UNIVERSITY FOR DEVELOPMENT STUDIES

POPULATION GROWTH, LAND SCARCITY AND COMPETITIVE USE IN THE BONGO DISTRICT

BY

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ABSTRACT

Rapid population growth and low economic standards of living have had consequences for agricultural land resources in Ghana. Land shortage and poverty taken together lead to non-sustainable management practices which contribute to the direct causes of land degradation. Land degradation in turn contributes to low and declining agricultural productivity which also contributes to the continuing or worsening poverty levels in Ghana. The Bongo District of the Upper East Region is no exception.

The focus of this study is "Population Growth, Land Scarcity and Competitive Use in the Bongo District". Participatory Rural Appraisal (PRA) Tools were used in data collection and analyses. These tools included Focus Group Discussions, Observations, Interviews and Questionnaires among others. The information was collected from major stakeholders such as land users, Chiefs, Tindanas (land priests), Herbalists and Organizations interested in and working in the area of natural resource management. Also, secondary data from Government agencies as well as information from the Internet, journals and books that were relevant to the study were used. The results revealed that the causes of land degradation in the Bongo District include continuous cropping, soil erosion and climate change. Indicators cited as evidence of land degradation were those that directly affected the yield components of land users - reduced crop yield, soil infertility, and soil erosion. The underlying causes mentioned included poverty, human population growth as well as ignorance and inadequate environmental education. The resulting effects however were loss of productive lands, reduced yields, and increased cost reduced vegetation and drought. Respondents suggested strategies for the management of land degradation and these included: cultivation along contours, stone bunding, tree planting, environmental education and the provision of agricultural inputs by Government.

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DEDICATION

I dedicate this piece of work to my husband, David, children; Emest, Eliakim and Eugene and my mum, Edwina.

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LIST OF ACRONYMS

ACC/SCN .....Administrative Committee on Coordination/Standing Committee on Nutrition

AGDP ..... Agro-gross Domestic Product

Al. .....Aridity Index

BAFP .....Bongo Agro-forestry Project

BDA ..... Bongo District Assembly

CECIK .....Centre for Cosmo Vision and Indigenous Knowledge

CIA .....Central Intelligence Agency

ECA ..... Economic Commission for Africa

EPA .....Environmental Protection Agency

ESCWA ..... Economic and Social Commission for Western Asia

FAO .....Food and Agricultural Organization

FSD .....Forestry Service Division

GDHS .....Ghana Demographic Health survey

GDP .....Gross Domestic Product

GEF ..... Global Environment Facility

GLASOD ..... Global Assessment of/on Soil Degradation

GNFS ..... Ghana National Fire Service

GOs .....Governmental Organization

HYVs ..... High Yielding Varieties

ICOUR ..... Irrigation Company of Upper East Region

ILRI ..... .International Livestock Research Institute

IF AD .....International Fund for Agricultural Development

IGOS .....Integrated Global Observation of Land

ISRIC ..... International Soil Resources and Information Centre

IUCN ..... The World Conservation Union

LADA .....Land degradation Assessment in Drylands

MOF A ..... Ministry of Food and Agricultural

NADMO .....National Disaster Management Organization

NGOs .....Non-Governmental Organizations

PACA .....Professional Alliance for Conservation of Agriculture

PET .....Potential Evapotranspiration

PRA .....Participatory Rural Appraisal

SLM ..... Sustainable Land Management

SSA .....Sub-Sahara Africa

UER .....Upper East Region

UNDP .....United Nations Development Programme

UNEP .....United Nations Environment Programme

UNFPA .....United Nations Population Fund

CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND

Agriculture is the main economic activity of the population of Ghana. It contributed over 40% of Gross Domestic Product(GDP) and employed about half of Ghana's labour force (Codjoe, 2006: 645) but now the GDP figure has decreased to 33.7% and employs! 55% of the population (CIA World Fact Book, 2011). Out of Ghana's total land area of 23,853,900 hectares, 13,628, 179 hectares (57.1 %) is suitable for agriculture. But the total area under cultivation in the year 2000 was 5,808,600 hectares (42.6%) of the agricultural area (MOF A, 2001).

Rapid population growth and low economic standards of living have had consequences for agricultural land resources in Ghana (Codjoe, 2006:645). Fallow lands have been reduced or eliminated. There has been massive migration of mainly the youth to mining and forest areas in southern Ghana. Asabere-Ameyaw et al (2008:29) indicate that the high population growth rates have increased the demand for housing. This together with other developmental projects like road construction and both conventional and unauthorized mining activities has led to serious land scarifications.

Tokle and Danso (2007:3) contend that the sustainability of the country's growth is based primarily on natural resources, which at the current rate of environmental degradation, are

threatened. The "Country Environmental Assessment" (a study conducted by the World Bank in 2006) notes that Ghana's natural resources, on which so much of the country economic activity and the population's livelihood depend, are being depleted at an alarming rate. More than 50 percent of the original forest area has been converted to agricultural land by slash-and-burn clearing practices. According to Tokle and Danso (2007:4), the cost of environmental degradation to GDP represents one-third of Ghana's $1.5 billion annual overseas development assistance.

In Fullen and Catt (2004:3), the International Development Research Centre (IDRC) based in Ottawa Canada estimated the world population to be 6,159,463,956 and the area of productive land at 8,585,272, 604 ha (values on 05 Nov. 2001). The US Bureau of Census placed the world population in mid-2003 at 6,302,486,693 and growing by an annual rate of 1.16 percent. That is an extra of 73,395,376 people in a year or on the average, an extra 8378 people per hour. Estimates of the world's current (June, 2011) population by US Bureau of Census stand at 6,956,065,450. Ghana's first post-independence population census in 1960 counted about 6.7 million inhabitants. In 2000, Ghana's population stood at 18,912,079 and the provisional results of the 2010 population census of Ghana recorded 24,223,432 inhabitants (Ghana Statistical Service, 2000, 2010). The IMF (2011) estimates that by 2015, Ghana's population would be 26.89 million persons. These values are best estimates but indicate the scale of the problem.

Malthus (1798, republished 1998) in his Essay on Population hinted a relation between population growth and impoverishment. According to Malthus, population is reaching the point when the food supply is reaching exhaustion. Malthus says the extra people have to die. Boserup (1965) says that you just have to upgrade the productivity of the' food supply.

Boserup argues that under pressure of numbers, with more mouths to feed, people put more labour and more intense effort into feeding themselves. They cultivate the land more intensively; they add extra manure, extra fertilizer, extra water and improve their crops. They invent their way out of the Malthusian crisis. Indeed if Boserup is right, then the most advanced agricultural technology should be found in places which are closest to a Malthusian crisis. Unfortunately, the places with the food shortages tend to have low-tech agriculture of which the Bongo District of the Upper East Region of Ghana is no exception.

The FAO (1992:30) states that lack of control over resources, population growth, a lack of alternative avenues of livelihood and inequity are all contributing to the degradation of resources. In turn, environmental degradation perpetuates poverty as the poorer attempt to survive on a diminishing resource base.

The World Bank (1992:3&7) emphasizes that rapid population growth exacerbates the mutually reinforcing effects of poverty and environmental damage. The World Bank further states that, poor families who have to meet short term needs mine the natural capital by excessive cutting of trees for firewood and failure to replace soil nutrients. The poor are both victims and agents of environmental damage.

The Land Degradation Assessment in Drylands (LADA) indicates that land degradation is a serious problem that crosses national borders, ecological zones and socio-economic levels. It can be especially devastating for the world's poorest people living in dry land areas (FAO, 2008). The FAO (1999) stresses that mismanagement of arable areas by farmers and grazing areas by livestock owners is one of the major causes of soil degradation. More sustainable

management of lands would reduce environmental pressures. Conservation tillage i.e. reduced or no tillage is the key to sustainable arable land management as it protects the soil resources, increases the efficiency of water use and, of special importance in semi-arid areas reduces the effects of droughts. A study by the FAO (1994) in the Asia Pacific Region indicated that continuing increase in rural agricultural population (population increase) together with land shortage is the second largest basic cause of degradation.

In a nutshell, environmental degradation is a serious threat to the lives of people animals and plants, making it imperative that people stop further degradation from occurring in order to conserve the soil resource base for current and future generations by launching conservation and rehabilitations programmes in the most critically affected and vulnerable areas such as the Bongo District of the Upper East Region of Ghana. Thus, the focus of this study is "Population growth, Land Scarcity and Competitive use in the Bongo District of the Upper East Region of Ghana." The study seeks to examine the implications and linkages between population growth, land scarcity and competitive use on land degradation in the district. The study will also examine the strategies which could be adopted to minimize or mitigate the problem of land degradation in the District.

