officers in the District. (Figure 4.6).

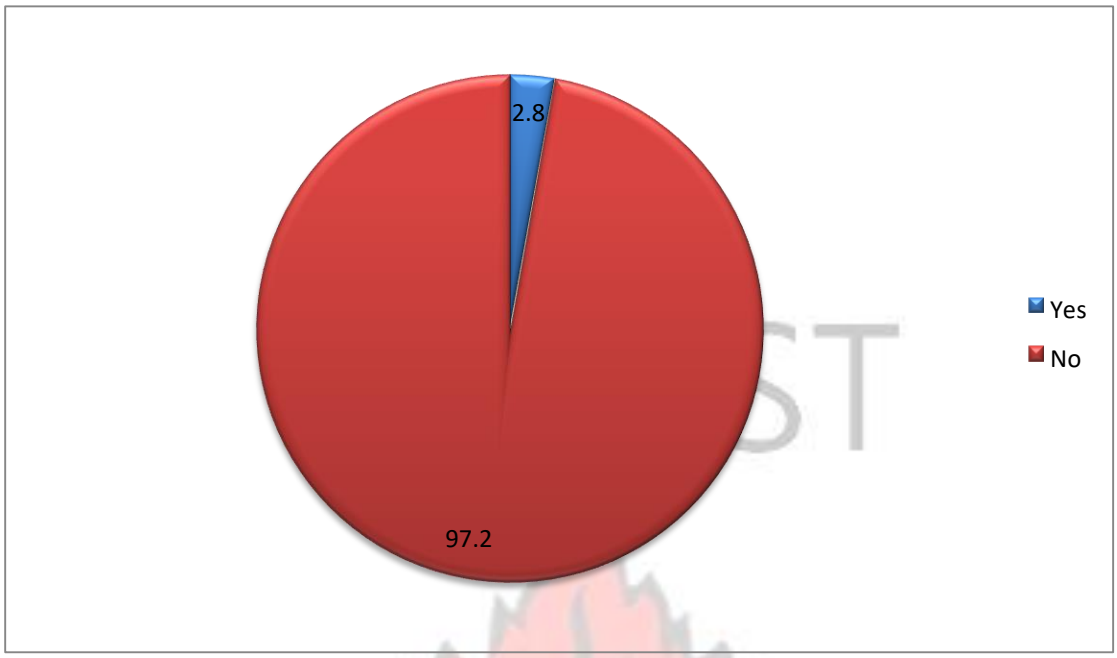


Figure 4.6: Percentage of farmers showing the presence of Forest Service Division (FSD) office is in the study area

It was found that, 84.2% of respondents were not happy or satisfied with how the chiefs manage the forest resources on their behalf (Table 4.12).

Table 4.12: Percentage of farmers indicating their perception about forest management in the study area

Management of forest resources	Number of respondents	Percentage (%)
Not Happy	149	84.2
Happy	23	13
Don't know	5	2.8
Total	177	100

Source: Field Survey, 2015

Respondents who were not happy with the way forest resources are managed in the area further advanced reasons in support of their views. Among these, 26% of farmers said

they are not happy because there is high level of corruption in the management of forest resources in the area (Table 4.13).

Table 4.13: Reasons for farmers' dissatisfaction in the management of forest resources in the study area

Reasons	Number of responses	Percentage (%)
Corruption	145	26
Lack of accountability and transparency	128	22.9
Lack of inclusiveness	99	17.7
Lack of free, prior and informed consent (FPIC)	97	17.4
Lack of fairness	89	15.9
Total	558	100

Source: Field Survey, 2015 (Multiple response question)

4.6.2 Access to Land and Tenure arrangements

Majority of farmers (78%) admitted that they do not own the land on which they farm. However, 22% of the respondents said they have ownership right to the land they cultivate (Figure 4.7 next page).

