EXPLORING TROPICAL FOREST EDGE EFFECTS ON ADJOINING COCOA AGRICULTURAL LANDSCAPES: A CASE STUDY OF THE KAKUM CONSERVATION AREA.

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ABSTRACT

The study investigated farmers' knowledge and perceptions of how the forest interacts with adjoining farms and the influence on their planting decisions around the KCA. Specifically, it analysed the key factors that inform farmers' decision whether to site their farms either close or away from the forest edge. 250 farmers in 10 villages were interviewed using semi-structured interviews.

The study concluded that, although farmers recognised that land closer to the forest margin has environmental conditions suitable for cocoa growth and development, the decision regarding where to farm is determined by the existing land tenure arrangements, risk of crop-raiding and other socioeconomic and institutional factors. Of these factors, farmers identified land tenure was identified as the most critical consideration since it defines the means of accessing and using land.

However, some challenges such as crop-raiding, limited extension support and high cost farm inputs were found to impinge sustainable cocoa production.

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LIST OF ACROYNMS AND ABBREVIATIONS

CBD	Convention on Biological Diversity
CEDECOM	Central Region Development Commission
COCOBOD	Ghana Cocoa Board
CRIG	Cocoa Research Institute of Ghana
CTFS	Centre for Tropical Forest Science
FAO	Food and Agricultural Organisation
FSD	Forest Services Division
CITIES	Convention on Internation Trade in Endangered Species
GAIN	Global Agricultural Information Network
GLSS	Ghana Living Standards Survey
GWD	Game and Wildlife Division
ISSER	Institute of Statistical, Social and Economic Research
KCA	Kakum Conservation Area
MLNR	Ministry of Lands and Natural Resources
MA	Millennium Ecosystem Assessment Report
MIDA	Millennium Development Authority
OASL	The Office of the Administrator of Stool Lands
PBC	Produce Buying Company
RAINFOR	Amazon Forest Inventory Network
REDD+	Reduced Emissions from Deforestation and Forest Degradation
RME	Research, Monitoring and Evaluation
TEEB	The Economics of Ecosystems and Biodiversity
UN	United Nations
UNESCO	United Nations Education, Scientific and Cultural Organisation

CHAPTER ONE

BACKGROUND TO THE STUDY

1.1 Introduction

Forest ecosystems play a significant role in terms of the socioeconomic wellbeing and development of economies particularly in the developing world where a majority of the populace (mainly rural dwellers) directly depend on forest resources for their primary sustenance. Hassan et al. (2005) summarised that forest ecosystems provide a range of ecological services ranging from provision of food, shelter, supporting services, regulating and cultural and aesthetic services. Considering the tropical forest, Malhi *et al*. (2010) identifies that they have a major influence on global patterns of biodiversity, ecosystem ecology, productivity and biogeochemical cycles, but remain understudied.

In this light, the few studies on tropical forests have revealed increased anthropogenic pressures resulting chiefly from rapid extensive agricultural expansion and logging. Falkowski *et al*. (2000) avers that the growing pressure on the developing world to increase food production has stimulated the conversion of forest ecosystems to agricultural uses effectively increasing the flux of carbon to the atmosphere while simultaneously reducing the land area available for active sink. This phenomenon has potential ramifications forest ecosystem health and functioning and by extension exacerbating the effects of global environmental change.

Within the Ghanaian context, anecdotal evidence suggests the incidence of high rate of deforestation of forest ecosystems (estimated at 2.19% a year) resulting from the fast-paced expansion of cocoa farms, uncontrolled logging and unsustainable surface mining practices (FAO, 2005). Agriculture, specifically the optimisation of cocoa production is increasingly seen as a major pathway through which the country can effectively alleviate poverty as

available statistics (COCOBOD, 2000) suggests that the cocoa sector alone employs nearly one million smallholder farmers and contribu tes 60-70% of rural household incomes (Frimpong *et al.* 2009).

Despite the increased fragmentation of forest ecosystems, experimental studies (e.g. Broadbent *et al*. 2008; Riutta et al. 2012) have revealed interactional linkages between forest ecosystems and adjoining agricultural landscapes by enhancing pollination services and regulating the micro climate conditions (through enhanced dew deposition in the early dry season) of agricultural landscapes in close proximity to the forest edge. For instance, Frimpong *et al.* (2011) reiterate that some studies on bee pollinated crops such as melon (Krenson *et al.* 2002), grapefruit (Chacoff and Aizen, 2006), eggplant (Gemmill-Heren and Ochiorg, 2008) show pollination services are influenced by gradients of distances between agricultural landscapes and natural forests.

Characteristically, cocoa is strictly entomophilous and obligatorily requires insect pollinators as shown by insect exclusion experiments (Ibrahim, 1988; Frimpong *et al.* 2011). Cocoa is also known to be sensitive to temperature and hence buffering of temperature extremes by remaining forest vegetation may be a critical microclimatic service. Anecdotal evidence suggests that farmers in many parts of the tropics prefer farming next to forest fragments because of enhanced dew deposition in the early dry season, which provides sufficient moisture input for cultivated crops (www.rainfor.org; Malhi et al. 2002; Frimpong *et al.* 2009).

Therefore, the study sought to investigate the nature of the forest influence on adjoining cocoa landscapes around the KCA. This is to achieve the net effect of understanding farmers planting decisions in respect of interactions across forest-cocoa agriculture landscapes so as to ensure sustainable cocoa production, whilst supporting forest conservation.

1.2 Research Questions

1. How does the forest edge influence yields and pest/ disease resistance of adjoining cocoa farms?
2. What other factors affect the overall yields in the selected cocoa farms within the study area?
3. What is the influence of land tenure on planting decisions in KCA?
4. Does wildlife conflict influence farmers' decisions to farm near the forest edge or farther away?

1.3 Research Aims and Objectives

The overarching aim of the study is to assess the planting decisions of farmers in respect of forest-agricultural landscape interactions around the KCA. Specifically, the study sought to assess through a participatory assessment of farmers' perceptions of how the remnant forest influences farming activities. The specific objectives are as follows:

1. To ascertain the ecological influence of the forest edge on cocoa yields and disease resistance of nearby cocoa farms.
2. To ascertain how knowledge of forest-agricultural landscape interactions influences planting decisions of cocoa farmers around KCA.
3. To identify and scale up social and ecological factors that motivate the situation of cocoa farms.
4. To assess the influence of land tenure on farming decisions around the KCA.
5. To make policy recommendations that will boost cocoa production without disturbing the remnant forest.

1.4 Scope of the Study

The study is case study based; focusing on the KCA located in the Central region of Ghana. Essentially, it draws from the use of primary and secondary data to analyse the research problem.

250 cocoa farmers from 10 villages buffering the KCA constituted the key informants for the investigation. Other institutional respondents interviewed included officials of the Ghana Forestry Commission and Local Produce Buying Agents.

1.5 Justification for the Study

In the wake of increased anthropogenic greenhouse gas emissions, natural resource use and climate change mitigation and adaptation efforts, there is often a socioeconomic trade-off between the conversion of remnant forests into other land uses (mainly agricultural and mining) and their conservation predominantly in developing countries (such as Ghana) due to the direct dependence on forests by surrounding local communities for basic sustenance. This phenomenon has often resulted in large scale fragmentation of forest habitats and ecosystem degradation over several years presenting serious ramifications for biodiversity and forest ecosystem health and functioning.

There is a paucity of data on local farmers' ecological understanding of forest-agricultural landscape interactions as most previous studies have largely focused on small field plot experiments. Therefore the findings from this study would contribute to academic knowledge in terms of understanding remnant tropical forest-agricultural ecosystem interactions and planting decisions of farmers. Additionally, it will help inform the basis for policy formulation on forest conservation and sustainable cocoa agriculture in Ghana.

1.6 Organisation of the Study

The study is organised into six chapters: Chapter One gives a brief background to the study indicating the rationale for undertaking the investigation.

Chapter Two provides the conceptual basis of the research. It delves into the significance of tropical forests, the current state of Ghana's forests, cocoa agriculture and land tenure arrangements.

Chapter Three provides the research methodology. It encapsulates the rationale for the techniques employed and a description of the sample size, data collection and analysis. The limitations of the study are also oultlined.

Chapter Four captures the profile of the study area highlighting its history, political administration and land use characteristics.

Chapter Five discusses the survey results and Chapter Six encapsulates the general discussions, conclusion and recommendations. Areas for further research are also outlined.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter broadly outlines the conceptual basis and framework of the study. It proceeds with an overview of tropical forests, describing their ecological significance and environmental benefits, narrowing down on the African context and the situation of Ghana's forests. It then presents an overview of cocoa agriculture, land tenure, environmental impact of current farming practices in Ghana and the significance of local knowledge in resource use and management.

2.2 Overview of Tropical Forest Ecosystems and Services

Various studies (e.g. MA, 2005; Malhi and Phillips, 2005; CBD, 2010) on tropical forests have illustrated their unique social-ecological features and diversity classifying them as the complex as the most complex of terrestrial ecosystems. In this sense, tropical forest play a significant role in global climate, biodiversity, the carbon cycle, the rate of climate change and human welfare. The succeeding paragraphs discusses the range of ecosystem services provided by tropical forests.

2.2.1 Ecosystem Services Typologies

Ecosystem services play a pivotal role in the functioning of ecosystems and are fundamental to the development of sustainable landscapes, though largely ignored or taken for granted in land management strategies (Castellanos *et al.* undated). The Millennium Ecosystem Assessment (MA) Report broadly defines ecosystem services as "the benefits people derived from ecosystems". Contanza *et al.* (1997) elaborates that ecosystem services consist of flows of materials, energy, and information from natural capital stocks which combine with manufactured and human capital services to produce human welfare. Based on the MA

(2005) classification, four main types of ecosystem services are identified and summarised below:

Table 2.1: Classification of Ecosystem Services

Classification	Description
Supporting services	Constitutes services that are necessary for the production of all other ecosystem services including photosynthesis, primary production, nutrient cycling and water cycling
Provisioning services	The products obtained from the ecosystems, including food, fibre, genetic resources, biochemical, natural medicines, pharmaceuticals, ornamental resources and freshwater
Regulating services	The benefits obtained from the regulation of ecosystem processes, including air quality regulation, climate regulation, water regulation, erosion regulation, water purification, disease regulation, pest regulation, pollination, natural hazard regulation
Cultural services	The non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation and aesthetic experiences (landscape values).

Source: Adapted from MA Report (2005)

In this light, various writers concede that knowledge of ecosystem services is germane for assessing potential opportunities and vulnerabilities of land use management options, for example, case cocoa farming and forest protection arrangements in the KCA, Ghana.

2.2.2 Significance of Tropical Forests

Synonymous with other common-pool resource systems and units, many products and ecosystem services provided by forests seldom appear in the formal market and are poorly quantified (Costanza *et al.* 1997). Resulting, they are often undervalued and subject to high risk of destruction (Costanza *et al.* 1997; TEEB, 2010).

Nevertheless, tropical forests have recently gained huge attention in both the academic and policy circles in a bid to understand their cultural, economic and ecological importance. The core significance of tropical forests is underpinned in the capacity to provide vital ecosystem

services elucidated above (*table 2.1*). Some of the vital services provided by tropical forest as highlighted in literature are listed below:

Act as carbon store and sink

Tropical forest serve as natural biological pumps holding about 40% of the carbon residing in terrestrial vegetation, and annually process about six times as much carbon through photosynthesis as humans release to the atmosphere through fossil fuel combustion (Malhi and Grace, 2010). In this light, several forest conservation initiatives such as REDD+ have been rolled out to support climate change migitation (FAO, 2010; Larson and Petkova, 2011).

Biodiversity Concentration and Richness

Again, tropical forests play a special role in conservation of biodiversity. They contain around 70% of the world's plants and animals - more than 13 million distinct species (Anon, 1996). Tropical forests contain 70% of the world's vascular plants, 30% of all bird species, and 90% of invertebrates. In terms of tree species alone, tropical forests are extremely diverse, typically hosting more than 100 species per hectare.

Socio-economic Importance

Besides their ecological importance, tropical forests provide the socio-economic needs of a majority of people living within or around them. It is estimated that about 150 million indigenous people rely on the forests for their way of life. Additionally, the forest provides a wide range of industrial wood products for various construction activities (Whitmore, 1998). The succeeding paragraphs discusses distribution of tropical forest in Africa.

2.2.3 The African Context

Mayaux *et al.* (2013) estimated that the rainforests cover only 13% of Africa's landmass, but accounts for more than 90% of the carbon stored in the continent's terrestrial ecosystems. The ecological zonation proposed by the UNESCO has three ecoregions dominated by

rainforests: Guinea-Congolean (in West and Central Africa), East Malagasy (Madagascar) and AfroMontane (Central and Eastern Africa) (White, 1983). Table 2.2 shows the current forest cover distribution in Africa.

Table 2.2: Forest Cover Area by Country

Country	Humid Rainforests (X 1000 ha)
Democratic Republic of Congo	107,181
Gabon	22,416
Cameroon	20,037
Central African Republic	5,833
Equitorial Guinea	2,163
Central Africa	178,564
Liberia	4,552
Nigeria	3,158
Cote D'Ivoire	1,530
Ghana	1,487
Other countries	1,273
West Africa	12,002
Madagascar	4,385
Eastern Africa	4,876
Total for Africa	199, 829

Source: Mayaux *et al.* (2013).

Ghana like other West African countries, is ecologically diverse with vegetation types that range from savannah to wet evergreen forests (Appendix 5). The tropical rainforest of Ghana is divided into five major forest types namely: wet evergreen; upland evergreen; moist evergreen; moist semi-deciduous (North-west and South-east subtypes) and dry semi-deciduous (Fire zone, inner zone and marginal subtypes) (Hall and Swaine, 1981; Anim-Kwapong and Frimpong, 2005).

Since the adoption of a forestry policy in 1948, Ghana's forests has undergone significant changes owing to the growing socio-economic needs of the population (EPA, 2004). Despite

the existence of various policy interventions, country surveys suggest that the destruction of the natural forests still persists. The present state of Ghana's forests is discussed in detail below.

2.2.4 The State of Ghana's Forests

Almost all the country surveys and studies (e.g. FAO, 2001; MLNR, 2012; Ofori *et al.* 2012) conducted have recorded a significant reduction of the forest estate over time despite the inconsistencies in assessments. For instance, the World Bank (2010) pegged the deforestation rate at 22,000 ha per year whilst Ghana's 2010 Report to the FAO's Forest Resource Assessment indicated a gross annual rate of 135,000 ha, even though the net figure was reduced by an annual reforestation programme of 20,000 ha per year (MLNR, 2012).

In view of this, Allotey (2007) maintain that the current area of intact forest is estimated to be between 10.9 and 11.8% of original high forest cover of about 145,000 km^2. In Oates (1999) and Decher and Abedi-Lartey (2002), both emphasised that the remnant forests are now situated in remote and inaccessible areas of the forest reserves established between 1919 and 1939 in three high forest national parks (Bia, Kakum and Ankasa Conservation Areas), and in "sacred groves"-traditionally protected forest-patches ranging in sizes from a few trees to several hundred hectares.

Presently, Ghana's permanent forest estate comprises of 291 reserves and 15 wildlife protected areas occupying more than 38,000 square kilometres (i.e. 16% of the total land area of Ghana) under the jurisdiction of the Forestry Commission. The traditional land uses in tropical areas are mainly small and large scale farming, game park reserves, forestry, wood fuel, cattle ranching, urbanisation and tree plantations of exotic and indigenous species (cocoa, rubber, timber). Within the reserves, agriculture is practised as a component of the

taungya system of plantation established under departmental control and supervision (Appenix 1).

Outside the forest reserves and other types of protected areas, it is challenging to find data which accurately quantifies specific land use types (MLNR, 2012). This is mainly because land use is not static, and over the past half century, the country has experienced a dramatic shift from forest to agricultural land use. For example, the COCOBOD reported that by 2012, land under cocoa had increased to 1.45 million hectares *(ibid).* This scale of forest fragmentation invariably influences the wider ecosystem interactions. The succeeding paragraphs discusses the development of cocoa agriculture in Ghana.

2.3 An Overview of Cocoa Agriculture in Ghana

Undoubtedly, cocoa (*theobroma cacao*) remains the major cash crop in Ghana (ISSER, 2010; Essegbey and Ofori-Gyamfi, 2012) and significant foreign exchange earner in other African countries notably Cote d'Ivoire, Nigeria and Cameroon, although it originated from South America (Wilson, 1999). Wilson (1999) records that cocoa is now grown in at least 16 African countries (ranging geographically between Sierra Leone, Uganda and Angola, with Cote d'Ivoire, Ghana, Nigeria and Cameroon dominating production) and production is the highest of any continent, about 64% of total world production.

Ghana is currently the world's second leading producer of cocoa beans, after Cote d'Ivoire (Essegbey and Ofori-Gyamfi, 2012). The cocoa industry in Ghana (the second largest source of export earnings) accounts for about 25-30% of total export earnings (ISSER, 2010; Essegbey and Ofori-Gyamfi, 2012 and GAIN Report, 2012). In terms of actual production figures, Ghana has experienced a chequered rise in cocoa production, reflecting in total export earnings overtime *(table 2.3 and figure 2.2).*

Table 2.3: Ghana's Export of Cocoa Beans & Processed Cocoa – 2001 to 2010

Year	Cocoa beans (US$ millions)	Cocoa processed (US$ millions)
2001	316.9	65.8
2002	392.5	81.9
2003	691.6	126.1
2004	984.4	41.2
2005	818.5	89.9
2006	1041.10	146.4
2007	975.7	157
2008	1225.10	261.9
2009	1422.40	443.7
2010	1660.00	625.2

Source: Essegbey and Ofori-Gyamfi (2012): ISSER, various years

2.3.1 Production of Cocoa in Ghana

Essentially, there are six (6) cocoa growing regions in Ghana namely, Ashanti, Brong-Ahafo, Central, Eastern, Western and Volta regions (figure 2.1).

Figure 2.1: Map of Ghana Showing the Cocoa Growing Region

Source: Anthonio and Aikins (2009)

The Western region currently dominates production accounting for more than 50% of total annual production (COCOBOD, 2004). Three main varieties of cocoa are cultivated in Ghana: Amelonado, Amazonia and hybrid cocoa. Amelonado, a Forastero cocoa native to the lower Amazon basin, gained its nickname Tetteh Quarshie from the itinerant cocoa worker who introduced it to Ghana upon his return from Fernando Po in the 1890s (Gockowski, 2011). Edwin and Master (2005) reported that, in the mid-forties, about 90% of the trees in Ghana were of Amelonado type.

The second variety of cocoa cultivated is Amazonian cocoa originally from Peru and sometimes referred to as F3 Amazon or Upper Amazon (UA) cocoa. Gockowski (2011) again explains that F3 Amazon has a shorter lag prior to bearing (2 to 3years) and is high yielding as compared to TQ variety. However, when with low shade and no fertiliser, F3 Amazon maintains its peak yield for a shorter time than TQ *(ibid)*.

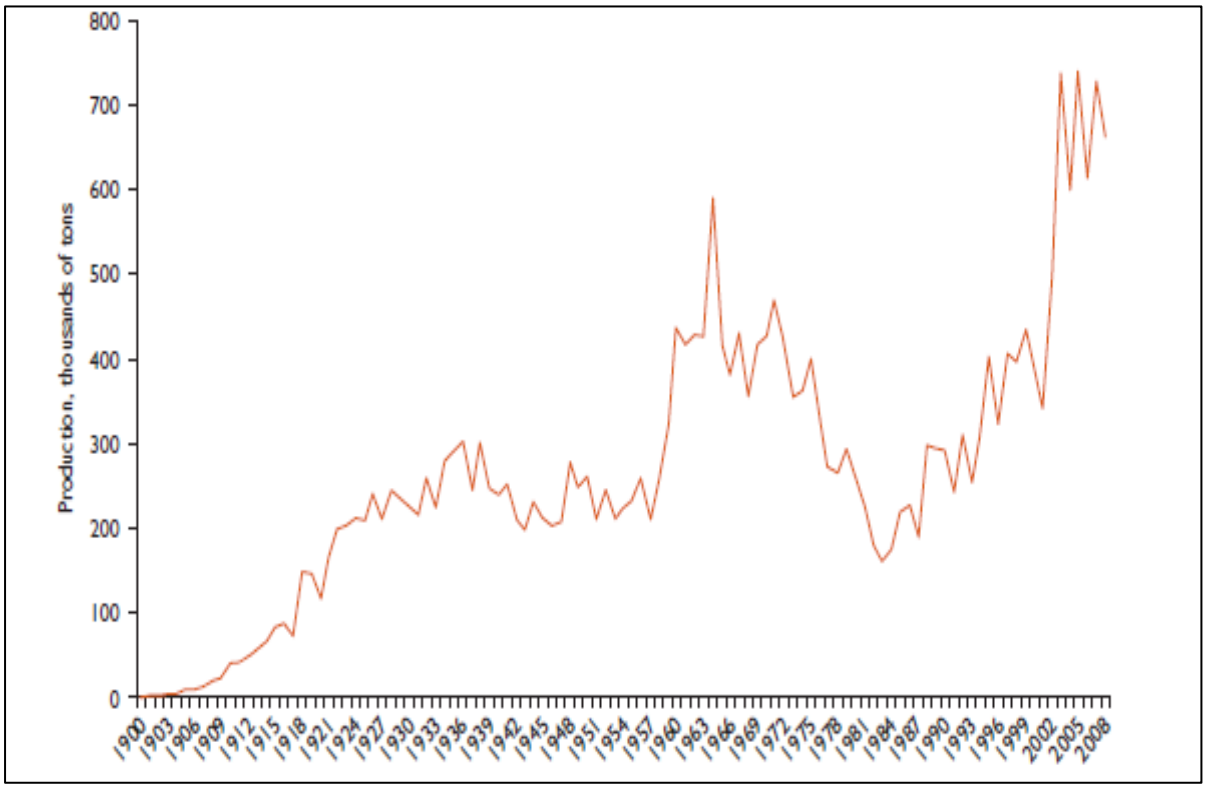
The third type is the improved "hybrid" cocoa based on bi-parental crosses among and between upper Amazonian, local Amelonado, and Trinitario cocoa parents (Gockowski, 2011). The hybrid varieties outperform the older "Amazonia" and "Amelonado" varieties in two ways- by producing trees that bear fruit in three years compared with at least five years for the older varieties, and by producing more pods per tree (Kolavalli and Vigneri, 2011). Edwin and Masters (2003) asserts that farmers have increasingly adopted hybrid varieties, whiles traditional varieties may have disappeared entirely from all fields planted after 1995. Conversely, Kolavalli and Vigneri (2011) posit that hybrid varieties require optimal weather conditions and complementary farming practices like application of chemical inputs, adoption of new planting procedures, pruning and spraying.

