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**UNIVERSITY OF GHANA**

**LOCAL KNOWLEDGE AND RESPONSE TO DEFORESTATION AND  
CLIMATE CHANGE PHENOMENA AMONG DIFFERENT LIVELIHOOD  
GROUPS**

**BY**

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**THIS DISSERTATION IS SUBMITTED TO THE UNIVERSITY OF GHANA,  
LEGON, IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE  
AWARD OF MA DEVELOPMENT STUDIES DEGREE.**

**JULY, 2015**

## DECLARATION

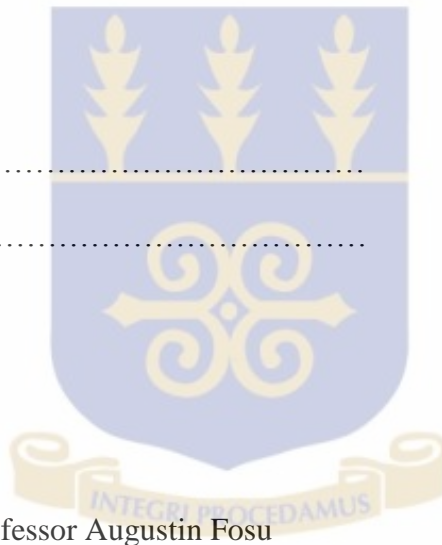
I hereby declare that this submission is my own original work towards the award of a degree of Master of Arts (MA) Development Studies programme at the Institute of Statistical Social and Economic Research (ISSER). This work, to the best of my knowledge, neither contains materials previously published by another person nor materials that have 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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Name of Supervisor: Professor Augustin Fosu

Signature: .....

Date: .....

## **DEDICATION**

This work is dedicated to my loving family for their support and encouragement given me throughout the duration of this programme.



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**TABLE OF CONTENTS**

<b>DECLARATION .....</b>	<b>i</b>
<b>DEDICATION .....</b>	<b>ii</b>
<b>ACKNOWLEDGEMENT .....</b>	<b>iii</b>
<b>TABLE OF CONTENTS .....</b>	<b>iv</b>
<b>LIST OF TABLES.....</b>	<b>ix</b>
<b>LIST OF FIGURES .....</b>	<b>x</b>
<b>LIST OF ABBREVIATIONS .....</b>	<b>xi</b>
<b>ABSTRACT.....</b>	<b>xii</b>
<b>CHAPTER ONE .....</b>	<b>1</b>
1.1 Introduction and Background of Study.....	1
1.2 Statement of the Problem.....	3
1.3 Aim and Objectives.....	6
1.4 Research Questions .....	7
1.5 Hypotheses .....	7
1.6 Justification of Study .....	9
1.7 Organisation of Chapters .....	10
<b>CHAPTER TWO .....</b>	<b>12</b>
<b>REVIEW OF RELEVANT LITERATURE AND CONCEPTUAL FRAMEWORK.....</b>	<b>12</b>
2.1 Introduction.....	12
2.2 Deforestation as a Global Problem .....	12
2.3 Deforestation in Ghana .....	13
2.3.1 Historical evidence .....	13
2.3.2 Drivers of Deforestation.....	15

2.3.3 Pressures of Deforestation .....	16
2.3.4 State of Deforestation .....	16
2.3.5 Impact of deforestation.....	17
2.3.6 Response to deforestation in Ghana .....	20
2.4 Local Knowledge .....	22
2.5 The Sustainable Rural Livelihoods Framework.....	24
2.6 Gap in literature .....	25
2.7 Conceptual Framework .....	26
2.7.1 Origins of DPSIR .....	26
2.7.2 Explanation of concepts under DPSIR .....	28
2.7.3 Justification for DPSIR conceptual framework.....	29
2.7.4 Strengths of DPSIR .....	30
2.7.5 Limitations of DPSIR .....	31
2.7.6 Application of DPSIR .....	31
2.8 Conclusion .....	31
<b>CHAPTER THREE .....</b>	<b>33</b>
<b>METHODOLOGY .....</b>	<b>33</b>
3.1 Introduction.....	33
3.2 Research Design.....	33
3.3 Methodology .....	34
3.4 Sources of Data .....	35
3.5 Methods of Data Collection .....	35
3.5.1 Survey.....	36
3.5.2 In-depth Interviews.....	38
3.5.3 Observation .....	40
3.5.4 Contingent Valuation Method .....	40
3.6 Target Population.....	42

3.7 Sampling .....	42
3.8 Data Analysis .....	43
3.9 Ethical Considerations .....	44
3.10 Profile of the Study Area .....	45
3.10.1 Geography of Nsawam Adoagyiri Municipal Assembly (NAMA) .....	46
3.10.2 Climate and Vegetation .....	46
3.10.3 Topography and Drainage .....	46
3.10.4 Demographic characteristics .....	47
3.10.5 Infrastructure .....	47
3.10.6 Environment .....	47
3.10.7 Transportation and communication .....	48
3.10.8 Economy .....	48
<b>CHAPTER FOUR.....</b>	<b>49</b>
<b>PRESENTATION OF RESULTS AND DISCUSSION OF FINDINGS</b>	
<b>.....</b>	<b>49</b>
4.1 Introduction .....	49
4.2 Demographic Characteristics of Respondents .....	49
4.2.1 Gender and Age of Respondents .....	49
4.2.2 Marital Status and Number of Children Of Respondents.....	50
4.2.3 Distribution of Respondents according main source of livelihood activity .....	51
4.2.4 Distribution of Respondents by Secondary Livelihood Activity .....	52
4.2.5 Livelihood Diversification In The Rural Economy .....	53
4.2.6 Respondents' Level of Education.....	54
4.2.7 Respondents' Level of Education and Main Livelihood Activity.....	54
4.2.8 Estimated Monthly incomes from Main Livelihood Activity .....	55
4.3 Forest Dependence and Importance to Livelihoods Groups.....	58
4.3.1 Importance of Forests to Livelihood Groups .....	58

4.3.2 Frequency of visits to forest in the month preceding the study.....	58
4.3.3 Activities carried out in the forest in the past year.....	60
4.4 Awareness of Drivers, Pressures, State and Impact of Deforestation Among Livelihood Groups .....	63
4.4.2 Local Perceptions and Understanding of Deforestation.....	64
4.4.3 Drivers of Deforestation.....	67
4.4.4 Pressures of Deforestation.....	69
4.4.5 State of Forests in Otu Kwadwo.....	71
4.4.6 Impact of Deforestation.....	74
4.5 Response to Deforestation .....	86
4.5.1 Concern about deforestation among livelihood groups.....	86
4.5.2 Community and Government response to deforestation .....	92
4.6 Hypothesis Testing.....	95
4.6.1 Testing of Hypothesis 1.....	95
4.6.2 Testing of Hypothesis 2.....	96
4.6.3 Testing of Hypothesis 3.....	98
<b>CHAPTER FIVE .....</b>	<b>101</b>
<b>SUMMARY OF FINDINGS, RECOMMENDATION AND CONCLUSIONS .....</b>	<b>101</b>
5.1 Introduction.....	101
5.2 Summary of Findings.....	101
5.2.1 Difference in knowledge of Deforestation .....	104
5.2.2 Difference in Knowledge of climate change .....	105
5.2.3 Differences in Response to Deforestation and climate change .....	105
5.3 Conclusion .....	106
5.4.1 Limitations of Study.....	107
5.5 Recommendations.....	107

5.5.1 Recommendations to curb deforestation .....	107
5.5.2 Recommendation for future research .....	109
<b>REFERENCES.....</b>	<b>110</b>
<b>APPENDICES .....</b>	<b>124</b>
<b>Appendix 1: Questionnaire .....</b>	<b>124</b>
<b>APPENDIX 2.....</b>	<b>131</b>
<b>QUESTIONS FOR INDEPTH INTERVIEWS WITH KEY INFORMANTS .....</b>	<b>131</b>
<b>Appendix 4 The role of Forests in Rural Livelihoods .....</b>	<b>133</b>
<b>APPENDIX 5 FOREST ECOSYSTEM SERVICES .....</b>	<b>134</b>
<b>Appendix 6 Annual Rainfall and Mean Temperature for Nsawam (1990-2010).....</b>	<b>135</b>

**LIST OF TABLES**

Table 4. 1: Main Livelihood activity by education.....	55
Table 4. 2: Frequency of visits to the forest .....	59
Table 4. 3: Indicators of decrease in forest land .....	64
Table 4. 4: Meaning of deforestation to respondents .....	65
Table 4. 5: Drivers of Deforestation .....	67
Table 4. 6: Pressures that result in deforestation .....	69
Table 4. 7: State of forest.....	72
Table 4. 8: Impacts of deforestation .....	75
Table 4. 9: Changes in temperature by type of respondent .....	82
Table 4. 10: Occurrence of extreme events by type of respondent .....	84
Table 4.11: Activities of respondents to combat forest land conversion to non-forest land .....	89
Table 4.12: Two-sample t test for willingness to pay before orientation by respondent group .....	96
Table 4.13: Two-sample t-test for willingness to pay after receiving information about Forest ecosystem services by respondent group .....	98
Table 4.14: One-way ANOVA test to determine the significance of the difference in mean WTP values before and after FES information treatment .....	99

## LIST OF FIGURES

Fig 2. 1: DPSIR Conceptual Framework .....	28
Fig 3. 1: Map of Nsawam Adoagyiri Municipality showing Otu Kwadwo (upper right corner).....	45
Fig 4.1: Distribution of respondents by gender.....	50
Fig 4.2: Marital status of respondents by gender.....	51
Fig 4.3: Distribution of main source of livelihood .....	52
Fig 4.4: Distribution of secondary livelihood activity.....	53
Fig 4.5: Estimated Monthly incomes from main livelihood activity (income in Ghana cedis).....	56
Fig 4.6: Forest activities in the past year by livelihood groups .....	61
Fig 4.7: GIS data on deforestation in Otu Kwadwo .....	73
Fig 4.8: Changes in rainfall by type of respondent.....	81
Fig 4.9: Changes in wind by type of respondent .....	83
Fig 4.10: Respondents' perceptions on the causes of changes in weather elements ..	85
Fig 4.11: Concern about the conversion of forest to other uses .....	87
Fig 4.12: Reasons for lack of concern about deforestation .....	88
Fig 4.13: Reasons why respondents are not doing anything about deforestation.....	90
Fig 4.14: Awareness of community efforts to deal with forest conversion.....	92
Fig 4.15: Measures taken by community to deal with forest conversion .....	93

**LIST OF ABBREVIATIONS**

BBC	British Broadcasting Corporation
CVM	Contingent Valuation Method
DPSIR	Drivers, Pressures, State, Impact, Response
FES	Forest Ecosystem Services
FAO	Food and Agriculture Organisation
NTFP	Non Timber Forest Product
WTP	Willingness To Pay
NAMA	Nsawam Adoagyiri Municipal Assembly
OECD	Organisation for Economic Co-operation and Development

## ABSTRACT

About 85% of Ghana's deforestation is human-induced, based on the quest for livelihoods. The Reduced Emissions from Deforestation and Degradation plus (REDD+) initiative aimed at mitigating climate change by providing incentives to conserve forest lands, is criticized as largely favouring rich investors and owners of large forests lands instead of the poor whose activities account for 85% of total forest loss. The poor, mostly rural dwellers, therefore have very little motivation to preserve forest resources under REDD+.

This study explores the viability of an enhanced knowledge and appreciation of forest ecosystem services as an alternative approach to motivate poor people to invest in forest preservation. To achieve this, the local knowledge of poor forest community dwellers regarding deforestation and climate change was critically examined. Literature abounds on rural farmers' knowledge of their environment but very little is known about the knowledge held by other forest inhabitants whose livelihoods do not depend on forests but are equally affected by distortions in the forest's ecosystem. The study thus sought to construct the current local knowledge of deforestation as exists among two main livelihood groups (individuals whose livelihoods depend on forest resources and those whose livelihood activity does not depend on forest resources).

The study employed the mixed methodological approach in its design. Questionnaires and interviews were used to gather information on the respondents' knowledge on deforestation and climate change. Contingent evaluation method was used to ascertain respondents' response to deforestation and climate change in terms of their willingness to pay to conserve forests. This was done in two phases. The first WTP bids were solicited from respondents immediately after gathering information on their current knowledge of the phenomena. The second WTP bids were solicited after respondents

were given information about Forest Ecosystem Services and its importance in to the ecosystem human existence. This enabled the study to draw meaningful conclusions about the potential for enhanced knowledge of Forest Ecosystem Services to serve as motivation to poor rural dweller to conserve forests.

The study did not find significant differences between local knowledge of deforestation held by the two livelihood groups. There were no significant differences between the two groups in their local experiences and perceptions of climate change. Both livelihood groups showed a lot of concern about deforestation since the difference in the level of concern showed was not statistically significant. Both groups had a positive response to deforestation and climate change as evidenced by the fact that both were willing to pay an average of GHC 8.2 (USD 2.4) to preserve secondary forests in the community. With enhanced knowledge of forest ecosystem services, both livelihood groups increased their mean willingness to pay amounts to GHC10.8 (USD 3.1).

The study thus concludes that the extent of livelihood diversification in the rural economy is such that even individuals whose main livelihood activities do not rely on forest resources, value the importance of the forests in meeting subsistence needs, thus are equally aware of and concerned about the problem of deforestation and climate change as individuals whose main livelihoods depend solely on forest resources. Knowledge of forest ecosystem services presents a viable alternative to incentivise all community members (rich, poor, farmers, non-farmers) to place a high premium on forest conservation.

## CHAPTER ONE

### 1.1 Introduction and Background of Study

About 31% of the earth's surface is covered with forests (Lindquist & al, 2012). Forests are essential to the survival of humans and the universe because of their role in protecting the ecosystem and providing crucial needs such as oxygen for breathing. Forests are important assets to communities and nations because they are embedded with resources which can be exploited for economic development and well-being of people and nations. Consequently, deforestation avails land for food production, mining, settlements and extraction of forest resources.

The Food and Agriculture Organisation (FAO) as well as other international bodies have recently been concerned about deforestation around the globe because of the alarming rate at which it is happening and its potential to destroy the biodiversity and ecological systems which sustain life including human life, agriculture as well as the economies that depend on forest resources (Duraiappah, 1996). Three million hectares of forests are lost worldwide each year (Scherr, 2000). A more graphic description of the amount of forest lost is given by the World Wildlife Organization which equates the annual forest loss to 36 football fields every minute (worldwildlife.org, 2015).

Africa is home to some of the world's largest forests with rich biodiversity (FAO, 2012). Between 1990 and 2010, Africa lost about 75 million hectares of forest equivalent to 10 percent of its total forest area (Ibid). FAO 2010 estimates Africa's present forest cover to be about 23 percent of the total land area. Between 1990 and 2005, Ghana lost about 26% of its total forest cover, equivalent to over a quarter of its national forest cover (Amisah et al, 2009). Forestry Commission, Ghana (2011) admits that the timber stocks in the off-reserve areas are disappearing at faster rates, reducing forest reserves to "*vulnerable small isolated islands*" with limited populations of trees and animals and

limited possibilities for genetic exchange among species. According to the International Tropical Timber Organization (ITTO), Ghana loses around 65,000 hectares of forest annually and the country's forest cover could completely disappear in 25 years if it continues at the current rate of deforestation. (ITTO, 2005)

As a carbon sink, forests trap and store about 289 gigatonnes of carbon in their biomass, hence they play an essential role in mitigating climate change by reducing the amount of carbons released into the atmosphere (FAO, 2010b, worldwildlife.Org, 2015). Traditionally, the highest contributors to global warming are industry and energy (IPCC 2007) but deforestation is now the third largest contributor of emissions, accounting for about 20% of global GHG emissions (Angelsen et al., 2009; Todaro and Smith 2011). The amount of GHG's released as a result of depleting and vanishing forests is now bigger than that of the world's transportation industry (Angelsen et al., 2009, IPCC 2007).

According to a 2014 report by the Forestry Commission of Ghana, Ghana's Land Use as well as Land Use Change and Forestry (LULUCF) sector recorded a 66% net carbon sink. Since 1996 Ghana's LULUCF has recorded a 96% decrease of the net greenhouse gas (GHG) removals within the LULUCF sector. The LULUCF sector became a net emitter of GHG, contributing 25%, of total emissions from 2006. Deforestation and conversion of forests to farmlands was the major reason for this change accounting for 60% share of total LULUCF emissions in 2006. (Forestry commission, 2014)

But the truth as FAO (2012 p.15) point out is that "most deforestation is intentional and is not irrational. Rather, it represents a deliberate decision to convert land to a use that is perceived as having a higher value than retaining the land as forest would have." Policy-makers are therefore faced with the dilemma that despite the critical roles that forests products and forest based ecosystems services play in sustaining economies and human

existence, there may be more urgent needs for forest land which necessitates its clearing(Ibid)

The most recent global and national policy adopted to fight deforestation and climate change is the Reduced Emission from Deforestation and Degradation (REDD+). REDD+ operates through the establishment of performance based economic incentives that provide monetary rewards for achievements in forest conservation and management (Asare & Kwakye, 2013). Among the incentives provided is the financial compensation to land owners who avoid converting standing forests to other land uses (Angelsen et al., 2009). This embodies a typical win-win situation where individuals are duly compensated for income traded-off in favour of conservation.

## **1.2 Statement of the Problem**

Asare and Kwakye (2013) posit that the REDD concept is hinged on the assumption that until the value of preserved forests increases to a level where it becomes indispensable to economic development strategies, it will be difficult to promote forest conservation as a solution to climate change. The main value attached to forest from the REDD+ concept is money. This makes REDD+ ideal for individuals with low discount rates for forest earnings because investors only get paid after a minimum of 30 years when it is ascertained that the forests they preserved have stored an appreciable amount of carbons that would have contributed to global warming and climate change (Schmidt and Scholz, 2008).

Studies such as Huberman (2007) and Asare & Kwakye (2013) have confirmed that REDD+ compensations tend to benefit large scale commercial farmers, private large scale forest land owners and the elite who have the capital to invest in agro forestry plantations and have low discount rates for the future earnings they derive from forests.

Unfortunately, these categories of forest users which REDD+ seeks to motivate do not form the majority of forest users in the world, Africa and Ghana.

Globally, it is estimated that 3 out of 4 people live in rural areas and depend on natural resources including forests (Scherr, White; and Kaimowitz 2004). 7 out of 10 of Africa's poor population live in rural areas and depend largely on forests (USAID 2006). About 2.5 million Ghanaians rely on forest resources for income. (Boafo, 2013). The majority subsistence farmers and rural dwellers are present oriented agents who live on subsistence basis mainly from forest resources thus forests are of more value in meeting present subsistence needs such as food and fuel need supplies, than in the future. (Angelsen and Kaimowitz, 1999).

For the poor, forest preservation demands a trade-off against their socio-economic well-being thus Turner et al (2002) argue that focusing solely on ecosystem payment services and other monetary compensations for forest preservation may not be an ideal strategy in tackling deforestation among poor communities. Hanley and Shogren, (2002) agree that in valuing environmental resources such as forests, the aim should not be on placing a monetary value on the resource but rather to depict the effect of a marginal change in the ability of forest to provide essential services such as ecosystems service provision on the very existence of humans and the earth that supports human life.

Lawrence (2000) insist that both economic and ecological values of forest held by forest dwellers must be considered if sustainable forest management practices are to be established. Perceptions held by community members thus contextualize the way individuals or group of people in a particular community will respond to deforestation and is useful in drafting appropriate policies and programmes to address them.

Traditionally, deforestation discussions at the rural level have revolved around individuals whose main livelihood activity is dependent on forest resources especially

farmers. This can be attributed to the fact that deforestation and agriculture combined contribute about 30% of global GHG emissions (IPCC 2007). Farmers are deemed to be knowledgeable about the negative impacts of deforestation on their livelihoods and hence are highly motivated to preserve forests. However, rural households pursue varied livelihood activities and thus may rely on a combination of livelihood activities for survival (Appiah et al., 2009; Sunderlin et al 2005). This implies that those who do not rely on forest for their main livelihood activity may not necessarily be independent of forest resources as is widely believed but rather rely on forest resources to diversify their livelihood strategies and maximize livelihood outcome (Sunderlin et al 2005).

The effects of deforestation such as global warming and climate change and its accompanying severe weather conditions such as droughts and floods have claimed the lives and livelihoods of many people across the globe. The importance of forest ecological services in climate regulation and human survival makes it imperative for all members of forest communities who do not necessarily own or clear large parcels of forest lands nor have the capacity to undertake REDD+ investments, but whose negligible forest activities, when put together, are eating away large tracts of forest lands, thereby reducing forest biodiversity and ecosystems services, be actively involved in fighting deforestation.

The village of Otu Kwadwo is located in an off- reserve forest area which implies that the forest can be converted to other uses especially agriculture. Farming is thus the major occupation of the inhabitants and has claimed almost all the forest trees in the area putting the sustainability of their livelihoods at risk. Thankfully, some portions of deforested lands located on a rocky hill are regenerating into secondary forests because the rocky nature of the hill makes it unattractive for neither farming nor housing. The ability of this area to fully regenerate into a secondary forest rests heavily on the

residents' understanding of the current state and impact of deforestation and an appreciation of the potential benefits of a secondary forest to their well-being and livelihoods.

This study analyses the problem of deforestation from the perspectives of inhabitants of Otu Kwadwo to discover the local knowledge and response (actual and potential) to deforestation among individuals whose main livelihood activities are forest dependent and those whose main livelihood activities do not rely on forest resources.<sup>1</sup>

### **1.3 Aim and Objectives**

The study's main objective is two-fold: first, to investigate whether there exists a difference between local knowledge of and response to deforestation and climate change among individuals whose main livelihood activity is entirely dependent on forest resources and those whose main livelihood activity does not depend on forest resources. Second, it is to ascertain if enhanced awareness of the importance of forest ecosystem services (FES) will prompt more positive responses to deforestation in terms of higher willingness to pay for preserving secondary forests.

The following are the objectives of the study:

- To compare local perceptions of the causes, impact and state of deforestation held by individuals whose main livelihood activity is forest dependent and those whose main livelihood activity is not forest dependent.
- To compare responses to deforestation among various livelihood groups in Otu Kwadwo.

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<sup>1</sup> Forest dependent main livelihood activities as used in this research refers primary livelihood activity that are entirely dependent on forest resources such that they cannot exist without the forest. E.g. agriculture, trade in NTFP's collected from local forest, carpentry and herbal medicine. Non-forest dependent main livelihood activities refer to primary livelihood activities that do not depend on forest activities to a large extent such that they continue to exist when the forest disappears. E.g. formal sector wage employment, selling of cooked food. skilled trade such as hairdressing and dressmaking.

- To compare the ability to link deforestation and climate change among the two livelihood groups
- To find out if enhanced knowledge of forest ecosystem services will have a positive influence on the current response to deforestation in terms of individual willingness to pay to preserve the secondary forest in Otu Kwadwo

#### **1.4 Research Questions**

The research questions to be investigated in this study are:

- Is there a difference in awareness of deforestation (in terms of the drivers, pressures, state and impact) among people whose main livelihood activity is forest resource dependent and those whose main livelihood activity do not depend on forests in Otu Kwadwo?
- Is there a difference in the awareness of climate change and its relationship with deforestation among forest dependent livelihood groups and non-forest dependent livelihood groups in Otu Kwadwo?
- Do individuals whose main livelihood activities depend on forest resources currently respond differently to deforestation compared to those whose main livelihoods are independent of forest resources?
- Will enhanced knowledge of forest ecosystem services improve individual response to deforestation in terms of willingness to pay to regenerate and preserve the secondary forest?

#### **1.5 Hypotheses**

Based on the sustainable livelihood theory, the study will test the following hypotheses:

Hypothesis 1

Ho: There is no difference between the mean willingness to pay values for individuals whose main livelihood activity is forest dependent and those whose main livelihood activity is not dependent on forest resources.

Ha: Mean willingness to pay to preserve secondary forests will be higher for people whose main livelihood activities are forest dependent

#### Hypothesis 2

Ho: There is no difference between the mean willingness to pay values after receiving information about forest ecosystem services for individual's whose main livelihood activity is forest dependent and those whose main livelihood activity is not dependent on forest resources.

Ha: Difference in mean willingness to pay after receiving information on forest ecosystem services  $\neq 0$

### Hypothesis 3

Ho: There is no difference between the mean willingness to pay before and after receiving information about forest ecosystem services.

Ha: Enhanced knowledge of forest ecosystem services will increase the mean willingness to pay to regenerate and preserve secondary forests.

## **1.6 Justification of Study**

Factors affecting deforestation vary widely, within and among countries. Deforestation phenomena are therefore always local and peculiar to each community (FAO, 2012) but environmental assessment tools such as the DPSIR framework are usually based on scientific understandings of environment and economy from the perspective of experts in the Global North, with little regard for the place specific alternative understandings and responses to environmental problems. In reality, perceptions of nature often vary according to the location or setting such that persons in the ‘Global South’ use and understand their environment differently from their counterparts in the ‘north’ (Escobar 1995; Leach and Fairhead 2000). There may even be variations in knowledge and response in different locations within the same country and among different socio-economic groupings. Focusing on local knowledge will clarify actual deforestation and climate change impacts as is being experienced at the community level (Laidler 2006). Local knowledge will provide the necessary information that will enable policy makers draft policies that reflect local concerns (Danielsen et al. 2005). This will not only encourage a bottom-up approach to forestry policies but will also ensure community ownership of policies.