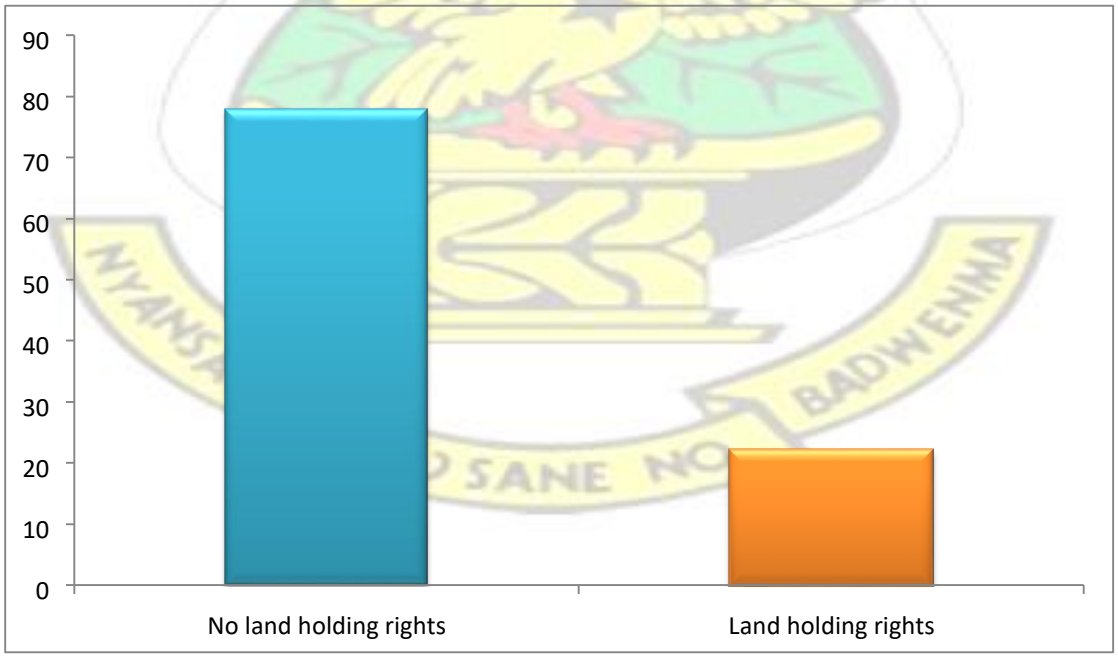


Figure 4.7: Respondents indicating their perception on land ownership in the district
Source: Field Survey, 2015

4.6.3 Tree tenure security

Most of the respondents said the trees belong to the chiefs or their landlords. However, 11.3% of them said the trees belong to the Government (Figure 4.8).

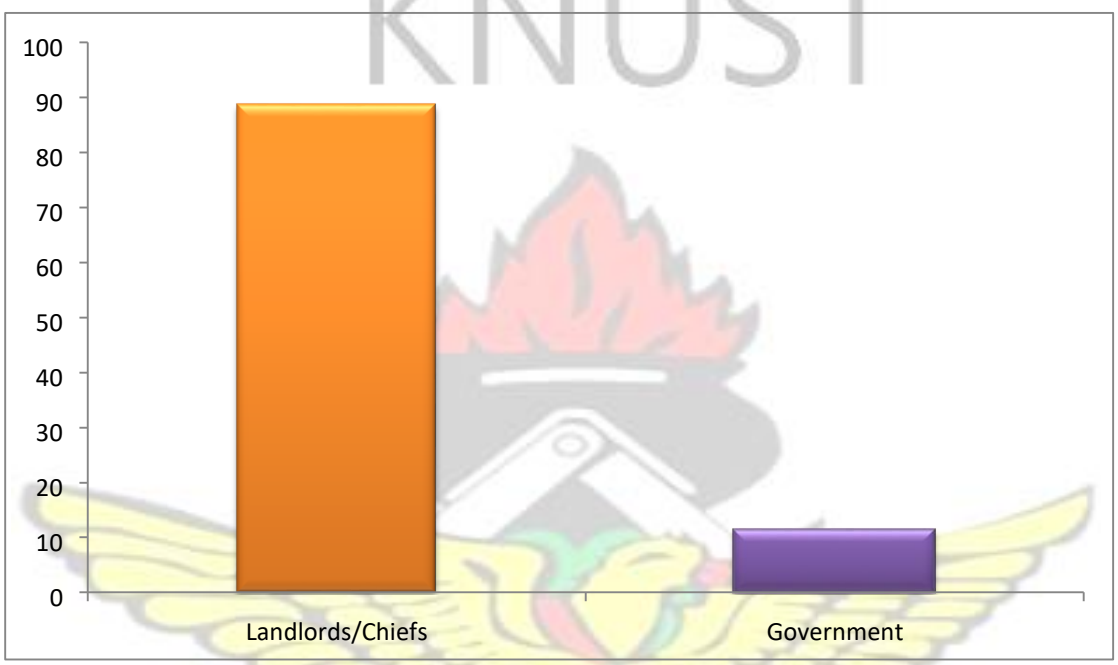


Figure 4.8: Percentage of respondents indicating owners of trees in the study area

4.6.4 Challenges farmers encounter with chainsaw operators in the study area

Farmers complained they have not been given any compensation for crop damage by chainsaw operators. As a result farmers ranked non-payment of compensation as a major challenge they encounter with chainsaw operators in the district (Figure 4.9).