In view of this, Anim-Kwapong and Frimpong (2005) maintained that, bulk of the country's cocoa is produced in the moist evergreen and moist semi-deciduous forest zones, mainly on small farms (ranging from 0.4 to 4.0 hectares adding up to about 1.45 million hectares of total cultivated area) using rudimentary technology with very little purchased inputs (Asenso-Okyere, 2001). Recent studies (e.g. Gockowski, 2007; Kolavalli and Vigneri, 2011) have questioned the viability of cocoa on small farms contending that significant share of small cocoa farms incur losses.

Surveys conducted by the Government of Ghana Task Force and the COCOBOD reveal that productivity per hectare is usually less than 250 kilograms and between 200 and 290

kilograms respectively (COCOBOD, 1998). This yield rate is low as compared with Cote d'Ivoire and Indonesia, whose estimated annual yield stands at 600 kilograms and 1000 kilograms per hectare respectively (ICCO, 2003). Figure 2.2 below typifies the trend in cocoa production in Ghana over successive years.

Figure 2.2: Ghana's Cocoa Production, 1900-2008



Source: Kolavalli and Vigneri (2011): Gill and Duffus Group

The figure above portrays the chequered rise overtime several factors have been identified by scholars as influencing this trend. The succeeding section discusses these factors in more detail.

2.3.2 Factors influencing Cocoa Production in Ghana

Research on cocoa production in Ghana have identified various factors that influence production ranging from environmental to economic and social considerations. Prominent among these factors are the cocoa producer price, climate and soil conditions and diseases and pests explained below:

- ✓ *Cocoa Producer Price*

Cocoa producer price is a strong determinant of production pattern. Anim-Kwapong and Frimpong (2005) aver that the setting of the cocoa producer price each year is a key economic policy of Ghana. The price setting process involves an estimation of the farmer's cost of production, anticipated FOB price", anticipated exchange rate, COCOBOD's cost and an explicit duty determined by the government revenue needs *(ibid).*

Cocoa price is an important mechanism for incentivising production and farmers have responded in varied ways over time, often changing the intensity of their farming (Anim-Kwapong and Frimpong, 2005; Kolavalli and Vigneri, 2011). Anim-Kwapong and Frimpong (2005) again assert that, if prices are not sufficient to cover normal variable cost including maintenance, the farmers reduce maintenance of their farms and stop new planting activities. If prices do not even cover harvesting, fermenting and drying, then harvesting will cease. Conversely, if prices cover or exceed the variable costs, farmers will intensify farm management through thorough harvesting initially and frequent weeding and application of other inputs. The figure below illustrates relationship between cocoa production and real producer price from 1990 to 2008.

Figure 2.3: Ghana Cocoa Production and Real Producer Price, 1990-2008

Source: Adapted from Kolavalli and Vigneri (2011)

- ✓ Climate and Soil

Currently, over 75% of the world's cocoa is grown within 8 degrees of the equator due to the favourable climate and soil conditions (Willson, 1999). Generally, the best soils for high cocoa productions have an average PH 5.6- 7.2 in 1:2.5 water (Ahenkorah, 1982), and a depth of at least 1.5 metres to permit the development of a good root system (Wilson, 1999). Adu and Mensah-Ansah (1969) categorised soils in Ghana into cocoa suitability soils based on textural and depth analyses. They explain that the model profile of good cocoa soils are deep and characterised by well drained non-gravelly top soil over sandy clay loam layer which usually contains both iron oxide concretions and quartz gravels. Based on the above, soils carrying cocoa in Ghana are grouped into unsuitable, suitable and highly suitable represented below:

Table 2.4: Classification of soils carrying cocoa in Ghana

Soil Classification	Basic Characteristics
Unsuitable soils (Forest Oxisols and Oxisol-Ochrosol intergrade)	Highly desaturated ferrallitic soils, primarily tropudults and paleudults covering the south of the Western region. Without fertiliser application, their lack of minerals results in limited yields and premature tree aging.
Suitable Soils(Dystropepts/Forest Ochrosols)	Moderately desaturated ferrallitic soils, primarily found in old cocoa growing areas of Eastern and Ashanti regions. Without fertiliser application and with light permanent shading, it is possible to achieve yields of around 1500 kg per hectare over 15 years or so.
Highly suitable soils (tropical eutrophic brown soils/ Forest Ochrosols-Rubrisol intergrade)	Slightly desaturated ferallitic soils with a high exchange capacity and better response to mineral fertilisers. These are generally well drained and deep soils occurring in limited areas in Ashanti and in the north of Western region.

Source: Based on Adu and Mensah-Ansah (1969)

In view of the above, cocoa is highly susceptible to drought and the pattern of cropping distribution is related to rainfall distribution (Anim-Kwapong and Frimpong, 2005). Willson (1999) notes that, the annual rainfall of most cocoa growing regions lies between 1150 mm and 2500 mm. Some studies (Ali, 1969; Brew, 1991) have reported significant correlations between cocoa yield and rainfall, identifying that a year with high rainfall is followed by a year with a large crop.

In Ghana, the rainfall distribution pattern is bi-modal from April to July and September to November. The main dry season spans from November to February- March, with total annual rainfall in the cocoa regions being less than 2000 mm (Anim-Kwapong and Frimpong, 2005). Given the absence of irrigation in the farming system, reliable rainfall is necessary for cocoa establishment and growth *(ibid).* However, Siqueira *et al.* (1995) reported substantial increase in yields when cocoa plants were irrigated.

Temperature and solar radiation are also critical climatic requirements of cocoa as a tropical crop. According to Willson (1999), most cocoa growing areas have temperatures ranging between 18-32^{o} Celsius. Furthermore, the lowest temperature that will not permanently damage cocoa is 10^{o} Celsius; a monthly average of 15^{o} Celsius is the lowest that can be tolerated *(ibid).* On the other hand, photosynthesis in cocoa is at a maximum in a light intensity of 25% of full sunlight making tropical forest regions suitable for its development (Okali and Owusu, 1975).

- ✓ Diseases and Pests of Cocoa

Various diseases and pests are known to affect cocoa at various stages of growth. In Ghana, the swollen-shoot virus and the black pod diseases have been identified as the most destructive, attacking the developing and riping cocoa pods (Willson, 1999; Anim-Kwapong and Frimpong, 2005). Opoku *et al.* (1999) notes that the black pod disease is caused by two *Phytophthora* species: P. *palmivora* and P. *megakarya* affecting both new and old farms. Additionally, the capsid pests are the most invasive pests affecting both young and matured cocoa. They damage the soft, young tissues of the trees causing shoot dieback and prevalent from September to March (Anim-Kwapong and Frimpong, 2005).

2.3.3 Principal Actors in Ghana's Cocoa Sector

Considering the institutional architecture of the cocoa industry in Ghana, eight principal actors are identifiable, each with a defined role within the supply chain. Five of the eight actors as described in the GAIN Report (2012) operate under the direct control of the Government of Ghana, which has monopoly over the purchase and export of cocoa beans. The eight principal actors include the Ministry of Finance and Economic Planning, COCOBOD and subsidiaries, License Buying Companies, Cocoa Processing Companies, Cocoa Farmers, International Buyers and Global Companies, Civil Society Organisations and Research Institutions of Ghana (CRIG, ISSER, RM & E).

Table 2.5: Institutional Players in the Ghanaian Cocoa Sector

The critical actors	Main roles and functions
Ministry of Finance & Economic Planning	Oversees Ghana's economic policies and programmes, national budget and resources allocation.
Ghana Cocoa Board (COCOBOD) and Subsidiaries	Implements government policies and programmes on cocoa and other selected cash crops.
License Buying Companies	Internal marketing of cocoa purchasing cocoa directly from the farmers and selling to statutory body.
Cocoa Processing Companies	Responsible for processing cocoa.
Cocoa Farmers	On-farm production and pre-harvest/ industrial processing of cocoa.
Internal Buyers/ Global Companies	Creating demand for cocoa.
Civil Society Organisations	Promoting rights and corporate responsibilities.
Research Institution of Ghana (CRIG, ISSER, RM & E)	Conducts research and development on the cocoa tree and farming systems for innovations.

Source: Essegbey and Ofori-Gyamfi (2012)

2.4 Environmental Impact of Current Farming Practices

In spite of the enormous ecological benefits of the forests and government's efforts to sustainably manage the reserves, shifting cultivation, uncontrolled logging, surface mining, charcoal production and population increase places a serious strain on Ghana's remnant forests (UNEP, 2006).

Various studies (e.g. Ruff and Schroth, 2004; Gockowski, 2011) have identified cocoa farming as a major driver of deforestation in many regions. Both Kolavalli and Vigneri (2011) and Gockowski (2007) aver that since the introduction of cocoa in West Africa, it has been the major cause of land use change in the high forest zones of regions in which it is grown, where it has replaced agricultural activity that incorporated fallowing to maintain land fertility. In Ghana's case, the FAO (2007) assert that large tracts of tropical forest have been cleared to support increasing cocoa cultivations, which Gockowski (2011) and FAO (2012)

explained is due to the continuous use of slash and burn cultivation methods and fact that cocoa is seen as a strategic crop for the development of the country.

Cocoa farming in Ghana is restricted to the forest region (Anim-Kwapong, 1994) dominated by smallholder farmers, majority of whom practise traditional "extensive" systems of cultivation. This system of cultivation involves the thinning out of the natural forest and planting cocoa under residual shade *(ibid),* which the World Bank (1987) identified as the major cause of deforestation in Ghana. Similarly, Kolavalli and Vigenri's (2011) contend that although the traditional shade-dependent and tolerant *tetteh quarshie* did not require forest clearing, trees have been cut down en masse in recent years to accommodate the open field variety, which grows in full sun conditions. Available statistics suggest that nearly three-quarters of Ghana's production area is with little or no shade *(ibid) (table 2*.6).

These farming practices even though resulted in some rise in cocoa production initially, most writers (e.g. Anim-Kwapong and Frimpong, 2005; Gockowski, 2011) have tagged them as unsustainable and ramifications for forest conservation, biodiversity and carbon sequestration (Norris, 2008). For instance, Gockowski (2011) stated that from 1988 to 2010, the extent of cocoa cultivation increased by nearly 1 million ha from a base of 720,000 ha to 1,625,000 ha with 86% of the rise occurring in the decade of the 90s. During this period, cocoa acreage expanded at an annual rate of 9.1% mainly at the expense of forest reserves in the Western region *(ibid).*

Table 2.6: Shade Levels in the Cocoa Belt of Ghana

Region	None to light (%)	Medium to heavy (%)
Ashanti	52	47
Brong-Ahafo	52	47
Eastern	50	49
Western	77	29
Ghana	72	29

Source: Gockowski and Sonwa (2007)

As evidenced in table 2.6, a majority of farmers in Ghana maintain a strong preference for full-sun crops which Obiri *et al.* (2007) claims, is because of the much shorter growing cycle of full-sun crops which is linked to higher short-term profits. Conversely, shade grown cocoa farms can reduce encroachment into forests and protected areas whilst providing ecological connectivity among protected areas as well as acting as carbon sinks (Asare *et al.* 2009). Environmental benign alternatives such as mixed agroforestry systems have been suggested as way to ameliorate the negative effects of cocoa farming practices but are rarely practised in Ghana, (Gockowski and Sonwa, 2007).

2.5 Effects of Shade in Cocoa Farming

Several contrasting views on the effects of shade in cocoa farming have been advanced by various scholars. Anglaaere (2005) recounted that traditionally in West Africa, cocoa shade relates to the density of forest trees left in the field after initial clearing of the forest. Some writers (e.g. Padi and Owusu, 1998; Ruff and Zadi, 1998) contend that the main objective for growing cocoa under shade in the past, was to lengthen the economic life of the cocoa tree, the technical difficulty of cutting down large trees due to absence of necessary equipment in those days and or socio-cultural reasons.

However, contrary to this earlier conception of cocoa thriving under heavy forest shade, some studies (Padi and Owusu, 1998; Anglaaere, 2005) advocate for mild shade to achieve high yields and precocity. Osei-Bonsu and Anim-Kwapong (1997) aver that, in Ghana the recommendation is to reduce overhead shade down to a maximum of 10 large and 15 medium sized trees per hectare or 4 trees per acre.

Regarding the importance of shade, Asare *et al.* (1999) explains that shade grown cocoa farms can reduce encroachment into forests and protected areas providing ecological connectivity among protected areas as well as help maintain soil and hydrological services. This system actively contributes to environmental and cultural conservation in regions experiencing intense pressure from logging, development and conventional mono crop agriculture (Whinney, 1998).

In view of this, Willson (1999) identifies a correlation between the amount of shade and eventual yield levels. Willson concluded that the level of light reaching the canopy of a cocoa tree has a large effect on the cocoa yield and the demand for fertilisers. With low light level, under heavy shade, the crop yield will be low and fertiliser application will have little or no effect. On the contrary, un-shaded cocoa gives a large response to fertiliser provided that the trees are well managed and there is adequate moisture in the soil throughout the year *(ibid).*

On the foregoing discussion, it is worth mentioning that despite observations that shade reduces photosynthesis, transpiration, metabolism and growth (Purseglove, 1968; Beer, 1987), shade remains beneficial from an environmental perspective and enhances the growth of young cocoa trees through microclimate regulation, pest and disease control, nutrient cycling etc. (Beer, 1987; Rao *et al.* 1997; Greenberg *et al.* 2000). Needless to say, local traditional knowledge is one of the principal areas relevant in having a broader understanding of the perceptions and inclination of local farmers to tree-crop interactions.

2.6 The Role of Local Knowledge in Sustainable Resource Use and Management

Although cocoa is not an indigenous Ghanaian crop and has only been cultivated over a few 100 years (Gockowski, 2011), farmers have through experience accumulated and transmitted local knowledge about its cultivation and management over several generations. Thus, there exist synergies between local knowledge and overall cocoa production in Ghana.

According to Anglaaere (2005), indigenous knowledge consists of facts, experiences, practices, resource management strategies, and production systems developed through trial and error during several millennia in a given community or region.

In spite of the various arguments challenging the relevance of local knowledge in resource conservation (e.*g.* Kruprik and Jolly, 2002; du Toit *et al.*2004), Walker *et al.* (1995) opined that over the past decade, its value in agriculture, agroforestry and rural development has become increasingly recognised. In developing countries where farm sizes are small (less than 2 hectares), improvements in farm outputs have traditionally not benefitted from a top-down, researcher-led approach (Goma *et al.* 2001).

Consequently, a bottom-up approach participatory evaluation of farmer practices and constraints and shared monitoring of new approaches to farming based on the local knowledge of farmers will achieve greater uptake of the identified technologies (Gandah *et al.* 2000). Despite the recognition that local knowledge is a critical resource for sustainable development, scientific understanding of complex agro-ecosystems such as traditional agroforestry systems is still weak (Anglaaere, 2005) given that different farmers have very different types and depths of knowledge (Joshi *et al.* 2001).

To this end, some scholars (Walker *et al.* 1995; Anglaaere, 2005) advocate for the integration of local knowledge with scientific knowledge as a means to achieving environmental sustainability. This certainly requires a detailed analysis of indigenous explanations of

ecosystem functions which also requires that farmers articulate their knowledge in detail (Joshi *et al.*2005). The role of land tenure in farming arrangements is discussed in the ensuing section.

2.7 The Role of Land Tenure in Farming Arrangements in Ghana

Land tenure and land resource use and management are inextricably linked and remain fundamental to survival in the developing world (West, 2000; de Soto, 2000; Auzins, 2004). Hanna *et al.* (1995) elucidated that in enhancing sustainable development, the design and structure of property rights regimes should link human and natural systems to the specific rights, duties and rules for resource use.

Notwithstanding the relevance of secured land tenure to sustainable development and environmental sustainability, various studies (e.g. Elkan, 1959; Myrdal, 1974; Mountjoy, 1975; Ault and Rutman, 1979; Bugri, 2005) have reiterated that it remains a dominant cause of poor agricultural performance and environmental degradation in Africa. They argue that African tenures have communal characteristics that the lack security of tenure necessary to stimulate investments in agriculture for enhanced productivity and sustainable land resource use (Bugri, 2005).

In most Ghanaian farming communities, customary land tenure (embedded within the national official land tenure system) plays a significant role in farming decisions. It remains the predominant means of accessing land for farming and as Törhönen (2004) explains, customary land tenure consists of the rights and restrictions in a society that are not documented but based on customs and defines the relationships between people and land.

Gockowski (2011) study of cocoa farming in Ghana observed that communities composed of both indigenous and migrant populations, manifest differences in land tenure arrangements between “citizen” and migrant cocoa farmers. These differences in means of accessing land

invariably influence key decisions relating to the siting and management of farms (Section 5.7). Again, the oral nature of most customary land transactions entail some level of in-security of tenure, but Gockowski (2011) emphasised that with cocoa farms, the act of planting effectively turns into a renewable land use right for about 40 years.

Presently, the management of OASL has helped streamline most land transactions and conferred some measure of security of tenure (*Appendix 2*). Through the OASL, farmers are now given farm plans, which provide a ready proof of ownership (not contingent on witnesses) and are admissible as collateral to secure loans from financial institutions (Somaila, 2010). The incidence of systematic rural land titling under the auspices of MIDA will go a long way to consolidate communal land ownership and afford a much solid security of tenure (Asante, 2012), which in turn will ease the tedium in accessing land and promote investments in rural agriculture in Ghana.

2.8 Summary

The chapter has examined the significance and the range of services provided by tropical forests. Moreover, it has discussed the current state of Ghana's forest before delving into cocoa agriculture in Ghana and other concepts like local knowledge and land tenure that influences farming decisions. This forms the basis for a detailed analysis of farmers' planting decisions around the KCA in the ensuing chapters.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

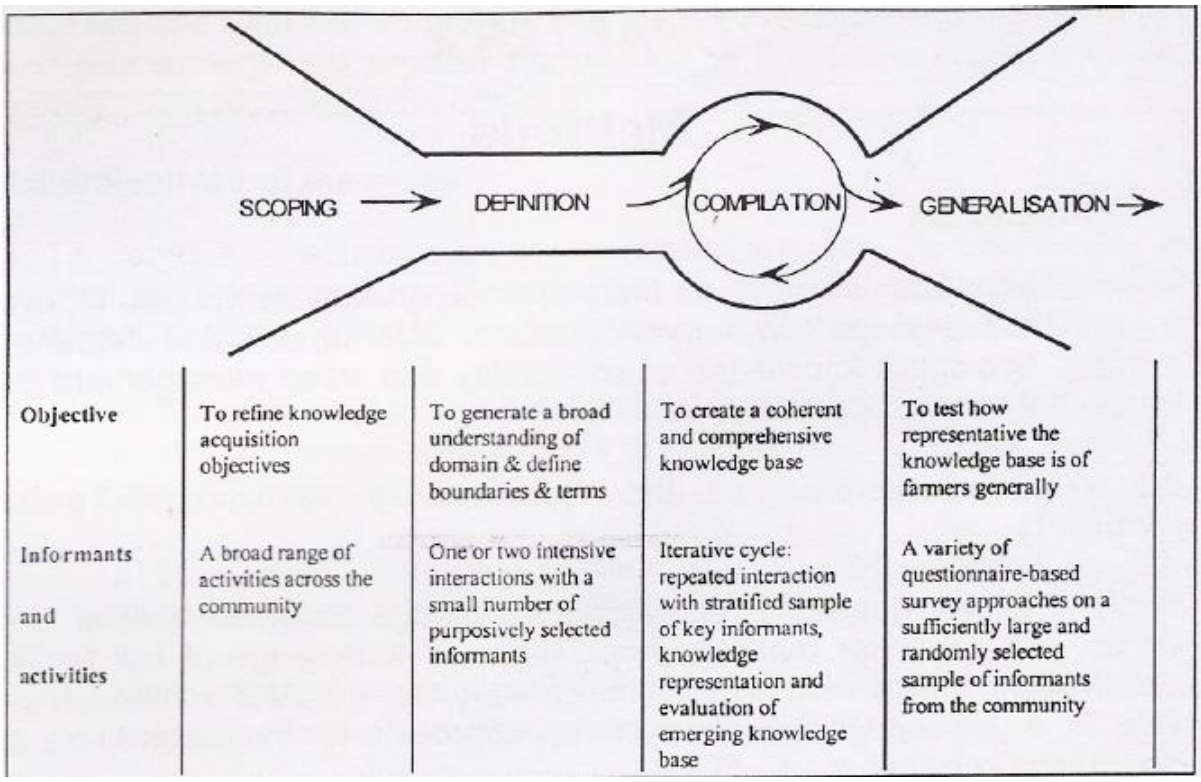
This chapter is devoted to a detailed description of the research methodology employed during the study. Essentially, it discusses the process by which data were collected, analysed, interpreted and reported. It is organised under three thematic sections discussed below:

3.2 Research Design

The research was case study based, limited to ten (10) selected communities buffering the KCA. Due to the nature of the topic and in order for the researcher to gain an in-depth understanding of the research problem, the case study approach was deemed suitable.