1.2 THE RESEARCH PROBLEM

Agriculture is the main stake of the Bongo District. The district is characterized by large household size, high population growth rate and high fertility rate. A report of the Bongo District Assembly in 2006 indicates that the district has a population growth rate of 2.8%. This is 0.4% higher than the national rate as indicated by the 2000 population and housing census. According to Asabere-Ameyaw et al (2008:16), this rapid population growth and the

pattern of its distribution influence the state of the environment by aggravating environmental degradation problems such as bush fires, land scarifications, overgrazing, desertification or deforestation, soil erosion and pollution.

Despite the increasing population in the district, there are no substantial areas of usable and /or unused land in the district. The scarcity of land in the district is aggravated by the presence of rocks on about 40% of its land surface (BDA, 2006). These two primary forces (limited land resources and increase in population pressure) combine to produce land shortage and competitive use. The increasing pressure on land, resulting in small farms, low production per person and increasing landlessness in the district cannot be understated. A consequence of landlessness is the next element of poverty (FAO, 1994).

Land shortage and poverty taken together lead to non-sustainable management practices, which contributes to the direct causes of degradation as poor farmers are led to clear forest, cultivate steep slopes without conservation, overgraze rangelands, make unbalance fertilizer applications and so forth (FAO, 1994). Non-sustainable management practices lead to land degradation which in turn leads to low productivity, hunger and poverty. It is therefore not surprising that the district is characterized by high food insecurity.

The problem that attracts the focus of this research is land degradation in Bongo District as a result of increased population, land scarcity and competitive use arrangements. This study will basically delve into the linkages between Population Growth, Land Scarcity and Competitive use in Bongo District. Furthermore, this study will seek solutions to the problem of land degradation from the perspective of various stakeholders as well as coping strategies

which could be adopted by the increasing population to minimize the degradation of land. The research therefore, seeks to answer the following questions.

1.3: MAIN RESEARCH QUESTION

What are the implications of high population pressure and land use competitiveness on the degradation of land in Bongo District?

1.4: SPECIFIC RESEARCH QUESTIONS

The specific Research Questions are:

1. What are the implications of population pressure on land degradation in the Bongo District?
2. What are the implications of land use competitiveness on land degradation in the Bongo District?
3. How can land degradation be minimized with the increasing population in the Bongo District?

1.5: MAIN OBJECTIVE

To establish the implications of high population growth and land use competitiveness on the degradation of land in the Bongo district.

1.6: SPECIFIC OBJECTIVES

The specific objectives are to:

- Assess the implications of population pressure on land degradation in the Bongo District.

- Assess the implications of land use competitiveness on land degradation in the Bongo District.
- Establish the link between population pressure, land use competitiveness and land degradation in the Bongo District.
- Identify coping strategies that could be adopted by the increasing population to minimize land degradation in the Bongo District.

1. 7: RELEVANCE OF THE RESEARCH

Increasing population and competitive land use leading to land degradation have been the phenomenon in many communities in developing countries including the Bongo District of the Upper East Region of Ghana. Since land degradation leads to decrease in yields and eventually hunger and poverty, there is the need to find ways to mitigate the problem,

The study seeks to contribute to existing knowledge on interaction between population growth, land scarcity and competitive use with a focus on the Bongo District of the Upper East Region of Ghana. The study will involve people and organizations with a stake on land use. The opinions and views gathered during the research process would be of immeasurable value in policy formulation, implementation and development process in general.

The study which involved the use of the Participatory Rural Appraisal (PRA) tool is expected to help the increasing population adopt coping strategies to minimize the problem of land degradation.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 INTRODUCTION

The chapter reviews the previous works and studies of different scholars that + relevant to the subject of degradation under study in order to obtain some facts that will provide the context within which this study can be made more comprehensive.

2.1.1 CONCEPTS OF LAND DEGRADATION, AND LAND USE COMPETITIVENESS

2.1.2 Land Degradation

According to Stocking and Murnaghan (2001:9), land degradation is a composite term, it has no single, readily identifiable definition but instead describes how one or more of the land resources (soil, water, vegetation, rocks, air, climate, relief) has changed for the worse. The change may prevail only over the short term with the degraded land recovering quickly or it may be a precursor of a lengthy downward spiral of degradation, causing a long-term permanent change in the status of the land.

Degradation is socially constructed and does not only encompass the biophysical environment (Stocking and Murnaghan, 2001:10). The social construction may be seen in two ways. First, in relation to the use of the land resource by society, a change in quality has a social construction. The more that people rely on a resource that is degrading, the greater is the disruption to society arising from the degradation. A farmer whose only means of livelihood

is the intrinsic quality of the land resources of the farm suffers greatly than another farmer who can gain some extra income from employment elsewhere. Again, social construction must be seen in terms of who does the perceiving. According to Stocking and Murnaghan (2001: 10), one section of society may put a completely different construction on evidence of degradation than another of society. Whilst soil degradation is recognized as a major aspect of land degradation, other processes which affect the productive capacity of cropland, rangeland and forests, such as lowering of the water table and deforestation, are captured by the concept of land degradation. Land degradation is, however, difficult to grasp in its totality. The "productive capacity of land" cannot be assessed simply by any single measure. Therefore, we have to use indicators of land degradation. Indicators are variables which may show that land degradation has taken place - they are not necessarily the actual degradation itself. The condition of the soil is one of the best indicators of land degradation.

UN/FAO defines degradation as the temporary or permanent decline in the productive capacity of the land (Stocking and Murnaghan, 2001:9).

Asabere-Ameyaw et al (2008:23) argue that environmental degradation involves the irresponsible utilization of environmental resources thereby making these resources unable to support life at their fullest potential.

According to Norbu et al (2003:90) land degradation is the decline of land's capacity to sustain agroforestal and other biotic production and diversity due to human activity. This definition has significant implications: it excludes decline in productivity that is due wholly to natural causes, and is restricted to anthropogenic effects. The definition in the South Asian

survey (Young, 1994) did not restrict degradation in this way, nor did Stocking (2001). However, Stocking and Murnaghan (2001) indicate that land degradation includes all productivity-reducing effects that are due to 'inappropriate use', implying that degradation is caused by human activities. The definition excludes changes, no matter how visible, that do not detract from the land's productivity.

Nkonya et al (2008:9) define land degradation as the loss of productive and ecosystem services provided by land resources. For example, the reduction or loss of the biological or economic productivity and complexity of rain fed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from processes such as soil erosion caused by wind and/or water; deterioration of the physical, biological or economic properties of the soil; and long-term loss of natural vegetation.

The Land Degradation Assessment in Drylands (LADA) project, executed by FAO with funding from UNEP, GEF defines land degradation as a reduction in the capacity of land to perform ecosystem functions and services that support society and development. LADA approaches land degradation as a biophysical, social, economic and environmental issue that must be dealt with through a combination of geo-informational, scientific and local knowledge tools (F AO, 2008).

Land degradation may involve not only soil degradation but also damage to the vegetation, changes in landforms so that the hydrology and water relations suffer, and changes to the climate. The deterioration of the soil (degradation) involves the loss of actual or potential productivity as a result of natural and anthropogenic factors which reduce the productivity of

the soil and its beneficial effects on the environment. While soil degradation can be an entirely natural process, human activities often accelerate the natural processes

There are several components of land degradation associated with different degradative processes. They may be conveniently divided into those due to chemical, physical and biological processes. Each of the processes creates typical symptoms which can be helpful in assessing the degree of degradation that has occurred, and the extent of degradation, Together these two cause a marked loss of soil productivity, which is a function of the chemical, physical and biological properties of the soil. The greatest significance of land degradation is associated with agriculture and pastoralism, which both cause land degradation (FAO, 1994).

More recently the International Soil Resources and Information Centre (ISRIC), under the aegis of UNEP and in collaboration with FAO, have produced a World Map of the Status of Human-Induced Soil Degradation at a scale of 1:10 m known as GLASOD (ISRIC/UNEP, 1990). It identified 4 degrees of degradation (light, moderate, strong and extreme). Five types of human interventions were identified as resulting in soil degradation: deforestation and removal of natural vegetation (579 million hectares); overgrazing of vegetation by livestock (679 million hectares); improper management of agricultural land (552 million) industrial activities leading to chemical pollution (22 million hectares). According to GLASOD, 1964 million hectares of agricultural land worldwide are degraded. Four hundred arid ninety-four (494) million hectares (25 percent) of these are in Africa.