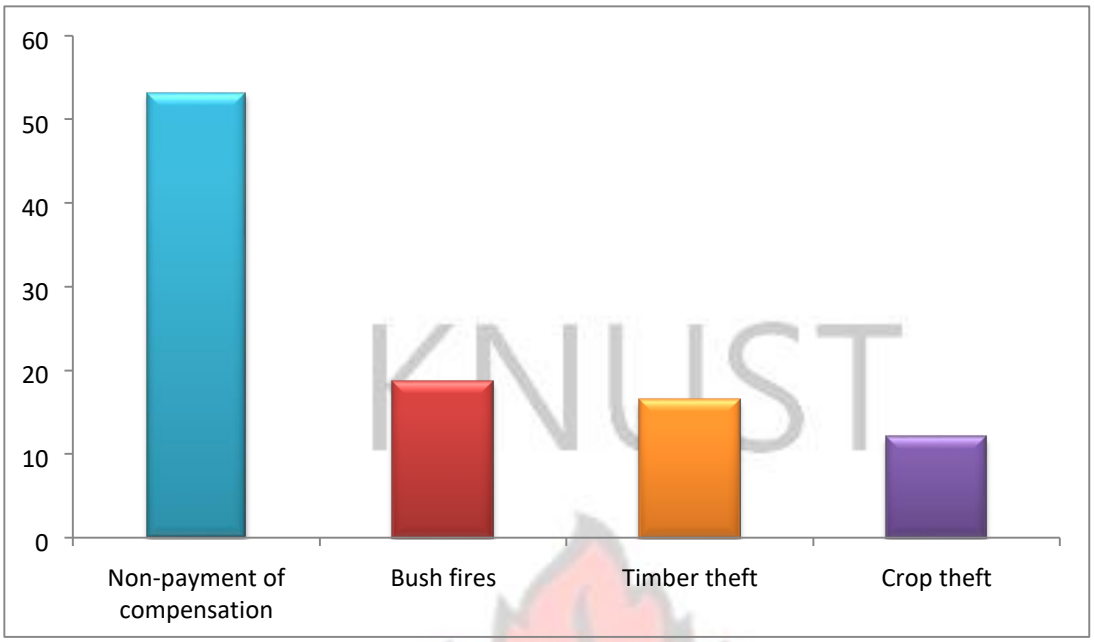


Figure 4.9: Percentage of farmers indicating challenges they encounter with chainsaw operators in the study area

4.6.5 Benefit sharing

Majority of farmers (85.3%) complained of the benefit sharing as being inequitable in the area and as a result they show their dissatisfaction (Figure 4.10).

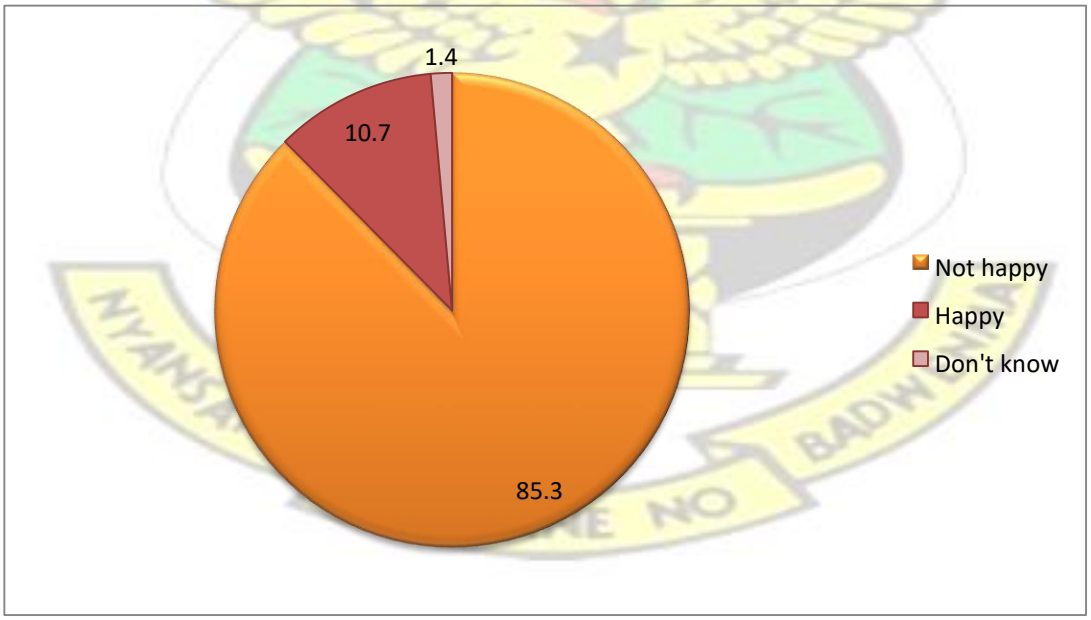


Figure 4.10: Percentage of farmers showing dissatisfaction in the benefit sharing

CHAPTER FIVE

DISCUSSION

5.1 Socioeconomic characteristics of respondents

Farmers' willingness to pay for provision of environmental services through integrating timber trees on farmlands depends on their socioeconomic status. Gender disparities in rural communities in terms of use and ownership of natural resources cannot be overemphasized. Women in the study area had difficulties in accessing land for farming. This confirms observations made by Ardayfio-Shardorf et al, (2007) indicating that men domination pose a lot of restriction to women for example when accessing land for farming. This could pose a great challenge to sustainable governance of agro-ecosystem in the area.

A study conducted by Nair (1993) points out that labour is among the most critical socioeconomic challenges likely to affect the output of tree planting programs. However, in the study area labour force is an advantage as majority of respondents belongs to the economically active groups. This would have a positive effect on the provision of environmental services through tree integration as the active age groups have the time, energy and resources that would be needed for the success of tree integration.

5.2 Factors influencing farmers tree related practices in the study area

Farmers' tree related practices depend on the type of tree in question. Fruit trees were given the utmost care and protection by weeding around them and also preventing them from wild fires while special care was not given to timber trees. Fruit trees were mostly retained because it served as a source of food on the farm and also as a source of income to some households. Most farmers especially migrants prefer keeping fruits trees on their farmland than timber trees because of competing claims associated with

keeping timber trees on farmlands. This result is similar to Wireko, (2011) and Hachoofwe, (2012) who indicated that farmers retain certain species of trees on their farmlands due to the various benefits they derived from them. If farmers could give same treatment to timber trees as it is with fruit trees on farmlands, it would help provide essential services like biodiversity conservation, climate regulation, nutrient cycling among others.