Based on the Dixon (2001) model of knowledge elicitation process (i.e. scoping, definition, compilation and generalisation), local ecological knowledge and planting decisions of cocoa farmers in the selected communities was elicited through the use of participatory rural appraisal techniques, namely, focus group discussions and interview questionnaires. Figure 3.1 illustrates a summary of Dixon's (2001) four stage knowledge elicitation process.

Figure 3.1: A Framework for Designing a Knowledge Elicitation Strategy



Source: Sinclair and Walker, 1999

3.2.1 The Selected Villages

The study was conducted in ten (10) villages organised into three clusters namely **A** (Homaho, Appiahkrom, Jerusalem, Nkwantaanan), **B** (Afiaso, Bobi, Antwikwaa) and **C** (Anomakwa, Gyaeware, Otabilkrom) based on their geographical distribution. The rationale for classification was to ensure the ease of data representation.

These villages were randomly selected after initial visits to the study area and based on briefings by officials of the GWD in charge of the KCA. The criteria for the village selection included, the proximity to the forest margin and their relative location around the KCA. Villages within cluster A, B and C are respectively situated in the northern, western and southern flanks of the KCA (figure 4.1).

3.2.2 Scoping

To facilitate unrestricted access during the actual survey and acquire preliminary information on farming systems in the selected communities, the researcher embarked on exploratory visits to the study area on two separate dates, 20th and 23rd June, 2013. During this period, courtesy calls were paid to the village authorities to explain the purpose of the investigation and to obtain formal ratification in accordance with local custom. Initial key informant interviews, expert consultations, transect walks (along the Park Boundary) and farm visits were conducted, after which the respondents were selected.

Plate 3.1: Introduction to the Chief and Elders of Bobi Village.

3.3 Actual Survey

After the reconnaissance survey, the actual field survey was conducted spanning a period of one month from 2nd July to 1st August, 2013. A detailed exposition of the entire process is elucidated below:

3.3.1 Selection of Key Informants

Following the demands of the study, targeted cocoa farmers in each village (key informants) were stratified into two classes, **CLASS 1 and CLASS 2**. CLASS 1 comprised of farmers farming within two kilometre range from the forest margin whilst CLASS 2 comprised of farms beyond two kilometre from the forest margin. Kumar (1987) explained that, key informants have been defined as a selected group of individuals who are likely to provide information, ideas and insights on a particular topic. In view of this, Anglaare (2005) indicated that several approaches including socioeconomic factors (gender, ethnicity etc.) and extent of subject knowledge have been employed by researchers in sampling key informants.

Regarding this study, the initial scoping exercise coupled with briefings by village authorities and park rangers enabled the key informants to be purposively identified based on their local knowledge in cocoa farming. In all, 250 cocoa farmers (150 farming next to the forest margin and 100 away from it) were sampled and interviewed. A summary of the distribution of respondents by village is presented in Table 3.1 below.

Table 3.1: Distribution of Key Informants

Village Cluster	Village	Farmers Interviewed		Total
		Class1*	Class 2*	
A	Homaho	25	15	40
	Appiahkrom	10	10	20
	Jerusalem	10	10	20
	Nkwantaanan	10	10	20
B	Afiaso	10	10	20
	Bobi	30	10	40
	Antwikwaa	10	10	20
C	Anomakwa	25	15	40
	Gyaeware	15	5	20
	Otabilkrom	5	5	10
Total		150	100	250

Source: Field Survey, 2013.

***** Class 1= Farmers closer to the edge and Class 2= Farmers away from the edge.

Apart from the selected cocoa farmers, institutional respondents such as officials of the FSD, GWD, Local Produce Buying Agents and Farmer Associations were also interviewed on some selected issues.

3.3.2 Data Collection

As averred by Jancowicz (2000), different kinds of issues demand various kinds of data gathering sources in order to ensure that the data are relevant, adequate, accurate and capable of providing findings that could be applied generally. In this light, data were collated from two principal sources, namely primary and secondary sources.

Documents both historical and contemporary, are a rich source of secondary data for social research (Punch, 1998). Thus through a review of relevant literature in articles, working documents and journal publications, data on the history of the KCA, land tenure and land use information of respective communities were obtained.

In view of this, information about farmers' ecological knowledge of forest-agricultural landscape interactions and their planting decisions was obtained through conducting informal interviews and focus group discussions with sampled respondents. Informal interviews and focus group discussions were deemed suitable because interviews are a good way of accessing people's perceptions, meanings, definition of situations and the construction of reality (Punch, 1998). They also afford flexibility in responses by interviews and are helpful in exploring areas of research that have received little prior attention such as farmers' ecological knowledge of forest interactions and planting decisions (Berg, 2009).

Despite some writers (e.g. Greer, 1991) arguing that focus group interviews are time consuming and difficult for analysis, they allow for dozen of persons to discuss the subject matter. Hence a useful approach to verify and fill identified data gaps from individual interviews (Ellis, 1994).

Against this background, the researcher, together with two other colleagues, all from the Environmental Change Institute (ECI) of Oxford University administered the interview questionnaires and visited respondents' farms for data verification. The team was assisted by one research assistant (a final year student of the University of Ghana) and a park-ranger, who were well-briefed to make sure they understood what was required of them. A checklist of themes was prepared to make sure nothing important was left out.

Appointments with key informants were pre-arranged a day before by the park-ranger and interviews were usually conducted early in the morning (about 7 am) lasting for about one-half hours. Tuesdays were usually used for the focus group interviews as farmers in the study area do not go farm on such days. Additionally, farm visits and transect walks along the boundary line of the reserves were usually done in the afternoons to validate responses gathered during the individual and group interviews.

Prior to commencing the interviews, the research team first explains the purpose of the visit and the study objectives before requesting permission to tape record the conversations. Having obtained the respondent's approval, the interview commences. As stated earlier, focus group interviews were organised inviting more than 50% of the key informants in each village, mainly to confirm the responses and fill in data gaps. Respondents patronised and actively participated in these sessions. The plate below typifies a focus group session in one of the villages.

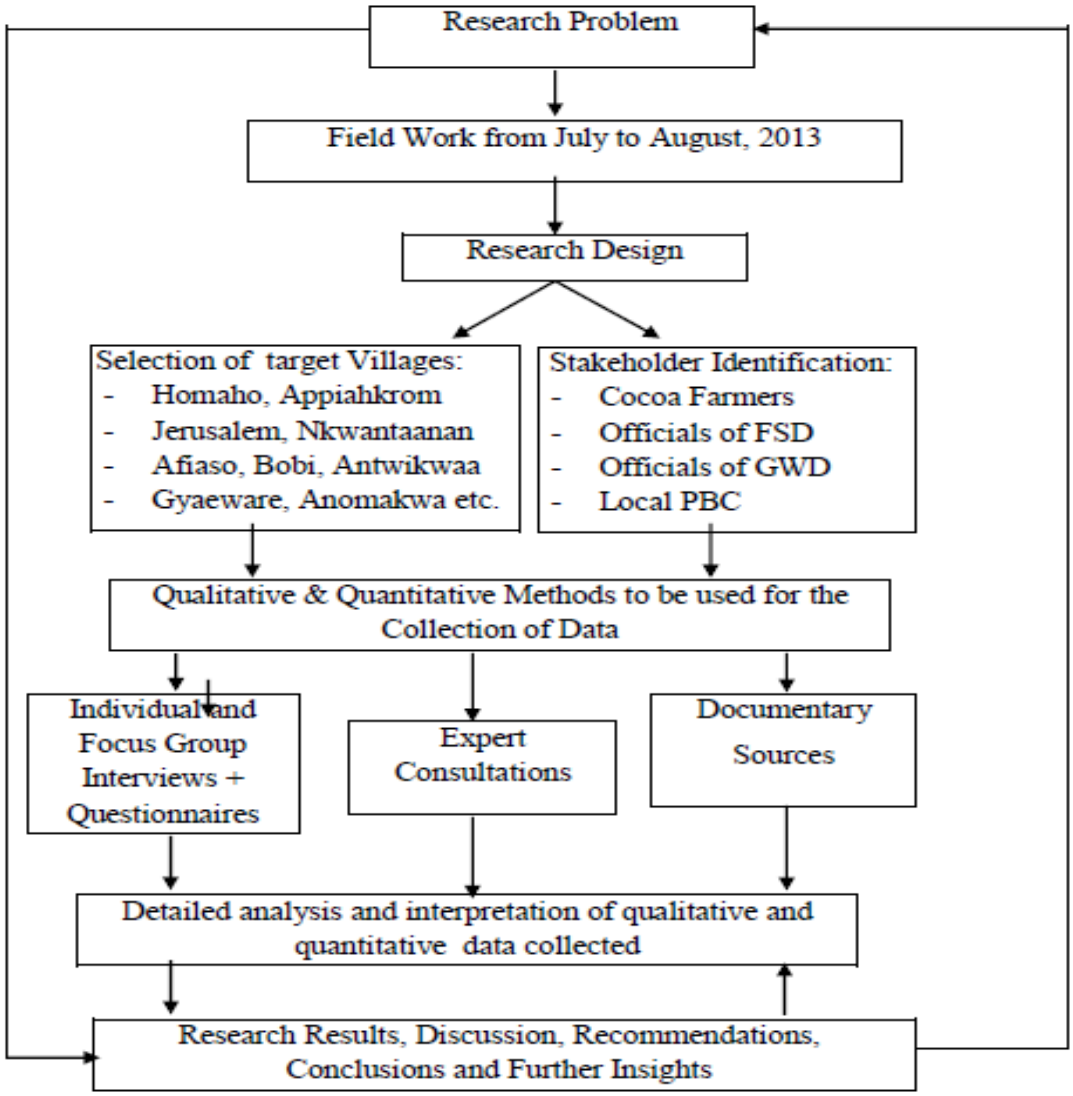
Plate 3.2: An Example of an Interview and Focus Group Session

3.3.3 Data Analysis and Reporting

The interviews were mainly conducted in Twi (a local Ghanaian language) in the case of the farmers and in English for the institutional stakeholders i.e. officials of the FSD and GWD. Afterwards, the tape recorded conversations (largely qualitative) were manually transcribed by the researcher and organised into themes employing thematic content analysis. Thematic content analysis (Holliday, 2002; Saldana, 2009; Darko-Mensah, 2011) involves the grouping of responses into broad themes to facilitate a detailed analysis of the field data.

Responses to pre-coded interview questions (such as farm sizes, yields and other demographic features etc.) were collated and fed into the Statistical Package for Social Sciences (SPSS) software (Version 20). Based on analysis of the qualitative responses and generated graphical outputs, inferences and generalisations of farmers knowledge forest-crop interactions and their planting decisions were made. A flowchart giving a snapshot indication of how the fieldwork was conducted is presented below:

Figure 3.2: A Schematic Representation of how fieldwork was conducted



Source: Author's Construct, 2013

3.4 Limitations of the Study

Although the study objectives were achieved, there were a number of limitations that if overcome, could improve some of the findings stated. First and foremost, the time frame for field work was approximately one month, which was inadequate given the size of the study area and the time demands of interviews. Thus interviews were conducted in whatever limited time farmers could offer. Additionally, the researcher only managed to visit ten (10) villages out of the about four hundred (400) villages buffering the KCA. Future research on farmers local knowledge in the study area should consider more villages to make the sample more representative.

Notwithstanding these limitations, the focus group interviews and feedback sessions with key informants and extra briefings by resident park rangers and extension officers allowed for knowledge triangulation.

CHAPTER FOUR

STUDY AREA PROFILE

4.1 Introduction

This chapter presents an overview of the Kakum Conservation Area highlighting its historical development, political administration and the major land use arrangements.

4.2 Brief History of the Kakum Conservation Area

The KCA is located in the Central region of Ghana and comprises of the Kakum National Park and its adjacent Assin-Attandanso Resource Reserve. Both reserves lie within latitudes 5^{o} 20` and $5^{o}$ 40` north and longitudes 1^{o} 30` and $1^{o}$ 51` west forming a block of 366 km^2 in the moist-evergreen zone (see figure 4.1 and Appendix 7).

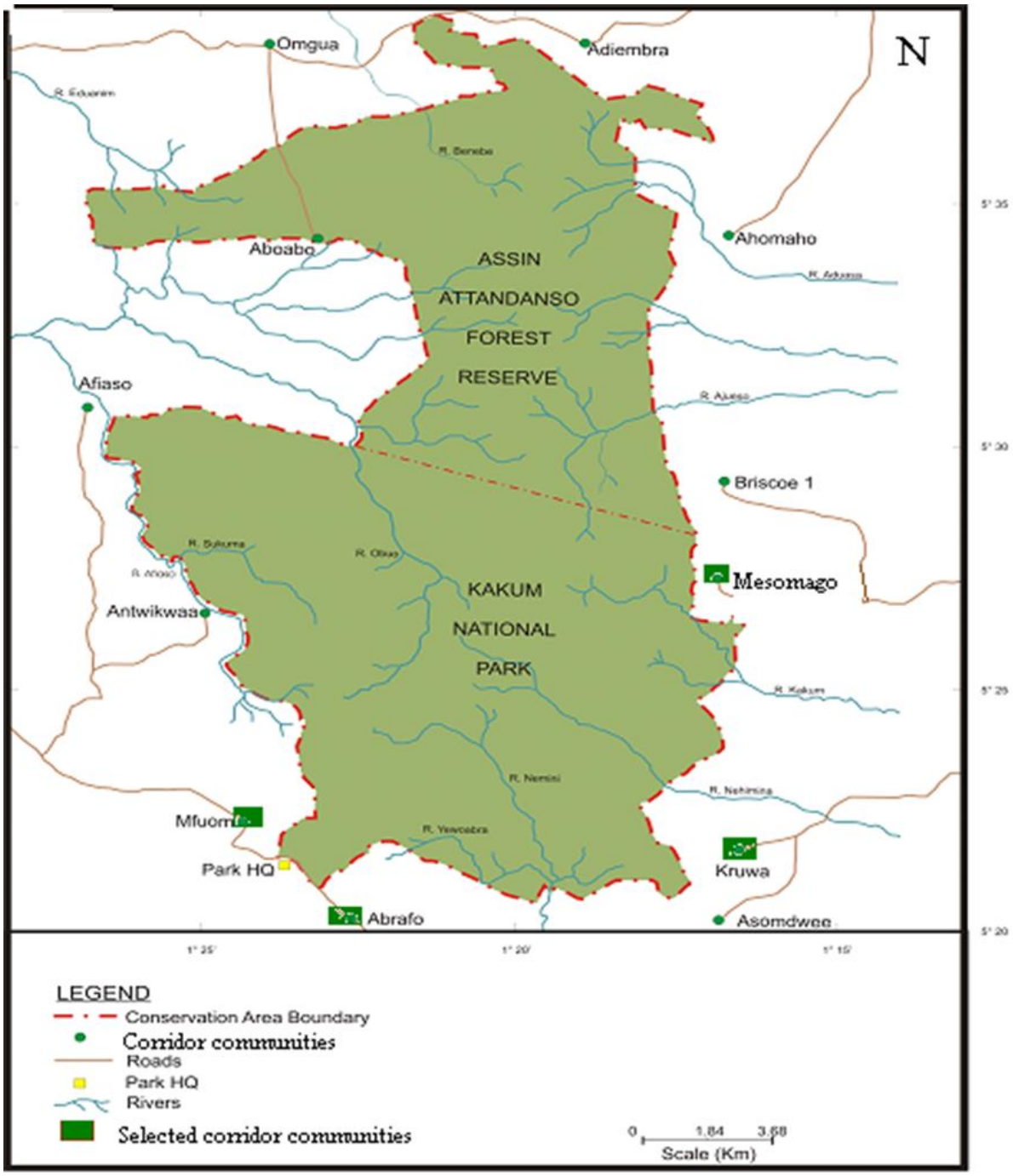
The history of Kakum Forest Reserve dates back to 1925 and 1926 (Kpelle, 1993), when it was selected and demarcated as a protected area following a recommendation by the Central Region Development Commission (CEDECOM). CEDECOM (established by the then Central Region Administration with the remit of overseeing the development of Cape coast), in search of a natural environment that blends well with the other tourist attractions (i.e. beaches, old forts and castles) subsequently identified the Kakum Forest Reserve as a "perfect setting".

Thus, by a Gold Coast Gazette Notice in 1933, the then Governor constituted the demarcated area into a forest reserve under Section 4(4) of the Forest Ordinance, Cap 63 purposely to protect the watershed of rivers and streams in the area. Human activities such as hunting and logging were however permitted in the reserve. The Forest reserve traditionally belonged to Assin Attandanso, Twifo Heman, Denkyira and Abura States, whose traditional leaders leased their portions of the forest to timber companies for extractions of timber on a commercial basis. Residents of the fringe communities gathered non-timber forest products

such as chewing sticks, canes, medicinal plants, snails and raffia from the reserve. Hunting and logging were therefore undertaken on both subsistence and commercial basis to supplement household incomes. The problem of hunting and logging coupled with the influx of migrant farmers such as the Kruwa community into the area however accelerated the clearance of the forest resulting in degradation of the reserve (Oppong, 2007).

CEDECOM identified Kakum Forest reserve in 1989 and approached the GWD to conduct a survey in the reserve to find out its suitability for ecotourism. The reserve was designated as a tourist site and formed part of the integrated Tourism Development Scheme of the region. It was officially made a national park under the Wildlife Reserve Regulation (L.I 1525) in 1992. The GWD was therefore mandated to take control of the park and a law was passed the same year making Kakum a no-go area. Local people have been denied access to the reserve on which they had previously depended for their livelihood.

Figure 4.1 The Area and Extent of the KCA.



4.3 Political Administration of KCA

The study revealed that KCA falls in the area of jurisdiction of three districts, namely Twifo Heman Lower Denkyira District, Komenda Edina Eguafo Abirim District and Assin North District Assembly. Although these districts officially play no role in the management of the

park, the assemblies are occasionally conduct awareness and anti-poaching campaigns in the fringe communities.

Similarly, the communities around the Kakum Park do no play any role in the management of the park even though the lands of the fringe communities were converted into the park. Compensation has not been paid to communities whose lands were acquired compulsorily by the Government.

4.4 Major Land Uses around the KCA

Apart from the protected reserves (i.e. the Kakum National Park and Assin-Attandanso Game Reserve), the dominant land uses surrounding the KCA are village settlements and farmlands established initially from the virgin forest and currently from secondary forests and abandoned cocoa farms outside the protected area. These farmlands are mainly for subsistence and commercial agriculture, with major cash crops like cocoa, oil palm, and citrus cultivated. Other food crops cultivated include maize, cassava, plantain, cocoyam, yam and vegetables.

CHAPTER FIVE

RESULTS AND DISCUSSION

5.1 Introduction

This chapter captures a presentation of the analysed results, deductions and inferences made, taking account of the study objectives outlined in Chapter One. It proceeds with an identification of the study objectives and demographic features before presenting the results of the analyzed data.

5.1.1 Study Objectives

The overarching aim of this study was to assess farmers knowledge of forest-agricultural landscape interactions in the KCA. The purpose was to determine whether knowledge of such interactions influence farmers' decision to farm closer to the forest edge or away from it. The results of the data analysis are presented as follows:

5.2 Demographic, Environmental and Climatic Conditions in KCA

5.2.1 Demographic Characteristics

Songsore (1998) explained that population refers not only to numbers of people but to density, age and sex composition, occupational structure and above all, the quality of the trained human resource of an area. Regarding KCA, official records of the Wildlife Division shows that there are about 400 fringe communities with a total population of about 93,562 as per the 2000 Population Census Report.