Carr et al. (2007) in a critique of the DPSIR framework reveals that the construction of knowledge within the DPSIR framework is mainly from the standpoints of development experts and government officials and that the framework only accommodates local knowledge within the impact and response indicators. To fully inculcate local knowledge into the DPSIR framework, Carr et al., (2007) recommend limiting “the application of DPSIR to local-scale studies” to realistically assess the nuanced understandings, inputs, opinions, and goals of multiple concerned stakeholders.

This study is being done at a period where a secondary forest is regenerating in the community. However, the point has been made of the existence of a trade-off between forest preservation and rural economic development. Findings of this study will be useful in conscientising the community about the need to consciously preserve the forest and formulate forest management plans that fully incorporate the trade-offs to be made in order to minimize income and welfare losses due to forest preservation.

Under Ghana’s current development framework, that is, the Ghana Shared Growth and Development Agenda (GSDGA) the forestry commission is tasked among other forest conservation and deforestation mitigation measures to “capture the full range of values derived from forests including biodiversity conservation and ecosystems services.” The findings and recommendations of this study will therefore contribute to research towards forest policy revision. This study is thus relevant at both the local and policy level

### **1.7 Organisation of Chapters**

Chapter 1 introduces the study giving a background to the problem, stating objectives that the study hopes to accomplish and outlining the significance of the study.

Chapter 2 will review relevant literature pertaining to deforestation, climate change, and valuation of forest resources and present the theoretical and conceptual framework that will be used in assessing deforestation and valuation of forest resources.

Chapter 3 outlines the methodology and design of the study. It also explains the selection of specific tools used in gathering and analysing data. Limitations that may hinder the research findings are discussed in this chapter. The chapter also presents a profile of the study area.

Chapter 4 presents, analyses and discuss the relevance of the findings from the data gathered.

Chapter 5 summaries the salient findings, draws conclusions from these findings and makes recommendations based on the study.

## CHAPTER TWO

### REVIEW OF RELEVANT LITERATURE AND CONCEPTUAL FRAMEWORK

#### 2.1 Introduction

This chapter reviews relevant discourses on the research topic according to the following themes: Deforestation as a global problem, deforestation in Ghana in terms of the drivers, pressures, state, impact and response. It also reviews Ghana's rural economy and present the debate on integrating local knowledge into studying environmental problems and the theoretical framework from which the study draws the hypothesis to be tested. Gaps in the literature as well as the limitations of the study be outlined. The final section of the chapter explain the conceptual framework adapted for the study

#### 2.2 Deforestation as a Global Problem

The Kyoto protocol classifies the induced conversion of forested land to non-forested land owing to direct human activity as deforestation. FAO (2001) describes deforestation as the clearing of forest to make way for other land-use options as well as the prolonged reduction of forest tree canopy cover below 10 percent . Deforestation is now the third largest contributor of emissions, accounting for about 20% of global GHG emissions (Angelsen et al., 2009). Traditionally, the highest contributors to global warming are industry and energy (IPCC 2007) but currently the amount of GHG's released as a result of depleting and vanishing forests surpasses that of the world's transport industry (Angelsen et al., 2009, IPCC 2007). The World Wildlife Fund (WWF) estimates that if we were to consider the amount of emissions emanating from deforestation, Brazil and Indonesia, which are home to some of the world's largest tropical virgin forests, would rank in the top 10 of the world's worst emitters because of the rate of deforestation in those countries. (Worldwildlife.Org, 2015)

## **2.3 Deforestation in Ghana**

### **2.3.1 Historical evidence**

Quantitative and qualitative studies estimating the actual trend of deforestation in Ghana have produced fragmented and conflicting results over the years. It is often speculated that the entire Southern Ghana, that is, one-third of total land area (Wagner and Cobbinah 1993) was occupied by about 8 million hectares of forest until early 1900. On the contrary, Fairhead & Leach, (1998) put the total forest cover before the 1990's at 5.5 million hectares. Hawthorne (1989) Repetto (1990) claim that by 1989, 78% of Ghana's tropical forest had disappeared. Ebregt (1995); Fairhead & Leach, (1998) estimated that by 1990 Ghana's forest cover totalled only about 2 million hectares implying a deforestation of 6 million hectares since 1900.

Qualitative data gathered from statements from the colonial administrators give credence to the sharp decline of Ghana's forest from 1900 to independence. Asante (2005) reveals that Thomas Chipp, a colonial administrator in 1923, based on a review of colonial reports and testimonies of local people, discovered that forests in the then Gold Coast were being "heavily attacked" and undergoing "rapid regression". By 1950, the colonial government admitted that Gold Coast forests were doomed for destruction if their timber continued to be extracted haphazardly without conscious efforts to replant them (Ibid).

The World Bank's Structural Adjustment Program (SAP) has gone under criticism for its role in Ghana's deforestation from the 1980's to 1990's (Reed, 1996). In 1979, the export of 14 timber species in log form were banned as part of species conservation and value addition measures but SAP in an attempt to revive the forestry sector and increase timber exports, removed the ban (Benhin& Barbier, 2003). Timber exports became a lucrative avenue for obtaining the much needed foreign exchange to service Ghana's foreign debts (Benhin& Barbier, 2003), increasing timber export earnings from \$ 21

million in 1984 to \$ 44 million in in 1986 (Owusu, 1994), an increase of more than 100% in only two years.

Between 1950 and 2000 Ghana lost over 60% of its forest cover estimated at about 2.7 million hectares (Owusu, et al., 1999). In 2006, the annual rate of deforestation in Ghana was around 3% (IUCN, 2006). Between 1990 and 2010, Ghana lost about 33.7% of forest cover at an average annual deforestation rate of 1.7% (FAO 2010). Currently Ghana's forest cover is said to be about 4,940,000 (4.9 million) hectares (ibid) far above the 1990 estimate of only 2 million hectares of forest cover (Fairhead & Leach1998) but also equivalent to the estimated forest cover of 22% in 1992.

The lack of consensus on Ghana's deforestation figures has been attributed to the non-existence of standardized and universally accepted definitions which has produced different methods for accessing forest resources in the tropics. Angelsen and Kaimowitz (1999) add that most of the data used in estimating deforestation are mere extrapolations based on forest cover data from a specific time with population density and ecological class as the only variables. Again, estimates are made over an array of time periods, which are difficult to sync in order to establish precise deforestation.

Despite the contradictions, one thing is clear: the 20<sup>th</sup> century marked a period of intense deforestation in Ghana as only 8 % of the estimated current forest cover of 4 million hectares is classified as primary forest; the only type of forest, rich in biodiversity and carbon sequestration functions.

The Ghana Forestry Commission's Strategic Environmental and Social Assessment report used both quantitative and qualitative methods to collect data from six regions across the two major ecological zones of Ghana, that is, forest and savannah and concluded that Ghana's problem in the 21<sup>st</sup> century is not dramatic but more of degradation at an incremental thus not a problem of deforestation (Forestry Commission

2014; Forestry Commission 2015). However, a National REDD+ Strategy compiled by Price Water House Coopers for Ghana's Forestry Commission makes the observation that Ghana's 2% annual rate of deforestation is one of the worst in the world and warns that that Ghana could lose all its non-reserve forests in 10 years if serious efforts are not made to address it (Ibid).

### **2.3.2 Drivers of Deforestation**

Angelsen and Kaimowitz (1999) summarize the findings of their earlier work which reviewed more than 140 models of deforestation around the world. The common underlying causes (drivers) of deforestation identified by the 140 models were population pressures, income level and economic growth, external debt, trade and structural adjustment, together with the effects of technological change. They also identify agriculture, availability of access roads to forests, property regime and tenure security and timber prices as the immediate causes (pressures) of deforestation.

Attempts at addressing deforestation in Ghana (Agyemang et al, 2007) have tended to discuss it under the broad theme of environmental degradation. The most comprehensive source of data on drivers and pressures of deforestation in Ghana, which runs through most of the literature, is the Forestry Commission. Forestry Commission (2014) groups deforestation drivers into four categories: (1) Policy drivers consisting of unequal exploitation rights in favour of large scale timber industry, weak regulatory mechanisms and weak law enforcement; (2) Demographic drivers made up of population growth, urban expansion, slash and burn agricultural practices; (3) Economic drivers such as high international demand for primary products coupled with low prices for lumber on the domestic market; and (4) Natural forces like wild fires, floods, pests and diseases.

### **2.3.3 Pressures of Deforestation**

Pressures are the human activities exerted on forest lands that convert them to non-forest use. Agricultural expansion, comprising the cultivation of cocoa, other tree crop plantations, food crop farming and slash-and-burn farming are responsible for agricultural expansion which accounts for between 50% - 70% of deforestation (Forestry Commission Ghana 2015; Osafa 2005). Wood harvesting by chainsaw operators, timber companies, charcoal producers and domestic fuel wood harvesting are responsible for 35% of deforestation (Forestry Commission Ghana 2015). Forests provide the main source of household energy needs for 67 % of Ghanaian households, in the form of fuel wood or charcoal, accounting for about 85% of the total wood removal (Forestry Commission 2011). Up until the 1990's when chainsaw operation was criminalised, chainsaw timber production supplied Ghana's domestic timber needs especially in the 1970's Amanor (2006). It has now become a clandestine industry, thus making it difficult to estimate the extent of wood removals though it is perceived as substantial. Increased demand for food crops, fuelwood, charcoal as well as construction materials in response to increasing population and development contributes 10% of deforestation activities, while mining and mineral exploitation in forest reserves by mining companies coupled with the illegal activities of small scale miners also cause 5% of Ghana's deforestation (Forestry Commission Ghana 2015).

### **2.3.4 State of Deforestation**

Aside the loss of trees and forest cover, the past decade has witnessed a high rate of biodiversity loss in terms of flora and fauna in Ghana, with more than 10 species projected to become extinct in less than a decade (Ministry of Lands and Water Resources, 2011). There has been a drastic reduction in most of the prime indigenous

timber species like the mahogany and Iroko-odum which generated substantial revenues for Ghana's economy (ibid) due to over exploitation of timber and wildlife resources in excess of 1.7 million m<sup>3</sup> annually, above the 2 million m<sup>3</sup> allowance.

### **2.3.5 Impact of deforestation**

The impact of deforestation with regards to soil and vegetation degradation threatens agricultural productivity, biodiversity, water availability and quality (Scherr and Yadav, 1996). 16% of agricultural land area in developing countries, have been degraded as a result of soil erosion, nutrient depletion and salinization caused by deforestation (Scherr,1999a). Biodiversity loss especially the loss of agrobiodiversity increases disease and pest problems related to rural agriculture (Scherr, 2000).

#### **2.3.5.1 Impact on Rural Livelihoods**

In Ghana, the inability of diminishing forests to support the production of NTFP's, which supplies 67% of rural livelihoods (Ministry of Land and Natural Resources, 2011), threatens the livelihoods of forest dwellers and plunges them into deeper poverty (Acheampong and Marfo 2011; Benhin and Barbier 2003). Deforestation can potentially deplete stocks of approximately 2,000 medicinal plants used locally (Benhin and Barbier, 2003). Deforestation also implies longer travel time to access forest products that ensure food security and the socio-economic well-being of rural forest dwellers (Bonsu et al, 2010). Longer travel distances may exclude the aged and weak from accessing forest resources.

### **2.3.5.2 Deforestation and Climate Change**

Climate change is seen both as a driver and an impact of deforestation (Goll , Nick, Li and McKay Jr and John, 2014). Extreme weather events such as drought make forests susceptible to wild fires, capable of wiping out entire forests as was seen in Ghana in 1983. Ghana's experience with climate change includes water stress, reduced food security, increased impacts from and vulnerability to extreme weather events, migration (due to floods and sea level rise), and a potential increase in the transmission of vector-borne diseases (Codjoe et al. 2012). Fruit farmers identify the negative effects of high temperatures on yields (Yaro 2013).

The BBC World Service Trust (2010) conducted exploratory research using qualitative approaches to investigate how people from selected African countries, including Ghana, perceive climate change. They found that most of the respondents emphasised the role of trees, and by extension forests, in preventing climate change, and thus largely blamed deforestation for climate change. Farmer groups in Yaro's (2013) qualitative research on the perceptions of climate change among commercial and small holder farmers produced similar results. Respondents in both studies however failed to recognise the contribution of global climate change to deforestation but rather blamed human activities and even advanced religious explanations to climate change.

### **2.3.5.3 Deforestation and Forest Ecosystem Services (FES)**

Ecosystem services are the ecological processes and mechanisms that provide the necessary conditions to sustain human life (Millennium Ecosystem Assessment, 2005). They can be categorised as provisioning services (e.g. food), regulating services (e.g. climate control and water regulation); supporting services (e.g. photosynthesis, nutrient cycling); and cultural services(e.g. aesthetic, cultural heritage) (Ibid). Deforestation

limits the ability to provide these services, rendering humans vulnerable to climate change and food insecurity, among others.

FES forms part of critical natural capital that performs important ecosystem services which cannot be substituted by other types of capital, such as human-made or social capital (de Groot, et al 2003; Dietz & Neumayer, 2007). FES, as a critical natural capital, is vital in guaranteeing the sustainability of human wellbeing and livelihoods (Brand 2011; TEEB, 2010), especially those of forest dependent people. FES should therefore be maintained at all cost for the benefit of present and future generations.

A global assessment revealed that 60% of ecosystem services are either degraded or being used unsustainably (MEA 2005). Forest ecosystem services like all other environmental goods are classified by economists as non-market goods since they cannot be exchanged for money. The non-existence of a monetary value of FES has led to a lack of appreciation, at both the micro and macro levels, of the critical role of ecosystem services in maintaining livelihoods and wellbeing (Kenter et al. 2011). Adekunle and Agbaje (2011) conducted a qualitative study using Willingness To Pay (WTP), which is a Contingent Valuation Method (CVM) tool, to elicit monetary values of ecosystem services in Akaranga forest in Abeokuta, Nigeria. The results indicated that respondents were willing to pay to preserve forest ecological services. A multiple regression analysis of the data showed that income and household size had positive effects, at 5% and 10% significance levels, respectively, on the amount the respondents were willing to pay for ecosystem services.

Kenter et al. (2011) employed a choice experiment in a participatory approach to study the differences in willingness to pay to protect FES based on two decision parameters, namely: (a) income trade-offs for preserving FES, and (b) the level of environmental improvement to be gained from preserving FES. The results indicate willingness to pay

for forest attributes to be much higher when decisions were based solely on environmental improvements offered by FES.

### **2.3.6 Response to deforestation in Ghana**

Response to deforestation, like any other environmental problem, may be at the individual, community or policy (government) level, and could be to prevent the causes, mitigate or adapt to the current state and impact, or simply do nothing. Studies of livelihood strategies have revealed that although the rural poor may lack resources, they still have considerable capacity to cope with environmental problems, either by mitigating its effects on their livelihoods or by restoring degraded resources (Scherr, 2000).

Alessa et al. (2008) posit that local knowledge held by individuals define the decisions to act or not in response to environmental problems. It also provides a better understanding of the complex nexus of factors defining individual and community response to deforestation and valuation of forest resources. Individual response may include practising tree planting, agroforestry and switching to use of liquefied petroleum gas (LPG) for domestic energy needs. At the community level, community forestry projects can be initiated while government policies and education can go a long way to induce positive responses to deforestation.

#### **2.3.6.1 Government Response**

Only the government of Ghana's response to deforestation will be discussed due to difficulty in finding literature on individual and community response. The high level of forest dependence among rural forest dwellers (Scherr, Angelsen, Kaimowitz, 2004) has made total restriction of forest use a difficult response measure by the government. As a

result the government of Ghana's response to deforestation has been to promote reforestation and sustainable use of forest resources to guarantee the continued existence of forests and sustainability of rural livelihoods. These policies are based on the participation of local forest dwellers in managing and preserving their forest resources. (Blay, 2007)

Ghana's present response to deforestation is grounded in the country's current development framework at the domestic level, and at the international level, by the paradigm of deforestation and climate change discourse. At the national level, the Ghana Shared Growth and Development Agenda which enjoins the forestry sector to meet certain targets in the fight against deforestation has led to the revision of the Ghana forest and wildlife policy to meet a number of targets including ; achieving "sustainable forest management by reducing deforestation and forest degradation and so developing a sustainable forest resource for Ghana's future (Forestry Commission 2011) as well as capturing "the full range of values of forests including biodiversity conservation, ecosystems services and related values" (ibid).

In line with international deforestation and climate change policy shifts, Ghana has been selected as a pilot country to implement REDD+ is the recent policy to curb deforestation rooted in the payment for ecosystem services (PES) paradigm. It is an extension of the Reduced Emissions from Deforestation and Degradation (REDD) that encompasses forest conservation, sustainable forest management, and enhancement of forest carbon stocks (Angelsen et al., 2009). Both REDD and REDD+ represent a shift in global warming and emission discourse from the industrial sector, as was the case under the Kyoto protocol to deforestation and forest degradation.

Goll et al (2014) applied both quantitative and qualitative methods to analyse deforestation and forest degradation in Liberia using the DPSIR framework and came to

the following conclusion about the nature of deforestation in the country. Among the main pressures on Liberia's forests were urbanisation and rural settlement, shifting cultivation, unemployment and livelihood activities as well as charcoal burning. These pressures are driven by factors such as poverty, civil war, economic growth and climate change.

Deforestation according to the study has resulted in the significant decline in forest cover and loss of biodiversity, the impact of which have been wildlife – human conflicts, loss of FES, climate change and health issues. Like most DPSIR studies on deforestation individual and community responses to the problem are not explored. The study only explored the government of Liberia's response to deforestation such as enacting the National Forest Policy of 2000 and implementing the UN sanction on Liberia's forestry sector in 2003.

#### **2.4 Local Knowledge**

The importance of local knowledge to individual and community response to environmental problems such as deforestation has been established. Recent concerns about declines in local habitats, species, and livelihoods especially in rural areas have increased calls for the potential contributions of local knowledge to ecosystem research and management to be explored and duly recognized.

Scoones and Thompson (1994) define local knowledge as dynamic and complex bodies of knowledge, practices and skills that are generated by community members and transmitted from generation to generation. FAO (2011) defines local knowledge as “the knowledge that people in a given community have developed over time, and continue to develop.” Local knowledge is based on experience, often tested over centuries of use, adapted to the local culture and environment, embedded in community practices,

institutions, and relationships, not documented but held by individuals or communities and changes with time. (ibid)

At the rural level, conservation decisions are made based on traditional knowledge and values, or a resurgence of these values where they had been abandoned (Johannes 2002). Additionally, the conscious decisions of local communities to conserve areas are often based on multiple objectives, including sustainable use and livelihood needs, cultural value, self-governance, and economic development (Berkes 2009). Perceptions held by local people concerning environmental degradation influences their environmental decisions (Barber, Biddlecom & Axinn, 2003), such that if a particular environmental problem is not regarded as such people will not do anything about it.

The characteristics of local knowledge are interrelated. “It is localized in nature and more often than not, traditional in context; it is unique to specific environmental and cultural conditions; it is knowledge constructed in informal setting; it is orally transmitted [and rarely documented]; it is dynamic, adaptive and holistic in nature and is a significant part of the way of life and subsistence of rural peoples everywhere (Beckford and Barker (2007), *The Geographical Journal*, 173: p121).”

Local knowledge has been subjected to intense empirical analysis, ignoring the socio-cultural contexts from which it is derived (Briggs 2005). The focus on empiricism with regards to local knowledge has hindered a more rigorous theorisation of the approach because as Briggs (2005) points out, local knowledge cannot be transferred from its local space, neither can it be generalised. This has created doubts about the usefulness of local knowledge outside the locality in which it is developed (Ibid; Briggs and Sharpe 2004) and has further raised questions about its usefulness in replacing scientific knowledge (Cleaver 1999).

The usefulness of local knowledge, however, is achieved when it is situated in the local socio-cultural, economic, environmental and religious context in which it is derived. That said, Barber, Biddlecom & Axinn, (2003), based on their study of the role of local knowledge among Jamaican yam farmers, argue that complementing scientific knowledge with local knowledge has immense benefits. Local Jamaican yam farmers in the study had successfully combined local and scientific knowledge in experimenting with the minisitt yam cultivation technique to the extent that their depth of knowledge was considered more “useful” compared to that of scientists. They therefore conclude that, in using local knowledge, the aim should not be to directly apply it to other spatial locations but rather, to transfer its principles and try to find locally appropriate examples that will be useful in the context of the study area.

## **2.5 The Sustainable Rural Livelihoods Framework**

The extent of dependence of rural livelihoods on their natural resource base in developing countries is explained by Ellis (2000), who indicates that all rural livelihoods (farm, off-farm and non-farm) are either directly or indirectly dependent on natural resources especially forests. Households in forest communities rely to a large extent on the extraction of non-timber forest products (NTFP's) to meet their consumption and livelihood needs (Neumann & Hirsch, 2000).

Since the early 90's studies on rural households have shifted from the processes that exclude and marginalize them to focus on how they survive i.e. their livelihoods (De Haan & Zoomers, 2005). The term “livelihoods” is simply as “all the means available to an individual or a community to enable him/it survive (Failler & Kane, 2002)”.

According to Rakodi (2002), the concept of livelihoods acknowledges that individuals and households engage in multiple activities for their sustenance and well-being.

Livelihoods are said to be sustainable if they withstand external shocks and stresses; do not rely on external support; maintain the long-term productivity of natural resources ; and do not undermine the livelihood opportunities open to others, including future generations. (Chambers and Conway1992; Scherr 2000; Scoones 1998). The sustainable livelihood approach thus considers both ‘welfare poverty’ and ‘ecological poverty’, that is, the capacity of natural resources available to the rural poor to ensure provisioning and environmental services essential for livelihood (Conway et al., 1999).

Situating this study in the sustainable livelihood framework is explained by the fact that FES such as freshwater resources, climate regulation and fertile soils (UNEP, 2005a) form part of the critical natural capital required to meet the minimal conditions necessary for livelihood sustainability. For the purpose of this study, rural livelihood activities will be distinguished as natural resource dependent livelihood activities and non- natural resource dependent livelihood activities.

## **2.6 Gap in literature**

There are increasing calls to estimate the value of ecosystem services in monetary terms (Carpenter et al., 2006; Sutherland et al., 2009; TEEB, 2010). However, research on the valuation of environmental goods and services is limited in developing countries, where much of the world’s biodiversity is located (Christie et al., 2008; Fazey et al., 2005;). The application of valuation techniques in Africa is still very low with the poorest countries and some regions having little or no coverage at all (TEEB, 2010). This study will contribute immensely to the body of knowledge on applying monetary valuation to biodiversity in developing economies.

Even though studies such as BBC World Service Trust (2010) and Yaro (2013) show that communities that rely on natural resources for their livelihood are conscious of the

environment and quickly discern anomalies such as climate change and resource degradation, there is very little room in current climate change literature for the local knowledge. This study will contribute literature in that direction.

The fact that farmers and those who depend mainly on forests for their livelihoods have been acknowledged as possessing valuable knowledge about their environment has placed the spotlight of discourses and studies on livelihoods and environmental degradation especially deforestation on farmers and agricultural livelihoods and forest based livelihoods in general (Sunderlin et al 2005; Yaro 2013). The knowledge and experiences of rural forest dwellers engaged in non-farm economic activities that do not depend on natural resources has thus received very little attention. This study will fill this gaping hole in the literature.

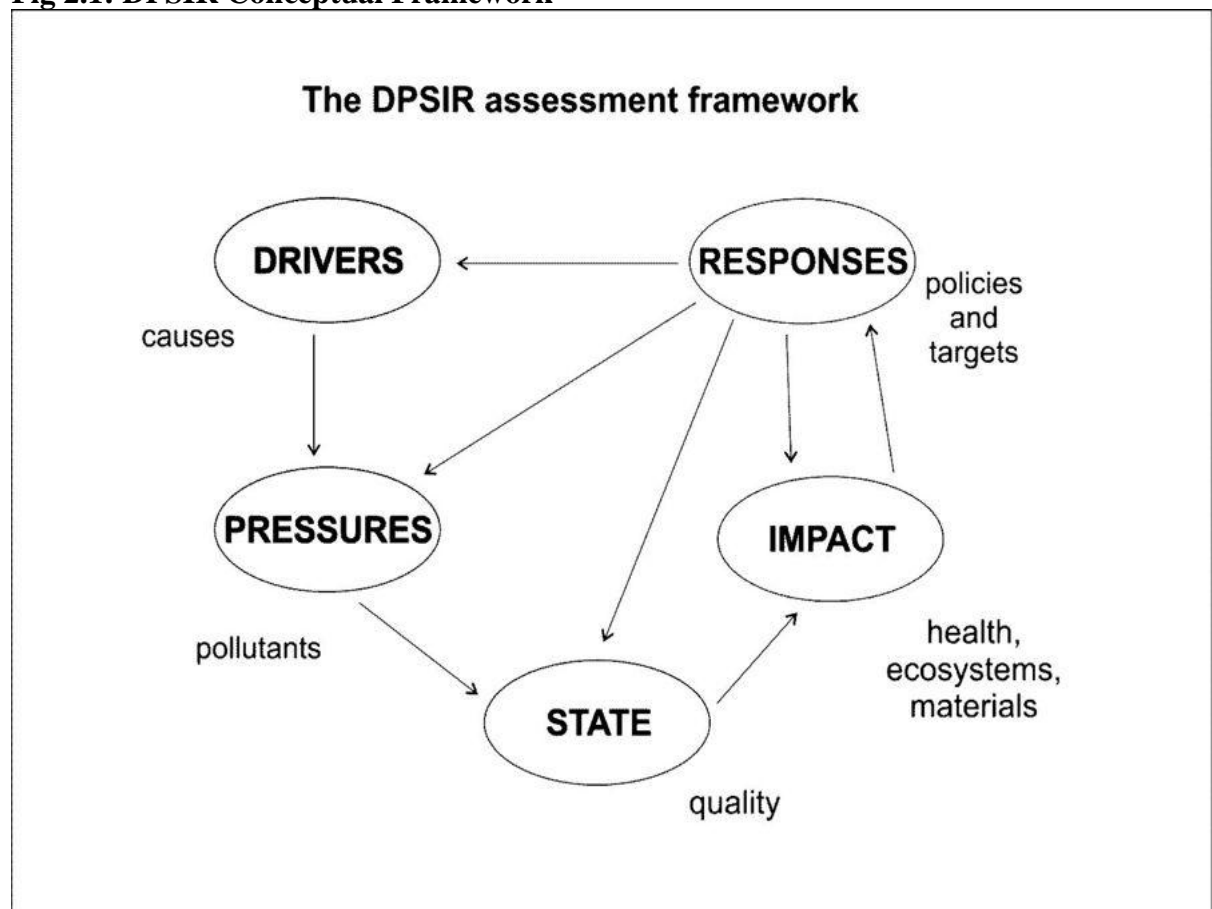
## **2.7 Conceptual Framework**

The study will adopt the United Nations Environmental Programme's (UNEP) Drivers-Pressures-State-Impact-Response (DPSIR) framework for assessing environmental problems.