It is obvious to say that farmers do not give special care to timber trees because of the fact that they do not have the right to use, inherit, own, transfer and alienate others from using the timber trees that they tend and nurture on their farmlands and hence selling them out to illegal chainsaw operators. This confirms observations made by Agyeman, (2004); Marfo, (2004); Odoom, (2005); Acheampong and Marfo, (2011). These studies indicated that some local communities in Ghana have strong support for illegal chainsaw operations for the fact that there is lack of clarity over forest and tree tenure especially trees on farms. In effect, if good governance arrangements are not in place to allow farmers to enjoy some user rights to the timber trees they tend and nurture on their farmlands, it could have negative implications for sustainable governance of agro-ecosystems and the involvement of local communities in the sustainable forest management.

Similarly, the activities of illegal chainsaw operators have also compromised farmers desire to integrate timber trees on farmlands. Even though commercial chainsawing has been banned and criminalized in Ghana since 1998 (Acheampong and Marfo, 2011) it is difficult for enforcement agencies to strictly enforce the ban. If law enforcement agencies are able to enforce the ban it would encourage farmers to integrate timber trees on farmlands.

5.3 Farmers' willingness to pay for provision of environmental services through integrating timber trees on farmlands

According to respondents, trees play a crucial role on their farms. It is possible that this has reflected in their willingness to integrate timber trees on their farmlands. Most especially farmers who engage in farming for more than 10 years are able to tell which particular timber tree is conducive to be incorporated into their farming systems. This is consistent with findings of Amanor, (1997) and Dumenu, (2010) showing that famers are knowledgeable about the types of trees that are conducive for soil conservation, soil fertility enhancement, shading out of pan tropical weeds and hence maintain these tree species on their farmlands.

This implies that farmers understand the interplay between socioeconomic and biological interface (Danquah and Kuwornu, 2015). For example, Kane (*Anogeissus leiocarpus*), Kyenkyen (*Antiaris toxicaria*), Ofram (*Terminalia superba*) and Papao (*Afzelia Africana*) species were good source of timber but are not suitable to integrate with farmers' staple crop (yam). Other farmers also said that some of the species like Kane (*Anogeissus leiocarpus*) attract charcoal producers and chainsaw operators and for the fear of them, farmers were not willing to integrate these species with food crops. These findings are consistent with Stosch et al. (2002) and Blay et al., (2007) who indicated that Kane (*Anogeissus leiocarpus*) produces high density charcoal and are preferred tree species for charcoal production.

In this regard respondents were willing to integrate Wawa (*Triplochiton scleroxylon*) because it grows taller and does not cast unnecessary shadows on food crops and also because it is a valuable species that is scarce in the area. They also prefer mahogany (*Khaya ivorensis*) because of its medicinal value over other species. This implies that farmers will be more willing to integrate only tree species that do not

hamper the growth of their crops and invite strangers (chainsaw operators and charcoal producers) into their farms. It is certain that farmers' knowledge about the

importance of keeping trees on farmlands will result in their corresponding willingness to pay to incorporate trees on farmlands.

Other respondents have mixed feelings about using their time, energy, opportunity cost of use of land and cost of obtaining seedlings as a form of payment to provide environmental services through integrating timber trees on farmlands on the following premise: First, some argue that it is the government that has to pay them for providing ecosystem services through integrating timber trees on farmlands. Most of respondents within this category were natives. This implies that if government should pay they would have the lion share as they own the land and migrants who have no land holding rights may end up getting nothing.

Secondly, difficulties in land acquisition were reported by respondents as a major factor discouraging farmers from paying for provision of environmental services through integrating timber trees on farmlands. Farmers within this category are migrant farmers with women affected the most. Women access to land is tied to their relationship with men as wives (Danquah and Kuwornu, 2015). This is a challenge to women participation in sustainable forest management in rural communities where men have exclusive access to land based on the fact that they are the head of the family. If gender related issues are addressed, it is possible women will be more willing to subscribe to programmes that will lead to improvement in the status quo of provision of environmental services.

Third, respondents (migrant/settler) farmers complained of indiscriminate logging as deterring them from subscribing to the programme. It is surprising to note that some native farmers did not complain of illegal logging. The reason is that most of

them own the chainsaw machines which they give to operators for some additional income.

Finally, inequitable benefit sharing was also a factor discouraging farmers from paying for provision of environmental services through integrating timber trees on farmlands. Farmers complained of the chiefs taking absolute control of timber revenues. They therefore describe the type of benefit sharing as “Royal Takes All”. If a fair and equitable benefit sharing scheme is institutionalized, it may affect good governance of agro-ecosystem negatively and also discourage farmers from integrating timber trees for improvements in the status quo of environmental services. Equity is said to be the central pillars of Payment for Environmental Services (PES) where providers of environmental services are compensated and those receiving the services pay for their provision (Pagiola and Platais, 2002). The absence of economic benefits makes farmers see the forest as a place for increasing agricultural productivity. This implies that equitable benefit sharing is important to enable farmers cause a change in land use that would improve the status quo of environmental services which is crucial in recent times as emerging effort to mitigate climate change.