Of all the respondents interviewed during the survey, 198 (79.2%) were male and 52 (20.8%) female. Out of this total, 228 (91.2%) were married with 2 (0.8%) single, 9 (3.6%) divorced and the remaining either widowed or separated. In terms of age distribution, a majority of the respondents (56%) were between 30 to 50 years constituting the working population who were mostly men. Further analysis of responses revealed that, the majority of the respondents

have had some level of formal education. 109 (43.6%) respondents were in the elementary category, 48 (19.2%) completed vocation/ secondary school, 91 (36.4%) had never been to school and less than 1% had completed tertiary education. This is a fair reflection of national statistics where 31% of all adults have never been to school and about 39% have elementary education (GLSS5, 2008). Table 5.1 below summarises the demographic characteristics of the sampled respondents.

Table 5.1: Summary Demographic Data of Respondents

Characteristics	Group	Community Cluster			Total (%)
		A	B	C	
Age (years)	< 30	6	4	2	12 (4.8%)
	30- 50	58	39	43	140 (56%)
	> 50	36	29	33	98 (39.2%)
Gender	Male	80	57	61	198 (79.2%)
	Female	20	13	19	52 (20.8%)
Education	Illiterate	40	24	27	91 (36.4%)
	Elementary	43	35	31	109 (43.6%)
	Sec/ Voc/Tech	17	9	22	48 (19.2%)
	Tertiary			2	2 (0.8%)
Communal Status	Native	43	25	33	101 (40.4%)
	Stranger	57	45	47	149 (59.6%)
Farmer Genealogy	1st Generation	23	42	51	116 (46.4%)
	2nd/3rd Gen.	77	28	29	134 (53.6%)

Source: Field Survey, 2013.

The sampled communities in table 5.1 are organised into clusters A (Homaho, Appiahkrom, Jerusalem, Nkwantaanan) , B (Afiaso, Bobi, Antwikwaa) and C (Anomakwa, Gyaeware, Otabilkrom) to allow for easy illustration. The demographic data is important because, it to a large extent informs the planting decisions and ecological understanding of respondents.

5.2.2 Ethnicity of Respondents

It was discernible from the survey that a majority of the respondents are settler farmers, who have migrated from other parts of the country to settle in the study area mainly for farming purposes. 86 (57.7%) were Fanti (from Gomoa, Ahanta, Efutu and Guan). The remaining constituting 63 (42.3%) had migrated from other parts of Ghana. Oppong (2007) recounts that the KCA traditionally is shared by Twifo, Assin, Denkyira and Fanti (Abakrampa) people, all of the Central region, with the Assins believed to have migrated to their present location from parts of Ashanti. This group forms Assin-Attandanso, Apimanin and Efutu-Ekwa (Agyare,1995).

5.2.3 Occupational Dynamics of Respondents

As alluded to earlier, agricultural land uses are predominant around KCA denoting that farming is the dominant occupation. Considering the dictates of the study, all respondents interviewed were cocoa farmers but a further inquiry was made to ascertain whether respondents had secondary jobs. In response, only 107 (42.8%) of the total answered in the affirmative. They cited other activities like petty trading, masonry, chainsaw logging and driving which were undertaken to supplement their farming income.

5.2.4 The Physical Environment and Climatic Conditions

According to Hall and Swaine (1976), the entire KCA is located within the moist evergreen and semi-deciduous forest zone. The vegetation comprises of mainly *Celtis Zenkeri-Triplochiton Seleroxylon* moist semi-deciduous forest, which is transitional towards the more rainforest type *Lophira alata- Triplochiton* association in the southern part of the Kakum Reserve (Dudley et al. 1992).

Rainfall is bimodal occurring in March-July and September-November followed by a long dry season between December and March. KCA has an average annual rainfall of 1,500-

1,700mm with generally light south westerly winds. The average relative humidity is about 85% with temperature fluctuating between 10.2^{o} C and 31.6^{o} C (Ghana Wildlife Division, 1996).

5.3 Farming History and Trends

Given the focus of the study as outlined above, the survey solicited information about farmers planting history and practices. Analysis of the various responses is discussed in the succeeding sections.

5.3.1 Farming Systems and Crops Cultivated

It was discernible from the survey that nearly all the farmers (98.4%) practiced mixed cropping and slash and burn farming techniques. Asked how many used chemical fertilisers and pesticides on their farmers, 96.4% of the farmers responded in the affirmative, whilst the remaining 3.6% claimed that their farms were still less than 4 years and therefore did not require fertiliser and chemical application. During the focus group sessions, the farmers confirmed that the commonly used fertilisers were *Asaasewura* and *Cocoafeed.*

In view of this, farmers were quizzed on other crops they cultivated beside cocoa (which was the dominant cash crop). The majority of the farmers (98.4%) confirmed that they intercropped cocoa with other food crops like maize, plantain, cassava and cocoyam. 23 (9.2%) of the farmers also indicated that they had oil palm and citrus farms. Regarding the variety of cocoa cultivated, 234 (93.6%) cultivated *Amazonia* (Agric) as opposed to 3 (1.2%) who cultivated *Amelonado* (Tetteh Quarshie). The remaining 13 (5.2%) had a mixture of Amazonia and Amelonado varieties (table 5.2).

Farmers displayed sufficient knowledge of the characteristics of the cocoa varieties cultivated during the focus group interviews. They acknowledged that the *Amazonia* (a hybrid variety developed by the CRIG) matures faster (between 3 to 4 years of cultivation) and has a high

yield. The *Amelonado* on the other hand, is an old variety which characteristically has low yield, late maturity and is difficult to maintain. The *Amelonado* variety was mainly found in old cocoa farms above 30 years in age.

Plate 5.1: An Example of a Cocoa Farm

5.3.2 Farmers' Experience

Farmers were asked about how they started cocoa farming and length of their experience. 134 (53.6%) were 2nd and 3rd generation farmers, implying that they inherited some farms from their parents or other relations. 116 (46.4%) indicated they started the farms all by themselves (1st generation farmers). On the question of their farming experience, 97 farmers (38.8%) stated that they have been farming for over 20 years, whilst 135 (54%) stated between 11-20 years experience. 18 farmers (7.2%) had 10 years or less experience. From the analysis of data, it was discovered that the length of farmers' experience largely influenced key planting decisions discussed in later sections.

5.3.3 Farm Age and Size

During the survey, farmers were questioned about their farm ages and sizes. It came to light that, majority of the farms were small in size and fairly old; reflecting respondents' status as smallholder farmers. Regarding the age distribution of farms, 80 (32%) farmers had farms ranging between 1 to 10 years with only 44 (17.6%) with farms over 20 years.

Quizzed about their farm sizes, 146 (58.4%) of the farmers interviewed indicated that their farms were approximately 1-5 acres. 70 farmers (28%) had farm sizes between 6-10 acres whilst 21 (8.4%) and between 11-15 acres respectively. Only 13 farmers (5.2%) had cocoa farms above 16 acres. Additionally, the analysis of data showed that, 80 farmers (32%) indicated that their farms were replanted cocoa farms. It can be speculated that, the reconversion of old and abandoned cocoa farms could be attributed to the limited available land and or, the COCOBOD initiative to rehabilitate old and abandoned farms started in 2011. Table 5.2 shows a summary of the farm characteristics discussed.

Table 5.2: Respondents Farm Characteristics

Category	Classification	Responses
Farmer Experience (years)	1-5	
	6-10	18
	11-15	50
	16-20	85
	Above 20	97
Farm Age (years)	1-10	80
	11-20	126
	Above 20	44
Farm Size (Acreage)	1-5	146
	6-10	70
	11-15	21
	16-20	3
	21-25	7
	26+	3
Variety of Cocoa	Tetteh Quarshie	3
	Amazonia (Agric)	234
	Mixture	13
Farm Type	Replanted	80
	New Planting	170

Source: Field Survey, 2013.

5.3.4 Farmer Associations and Extension Services

Although majority (56%) of the farmers interviewed did not belong to any association, the minority who constituted (44%) admitted that they benefitted from training schemes on farm maintenance (i.e. fertiliser and chemical application, water conservation and waste management techniques) organised by local NGOs. 65 farmers (26%) conceded that by virtue of their Association membership, they had access to soft loans, pesticides and fertilisers on

credit. Amongst the Farmer Associations identified by respondents included the Cocoa Conservation Association, *Akuapa-Adanfo* etc.

Even though a majority (82%) of the farmers acknowledged that they benefitted from government extension services, they lamented the services were irregular owing to the limited number of extension officers. The remaining (18%) farmers mostly in the smaller villages (Otabilkrom, Appiahkrom) articulated that they only relied on their own experience and occasional support from some local NGOs.

As typified in figure 5.1, the majority of the farmers interviewed are not members of any formal association, which implies their means of farm education is through training sessions organised at the community level and learning from colleague farmers who are members of farmer associations. Asked why they are not members of any association, the majority (47%) claimed such associations were absent in their villages, whilst the remaining (9%) simply retorted that "….we do not have money to pay membership dues".

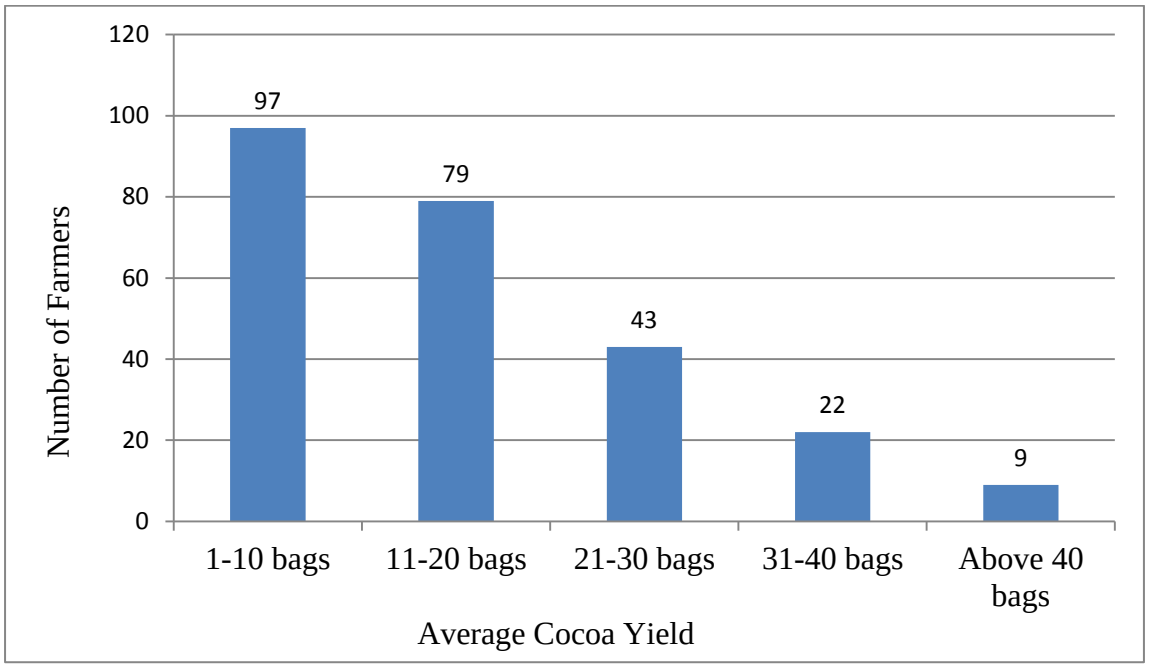
5.3.5 Farm Productivity

The productivity of cocoa farms remains vital for farmers, as that invariably determines the profitability of cocoa farming as an investment. It was evident from the survey that, all the farmers interviewed depended directly on the sale of cocoa (approximately GHC 200 per bag) for their basic sustenance, although no accurate records of yields were kept. The absence of detailed record keeping by the farmers was mainly due to their low level of education and the phasing out of the cocoa passbooks which held detailed records of their annual yields, recorded by licensed produce buyers.

Plates 5.2 and 5.3: A Cocoa Pod and Dried Beans

Nonetheless, the yield records of some farmers were verified from the local produce buying agents in the respective villages. Analysis of figure 5.2 showed that 97 (38.8%) of farmers produced between 1 to 10 bags of cocoa, with 79 (31.6%), 43 (17.2%) producing between 11 to 20 and 21 to 30 bags respectively. The remaining 31 farmers (12.4%) recorded yields above 30 bags of cocoa.

Figure 5.1: Average Cocoa Yield of Farmers



Source: Field Survey, 2013.

Figure 5.2 vividly shows that most of the farmers recorded yields lesser 30 bags, giving an indication of their status as smallholder farmers. When questioned about factors that influenced the level of cocoa yields, farmers identified the size of farm, age and management practices. It is worth noting that the recorded yields correlated directly with the size and age of farms, as evidenced in Section 5.3.6

5.3.6 Relationship between Farm Size and Yield

From figure 5.2, a positive correlation between farm size and average yield is discernible, which becomes obvious with increasing farm size.

Figure 5.2: Relationship between Farm Size and Average Yield

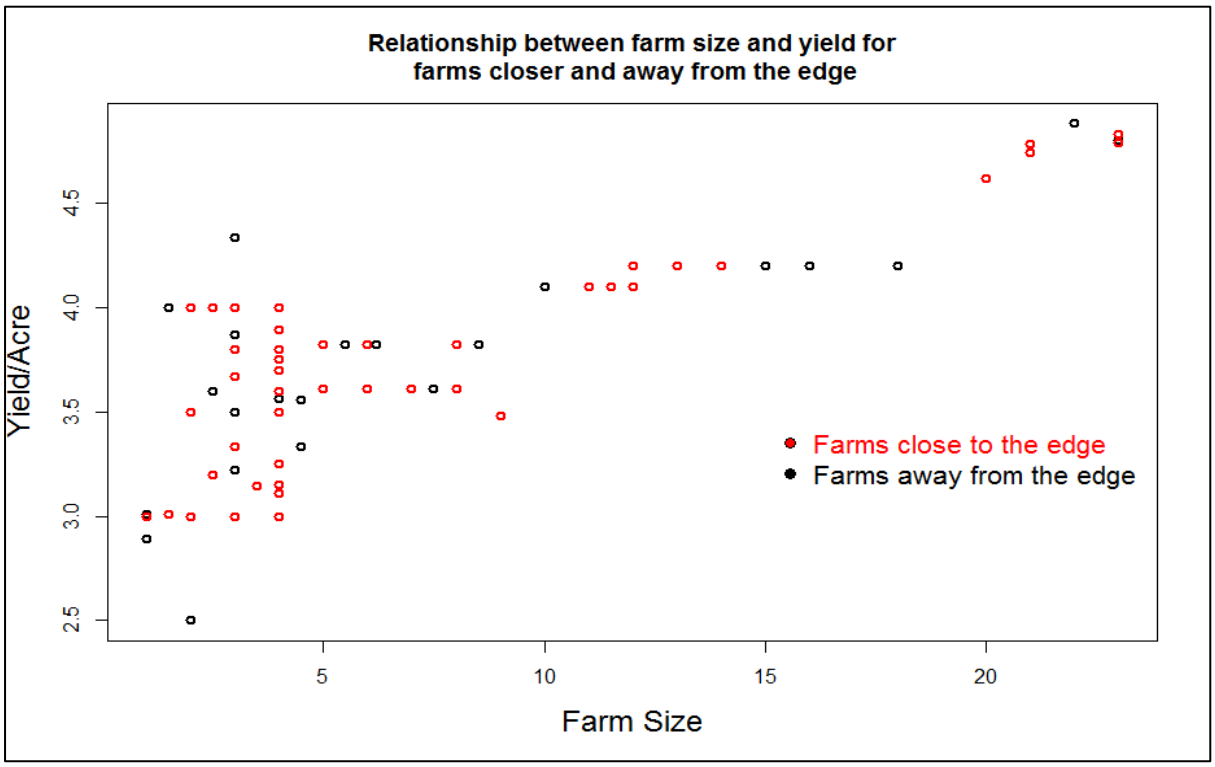
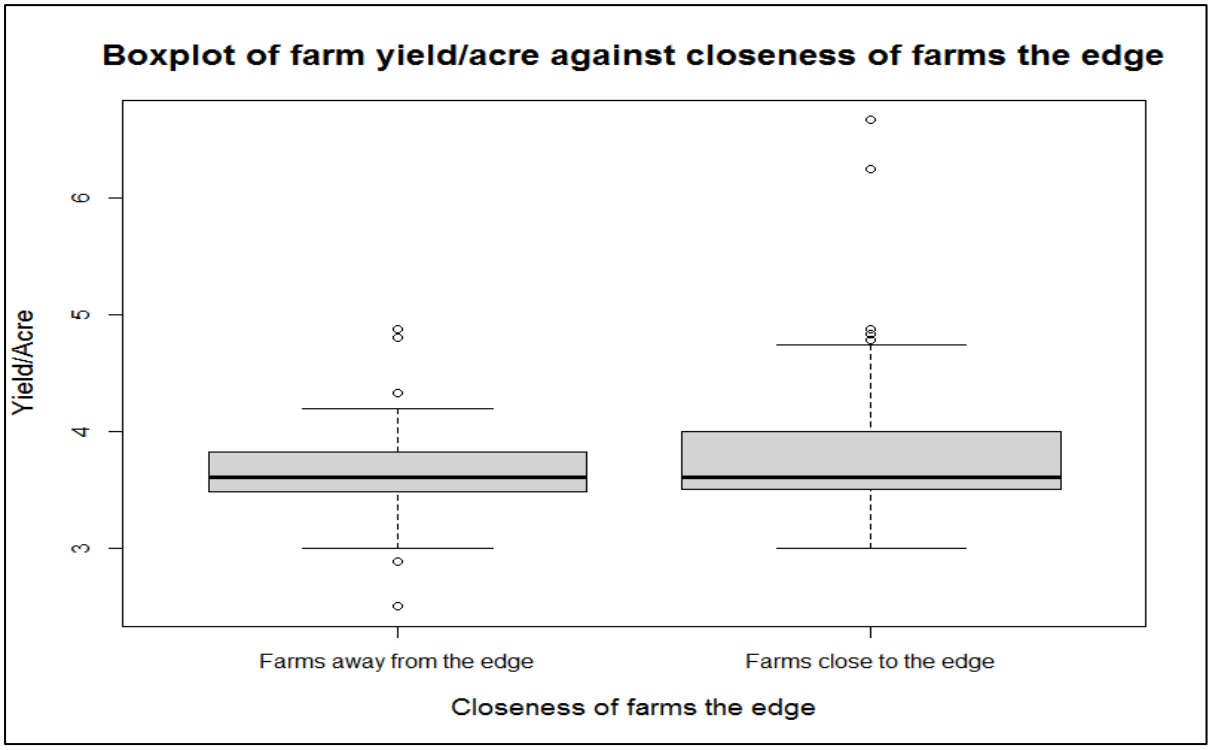


Figure 5.3: A Box Plot Comparing Yield



It is observed from plot that farms close to the edge have average yield almost the same as farms away from the edge. Thus, there is no significant difference between the yield of farms close to the edge and farms away from the edge. Additionally farms close to the edge have higher variability in yield compared to farms away from the edge. This may be due to the effect of crop-raiding, management practices which results in an unstable yield by farmers closer to the edge.

5.4 Farmers Ecological Knowledge and Perceptions

The importance of local knowledge has been emphasised in Chapter Two of this study. Walker *et al.*(1995) concluded that the creation of a knowledge base representing local ecological knowledge of a community of interest can have a significant utility in better understanding that community and thereby make research and extension services more relevant to that community. In this light, results of farmers local knowledge and perceptions about forest-agricultural landscape interactions are presented as follows.

5.4.1 Perceptions about the Forest

Farmers' perceptions of the Kakum and Asian-Attandanso forests were solicited. They were asked about their conception of forest importance and the influence on farming activities in the study area. From the survey, all farmers perceived the forest to be very important and citing three principal reasons:

- ✓ Microclimate Regulation

Of the 250 farmers who were interviewed, 242 (96.8%) identified that the forest plays an important role in their farming activities by enhancing rainfall, and regulating temperature conditions which is critical for cocoa cultivation especially during the seedling stage. They pointed out that during the dry season (December to March), enhanced dew deposition mainly in farms closer to the forest margin provides soil moisture balance for sustaining their

crops. A cross section of the farmers (about 32.7%) also observed that, the forest serves a wind barrier protecting their crops and houses from adverse winds during the harmattan seasons.

- ✓ Conservation of Biodiversity

247 (98.8%) out of the 250 farmers interviewed articulated that, the forest provided suitable habitat and protection for various rare fauna and flora species. Notable amongst the tree species identified in the KCA include *khaya ivorensis* (African Mahogany), *millicia-excels* (Odum), *triplociton scleroxylon* (wawa) and other medicinal plants. The category of animal species include, *tragelaphus scriptrus* (bushbuck), cephalophus (duikers-ogilby maxwell blayblack, black-backed, grey-crowned), *neotrbgus pygaeus* (royal antelope), *thrynonys svinderienous* (cane rat) etc. (Kakum National Park Guide, 2010).

- ✓ Tourism and Employment Opportunities

In view of the above, the forests were identified by farmers as important national assets and revenue sources for the Government of Ghana. They explained that through tourism, employment opportunities are created for the youth in the fringe communities.