### **2.7.1 Origins of DPSIR**

The first framework for assessing environmental problems was developed by Anthony Friend and David Rapport and was based on ecosystem behaviour. The framework used causality to analyse how ecosystems reacted to stress. Their framework was known as the Stress-Response framework and categorized environmental problems into environmental stress, the state of the ecosystem and the ecosystems response to the problem (Gabrielsen and Bosch (2003). The Organisation for Economic Co-operation and Development (OECD) modified the Stress-Response framework by interpreting the

response indicator to mean only societal response. The OECD thus came up with the State Pressure Response (PSR) framework. Environmentalists who wanted to find out how economic activities influence the pressures, state and response to environmental problems further modified the PSR framework into the current Drivers-Pressures-State-Impact-Response (DPSIR) framework. The addition of the “Drivers” category caters for the economic origins of environmental pressures, state and responses. DPSIR has since evolved from a framework for assessing depleting ecosystems to one that examines environmental stress using human-environment interactions. Environmental health professionals have further customized the framework to Drivers-Pressures-State-Exposure-Effect and Action (DPSEEA) to enable them introduces health indicators to the framework. (Gabrielsen and Bosch, 2003)

**Fig 2.1: DPSIR Conceptual Framework**

Adopted from United Nations Environmental Programme (UNEP 2007).

### 2.7.2 Explanation of concepts under DPSIR

**Drivers:** Drivers are needs that arise from socio-economic and demographic advancement in a community which results in changes in lifestyle, consumption and production (Gabrielsen and Bosch, 2003). Primary driving forces include the need for food, shelter and water. For industries, the primary need to make profits is the main driver of the stress they exert on the environment (Kristensen 2004)

**Pressures:** In a bid to satisfy their needs, humans exert pressures such as the use of land, and the emission of harmful substances into the environment. Typical pressures are food cultivation, housing and pollution. Kristensen (2004) identifies three main types of

pressures, namely: Excessive use of environmental resources, changes in land use **and** pollution of natural resources.

**State:** Pressures affect the state of the environmental resource (biological, chemical and physical) through the degradation of natural resources, resulting in the reduction in the quantity of the resource available, poor resource quality and the inability of the resource to perform its core functions properly (Gabrielsen and Bosch, 2003).. Examples include poor air, water and soil quality, loss of ecosystems and poor health conditions in human population

**Impacts:** These are environmental, social and economic consequences of the changes to the state of the environment that influence the proper functioning of the environment in terms of supporting human life , ecosystem health and resource availability

**Responses:** Responses comprise individual, community and policy makers' reaction to the impact of the environmental stress on ecosystem services or the perceived value of the environmental resource. Responses could be taken to prevent, compensate, ameliorate or adapt to changes in the state of the environment. Three main forms of responses are anticipated in dealing with environmental problems according to Kristensen (2004). They are:

- Control drivers or pressures through regulation, prevention, or mitigation
- Directly maintain or restore the state of the environment
- Deliberately “do nothing”

Responses can be in reaction to any part of the framework from driving forces to impacts

### **2.7.3 Justification for DPSIR conceptual framework**

The study seeks to compare local knowledge of and response to deforestation and climate change from the viewpoints of two main livelihood groups. Knowledge of

deforestation implies awareness of the cause and effects of the phenomena. Responses to environmental issues including deforestation may vary from controlling the drivers and pressures of the problem, maintaining or restoring the state of the environmental resource, finding adaptation strategies to cope with the impact of the problem or simply doing nothing.

#### **2.7.4 Strengths of DPSIR**

The DPSIR framework as discussed, allows for the inculcation of local knowledge in environmental issues when it is applied in place-specific analysis of environmental problems. Since this study deals specifically with deforestation and climate change experiences in a specific rural context, the DPSIR framework fits perfectly. The DPSIR framework is simple and easily understood by both researchers and stakeholders because it simplifies the complex connections between humans and the environment, making it easy to communicate (Gabrielsen and Bosch (2003)). The conceptual framework uses a causality approach to link the various contributory factors (drivers, pressures, state and impact) of environmental issues (Kristensen 2004) so it will be ideal in analyzing local perceptions about the contributory factors and effects of deforestation especially the effects on climate change and FES. The concept of response in the framework relies on the knowledge of the other concepts in the framework. The decision to do nothing has typically been associated with inadequate knowledge of the problem and a lack of appreciation for the value of the environmental good. The framework is thus apt for the study.

### **2.7.5 Limitations of DPSIR**

The concepts under the DPSIR are closely related and sometimes tend to overlap (Cooper, 2013). A typical example are the concepts of state and impact that are easily confused. DPSIR framework describes a causal chain relationship between the indicators and thus fails to bring out the complexity of ecological and social interactions.

### **2.7.6 Application of DPSIR**

DPSIR has been widely used for many applications, including climate change, deforestation and air pollution. The DPSIR framework has been used by the United Nations (UNEP 2007) and European Environmental Agency EEA (1999) to relate human activities to the state of the environment. Kristensen (2002) presents the use of DPSIR in assessing the vulnerability of water resources to environmental change. Agyemang et al (2007) used the DPSIR framework to assess environmental degradation in Bolgatanga and Tongu in the upper East Region of Ghana.

## **2.8 Conclusion**

Deforestation has been a menace in Ghana since the colonial era and continues to eat away Ghana's forest cover. The contribution of deforestation to global warming has gained international recognition thus the formulation of REDD+ to combat it. The success of REDD+ relies largely on its ability to address peculiar local contexts and experiences of deforestation. However, the literature clearly shows a lack of application of environmental assessment tools to access country and place-specific environmental problems developing countries like Ghana and particularly in rural areas. There is clearly a lack of understanding on the local knowledge that informs people's response to deforestation thus this research is very relevant. African forests possess large stores of

complex ecosystems that support nature, livelihoods and human lives. Deforestation impedes the forests ability to perform important ecosystem functions a result of which is the effects of climate change that make daily livelihood activities challenging for rural forest dwellers. The importance of FES as a critical natural capital especially with regards to the sustainability of rural livelihoods demands that all livelihood activity groups and not just farmers and other forest based livelihood groups are involved in deforestation discourses. The use of the DPSIR in analyzing deforestation at the local level is appropriate in determining the knowledge and perceptions of the phenomena in a particular location and within a specific cultural setting to uncover local nuances in knowledge and response to deforestation.

## **CHAPTER THREE**

### **METHODOLOGY**

#### **3.1 Introduction**

This chapter outlines the methodological approach used in designing the research in terms of sampling procedure, data collection methods, tools used in collecting data as well as details of how data collected was analysed. The chapter is divided into two sections; the first section describes the methods and tools used in collecting data for the study. The second section gives a description of the study district and area.

#### **3.2 Research Design**

This study is both descriptive and exploratory. It is descriptive in the sense that it collects data to describe in a comparative manner the nature of deforestation (Saunders, Lewis and Thronhill 2003) in Otu Kwadwo from the perspective of individuals whose main livelihood activities are forest dependent and individuals whose main livelihood activities do not rely on forest resources. The study also explores in a comparative manner if there exist any difference in the response to deforestation among the two livelihood groups in terms of their willingness to pay to preserve the secondary forest. It also discovers the potential for enhanced knowledge of forest ecosystem services to produce positive response to deforestation in terms of higher willingness to pay values. To achieve this, the study uses both quantitative and qualitative research techniques. While quantitative data is helpful in providing factual evidence and trends of environmental problems, it cannot explain perceptions and localised experiences of these trends. Qualitative research methods were thus used to unearth the complex nature the problem deforestation and climate as experienced by community dwellers.

### 3.3 Methodology

Environmental scientists have favoured the classical approach to assessing environmental degradation because it is purely quantitative and applies scientific models to understanding environmental degradation (Stringer and Reed, 2007). The use of purely quantitative methods to solve environmental problems however does not give an accurate representation of the complex nature of environmental degradation especially in relation to people's experiences.

The populist approach which emerged out of the Principle 10 of the Rio declaration (UNCED, 1992) therefore involves stakeholders and applies local knowledge of community members in assessing environmental degradation. This helps to capture complex human interactions and other dimensions to environmental degradation that scientific modelling fails to capture.

The methodological triangulation approach is a hybrid between the classical and populist methods of environmental assessment. The approach makes up for the shortcomings of both the classical and populist approaches by combining scientific and local knowledge. For the purpose of this research, the methodological triangulation method approach comprising qualitative and quantitative data will be used.

The reason for using the mixed methodological approach is that part of the objectives of this study, i.e., people's perceptions of deforestation and their experiences of climate, are disparate. It is therefore necessary to combine both qualitative and quantitative research methodologies in a complementary fashion such that while quantitative statistical meanings can be drawn from the quantitative data to make generalisations and recommendations, qualitative data gathered will provide in-depth explanations of quantitative findings.

Fitzpatrick & Boulton, (1994) have praised the methodological triangulation method for providing the means for cross validating results around a common reference. The choice of a research methodology must thus be guided by the nature of research as well as the information needed as is done in this study.

### **3.4 Sources of Data**

Primary data was generated by the researcher for use in a study. Primary data was generated from the study community through the use of a structured questionnaire, in-depth interviews and direct observations

Secondary data is data that is already in existence and available to the researcher (Ahiadeke, 2008) for appropriately incorporated in a research. Secondary data was obtained from published works and reports on the subject, census data from the Ghana Statistical Services, documents and reports from the Forestry Commission and websites. Geographical Information Services (GIS) information about the extent of deforestation in Otu Kwadwo in the last 29 years was acquired from the Centre for Remote Sensing and Geographical Information Services (CERSGIS) of the University of Ghana. The accuracy of the GIS information received was verified at the community level using direct observation.

### **3.5 Methods of Data Collection**

Primary data was collected using a survey instrument, in-depth interviews, direct observation and the contingent valuation method.

### 3.5.1 Survey

A survey is a data collection method that collects responses from a sample population through the use of survey tools such as a questionnaire (Zikmund and Babin, 2010). Fowler (2002) adds that surveys gather data on participants' perceptions, attitudes and beliefs. The use of the survey questionnaire provided information about the local knowledge and perceptions underlying the drivers, pressures, state, impact and response to deforestation.

This research chose an individual questionnaire over a household questionnaire for several reasons. A household questionnaire requires the household head to answer questions on behalf of all household members. This research however investigates individual nuances in perceptions and response to deforestation and climate change and willingness to pay, thus eliminating free-riding as much as possible.

Household questionnaire will have meant choosing the sample population from a total of only 144 households (Ghana Statistical Service, 2010). Since deforestation and climate change happen over an extended period of time at least 10 years the research, using the household questionnaire would have required the selection of heads of households who have lived in the area for at least 10 years. This would have greatly reduced the sample population and findings risk not being representative thus cannot be generalized.

In the Ghanaian setting, the household head is traditionally the male. It is common knowledge that a majority of rural men engage in agricultural livelihoods while the women tend to engage more in diversified livelihood activities including petty trading and non-agricultural micro-enterprises. Also, according to a 2014 report of the Nsawam Adoagyiri Municipality (NAMA) where the study area is situated, agriculture has become unproductive and unattractive to the youth, who prefer to work for agro-

processing companies, engage in commerce or migrate to the capital. Concentrating on household heads would have implied that a disproportionately large number of respondents in the sample would be males engaged in agricultural livelihoods. The use of such a sample would therefore not be representative of the target population and would actually miss the representation of different livelihood activities of the women and youth.

The assumption underlying the use of individual questionnaires is that individuals will give independent responses. To achieve this, the questionnaire was administered on a one-on-one basis in a private environment with little distractions. Due to the close-knit nature of the study area, it was easy to schedule appointments with respondents in the sample. The community provided seats at vantage points where there were very little distractions and respondents came over to answer their questionnaires. The cooperation of the community was achieved due to the use of appropriate community entry tools and paying courtesy calls to the community gate-keepers including the village head (odikro), assembly man and opinion leader in the person of the chairman of the farmer's cooperative union.

The questionnaire covered questions pertaining to sample demographics, local knowledge and perceptions of drivers, pressures, state and impact of deforestation, link between deforestation and climate change, individual, community and government response to deforestation as well as willingness to pay to conserve forest.

Questionnaires were administered by the researcher and two field assistants. Personal administration of the questionnaires ensured 100% response rate and researchers were able to explain the questions in the 3 main local languages (Twi, Ga, and Ewe) for easy understanding. The questionnaires were administered over a four-day period, beginning on a Saturday and ending on a Tuesday. The reason for administering questionnaires

over a weekend was that the study area is a village whose inhabitants are mostly farmers and go to the farm during the weekday. Also, some wage workers especially those in the public sector work outside the village are not available during the weekday. The weekend surveys thus concentrated on farmers and wage workers working outside Otu Kwadwo. The week day interviews focused on petty traders and local SME owners and employees as well as aged farmers who return early from their farms. The use of the questionnaire allowed respondents to answer standardized questions such that there was little room for deviation in responses. This facilitated comparison of data across groups. All responses were duly captured on the questionnaire, but those responses that provide detailed explanations on motivations and beliefs underlying certain perceptions and attitudes were captured in field notes and analysed using text analysis.

### **3.5.2 In-depth Interviews**

Key informants deemed knowledgeable about the study topic were interviewed to obtain their perspectives and also cross validate information gained from the survey, GIS data and other secondary sources. Qualitative data obtained from in depth interviews were relevant in explaining quantitative data gathered from individual questionnaires. Key informants were divided into three main categories as represented in Table 3.1.

**Table 3.1: Categories of Key Informants for In-depth Interviews**

Type of Information	Category of Key Informants		Selected Key informant
1. Individual Level	Respondents whose main livelihood activities are obtained from forest resource	Farmers (small holders and subsistence)	Chairman of farmers' cooperative union 88 year old female farmer
		Petty traders and SME's who rely on NTFP's e.g. herbalists)	NTFP Market woman Chain saw operator
	Respondents whose main livelihood activities are not obtained from forest resource	Wage workers (e.g. public workers, employees of non-forest dependent SME's	An employee of Ghana Airports
		Petty traders and SME's not dependent on forest resources (provision shop operators, dressmakers)	Provision shop owner
2. Community Level	Traditional leader		Village head
	Political Leader		Assembly man
3. Policy Level	Official of the Forestry commission		Regional Manager, Forestry Service Division

Interviews were conducted using a flexible interview guide to ensure structured responses while allowing for detailed discussions of issues. It also allowed diversion into emerging topics that were not anticipated but which provided better clarity of issues. Interviews were recorded with the permission of interviewees.

### **3.5.3 Observation**

Personal observation carried out in the study area included a guided tour to the small patch of remaining virgin forest which is privately owned, as well as the portion of forest that has been left to regenerate due to the rocky and hilly nature of the land. The guided tour also afforded the researcher the opportunity to familiarize herself with the community such that on subsequent visits, the researcher was able to hold informal interviews with community members outside target population and sample frame. This helped in understanding some responses to survey and in-depth interview questions. It also provided a strong foundation for understanding the individual response to deforestation. The researcher took advantage of visits to the community to observe at first hand the use of forest resources in the daily lives of community members. Observations made were noted in field notes. The researcher's experience with using observation techniques gave credence to the Brokensha & Castro (1983) assertion that observation is the foundation of data collection because it helps in explaining the feelings and attitudes of respondents.

### **3.5.4 Contingent Valuation Method**

Asafu-Adjei (2011) describes the contingent valuation method (CVM) as a non-economic valuation tool used to value non-market environmental goods based on their individual's willingness to pay (WTP) for the resource or accept compensation for the degradation of the resource. CVM was used to determine individual willingness to pay for forest preservation in Otu Kwadwo through the creation of a hypothetical market situation. NOAA (1993) recommends the referendum format over the open-ended format; however, studies have shown that because CVM takes cognizance of budget constraints facing participants, researchers applying CVM in developing countries and

rural areas tend to present participants with low bids based on the assumption of low income. According to Whittington (1998), the main reason for setting the highest referendum 'choke price' too low is to avoid embarrassing situations where interviewers may be required to ask respondents if the referendum price is too high.

Kenter et al (2011) shows that despite income constraints, poor people with little knowledge of environmental goods may be willing to pay high amounts to protect environmental goods and may even consider such goods as priceless once they become well informed of their importance in their socio-economic welfare. To avoid setting overpriced or under-priced bids, this study uses the open-ended questions method to elicit bids.

Bids were elicited in two stages, borrowing from Whittington et al. (1992) where contingent valuation was used to determine the WTP for water supply in Nigeria. Kenter et al (2011) studied the importance of deliberation on ecosystem valuations and concluded that discussions and deliberations on ecosystem services promote learning which translates into high WTP.

This study borrowed and contextualized the nuances in applying CVM from these two studies. The first WTP quote was elicited right after respondents provided their demographic information and stated the importance of forests to their livelihoods. Borrowing from Kenter et al. (2011), after recording the initial bids, participants went through survey questions about the drivers, pressures, state and impact of deforestation. This focused their attention on deforestation. At the end of the questionnaire, respondents were given information about FES and its importance to their livelihoods and wellbeing in order to enhance their knowledge and appreciation of it. Respondents were allowed to ask questions for further clarification and deliberation after which they answered a second WTP question. This strategy provided both learning and time to

ponder over values of FES, and thus was useful in determining whether enhanced knowledge about FES increases WTP for forest preservation.

### **3.6 Target Population**

The target population was all adults aged at least 25 years who have lived in the community for at least 10 years and have some form of employment or livelihood activity. The reason for pegging the minimum age of the target population is because respondents chosen from the population will need to have a good recollection of the state of the forest at least 10 years ago which implies that they need to remember how their environment looked like when they were at least 10 years old. A study of infantile amnesia found that at age 10, children are able to recall events in their past and this recollection lasts a lifetime (Peterson, Warren and Short 2011). Changes in climate occur over an extended period of time so the study required individuals who could recollect how the climate has changed within at least, the past 10-20 years.

### **3.7 Sampling**

A list of all inhabitants aged at least 25 years and have lived in Otu kwadwo for at least ten years was generated with the help of the Assembly man and chairman of the cooperative farmers' union. The list also comprised individuals who were born and lived in the community for at least ten years, left and have returned to the community. This is because these people are aware of what the forest used to be like when they lived in the area and may even have a better picture of the extent of deforestation because for them the contrast will be very sharp compared to those who have lived through and may have come to accept the current situation as normal. The list produced 283 people. All unemployed people were taken out of the list to get a total of 268 people as the target population.

The Yamane formula below was used to indicate the sample size required:

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

Where :

n = sample size

N = population size

e = the level of precision (0.05)

Using the formula,  $n = 268 / 1 + 268 (0.05)^2$

$$\underline{n = 160}$$

A sample size of 160 respondents was arrived at.

Simple random sampling without replacement was used to select the 160 respondents.

In identifying the study area, purposive sampling was used to select a community that may still have an existing forest due to the extent of deforestation which made it extremely difficult to find a standing forest in the municipality. An observation was carried out in the selected community to determine the presence of a forest. Purposive sampling technique was also used to select key informants for in depth interviews based on their knowledge on deforestation issues, communal and government response to deforestation in Otu Kwadwo.

### **3.8 Data Analysis**

The main tool used for quantitative data analysis was the STATA statistical analysis software. Data pertaining to demographic and socio-economic characteristics of participants were analysed using descriptive statistical tools such as means, percentages and frequencies and presented in pie charts and graphs. Cross tabulations were used to depict relationships between certain social and economic characteristics of respondents

and presented in tables. Responses to questions about the DPSIR indicators were analysed using frequencies and presented in the DPSIR framework in descending order (Agyemang, McDonald & Carver, 2007). This helped to show the similarities and differences in perceptions and response to deforestation and climate change

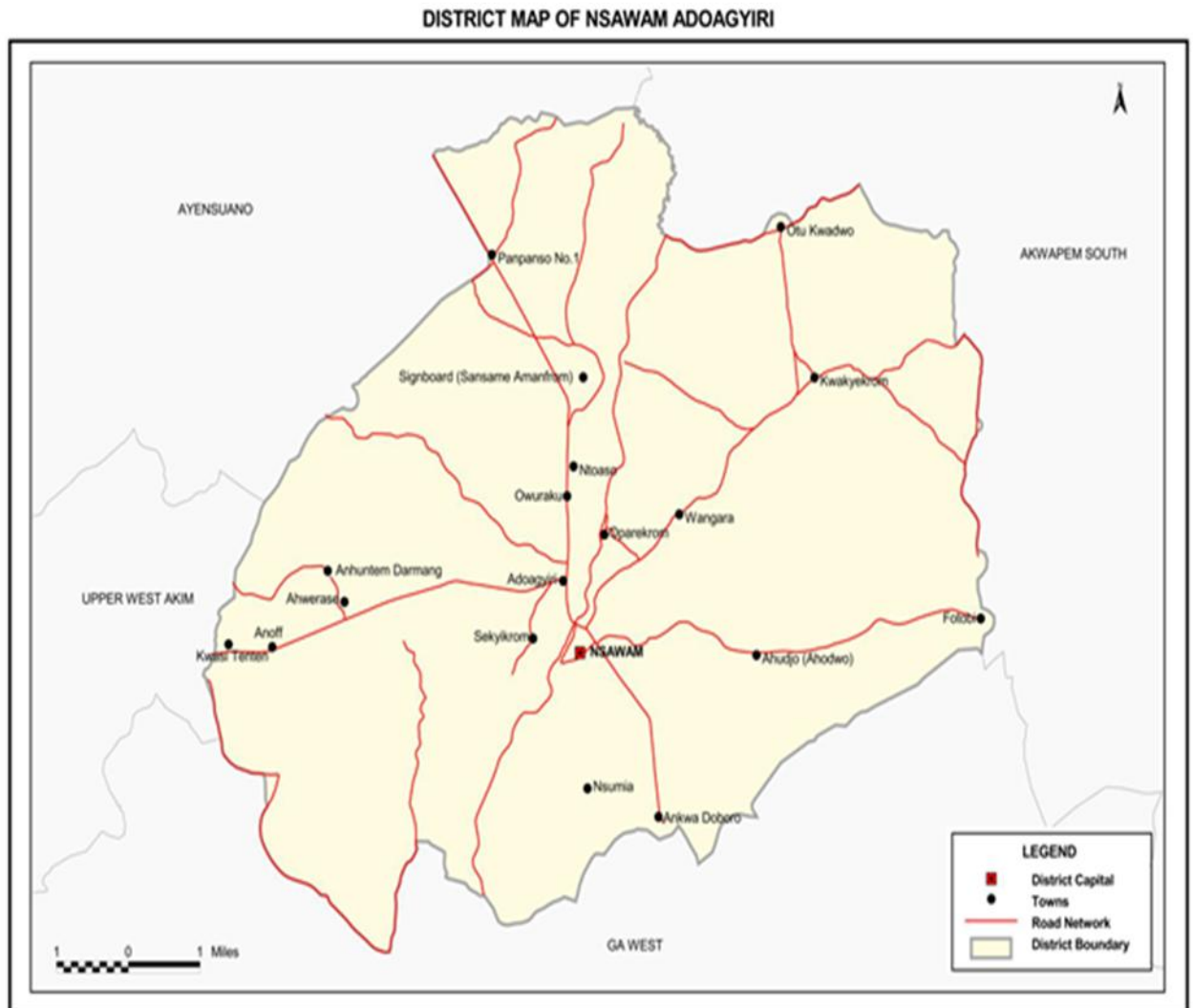
The differences in responses among the two respondent groups to various questions were analysed using chi-square analysis. A T-test was used to test the difference in means for the willingness to pay values, for the two respondent groups. To determine whether the treatment using information on FES had an effect on the willingness to pay values, an ANOVA test was run on the mean WTP values recorded before and after the FES treatment. Recorded interviews were transcribed for analysis using content analysis of emerging themes. The content analysis made meaning of the interviews and provided deeper insights and explanations to trends in perception and response to deforestation observed from the data. Some portions of the qualitative data is presented in the form of quotations and in-text references.

### **3.9 Ethical Considerations**

The consent of all participants was obtained prior to data collection. The purpose and scope of the study was communicated to all respondents sometimes in the local language before questionnaires were administered. The confidentiality of questionnaire and interview responses was also guaranteed. Appropriate community entry protocols were followed.

### 3.10 Profile of the Study Area

**Fig 3. 1: Map of Nsawam Adoagyiri Municipality showing Otu Kwadwo (upper right corner)**



Source: Ghana Statistical Service, (2010)

The preceding information about the profile of the study area was gathered solely from the 2014 Nsawam Adoagyiri Municipal Assembly report.