5.4.2 Vehicle of Payment for tree integration

The result suggests that respondents needed some comfort in the payment mode in order to integrate timber trees on their farmlands. It is reflected in majority of respondents selecting donations as the payment vehicle. It is possible that farmers were not comfortable with the other payment vehicles e.g. increase in price of farming inputs, tax on farm products and utility bill. For example, farmers have complained of paying high electricity bills but have not received stable power for the past two years and cannot stand an increase in their utility bills as payment vehicle. Farmers have also complained of high cost of farming inputs. So there is the possibility that farmers would

find it difficult to pay if the payment is scheduled in the form of increased in price of farming inputs. However, they find it very convenient to pay required amount as donations which can be in the form of farm produce (such as maize, yam) at the end of their farming season.

5.4.3 Preferred farmland for tree integration

Food crop land is the type of land currently under cultivation. Respondents stated that they will have enough time for the trees as they tend the food crops and the trees concurrently. It is possible that trees integrated on food crop lands are likely to be protected from bush/wild fires. This implies that delivery of environmental services will be protected. However, there is the danger that some can be destroyed especially during weeding.

Fallow land on the other hand is crop land left with no crops on for a season in order to recover its fertility. Some respondents stated that they preferred integrating trees on their fallow because it will help regain nutrients for the soil. This confirms observations made by Alardi and Olujobi, (2014) showing that trees can be retained to maintain soil fertility on fallow lands. This implies that trees grown on fallow lands help to recover soil fertility faster than leaving the land under natural regeneration which may take a longer period to recover.

5.5 Factors influencing farmers' willingness to pay for provision of environmental services through integrating trees on farmlands

Gender was a significant factor and positively influenced farmers' willingness to pay for environmental services through integrating trees on farmlands. This implies that more men are willing to pay for environmental services than women. This result similar with other studies showing that gender related issues are very critical and influencing decision to conserve natural resources in rural communities of Ghana

(Wireko, 2011; Bucagu et al., 2012; Danquah and Kuwornu, 2015). However, other studies show a negative relationship between gender and tree planting (Fabiyi et al, 1991; Zhang et al, 2007; Ayuya et al, 2011; Wireko, 2011). Gladwin and McMillan, (1989) posit that innovative approaches such as tree planting program to boost soil fertility is likely to depend on rural women as they produce majority of food crops in many African communities. This implies that women participation in conservation practices such as willingness to pay to improve upon the status quo of environmental services through integrating trees on farmlands is important to sustainable forest management and climate mitigating strategies.

Age was significant and positively correlated to farmers' willingness to pay for environmental services through integrating trees on farmlands in the study area. Respondents within the active age group of 20-50 years were more willing to pay for environmental services through integrating trees on farmlands than the non- active age group. The active age group are stronger, healthier and full of energy and can farm a large number of hectares and are capable of keeping more than one farm. This is contrary to the misconception that it is only the aged that remains in farming in rural areas (Alardi and Olujobi, 2014). It is highly certain that the involvement of the active age group in tree planting could lead to achieving a greater output.

These results are consistent with other studies showing that age would likely influence participation in tree planting program positively (Shaikh et al, 2007; Alardi and Olujobi, 2014). This is contrary to Odera et al, (2000); Gockowski and Ndoumbe, (2004) and Wireko, (2011) showing that age does not influence the adoption of agro-forestry.

Educational status of respondents was also found to be significant showing that farmers with formal education are more willing to pay for environmental services than

those without formal education. Some authors are of the view that formal education is a prerequisite for farmers' participation in tree planting program. According to Alardi and Olujobi, (2014), farmers with high level of education are of good advantage as they are able to understand new farming methods and innovation leading to their application. Owubah et al, (2001); Dumenu, (2010) and Danquah and Kuwornu, (2015) posit that the educational status of farmers could affect their willingness to take part in sustainable forest management (integrating trees on farmlands). Ardayfio-Schandorf et al (2007) added that education could create the awareness in farmers toward the conservation of natural resources. This is a confirmation that increased education is positively associated with respondents' willingness to pay to provide environmental services through integrating timber trees on farmlands.

Shaikh et al (2007) however points out that farmers with higher level of education could influence the probability of accepting to pay to integrate trees on farmlands negatively. This view which appears to be supported by Baidoo and Amoatey (2012) suggests that educational status of respondents is not significant when paying for improvement in agricultural activities in West Akim district of Ghana. Other studies (Stoll-Kleemann and O'riordan, 2002; Wireko, 2011) also show a negative association between tree planting and educational status of respondents.

Farmers' perception of climate change was also a significant factor influencing willingness to pay for environmental services. It is possible that farmers with knowledge of climate change and the effects on agriculture will invest more in tree planting program than those without such knowledge. This means that farmers with local knowledge about climate change and its likely impacts are more willing to pay for environmental services. This confirms observations made by Danquah and Kuwornu

(2015) showing that farmers' perception of climate change affects farmers' WTA positively.