Regarding the use of products from the reserve, all farmers interviewed responded in the opposite. The common statement that featured in all the interview sessions was "…we are not allowed to enter the reserve; and if you are caught entering by the GAME (Wildlife personnel), you will be severely beaten and reported…". During the focus group interviews, it emerged that, prior to declaring the entire KCA as a protected area; farmers had access to the forest for harvesting wood products, medicines and hunting which constituted an integral part of their livelihood.

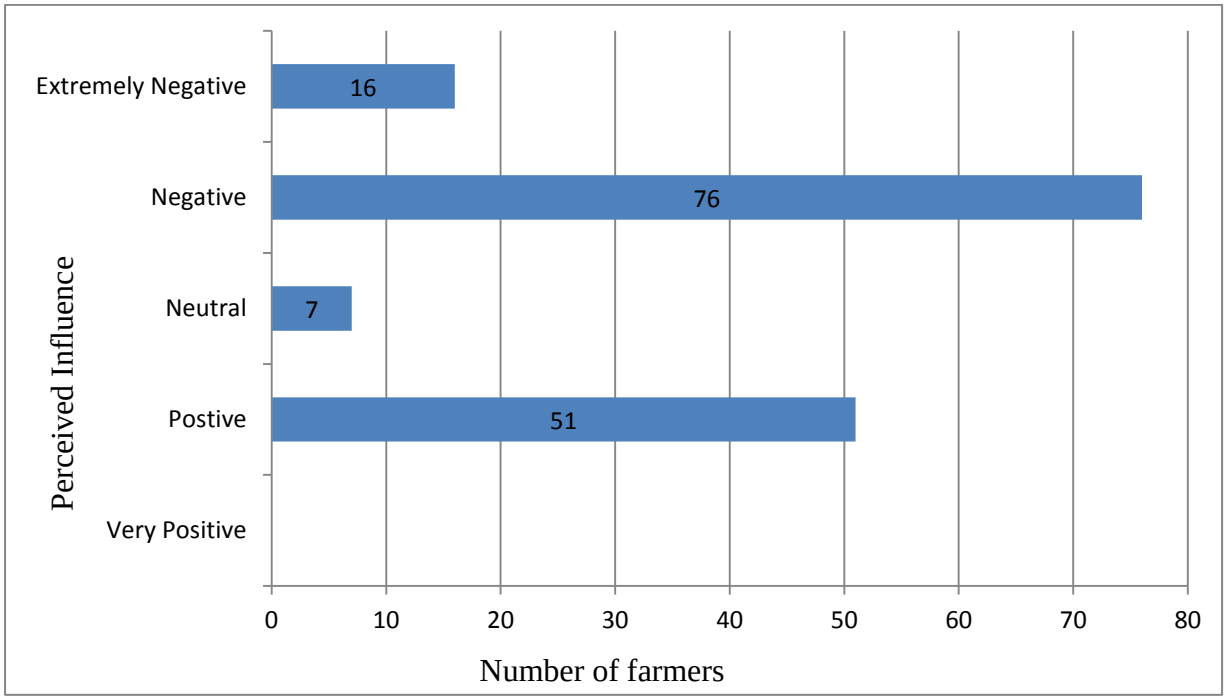
Nevertheless, majority of the farmers conceded that the protection of the forest has enhanced the conservation of biodiversity. Some officials of the GWD claimed that, farming activities closer to the forest margin has resulted in a decline in the habitat range of some fauna species

which sometimes stray outside the reserve to browse. This phenomenon, they explained has exacerbated the problem of crop raiding discussed in Section 5.5.1.

5.4.2 Forest Influence on Farming Activities

Edges may have either positive or negative impact on ecosystems depending on the type of effect (Broadbent *et al.* 2008). To this end, farmers farming closer to the forest edge (Class 1) were interviewed on how it influences their farming activities. Of the 150 farmers in this category, 92 (61.3%) farmers perceived the influence of the forest on their farming activities to be negative as opposed to 51 (34%) farmers indicated a positive influence. The remaining 7 (4.7%) farmers maintained that the influence is neutral. The perception of farmers about the general influence of the forest is graphically represented below:

Figure 5.4: Farmers Perception about the Forest Influence on Farming Activities



Source: Field Survey, 2013.

When asked about the benefits associated with farming closer to the forest margin, the opinions of farmers were divided. 83 (55.3%) farmers responded positively as against 67 (44.6%) who did not recognise any net benefit with farming closer to the forest. Prominent

amongst the reasons for farming nearer the forest margin included land availability, good soil conditions, improvements and quality of crop yields, protection against livestock grazing and theft. Nonetheless, farmers added that crop raiding in farms next to the forest margin constituted a great nuisance and cost to their farming operations. To this end, the farmers were quizzed about whether the proximity of their farms to the forest margin influenced their yields and the resistance to pests and diseases. Analysis of farmers' responses is presented in the next section.

5.4.3 Influence on Cocoa Yields

On the question whether proximity to the forest margin affected cocoa yields, farmers indicated that a combination of factors come to play. They affirmed that the level of yield is dependent not only on good soil and favourable climate conditions, but farm sizes and management practices (weeding, spraying and fertiliser application). Against this background, 165 farmers (66%) were of the view that on farms around the edge, cocoa fruits are usually bigger and healthier than in farms away. They reasoned that the area around the edge is characterised by good soil and favourable microclimate conditions which supports cocoa growth.

Despite this observation, the farmers lamented that the problem of crop raiding affected yields negatively. During the focus group interviews, they confirmed that the elephants did not only destroy young cocoa trees, but ate the fruits thereby considerably reducing yields. One farmer famously remarked that "…we are now sharing our cocoa with elephants..." Regarding pest and disease resistance of their crops, all the farmers expressed that the proximity of their farms to the edge did not have any influence. Instead, they emphasised that lack of good farm management would result in pest and disease infestation irrespective of the

location of the farm. A comparison of farmers' assessment of farming conditions around and away from the edge is elucidated in Section 5.4.4.

5.4.4 Comparison of Farming Conditions Near and Away from the Edge

In comparing farming conditions near and away from the edge, almost all the farmers interviewed expressed that there are differences in farming conditions which changes with distance from the forest edge. Reasons cited for the difference included the soil fertility and the problem of crop raiding which was prevalent around the edge. Few of the farmers (4.8%) however stated that, with good farm management practices there is no difference in farming conditions either close or away from the edge. The table below sheds more light on the farmers assessment of farming condition away and near the edge.

Table 5.3: Farmers' Assessment of overall farming conditions closer and away from the edge respectively

Description	Farm Location	
	Closer to the Edge	Away from the Edge
Lot Better		
Better	11 (7.3%)	9 (9%)
Good	42 (28%)	38 (38%)
Okay	15 (10%)	35 (35%)
Poor	81 (54%)	18 (18%)
Very Poor		
Don't Know		
Total	150 (100%)	100 (100%)

Source: Field Survey, 2013.

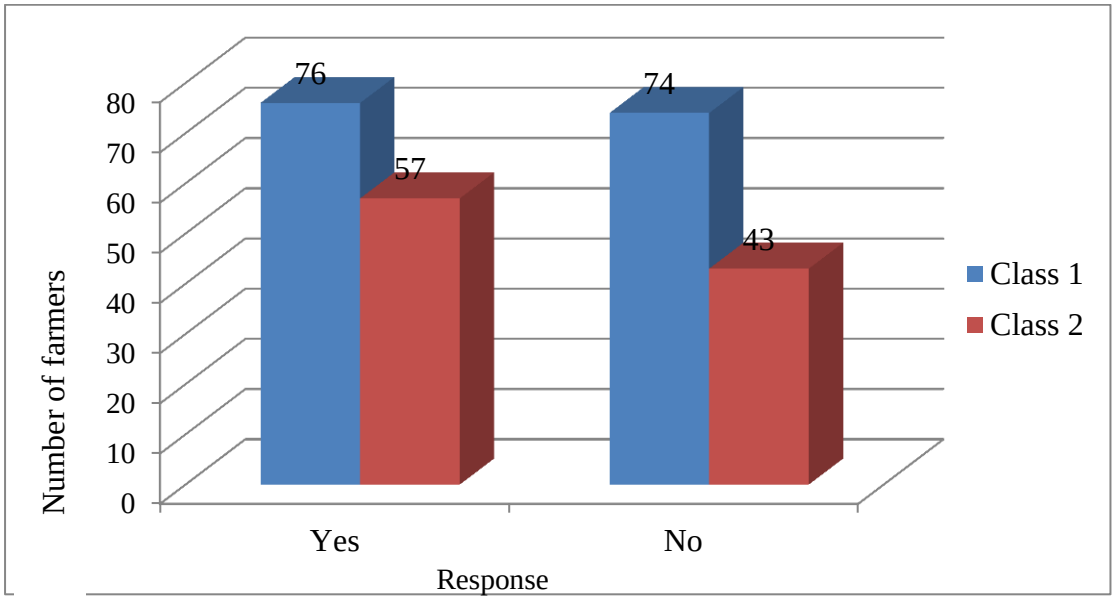
From table 5.3, it is discernible that the majority of the farmers (54%) farming around the edge saw conditions as "poor", as against the remaining (46%) who had differing opinions (i.e. "okay", "good" and "better") about the farming conditions. On the flip-side, out of the 100 farmers farming away from the edge, only 18% described the conditions there as "poor".

The majority of farmers (82%) expressed views which could be inferred as suitable farming conditions. It can be inferred from the analysis that, various factors have influenced farmers' perception about farming near the edge. The subsequent paragraphs shed more light on this observation.

5.4.5 Preference to Farm near the Edge

Following the farmers' assessment of farming conditions away and near the edge, their views on whether they would prefer farming close to the edge was solicited. The import of this question was to gain a holistic picture of farmers' perception about farming conditions around the edge; irrespective of their farm locations. In this regard, 133 (53.2%) of the total 250 farmers interviewed maintained that they prefer farming close to the edge, citing good soil and microclimate conditions as the main motivating factors. The remaining 117 (46.8%) indicated that, they would prefer farming away from the edge. The chief reason for their choice was to avoid crop raiding mostly by elephants, which they describe as pervasive around the edge. Figure 5.5 depicts the views of the farmers' pictorially.

Figure 5.5: Farmers Preference to Farm Closer to the Edge



Source: Field Survey, 2013

From figure 5.5, Class 1 represents all farmers farming close to the edge, whilst Class 2 constitutes those farming away from it. 57 out of the 100 farmers in Class 2 expressed preference to farm near the edge if given the opportunity against 43 who answered "No". Similarly, 76 farmers currently farming closer to the edge (Class 1) answered "Yes" against 74 farmers who responded "No".

These statistics when contrasted with table 5.3 reveal that, despite the majority of the farmers (54%) in Class 1 describing farm conditions closer to the edge as "poor", as much as 50.7% still preferred farming near the edge. Also, of the 82% of farmers in Class 2, who described farming conditions away from the edge as favourable, as much as 57% preferred to farm closer to the edge. This gives the indication that other factors beside farming conditions influence farmers' decisions as to where to farm. The succeeding section discusses the human-wildlife interactions as evidenced during the survey.

5.5 Evidence of Human-Wildlife Conflict

Various studies (e.g. Barnes *et al.* 2005; Sam *et al.* 2005) conducted in the KCA revealed the incidence of crop-raiding on nearby farms. Barnes (1993) concluded that the risk of crop-raiding is highest close to the forest edge and diminishes as one moves further from the forest. Resulting, farmers farming around the edge were questioned on the issue of crop-raiding to ascertain the nature and the influence it has on their planting decisions.

From the survey, all farmers farming around the edge confirmed that crop-raiding is very pervasive, accounting for a significant reduction in crop yields. On the question of animal species responsible for crop-raiding, all the farmers cited elephants as the most destructive species accounting for more than 80% of all crop destructions. They however identified other fauna species like monkeys, duikers, grass cutters and squirrels that also destroy crops.

The farmers articulated that the animals damaged food crops, young cocoa trees and recently ate the cocoa beans. This evidence contradicts the earlier report by Azika (1992) that, the elephants in the Kakum forest only destroyed food crops but did not eat cocoa beans. This phenomenon has resulted in a serious human-wildlife conflict and exacerbated the already strained relationship between farmers and wildlife officials. The farmers blamed the GWD officials for not being proactive in arresting the situation. A common statement by most of the farmers was that "…the elephants used not to eat cocoa, but now they consume everything on the farm..". Captured below are examples of cocoa pod damage in a recently raided farm at Anomakwaa village.

Plate 5.4 and 5.5 Examples of Cocoa Pod Damage

On account of this, the farmers were further asked about the frequency of crop-raiding and the estimated quantity of loss. Analysis of the responses is presented below:

5.5.1 Frequency of Crop-Raiding

It was discovered from the analysis that the frequency of crop raiding varied depending on the stage of growth. All the farmers interviewed affirmed that the crop-raiding was prevalent

during the flowering and fruiting stage. They indicated that the elephants usually raided their farms seasonally at the time the cocoa and other food crops are ready for harvesting (July to October and December to March).

However, the farmers were indeterminate as to the exact quantity of loss but estimated that about 50% of crop yields could be lost. Interestingly, a cross-section of the farmers claimed that the elephant dung served as a medicinal treatment for pregnant women and new-born babies. Thus, they collected elephant dung deposited on their farms for processing and use. The picture below shows piles of elephant dung in the process of drying before for use.

Plate 5.6: Piles of Collected Elephant Dung being Processed

Apart from the initial poaching of animals by the farmers, an official of the Wildlife revealed that, a special task force named the Game Control Unit was established in the 1960s. This unit dealt with the conflict by killing elephants which seem an effective deterrent until the intensification of global pressure through CITIES. Subsequently, several anti-raiding measures have been adopted by farmers (Section 5.5.2).

5.5.2 Anti-Raiding Methods Employed

From the survey, it was discovered that various traditional techniques such as “setting fire” with palm fibre at vantage locations along the buffer zone, noisemaking, use of scarecrows and guarding were still employed in protecting farms. Of the 150 farmers interviewed (Class1), as many as 94 farmers (62.7%) used the traditional methods above, but only 18 farmers (19.2%) described them as effective. Plate 5.7 below shows a demonstration of the noise making technique by a farmer.

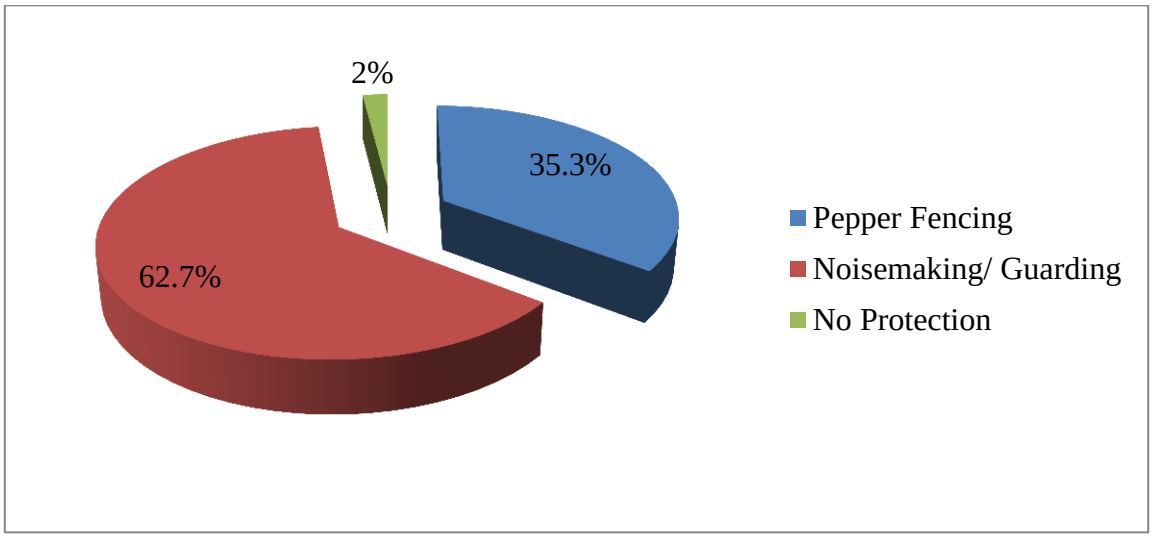
Plate 5.7: Demonstration of the Noisemaking Technique

Moreover, the GWD in collaboration with some conservation NGOs introduced an innovative technique called chilli-based (pepper) fencing as a protective measure against crop-raiding. As described by the farmers, the pepper fencing comprised of ground pepper mixed with “dirty” oil and grease applied on rugs mounted around the edge-facing perimeter of farms. An example of a mounted pepper fencing (also known as pepper bomb) around a farm in Afiaso is shown below:

Plate 5.8 An Example of a Pepper Fencing around a Cocoa Farm

Notwithstanding the fact that few farmers (35.3%) adopted the pepper fencing, all the farmers interviewed admitted that it was an effective but cost-intensive method. They indicated that for an average 1.5 acre farm, it cost about GHC 100 to mount pepper fencing. However, with the necessary financial support, the farmers expressed their willingness to adopt the method. Figure 5.6 illustrates the anti-raiding methods adopted by the farmers.

Figure 5.7: Anti-Raiding Methods Employed



Source: Field Survey, 2013.

It is discernible from figure 5.6 that, the patronage of the pepper fencing method as compared with guarding and noisemaking is still low among the farmers. Remarkably, 3 farmers (2%) indicated that they employed no form of protection on their farms even though they experienced crop-raiding. They explained that they could not afford the pepper fencing and were also very old to guard their farms.

The next section considers how the farmers' access and use land, after which an analysis of the various considerations by farmers in establishing farms is presented.

5.6 Land Tenure Arrangements

Oppong (2007) asserts that in Ghana, rural livelihoods are derived mainly from the ownership and use of land and natural resources. Thus, the denial of access to land could lead to protracted disputes.

The land tenure regime around the KCA is not different from what pertains in other parts of Ghana; especially the south where matrilineal inheritance is practised. From the survey, it was discovered that the entirety of land in KCA is vested in five traditional authorities namely the Denkyira, Assin-Apemamim, Efutuakwa/ Hemang, Assin-Nyankumase and Abura stools. The lands are communal lands which the chiefs hold in trust for their subjects. Thus subjects of the various by stools by virtue of their communal membership obtained usufructuary rights in land, which exempted them from the payment of royalties. For instance, subjects of the Assin-Nyankumase stool farming in the Jerusalem village obtained their farmlands in gratis.

Nevertheless, subsequent acquisition of lands by the State has since vested the entire area covered by the Kakum National Park and Assin-Attandanso Game Reserve in the State. Lands outside these reserves still remain under communal ownership but various grants have

been made to some indigenous and settler farmers for the purposes of agriculture. The succeeding paragraphs delve into the tenurial status of the respondents' farmlands.

5.6.1 Categories of Land Ownership

From the survey, four main categories of farmland ownership were identifiable: family land, individual land, sharecropping and caretaker farmers. Each of these ownership types are explored below:

5.6.1.1 Family Land

This encapsulates farmlands that were acquired by farmers' parents or grandparents along matrilineal lines, through clearance of virgin forest or sharecrop agreements. Out of the 250 farmers interviewed, 85 farmers (34%) had their farms in this category. Such farmlands are not inheritable, but farm proceeds are enjoyed solely by the farmer. However, the disposition of such farmlands is done in consultation with other family members with a claim on the land.

5.6.1.2 Individual Land

This refers to land acquired through inheritance or outright purchase by the farmer. 62 farmers (24.8%) fell in this category. These farmers had absolute right of use and enjoyment over their farmlands, implying that they had the complete right to take key planting decisions.

5.6.1.3 Sharecropping

Synonymous with other parts of the country, the two main sharecropping arrangements identified were *abunu* and *abusa*.

- ✓ Abunu

The *abunu* sharecropping system is practiced for permanent crops like cocoa and oil palm. Under this arrangement, the landlord provides the land and assists the tenant to establish the tree crop, while the tenant intercrops it with food crops in the initial year of establishment. The products from the food crops is solely for the tenant who may give some to the landlord

if he so wishes. After the establishment of the tree crop (in 3– 6 years), the plantation is shared on a 1:1 basis between the landlord and the tenant (Anglaare, 2005). The tenant retains ownership of his/her portion of the farm for the entire life of the crop.

87 farmers (34.8%) worked under this arrangement, which is very common around the KCA. The farmers articulated that, *abunu* is a secured way of accessing farmlands especially in the case of migrants. However, the tenant's right over the land is only secure as long as he/she maintains the land use. In most cases, original landowners are absentee farmers living elsewhere, and tenants are liable for annual payments to the local chiefs.

- ✓ Abusa

Under this arrangement, the landlord claims one third (1/3) of the crop yield each year whilst the tenant takes the two thirds (2/3). *Abusa* is commonly used for food crops like plantain, maize and cassava, but applicable in cocoa farming. This arrangement was very common in Homaho and Appiahkrom, and a total of 15 (6%) farmers held farmlands under this arrangement. The farmers complained that, it is an unfair and insecure arrangement as the land, once it is exhausted, reverts to the landlord.

5.6.1.4 Caretaker Farmers

Caretaker farmers are employed to look after the cocoa and often play no part in establishing the plantation. Their duty is to maintain the farm, i.e. weed, spray insecticides and fungicides, harvest and process the beans for sale. They take 1/3 of the yield of the cocoa farm as payment. Caretaker farmers do not have any right over the farm and thus, are ineligible to make critical planting decisions. Only 1 farmer worked under this arrangement. Table 5.4 outlines the ownership categories explained above.