### **3.10.1 Geography of Nsawam Adoagyiri Municipal Assembly (NAMA)**

Otu Kwadwo is a village located in Nsawam Adoagyiri Municipal Assembly. The municipality is located between latitude  $5.45^{\circ}$  N and  $5.58^{\circ}$  N and longitude  $0.07^{\circ}$  and  $0.27^{\circ}$  W. Otu kwadwo lies on the border which the municipality shares with Akwapim North Municipal Assembly. It is approximately 20 minutes' drive from Nsawam.

### **3.10.2 Climate and Vegetation**

The municipality lies in the wet semi-equatorial climate with a double maxima rainfall recording an average annual rainfall of between 125cm and 200cm. The weather is thus generally cool. The highest temperatures averaging  $30^{\circ}\text{C}$  are recorded between March and April, while the lowest average temperature of  $26^{\circ}\text{C}$  recorded in August. There are two rainy seasons in the municipality. The first rainy season is from May to June, with the heaviest rainfall experienced in June and a second rainy season from September to October. Agriculture in the municipality is rain-fed; thus the two rainy seasons explain the two farming seasons in the area.

Otu Kwadwo lies in an off-reserve moist semi-deciduous forest however, with very little of this forest remaining today as a result of timber logging and shifting cultivation farming practices. The soil supports the cultivation of a variety of crops, including cocoa, pineapples, citrus, oil-palms and most of the staple root tubers and vegetables in Ghana.

### **3.10.3 Topography and Drainage**

The area's topography is made up of the Pompon narrow land and the Akwapim Togo Mountain Range. The main rivers in the Village are the Pompon and Asisabiw Rivers, a tributary of the Densu River located right on the outskirts.

#### **3.10.4 Demographic characteristics**

According to the 2010 census, Otu Kwadwo has an estimated population of 766, made up of 762 Ghanaians and 4 non-Ghanaians. The population distribution is as follows: 367 males and 399 females living in 144 households with an average household size of 5.3. The number of people 11 years and older who are literate is 397 and 125 are illiterate. The active labour force is 335. Located in the Eastern region, one of the Akan speaking regions in Ghana, the municipality is apparently ethnically dominated by Akans, specifically the Akwapim. Other ethnic groups in order of size are Ga, Ewe, Guan, Gurma and Grusi. Inhabitants are mostly Christians with only 3 Muslims, 2 traditionalists and 11 people belonging to other religions.

#### **3.10.5 Infrastructure**

Boreholes supply drinking water to 131 households. The remaining households rely on rain water, rivers and streams for drinking water. There are 4 basic schools in the area, one of which is public. There is a Community-based Health Planning and Services (CHPS) compound that provides healthcare to inhabitants.

#### **3.10.6 Environment**

Like the rest of the municipality, the original vegetation and biodiversity of the area has deteriorated over the years as a result of human activities such as slash-and-burn farming practices, timber logging and extraction of fuel wood. Little of the original vegetation remains. A major effect of deforestation and bad agricultural practices is the noticeable decline in soil fertility. Fuel wood is the main source of fuel for cooking in 118 out of the 144 households. Only 16 households use Liquefied Petroleum Gas (LPG) and 6 households use charcoal.

### **3.10.7 Transportation and communication**

Thanks to the Millennium Development Agency (MiDA) the main road leading to Otu Kwadwo has been tarred. All major mobile telecommunications networks have signals in the village though some are not very strong. There is no internet café that provides internet access. They rely on Nsawam, the municipal capital for postal services.

### **3.10.8 Economy**

The different vegetation in the village is good for the cultivation of a wide range of crops. Farming is thus the major economic activity in the area. The majority of farmers are however engaged in crop farming. Cocoa farming has been introduced to the village recently as parts of efforts to replant trees. There is a village market but most trading is done along the main road. Traders mostly sell farm produce and operate small shops. There are a number of skilled artisans such as hairdressers, seamstresses, mechanics and carpenters. There are no financial institutions in the area. The public sector employs 18 people in the community, while private formal sector employs 7. Majority of employment in the village is in the private informal sector.

## **CHAPTER FOUR**

### **PRESENTATION OF RESULTS AND DISCUSSION OF FINDINGS**

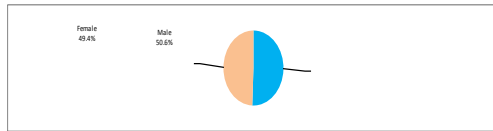
#### **4.1 Introduction**

This chapter analyses the data gathered from the field and discusses the findings on local knowledge of and response to deforestation and climate change. It is divided into 4 main sections. Section 4.2 presents the findings on the respondents' demographics showing the socio-economic characteristics of the sample. Section 4.3 puts the data analysis into context by delineating the nature of forest dependence and importance among the two livelihood groups. Section 4.4 discusses the local knowledge and awareness of the deforestation and climate change in terms of drivers, pressures, state and impact of the phenomena in the community. The analysis of the impact of deforestation include detailed discussion on the climate change awareness and impact. Section 4.5 analyses responses of individuals, the community and government to deforestation. Section 4.6 presents the findings of the tests of the two hypotheses.

#### **4.2 Demographic Characteristics of Respondents**

##### **4.2.1 Gender and Age of Respondents**

In all, 160 residents of Otu Kwadwo in the Nsawam Adoagyiri Municipality of the Eastern region, aged at least 25 years and have lived in the village for at least 10 years were interviewed. A total of 81 respondents constituting 50.6% of the entire sample were male and 79 (49.4%) were female. Figure 4.1 shows the distribution of respondents by gender.

**Fig 4. 1: Distribution of respondents by gender**

Source: Field Data (2015)

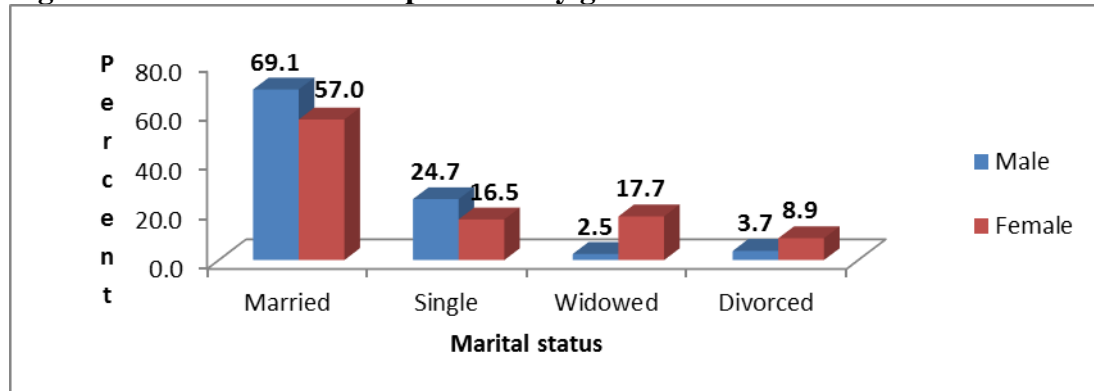
The mean age of the respondents was 45.24 with a standard deviation of 15.62. The youngest respondent was 25 years for both sexes whereas the oldest male and female were 73 years 88 years, respectively. A higher mean age of 48.39 years with a standard deviation of 17.72 was obtained for the female respondents compared to 42.17 years with an associated standard deviation of 12.63 for the male respondents. This difference in age for the respondents was found to be significant at the 5% level (p-value of 0.0114).

#### **4.2.2 Marital Status and Number of Children Of Respondents**

As seen in figure 4.2, the greatest proportion of the respondents was married (63.1%). The remaining respondents were either single (20.6%), widowed (10%) or divorced (6.3%). A greater proportion of the male respondents were either married (69.1%) or single (24.7%) than the female respondents (57% and 16.5%, respectively). This was found to be significant at the 1% level (a p-value of 0.003).<sup>2</sup>

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<sup>2</sup> Female household heads are likely to be in the divorced or widowed category which only forms 16.3% of respondents. The high proportion of married males justifies the choice of the individual questionnaire in order to avoid having a disproportionate number of male headed households.

**Fig 4. 2: Marital status of respondents by gender**

Source: Field Data (2015)

The respondents were asked to indicate whether they have children or dependents. The survey results showed that 9 out of every 10 respondents had children or dependents. Nearly one percent of the married respondents did not have any children or dependents, whereas about 45.5% of those who were single did not. However, all the respondents who were widowed or divorced had children and dependents.

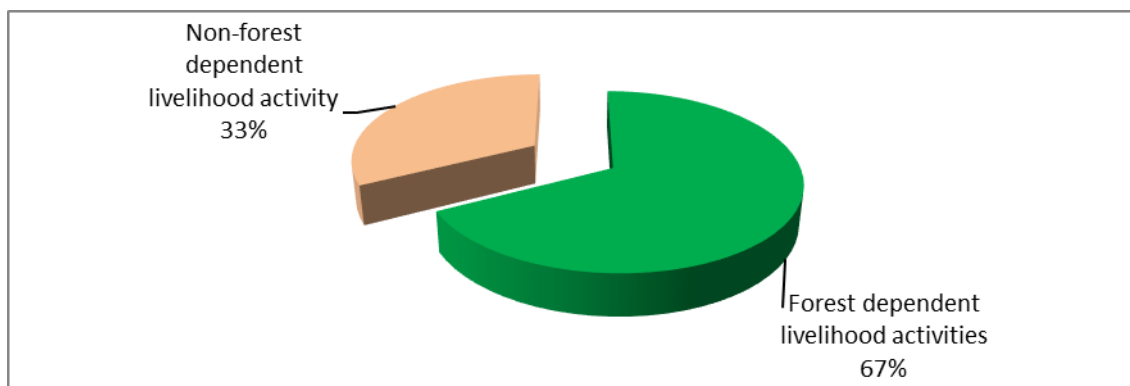
#### 4.2.3 Distribution of Respondents according main source of livelihood activity

A greater proportion of the respondents were subsistence farmers (45%), followed by NTFP petty traders (19.4%), and then non-forest dependent self-employed. e.g., seamstress (16.2%). Petty traders dealing in non-forest products constituted 8.8%, wage/salary workers and forest resource dependent self-employed (eg carpenter) were 7.5% and 3.1%, respectively. Figure 4.3 shows that 67% (i.e., about two out of every three respondents) engage in a forest dependent livelihood activity as opposed to 33% in non-forest based livelihoods. However, a total of 55% of respondents are engaged in non-agricultural livelihood activities as against 45% agricultural livelihoods.

A slightly higher proportion of the male respondents (69.1%) had their main source of income from a forest-dependent livelihood activity than the female respondents (65.8%). This justifies the use of an individual questionnaire since a household questionnaire will

most likely have produced a sample with a high proportion of male farmers which would have defeated the purpose of comparison across livelihoods.

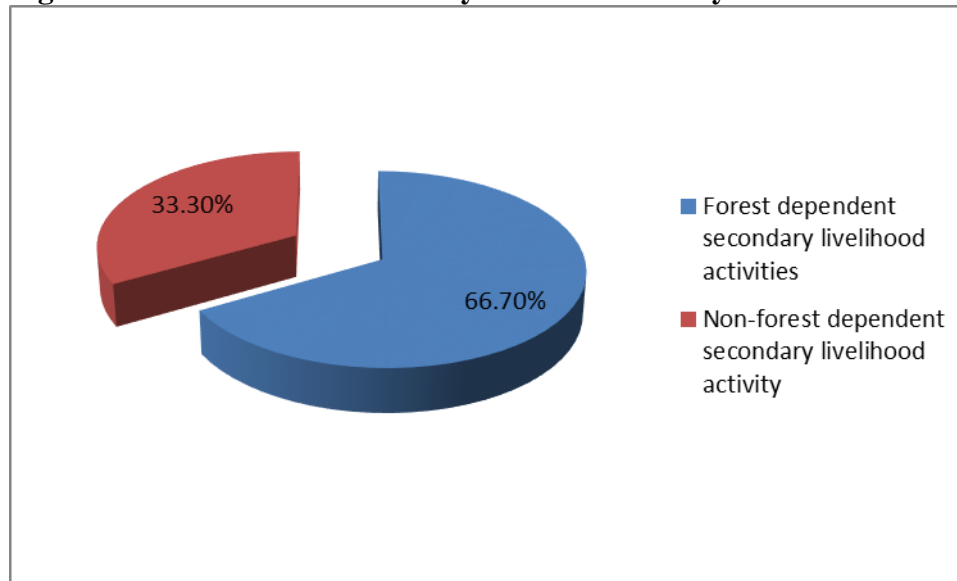
**Fig 4. 3: Distribution of main source of livelihood**



Source: Field Data (2015)

#### **4.2.4 Distribution of Respondents by Secondary Livelihood Activity**

Over half of the respondents (52.5%) had a secondary source of livelihood. The agriculture- non- agriculture secondary livelihood divide is 44% versus 56%, respectively, while the forest dependent livelihood and non-forest dependent livelihood divide 66.7% versus 33.3%. Figure 4.4 shows the distribution of respondents according to their secondary livelihood activities.

**Fig 4. 4: Distribution of secondary livelihood activity**

**Source: Field Data (2015)**

#### **4.2.5 Livelihood Diversification In The Rural Economy**

Of the 44% secondary subsistence farmers, 21.4% of them had main livelihoods in non-forest dependent self-employed occupations such as hairdressing and tailoring 17.9% were people whose main occupation was petty trader (NTFP) whereas, 10.7% were non-forest petty traders. Self-employment in non-forest dependent activities was the next important source of secondary livelihood making 20.9%. Wage/ salary worker secondary livelihood activities were 1.2%.

About 53.2% of the female respondents compared to 51.9% of the male respondents had secondary occupation. A greater proportion of the female respondents with secondary occupation were involved in forest dependent livelihood activities as compared to the male respondents; 81% and 52.4% respectively. This difference was found to be significant at 1%; p-value of 0.005.

#### **4.2.6 Respondents' Level of Education**

About 21.9% of the respondents have never been to school. However, a greater proportion (33.8%) had completed Junior Secondary School or Middle School whereas 22.5% had their highest level of education being primary school. Nearly 4.4% of the respondents have schooled to the tertiary level whilst about 14.4% were secondary school leavers. In general, over 52% had a Junior High School certificate or better. Two-thirds of the male respondents had completed at least a Junior High School compared to 38% of the female respondents. These differences in the educational level by gender was significant at 1%; p-value of 0.000.

#### **4.2.7 Respondents' Level of Education and Main Livelihood Activity**

Table 4.1 shows that respondents who were engaged in the forest dependent livelihood activities were mainly Junior high School leavers (31.5%) and those who have never been to school (29.6%). On the other hand, people with Junior High School qualification (38.5%) and Senior High School qualification (26.9%) dominated those engaged in non-forest dependent livelihood activities. These differences were significant at 1%; p-value of 0.000. This conforms with the widely held view that in most rural communities in developing countries, agriculture is dominated by the uneducated, a reason blamed for the lack of innovation in the sector.

**Table 4. 1: Main Livelihood activity by education**

Level of Educational	Forest dependent livelihood activities		Non-forest dependent livelihood activities		Overall	
	N	%	N	%	N	%
No school	32	29.6	3	5.8	35	21.9
Preschool	4	3.7	1	1.9	5	3.1
Primary	27	25	9	17.3	36	22.5
JHS/Middle School	34	31.5	20	38.5	54	33.8
SHS/GCE O'Level	9	8.3	14	26.9	23	14.4
Tertiary	2	1.9	5	9.6	7	4.4
Total	108	100	52	100	160	100

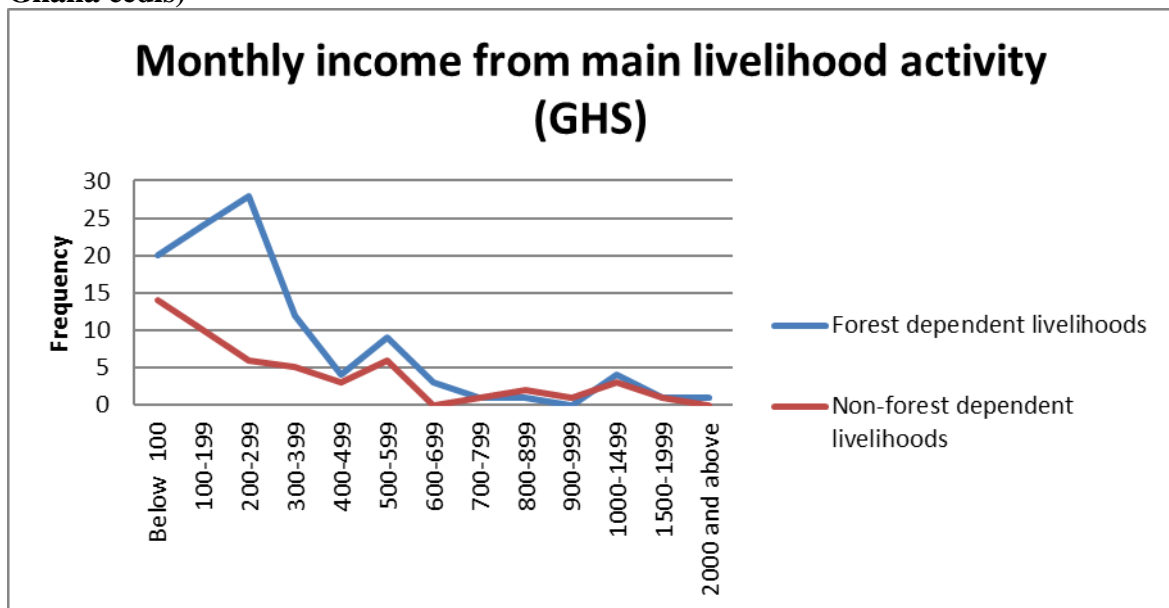
Source: Field Data (2015)

#### 4.2.8 Estimated Monthly incomes from Main Livelihood Activity

Using the current (June 2015) exchange rate of GHS 3.40 = \$1, figure 4.5 below , indicates that, more forest dependent respondents, i.e. 44 (40.7%) out of 108, are poor people living on less than \$2 (below 200 GHS) a month as against 24 (42.6%) out 58 of non-forest dependent respondents. Using and income of \$1 as an indicator of the extremely poor, 20 (18.5%) forest dependent respondents are extremely poor compared to 14 (26.9%) of non-forest dependent livelihood respondents. Overall, 42.6% , close to half of the respondents, earned less than \$2 (below GHS 200) in a month and can therefore be classified as poor people. Of the total number of poor people, half of them earned less than \$1 (below GHS 100) a month. The overall percentage of poor and extremely poor people was equally distributed i.e. 21.3% respectively. This is a reflection of the low incomes and income poverty in the Ghanaian rural economy. As

seen in figure 4.5, while forest dependent livelihood groups had slightly higher daily incomes at income levels of between \$ 2-\$6 (GHS 200 - 699), beyond a daily income level of \$7 (GHS 700 and above), there were very little differences between the two livelihood groups.

**Fig 4. 5: Estimated Monthly incomes from main livelihood activity (income in Ghana cedis)**



Source: Researcher's Field Data (2015)

The slightly better incomes recorded by the forest dependent livelihood groups can be associated with the practice of chainsaw timber harvesting. Also, though off-farm income sources are an important source of income in rural communities, due to the low levels of rural income, people pay less for goods and service rendered.

On the question of whether the respondent was a native of Otu Kwadwo, most of the respondents (68.8%) responded in the affirmative. A higher proportion of the female respondents (73.4%) were natives of the community compared to the male respondents (64.2%). Also, about three-quarters of those who were engaged in non-forest related

activities were natives of the community compared to 65.7% of those who engaged in forest-related activities.

#### **4.2.9 Respondents Native Status and Length of Stay in Study Community**

Most of the natives have lived in the community all their lives (61.3%). A greater proportion of the female respondents (73.4%) have never moved out of the community compared to the male respondents (64.2%). This is normal as research shows that males have the tendency to be more mobile migrate in search of better opportunities.

On the average, the respondents have lived in the community for about 37 years with a standard deviation of 19.15. Those who have not lived in Otu Kwadwo throughout their lives had a mean of 22.63 years with a standard deviation of 13.43. On the other hand, natives of Otu Kwadwo had lived there for about 40.37 years with a standard deviation of 19.27 whereas non-natives have lived there for about 29.52 years with a standard deviation of 2.37. These differences were found to be significant at the 1% level of significance (p-value of 0.0008). Respondents have thus had a considerable experience with the changing forest cover over the years.

The results from the demographic data are consistent with other findings that depict a high level of poverty and dependence of rural communities on natural resources such as forest, (Angelsen and Kaimowitz 1999; Benhin 2006; Scherr 2000). The results also support the view that rural livelihoods are diversified into non-agricultural and non-farm activities. Darko Obiri and Damnyag (2011). The results of this study show as high as 55% and 56% non-agricultural livelihoods in main and secondary livelihood activities respectively compared to that of Ellis (1999) which found that non –agricultural livelihoods could be between 30%-50% in rural areas in sub-Saharan Africa. It is also higher than the Obiri (2003) conclusion that Ghanaian rural economies are characterized

by about 30% of small businesses, that generate income to supplement income from agriculture, the major occupation and source of livelihood

Contrary to studies which categorize rural forest dwellers into two main livelihood groups, namely, hunters and gathers and shifting cultivation farmers (Bryon and Arnold 1999; Angelsen & Wunder 2003; and Vedeld et al. 2004) and as such tend to regard rural forest dwellers as a homogenous group of poor people, usually engaged in farming and having similar goals and needs (Sam and Shepherd, 2011), these results show that forest communities are ethnically, socially and economically diverse (Banerjee and Duflo 2007). It also supports the claim that rural communities comprise inhabitants divided along ethnic, gender, age, wealth, status, native and non-native lines (McDougall, Prabhu and Fisher, 2007).

### **4.3 Forest Dependence and Importance to Livelihoods Groups**

#### **4.3.1 Importance of Forests to Livelihood Groups**

All respondents (100%) engaged in forest dependent livelihoods found forests to be important to their livelihoods, while 96.9% of those in non-forest dependent livelihoods saw the importance of forest to their livelihoods. In all only 3.1% of total respondents, all of whom were engaged in non-forest dependent livelihood activities, found forest resources not to be important to their livelihood. This was significant at 1% (p-value of 0.001).

#### **4.3.2 Frequency of visits to forest in the month preceding the study**

The respondents were asked to indicate the number of times they visited the forest in the past month to indicate the frequency of use of forest resources to meet recurrent needs.

**Table 4. 2: Frequency of visits to the forest**

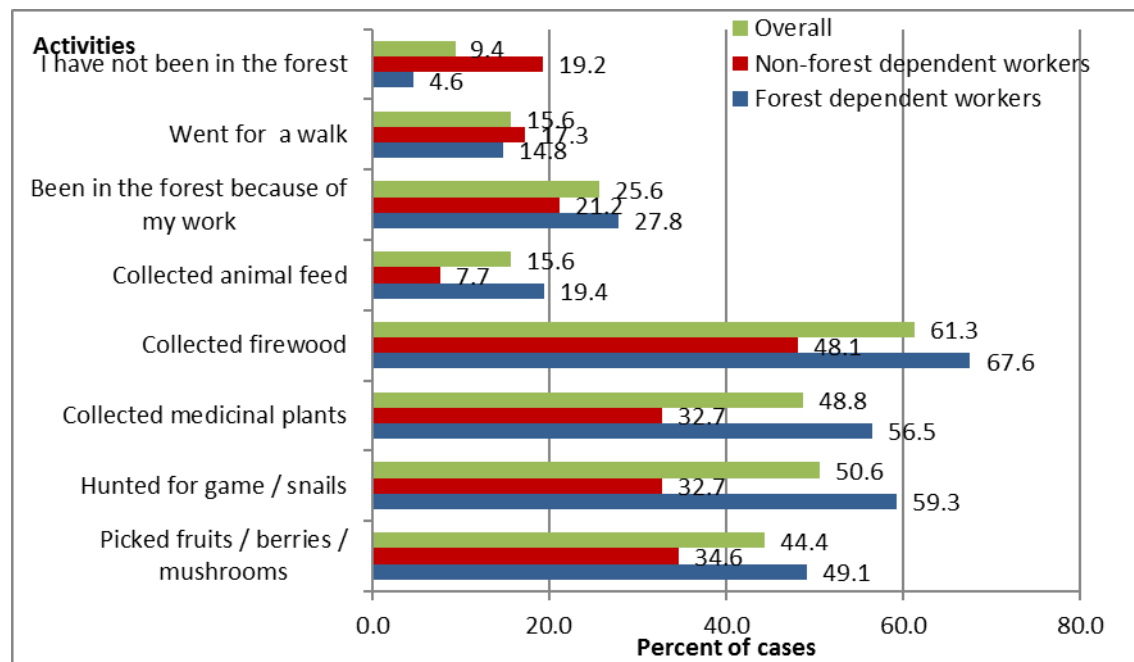
Frequency	Forest dependent livelihood activities		Non-forest dependent livelihood activities		Overall	
	No.	%	No.	%	No.	%
Daily	18	16.7	4	7.7	22	13.8
Several times per week	43	39.8	7	13.5	50	31.3
About once a week	14	13	15	28.8	29	18.1
Several times in a month	16	14.8	13	25	29	18.1
I have not been there	17	15.7	13	25	30	18.8
Total	108	100	52	100	160	100

Source: Field data (July 2015)

Table 4.2 above reveals that, nearly one-third of respondents visited the forest several times in a week (31.3%). Close to 40% of forest dependent livelihood activities workers visited the forest several times in a week compared to 13.5% of those engaged in non-forest dependent economic activities. Non-forest dependent economic activity workers, on the other hand, visited the forest about once a week (28.8%), followed by several times a month (25%) and daily (7.7%). It is worthy to note that 15.7% of forest dependent respondents had not visited the forest in the past month. The main reason From table 4.2, nearly one-third of respondents visited the forest several times in a week (31.3%). Close to 40% of forest dependent livelihood activities workers visited the forest several times in a week compared to 13.5% of those engaged in non-forest dependent economic activities. Non-forest dependent economic activity workers, on the other hand, visited the forest about once a week (28.8%), followed by several times a month (25%) and daily (7.7%). n advanced by this group was the fact that the delay in rainfall had caused their crops to die thus there was no need visiting their farms. They rather spent the past month engaging in alternative livelihood activities.