2.1.3: Land Use Competitiveness

Land use as defined by IGOS (2007:20) is the arrangements, activities and inputs people undertake within a land cover type to augment, enhance, change or maintain it. Land use is

distinct from land cover in that specific use characteristics are associated within a land use category, whereas a land cover may be used for a variety of activities or purposes. According to IGOS (2007), characteristics related to the intensity, extent and duration of land use activities provide additional information to distinguish various properties associated with a land use.

According to Dei Congressi (2009:5), landlessness and land fragmentation are growing worldwide and the FAO (2008) asserts that land use is a major driving force of land degradation.

Giller et al (2008:1) say that competing claims on natural resources become increasingly acute, with the poor being most vulnerable to adverse outcomes of such competition They contend that land use is largely influenced by a number of factors, the main ones being climate, socioeconomic (culture and population dynamics) and government policies

From the USAID (2006:1), control or access to land and natural resources is important for sustainable management, good governance and empowerment of the rural poor for several reasons:

1. Land and natural resources are important assets for individuals and households in meeting subsistence needs including food and shelter. To that end, access to land and natural resources (renewable natural resources in particular) is critical for poverty alleviation and food security.
2. Land and natural resources provide important assets for income generation for most rural households. Rural households may generate income through production of cash crops, or from collection and sale of forest, marine or coastal resources. Indeed,

households with secure rights to land are typically better off than those with insecure, limited or no land rights at all.

Scherr (2000:479) states that agriculture accounts for most land use in developing countries and thus is probably the single most powerful influence on environmental quality. At the same time, agriculture remains the principal livelihood of the rural poor. Otsuka (2001:1 &5) argues that as population increases, land becomes scarce relative to labour. According to Otsuka, the growing population will require increasing area for agricultural production and hence large areas of forest are opened up. Massive degradation of natural resources including forests, rangelands and irrigation water take place in the third world. The growing population has increased demand for land, trees, water which, coupled with tenure insecurity or absence of clear property rights, has resulted in over-exploitation of these natural resource. This has in turn threatened sustainable development of agriculture, forestry and livestock sectors.

According to Zeleke et al (1999) cited in Nyssen et al (2008:1), the declining soil fertility where permanent upland farming dominates and where population factors have led to land scarcity induces conflicts in land use for forestry, agriculture and livestock. Tukahirwa (2002:28), Nyssen et al (2008:1) and De Writ (2003:2) maintain that population growth is expected to cause expansion of cultivated area in less densely populated areas where expansion is feasible or to increase the labour intensity of agriculture where expansion is less feasible.

Tukahirwa (2002: 15) states that land utilization relates closely to the different tenure systems. This is because the interests and rights of the parties involved impact greatly on the activities

and innovations that the occupants and/or owners can undertake on the land. The implication here is that majority of the population have resorted to trying to access land for cultivation and grazing, a condition that has culminated into excessive and sometimes unwise utilization and subsequent degradation. The Economic Commission for Africa-ECA (2004:21) also asserts that land tenure issues have links with land-use, agricultural production efficiency, access to credit, conflict management mechanisms, fragmentation of landholdings and so on, to include all aspects of power/politics and social position.

Land fragmentation may undermine farmer's interest in undertaking some type of land management. In dispersed and distant plots, the cost of hauling manure or organic materials may not be worth trying. The larger the number of parcels of plots a farmer owns and manages, the greater the amount of time loss in traveling from one plot to another and less the time left for manuring and soil conservation activities. Thus, large number of farm plots is associated with lower levels of applying manure and adoption of improved soil and water conservation strategies (Yohannes, 1992:188, Berhanu and Swinton, 2003).

In Ghana, sharecroppers have put enormous pressure on soil fertility to secure high yields in order to pay land rents. Farmers in such situations discount the future at very high rates, thereby reducing the incentive for long-term investments in improved soil fertility. Besides, the distance travelled to a farm may be related to land accessibility and availability (Codjoe: 2006:653). As a result of land shortages, even the most fragile areas are not spared. This has increased pressure on the ecosystems resulting in the current degraded state (loss of biodiversity; over-cultivation; soil erosion; declining productivity) and more poverty. Codjoe emphasizes cattle grazing areas are prone to bush fires, treading and overgrazing. Overgrazing

and bush fires have been the greatest culprits of biodiversity reduction as they result in the extermination of the most grazed species as well as pyrophlitic (fire-resistant) species and in their place are low bromalytic (nutritive) species such as *Erogrostics, Sporobolus* and *Digitalia.*

De Writ (2003:2) observed that the global per capita available land has been reduced from 0.3ha in 1961 to 0.27ha in the 1990s. The land/man ratio for the African continent has decreased from 0.62ha in 1962 to merely 0.26ha in 1995. In countries like Rwanda and Malawi this figure has even dropped to almost 0.15ha. Intensification of agricultural production has not yet given the desired results to respond to this decreasing land/man ratio, mainly because modem techniques and farming systems are not within the reach of the average African farmer. Moreover, agric extension services in developing countries only target the better off rural households because immediate results are easier to obtain.

Dawidson and Nilson (2000: 32) indicate that in the Upper East Region, about 90% of the population are engaged in cattle rearing and crop production. Every available land is used for cultivation and most farmers have very small fields. They stated that the average farmer has approximately 1 hectare. The population pressure has resulted in continuous cultivation in a compound farming system. Fire is common before cultivation to prepare for new crops. On the field closest to the compound, farmers grow crops such as early and late millet *(pennisetum americanum),* sorghum *(sorghum bicolour),* bambara beans, cowpea *(vigna uniguiculata)* and vegetables.

Blench (1999:26) reveals that a major source of pressure on the environment is the need for cooking fuel. Traditionally, all cooking was done in open fire with cooking pots supported by three stones. Firewood was gathered in the woodland areas and apart from restrictions, individual tree species were considered freely available. Although great majority of households still gather fuelwood in the higher-density areas of the Upper East Region (UER), this has become a scarce commodity. The principal substitute for fuelwood is cereal stems and dung. The use of dung in the UER is common due to the absence of accessible fuelwood. This has serious consequences for the renewal of soil fertility in the region. Dawidson and Nilson (2000:30) assert that population pressure and intense cultivation have resulted in enormous soil erosion in the Upper East Region. Increased cultivation has contributed to le0ss vegetation cover which without proper management increases the risk of erosion.

Blay et al (2004:46) in a case study in Tanzania indicate that due to over exploitation of woodlands and especially overgrazing, charcoal production and firewood collection, recovery of vegetation becomes difficult and slow. Recovery of woodlands was possible after an area had been excluded from grazing for a period of as short as one to two years.

According to Blay et al (2004:14), within the dry-lands zone, land degradation or desertification is reported to be occurring at various levels depending on land use. For example, it is moderate in irrigated croplands (1. 9 million hectares or 18% of Total irrigated cropland) while it is high in rain-fed croplands and rangelands (48.9 million ha o 61% ofrainfed croplands and 995.1 million ha or 74% of rangelands). The annual rate of desertification is about 10% in arid lands, 1 % in semi-arid lands and 0.1 % in dry sub-humid lands, leading to an annual increase of lands affected of: 156.9 million ha in arid areas, 23.0 million ha in semi-

arid areas and 1.3 million ha in dry sub-humid areas. These give an average rate of desertification of 3.5% per year.

The dominant type of land tenure in any community can greatly affect the total agricultural land cropped (Codjoe: 2006:653). He asserts that in communities where there are flexible land tenure systems, (i.e., splitting into two; farm proceeds shared in ratio of 1:2 between farmer and landowner or splitting into three; farm proceeds shared in ratios of 1:3) members may put more land under cultivation. But areas with very stringent land tenure systems or in situations where land may be hired, land accessibility may be difficult.