Access to land was again a significant factor influencing willingness to pay. This means that farmers with access to land are more willing to pay than those without access to land. In the study area, women and migrant farmers are most affected n terms of access to land. This confirms observations made by Danquah and Kuwornu (2015) showing that, women are generally restricted when it comes to resources especially property rights on land and trees. The number of years into farming was however not significant. This means that the decision to integrate timber trees on farmlands does not depend on the number of years into farming. However, there is an overall joint effect of the variables (age, educational status, access to land, gender and perception of climate change) under consideration on farmers' willingness to pay for environmental services through integrating timber trees on farmlands. This means that the variation in farmers' willingness to pay for environmental services through integrating timber trees on farmlands is explained by age of respondents, their educational status, gender, access to land and their perception to climate change.

5.6 Institutional structures and governance arrangements

5.6.1 Institutional structures

There is no FSD department in the study area since the district was created in 2012. However, the nearest FSD office (forest district) is located at Atebubu. As a result, there is lack of monitoring and supervision in the study area. Management of timber in the area is done by farmers and chiefs/landowners. This is similar to Domenu (2010) showing that the FSD only does monitoring in off-reserves occasionally to take inventory for allocation of timber utilization permits (TUPs) or timber utilization contracts (TUCs).

There is the likelihood that low supervision by the FSD could affect sustainable use of timber and other natural resources in the area and could lead to their depletion and extinction.

5.6.2 Easy access to land and favourable Land Tenure System

Land tenure has been a long-time problem to many farmers especially migrants in the study area. Land tenure arrangements tend to favour landowners than it is to farmers (migrants). For example, respondents stated that the landlords/chiefs determine who could farm on a particular land and for how long. This is not favourable to migrant farmers who came to the area purposely for farming and as a matter of fact a threat to improving upon the status quo of environmental services. This is because trees take longer periods/years to get matured and as farmers do not have any land holding rights, it is possible that they may be sacked by landlords on the land before the trees are matured. Some landlords do not also allow tenants to grow permanent trees as this is perceived to be a sign of claiming ownership of their land. This is a setback and could discourage farmers' participation in a tree planting program as a conservative practice to improve upon the provision of environmental services. This could affect the local climate negatively and consequently affect sustainable forest management.

5.6.3 Flexible Tree tenure

Tree tenure is explained to mean a bundle of rights over tree and tree product, each of which may be held by different people at different times (Fortmann, 1985). It can be inferred from the above that rights to a tree means the right to own, dispose, inherit, use and exclude others from using trees and tree products. Respondents stated that they have no rights to trees on their farmlands in the study area and could be a factor promoting deforestation in the area.

However, if farmers can own the trees they maintain on their farmlands and also have the right to transfer to a second user could be a favourable arrangement that would increase farmers' willingness to pay to integrate timber trees on their farmlands. This could result in the provision of essential services such as climate mitigation and fostering agriculture in the area.

5.6.4 Equitable Benefit Sharing (Farmer inclusive)

The benefit sharing existing in the study area deviates even from the conventional one stipulated in the 1992 constitution of the Republic of Ghana and could be termed as "Royals Take All (RTA)". The traditional authority (Chiefs) has total rights over the trees and all the revenue accruing from it. They are responsible for giving verbal or oral TUCs to illegal chainsaw operators and persons purporting to be agents for Timber Companies outside the district for huge sums of money. The District Assembly also gets it share through collection of revenue from the purported agents. The ordinary farmer who tends and nurtures the trees on farmlands is left out resulting in inequitable benefit sharing.

It is possible that this was the reason why respondents were dissatisfied and agitating for equitable benefit sharing (farmer inclusive) that will pay them for their earnest dedication to maintaining trees on farmlands among all odds. This in effect would encourage farmers to keep and maintain trees on farm and fallow lands.

5.7 Institutional structures and governance arrangements required to support the integration of timber trees on farmlands.

Institutional structures and governance arrangements are very important in the provision of environmental services on farmlands. The following institutional

structures: enforced laws on use of harmful chemicals, bush fires, deforestation and illegal logging and governance arrangements: incentives for land managers, community ownership of forest resources, equitable benefit sharing are very essential to enhance the provision of environmental services on farmlands.

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1 Conclusion

Provision of environmental services in agricultural landscape has been given a lot of attention as a way of offsetting greenhouse gas emission in the atmosphere and a climate mitigation strategy across the globe. However, farmers' ability to integrate timber trees on farmlands is undermined by poor governance and unfavourable policies in agro-ecosystems. This creates a disincentive for farmers to invest in the provision of environmental services. Farmers now see the forest as a place to increase food, fiber and fuel production at the expense of the provision of environmental services.