Table 5.4: Summary of Farmland Ownership

Category	Number of Farmers
Family Land	85 (34%)
Individual Land	62 (24.8%)
Sharecropping- Abunu	87 (34.8%)
Sharecropping- Abusa	15 (6%)
Caretaker Farmer	1 (0.4%)
Total	250 (100%)

Source: Field Survey, 2013.

Each ownership category discussed above has distinct characteristics, which influence the overall planting decisions of farmers. The next section analyses the various factors that inform farmers planting decisions as identified from the survey.

5.7 General Factors Influencing Farmers' Planting Decisions

From the analysis above, it is discernible that the decision of farmers to farm either close or away from the edge revolves around a myriad of factors. Prominent amongst the factors identified by the farmers interviewed include land availability, soil fertility and crop-raiding considerations presented above. Each of these factors has varying degree of influence on farming decisions.

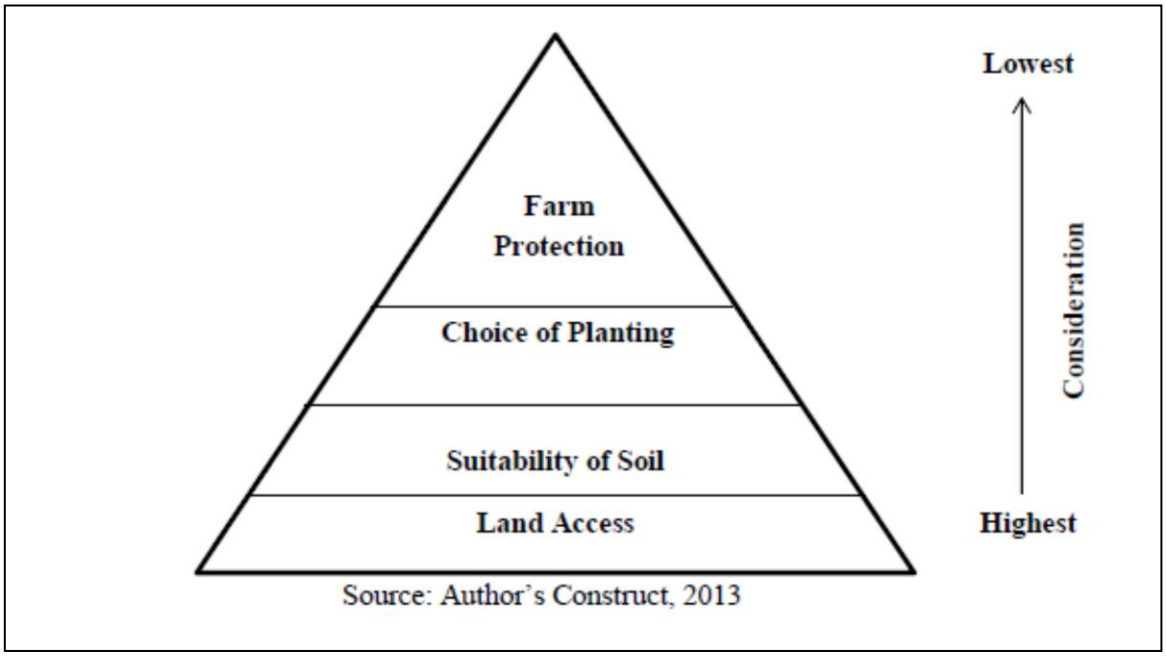
To this end, farmers were questioned about factors they considered as critical in establishing a cocoa plantation. Analysis of their responses is discussed in the ensuing paragraphs.

5.7.1 Considerations in Establishing a Cocoa Farm

Although all the farmers interviewed affirmed that farmlands closer to the forest edge often have good soil and microclimate conditions resulting in high yields; land access was deemed as the most critical consideration in any farming activity.

During the survey, all the farmers stated that land tenure largely dictated where to farm as well as the type of crops cultivated. Apart from the farmers who owned their farmlands, the other farmers (especially sharecroppers) occupied farmlands based on conditions elucidated under section 5.6.1. Figure 5.7 depicts the factors farmers considered as critical in establishing farms in the study area.

Figure 5.7: Factors Influencing the Siting of Farms



From figure 5.8, land tenure is the fundamental consideration followed by soil suitability, choice of planting and farm protection (if closer to the forest edge). It is necessary to point out that, these factors do not operate in isolation but other factors such as general land use layout and labour considerations come to play. The next section discusses the challenges encountered by farmers in the study area.

5.8 Challenges of Cocoa Farming in KCA

During the survey, the farmers alluded to various problems that impinge the productivity of their farms. Notable amongst the key problems cited are discussed below:

5.8.1 Tedium of Access to Farmland

Almost all the respondents articulated that, it is currently difficult to have access to farmland around KCA, mainly because there is no new land available. The sharecroppers interviewed, pointed that the sharing of the produce remains problematic and unfair. Thus, farmers have shortened fallow periods to allow for continuous cultivation, which could result in over-exploitation.

5.8.2 Inadequate Financing and Cost of Inputs

Overwhelmingly, all the farmers interviewed stated that their production capacity is stifled by limited financing opportunities and high cost of farm inputs, chemicals and fertilisers. The majority of the farmers articulated that beside the government cocoa mass spraying exercise (which is quite sporadic), they were unable to spray their farms regularly. The cascading effect of this phenomenon is the low yields recorded by the farmers.

5.8.3 Problem of Crop-Raiding

As noted above, farms closer to the edge suffer from crop damage mostly by elephants and monkeys. The farmers cited that the menace of crop-raiding also considerably reduces their crop yields and expected income. Although some protective mechanisms have been adopted by the farmers, the majority noted that these techniques were counterproductive and sometimes costly.

5.8.4 Limited Extension Support

A cross-section of the cocoa farmers mostly in the smaller villages, lamented that they do not have access to any form of extension support. The few who benefited from such support indicated that they were intermittent and often provided by local NGOs and farmer Associations. All the farmers conceded that, extension services are vital in the entire production process as it offer them the opportunity to learn about sustainable and good farm practices.

CHAPTER SIX

GENERAL DISCUSSION, CONCLUSION AND RECOMMENDATIONS

6.1 What does all this mean?

The study was set out to assess cocoa farmers local knowledge of forest-agricultural landscape interactions in ten villages buffering the KCA. The purpose was to examine farmers' planting decisions in respect of farming either close to the forest edge or away from it.

Face-to-face interviews and focus group discussions were conducted mainly with sampled cocoa farmers and identified institutional stakeholders i.e. officials of the GWD and FSD, all of the Ghana Forestry Commission. Considering the study objectives in Chapter One, the following of conclusions are drawn:

It was evident from the study that, agriculture is the main land use around the KCA. Essentially, cocoa plantations intercropped with food crops such as plantain, cassava etc. dominate the agricultural land uses. Other agricultural land uses identified were oil palm and citrus plantations.

6.1.1 Knowledge of Forest-Agricultural Landscape Interactions

Based on the evidence obtained during the field survey, farmers generally recognise that land closer to the forest margin is mostly fertile with favourable microclimate suitable for the cultivation of cocoa. This is on account of the reliable rainfall, suitable temperature and enhanced dew deposition that improves environmental conditions around the edge.

Thus, farmers' precluding the influence of land tenure and crop-raiding ordinarily would want to take advantage of these environmental conditions to establish their farms closer to the edge.

6.1.2 Influence of Land Tenure on Planting Decisions

Section 5.7 establishes that land tenure remains the most critical factor that dictates where to farm in the study area. It largely defines the terms governing access to land acquisition and ownership, control and use of farmlands and forests (Oppong, 2007). As discernible from the survey, the influence of land tenure depending on the category (section 5.6.1) transcends access to farmland to the determination of crop type cultivated. For instance, in the case of the *abusa* arrangement, farmers only had user rights over the land with the crop type agreed with the landlord prior to cultivation.

These tenurial arrangements coupled with increased population density and other social pressures, has led to a significant reduction in the forest cover outside the Reserve due to the intensity of cultivation. This phenomenon has the propensity to result in the over-exploitation and use of resources, since some of the farmers conceded that, fallow periods have shortened and no new land lies idle of cultivation.

6.1.3 Influence of Wildlife Conflict on Planting Decisions

Furthermore, the decision to farm close to the edge is not only occasioned by land tenure but also the risk of crop-damage resulting from wildlife (mainly elephants) depredations. Barnes (1993) rightly observes that wherever man and elephants live side by side, conflict is unavoidable. From the analysis in section 5.4 and 5.6, although crop-raiding did not constitute the main determinant of where to farm, it featured prominently in the planting decisions of most farmers. As many as 117 (46.8%) admitted that, they would prefer farming away despite the suitable environmental conditions around the edge.

A worrying dimension to this problem as articulated by the farmers is that, the elephants now eat cocoa beans contrary to earlier observations by Azika (1992) and Barnes (1993). This

could have ramifications for future cocoa production and livelihoods. Therefore, crop-raiding needs to be studied in detail in order to devise solutions that tackle the underlying causes rather than the symptoms of the problem. Some useful areas for consideration include:

1. A clear understanding of the distribution of elephants within the forest and the factors that attracts them to the forest margin, where they venture out into the farmlands.
2. Factors within and outside the forest which may "push" and "pull" the elephants to the farmlands and an inquest into their preference for the cocoa beans.

Answers to these questions lie outside the scope of this investigation, but remain necessary for developing effective management options.

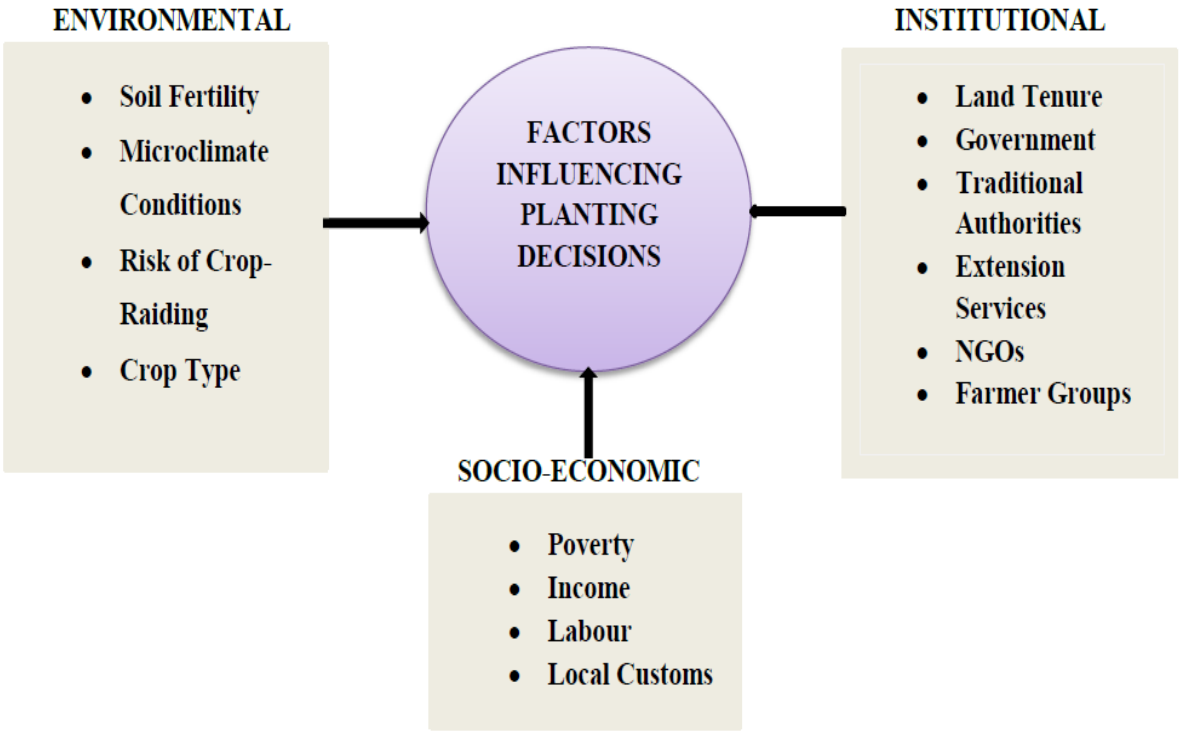
6.1.4 Influence of Forest Edge on Yields

Analysis under section 5.3.6 and 5.4.3 revealed that, the variability in yields is not only influenced by soil fertility and climatic conditions, but other critical factors such as farm size, age and management practices. Although there is no significant difference between the yield of farms close to the edge and those away, farms close to the edge have higher variability in yield. This may be due to the effects of crop-raiding.

6.1.5 Factors Influencing Planting Decisions

The survey discovered that a myriad of factors influences farmers' planting decisions (Section 5.7). These factors are summarised in the model below:

Figure 6.1: General Factors Influencing Planting Decisions



Source: Author's Construct.

As highlighted in the above figure, the various environmental, institutional and socioeconomic factors collectively interact to inform farmers overall planting decisions pertaining to farm establishment and management. The discussion has so far established that, these factors (mainly land tenure, soil and climatic conditions and crop-raiding) have different levels of influence relating to where to establish a cocoa farm and future connotations for deforestation. More research is needed to comprehensively understand the magnitude of influence each of the broad factors have on farming decisions and forest conservation.

6.2 Conclusion

The central idea of this study was to analyze local farmers' perceptions about the forest influence on farming activities and the associated planting decision-making processes around the KCA. Even though the study was basically exploratory and not detailed, it did reveal

great potential for understanding farmers' reasons for farming either near or away from the forest edge and some other considerations in the farming decision-making process.

The KCA as a crucial ecosystem for wildlife conservation is surrounded by agricultural landscapes forming a complex system with cross-interactions and feedbacks. Farmers form part of this complex system, since their activities imparts significantly on the entire ecosystem health and functioning. Therefore, the knowledge articulated by the farmers on the nature of the forest influence on their farming operations and associated planting decisions offer very useful insights, which contributes to the scientific discourse on tropical forests and the development of sustainable strategies that will improve rural livelihoods and wildlife conservation in KCA. A few observations have been made in respect of the entire discussion above.

6.3 Recommendations

1. Intensification of farmer education and provision of support by relevant stakeholders such as the Ministry of Food and Agriculture, COCOBOD and the Forestry Commission. This could be achieved through the organisation of conservation educational programmes and regular extension support to assist farmers adopt sustainable farming practices.
2. To promote sustainable cocoa production and reduce extensification, it is proposed that the government through the COCOBOD should support farmers to revamp all abandoned/ old cocoa farms. This when done will not only boost farm productivity, but assist in sustaining employment opportunities for the majority of the rural populace in cocoa growing areas.
3. Broadening the scope of community wildlife and crop protection volunteer squads, and support for farmers farming next to the forest edge. The volunteer squads could patrol farms and alert farmers on the presence of elephants in their farms.

Additionally, the GWD in partnership with the COCOBOD could assist farmers with the pepper fencing to protect their farms against crop-raiding.

4. Popularisation of cocoa certification schemes and formation of farmer associations. The formation of associations could assist farmers in negotiating soft loans from financial institution and facilitate expert and peer education on sustainable farming practices.
5. Streamlining of the land tenure regime through systematic land titling to formalise and ease the difficulty in accessing land for farming purposes.

6.4 Further Research

Although the study is a good attempt, a number of issues still require further investigation to in order to gain a fuller understanding of the nature of forest-agricultural landscape interactions in the KCA. Itemized below are some areas requiring research attention:

1. Investigate the land rights and uses and its impact on forest conservation.
2. Assessment of the intensity of crop-raiding around the KCA.
3. Extent of community participation in the management of the Kakum National Park.
4. Assessment of the human pressures and land use changes around the KCA.

REFERENCES

Adu, S.V. and Mensah-Ansah 1969), Classification of Ghanaian soils for cocoa rehabilitation. *Proc.3rd Intl. Cocoa Research Conference,* Accra, 56-64.

Agyare, A.K. (1995), Draft Report: Socio-Economic Perspective of Kakum and Assin-Attandanso Resource Reserve. Wildlife Division, May 1995 (Unpublished).

Ali, F.M. (1969), Effects of rainfall on yield of cocoa in Ghana. *Experimental Agriculture,*5: 209-213.

Allotey J. (2007), Status of biodiversity and impact assessment in Ghana. Biodiversity and Impact Assessment. Doc/ED'sDoc/26/04/2007.

Alverson, W.S., Walker, D.M. and Solheim, S.L. (1988), Forests too deer: Edge effects in northern Wisconsin. *Conservation Biology*, 2(4): 348-358.

Asare, R., David, S. and Sonwa, D. (eds.) (2009), Good Agricultural Practices for Sustainable Cocoa Production: A Guide for Farmers Training Manual No.3: Conservation and Biodiversity in and around Cocoa Farms. Development and Environment Series 12 – Revised 2011. Forest & Landscape, Denmark.

Asenso-Okyere, K. (2001), Transforming Agricultural production and productivity for sustained rapid growth and development. *In*: *Ghana in the 21st Century*. *ISSER millennium seminar series, No. 4.* Institute of Statistical, Social and Economic Research (ISSER), University of Ghana. 34pp.

Anglaaere, L.C.N. (2005), Improving the Sustainability Cocoa Farms in Ghana through the Utilization of Native Trees in Agroforestry Systems. A Thesis Submitted in Partial Fulfillment for the Philosophiae Doctor the University of Wales, Bangor, UK.

Antwi, A (1998), *The Property Rights Question: The Economics of Urban Land Management in sub-Saharan Africa*, A Paper Prepared for the Our Common Estate Programme, RICS, London.

Anim-Kwapong, G.J. and Frimpong, E.B. (2005), Vulnerability of Agriculture to Climate Change on Cocoa Production: Vulnerability and Adaptation Assessment under the Netherlands Climate Change Studies Assistance Programme Phase (NCCSAP2).

Anthonio D, C. and Aikins E,D.(2009). Reforming Ghana's cocoa sector: an evaluation of private participation in marketing. Master Thesis, Lulea University of Technology, page 42.

Appiah, M., Blay, D., Dannyag, H., Dwomoh, F.K., Pappien, A. and Luukkanen, O. (2009), Dependence on forest resources and tropical deforestation in Ghana. *Environmental, Development and Sustainability*, Volume 11, Issue 3, pp. 471-487.

Asante, J. (2012), Systematic Rural Land Titling in Ghana: A Case of the Millennium Development Authority Pilot Survey at Senya Brekum, Ghana. An unpublished thesis submitted to the Department of Land Economy, Kwame Nkrumah University of Science and Technology towards the award of a Bachelor of Science degree in Land Economy.

Ault, D. E. and Rutman, G. L. (1979), The Development of Individual Rights to Property in Tribal Africa, *Journal of Law and Economics*, Vol. 22 (1), pp163-182.

Auzins, A. (2004), Institutional Arrangements: A Gate towards Sustainable Land Use, *Nordic Journal of Surveying and Real Estate Research*, Vol. 1, pp57-71.

Azika,S. (1992), A Study of the Extent of Crop Destruction Farms Surrounding Kakum Nature Park and Assin-Attandanso Game Production Reserve by Forest Elephants.

Barnes, R.F.W.(1993), The Elephants of Kakum and Assin-Attandanso Forests: A Report of a Consultancy Under Contract for Conservation International.

Berg, B.L. (2009), Qualitative Research Methods for the Social Sciences. 7th ed. Boston: Allyn & Bacon.

Bond, I., Grieg-Gran, M., Wertz-Kanounnikoff, S., Hazlewood, P., Wunder, S. and Angelsen, A. (2009), Incentives to sustain forest ecosystem services: A review and lessons for REDD. *Natural Resource*, Issue No. 16. International Institute for Environment and Development, London, UK, with CIFOR, Bogor, Indonesia, and World Resources Institute, Washington D.C., USA.

Brew, K.M. (1991), Relationship between yield, rainfall and total sunshine hours. *Rep. Cocoa Research Institute of Ghana*. 1988/89, p30-32.

Bruner, A.G, Gullison R.E, Rice, R.E. and da Fonseca, G.A.B. (2001), Effectiveness of parks in protecting tropical biodiversity. *Science*, 291, 125-127.

Bugri, J.T. (2005), Land Tenure and Sustainable Livelihoods in North-East Ghana. An Unpublished Thesis Submitted in partial fulfillment of the requirements of the University of Greenwich for the Degree of Doctor of Philosophy .

Convention on Biological Diversity (CBD), Fourth National Report: Ghana. Available online at www.cbd.int/doc/world/gh/gh-nr-04-en-do (Accessed on 01/06/2013).

Ch'oc, G. (2011), Indigenous peoples and the struggle for governance of natural resources in Belize: *In* Painemilla, K. W., Rylands, A. B., Woofter, A. and Hughes, C. (eds.) (2011), *Indigenous Peoples and Conservation: From Right to Resource Management*.

Constanza, R., d' Arge, R., de Groot, R., Farber, S., Grasso, M., Hanno, B., Limburg, K., Naeem, S., O'Neill, R., Paruelo, J., Raskin, R.G., Sutton, P. and Van den Belt, M. (1997), The Value of the World's Ecosystem Services and Natural Capital. *Nature*, Volume 387.