2.2.0 TYPES OF LAND DEGRADATION

According to Diao and Sarpong (2007:5), the major types of land degradation in Ghana are physical (erosion, compaction, crusting and iron pan formation); chemical (depletion of organic matter and nutrients, salinization and acidification); and biological (loss of organic matter). Although wind erosion is presently of no major consequence, it can be serious as the area of bare land increases due to the removal of vegetation. Water erosion is presently a problem. The EPA-Ghana (2002:66) reveals that the extent of erosion covers 70,441 km^2 as slight to moderate sheet erosion, 103,248 km^2 of severe sheet and gully erosion and 54,712 km^2 as very severe sheet and gully erosion. These forms of erosion occurred in both the savannah and forest zones, hilly areas and steep slopes (most vulnerable zones are in Guinea and Sudan Savannah with the Upper East Region). Most of the soils in the Forest-Savannah, Transition, Guinea and Sudan Savannah Zones are affected by subsoil compaction and severe soil physical degradation. According to the EPA-Ghana (2002:66), over 96,000 km^2 of land in Ghana have been found to contain ironpan. The EPA-Ghana adds that annual nutrient

depletion rates, as one of the main chemical degradation processes in Ghana, are pf 35 kg N, 4 kg P and 20 kg K/ha $^{-1}$. Nutrient depletion is widespread in all agro-ecological I zones of the country and more pronounced in the coastal, Guinea and Sudan Savannahs due 1jo high losses of organic matter

2.2.1 Physical Land Degradation

Erosion

Erosion is a natural and continuous process. Soils are created through erosion of parent material and either local deposition or transport and deposition elsewhere. According to Ballayan (2000:8), erosion is defined as the detachment or uptake, and transport over a certain distance of material of the upper layer of the earth crust by an agent, like water, wind or ice. This mass movement of soil particles is part of the process of soil degradation. Before erosion takes effect, the degradation process often has started with qualitative changes in the soil, like loss of nutrients, loss of organic materials, reduced soil life and loss of soil structure.

There are three forms of erosion characteristic of degraded arid and semi-arid rangeland areas (Ballayan, 2000:8). These are:

1. Sheet erosion is the most common form of erosion. Unprotected soil particles are loosened by trampling, through wind erosion and by the impact of rainfall. The soil particles are then transported by rainwater surface flow to the river and stream systems. Sheet erosion is characterised by a general lowering of the soil level, leaving raised pedestals where the root mass of the remaining vegetation protects it.
2. Wind erosion is less common, but again it takes place after vegetation has been lost and when soil particles are loosened. Early signs of wind erosion include deposition of

- sand particles around plants and micro-ripples on the surface of exposed areas. The final extreme is the classic sand desert dune structures. Wind erosion occurs most frequently in the arid and semi-arid regions of the tropics, but wind erosion is also a problem in flat lands even up to rainfalls of 750 or 800 mm. In (semi-) arid climates natural wind erosion is often difficult to distinguish from human induced wind erosion, but natural erosion is often aggravated by human activities.

3. Gully Erosion the most obvious and dramatic demonstration of erosion although in most areas actually less significant in terms of total land degradation. Gully erosion rarely occurs without sheet erosion. The trigger for gullying can be the loss of vegetation in areas where the micro topography results in concentrate stream flow during the rains. They can also be triggered by erosion along livestock tracks, footpaths and road edges. The process can start with 'rills' and end up with gullies that are tens of metres deep.

ESCWA (2007:34) states that water erosion resulting from both torrential rain and unsustainable human practices contributes to degradation. It is more apparent in dry periods when the land surface is cracked, and then a powerful flow of water comes scouring the land surface, widening cracks into gullies and eroding the soil in a down-flow direction. Sloping surfaces and valleys are the most affected by this process, which is becoming increasingly serious as people exploit more of those lands for agriculture and housing purpose , thereby making them even more susceptible to degradation. The process may contribute further to the accumulation of sediments downstream, which may increase silt build-up in artificial reservoirs and, in a worst case scenario, under arid conditions form salt plains.

- ***Crusting and Compaction***

Compaction, sealing and crusting occur, under nearly all climates and soil physical conditions. Soil crusting and compaction tend to increase runoff, decrease the infiltration of water into the soil, prevent or inhibit plant growth and leave the surface bare and subject to other forms of degradation (Oldeman et al, 1991:13). According to Oldeman et al, compaction of the soil often arises from unsatisfactory cultivation practices, especially when mechanical cultivation methods are used.

2.2.2 Chemical Land Degradation

The chemical process mostly causing soil degradation is the removal of nutrients, which reduces the capacity of the soil to support plant growth and particularly crop production. Replenishment or recycling of nutrients by natural processes is less able to support crop production. Chemical land degradation may be categorized as follows:

Depletion of organic matter and nutrients

One well-accepted indicator of increased erodibility is the level of soil organic matter. Where the organic matter content of soil falls below 2 per cent, the soil is more prone to erosion, because soil aggregates are less strong and individual particles are more likely to be dislodged (Stocking and Murnaghan, 2001:13). Some environments are naturally more at risk to land degradation than others. Factors such as steep slopes, high intensity rainfall and soil organic matter influence the likelihood of the occurrence of degradation.

According to Norbu et al (2003:91), quite small depletions of some nutrients may lead to a decrease in soil organic matter. This in turn may weaken the physical structure of the topsoil, making it easier for rainfall and surface runoff to remove it. ESCWA (2007: 16) contends that

sandy and silty soils with low organic matter content are highly vulnerable to Wind and water erosion.

Salinization and acidification

The EPA-Ghana (2002:68) alleges that salinity is a problem in Ghana with most of the soils along the coast due to salt-intrusion. These soils occur mostly within the coastal savanna zone. Acid sulphate clay soils and salt affected soils also occur oddly along the coast in the west where annual rainfall is about 2000 mm. Over 10,000 km^2 of these degraded soils have been mapped and classified as Arenosols, Solonetz and Solonchak:s (Asiamah, 1995). Apart from their high salt content and high acidity, most of these soils are heavy-textured, poorly drained with columnar structures.

Greenland (1998) explains that salinization is a major problem when the concentration of salt in the soil causes the osmotic pressure of the soil solution to be high enough to reduce the entry of water and nutrients into plant roots. Where the salts which accumulate are dominantly sodium chloride, carbonate or sulphate the problem of sodification arises. Sodification is the replacement of calcium by sodium ions, or occasionally magnesium and sodium ions, causing the clay particles in the soil to disperse. They then block the pores through which air and water move, and which are easily penetrated by plant roots, promote crust formation at the soil surface and restrict water entry, all factors which are detrimental to plant growth.

Increased population and agricultural activity have also raised water demand. This has led to an overexploitation of groundwater resources, which has aggravated the salinization process

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and the increased destruction of plant and animal habitats (ESCW A, 200~ :40). This is particularly common in the Western Asia.

2.2.3 Biological Land Degradation

Loss of organic matter

Many key soil functions are underpinned by biodiversity and organic matter. Organic matter enters soils principally from plant remains and organic manure additions, and is primarily made up of carbon, nitrogen, and phosphorus. Biodiversity and organic matter c decline due to erosion or pollution, leading to a reduction in soil functions such as control of water and gas flows.

2.3.0 LAND DEGRADATION IN SUB-SAHARAN AFRICA (SSA)

Sub-Saharan Africa can be broadly classified into three zones comprising humid lands, sub-humid lands and dry-lands based mainly on the aridity index (Al) of climate. The AI is derived from the ratio of mean annual precipitation (P) to mean annual potential evapotranspiration (PET) (UNDP/UNSO, 1997). Both the sub-humid and dry zones have an annual moisture deficit (Blay et al, 2004:12).

Land degradation is also a major cause of poor agricultural performance in the SSA. Nearly two-thirds of agricultural lands in Africa were estimated by one influential study to have degraded between 1945 and 1990, with serious degradation (involving major loss of productivity) on nearly one-fifth of agricultural land. Degradation is particularly severe in the drylands of SSA with about half of these lands estimated to be severely degraded. The most important forms of degradation are soil erosion, caused by both water and wind, and soil

nutrient depletion, caused by overgrazing, devegetation, crop production on fragile lands without sufficient soil cover or use of conservation measures, declining use of fallow, and limited application of soil nutrients(Nkonya et al: 2008: 1).

Brady cited in Diagana (2003:3) estimated only 12% of African soils to be "moderately fertile, well-drained soils", compared to 33% in Asia. According to Diagana (2003:3), Batjes reports that degraded soils amount to about 494 million ha in Africa. It is also estimated that 65 per cent of SSA's agricultural land is degraded because of water and soil erosion, chemical and physical degradation (Oldeman et al. 1991). Of the total degraded area overgrazing, agricultural mismanagement, deforestation and overexploitation of natural resources are said to account respectively for 49, 24, 14 and 13 percent.