The present study revealed a lot of issues and challenges to the provision of environmental services on farmlands. Farmers are more interested in weeding around fruit trees as opposed to timber trees which are not given any special care. Among the major timber tree related practices in the area were setting fire at the roots of timber trees and clearing of timber trees to make way for farming. Farmers engage in these practices on the basis that tree governance in the area is very complicated. Management of timber resources is left to the traditional Authorities (chiefs). The Forest Service Division (FSD) hardly performs its monitoring and supervisory roles on the premise that the nearest FSD administrative district in Atebubu is far from the study area. This has given the Chiefs authority over timber resources and they account to no one. Though farmers continue to pass judgment over the type of trees to retain on their farms and fallows they are not involved in the management process. These and other factors such as inequitable benefit sharing, unfavourable land tenure systems, and illegal chainsaw activities among others are undermining farmers' interest in integrating timber trees on farmlands in the study area even though they have some knowledge of the importance

of timber trees on their farms and fallows such as its contribution to rainfall, improvement in soil fertility, checking of erosion among others.

The survey result indicated that, 59% of farmers were willing to pay for provision of environmental services through integrating timber trees on farmlands. A multiple regression results show that gender, age, educational status, access to land and farmers' perception to climate change are significant variables influencing farmers' willingness to pay for provision of environmental services. But farmers' years into farming was found not to be significant This means that the variables (age, gender, educational status, access to land and perception to climate change) under consideration do have influence on farmers' willingness to pay for environmental services through integrating timber trees on farmlands.

Based on the above results, farmers' willingness to pay for provision environmental services through integrating timber trees on farmlands in the study area and Ghana as a whole depend on the direct benefit farmers could derive for not putting their land into productive agriculture. In view of this, favourable land tenure systems, equitable benefit sharing, accountability in timber revenue disbursement; enforceable forestry laws and policies are vital and should be considered by recent forest governance reforms in Ghana in order to enhance the provision of environmental services on farmlands as well as good governance of agro-ecosystems.

6.2 Recommendation

The study recommends that FSD office (forest district) in Atebubu should ensure effective monitoring and management of natural resources in the area until a substantive FSD office is established. If this is done, it could lead to sustainable management of forest resources in the area as forest laws and policies could be enforced.

Secondly, there should be a farmer inclusive benefit sharing scheme to enable farmers gain some economic benefit from the timber trees they tend and nurture on farmlands. This calls for a review of the current benefit sharing scheme established by the 1992 Constitution of Ghana. This could encourage farmers' willingness to integrate trees on farmlands in the area.

Thirdly, the district assembly in the study area in collaboration with other stakeholders should come out with proactive measures to regulate illegal chainsaw operators in the area. This can be achieved by enforcing the ban on illegal chainsaw milling as well as other ways of regularizing their activities in the study area. This could lead to sustainable forest management and also prevent future conflicts between farmers and chainsaw operators in the study area.

Fourthly, the Traditional Authorities should make land acquisition and tenure systems flexible to enable farmers especially settler farmers and women to participate actively in tree planting programs. Since farmers' perception to climate change strongly influences their willingness to pay for provision of environmental services, there is the need for policy instruments directed towards educating farmers on the importance of maintaining timber trees on farmlands.

Finally, 59% of farmers were willing to pay for environmental services through integrating timber trees on farmlands in the study area. This finding could be used to implement the REDD+ pilot as PES in off-reserves in Ghana. This can be achieved by institutionalizing a clear and secure tenure as one of the strong enabling environment for the implementation of REDD+ activities. There is also the need for a comprehensive tenure reform and its enforcement in off-reserve to formally recognize communal tenure through a modification in land tenure agreements and farmers' rights to trees on farm as well as future REDD+ benefits. There is the need for more studies in the district

to ascertain farmers' willingness to accept compensation to integrate trees on farmlands and implication for REDD+ implementation in the study area.

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Appendix A

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF SILVICULTURE AND FOREST MANAGEMENT

QUESTIONNAIRE FOR INDIVIDUAL FARMERS

Name of Enumerator: .....
Date of Interview: .....
Start time: ..... End time: .....

Introduction

The researcher is an MPhil student of the Kwame Nkrumah University of Science and Technology working on farmers' willingness to integrate commercial trees (timber) on farmlands in Sene East. The information is required to determine farmers' willingness to integrate these trees and the institutional structures and governance arrangements required to support the integration. Please, I assure you that any information provided would be treated with high degree of confidentiality and will be used purely for academic purpose.

Section I: Background Questions

1. Gender: Male [ ] Female [ ]
2. Age:
   A. Below 20 [ ] B. 21-30 [ ] C. 31-40 [ ] D. 41-50 [ ] E. 51-60 [ ] F. 60+ [ ]
3. Educational level:
   A. No education [ ] B. Basic [ ] C. Secondary [ ] D. Tertiary [ ] E. Other.....

Section II: Farmers tree management practices

4. How many years have you been into farming? .....

5. Are there trees on your farm?

   Yes [ ] No [ ]

6. If Yes, give examples of the trees according to the types provided below

Fruit trees	....
Commercial (timber) trees	....
Fuel wood trees	....
Fodder trees	....

7. What treatment do you give to the various examples of trees on your farm before planting?

Fruittrees: .....
.....
Commercial(Timber)trees:
.....
Fuelwoodtrees:
.....
Fodder trees: .....
.....
..... Why do you treat these trees differently? Fruit trees
.....
Commercial (timber) trees
.....
Fuel wood trees
.....
Fodder trees
.....

Section III: Implication of Farmers tree management practices

8. Do you get enough rains for your farming this year?
   Yes [ ] No [ ]
9. If yes, for how long does it last?
   .....
   .....
   .....