COCOBOD (2000), *Ghana Cocoa Board Handbook*. 8th ed. Jamieson's Cambridge Fax books Limited, Accra. 62pp.

Darko-Mensah, A. (2011), Environmental Performance and Disclosure: A Tool for Promoting Environmental Governance in Ghana? An Unpublished Thesis Submitted in partial fulfillment of the requirements for the Degree of the Master of Science in Environmental Change and Management, University of Oxford.

de Soto, H. (2000), *The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else*, Basic Books, New York.

Decher, J. and Abedi-Lartey, M. (2002), Small mammal zoogeography and diversity in West African forest remnants. Final Report: Ghana Wildlife Division, National Geographic Committee for Research and Exploration, University of Vermont, 32 pp.

Dudley, J.P., Mensah-Ntiamoah, A.Y. and Kpelle, D.G. (1992), Forest Elephants in a Rainforest Fragment: Preliminary Findings from a Wildlife Conservation Project in Southern Ghana. African Journal Ecology 30, 116-126.

Edwin, J. and Masters, W.A. (2003), "Genetic Improvements and Cocoa Yields in Ghana". Working Paper, Purdue University, West Lafayette, IN.

Elkan, W. (1959) Migrant Labour in Africa: An Economist's Approach, *American Economic Review*, Vol. 49, pp188-197.

Ellis, L. (1994), Research Methods in Social Sciences, WCB Brown and Benchmark Publishers, Madison.

Environmental Protection Agency (EPA) (2004), Ghana State of the Environment Report, EPA, Ghana. Accra, Pp. 11-51.

Essegbey, G.O. and Ofori-Gyamfi, E. (2012), Ghana Cocoa Industry: An Analysis from the Innovation System Perspective. *Technology and Investment*, 3, 276-286. Available online at www.scirp.org/journal/ti (Accessed on 18/06/2013).

FAO (2012), State of the World's Forest, Rome.

Gardner, T.A., Barlow, J., Chazdon, R., Ewers, R.M., Harvey, C.A., Peres, C.A. and Sodhi, N.S. (2009), Prospects of tropical forest biodiversity in a human-modified world. *Ecology Letters*, 12, 1-21.

Gockowski, J. (2011), Agricultural Intensification as a Strategy for Climate Mitigation in Ghana. An evaluation study of the COCOBOD High Tech Program, rural incomes, and forest resources on the Bia (Juaboso) District of Ghana.

Gockowski, J. and Sonwa, D. (2007), Biodiversity Conservation and Smallholder Cocoa Production Systems in West Africa with Particular Reference to the Western Region of Ghana and the Bas Sassandra region of Cote d'Ivoire". Draft paper, Institute of Tropical Agriculture, Ibadan, Nigeria. Available online at www.odi.org.uk/events/2007/11/19/434-paper-discussion-biodiversity-conservation-smallholder-cocoa-production-systems-west-africa.pdf. (Accessed on 18/06/2013).

Goldsmith, F.B. (*ed*) (1998), *Tropical Rainforest: A Wider Perspective*. Chapman and Hall, 310 pp.

Greer, J. G. (1991), Do Open-ended Questions Measure "Salient" Issues? Public Opinion Quarterly, Vol. 55, pp360-370.

Hall, J.B. and Swaine, M.D. (1976), Classification and Ecology of Closed-Canopy Forests in Ghana. *Journal of Ecology*, 64: 913-915

Hall, J.B. and Swaine, M.D. (1981), *Distribution and Ecology of Vascular Plants in a Tropical Rainforest*. Junk, The Hague.

Hanna, S., Folke, C. and Mailer, K. G. (1995), Property Rights and Environmental Resources, in Hanna, S and Munasinghe, M. (eds.), *Property Rights and the Environment: Social and Ecological Issues*, The International Bank for Reconstruction and Development/The World Bank, Washington, DC.

Hassan, R.M., Scholes, R. and Ash, N. (*eds*) (2005), Ecosystems and Human well-being: Current State and Trends: Findings of the Condition and Trends Working Group. Millennium Ecosystem Assessment Series, Volume 1. Island Press, Wshington, D.C., USA. Available at www.millenniumassessment.org/en/index.aspx. (Accessed on 01/06/2013).

Holliday, A. (2002), Doing and Writing Qualitative Research. London: Sage Publications.

Huntingford, C., Zelazowski, P., Glabraith, D., Mercado, L.M., Sitch, S., Fisher, R., Lomas, M., Lwis, S.L., Phillips, O.L., Atkin, O.K., Lloyd, J., Citoor, E., Zaragoza-Castells, J., Meir, P., Betts, R., Hanas, P.P., Nobre, C., Marengo, J. and Cox, P.M. (2013), Simulated resilience of tropical rainforests to CO_2- induced climate change. *Nature Geoscience*, Advance online publication. Available online at www.nature.com/naturegeoscience. (Accessed on 01/06/2013).

ISSER (2011), "*The State of the Ghanaian Economy in 2010*" .Institute of Statistical, Social and Economic Research, University of Ghana, Legon.

ICCO (2003), International Cocoa Annual Report 2003/04. Available at www.icco.org (Accessed on 01/06/2013).

Jancowicz, A.D. (2000), Business Research Projects. 3rd ed. Holborn: Thomson Learning.

Kolavalli, S. and Vigneri, M. (2011), Chapter 12: Cocoa in Ghana: Shaping the Success of an Economy. *In* Chuhan-Pole and Angwafo, M. (eds.) (2011), *Yes, Africa Can: Success Stories from a Dynamic Continent*, The World Bank Publications.

Kpelle, D.G. (1993), Evaluation of Past Management and Resource Use of the Kakum and Assin-Attandanso Forest Reserves. Unpublished Report, Department of Wildlife, Accra.

Kumar, K. (1987), Conducting Group Interviews in Developing Countries. A.I.D. Program Design and Evaluation Methodology Report No.8. Trends in Ecology and Evolution 4: 375-379.

Larson, A.M. and Petkova, E. (2011), An Introduction to Forest Governance, People and REDD+ in Latin America: Obstacles and Opportunities. *Forest 2011*, 2, 86-111. Available online at www.mdpi.com/journal/forests. (Accessed on 01/06/2013).

Laurance, W., Bierregaard, R. O., Gascon, C., Didham, R. K., Smith, A. P., Lynam, A. J. , Viana, V.M., Lovejoy, T. E., Sieving, K. E., Sites, J. W. Andersen, M., Tocher, M. D., Kramer, E.A., Restrepo, C. and Moritz, C. (1997), Tropical Forest Fragmentation: Synthesis of a Diverse and Dynamic Discipline in: Laurance, W.F. and Bierregard, R.O. Tropical Forest Remnants Ecology, Management, and Conservation of Fragmented Communities, Chicago University Press, Chicago 616 pp.

Malhi, Y. (2010), The Carbon Balance of Tropical Forest Regions, 1990- 2005. Current opinion in *Environmental Sustainability 2010*, 2: 237-244.

Matlack, G.R. (1993), Micro-environmental variation within and among forest edge sites in the eastern United States. *Biological Conservation*, 66: 185-194.

Mayaux, P., Pekel, Jean-Francois, Desclee, B., Donnay, F., Lupi, A., Chard, F., Clerici, M., Bodart, C., Brink, A., Nasi, R. and Belwand, A. (2013), State and evolution of the African Rainforests between 1990 and 2010. Available at www.rstb.royalsocietypublishing.org (Accessed on 28/08/2013).

Millennium Ecosystem Assessment (2005), Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC.

Morato (1994), Abundance and diversity of Euglossini males (Hymenoptera: Apidae) in a terra firme forest and cleared areas, in the vicinity of Manaus (Brazil). Boletim do Museu Paraense Emilio Goeldi Seroe Zoologia, 10(1): 95-105.

Murcia, C. (1993), Edge Effects on the Pollination of Tropical Cloud Forest Plants PhD thesis, University of Florida, 102 pp.

Nabuurs, G.J. *et al.* (2007), Forestry. *In* Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Metz, B., Davidson, O.R., Bosch, P.R., Dave, R., Meyer, L.A. (eds.), Cambridge University Press, United Kingdom and New York, NY, USA.

Norris, K. (2008), Exploring the Potential for Cocoa Carbon in Ghana. Centre for Agri-Environmental Research, University of Reading.

Oates, J.F. (1999), Myth and reality in the rainforest: how conservation strategies are failing in West Africa. University of California Press, Berkeley, xxviii+310pp.

Opoku, I.Y., Akrofi, A.Y. and Appiah, A.A. (1999), The spread of *Phytophthora megakarya* on cocoa in Ghana. *Journal of Ghana Science Association* (Special edition), 2 (3) 110-116.

Oppong, J.Y. (2007), Wildlife Conservation and Livelihood Options: A Case Study of the Kakum Conservation Area. A Masters thesis Submitted to the University of Cape oast in Partial Fulfillment of Requirements for the Award of Master of Arts Degree in Environmental Management and Policy.

Punch, F. K. (1998), Introduction to Social Research: Quantitative and Qualitative Approaches, Sage, London.

Rodrigues, E. (1993), Ecologia de fragmentos florestais ao longo de um gradient de urbanizacao em Londrina-PR. Master's Dissertation: Universidade de Sao Paulo, Sao Carlos-SP Brasil 110 pp.

Rodrigues, E. (1998), Edge Effects on the Regeneration of Forest Fragments in South Brazil. A thesis submitted to the Department of Organismic and Evolutionary Biology in partial fulfilment of the requirements for the degree of Doctor of Philosophy in Biology, Harvard University.

Saldana, J. (2009), The Coding Manual for Qualitative Researchers. London: Sage Publications Ltd.

Skole, D. and Tucker, C. (1993), Tropical deforestation and habitat fragmentation in the Amazon: Satellite data from 1978 to 1988. *Science*, 260: 1905-10

Smucker, T. (2002), *Land Tenure Reform and Changes in Land-Use and Land Management in Semi-Arid Tharaka, Kenya*, Land Use Change Impacts and Dynamics (LUCID) Project Working Paper 11, International Livestock Research Institute, Nairobi.

Struhsaker, T.T. and Oates, J.F. (1995), The biodiversity crisis in Southwest Ghana. *African Primates*, 1(1), 5-6.

Somaila, I. (2010), Access to Land for Agiculture in Ghana: A Case Study of the Tease Afram Plains. An unpublished thesis submitted to the Department of Land Economy, Kwame Nkrumah University of Science and Technology towards the award of a Bachelor of Science degree in Land Economy.

Songsore, J. (1998), The Urban Transition in Ghana: Urbanization, National Development and Poverty Reduction. Study Prepared for the IIED as part of its Eight Country Case Studies on Urbanization.

Törhönen, M.P. (2004), Sustainable Land Tenure and Land Registration in Developing Countries, including a Historical Comparison with an Industrialized Country, *Computers, Environment and Urban Systems*, Vol. 28, pp545-586.

TEEB (2010), The Economics of Ecosystems and Biodiversity Ecological and Economic Foundations. Edited by Pushpam Kumar. Earthscan, London and Washington.

UNEP (2006), Press Release on Ghana: Available online at www.unep.org/Ghana-_Africa_Atlas (Accessed on 18/06/2013).

Veeman, T. S. and Politylo, J. (2003), The Role of Institutions and Policy in Enhancing Sustainable Development and Conserving Natural Capital, Environment and Development, in Hanna, S. and Munasinghe, M. (eds.), *Property Rights and the Environment: Social and Ecological Issues*, The International Bank for Reconstruction and Development/The World Bank, Washington, DC.

Walker, D.H., Sinclair, F.L. and Kendon, G. (1995), A Knowledge Based Systems Approach to Agroforestry Research and Extension. AI Applications 9(3): 61-72.

West, H. W. (2000), *On African Land Holding: A Review of Tenurial Change and Land Policies in Anglophone Africa*, Studies in African Economic and Social Development, Vol. 16, The Edwin Mellen Press, Lampeter.

Whitmore, T.C. (1998), An Introduction to Tropical Rain Forests. Oxford University Press, Oxford, United Kingdom.

White, F. (1983), The Vegetation of Africa: a descriptive memoir to accompany the UNESCO, Association pour l'etude taxominique de la flore d'Afrique tropicale.

Willson, K.C. (1999), *Coffee, Cocoa, and Tea*: Crop Production Science in Horticulture Series. CABI Publishing, Wallingford, United Kingdom.

APPENDICES

APPENDIX 1: INTERVIEW QUESTIONNAIRE

Introduction: This research survey instrument is designed to collect data on the ecological importance of remnant forest, land tenure, farming decisions and traditional knowledge on forest-cocoa agriculture interactions in the Kakum Conservation Area (KCA), the results of which are to be used for an MSc thesis only and responses are strictly confidential. (Ask for permission to tape record the interview).

1. What is the history of this community?
2. What is the pattern of land tenure in this community?
   [Probe: understanding of land tenure, existing ownership arrangements, others]
3. What role do you play with respect to farming in this community?
   [Probe: land use, farm management, decision-making, others]
4. In whom is the absolute title to land in this traditional area vested? Why?
5. What are the current procedures for land acquisition for farming in your community?
   [Probe: customary and state procedures relating to respondent's own experiences]

4. In your opinion, does land tenure have any influence on farming decisions? How?
   [Probe: security of tenure, access to land, restrictions on use, others]
5. In your opinion, do beliefs and traditions influence farming activities? How?
   [Probe: taboos, sacred groves, others]
6. What is your understanding of the term "forest"?
   [Probe: spiritual interpretation, biophysical interpretation]
7. In your opinion, is the forest important? How?
   [Probe: beliefs/ perceptions about the forest, importance, benefits derived]
8. In your view, does the forest influence farming activities? How?
   [Probe: forest edge effect, influence on crop yields, pests and diseases]
9. In your opinion, what advantages and disadvantages (if any) associated with farming closer to the forest edge?
   [Probe: perceptions about the forest edge, crop yields, human-wildlife conflict]

10. In your opinion, what advantages and disadvantages (if any) associated with farming away from the forest edge?

11. In your opinion are there any variation(s) in yields regarding farming away and near the forest edge? How?

[Probe: reasons for variation]

12. What do you perceive as the critical considerations in siting a cocoa farm?

[Probe: land access, government support, soil conditions, climate, others]

13. What is your perception about cocoa farming in this community?

[Probe: pattern of production: increasing or declining, profitability, others]

14. What do you see as the most serious problems facing cocoa farming in this community?

15. How do you think the problems listed above can be solved?

Thank respondent, explain the need for and ask permission to have personal data of respondent.

18. Name:

Age:

Sex:

Town/Village:

Community member/stranger:

Educational level:

Occupation:

Customary title:

APPENDIX 2: SURVEY QUESTIONNAIRE FOR COCOA FARMERS

Introduction: This research survey instrument is designed to collect data on the ecological importance of remnant forest, land tenure, farming decisions and traditional knowledge on forest-cocoa agriculture interactions in the Kakum Conservation Area (KCA), the results of which are to be used for an MSc thesis only and responses are strictly confidential.

SECTION A: PERSONAL DATA OF RESPONDENT

1. (a) Respondent's name (optional) ----------

(b) Respondent's sex: M [ ]1 F [ ]2

(c) Name of respondent's community ----------

Community member? [ ]1 Stranger? [ ]2

(d) What is your marital status?
Married [ ]1 Single [ ]2 Divorced [ ]3 Widowed [ ]4 Separated [ ]5

(e) What is your age? ----------

(f) What, if any, is your level of formal education?

Never been to school	[ ]1	Primary/Middle school	[ ]2
Voc./ Sec./ Comm./ Tech.	[ ]3	Training Col./ Post Sec.	[ ]4
University	[ ]5	Other (specify)	[ ]6

(g) How did you get into farming?
First generation farmer *(farmer started all his farms by himself)* [ ]1
Second/ third generation farmer *(farmer inherited some farms from parents and might have cultivated others)* [ ]2
Other *(specify)* [ ]3

(h) Are you a member of any cooperative?
Yes [ ]1 No [ ]2

(i) If Yes, what benefit(s) do you gain by being a member?

(j) If No, why not? (Please explain)

(k) Have you received any farm training from any organisation?
Yes [ ]1 No [ ]2

(l) If Yes, what were you trained in?
Farm maintenance [ ]1 Farm establishment [ ]2 Others *(specify)* [ ]3

(m) Which organisation trained you? ----------

SECTION B: BASIC FARM DATA

2. (a) How many cocoa farms do you have?----------

(b) Where are the farms situated ? and why?

(c) What is the age distribution of the farms?

(d) How old is your youngest farm and where is it situated?

---

3. (a) How did you learn about cocoa farming? (Please explain)

(b) How long have you been in cocoa farming? (Tick only one).

1-5 years [ ]1 6-10 years [ ]2 11-15 [ ]3

16-20 years [ ]4 20 + years [ ]5

(c) Are you engaged in other farming activities apart cocoa farming?

Yes [ ]1 No [ ]2

(d) If Yes, are all the activities situated on the same farmland?

Yes [ ]1 No [ ]2

(e) What other crops are cultivated? *(Please state)*

(e) What variety(s) of cocoa is/are found on your farm?

Amelonado (Tetteh Quarshie) [ ]1 Amazonia (Agric) [ ]2 Hybrid [ ]3

(f) What agricultural are you practicing currently*? (Tick as many as apply)*

	A
Mono Cropping	[ ]1
Mixed Cropping	[ ]2
Share Cropping	[ ]3
Agroforestry	[ ]4
Slash and Burn	[ ]5
Shifting Cultivation	[ ]6
Use of chemical fertilisers	[ ]7
Use of organic manure	[ ]8
Other *(specify)*	[ ]9

(g) How old is (A) your farm and (B) majority of your cocoa trees?

A---------- B----------

(h) Is your farm a replanted old farm or a new farm?

Replanted [ ]1 New Planting [ ]2

(i) What is approximate size of your farm in acreage?

1-5 [ ]1 6-10 [ ]2 11-15 [ ]3 16 and above [ ]4

(j) Has the size of your farm increased over the last 5 years?
Yes [ ]1 No [ ]2

(k) If Yes, give reason(s) for your answer:

(l) Are you planning to increase the size of your farm?
Yes [ ]1 No [ ]2

(m) What is/are the source(s) of farm labour? *(Tick as many as apply)*
Self [ ]1 Wife/ Husband [ ]2 Children [ ]3 Hired labour [ ]4
Group mutual help [ ]5 Other *(specify)* [ ]6

(n) Please complete the table below:

No. of farms	Farm size(acreage)	Average cocoa yield *(cocoa bags)*		
1 [ ]	1-3 [ ]	Last season	2seasons ago	3 seasons ago
2 [ ]	4 – 6 [ ]			
3 [ ]	7 – 10 [ ]			
4 + [ ]	11 and above			

3. (a) Are you getting any extension services?
Yes [ ]1 No [ ]

(b) If Yes, what services? *(Please state)*

(c) Who is rendering the extension services?

(d) Please indicate your extent of satisfaction with the extension services:
Very satisfied [ ]1 Satisfied [ ]2
Uncertain [ ]3 Unsatisfied [ ]4 Very unsatisfied[ ]5

(e) How do you finance your farming operations? *(Tick as many as apply)*
Self [ ]1 Family [ ]2 Remittance [ ]3 Professional money lender [ ]4
COCOBOD [ ]5 Off-farm employment [ ]6 License Buying Company [ ]7
Other *(specify)*[ ]8

SECTION C: KNOWLEDGE OF FOREST-AGRICULTURE INTERACTIONS

4. (a) Have you heard of environmental services?
Yes [ ]1 No [ ]2

(b) Do you feel it is important to protect the forest?
Yes [ ]1 No [ ]

(c) Give reason(s) or evidence for your answer.

(d) Do you make use of any products from the forest ?
Yes [ ]1 No [ ]

(e) If Yes, what products do you use from the forest? *(Please list them)*

(f) In your view, what are the benefits of the forest to farming activities?

(g) How do you perceive the influence of the forest on your farming activities?

Very positive [ ]1 Positive [ ]2 Neutral [ ]3 Negative [ ]4 Extremely negative [ ]5 Don't Know [ ]99

(h) Give reason(s) or evidence for your answer.

(i) What was the previous land cover for this farm?

Fallow land [ ]1 Forest land [ ]2 Secondary Forest [ ]3 Swamp[ ]4 Abandoned cocoa farm [ ]5 Don't Know [ ]99 Other *(specify)* [ ]6

(j) In your view, what factors influences cocoa yields? *(Please state)*

(k) In your view, what general factors influences the resilience of your farm to pest and disease attack? *(Please state)*

---

5. (a) Is your farm situated close to the *forest edge* or margin?

Yes [ ]1 No [ ]2

If the answer to 5 (a) above is No , go to question 6

(b) What is/ are reason(s) for farming closer to the *forest edge* ? (Please explain)

(c) Is there any benefit(s) of farming closer to the *forest edge* ?

Yes [ ]1 No [ ]2

(d) If Yes, what benefits associated with farming next to the *forest edge*? (Please explain)

(e) Are there any disadvantages associated with farming closer to the *forest edge*?