Blay et al (2004:2) contend that the process of land degradation usual starts with deforestation and there is evidence to show that over 90% of the original moist forests have been lost or have become degraded remnants, whilst about 600,000 ha of indigenous forests in the sub-humid zones are cleared annually for other land uses. The annual rate of degradation (or desertification) in the drylands varies from 10% (in arid lands), 1 % (in semi-arid lands) and 0.1 % (in the dry sub humid lands). There is clearly an urgent need for improved and harmonized methods for gathering data and monitoring changes.

Blay et al (2004:12 &13) noted that one of the biggest problems threatening the lives of millions of inhabitants in SSA, especially those residing in the rural areas, is land degradation. Although a worldwide problem, land degradation is said to be most acute in SSA where it is characterized by decreasing production of forest products and food and worsening levels of

poverty and malnutrition. Land degradation is occurring in all the three zones occasioned by the same driving factors, albeit at different levels. Within the humid forest ecosystem key driving factors of degradation include clearing trees for agricultural expansion (subsistence or commercial farming), logging, firewood gathering and charcoal production, mining, human settlements, infrastructural and industrial developments (Evans, 1994; Raymond et al, 1994). The same factors are also responsible for land degradation in the sub-humid l zone though overgrazing and uncontrolled fires become more important as one gets into the dry sub-humid areas. Middleton and Thomas (1997) cited in Blay et al (2004: 13) assert that within the dry-lands (semi-arid and arid zones), overgrazing combined with unsustainable agriculture and over-exploitation of natural resources are important factors of degradation. In general, land degradation in the dry sub-humid and dry-land zones leads to desertification.

Soil degradation incurs substantial loss to productivity. The average loss in crop yields due to erosion for SSA is estimated at 6 percent, and in 1989, 3.6 million tons for cereals, 6.5 million tons for roots and tubers, and 0.36 million tons for pulses were lost by erosion. If this erosion level continues, yield loss by the year 2020 would be 14.4 percent (Dejene ~t al, 1997:3). According to the FAO (2001), the process of land degradation usually starts with deforestation; for example, the rain forests of West Africa are said to be disappearing at the rate of 5% annually with nearly 90% of the original moist forests having gone or having become fragmented and/or degraded remnants.

2.4.0: LAND DEGRADATION IN GHANA

Agriculture contributes over 40% of Gross Domestic Product and employs about half of Ghana's labour force. Out of Ghana's total land area of 23,853,900 hectarer, 13,628,179

hectares (57.1 %) is suitable for agriculture. But the total area under cultivation in 2000 was 5,808,600 hectares (42.6%) of the agricultural area. This cultivated area also includes fallow agriculture (a system whereby land is left unploughed and unseeded to allow for fertility regeneration). In the past, for every 5 to 6 hectares of cropped land, about one hectare was left fallow. Nowadays, fallow agriculture and/or fallow periods are on the decline, throughout Ghana, and the use of more intensive (e.g., application of fertilizer, phosphate rock, intercropping with legumes, green manure, exchanges with Fulani herders for manure, etc.) systems of farming are widespread. Rapid population growth and low economic standards of living have had consequences for agricultural land resources in Ghana. Fallow lands have been reduced or eliminated (Codjoe, 2006:645).

The EPA-Ghana (2002:50) reveals that the major droughts of 1968-73, 1982-85 and 1990-92 in Ghana caused serious hydrological imbalances that negatively affected land resources, particularly soil quality, fresh water supply, vegetation and crops. Furthermore, the FAO (2001) indicate that Ghana's total forest as at 1990 was 7535000 ha and by 2000, the total forest had depleted to 6335000 ha representing an annual change of -120 ha and an annual rate of change of -1. 7%.

Quansah (2001) in Cofie and De Vries (2002:3) observed that large tracts of land have been destroyed by water erosion leading to soil nutrient losses as well as flooding and siltation of river bodies. Seventy percent (70%) of the country is subject to moderate to severe sheet or gully erosion and about 40% of this land is in the savanna areas. Soil erosion hazard on regional basis is shown in Table 1 below.

Table 1: Erosion hazard on regional basis in Ghana

Region	Slight to moderate sheet erosion (Km^2)	Severe sheet and gully erosion (Km^2)	Very severe sheet and gully erosion (Km^2)
Northern	23310	19062	23330
Upper East	4574	3774	964
Upper west	7288	4470	7148
Brong-Ahafo	10697	20932	5219
Volta	6615	7376	2901
Ashanti	7115	11826	6017
Greater Accra	3005	101	85
Eastern	3090	11015	2852
Central	2002	7780	521
Western	2745	16913	2675

Source: Asiamah (1987) in Cofie and De Vries (2002:3)

Diao and Sarpong (2007:5) states that the major processes of land degradation in Ghana are physical (in the form of soil erosion, compaction, crusting, and iron-pan formation), chemical (depletion of nutrients, salinity, and acidification), and biological (loss of organic matter). Obeng (1971) in Diao and Sarpong (2007:5) reveals that water erosion has destroyed tracts of land throughout Ghana, as evidenced by the Erosion Hazard Map of Ghana. This map shows that many regions of Ghana contain land affected by severe sheet and gully erosion, with very

severe erosion being particularly prevalent in the Upper West Region, Northern Region and Ashanti Region.

2.4.1 Land Degradation in the Upper East Region

The Upper East Region belongs to the savanna high plains consisting mostly of granites and Birrimian rocks. The land surface has leveled into erosion-plateau or tropical Pediplains through chemical and physical weathering. The surface is today quite flat with slopes less than 2%. The whole area lies about 300 meters above sea level. Only a few hills exist, rising 100 to 150 meters above the plateau (Dawidson & Nilsson 2000:29).

The region is characterized by a natural vegetation of savannah woodland with predominant species such as *Parliia jilicoidea (dawa-dawa)*, *Butyrospermum parkii* (shea butter), and *Acacia albida* (Folly, 2000:459).

Dawidson and Nilsson (2000:29), indicate that the soils of the region are generally coarse textured and have a low accumulation of organic matter and low fertility, due to the rapid decomposition and frequent burning of the lands. The soils also have low nitrogen content. The extreme shifts between dry and wet conditions in the Upper East Region cause intense leaching of nutrients out of the topsoils. The lower nutrient status and the lack of water decrease potential productivity. Much of the topsoil in the study area consists of aeolic deposits, caused by the harmattan.

Adu (1996) in Dawidson & Nilsson (2000:29) indicate that loss of moisture can lead to a hardening of the subsoils resulting in the development of iron-pan, also known as laterite.

When the soil is exposed to the sun, this phenomenon can become a permanent condition. Laterite is prone to weathering and is a non-productive soil that quickly becomes incapable of sustaining plant growth if vegetation is removed or burned.

2.5.0 CAUSES OF LAND DEGRADATION

The causes of land degradation can be divided into natural hazards, direct causes and underlying causes (FAO, 1994). Natural hazards are the condition of the physical environment which leads to the existence of high degradation hazard, for example steep slopes as a hazard for water erosion. Direct causes are unsuitable land use and inappropriate land management practices for example the cultivation of steep slopes without measures for soil conservation. Underlying causes are the reasons why these inappropriate types of land use and management practiced for example the slope may be cultivated because the landless poor deed food and conservation measures are not adopted because these farmers lack security of tenure

2.5.1 Direct Causes of Degradation

Deforestation: Deforestation is both a type of degradation as such, and also a cause of other types, principally water erosion. Deforestation in itself is not necessarily degrading, without it most productive agricultural lands (in the temperate zone as well as the tropics) would not be available. Deforestation becomes a cause of degradation first, when the land that is cleared is steeply sloping, or has shallow or easily erodible soils; and secondly, where the clearance is not followed by good management. It is also a contributory cause of wind erosion, soil fertility decline and salinization.

As a result of high population growth rate, there has been the depletion of forests to expand agricultural land to produce food for the ever-increasing population, and logging to provide wood for export and domestic use-fuel wood and charcoal production (Asabere-Ameyaw et al, 2008:26).

Rural people cut natural forests, woodlands and shrub lands to obtain timber, fuel wood and other forest products. Such cutting becomes unsustainable where it exceeds the rate of natural re-growth. This has happened widely in semi-arid environments, where fuel wood shortages are often severe. Impoverishment of the natural woody cover of trees and shrubs is a major factor in causing both water erosion and wind erosion.