10. If No, for how long have you experienced the shortage?
    .....
    .....
    .....

11. Do you think farming practices play a role in the fluctuations?
    Yes [ ] No [ ]
12. If yes, what are some practices that contribute to this?
    .....
    ..... If No, why?
    .....

Section IV: Farmers' willingness to integrate timber trees on farmlands

(Attitudinal and behavioural change questions)

(A) **(B)**

(Trees with food crops) (Trees fell and sawn illlegally)

13. What can you see in picture (A) above?
    .....
    .....
    ..... What can you see in picture (B) above?
    .....
    ..... Which of the pictures do you desire? Picture
    (A) [ ] Picture (B) [ ]

(Questions about the actual WTP and WTA to integrate timber trees on farmlands)

14. If you desire picture (A) what can be done to get it?

A. Plant timber trees on farmlands [ ] B. Cut down trees [ ] C. Others specify.....

15. If your answer is (A) in 18, will you be willing to integrate timber trees on farmlands?
    YES [ ] NO [ ]
16. If YES, why?
    .....
    ..... If NO, why?
    .....
    .....

17. If your answer is YES in 19, which of your farmland would you integrate trees?
    a. Fallow land b. Food crop farmland c. Cash crop farmland d. Other specify.....

18. Give reasons for your preferred type of farmland?
    .....
    .....
    .....
19. Suppose integrating timber trees on farmlands comes with benefits and cost. How much will you be willing to spend to integrate timber trees on hectare (2.5 acres) of your preferred farmland?

a.....GH₵300 b..... GH₵400 c..... GH₵500 d..... GH₵600 e..... GH₵700 f.....Others specify..... GH₵.....

20. Suppose the amount chosen in 19 is further increased by 50%. Will you be willing to pay?
    YES [ ] NO [ ]
21. If NO, why?
    .....
    .....If YES, if the amount is increased again by 70%. Will you be willing to pay?
    YES [ ] NO [ ]
22. If NO, why?
    .....
.....
23. If YES, what payment vehicle will be good for you?

A. Tax on farm products B. Increase in price of farming inputs C. Utility bill
D. Donations C. Other specify.....

24. Will you be willing to pay this amount on daily, weekly or monthly basis? Daily [ ] Weekly [ ] Monthly [ ] Others specify.....

Section V: Institutional structures and governance arrangements

25. Are there Forest Service Division officers in your district?
    YES [ ] NO [ ]
26. Do you have the right to own the trees found on your farmlands?
    YES [ ] NO [ ]
27. If NO, who owns the trees?
    .....
    .....
    .....
28. Are there chainsaw operators in the district? YES [ ] NO [ ]
29. If YES, what can you say about chainsaw operators in your district?
    .....
    .....
    ..... Do the activities of chainsaw operators affect your farming?
    YES [ ] NO [ ]
30. If YES, in what way?

.....
.....

..... Do you get compensation for crop damaged by chainsaw operators? YES [ ] NO [ ]

Appendix B

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF SILVICULTURE AND FOREST MANAGEMENT

QUESTIONNAIRE FOR GOVERNMENT AGENCIES/ NGOS

Name of Enumerator: .....

Date of Interview: .....

Start time: ..... End time: .....

Introduction

The researcher is an Mphil student of the Kwame Nkrumah University of Science and Technology working on farmers' willingness to integrate commercial trees (timber) on farmlands in Sene East. The information is required to determine farmers' willingness to integrate these trees and the institutional structures and governance arrangements required to support the integration. Please, I assure you that any information provided would be treated with high degree of confidentiality and will be used purely for academic purpose.

Section I: Background Questions

1. Gender: Male [ ] Female [ ] 2.
Age:
   A. Below 20 [ ] B. 21-30 [ ] C. 31-40 [ ] D. 41-50 [ ] E. 51-60 [ ] F. 60+ [ ]
3. Educational level:
   A. No education [ ] B. Basic [ ] C. Secondary [ ] D. Tertiary [ ]
   E. Other.....
4. Which category of respondent are you?
   a. MOFA [ ]
   b. FSD staff [ ]
   c. NGO Staff [ ]
   d. CBO/CSO [ ]

\

5. What are the major farming practices in the district? .....

.....
.....
.....

6. Do farmers indiscriminately cut down trees before planting?
   YES [ ] NO [ ]
7. If YES, what are the major trees fell by farmers?
   (You can tick more than one)

Fruit trees (.....) Commercial (Timber) trees (.....) Fodder trees (.....) Fuel wood trees (.....)

8. What reasons account for farmers' decision to cut down these trees?

Fruit trees

.....
.....

Commercial (timber) trees

.....
.....
.....

Fuel wood trees

.....

Fodder trees

.....
.....
.....

9. What are the challenges associated with keeping trees on farmlands?

.....
.....

10. Are these challenges prevalence in the district? YES [ ] NO [ ]
11. If YES, what measures are put in place to curb these challenges?

.....
.....
.....

12. Is there any timber company operating in the district?
    YES [ ] NO [ ]

13. If YES, how do they get access in to the forest for timber resources?

.....
.....