### **4.3.3 Activities carried out in the forest in the past year**

To capture the full extent of forest use and dependence, especially for those who have not visited the forest in the past month, respondents were asked to indicate the activities they have carried out in the forest in the year preceding the study. From figure 4.6 below, it is realised that when the time span for forest use is increased to a year, only a few respondents had never visited the forest in the past year (9.4%) compared to 18.8% who has not visited the forest in the past month. Respondents who were engaged in forest dependent economic activities went to the forest to collect firewood (67.6%), hunt for game / snail (59.3%), collect medicinal plants (56.5%), and pick fruits / berries / mushrooms (49.1%) amongst others. Smaller proportions of non-forest dependent workers went to the forest to collect firewood (48.1%), pick fruits / berries / mushrooms (34.6%), hunt for game / snail and collect medicinal plants (32.7%) Quite a small number of forest dependent respondents (27.8%) had been to the forest in the past year because of their work.

**Fig 4.6: Forest activities in the past year by livelihood groups**

Source: Field Data (2015)

Some non-forest dependent livelihood groups, such as cooked food vendors, rely on the free supply of fuelwood from the forest to cut down the cost of buying charcoal. Some non-forest dependent petty traders trade under wooden stalls made entirely of local forest products, and thus go there to get materials to roof their stalls or do repair work (See appendix 2). This explains the relatively high frequency of forest visits by non-forest dependent livelihood groups for work purposes.

Some aged farmers and those who, as a result of some injury or illness, are incapable of actively working on their farms employ the services of farm labourers. There are also some who engage in share-cropping with migrants and landless people since they cannot farm themselves. This accounts for the 4.6% of forest-based livelihood groups who have not been in the forest in the past year.

On the whole, only 9.4% of respondents had not entered the forest in the past year. These were mostly the youth, aged at most 32 years, who were either involved in skilled

employment such as hair dressing, or retail of fast moving consumer goods and thus did not go to the forest. A major reason given by this category of respondents was the fact that the NTFP's such as snails, fruits, and fuelwood that attracted them to the forest in the past are no longer readily available and thus going into the forest is a waste of time. They prefer to buy charcoal, fruits and other NTFP's that are from the market.

Amongst the popular activities of residents in the forest in the past year were firewood collection (61.3%), game or snail hunting (50.6%), collection of medicinal plants (48.8%) and wild fruits / mushroom harvesting (44.4%). These forest uses are consistent with finding from similar research, such as Angelsen and Wunder (2003); Cavendish (2002) Vedeld et al. (2002). (See appendix 3). These studies grouped the importance of forest to the daily lives and activities of rural forest community into three main groups namely: safety net, consumption support, and poverty reduction. The first two services, i.e. safety net and consumption support, are actual roles that forest play to insure against food and income shortfall as well as provide daily food needs and supplements. Poverty reduction roles of forest is considered as a potential role, as the availability of forests in itself does not reduce poverty but rather provides assets and opportunities (livelihood diversification) that facilitate poverty reduction programmes.

The high percentage of respondents whose main livelihood activities are non-forest dependent yet deem the forest as important to their livelihoods is interesting to note and confirms the high level of forest dependence for both main and secondary livelihood activities by both groups of respondents. demographic characteristics of the respondents which portray low income levels thus the forests has become the most important source of both main and secondary livelihood activities.

It is also a reflection of the intimate relationship that forest dwellers have with the forest regardless of whether it provides their main source of income or not. Though the

difference in importance is statistically significant the margin is not drastic. The statistically significant difference therefore does not justify the emphasis on forest based livelihood groups, especially farmers, in deforestation discourses. It is possible that with some outreach to the 3.1% who do not see the importance of forests to their livelihood, the support of the entire community (both forest dependent and non-forest dependent livelihood groups) can be garnered to protect and preserve forest resources.

#### **4.4 Awareness of Drivers, Pressures, State and Impact of Deforestation Among Livelihood Groups**

This section presents results of respondents' awareness of deforestation, its drivers, pressures, state and impact of deforestation.

##### **4.4.1 Awareness of Deforestation and its indicators**

Majority of the respondents (84.4%) were of the opinion that there has been a decrease in forest land in Otu Kwadwo over the past 15 to 20 years. A slightly higher percentage of respondents whose main occupation is forest dependent (85.2%) indicated there has been a decrease in forest land as compared to 82.7% of those in non-forest dependent activities. Table 4.5 below depicts the indicators used by respondents to substantiate their claims of diminishing forest land.

**Table 4. 3: Indicators of decrease in forest land**

Reasons	Forest dependent workers		Non-forest dependent workers		Overall	
	No.	Percent of cases	No.	Percent of cases	No.	Percent of cases
Fewer trees	63	68.5	27	62.8	90	66.7
Difficulty finding medicinal plants	63	68.5	19	44.2	82	60.7
Difficulty harvesting firewood	53	57.6	18	41.9	71	52.6
Less rainfall	45	48.9	17	39.5	62	45.9
Fewer wild fruits	36	39.1	18	41.9	54	40.0
Increased distance to the forest	25	27.2	12	27.9	37	27.4
Total valid cases	92	309.8	43	258.1	135	293.3

Source: Field Data (2015)

From table 4.3 above, two-thirds of those who revealed there has been a decrease in the forest land determined that with reduced trees on the land, whereas about 60.7% observed the reduction in forest through the difficulty in finding medicinal plants. Other respondents also used the difficulty in harvesting firewood (52.6%), less rainfall (45.9%), fewer wild fruits (40%), and increased distance to the forest (27.4%) to tell. Difficulty in finding medicinal plants and fewer trees (68.5% each) dominated the reasons given by forest dependent workers whereas fewer trees (62.8%) topped the list of reasons provided by non-forest dependent workers.

#### **4.4.2 Local Perceptions and Understanding of Deforestation**

During the initial stages of this study, the researcher discovered that there were varied perceptions of what type of forest use constituted deforestation. The tendency was to

exclude perceived “beneficial” and “necessity” uses of forest from the term deforestation. It was therefore necessary to find out what respondents considered as deforestation to better situate the findings of the study in the local context. Table 4.6 shows the local perceptions of the types of forest use that can be classified as deforestation.

**Table 4. 4: Meaning of deforestation to respondents**

Meaning of deforestation	Forest dependent worker		Non-forest dependent worker		Overall	
	No.	Percent of cases	No.	Percent of cases	No.	Percent of cases
Cutting down of timber from the forest for sales	83	76.9	34	65.4	117	73.1
Converting forest land to farm land	78	72.2	23	44.2	101	63.1
Converting forest land to housing	54	50.0	20	38.5	74	46.3
Cutting down forest trees for firewood	30	27.8	11	21.2	41	25.6
I have no idea	-	-	2	3.9	2	1.3
Total valid cases	108	226.9	52	173.1	160	209.4

Source: Field Data (2015)

Table 4.4 above shows that majority of respondents associate deforestation with cutting down of trees for timber from the forest (73.1%), followed by converting forest land to farm land (63.1) and cutting trees for firewood (25.6). Only 1.3% of respondents, all of

whom had non-forest dependent livelihoods, had no idea what forest uses constituted deforestation.

The results suggest that local people shared the similar views about deforestation as the Forestry Department which considers any form of forest conversion whether for positive or negative activities as deforestation. Unlike the respondents, officers at the municipal agricultural department did not, however, interpret the vanishing forests as a case of deforestation. Officers of this department indicated that using off-reserve forest for agriculture in a farming community does not count as deforestation since it is crucial to sustain the main source of livelihood and moreover, the land is not a forest reserve. They explained that almost all communities in the Nsawam Adoagyiri municipality are regarded as farming communities, thus the forests are meant for farming so cutting down forest trees only avails the land for its rightful use as farmland. To them, it is only farming in a forest reserve that counts as deforestation.

Although respondents in the study regarded the conversion of forest lands for agricultural purposes as deforestation, they also admitted that agricultural land use was indispensable to their livelihoods.

*“You see we also need to survive. Cutting the trees allows us to plant food crops which we use to feed our families and sometimes sell to earn money for school fees and other expenses. Apart from cocoa which grows well under trees, most food crops need direct sunlight”.* (Chairman of farmer’s cooperative union)

Nevertheless, they thought they could have used better agricultural practices like agro-forestry, engaged in tree planting, and probably reserved the forests on the rocky hills since it is impossible to farm there. These according to them would have reduced the extent of deforestation. Local knowledge of respondents in this instance seemed more

“useful”, as observed with Jamaican yam farmers, compared to scientific knowledge of the agriculture department. (Barber, Biddlecom & Axinn, 2003)

#### 4.4.3 Drivers of Deforestation

The socio-economic factors underlying people’s decisions to convert forests to other uses are poverty (73.8%), household subsistence needs (61.3%), and population increase (60%). A few respondents (3.1) however did not have any idea on what motivated people to turn forests to other uses. These and other drivers of forest conversion have been presented in Table 4.5 below.

**Table 4. 5: Drivers of Deforestation**

Drivers	Forest dependent worker		Non-forest dependent worker		Overall	
	No.	Percent of cases	No.	Percent of cases	No.	Percent of cases
Poverty (Income)	79	73.2	39	75.0	118	73.8
Household subsistence	70	64.8	28	53.9	98	61.3
Population increase	69	63.9	27	51.9	96	60.0
Lack of regulation on	14	13.0	7	13.5	21	13.1
Health needs	13	12.0	4	7.7	17	10.6
Lack of enforcement	11	10.2	6	11.5	17	10.6
No idea	2	1.9	3	5.8	5	3.1
Total valid cases	108	238.9	52	219.2	160	232.5

Source: Field data (July 2015)

From table 4,7, it is clear that the forest is the main source of income for the community. There are very few formal jobs that provide employment to inhabitants. The general lack of employment and economic opportunities push people into agriculture as the only

means of poverty alleviation because agricultural activities have virtually no entry restrictions and little startup costs. Aside cultivating forest land, forest products are used for food, as building materials and even sold for income.

According to a market woman who trades in farm produce, poverty has resulted in the deforestation of rocky lands that do not even support agriculture. She explains that poverty drove people to illegally fell the tree on the rocky land for timber, and also cut down fruit trees either for sale or domestic use as firewood instead of using LPG.

Population increase in the municipal capital Nsawam and the national capital Accra have had spill over effects in Otu Kwadwo. According to the 2010 population and housing census, out of the community's population of 766, 402 are non-natives including 4 foreigners. The influx of migrants has brought a boom in the sale of lands such that land that hitherto belonged to families is now individually owned. The boom in land sales has decreased family lands available for farming even by family members.

According to respondents, they used to practice bush fallow farming technique to allow the soil time to replenish it, but the increase in population has made agricultural land scarce to the extent that there are no alternative lands to farm on should one decide to leave their land to fallow. What this means is that farmers are restricted to their current land size so they either practice intensive farming or clear forest areas to expand their farms all of which have negative consequences on the environment. *“If you leave your farmland to fallow your family will give it out to a desperate landless resident on share cropping basis because the land belongs to your family and they can give it to anyone. Even if the soil is degraded you apply fertilizer to make it more productive because you cannot risk leaving it to fallow”* (Chairman of farmer's cooperative)

The influx of migrants has also increased the practice of share cropping popularly called “abunu” (divide into two) and “abusa” (divide into three), where land owners seeking

alternative income sources give out their lands to landless migrants who farm and share the proceeds with the land owner either on “abunu” or “abusa” basis. This finding is contrary to studies such as Vedeld et al.,(2002) which claims that forest land is of little importance to landless people since they have no use for it.

#### 4.4.4 Pressures of Deforestation

The drivers of deforestation identified above result in changes in land use to satisfy the drivers. Table 4.6 shows that the dominant use of land in Otu Kwadwo is for agricultural purposes (84.4%), followed by housing (60.6%). Other activities resulting in deforestation are collection of firewood (36.3%), timber harvesting (30%) and harvesting of medicinal plants (10.6%). Also, according to about 20.6% of respondents, bush fires also cause deforestation. A further probe into the incidence of bush fires revealed that respondents who mentioned it were referring to the widespread bush fires that occurred during a prolonged period of drought in Ghana in 1983.

**Table 4. 6: Pressures that result in deforestation**

Pressures	Forest dependent worker		Non-forest dependent worker		Overall	
	No.	Percent of cases	No.	Percent of cases	No.	Percent of cases
Agriculture	93	86.1	42	80.8	135	84.4
Housing	67	62.0	30	57.7	97	60.6
Collection of firewood	38	35.2	20	38.5	58	36.3
Timber harvesting	35	32.4	13	25.0	48	30.0
Bush fire	25	23.2	8	15.4	33	20.6

Harvesting / collecting medicinal plants	14	13.0	3	5.8	17	10.6
Total valid cases	108	251.9	52	223.1	160	242.5

Source: Field Data (2015)

Despite the large volumes of firewood stocks around homes in the community, observed during field visits, respondents indicated that they do not cut down trees for firewood but rather collect fallen tree branches or pick remnants left by chainsaw operators. Some key informants however explained that the days of fetching only dead branches as firewood are long gone because currently trees are cut for firewood. *“Now that there are fewer trees, there are very few dead braches to collect so is very difficult to get firewood without cutting down some trees”* (Provision shop owner). The chairman of the farmers’ cooperative added that *“there used to be a lot of mango trees in this community but all of them have been cut for firewood”* (Chairman of farmers’ cooperative)

Almost all respondents and key informants maintained that harvesting leaves, roots and tree bark for medicine did not destroy trees thus the low number (17) recorded in table 4.6, despite the fact that it was part of a multiple response question. A few including the chairman of the farmers’ cooperative however admitted that: *“Excessive harvesting of tree bark and roots could kill a tree but that takes a very long time to happen.”* (Chairman of farmers’ cooperative)

Nearly the entire forests in Otu Kwadwo have vanished completely as indicated by respondents in loss of forest cover (75%) and non-existence of timber trees (64.4%). Some believe that the forest has undergone degradation (62.5%).

### **Contribution of timber harvesting and illegal chainsaw operators to deforestation in Otu Kwadwo**

According to local accounts, the Nsawam Prison's used to log timber in the communities' forests during the 1980's and that paved way for indiscriminate logging by chainsaw operators. There used to be police patrol in the area that arrested illegal chainsaw operators. The Regional Manager of the Eastern Region Forestry Department confirms this and adds that the chainsaw operators have changed their modus operandi; they now move in armed gangs and operate at night. Even with reinforcement from the Ghana Army they are not able to contain them. *"Because of the individual /family land ownership, people do not interfere when they hear people cutting down on trees in another person's land."* (Employee of Ghana Airports)

Some farmers intentionally cut down timber trees on their farms because chainsaw operators might fell them illegally, drag the log through their farms, thus destroying their crops in the process. Others are left at their mercy: *"I know the value of the trees on my land so I will not sell them to chainsaw operators but you wake up and the tree has already been cut by chainsaw operators and your crops also destroyed in the process."* (88-year-old woman)

#### **4.4.5 State of Forests in Otu Kwadwo**

The study sought to find out how respondents perceived the current state of forests in their community. The results in table 4.9, point to an almost devastated forest since a large proportion of respondents (75%) believe the forest has lost its cover, while 64.4 % of responses indicated the non-existence of timber trees.

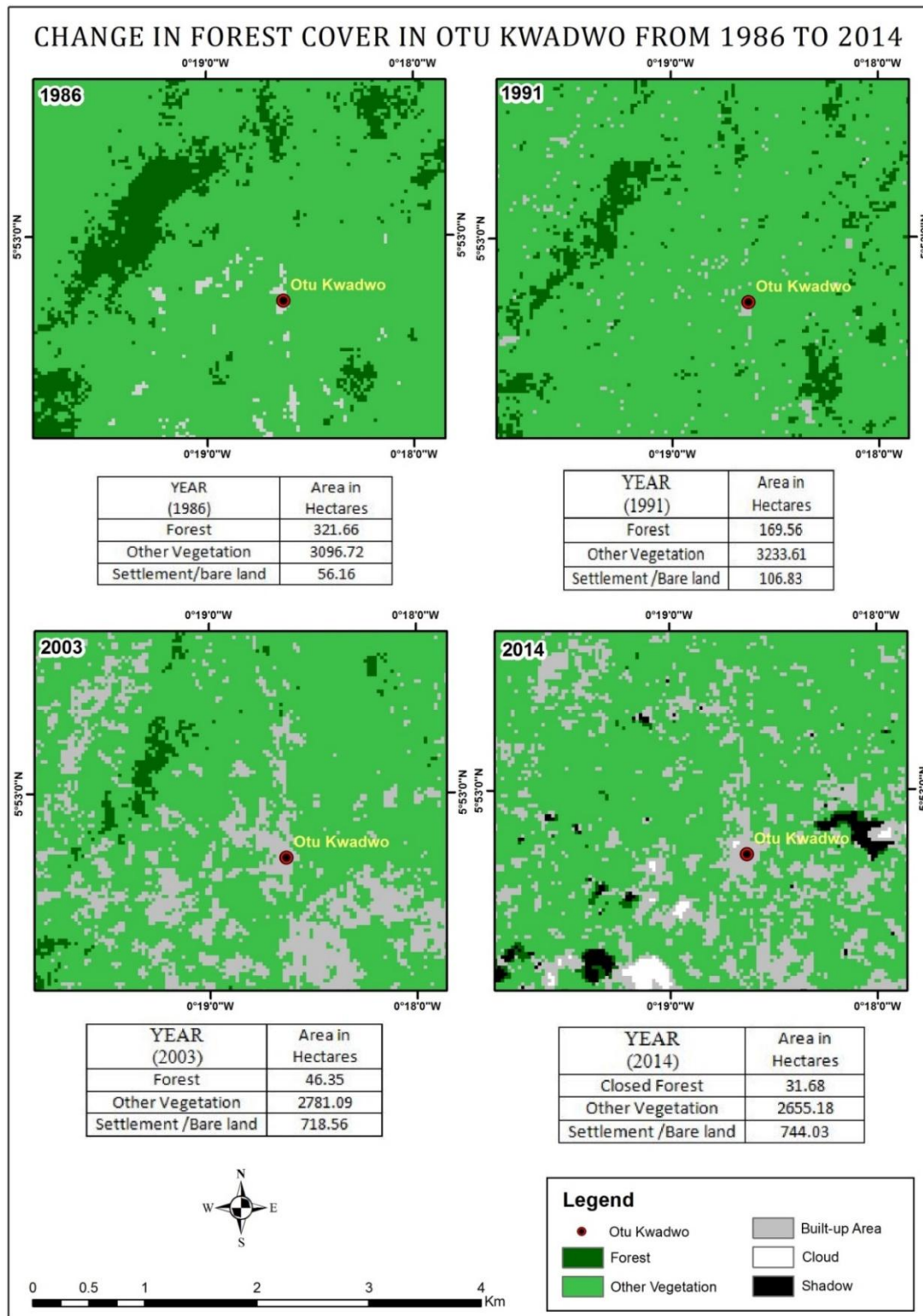
**Table 4. 7: State of forest**

Current state	Forest dependent worker		Non-forest dependent worker		Overall	
	No.	Percent of cases	No.	Percent of cases	No.	Percent of cases
Loss of forest cover	82	75.9	38	73.1	120	75.0
There are no timber trees left	70	64.8	33	63.5	103	64.4
Forests have been degraded	70	64.8	30	57.7	100	62.5
Total valid cases	108	205.6	52	194.2	160	201.9

Source: Researcher's Field Data (2015)

The respondents' perception of devastation of the forest was corroborated by the GIS data in figure 4.6 below, obtained from Centre for Remote Sensing and Geographic Information Services at the University of Ghana, Legon.

**Fig 4. 7: GIS data on deforestation in Otu Kwadwo**



Source: Field Data (2015) obtained from CERSGIS, University of Ghana.

The GIS image shows a total forest cover of 321.66 hectares in 1986 and in just five years approximately half of the forest had disappeared, reducing it to 169.56 hectares. Within a period of 12 years (1991-2003) the forest cover was further reduced to 46.35 hectares implying a loss of about three-quarters of the previous cover. As at 2014, only 31.68 hectares of forest existed, one-tenth of its size in 1986. At this rate, the forest will completely disappear in the next 20 years.

Realistic descriptions of current state of the forest according to local knowledge is captured in the comments below:

*“At first when you went into the forest, you do not feel the sunlight. Sometimes you do not even see it. The forest was very dense and the canopy was very thick.”* (88 year old female farmer)

*“Now I do not get that eerie feeling when I go into the forest. I used to be afraid of going there. Now I am no longer afraid because there are fewer trees so the sun brings in light.”* (NTFP market woman)

The 62.5% of respondents who indicated that the forest has been degraded referred mostly to what was left of it now at the outskirts of the village.

*“There is some forest remaining at the outskirts of the village but in fact it is not like it used to be. Now, the trees are not as much as they used to be when you are in it you can even feel the sunlight, there are no antelopes and bush meat like before.”* (Illegal chainsaw operator)

#### **4.4.6 Impact of Deforestation**

Table 4.8 below, provides on information on the impacts of deforestation by type of livelihood activity. According to the respondents, climate change was a major impact of deforestation (79.9%). Drying of rivers and other water bodies (50.9%), poor soil quality

(47.8%), people migrating out of the community (23.9%) and inability to control diseases and pests (12%) were amongst the common impacts of deforestation cited by the respondents.

**Table 4. 8: Impacts of deforestation**

Impact	Forest dependent worker		Non-forest dependent worker		Overall	
	No.	Percent of cases	No.	Percent of cases	No.	Percent of cases
Climate change	86	79.6	41	80.4	127	79.9
Drying of springs and river	58	53.7	23	45.1	81	50.9
Poor soil quality	56	51.9	20	39.2	76	47.8
Loss of NFTP's	46	42.6	24	47.1	70	44.0
Migration	27	25.0	11	21.6	38	23.9
Disease and pest control	15	13.9	4	7.8	19	12.0
Total valid cases	108	266.7	51	241.2	159	258.5

Source: Field data (July 2015)

The data suggests a strong link between deforestation and climate change (79.9%) among both livelihoods groups. Evidence of climate change stems from local knowledge and experience of changes in weather elements, especially rainfall (BBC World Service Trust 2014; Yaro 2013), and not from the scientific knowledge of global warming. Associations of deforestation to less rainfall are due to local belief that trees attract rainfall. (BBC World Service Trust 2014)

*“Those days when it was about to rain, you will see vapour rising up from two ends of the forest and moving towards each other. When the vapour meets it rains.”* (88 year old woman)

*“The forest has a way of creating its own rain. Sometimes dark clouds converge over a portion of the forest and it rains only in that portion”* (Assembly man)

The emphasis on trees in explaining climate change is not limited to Otu Kwadwo but the rest of Africa as the BBC research revealed (BBC World Service Trust, 2014) People simply explain less rainfall as a direct result of rising temperature due to fewer trees. However, the interaction between deforestation and climate change goes deeper. Deforestation reduces carbon sequestration thus increases the concentration of GHG's which increases the earth's temperature. This leads to changes in temperature, rainfall among other climatic changes. These changes are however not peculiar to local communities that deforest but rather affect the whole world.

Similar to respondents in the BBC study, community members believe climate change occurs at the local level and affects the local community where deforestation is happening. They fail to realise the effects of global climate change and the contribution of industrialised nations to their climate problems

Nearly the same proportion of forest dependent workers and non-forest dependent workers indicated climate change as a major impact of deforestation (79.6% and 80.4%, respectively) which is not surprising as climate change affects the entire community. Drying of rivers and other water bodies (50.9%), poor soil quality (47.8%), people migrating out of the community and inability to control diseases and pests (12%) were amongst the common impacts of deforestation cited by the respondents. The easily identifiable changes in climate that came up were changes in rainfall and strong destructive winds.

Respondents also identified drying up of water bodies as a result of cutting down the trees that protected the water bodies from drying.

*“There used to be trees along the river banks that shaded it from the sunlight so it did not dry up as the area was always cool.”* (NTFP market woman)

*“Our river comes from the rocks in the hills. Since they cut the trees on the hill, the water does not flow as it used to. Sometimes it dries up”* (Assembly man)

For obvious reasons, farmers pointed out poor soil fertility as the third most important effect of deforestation while it ranked fourth for non-forest based livelihoods. The fact that poor soil quality even came fourth for non-forest based livelihoods is noteworthy because it depicts the diversification of livelihoods into forest dependent livelihoods such as farming, among people whose main livelihoods activity has nothing to do with forests. The Regional Manager of the forestry department predicts that the state of degradation and soil quality means *“in the not too distant future, we will have difficulty finding food to eat because the region is an important food basket for the country”* (Eastern Regional Manager, Forestry Department)

Loss of forest resources also featured prominently in the impact of climate change, in fact is ranked third by both livelihood groups. A reason for this could be the fact that people engaged in non-forest based livelihoods usually will not travel deep into the forest to look for NTFP’s but rather stick to the deforested area surrounding them whereas those whose livelihoods rely on forest generally use the forest more and venture deeper.