Foley (1991:23) maintains that cutting trees and turning the land over t farming is economically far more productive. There is therefore an almost irreversible economic pressure to get rid of forests and put the land to other uses which for local people will almost invariably be agriculture, logging is also a means of turning the low economic value of standing trees into valuable timber-a process which countries under great pressure to pay back foreign debt find it difficult to forego. However, none of this suggests that the loss of tropical forest is anything but a tragedy for the world, both in terms of losing biological wealth and one of the primary risk for carbon.

Baumer (1990:16) indicates that desertification is the most serious environmental problem facing the world, and more especially Africa today. According to Baumer, in Africa, it is estimated that south of the Sahara there are more than 75 million people, 15% in towns, 62% mainly in agriculture and 23% mainly in stock-raising. The people living in dry regions are almost all affected by desertification or threatened by it.

Overgrazing: According to the FAO (2005: 17), there is a tendency throughout the world to overstock grazing land above its carrying capacity. Cows, draught animals and small ruminants graze on communal grazing areas and on roadsides, stream banks and other public land. Overgrazing destroys the most palatable and useful species in the plant mixture and reduces the density of the plant cover, thereby increasing the erosion hazard and reducing the nutritive value and the carrying capacity of the land.

In many African countries, the number of cattle one possesses tends to be a status symbol irrespective of their economic condition. For example, in savannah zones of Ghana where bride price is paid in cattle, the wealth and social status of an individual is measured partly by the size of cattle which is kept in open ranges (Asabere-Ameyaw et al, 2008:31). Such environmentally unfriendly methods of animal husbandry jeopardise the sustainability of the already fragile savannah ecosystem. According to Asabere-Ameyaw et al, overstocking of cattle and small ruminants usually destroys natural vegetations and accentuates the problem of drought in these areas. In semi-arid land, overgrazing is particularly disastrous as it may result in desertification.

Improper crop rotations: As a result of population growth, land shortage and economic pressures, farmers in some areas have adopted cereal-based, intensive crop rotations, based particularly on rice and wheat, in place of the more balanced cereal-legume rotations that were formerly found. This is a contributory cause of soil fertility decline (FAO, 1994).

Unbalanced fertilizer use: The FAO (1994) maintains that where soil fertility has declined as a result of prolonged cultivation or erosion, farmers attempt to maintain crop yields. The primary method available for doing so is application of fertilizer. In the short term, a yield

response is most readily and cheaply obtained from nitrogenous fertilizer. There has been a steady increase in the ratios of nitrogen to phosphorus, and nitrogen to all other nutrients, in the region. Where phosphate deficiencies have been recognized and counteracted by phosphatic fertilizer, deficiencies of other nutrients, including sulphur and zinc, have been reported.

According to the F AO (1994), the short-term measure of combating fertili decline by application only of macronutrients, and particularly nitrogenous fertilizer, is leading to a greater problem of nutrient imbalance in the medium term. Among the consequ nces is likely to be longer yield responses to fertilizer.

2.5.2 Underlying Causes of Degradation

There are more basic reasons underlying the reasons for land degradation outlined above. These include;

Land shortage: It has always been recognized that land is a finite resource, but only recently has the full impact of this fact occurred. In earlier times, food shortage or poverty could be combated by taking new, unused, land into cultivation. When combined with increases in population, land shortage has led to decreases in the already small areas of agricultural land per person.

Land tenure: tenancy and open access resources: Evidence suggests farmers are reluctant to invest in measures to conserve land resources if their future rights to use these resources are not secure. Two kinds of property rights lead to this situation, tenancy and open access resources (FAO, 1994). Despite efforts by legislation and land reform programmes over many years, tenant occupation of farmland is still very widespread. The landowner rent the land out and it is farmed by tenants paying some form of rental. Relations between landlord and tenant

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are often good, and the tenant in fact remains on the same farm for many years. However, such tenants lack the incentive to maintain the land in good condition, being interested mainly in the immediate harvest. Baidu-Forson (1999) in Adugna (2005:44) observed that plot ownership arrangement has influence on farmers with regard to land management. Abdulai et al (2010:9) also reveal that owner cultivated plots are more likely to apply organic fertilizers than both sharecroppers and fixed rent tenant.

Open access land resources are those which anyone, in practice the poor and otherwise landless, can use, without rights of continuing usufruct or tenure. This applies mainly to forest lands, nominally under government ownership but which are settled on a squatter basis.

According to the FAO (1994), there is a distinction between common property and open access resources. In common property resources, use is restricted to members of community, village or clan, and is subject to constraints and is socially applied. For example, pastoralists often have customs for when certain areas must be rested from grazing; villages restrict the cutting of communal woodland. On open access land there are no such constraints. With no legal basis to their use, incentive to farm the land other than for immediate needs is completely lacking. This is a serious cause of deforestation followed by water erosion.

Economic pressures and attitudes: Small land holdings lead to severe economic pressures on farmers to obtain sufficient food and income to meet immediate needs (FAO, 1994). Because of such pressure in the short term, labour, land and capital resources cannot be spared to care for the land, for example green manuring or soil conservation structures. This is also the underlying reason for two other direct causes noted above, improper crop rotations and unbalanced fertilizer use.

A contributory factor, not always appreciated by outside observers, is a change in economic attitudes. In former times, most farmers accepted the situation into which they were born, even if it was one of relative poverty. Modem communications and influence have led to greater aspirations and consequent requirements for income, thus increasing economic pressures. Another underlying cause of land degradation is poverty and population discussed in the next sub-section.

2.6.0 POPULATION GROWTH

The International Development Research Centre (IDRC) cited in Fullen and Catt (2004:3) estimated the world population to be 6,159,463,956 and the area of productive land at 8,585,272, 604 ha (values on 05 Nov. 2001). The US census placed the world population in mid-2003 at 6,302,486,693 and growing by an annual rate of 1.16 per cent. That is an extra of 73,395,376 people in a year or the on average, an extra 8378 people per hour. Estimates of the world's current (June, 2011) population by the US Bureau of Census stand at 6, 956,065,450.

Ghana's first post-independence population census in 1960 counted about 6.7 million inhabitants. In 2000, Ghana's population stood at 18,912,079 and the provisional results of the 2010 population census of Ghana recorded 24, 223,432 inhabitants (Ghana Statistical Service, 2000, 2010). The International Monetary Fund-IMF (2011) projects that by 2015, Ghana's population would be 26.89 million persons.

In 1984, the population of the Upper East Region stood at 772, 744, by 2000, the population increased to 920,089 and the provisional results of the Ghana population census 2010 indicate

a population of 1,031,478, a percentage increase of 16% from 1984 with an intercensal growth rate of 1.1 % (Ghana Statistical Service, 2010). Although all these values are best estimates, they indicate the scale of the problem of population growth.

2.7.0 THE CONCEPT OF POVERTY

Poverty is as much a reality as it is a perception, it is absolute but also relative, it is economic as well as socio-cultural and religious and it is technological as it is political. The complexity of poverty is what makes any attempt at definitions without qualified assumptions invalid (Dittoh, 2008:3). Dittoh maintains that poverty is very dynamic and thus is largely time specific, place-specific and people specific. It is therefore very possible that the type of poverty that existed in northern Ghana in the 1980s is very different from what obtains now, thus the method of alleviation in the 1980s will be very different from that of today.

The UN Statement, June 1998 signed by the heads of all UN agencies defines poverty as *"Fundamentally, poverty is a denial of choices and opportunities, a violation of human dignity. It means lack of basic capacity to participate effectively in society. t means not having enough to feed and clothe a family, not having a school or clinic to go to, not having the land on which to grow one's food or a job to earn one 's living, not having access to credit. It means insecurity, powerlessness and exclusion of individuals, households and communities. It means susceptibility to violence, and it often implies living on marginal or fragile environments, without access to clean water or sanitation".*

Poverty is a concept which indicates absolute or relative welfare deprivation. It may be defined in terms of private consumption alone, or extended to include access to common

property resources and state-provided commodities, personal assets or wealth, and even subjective assessments of "dignity" and "autonomy" (Baulch 1996). According to McNicoll (1997:8), absolute poverty is a term that came into vogue in Robert S. McNamara's tenure as World Bank president. Worldwide in the 1990s over one billion persons are estimated to have a purchasing power of below a dollar per day, the conventional demarcation of "absolute poverty" (McNicoll, 1997:2).