Yes [ ]1 No [ ]2

(f) If Yes, list some of the associated disadvantages:

Does proximity of your farms to the *forest edge* affect (A) yields and (B) pest and disease resistance?

	A	B
Yes	[ ]1	[ ]1
No	[ ]2	[ ]2

(g) If Yes, give reason(s) or evidence for your answer:

(h) In your view, is/ are there any difference(s) in farming here as opposed to farming away from the *forest edge*?

Yes [ ]1 No [ ]2

(i) If Yes, give reason(s) or evidence for your answer?

(j) How would you describe farming conditions around the *forest edge*? (*Tick once*)
Lot Better [ ]1 Better [ ]2 Good [ ]3 Okay [ ]4 Poor [ ]5
Very Poor [ ]6 Don't know [ ]99

(k) Give reason(s) or evidence for your answer:

---

6. (a) Given the opportunity, would you prefer to farm close to the *forest edge*?
Yes [ ]1 No [ ]2

(b) If Yes, give reason(s) for your answer:

(c) If No, give reasons for your answer.

(d) In your view, does farming away from the *forest edge* have any affect your (A) yields (B) crop resistance to pest and disease?

	A	B
Yes	[ ]1	[ ]1
No	[ ]2	[ ]2

(e) If Yes, give reason(s) or evidence for your answer?

(f) In your view, is/ are there any difference(s) in farming here as opposed to farming around the *forest edge*?
Yes [ ]1 No [ ]2

(g) If Yes, give reason(s) or evidence for your answer?

(h) How would you describe farming conditions *away from* the *forest edge*? (*Tick once*)
Lot Better [ ]1 Better [ ]2 Good [ ]3 Okay [ ]4 Poor [ ]5
Very Poor [ ]6 Don't know [ ]99

(l) Give reason(s) or evidence for your answer:

---

7. (a) Does your religious beliefs inform your farming decisions?
Yes [ ]1 No [ ]2

(b) If Yes, give reason(s) for your answer.

(c) Are there any beliefs and traditions associated with farming in and or around the forest?
Yes [ ]1 No [ ]2

(d) If Yes, what are these beliefs and traditions? *(Please explain)*

(e) Do these beliefs and traditions influence your decision on where to farm?

Yes [ ]1 No [ ]2

(f) If Yes, give reason(s) or evidence for your answer:

(a) Are there any animal disturbance or conflict affecting your farming activities?

Yes [ ]1 No [ ]2

(b) If Yes, give reason(s) or evidence for your answer:

(c) Please indicate the animal species involved: *(Tick as many as apply)*

Elephants [ ]1 Duikers [ ]2 Baboons [ ]3

Rodents [ ]4 Deers [ ]5 Others (specify) [ ] 6

(d) What specific damage(s) are caused by these animal species?

(e) How frequent are these disturbances encountered? (Tick one only)

Daily [ ]1 Weekly [ ]2 Monthly [ ]3 Seasonally [ ]4

Don't Know [ ]99 Other (specify) [ ]5

(f) At what stage of growth is the disturbance or destruction critical?

Seedling stage [ ]1 Flowering [ ]2 Fruiting stage [ ]3

Matured stage [ ]4 Don't know [ ]99 Other (specify) [ ]5

(g) Approximately, how much is your loss due to the animal raids? *(In terms of number of cocoa bags)*

(h) What methods or strategies are employed to protect farms? (Tick as many as apply)

Fencing [ ]1 Guarding [ ]2 Scarcecrows [ ]3 Making noise [ ]4

Don't know [ ]99 Others [ ]5 (specify)

(i) Have these methods minimised the animal disturbance?

Yes [ ]1 No [ ]2

(j) Does the animal disturbance constitute a major factor in deciding where to farm?

Yes [ ]1 No [ ]

8. (a) What do you perceive as the *most critical* considerations in siting a cocoa farm? *(please list them)*

(b) What *other* factors influence the siting of cocoa farms in this community?

SECTION D: LAND TENURE DYNAMICS

9. (a) Do you own the land you are farming on?

Yes [ ]1 No [ ]2

(b) How was the land first acquire? *(Tick once)*

Inherited [ ]1 Leased [ ]2 Sharecropper (Abunu, 50 – 50) [ ]3
Sharecropper (Abusa, 67 – 33) [ ]4 Share crop - owner [ ]5
Caretaker [ ]6 Cash purchase (Individual) [ ]7
Cash purchase (Stool) [ ]8 Gift [ ]9 Other (specify) [ ]10

If share cropper go to 10(c); if any other go to question 10(f).

(c) Who determined the boundaries?
Share cropper [ ]1 Land owner [ ]2 Chief [ ]3 Surveyor [ ]4
Other *(specify)* [ ]5

(d) At what age of cocoa was the land shared? ----------

(e) Who made the first choice?
Share cropper [ ]1 Land owner [ ]2

(f) Is the farmland inheritable?
Yes [ ]1 No [ ]2

(g) If No, to whom does the land revert to when you no longer use it?

Landlord [ ]1 Forestry [ ]2 Chief/ Stool [ ]3 Family [ ]4 Other *(specify)* [ ]1

(h) Are there any restrictions in terms of (A) crops cultivated and (B) farm expansion?

A	B
Yes [ ]1	Yes [ ]1
No [ ]2	No [ ]2

A ---------- B ----------

(f) If Yes, Give reason(s) or evidence for your answer.

(g) Are there any *other* conditions under which you occupy the land?
Yes [ ]1 No [ ]2

(h) If Yes, what are these other conditions? *(Please explain)*

(i) Are these conditions favourable to you?
Yes [ ]1 No [ ]2

10. (a) Has tenure any influence on where to farm? Yes [ ]1 No [ ]2

(b) If yes,give reason(s) or evidence for your answer

(c) Does other land uses influence where to farm ?
Yes [ ]1 No [ ]2

(d) If yes, what are these land uses? *(Please mention)*

(e) What is the nature of this influence? *(Please explain)*

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11. Please tick the appropriate box to express the extent of your opinion on the following statements:

Statement	Strongly Agree (5)	Agree (4)	Uncertain (3)	Disagree (2)	Strongly Disagree (1)
1. Local communities have the traditional responsibility to protect the forest					
2. Land tenure is a determinant in the siting of cocoa farms in KCA					
3. Animal destruction is a major consideration in the siting of cocoa farms					
4. Cocoa agriculture has contributed significantly to forest loss in KCA					
5. Closeness of a farm to the *forest edge* influences crop yields					
6. Closeness of a farm to the *forest edge* influences its resilience to pests and dieseases					
7. Protection of the forest is very beneficial to farming activities in KCA					

12. (a) What do you see as the most serious problems facing cocoa farming in this community? *(Please list them)*

(b) How do you think the problems listed above can be solved? *(Please explain)*

THANK YOU

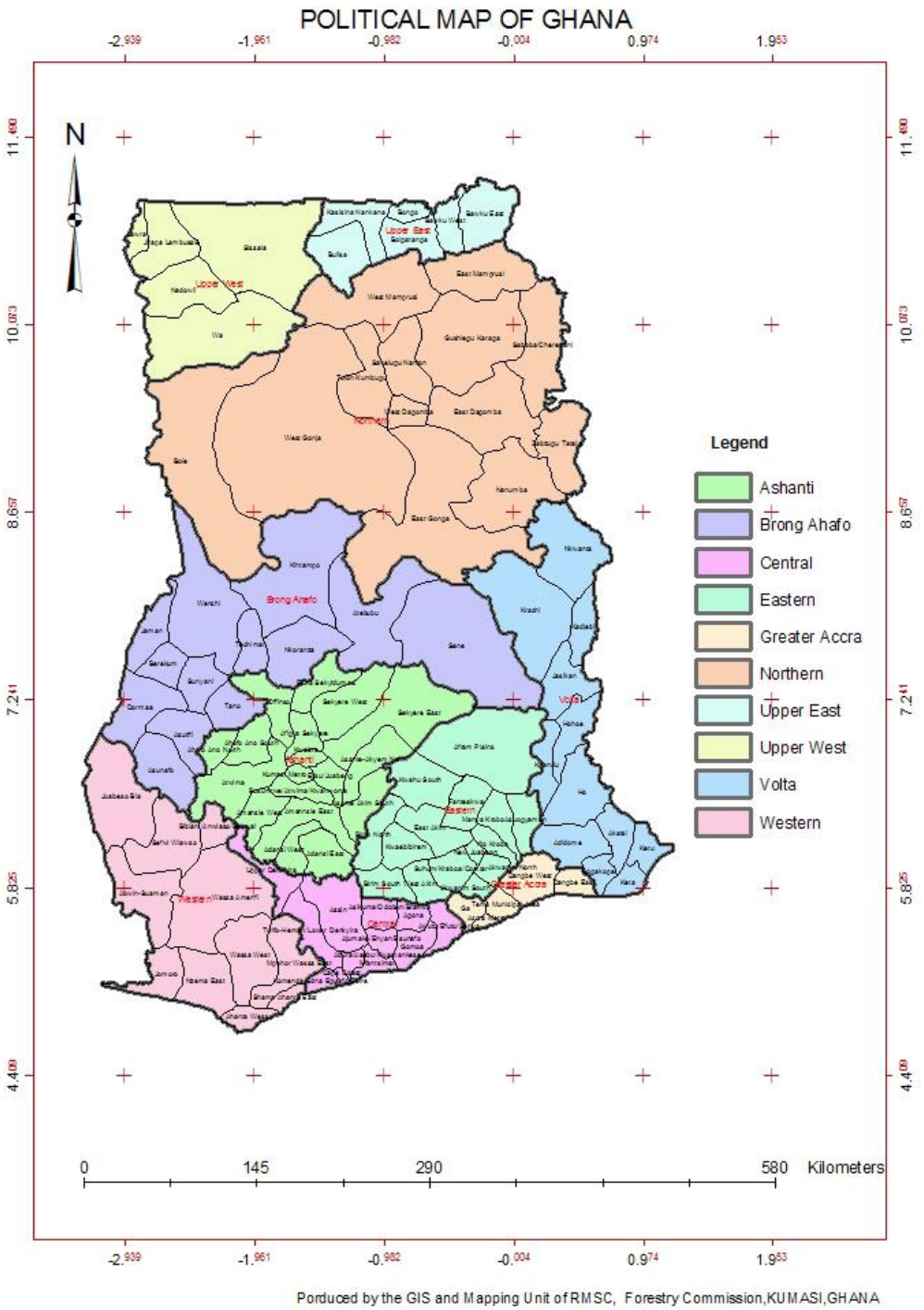
APPENDIX 2: EXPLANATION OF SOME TERMINOLOGIES USED

The Taungya System
Taungya system is a system of forest plantation in which small-scale farmers are allowed to cultivate crops between the seedlings of a forest plantation in the forest, few years after planting (Amanor, 1996). According to Boakye and Baffoe (undated)The system was introduced in 1928 to restore Ghana's forest cover, solve the land shortage problems of farmers living near forest reserves, and provide the Forestry Department with labour for plantation development.
Stool Land
As defined under Chapter 26, Article 295 of the 1992 Fourth Republican Constitution of Ghana, a stool land includes any land or interest in, or right over, any land controlled by a stool or skin (the traditional symbol of authority), the head of a particular community or the captain of a company, for the benefit of the subjects of that stool or the members of that community or company.
The Office of the Administrator of Stool Lands
The Office of the Administrator of Stool Lands was established under Article 267 of 1992 Fourth Republican Constitution of Ghana. The Office is mandated to establish a stool land account for each stool; collect stool land revenue and account for same to the beneficiaries, disburse stool land revenue in accordance with a formula prescribed by the constitution.

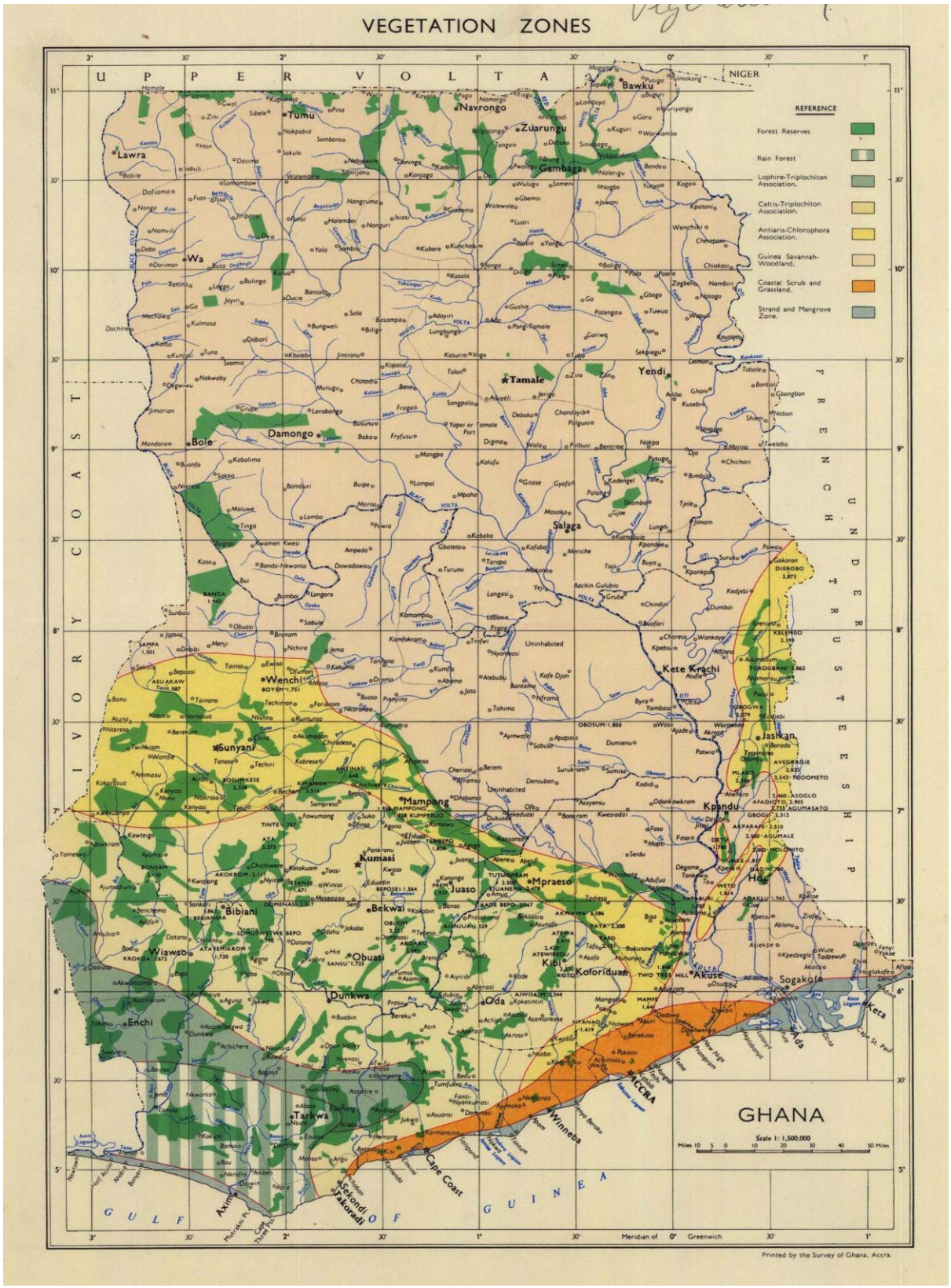
APPENDIX 3: SOME EXEMPLARY QUOTES FROM INTERVIEWS

Forest Perceptions	..the forest provides rainfall ("nso").. ..the forests provides a suitable habitat for the wild animals.. ..given the opportunity, we will farm the whole conservation area..*(A farmer at Homaho)* ..we are not allowed to enter the reserve; and if you are caught by the GAME people, you will be beaten severely..*(Focus Group Interview at Bobi)* ..the protected area is too big: should be given some of the forest land for farming…*(Focus Group Interview at Homaho)*
Crop-Raiding	..I cannot always be sharing my harvest with elephants, which are of no use to me..*(A farmer at Afiaso)* ..the elephants have the same taste as humans: they enjoy all the food crops and recently cocoa beans..*(Focus Group Interview at Antwikwaa)* ..hitherto, the elephants did not eat cocoa, but now they do… ..farming close to the edge is no longer profitable because of the elephants..*(A farmer at Appiahkrom)*
Tenurial Conditions	..we are not supposed to farm and cross some waterbodies on Tuesdays ("*benada*") and Akwasidae, the earth goddess "*Asaase Yaa/Efua*" may have enough rest...*(All Focus Group Interviews)*
Cocoa Cultivation	..poor yields are sometimes results from "*anunum*" (overshading and excessive rains) and "*nkrampan*" caused by birds...*(Focus Group Interview at Homaho)* ...shade trees suitable for cocoa include *pampena*, *okoro Awiemfosamina*..*(Focus Group Interview at Homaho)* ..trees like *onyina, celba pentandra, akata bonbae* are not suitable for cocoa shade because of their deep root system and dense canopy cover..*(Focus Group Interview at Homaho)*

APPENDIX 4: MAP OF GHANA

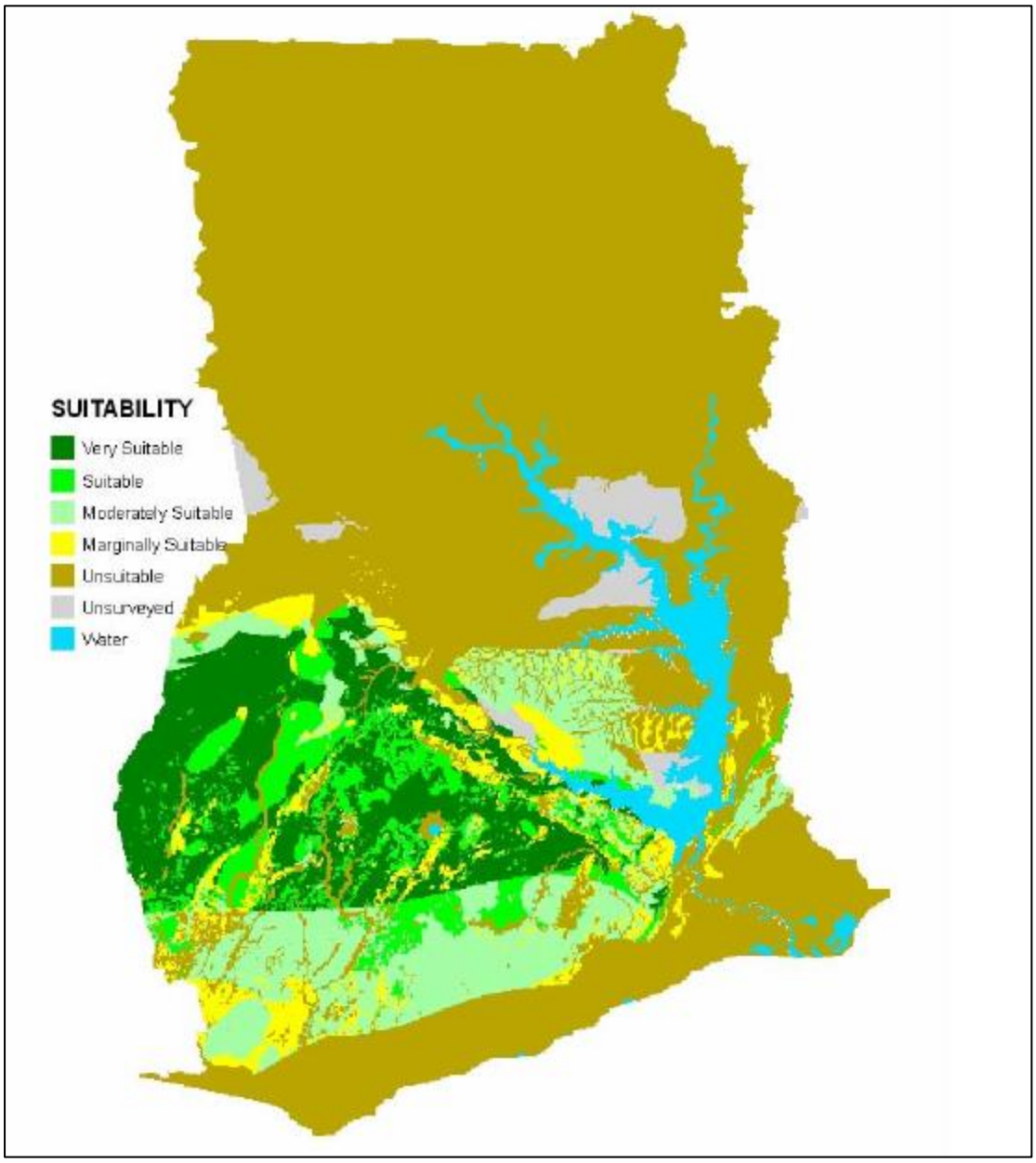


APPENDIX 5: VEGETATION MAP OF GHANA



Source: Wageningen University Library, 2013. Available at www.library.wur.nl/WebQuery/isric/19192 (Accessed on 27/08/2013).

APPENDIX 6: SUITABILITY OF COCOA PRODUCTION IN GHANA



Source: Chamberlin, 2007.

APPENDIX 7: A MAP SHOWING SOME VILLAGES BUFFERING THE KCA