In referring to the loss of NTFP’s farmers referred to their non-availability in the forest *“Now when you go into the forest you don’t find mushrooms and snails like before, not even when they are in season.”* (Chairman of farmer’s cooperative)

*“I used to enjoy going to the farm because whenever we go, we harvested wild yam in cocoa farms, cassava, plantain, snails and sometimes even kill bush animals to cook but now that is no more”* (88-year-old female farmer)

Those involved in non-forest based livelihoods cited examples such as “previously, you could come out of your house and pick a bucket full of snails within minutes but now you have to go into the forest”. (Provision shop owner). This suggests a belief that there may still be NTFP stocks in the forest

In total, only 23.9% of respondents identified migration as a consequence of deforestation. The low frequency for migration could be due to the high rural urban migration in the municipality among the youth as noted in the 2014 municipal report, and thus was seen as a normal activity and not so much as a result of deforestation. Also it may be difficult for those who do not till the land to attribute poor soil to migration. Those who identified migration as deforestation induced explained that there have been years when yields were very poor which drove some inhabitants into more fertile areas in the region in the same way as Otu Kwadwo’s rich soil and bumper harvests attracted migrants in the past. Again, some youthful respondents claimed that the use of fertilisers to enrich the soils has made agriculture expensive and that they would rather look for jobs in Nsawam or Accra than stay in the village to farm.

This finding is consistent with Yaro (2013) which conducted a climate change study among some farmers in the municipality and revealed that consistent low farm productivity over the years, has made farming expensive because of fertilizers and pesticide usage and a risky gamble thus farmers have diversified their livelihood activities into more predictable off- farm activities such as trading. It also found reports of farmers quitting the farm and migrating to the capital city of Accra in search of jobs.

The loss of the forest’s ability to control disease and pest control effects of deforestation was difficult to tell for some respondents because farmers use a lot of chemicals to fight diseases and pests. Interestingly, two respondents also talked about the loss of biodiversity in terms of some species of mushrooms, snails and birds that have become

extinct. This tells the depth of knowledge of the forest. Some respondents recounted how the loss of forests have halted educational tours to the village forests by some foreign students. A common theme that runs through the responses to the impact of deforestation was poverty. The loss of NTFP's has necessitated the purchase of food items that were previously not part of the respondents' budget. Poor harvest and crop failures bring hardships to farmers. Deforestation thus exacerbates rural poverty and makes rural livelihoods risky and unsustainable (Acheampong and Marfo, 2011).

#### **4.4.6.1 Climate Change Awareness**

This section of the report discusses respondents' knowledge on climate change. Most of the respondents were aware of climate change (86.9%). A slightly higher proportion of the non-forest dependent workers (15.4%) have never heard of the term "climate change" compared to 12% of the forest dependent workers. It was only 2.9% of the respondents with no education and 22.2% each of primary school leavers and junior high school leavers that had not heard of climate change.

The question on knowledge of climate change only sought to know the respondents' familiarity with the term "climate change" and not their understanding of what it means. A majority of respondents who answered in the affirmative to being familiar with the term "climate change" were quick to add that they heard it on the radio but were not knowledgeable about it. It must however be mentioned that most African local languages, including Twi, Ewe and Ga which was used for the study, have no equivalent for 'climate change' and thus explained it in terms of changes in local weather. Knowledge of the term climate change was in terms of literal translation to mean changes in weather pattern such as rainfall and heat. This is not peculiar to Otu Kwadwo. A BBC study discovered similar patterns across Africa among both the elite and illiterate

(BBC World Service 2010). The localization of climate change to mean changes in local weather is not entirely problematic. Localizing it will make it easier to mobilize communal effort and support for afforestation initiatives and climate smart decisions such as recycling because they will be seen as taking action to protect themselves and their livelihoods rather than the bigger picture of saving the world from climate change.

This seemingly high level of awareness of the term climate change is thanks to the proliferation of radio stations in Ghana especially those that transmit in the local languages. In the rural areas, radios are the most affordable and easily accessible form of mass media. It is also the source of the loose interpretation of climate change to mean changes in weather.

Whereas 86.9% of respondents had heard about climate change, when asked to indicate if they have noticed any changes in the climate, 89.4% of the respondents revealed they had noticed changes in the weather conditions within the last 15 to 20 years. In all, 2.5% of respondents who had noticed changes in their climate had not heard of the term “climate change”. About 19.2% of non-forest dependent workers compared to 6.5% of forest dependent workers have not noticed any weather changes. This difference was significant at 5% as a Pearson's chi-square test resulted in a p-value of 0.014

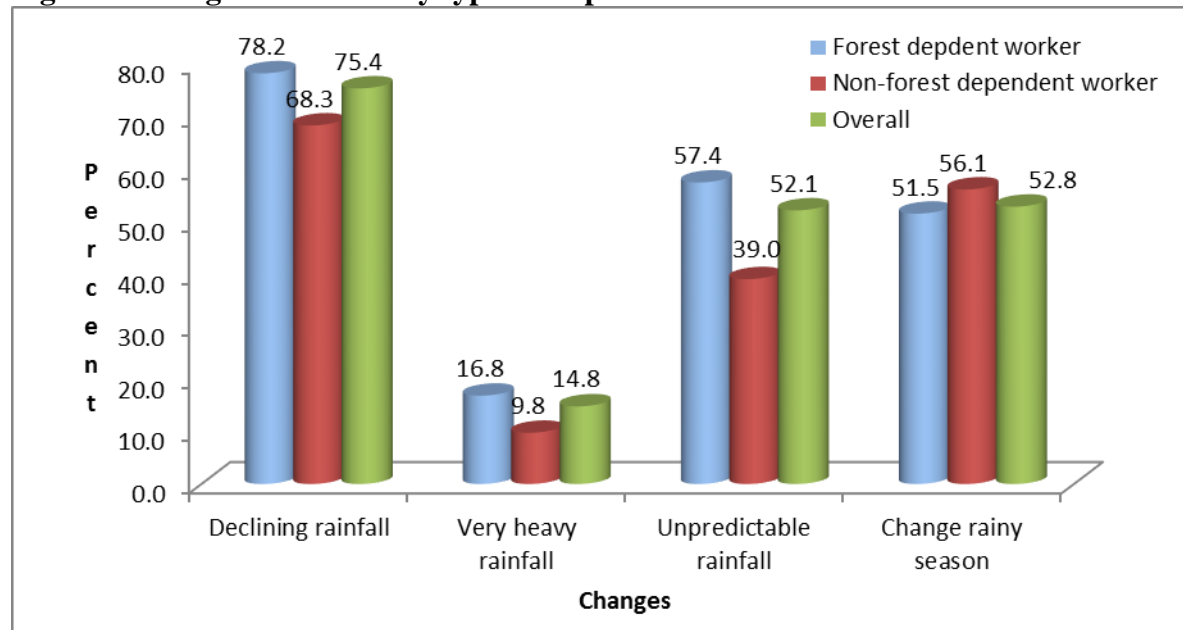
This finding is consistent with that of BBC World Service Trust, (2014) which found that respondents in the African nations they studied, had good knowledge of the changes they had experienced in their climate but had no scientific or formal knowledge about it.

#### **4.4.6.2 Identified Changes in Local Climate.**

Changes in rainfall, temperature, wind and other extreme weather conditions make up local accounts of climate change. With regards to rainfall, Figure 4.8 below indicates that most of the respondents observed change in the frequency of rainfall (75.4%), a

change in rainy season (52.8%) and unpredictable rainfall (52.1%). A few respondents however mentioned very heavy rains as part of changes in weather conditions within the past 15-20 years (14.8%). A lot more respondents involved in forest dependent livelihood activities stated declining rainfall (78.2%) and unpredictable rainfall (57.4%) as some of the observed changes in the weather compared to 68.3% and 39% of those involved in non-forest dependent livelihood activities as seen in Figure 4.7.

**Fig 4. 8: Changes in rainfall by type of respondent**



Source: Researcher's field data (2015)

Farmers disclosed that the usual start of the rainy season in April changed to June in recent times but reverted to April recently. In 2015, they planted their crops in anticipation of April rains which never came so all their crops died. This is how they explained changes in the rainy season and the unpredictability of rainfall.

*“It used to rain immediately rain clouds gathered and turned very dark but lately it takes a long time for the rains to fall after the clouds gather. Sometimes the wind blows the rain clouds away and sends the rains somewhere else”* (88-year-old woman)

There has been a general decline in rainfall and isolated cases of very heavy rainfall in the past 15 – 20 years. These findings are consistent with findings in Yaro (2013). (See appendix 4).

Table 4.9 below presents the findings on respondents ‘observed changes in the local temperature over the past 15-20 years. Close to three-quarters of the respondents indicated the weather is hotter than before whilst about 47.6% and 39.9% stated they have observed longer hot seasons and extreme heat.

**Table 4.9: Changes in temperature by type of respondent**

Change	Forest dependent worker		Non-forest dependent worker		Overall	
	No.	Percent of cases	No.	Percent of cases	No.	Percent of cases
The weather is hotter than before	76	75.3	31	73.8	107	74.8
Longer hot season	50	49.5	18	42.9	68	47.6
Extreme heat	40	39.6	17	40.5	57	39.9
Total valid cases	101	164.4	42	157.1	143	162.2

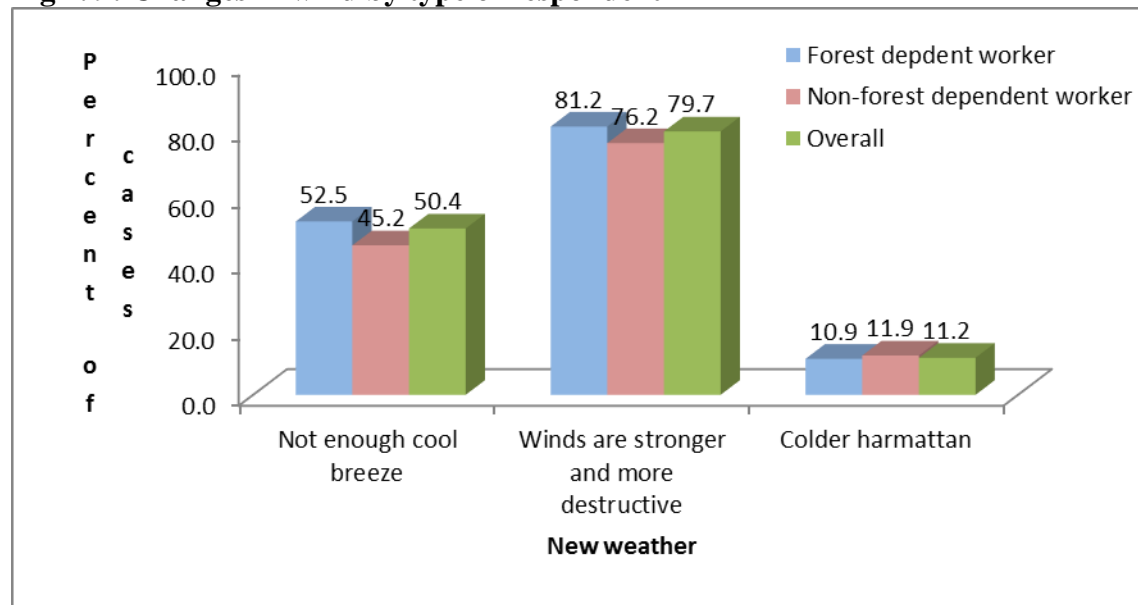
Source: Researcher’s Field data (2015)

Some respondents cited extremely warm nights when they had difficulty sleeping. Again the heat is rather merely associated with lack of trees to provide shade and blow cool air and not with the global concentration greenhouse gases (GHG’s) that has increased global temperatures.

Respondents also indicated the changes in wind patterns over the past 15-20 years. The results in table 4.8 show that nearly 80% of the respondents who have observed changes

in the weather condition revealed there are stronger and more destructive winds than before. Just a small proportion of these respondents indicated they experience colder harmattan (11.2%). However, about half of them indicated there has not been enough cool breeze in recent years (50.4%).

**Fig 4. 9: Changes in wind by type of respondent**



Source: Field data (2015)

Respondents blamed the lack of trees to serve as windbreaks for the destructive wind. According to them they did not experience such strong winds in the past when there were a lot of trees. The winds are said to break trees, and rip off roofing sheets of houses.

About half of those who indicated that they had noticed changes in the weather also noted that extreme events such as drought and wind storms have been occurring. Of the half, about a quarter of these respondents also said there have been floods (24.7%). On the contrary, about 25.4% of these respondents indicated they have not witnessed any extreme event as a result of changes in weather conditions.

Presented in Table 4.10 is a complete list of the extreme events respondents have experienced.

**Table 4. 10: Occurrence of extreme events by type of respondent**

Extreme events	Forest dependent worker		Non-forest dependent worker		Overall	
	No.	Percent of cases	No.	Percent of cases	No.	Percent of cases
Drought	50	50	21	50.0	71	50.0
Floods	25	25	10	23.8	35	24.7
Wind storms	48	48	23	54.8	71	50.0
None	27	27	9	21.4	36	25.4
Total valid cases	100	150	42	150.0	142	150

Source: Student's field data (2015)

While anecdotes of droughts and wind storms were given in support of claims of the occurrence of these extreme events, respondents who said they had noticed floods often referred to some flooding event in the past or a recent flooding of the Pompon River. According to accounts the flooding of the Rivers cut off the community for a whole day until the water receded. One would have thought that flooding of this nature will come readily to mind but the low frequency recorded for flooding makes this study conclude the evidence is inconclusive.

The main causes of weather changes as identified by the forest dependent group and non-forest dependent group respectively are: act of God (36.6% versus 35.7%), deforestation (33.7% versus 31%), immoral behaviour (21.8% versus 11.9%), global climate change (6.7% versus 11.9%) and part of normal climate change (1.2% versus 9.5%)

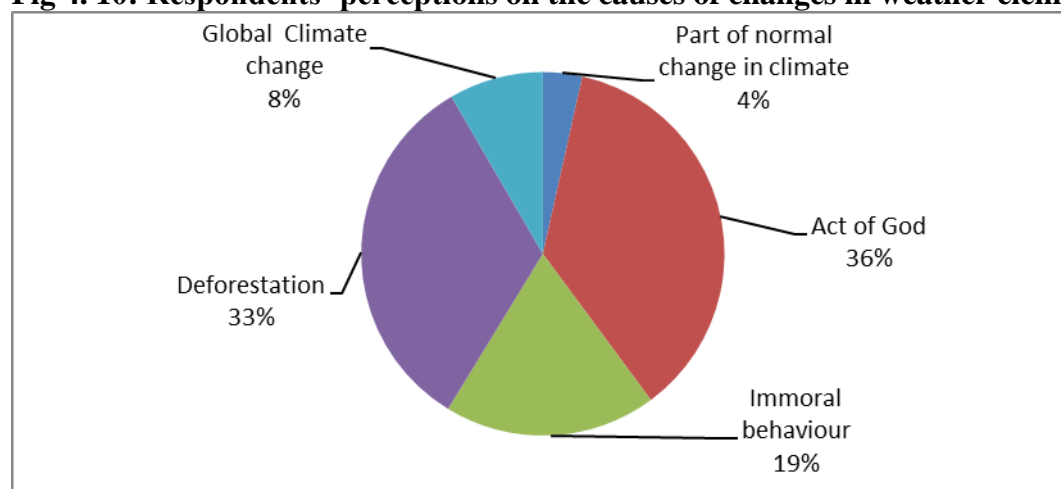
Despite the assertion that people with higher levels of education are better informed about climate change only 11.9% of non-forest dependent livelihood respondents who had higher educational levels identified global change in climate and normal change in climate as causes as against 6.7% forest dependent livelihood groups. The two groups of

respondents had different views on the causes of these weather changes. The divergent views were found to be significant at 10% (p-value of 0.084).

#### 4.4.6.3 Perceptions on causes of changes in local climate

To determine the local knowledge of the causes of climate change, respondents were asked to indicate their perceptions on the causes of the changes they have witnessed in the local climate. These perceptions are presented in figure 4.10

**Fig 4. 10: Respondents' perceptions on the causes of changes in weather elements**



Source: Field Data (2015)

These findings are similar to those of the BBC World Service (2014) which found that most Africans fail to associate weather changes or environmental issues including deforestation to climate change in the world. The tendency is to blame themselves individually or collectively as responsible for degrading the environment, in this case the forest, thereby causing the changes in the weather. (BBC World Service, 2014). Act of God, immorality and deforestation make up 88% of reasons advanced for changes in local weather. Very few people are conscious of global climate change (climate change 8%, normal change in climate 4%)

Otu Kwadwo has 689 Christians, 3 Muslims, 2 Traditionalists and 11 people belonging to other religions. Only 61 people have no religion (GSS, 2010). The 36% of respondents

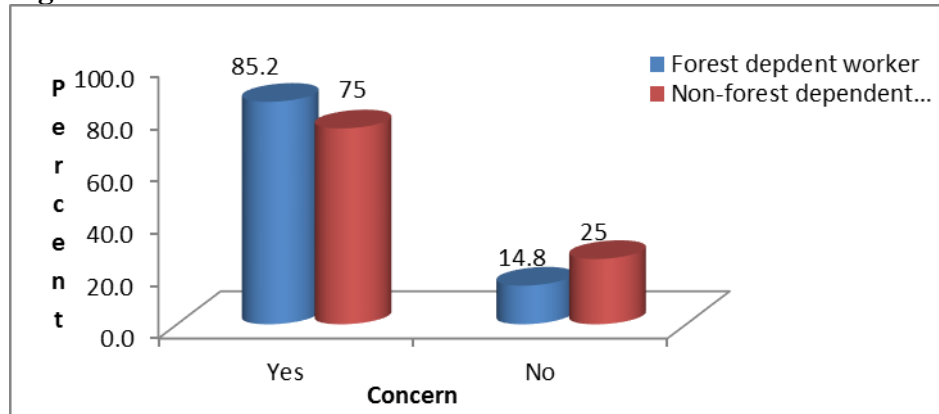
who believe deforestation as an act of God is therefore not surprising. Respondents supported their answers with quotes from the bible that predicted changes in season. For those who believed immorality was the cause of changing weather, the weather conditions were God's form of punishment. Women and rural populations have been found to be very religious and tend to explain climatic changes along religious lines (BBC, 2014). The findings indicate that 22.7% males compared to 51.2% believed the weather changes were an Act of God while 26.7% females as against 10.3 males blamed climate change on immorality. The findings therefore confirm the high religiosity of women and its influence in their explanation of climatic changes.

#### **4.5 Response to Deforestation**

To complete the DPSIR analysis of deforestation in Otu Kwadwo, the study probed into the response to deforestation in Otu kwadwo at the level of the two livelihood groups, community and government levels.

##### **4.5.1 Concern about deforestation among livelihood groups**

Close to 82% of the respondents were concerned about the conversion of forest to other uses. Majority of the respondents whose main livelihood activity was forest dependent (85.2%) were worried about the conversion of forest land to other uses as compared to those whose main economic activity was not dependent on forest (75%). The differences in concern for deforestation produced a Pearson's chi-square test p-value of 0.117 which is marginally significant. Figure 4.11 shows the level of concern about deforestation among the two livelihood groups.

**Fig 4. 11: Concern about the conversion of forest to other uses**

Source: Field Data (2015)

Respondents who expressed concern about deforestation cited negative effects that the loss of trees had brought them such as destructive winds, heat due to lack of shady trees, poor soil quality, and drought. Only a few were worried that their children will not benefit from the forest the same way they did which is disappointing considering that 90% of respondents had children with some having as many as 11. For those who were worried that their children will not benefit from forest, they even cited educational reasons as seen below:

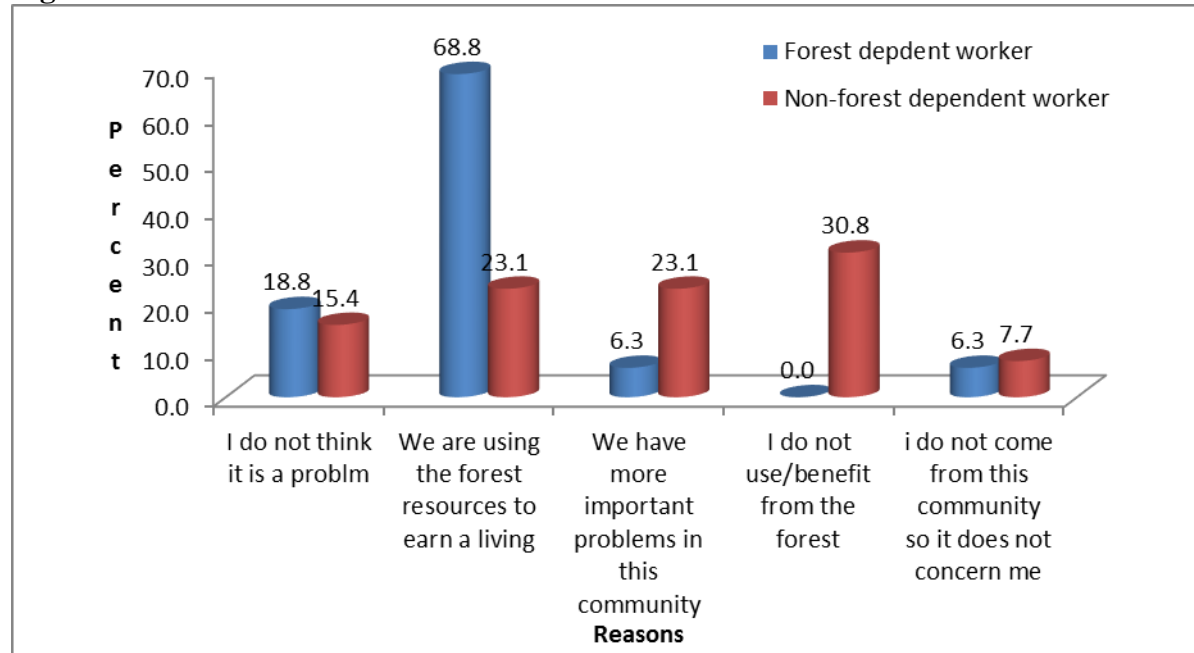
*“My grandchildren have no idea what a real forest looks like and they have never seen big timber trees like Odum and Mahogany... our grandchildren could have also gone there to learn what they [white students] were learning.”* (88-year-old woman)

Others were also concerned purely on sentimental grounds. They recalled how easy it was to find fruits, snails and mushrooms around the community. In all concerns were based on welfare benefits of forests that had been reduced or were lost due to deforestation.

Almost an equal number of non-residents belonging to both livelihood groups believed that the deforestation problem did not concern them since they are not natives of Otu Kwadwo. This supports the view that non-natives have little incentive to conserve resources in foreign communities.

Having established the importance of forest resources to the livelihoods of both groups, the study probed into the reasons why some respondents were unperturbed about the spate of deforestation. The findings of the probe are presented in figure 4.12 below.

**Fig 4.12: Reasons for lack of concern about deforestation**



Source: Field Data (2015)

#### 4.5.1.1 Response to deforestation among the two livelihood groups

Over 58% of the respondents were not doing anything to stop deforestation. However, a significant proportion of the respondents are involved in tree planting (24.4%) and awareness creation through education (8.8%). A lot more forest dependent workers planted trees than non-forest dependent workers (28.7% and 15.4%, respectively). This difference was significant at 5% ( p-value of 0.019). Table 4.11 gives a detailed distribution of the activities of respondents to stop deforestation by category of livelihood activities. Also, a lot more female respondents (65.8%) were doing nothing about deforestation than male respondents (50.6%). However, a greater proportion of the

females (29.1%) planted trees than the males (19.8%). These differences were found to be significant at 1% as a Fisher's exact test of significance gave a p-value of 0.000.

**Table 4.11: Activities of respondents to combat forest land conversion to non-forest land**

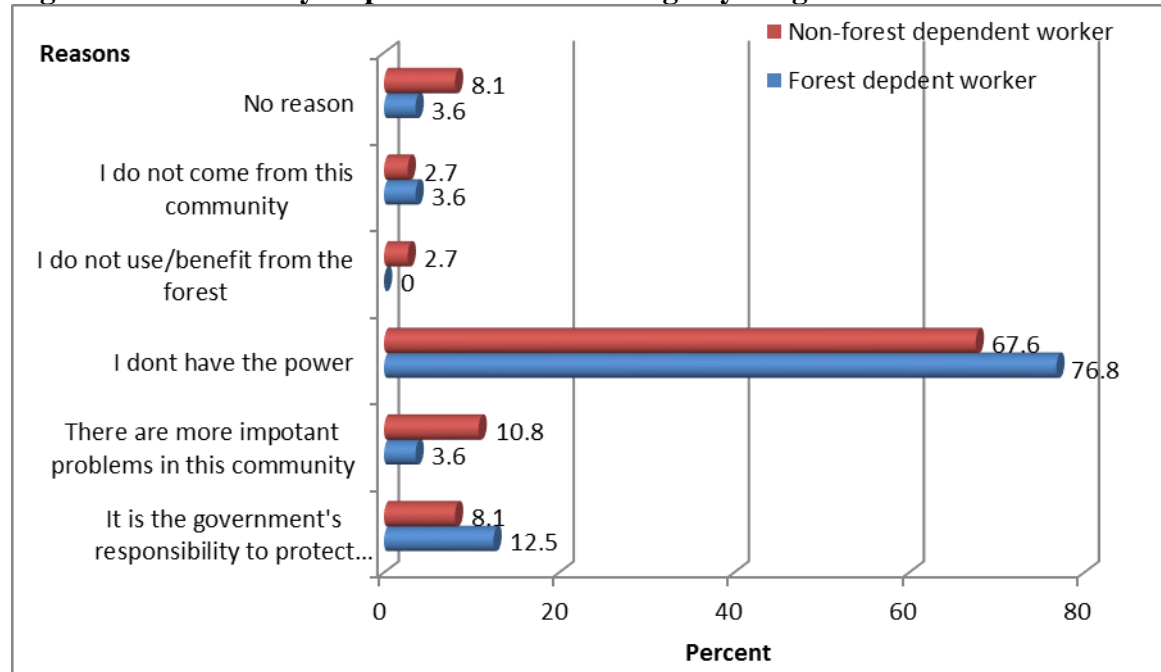
Activities	Forest dependent worker		Non-forest dependent worker		Overall	
	No.	%	No.	%	No.	%
Tree planting	31	28.7	8	15.4	39	24.4
Educating people	8	7.4	6	11.5	14	8.8
Avoiding slash and burning farming	10	9.3	0	0	10	6.3
Switched from firewood to LPG	1	0.9	1	1.9	2	1.3
Practicing agro-forestry	2	1.9	0	0	2	1.3
Nothing	56	51.9	37	71.2	93	58.1
Total	108	100	52	100	160	100

Source:Field Data (2015)

Apart from two respondents, a farmer and a public servant, both of whom had tertiary education, and had planted substantial areas of trees, the rest had planted trees mainly to shade cocoa farms or around their house for shade. As is the practice in most rural areas, visitors are mostly hosted under shady trees in the compound, hence the interest in tree planting around the house. The low level of tree planting in light of the havoc caused by strong winds goes to say that trees were planted to serve individual household needs rather than as a preventive measure to deforestation or adaptive measure for climate change. The fact that only 2 out of a sample of 160 were using liquefied petroleum gas (LPG) for cooking implies a huge reliance on firewood and charcoal which means the forest will see further exploitation in the coming years especially for fuelwood.