According to Gordon (2005), absolute poverty has been defined as "a condition characterized by severe deprivation of basic human needs, including food, safe drinking water, sanitation facilities, health, shelter, education and information. It depends not only on income but also on access to services". Gordon emphasizes that overall poverty takes various forms, including lack of income and productive resources to ensure sustainable livelihoods hunger and malnutrition; ill health; limited or lack of access to education and other basic services; increased morbidity and mortality from illness; homelessness and inadequate housing; unsafe environments and social discrimination and exclusion. It is also characterized by lack of participation in decision making and in civil, social and cultural life. UN (1995) cited in Gordon (2005) asserts that poverty occurs in all countries: as mass poverty in many developing countries, pockets of poverty amid wealth in developed countries, loss of livelihoods as a result of economic recession, sudden poverty as a result of disaster or conflict, the poverty of low-wage workers, and the utter destitution of people who fall outside family support systems, social institutions and safety nets.

IFAD (1992) identified five types of rural poverty which have different links with agriculture and the environment. Material deprivation and alienation cause "interstitial poverty", or

pockets of poverty surrounded by power and affluence. "Peripheral poverty" is similar, but found in isolated, marginal areas. "Overcrowding poverty" is material deprivation arising from population pressure and limits on resources. Vulnerability to natural calamities, labour displacement and insecurity produces "traumatic or sporadic poverty", which can be transitory. Isolation, alienation, technological deprivation, dependence and lack of assets are signs of "endemic poverty."

According to Reardon and Vosti's (1997) typology of poverty, "welfare poverty "criteria can miss a potentially large group of households that are not "absolutely poor" by the usual consumption-oriented definition, but are too poor in that their surplus above the minimum diet line is still too small to make key conservation or intensification investments necessary to prevent their land use practices from damaging the resource base or leading them to push onto fragile lands. They prefer use of a measure of "conservation-investment poverty ", the cut-off for which is site specific, a function of local labour and non labour input costs and the types of investment that are needed for the particular environmental problems or risks faced.

Dittoh (2008:12) observes that poverty in Ghana is largely a rural phenomenon even though the increase in poverty in the Greater Accra Region between 1998/99 and 2005/06 is indication of increasing urban poverty. With respect to northern Ghana, poverty is very severe especially in the rural areas which are populated by crop farmers.

Canagarajah and Pörtner (2003:17) in a survey titled *"Evolution of Poverty and Welfare in Ghana in the 1990s,* " assert that the Upper East Region experienced the largest absolute increase in both poverty and extreme poverty and is now the poorest region in Ghana. The survey further states that, almost 90% of the population of the region was poor and almost

80% extremely poor. According to Canagarajah and Pörtner (2003: 19) while the Ghanaian economy generally has grown, the people of the two upper regions, and especially the food crop farmers, have been left behind and are actually worse off than at the beginning of the decade. They contend crop productivity has decreased, a result of decreased soil fertility signifying degradation of crop land the areas.

2.8.0 POVERTY AND LAND DEGRADATION

There is much controversy surrounding the poverty-environmental degradation nexus. The predominant school of thought argues that poverty is a major cause of environmental degradation and if policy makers want to address environmental issues, then they must first address the poverty problem. Another school of thought argues that a direct link between poverty and environmental degradation is too simplistic and the nexus is governed by a complex web of factors (Duraiappah, 1996).

Reardon and Vosti's (1997) typology of poverty is explicitly linked to environment. According to them, the strength and direction of the poverty-environment links in rural areas would differ depending on the composition of the assets held by the rural poor and the types of environmental problems they face. One of the major findings of their study is that the level of poverty conditions the links.

Nkonya et al (2008:9), Agersnap and Funder (2001:99), UNDP (1990), and Dejene et al (1997: 3) all argue that poverty leads to land degradation. According to them, poverty is hypothesized to contribute to land degradation as a result of poor households' presumed short-term perspective and inability to invest in natural resource conservation and improvement. The

- poor seek to maximize their immediate gains and overexploit natural resources to secure their basic necessities. Let us call this relationship R_1• Then, **R_1:** Poverty→Land degradation

A counter argument to the poverty-degradation hypothesis is the notion that it is not poverty but a combination of greed, power and wealth that causes environmental degradation in many developing countries (Boyce, 1994). In his influential 1985 book *Abandon Affluence*, Australian sociologist Ted Trainer made the argument that the capitalist economies of the rich world, and the wasteful consumer culture they spawned, were unsustainable and the ecological limits of capitalist growth were fast approaching. Low income households in Africa, Asia, and Latin America are increasingly both the victims and unwitting agents of ecological damage, increasing numbers of poor families can only stay alive by destroying their own natural resource base (ibid).

Scherr (1999) explains that although the poor do play an important role in unsustainable agricultural intensification, expansion of farming into marginal lands and over-exploitation of vegetation, they are implicated in only a part of this degradation and its consequences. Wealthier farmers, agricultural investors, and multinational corporations typically control much more total land area than the poor, and have played a prominent role in large-scale clearing of natural vegetation, over-use of agro-chemicals, large-scale degradation of grazing lands, over-exploitation of soils for export production. Nayak (2004:1) identifies the poor as the victims of environmental degradation as well as the agents, the perpetrators of the degradation. The consequences of degradation for the poor also tend to be more serious, because they lack assets to cushion the effects (Scherr, 1999). Nkonya et al (2008:9) also reveals that land degradation can contribute directly to poverty, separately from its impact on

agricultural productivity, by reducing the availability of other valuable good and services important to poor households (for example, fuelwood, construction materials, wild foods, and medicinal plants) and by increasing the demands on labour needed to forage for such goods. Let this relationship be described as R_2. Thus, **R_2:** Land degradation→Poverty.

A third possible relationship looks at the link between market and institutional failures with environmental degradation respectively. In many of the previous studies on poverty and environmental degradation, the authors fail to make a distinction between market and institutional failures. In many instances, a general category called institutional failure is used to define both mechanisms. This aggregation becomes unsatisfactory when policy implications and prescriptions are addressed; and each failure in turn needs a unique prescription. For example, policy responses to incorrect price signals (market failure) will be quite different from policy initiatives needed to establish and enforce well defined property rights /institutional failure (Duraiappah, 1996:5). Let us call this relationship R_3. Then,

R_3A: Institutional Failure →Environmental degradation.

R_3B: Market Failure→Environmental Degradation.

2.9.0 POPULATION AND POVERTY

Relation between demography and poverty is by no means a new issue. For Neo-Malthusian, the issue is straight forward: rapid population growth is a direct cause of poverty and hence, malnutrition and hunger. The solution to this is equally simple: invest in family planning (alone) to reduce poverty. However, recent research has shown that misguided agricultural and trade policies and poor food distribution (and hence entitlements to food) may be the root causes of hunger and malnutrition, whereas rapid population magnifies bad policies (Ftikhar,

2003:6). This argument, in more recent times, has been updated by Neo-Malthusians to encompass all resources (Findlay, 1995).

Malthus (1798, republished 1998) in his Essay on Population already hinted a relation between population growth and impoverishment, to the point of urging couples not to marry and have children unless they could afford to support them. Malthus (1798:6, republished 1998) postulates that population when unchecked increases in a geometrical ratio and subsistence for man in an arithmetical ratio. For Malthus (1978:26), an increase in population without a proportional increase of food will evidently have the same effect in lowering the value of each man's patent. He argues that epidemics are ways by which population is repressed and prevented from increasing beyond the means of subsistence in any country. Furthermore, death especially among children of the poor is a positive check to population since the poor cannot find them proper food and attention. Malthus also advocated population control measures to curb impoverishment.

According to the FAO (1994), increase in population constantly drives the cycle that leads to poverty and land degradation. Ashford (2007:2) explains that high fertility and poor maternal and child health are often symptoms of poverty and at the same time prevent families from escaping poverty. Although population growth is not the major factor behind hunger, population growth has clearly aggravated grinding poverty and in some cases environmental destruction has kept people from growing or getting enough (Mortimore, 1993:151). He alleged that food production had already declined in Africa from 20 to 15% on a per capita basis since 1970, and at least a fifth of Africans do not have enough to eat to lead healthy productive lives. There have however been counter arguments on the population- poverty relationship.

Boserup (1953:53) contrary to Malthus argues that with rapid population growth, the process of intensification takes place much more quickly. For Boserup, a large amount of land clearing, land improvement and drainage or investment in irrigation facilities takes place simultaneously with population growth. She contends that contemporary observers would not fail to notice this increased activity and they might well describe the period of rapidly rising population as a period of agricultural revolution. The agricultural revolution in Eighteenth-Century Western Europe seems to have been of this type, and the agricultural changes which are now occurring in many underdeveloped countries seem to provide us with another example of rapid spread of the techniques of intensive agriculture owing population pressure. For Boserup, population growth does not lead to poverty. Marquette (1997:1) observed that Malthus did not foresee the important technological advances that have accompanied population growth.