For those who were doing nothing about deforestation, figure 4.13 gives the reasons behind their inaction.

**Fig 4.13: Reasons why respondents are not doing anything about deforestation**



Source: Field data (2015)

The major reason for doing nothing about deforestation is the sense of powerlessness (73.1) whereas others saw it as the responsibility of the government (10.8%). A higher proportion of forest dependent workers were of the view that forest protection was the government's responsibility than non-forest dependent workers: 12.5% and 8.1, respectively. On the other hand, relatively a lot more non-forest dependent workers as compared to forest dependent workers believed there were more important problems in the community than deforestation: 10.8% and 3.6%, respectively.

An explanation for the sense of powerlessness is the fact that respondents have a fear of chainsaw operators because as the Regional Manager for the forestry department puts it *“they [illegal chainsaw operators] will deal with you if they out-number you especially*

*when you confront them alone. Now we [Eastern Region Forestry Division] have a joint patrol team made up of the police and army”*

The regional manager also explained that community members often reforestation as a daunting task taking into consideration the grave state of the forest. He added that high poverty levels coupled with the fact that timber seedlings are not supplied for free also accounts for the low rate of tree planting.

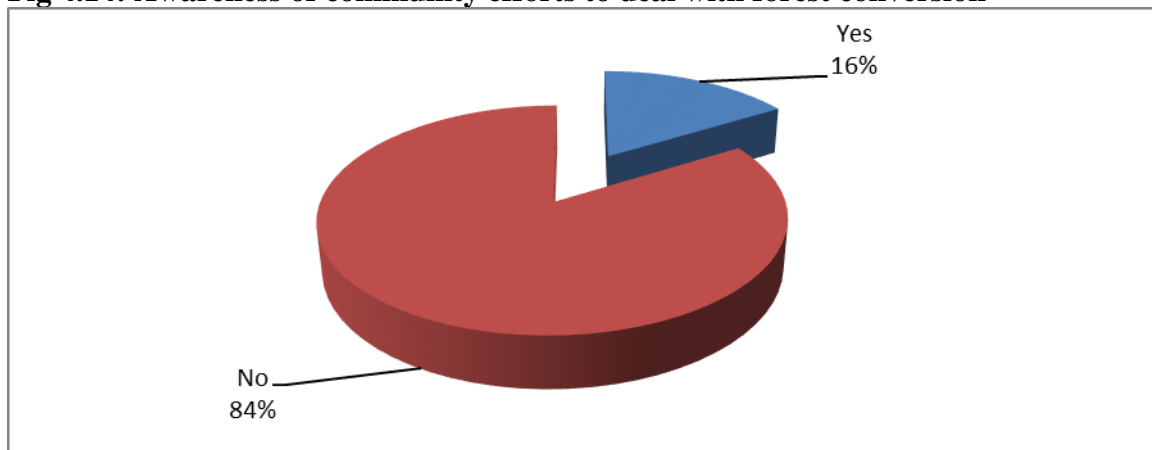
Surprisingly, few people thought it was the government’s decision to do something about deforestation in the community. This can be attributed to the tendency to blame themselves for deforestation and climate change conditions and impacts in the community. This acceptance of responsibility can be harnessed to start community projects to curb deforestation and climate change.

In addition to the lack of individual response to deforestation community response was also lacking. Majority of the respondents (83.8%) were not aware of any community efforts to deal with forest conversion. A slightly higher proportion of non-forest dependent workers (19.2%) had some knowledge on the efforts of the community to deal with forest conversion than forest dependent workers (14.8%).

#### 4.5.2 Community and Government response to deforestation

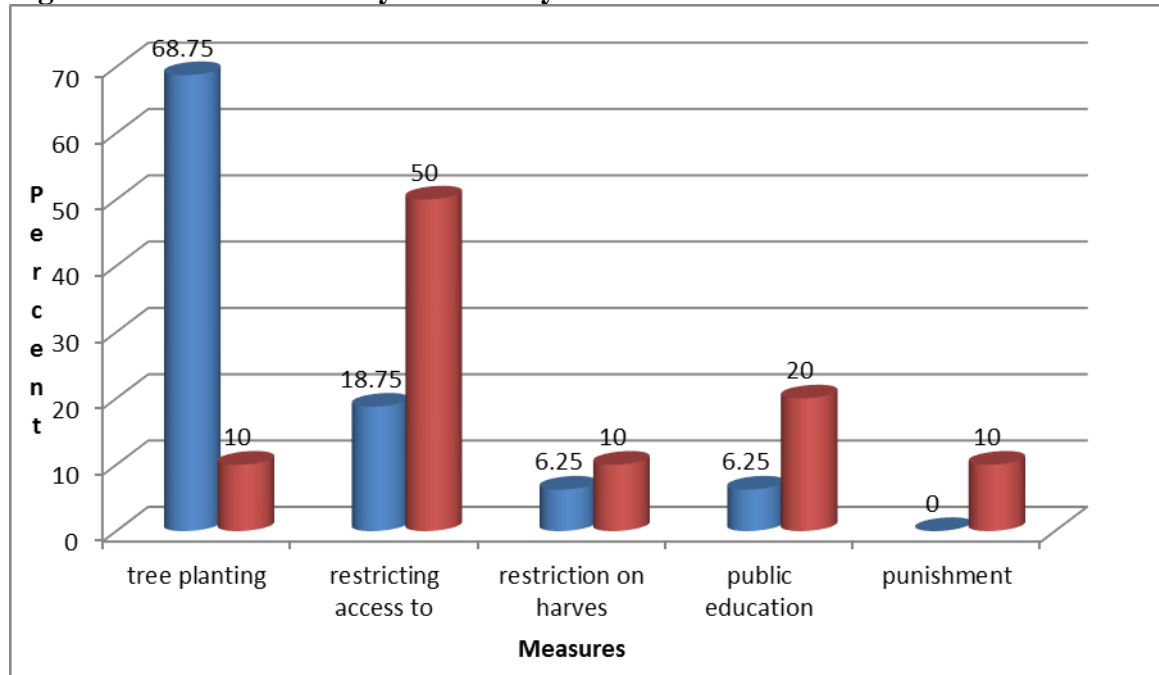
To understand the community's response to deforestation, the study sought to determine respondents' level of awareness of efforts by the leadership of the community to deal with deforestation. The findings in figure 4.14 indicate that very few respondents (16%) were aware of any efforts by the community to deal with deforestation. These findings were verified through an in depth interview with the village head. Figure 4.13 shows how aware respondents were on communal efforts to combat deforestation.

**Fig 4.14: Awareness of community efforts to deal with forest conversion**



Source: Researcher's Field Data (2015)

The main measures undertaken by the community to deal with forest conversion, according to those who were aware of the community measures, were tree planting (46.2%) and restricting access to forest (30.8%). A few other respondents indicated public education (11.5%), restrictions on harvesting forest trees (7.7%) and punishment (3.9%). Whereas about 68.8% of the respondents engaged in forest dependent activities were aware of tree planting as means to deal with forest conversion by the community, half the non-forest dependent workers were aware of restricting access to forest. These differences were found to be significant at 5% (p-value of 0.017).

**Fig 4.15: Measures taken by community to deal with forest conversion**

Source: Field Data (2015)

The study found the information about measures to deal with deforestation to be very imprecise; some claim it was started in the past, others refer to patrols and arrests by the regional forestry department (which is not a community initiative). The Assembly man explained that there used to be regulations on forest use but no one adhered to them.

Respondents blamed corrupt forestry officials and police patrol teams who take bribes from chainsaw operators as the reason for the lack of enforcement of restrictions. A farmer who also runs an illegal chainsaw business confessed that at the beginning of the year all illegal chainsaw operators contribute money to be given to officers at the regional forestry department so that they do not disturb them. Another illegal chainsaw operator admitted that they know their activities are bad but then if even if they stop cutting trees, forestry official and the police will connive with other illegal operators to cut the trees.

The Village head insists that they do punish people who cut trees illegally in the community. He lamented on how the current land holding system which vests lands in

the hands of families and individuals has resulted in the individual and family ownership of most of existing forests and deforested lands. It therefore means that even if village took the decision to replant and preserve secondary forests, they will be limited to the small parcels of communal forest since it will be difficult forcing individual forest owners to replant their forests. Similarly, majority of the respondents (68.1%) were not aware of any policies advanced by the government to prevent deforestation in Otu Kwadwo. Not much difference was found between the awareness of non-forest dependent workers (69.2%) and forest dependent workers (67.6%) of policies or plans by the government to curb deforestation (p-value of 0.835). The reality is that there are no government plans or policies being implemented in the community. Those who claimed there was some government response referred to patrols and arrests by the forestry patrol teams in the 1980's and 1990's when logging was at its peak in the area. The Regional Forestry Manager explained that forest guards only protect forest reserves. In off-forest reserves, patrol is carried out by the forestry officers and police sometimes with the help of the army and usually based on tip off. He mentioned that they take advantage of community durbars to educate people about the evils of deforestation. Though they encourage community tree planting projects, he admitted that they do not have the funds to provide seedlings to the communities. He added that most of these communities are rural and poor so asking them to go to Kumasi (that is the only place where seedlings of timber species are nursed) to buy seedlings at between GHC1-GHC 2 is difficult.

## 4.6 Hypothesis Testing

The study made three hypotheses on the potential response the two livelihood groups to monetary payments aimed at providing funds for regenerating and preserving secondary forests in the community. The results of the hypotheses testing are discussed in this section.

### 4.6.1 Testing of Hypothesis 1

Hypothesis 1

Ho: There is no difference between the mean willingness to pay values for individuals whose main livelihood activity is forest dependent and those whose main livelihood activity is not dependent on forest resources.

Ha: Mean willingness to pay to preserve secondary forests will be higher for people whose main livelihood activities are forest dependent

Table 4.12 shows the results of a two-sample t test was used to determine whether there are any differences in the mean amount respondents were willing to pay every month to regenerate and preserve forests. The two groups of respondents are people whose main livelihood activity depends on forest and those whose main livelihood activity does not depend on forest. Twelve respondents made up 24 forest dependent respondents and 8 non-forest dependent respondents were not willing to pay anything to preserve the secondary forests. The forest dependent main livelihood group is willing to pay GH¢ 1.01 more than those whose main livelihoods do not depend on forests. Non-forest dependent livelihood group are willing to pay GH¢ 7.54 on average for forest regeneration and preservation compared with GHC 8.55 for respondents whose main livelihoods depends on forests. The p-value obtained after running the test for the null

hypothesis is 0.3046 which is not statistically significant. Thus, the null hypothesis which states that there is no difference between the mean amounts the two respondent groups are willing to pay fails to be rejected. This study therefore concludes both forest dependent and non-forest dependent livelihood groups are willing to pay a mean amount of GHC 8.2 per month to regenerate and preserve the secondary forest in Out Kwadwo.

**Table 4.12: Two-sample t test for willingness to pay before orientation by respondent group**

Group	N	Mean	Standard Error	Standard deviation	95% Confidence interval	
Forest dependent worker	98	8.55102	0.627097	6.207947	7.306406	9.795635
Non-forest dependent worker	50	7.54	0.611595	4.324633	6.310953	8.769047
Combined	148	8.209459	0.464224	5.647531	7.292044	9.126875
Difference		1.01102	0.981297		-0.92836	2.950403

P-value ( $H_0$ ) = 0.8477

P-value ( $H_a < 0$ ) = 0.1523

P-value ( $H_a > 0$ ) = 0.3046

#### 4.6.2 Testing of Hypothesis 2

Hypothesis 2

Ho: There is no difference between the mean willingness to pay values after receiving information about forest ecosystem services, for individual's whose main livelihood activity is forest dependent and those whose main livelihood activity is not dependent on forest resources.

Ha: Difference in mean willingness to pay after receiving information on forest ecosystem services  $\neq 0$

Table 4.13 below shows the results of a t-test for hypothesis 2. The respondents were given information on forest ecosystem services and were then asked to indicate an amount they would be willing to pay every month to regenerate and preserve the secondary forests in the community. All the respondents were now willing to contribute something towards the project. The minimum amount quoted was GH¢ 3 (5%) whilst the maximum was GH¢ 25 (0.6%). The results show that forest dependent workers, on average, were willing to contribute a higher amount of GH¢ 10.96 with a standard deviation of 0.54 as compared to GH¢ 10.65 with a standard deviation of 0.78 for the non-forest dependent workers. It is worthy to note that the WTP values of GH¢ 10.96 and GH¢ 10.65 recorded after receiving information about FES are higher compared to the mean WTP values obtained before information on FES of GH¢ 8.55 and GH¢ 7.54. The differences in means obtained after receiving information on FES were not statistically significant as a t-test between the amount the respondents were willing to pay and the type of respondent gave a p-value of 0.7447. Thus, we fail to reject the null hypothesis that there is no difference between the mean amounts the respondents are willing to pay after receiving information on forest ecosystem services. We therefore conclude that after receiving information on FES, both forest dependent and non-forest dependent livelihood groups are willing to pay a higher mean amount of GH¢ 10.86 per month compared to the previous amount of GH¢ 8.2, to regenerate and preserve the secondary forest in Otu Kwadwo.

**Table 4.13: Two-sample t-test for willingness to pay after receiving information about Forest ecosystem services by respondent group**

Group	N	Mean	Standard Error	Standard deviation	95% Confidence interval	
Forest dependent worker	108	10.96296	0.536957	5.580215	9.898509	12.02742
Non-forest dependent worker	52	10.65385	0.788724	5.687567	9.070417	12.23727
Combined	160	10.8625	0.442663	5.59929	9.988243	11.73676
Difference		0.309117	0.947771		-1.56282	2.181051

P-value ( $H_0$ ) = 0.7447

P-value ( $H_a < 0$ ) = 0.6276

P-value ( $H_a > 0$ ) = 0.3724

#### 4.6.3 Testing of Hypothesis 3

Hypothesis 3

$H_0$ : There is no difference between the mean willingness to pay before and after receiving information about forest ecosystem services.

$H_a$ : Enhanced knowledge of forest ecosystem services will increase the mean willingness to pay to regenerate and preserve secondary forests.

The mean for the entire sample before the respondents were given information on forest ecosystem services is GH¢ 8.21 with a standard deviation of 0.46. A higher mean for the

sample of GH¢ 10.82<sup>3</sup> with a standard deviation of 5.55 was obtained after the awareness creation.

**Table 4.14: One-way ANOVA test to determine the significance of the difference in mean WTP values before and after FES information treatment.**

Source	SS	df	MS	F	Prob > F
Between groups	235.2013	10	23.52013	0.72	0.7012
Within groups	4453.305	137	32.50588		
Total	4688.507	148	31.8946		
Chi-squared(9)	=	16.6333	P-value	=	0.055

A one-way analysis of variance test (ANOVA) was used to test the significance of the difference between the mean WTP amounts before and after respondents received information on forest ecosystem services. The entire model was significant at 10% given a p-value of 0.055. A p-value of 0.7012 was found for the differences between these two amounts the respondents were willing to pay. Thus the null hypothesis which states that there is no difference between the two means fails to be rejected. We therefore conclude that, enhanced knowledge of forest ecosystem services motivates higher willingness to pay values to regenerate and preserve secondary forests.

Reasons accounting for the unwillingness of some respondents to pay to regenerate and preserve the secondary forest as well as the low WTP values in the first WTP question include the nature of land tenure system which has demarcated primary and secondary forests among family and individual owners thus making respondents unwilling to

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<sup>3</sup> Some respondents were not willing to pay for forest regeneration and preservation before the information on forest ecosystem services was given. These 12 respondents were automatically excluded by STATA in calculating the comparative mean after this information was given.

reforest another person's land and also leaving very little communal lands which respondents believe will make very little impact when reforested. Also, previous experiences with illegal chainsaw operators who have fallen trees that belonged to individuals without permission and perceptions that once the planted trees are of age the government will claim of ownership of the timber trees account for the unwillingness by some respondents to pay to preserve the forest as well as the low WTP values recorded before the information on FES was given.. The Forestry manager explained that timber trees growing wildly are all vested in the state. Individuals can only cut them if they are situated in off-reserve areas to make way for farms. They can however not process trees that have been fallen in an off-reserve area for timber without authorization from the forestry department. Without the proper authorisation, the right thing to do when one fells a tree in an off-reserve area is to call the forestry division to process it for timber so that the state does not lose timber revenues. However, trees planted by an individual or a community belong exclusively to that individual or community and the government has no control over them.

For any forest conservation project to be successful, the value of forest should be more valuable as forest than in any other form. Some studies reveal that with knowledge of FES, forests were sometimes seen as priceless

## CHAPTER FIVE

### SUMMARY OF FINDINGS, RECOMMENDATION AND CONCLUSIONS

#### 5.1 Introduction

This chapter summarizes the main findings of the study in relation to the objectives it set out to achieve. It begins with a brief summary of the goal of the study, literature pertaining to the subject, the methodology used in the study, before summarizing the main findings. It then concludes on the study and makes recommendation for individuals, the community and government concerning deforestation and climate change. It ends with recommendations on areas that could be explored for future research purpose.

#### 5.2 Summary of Findings

Forests in Ghana have undergone exploitation since colonial times, to support the country's economy and also provide food, shelter, medicine among other needs to Ghanaians. However, the discharge of forest ecosystem services such as carbon sequestration maintains order in the world's climate and supports human lives and biodiversity all of which ensures human survival. The loss of forest ecosystem services is a major factor driving global warming and climate change worldwide. For every tree that is cut, there is an i trade-off with forest ecosystem services in that, it reduces the ability of the forest to provide vital ecosystem services. Thus, in managing the world's forests, solutions should seek to create a middle ground where forest use and conservation results in win-win outcomes. REDD+ is the latest intervention to curb deforestation around the world by motivating forest owners to preserve forests in return for monetary compensation.

In Ghana, agricultural use accounts for 50% of deforestation while the use of forest trees for fuelwood takes up 35%. This implies that the quest for livelihoods is the singular most important factor in deforestation in Ghana. Forest is of utmost importance in the livelihoods of rural populations because their main livelihood activity which is agriculture depends on forests. Rural households also rely on forests for NTFP's that provide basic household food and shelter needs. The importance of forests for daily livelihood needs makes their preservation under REDD+ unattractive to rural dwellers despite the monetary reward. For their own survival, however, forest-dependent communities need to preserve and properly manage their forests to sustain their livelihoods and those of generations to come.

The rural economy has become increasingly diverse in response to diversity in livelihood activities and opportunities. There are now increasing numbers of rural forest dwellers whose main livelihood activity is independent of forest resources. Despite the diversity in the rural economy, there is still a high dependence on basic forest services, especially its provisioning services that are used to diversify income streams and livelihood options. This study was embedded in the sustainable livelihood theory which posits that livelihoods are only sustainable if they can withstand external pressures, preserve the natural resource that supports them and also ensure the availability of the resource for use by future generations. Borrowing from the sustainable livelihoods theory, the study sought to examine the phenomena of deforestation and climate change which threatens the sustainability of livelihoods in rural forest communities.

In the fight against environmental degradation such as deforestation, there have been growing calls to inculcate the local knowledge of the people who live around and use the natural resources on a daily basis for their livelihoods. These calls are due to the growing recognition that forest dwellers possess very vital knowledge that may not necessarily be

reflected in scientific knowledge, but which informs their decisions to degrade or protect the environmental resource

The goal of this study is to understand the local knowledge of deforestation held by forest dwellers whose main livelihood may or may not depend on forest resources. The aim is to find out if there exist differences in the local knowledge of the drivers, pressures, state, impact and response to deforestation and climate change among individuals engaged in different main livelihood activities that may depend on entirely the forest or be largely independent of forest resources. The study also sought to explore whether the current knowledge of deforestation and climate change held by respondents will induce some level of willingness to pay to regenerate and preserve a secondary forest in the community and more importantly if further knowledge of forest ecosystem services will increase willingness to pay to preserve and the secondary forest.

Based on the importance of forests in sustaining rural livelihoods, the study makes two hypotheses First, is that individuals whose main livelihood activity depends on forest resources will be willing to pay more to regenerate and preserve the secondary forest compared to individuals whose main livelihood activity does not depend on forests. Second, is that further knowledge of forest ecosystem services will not produce a difference in mean willingness to pay values for individuals in both livelihood groups.

The methodological triangulation approach was used to design a descriptive and exploratory research which employed both quantitative and qualitative data to examine deforestation in Otu Kwadwo. A total of 160 individuals aged at least 25 and have lived in the community for at least 10 years were sampled and interviewed using an individual survey questionnaire.

The data showed evidence of about 45% versus 55% diversification of the rural economy of Otu Kwadwo in terms of agricultural activities and non-agricultural activities,

respectively, both as main and secondary livelihood activities. Between forest dependent and non –forest dependent livelihood activities, the diversity was about 67% - versus 33%, respectively, indicating the importance of forest resources to majority of rural livelihood activities including off-farm livelihoods.

### **5.2.1 Difference in knowledge of Deforestation**

There were similarities between the two livelihood groups in terms of their knowledge of the drivers, pressures, state and impact of deforestation. Whereas there were slight differences in the ranking of indicators under each concept of the DPSIR framework, these differences were not substantial to indicate a difference in knowledge but rather revealed differences in importance of certain qualities and services e.g. the importance of soil quality to agricultural livelihoods. The uniformity in depth of knowledge of deforestation across both groups is attributable to the diversity in rural livelihoods such that more than half of respondents had secondary income activities, most of the time totally different from the main livelihood activity and having some level of dependence on forest resources. For those whose main livelihoods depends on forests such as farmers, livelihood diversity is mostly into non-farm and non-forest dependent activities that serve as insurance in times of poor harvest and crop failure due to extreme weather. Those whose main livelihood activities were independent of forest exploited forest resources such as wild fruits, to complement their incomes and supplement household food needs. There were therefore no significant differences between local knowledge of deforestation held by individuals engaged in forest –dependent main livelihood activities and those whose main livelihood activities do not depend on forest resource.

### **5.2.2 Difference in Knowledge of climate change**

On knowledge of climate change among the two livelihood groups, again both groups did not show much difference in their local experiences and perception of the problem. A slightly higher percentage of non-forest based livelihoods, about 3.4%, had never heard of the term climate change. Interestingly whereas only 2.9% of respondents with no education were ignorant about climate change the proportion was much higher at 22.2% among primary school and junior high school leavers. There were statistically significant differences in observance of climate change in the community in favour of non-forest based livelihoods

The main causes of weather changes as identified by the forest dependent group and non-forest dependent group respectively are: act of God (36.6% versus 35.7%), deforestation (33.7% versus 31%), immoral behaviour (21.8% versus 11.9%), global climate change (6.7% versus 11.9%) and part of normal climate change (1.2% versus 9.5%)

### **5.2.3 Differences in Response to Deforestation and climate change**

Both livelihood groups showed a lot of concern about deforestation. There was no statistically significant difference between concerns for deforestation between the two groups. The percentages of forest based livelihood individuals who planted trees compared to those in non-forest dependent livelihoods were statistically significant in favour of the former. Women also planted more plants than men. All these differences were statistically significant. A greater proportion of respondents however were doing nothing in response to deforestation because they felt they did not have the power to do something.

The study found that there was no statistically significant difference in the mean amounts that individuals in both livelihood groups were willing to pay to preserve the secondary forest. Both groups will be willing to pay an average of GHC 8.2 (USD 2.4).

The results of the T-test for the second willingness to pay values show that further knowledge of forest ecosystem services increased the mean willingness to pay to preserve and protect the forest. With the enhanced knowledge, both groups substantially increased their willingness to pay amount to arrive at a higher mean of GHC 10.8 (USD 3.1), compared to GHC 8.2 (USD 2.4).

### **5.3 Conclusion**

In conclusion, rural forest communities have always been regarded as comprising poor farmers who only rely on the forest for subsistence and cannot afford to make financial commitments to protect their environment. This study demonstrates the diversity in the rural economy and the commitment to preserve their forests to the extent that they are willing to pay to regenerate and protect a secondary forest.

\The fact that people who do not rely on forests for their main livelihood activities are still concerned about deforestation and are willing to pay the same amounts of monies as those whose main livelihood activity relies on forest resources, in order to prevent the loss of forest ecosystem services to deforestation is important to note.

The higher willingness to pay value of GHC 10.8 (USD 3.1), recorded for both livelihood groups after receiving information on FES compared to the WTP value of GHC 8.2 (USD 2.4) obtained before receiving information about FES, goes to say that FES can be used as a viable incentive for people who do not benefit from REDD+ payments to preserve and properly manage their forests. Thus the discussion on deforestation and forest management should be opened up to include non-forest

dependent livelihood groups with more emphasis on the value of forest ecosystem services.

#### **5.4.1 Limitations of Study**

Some respondents were hesitant in disclosing their actual incomes while some found it difficult estimating their monthly incomes because they only earned money only after harvesting their crops usually between 3 – 6 months' intervals. Again, for households that relied on remittances from family members, it was difficult to estimate the monthly incomes since the remittances were not consistent. Using the income as an indicator of poverty levels has been criticised for failing to capture non-monetary forms of wealth such as assets. The difficulties in measuring income implies that there is a likelihood that the income data used in this study may have significant measurement errors.

Researchers also faced difficulties in explaining the hypothetical scenario for the WTP question (Whittington, 1998) because the question was met with outright rejection by some respondents due to some negative experiences they had had with illegal chainsaw operators and government ownership rights of timber. It therefore took a lot of time to let them know that the scenario and payment were merely hypothetical and for research purposes only.

### **5.5 Recommendations**

#### **5.5.1 Recommendations to curb deforestation**

Based on the findings of this research, the following recommendations may help to curb the fast rate of deforestation in the study area and by extension rural forest communities in Ghana.

Given the importance of trees in rural communities and the widely held perception that deforestation and climate change experiences are due to the loss of trees, tree planting could be encouraged at the individual and community levels. This will serve as a good entry point for further interventions to stop deforestation. Tree planting should be encouraged at the individual and household levels to serve as wind breakers during wind storms. Fruit trees are easier to plant because of the availability of seeds once the fruit is consumed. People should be encouraged to plant at least four fruit trees around their homes to reap the future benefits of food provision and wind break services at virtually no cost.

Individual willingness to pay to regenerate and preserve the secondary forest should be explored and a common fund be established to manage the fund at the community level because of mistrust of government officials and programmes. This can only work if the community is assured that all benefits from any timber trees they plant accrue to them and that the government has no stake in their secondary forest.

There is the need for community-wide education about the different roles and rights of government and the community concerning planted timber trees. Forest communities should also be sensitized about the importance of forest in combatting climate change and supporting rural livelihoods. since knowledge about FES and climate change is lacking at the local level. Climate change has been overly simplified to mean changes in weather due to the lack of trees. Education will provide a better understanding and appreciation of the importance of forests.

Based on the dominance of religious explanations proffered for climate change, the role of religious and faith leaders in communicating about climate change should be explored. Ghanaians especially those in rural areas tend to be very religious, so it will be necessary

to make discussion about climate change sensitive to people's religious belief in order to get the acceptance of the entire community.

It is a well-known fact that the non-agriculture sector places minimal stress on forest resources. Therefore, government should pursue rural livelihoods diversification especially through the promotion of small businesses and off-farm employment. This will go a long way to ease the stress on forests thereby reducing deforestation in rural forest communities.

The need for serious land reforms in Ghana cannot be overemphasised. Community members constantly reminded the researcher about the scarcity of communal land to undertake any forest plantation since almost all the lands have been sold to individuals.

#### **5.5.2 Recommendation for future research**

Future research could explore local knowledge of FES in REDD+ pilot zones to ascertain the level of community knowledge of the importance of the REDD+ project and its implications on their livelihoods and efforts at mitigating against global climate change.

A further study can also look at climate change knowledge differentials between the young and older generations as well as the values that these two groups of people attach to forests.

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**APPENDICES****Appendix 1: Questionnaire**

University of Ghana

Institute of Statistical, Social and Economic Research (ISSER)

Questionnaire on Local Knowledge Of And Response To Deforestation And Climate Change Phenomena Among Different Livelihood Groups

This study is being conducted in partial fulfillment for the award of a Masters' Degree in Development Studies by the University of Ghana, Legon. I would be grateful if you could participate in the study by helping complete this questionnaire. You will be assisting the researcher in purely academic work. Your confidentiality is however highly guaranteed.

Section A: Demographics			
Variables label		Responses	Skip Rules and Information
01	Name of respondent		
02	Gender of respondent	1. Male 2. Female	
03	Contact Number		
04	Age of respondent		
05	What is your marital status?	1. Married 2. Single 3. Widow/Widower 4. Divorced 5. Other (Specify)	
06	Do you have children / or dependents (nieces, nephews, adopted children etc)?	1. Yes 2. No	
07	Educational Level completed	1. No School 2. Preschool 3. Primary/Basic 4. JHS/Middle School 5. SHS/ GCE O' Level 6. Tertiary	
08	What is your main source of livelihood that provides your most important source of	1. Subsistence farmer 2. Petty trader (NTFP's)	

	income?	<ol style="list-style-type: none"> <li>3. Petty trader (non-forest product)</li> <li>4. Self-employed (non-forest dependent SME e.g. provision shop, hairdressing)</li> <li>5. Self-employed (forest resource dependent SME e.g. herbalist)</li> <li>6. Wage worker in the public sector / industry /other Organisation</li> </ol>	
09	Do you have a secondary source of livelihood?	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. No</li> </ol>	If <i>No</i> please skip Q. 11
10	What is your secondary livelihood activity	<ol style="list-style-type: none"> <li>1. Subsistence farmer</li> <li>2. Petty trader (NTFP's)</li> <li>3. Petty trader (non-forest product)</li> <li>4. Self-employed (non-forest dependent SME e.g. provision shop, hairdressing)</li> <li>5. Self-employed (forest resource dependent SME e.g. herbalist)</li> <li>6. Wage worker in the public sector / industry /other Organisation</li> </ol>	
11	(Estimated) Monthly income from main livelihood activity	<ol style="list-style-type: none"> <li>1. Below GHS 100</li> <li>2. GHS 100 – 199</li> <li>3. GHS 200 – 299</li> <li>4. GHS 300 – 399</li> <li>5. GHS 400 - 499</li> <li>6. GHS 500 – 599</li> <li>7. GHS 600 - 699</li> <li>8. GHS 700 – 799</li> <li>9. GHS 800– 899</li> <li>10. GHS 900- 999</li> <li>11. GHS 1000 – 1499</li> <li>12. GHS1500-1999</li> <li>13. GHS 2000 and</li> </ol>	Monthly estimate

		above	
12	Are you a native of Out kwadwo?	1. Yes 2. No	
13	Have you lived in Otu Kwadwo all your life	1. Yes 2. No	If Yes, skip question 14.
14	How long have you lived here (in years)		
<b>Section B: Forest dependence and importance to livelihoods</b>			
15	How important are forest resources to your livelihood	1. Very important 2. Important 3. I don't know/ no opinion 4. Not important	
16	Assuming that you had to pay a monthly amount of money to regenerate and preserve the secondary forest in your community. How much money will you be willing to pay? GHS_____		
17	How many times have you been in the forest this past month?	1. Daily 2. Several times per week 3. About once a week 4. Several times in a month 5. I have not been there.	
18	Which of the following forest activities have you done at least once in the past year? (Choose as many as apply to you)	1. Picked fruits/ berries/ mushrooms 2. Hunted for game/ snails 3. Collected medicinal plants 4. Collected firewood 5. Collected animal feed 6. Been in the forest because of my work (farming, herbal medicine, wood carving, etc.) 7. Went for a walk 8. I have not been in the forest	
<b>Section C: Awareness of drivers, pressures, state and impact of Deforestation</b>			
19	Do you think there has been a decrease in forest land in your community over the past 15 - 20 years?	1. Yes 2. No	If your answer is <i>No</i> skip Q 21
20	How can you tell that that there has been a decrease in forest land? (Choose as many as apply to you)	1. Fewer wild fruits 2. Difficulty finding medicinal plants 3. Difficulty harvesting firewood 4. Fewer trees 5. Less rainfall 6. Increased distance to the forest	
21	What does deforestation mean to you? (Choose as many as apply to you)	1. Cutting of timber from forest for sale 2. Converting forest land to farm land	

		<ol style="list-style-type: none"> <li>3. Converting forest land to housing</li> <li>4. Cutting down forest trees for firewood</li> <li>5. I have no idea</li> </ol>
22	Which of these have been the main drivers of deforestation to other uses Otu Kwadwo? (Choose as many as apply to you)	<ol style="list-style-type: none"> <li>1. Poverty (Income)</li> <li>2. Household subsistence needs</li> <li>3. Population increase ( need for shelter)</li> <li>4. Health needs (herbal medicine)</li> <li>5. Lack of regulation on forest use</li> <li>6. Lack of enforcement of forest regulations</li> <li>7. I have no idea</li> </ol>
23	Which of these activities (pressures) have resulted in the deforestation land in Out Kwadwo? (Choose as many as apply to you)	<ol style="list-style-type: none"> <li>1. Agriculture</li> <li>2. Housing</li> <li>3. Timber harvesting</li> <li>4. Collection of firewood</li> <li>5. Bush fire</li> <li>6. Harvesting /collecting medicinal plants</li> <li>7. I have no idea</li> </ol>
24	What is the current state of forests in Otu Kwadwo? (Choose as many as apply to you)	<ol style="list-style-type: none"> <li>1. Loss of forest cover</li> <li>2. There are no timber trees left</li> <li>3. Forests have been degraded</li> </ol>
25	Which of these impacts of deforestation do you know of? (Choose as many as apply to you)	<ol style="list-style-type: none"> <li>1. Drying of springs and rivers</li> <li>2. Loss of NTFP's such as mushrooms, herbs and wild fruits</li> <li>3. Climate change</li> <li>4. Poor soil quality</li> <li>5. Disease and pest control</li> <li>6. Migration</li> <li>7. None</li> </ol>
Section D: Response to deforestation		
26	Are you concerned about the deforestation to other uses	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. No</li> <li>3. Indifferent</li> </ol>
		If you answered <i>No</i> or <i>Indifferent</i> please answer Q.28
27	Why are you not concerned or indifferent forest conversion	<ol style="list-style-type: none"> <li>1. I do not think it is a problem</li> <li>2. We are using the forest resources to earn a living and supplement household needs which is beneficial</li> <li>3. We have more important problems in this community</li> <li>4. I do not use/benefit from the forest</li> <li>5. I do not come from this community so it does not concern me</li> </ol>

28	What are you doing as an individual about the deforestation lands to non-forest lands	<ol style="list-style-type: none"> <li>1. Tree planting</li> <li>2. Avoiding slash and burn farming</li> <li>3. Switched from firewood to LPG</li> <li>4. Practicing agro-forestry</li> <li>5. Finding alternative non forest based livelihood activities</li> <li>6. Educating people</li> <li>7. Nothing</li> </ol>	If you answered <i>Nothing</i> answer Q.30
39	Why are you not doing anything about deforestation in Otu Kwadwo?	<ol style="list-style-type: none"> <li>1. It is the government's responsibility to protect forests</li> <li>2. There are more important problems in this community</li> <li>3. I do not have the power</li> <li>4. I do not use/ benefit from the forest</li> <li>5. I do not come from this community</li> <li>6. No reason</li> </ol>	
30	Are you aware of any community efforts to deal with forest conversion?	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. No</li> </ol>	If <i>No</i> , skip to Q 36
31	Which of these measures is your community taking to deal with forest conversion	<ol style="list-style-type: none"> <li>1. Tree planting</li> <li>2. Restricting access to forest</li> <li>3. Restriction on harvesting forest trees</li> <li>4. Public education</li> <li>5. Forest regeneration ( secondary forest)</li> <li>6. Punishment (e.g. fines) for people who cause bush fire</li> </ol>	
32	Is (Are) the measure (s) working	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. No</li> </ol>	If <i>Yes</i> go to Q. 34 if <i>No</i> go to Q. 35
33	What tells you that they are working	<ol style="list-style-type: none"> <li>1. Trees planted are growing well</li> <li>2. Forest not easily accessible to community</li> <li>3. Reduction in harvesting of forest trees</li> <li>4. Community aware of dangers of deforestation</li> <li>5. Regenerating secondary forest</li> </ol>	

		6. People are punished for bush fires	
34	What accounts for the failure?	<ol style="list-style-type: none"> <li>1. Trees have not been planted</li> <li>2. Forest restrictions not strictly enforced</li> <li>3. Continued harvesting of forest trees</li> <li>4. Community aware of dangers of deforestation</li> <li>5. Secondary forest is being converted to other use</li> </ol>	
35	Are you aware of any government policies/plans to prevent deforestation in your community	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. No</li> </ol>	
Section E: Climate Change Awareness			
36	Have you heard of the term “climate change”	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. No</li> </ol>	
37	Have you noticed any changes in the weather conditions within the last 15-20 years?	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. No</li> </ol>	If you answered “No” please move to Q. 43
What changes have you noticed in the following weather elements? ( Choose as many as applies to you)			
Weather Element		Observed change	
38	Rainfall	<ol style="list-style-type: none"> <li>1. Declining rainfall</li> <li>2. Very heavy rainfall</li> <li>3. Unpredictable rainfall pattern</li> <li>4. Change rainy season</li> </ol>	
39	Temperature	<ol style="list-style-type: none"> <li>1. The weather is hotter than before</li> <li>2. Longer hot season</li> <li>3. Extreme heat</li> </ol>	
40	Wind	<ol style="list-style-type: none"> <li>1. Not enough cool breeze</li> <li>2. Winds are stronger and more destructive</li> <li>3. Colder harmattan</li> </ol>	
41	Extreme events	<ol style="list-style-type: none"> <li>1. Drought</li> <li>2. Floods</li> <li>3. Wind storms</li> </ol>	
42	What factors, in your view, cause the observed changes in weather elements	<ol style="list-style-type: none"> <li>1. Part of normal change in climate</li> <li>2. Act of God</li> <li>3. Immoral behaviour</li> <li>4. Deforestation</li> <li>5. Global climate change</li> </ol>	

Willingness to pay to regenerate and preserve secondary forest after receiving information about forest ecosystem services. Respondents will be informed about forest ecosystem services after which they will answer the following questions:	
43	Based on the information you have received, assuming that you had to pay a monthly amount of money to regenerate and preserve the secondary forest in your community. How much money will you be willing to pay? GHS_____

## APPENDIX 2

### QUESTIONS FOR INDEPTH INTERVIEWS WITH KEY INFORMANTS

#### Local Knowledge of and response to deforestation

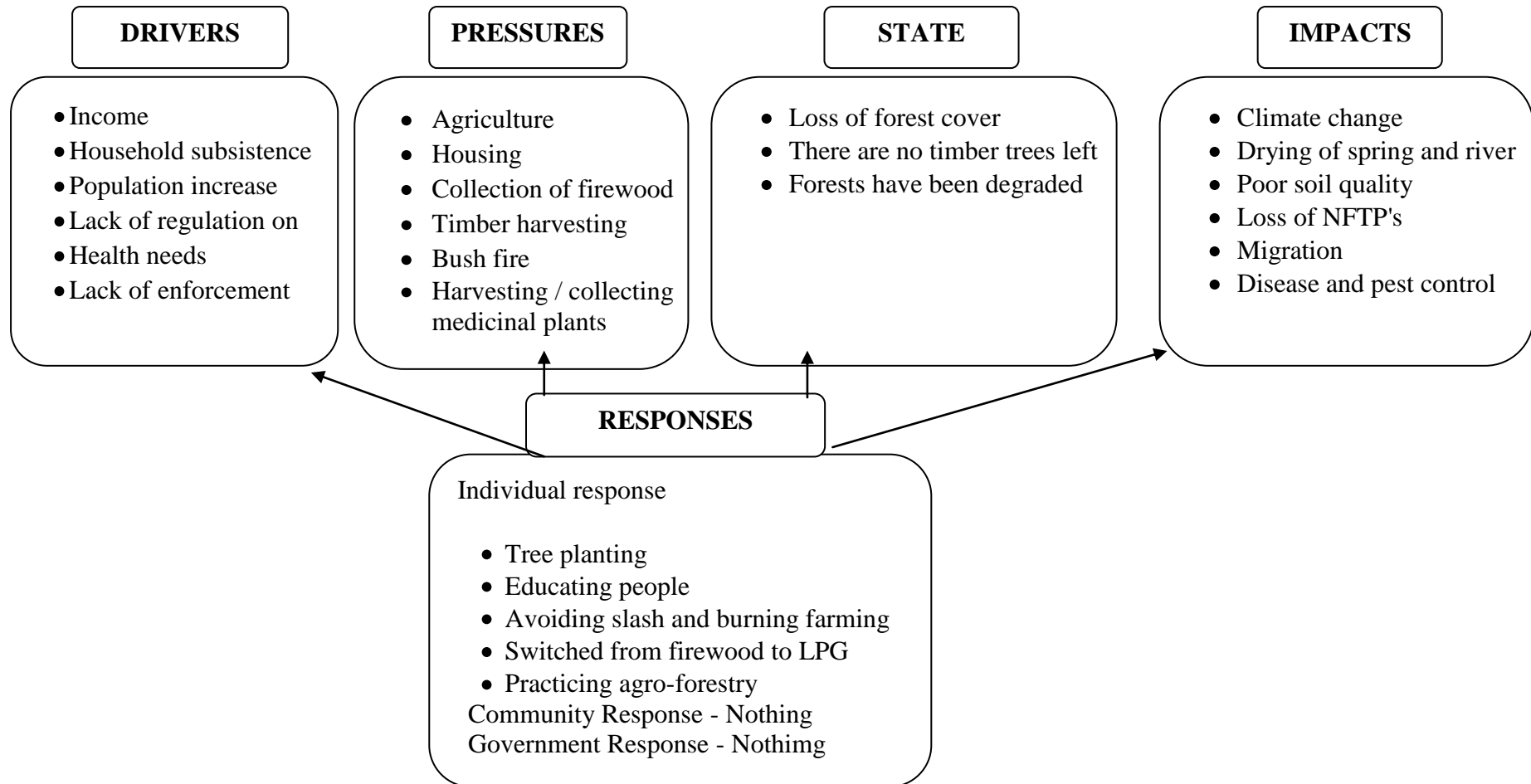
1. What are the main causes of deforestation in Out Kwadwo?
2. What socio economic conditions drive the causes of deforestation identified?
3. What is the current state of forests in Otu Kwadwo?
4. What have been the impacts of deforestation in Otu Kwadwo?
5. What has been your reaction to deforestation in Otu Kwadwo?
6. How is the community responding the deforestation?
7. How is the state intervening in the deforestation problem?
8. What are the challenges to fighting deforestation in Out Kwadwo?

#### Local Knowledge Of And Response To Climate Change

1. Have you heard about the term climate change?
2. What do you know about climate change?
3. Have you noticed any changes in the weather conditions within the last 10-15 years?
4. What changes have you noticed in the following weather elements?
  - I. Rainfall
  - II. Temperature
  - III. Wind
  - IV. Extreme events
5. What factors in your view account for the observed changes in the weather?
6. What are the impacts of climate change in your community?
7. How are you adapting to climate change?

**APPENDIX 3: LOCAL KNOWLEDGE OF AND RESPONSE TO DEFORESTATION AMONG RESPONDENTS ENGAGED IN FOREST**

**DEPENDENT LIVELIHOOD ACTIVITIES AND RESPONDENTS IN NON-FOREST DEPENDENT LIVELIHOOD ACTIVITY**



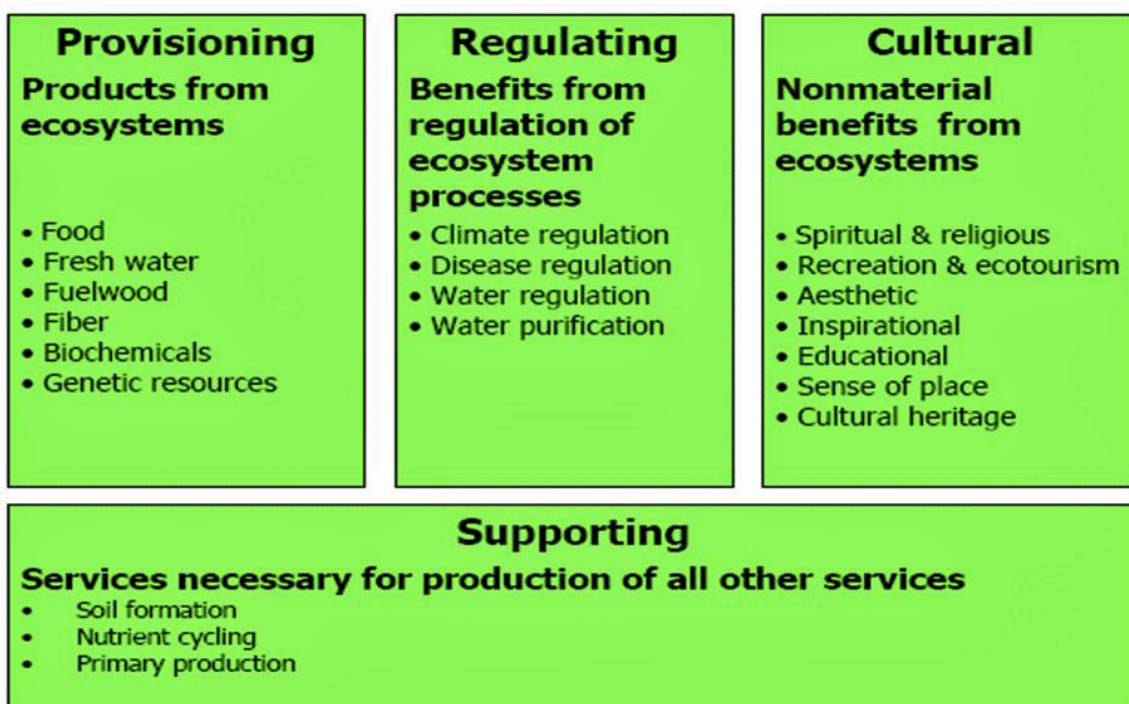
#### Appendix 4 The role of Forests in Rural Livelihoods

Poverty Aspect	Function	Description
Safety net	Insurance	Food and cash income in period of unexpected food and income shortfall
Support Consumption	Current Gap-filling	Regular (seasonal, for example) shortfall of food and income
		Regular subsistence uses
		Fuelwood, wild meat, medicinal plants, etc
		Low-return cash activities
Poverty reduction	Specialised forest strategies	A wide range of extractive activities, normally in economies with low market integration
		Diversified forest strategies
		Forest activities that are maintained in economies with high market integration
	Payment for environmental services	Forest activities that form the majority of the cash income in local economies with high market integration
		Direct transfers to local communities from off-site beneficiaries

Source (Vedeld et al., 2002)

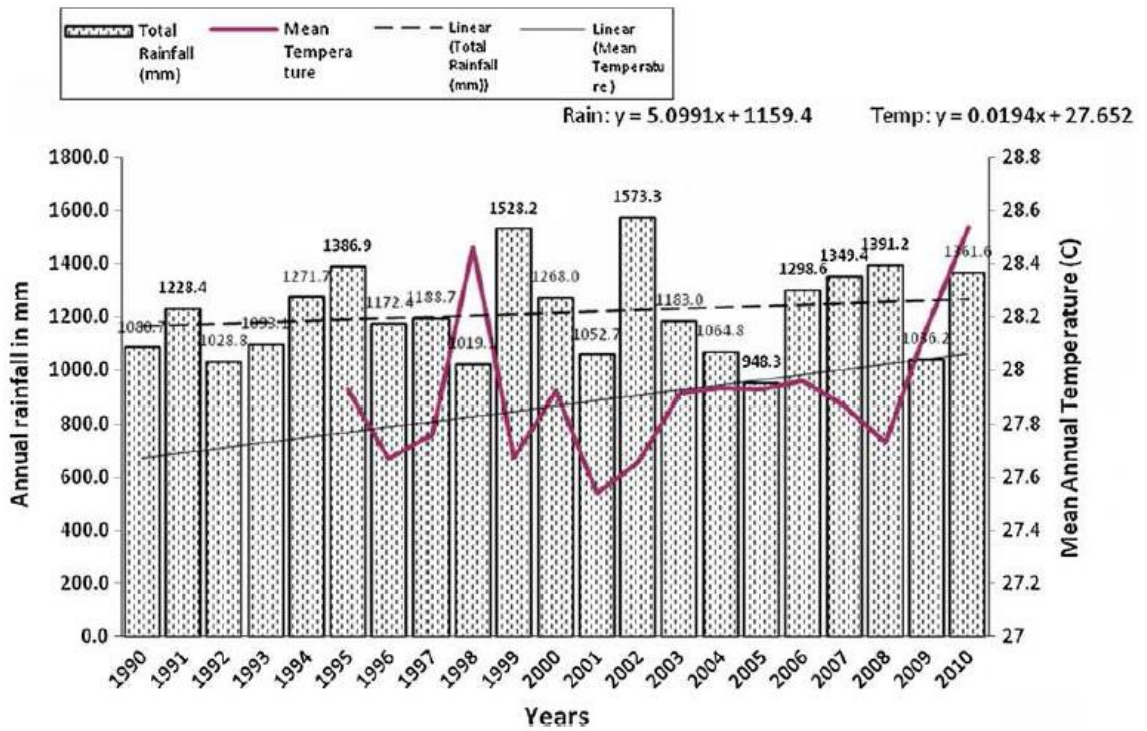
## APPENDIX 5 FOREST ECOSYSTEM SERVICES

# Ecosystem Services



Source: Millennium Ecosystem Assessment, 2005

**Appendix 6 Annual Rainfall and Mean Temperature for Nsawam (1990-2010)**



Source: Yaro (2013)