Simon (1990) and Tiffen and Mortimore (1994:999) agree with Boserup assertion that population growth does not have a negative effect upon economic growth in either more developed or less-developed countries. They argue that empirical studies find no statistical correlation between countries' population growth and their per capita economic growth. McNicoll (1997:5) also affirms that causal links between population growth and absolute deprivation are not well understood. Research has not established a strong causal link running from high fertility to poverty.

Sen (1981) has been instrumental in highlighting that the issue is about access to food, in contrast to its production, as the most important explanatory variable in food security and

resilience of populations. Sen goes on to argue that entitlements are actual and potential bundles of commodities which individuals can access and that most famines are caused by circumstances of entitlements failure caused by human political action. It is therefore fittingly pointed out that the debate has to be concerned with the underlying vulnerability of societies to the poverty and resources issue in the context of population pressure. More recently, authors such as Leach, et al (1997a, b) have adapted Sen's entitlements approach. This approach entitled environmental entitlements similarly shifts the emphasis from questions of resource scarcity to those of access, control and management. One of the key aspects of this approach is that it looks at the role that formal and informal institutions play in shaping people's resource endowments and entitlements, and hence mediating people-environment relations, so that any relationship between poverty and environment is indirect (Leach, et al, 1997a, b).

2.10.0 POPULATION AND LAND DEGRADATION

Mortimore (1993:15), De Writ (2003:2), Nyssen et al (2008:1) Tukahirwa 42002:8) and Otsuka (2001: 1 &5) all argue that population pressure contributes to land degradation. According to Mortimore (1993:15), as population pressures mount, the degradation of arable lands in wide areas of Africa, Asia, and Latin America increases.

Many authors argue that the growing population requires increasing area for agricultural production and hence, large areas of forest land are opened up. Population pressure also causes farmers to abandon conservation measures such as terraces particularly those that reduce cultivated area as well as encouraging cultivation of steeper and more fragile and marginal lands (Mortimore, 1993:15, De Writ, 2003:2, Nyssen et al, 2008:1, Tukahirwa, 2002:8 and Otsuka, 2001: 1 &5). This, they maintain results in degradation.

According to Marquette (1997:3), one current line of thought sees population size as interacting in a multiplicative way with other factors to create impacts on the environment. One of the most frequently used multiplier approaches is the so-called "IP AT" equation in which: Environmental impacts = (Population size) (Level of affluence or per capita consumption) (Level of technology)

or I=PAT (Ehrlich and Holdren 1971 and 1974; Harrison 1992; Commoner 1991 and 1992). The IPAT equation sees the combined interaction rather than independent effects of population size, consumption and technology as important in determining environmental change.

Shaw (l989a, b, c and 1992) has proposed an alternative multiplicative scheme in which the interactive effects between population, consumption, and technology are further specified. He distinguishes between ultimate causes, or the driving forces behind environmental impacts, and aggravating factors. In the case of environmental degradation, consumption and technology are ultimate causes while population is an aggravating factor which increases the intensity of impacts which ultimate causes have on the environment (Shaw, 1989c; Hogan, 1992).

The provisional results of the Ghana population census 2010 reveal that there is increasing pressure on land by population. The number of persons per square kilometer (population density) is almost doubled from 52 in 1984 to 102 in 2010. According to the provisional report, the pressure has been more intense in the Greater Accra and Ashanti Regions ; however, the Upper East Region has seen an enormous increase in population density from l87 in 1984 to 117 in 2010, the fifth highest in the country. Dickson & Benneh (1988) cited in Dawidson

and Nilsson (2000:34) reveal that the Upper East Region is one of the most densely populated areas in the country. According to the Ministry of Food and Agriculture (2000), the population density within the area, excluding the mountain areas, amounts to about 200 persons per square kilometer. Dawidson and Nilson (2000:33 & 34) disclose that although the Upper East Region is not more suitable for farming than the rest of the country, it is heavily used for cultivation because of the population pressure. They stated that the erosion risk is generally high in the densely populated Upper East Region since the permanent cultivation constantly exposes the soil.

In the year 2000, the population density for the Bongo District was 169 persons per sq. km. Projections made in 2006 by the Bongo District Assembly put the population density at 200 persons per sq. km with the land size of 459 sq. km. A report from the Bongo District Assembly (2006) reveals that its land carrying capacity keeps on dwindling with the increase in population. According to the Bongo District Assembly, the situation is more serious since about 40% of the land surface has been covered with rocks which make farming and other activities very difficult.

There have been counter arguments against the population-poverty hypothesis. In fact, there is much evidence highlighting for example, that increasing population growth has led to the rehabilitation and profitability of degraded, unproductive lands (Tiffen et al., 1994).

2.11.0 POPULATION-POVERTY-ENVIRONMENT (PPE) NEXUS

The Population-Poverty-Environment relationship is often referred to as the downward spiral hypothesis. According to this hypothesis, land degradation contributes to low and declining agricultural productivity, and this in turn contributes to continuing or worsening poverty. This downward spiral hypothesis is often augmented by linkages with population pressure, which is asserted to cause both poor land management and poverty directly and which in turn is exacerbated by poverty. Reardon and Vosti (1997) call the relationship between population, poverty and environmental degradation the "critical triangle of development objectives".

According to the FAO (1994), the direct and indirect causes of degradation are linked by a chain of cause and effect or causal nexus and the two external or driving forces are limited land resources and increase in rural population. Expressed another way, there are no longer substantial areas of usable, unused land; but the number of people to be supported from this finite land resource is increasing every year. These two primary forces combine to produce land shortage. This refers to increasing pressure of population on land, resulting in small farms, low production per person and increasing landlessness. A consequence of land shortage is the next element, poverty.

Dejene et al (1997:3) assert that in many localized areas of SSA, there is a synergy linking declining food production, high population growth, and natural resource degradation. This nexus dynamic creates a negative synergy that depletes soil productivity and results in a vicious cycle of poverty and food insecurity. Nkonya et al (2008:9) explains that the intersection of poverty, low agricultural productivity, land degradation (or more generally, natural resource or environmental degradation), and rapid population growth in SSA and some

other developing regions has contributed to a commonly held hypothesis of a downward spiral of mutually reinforcing linkages among these factors.

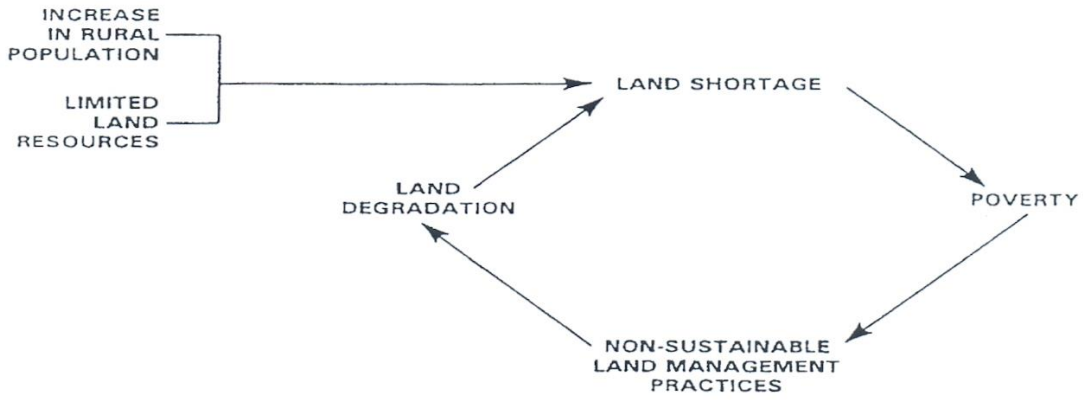
An earlier study in Western Ghana by Benneh et al. (1998) cited in the UNFM, UNEP and IUCN Report on Population-Poverty-Environment (PPE) Linkages (1998:5) shows that PPE linkages exist even in regions of low population density (62 persons per sq. km), high rainfall and apparently abundant natural resources. From the study, the area characterized by high in-migration and a receding forest frontier is home to many multinational mining corporations. Deregulation of the Ghanaian economy has given preference to such export-oriented industries, even though these privatized lands claim a disproportionate amount of the surface area. Poor farmers are forced into forest reserves and onto marginal lands in order to subsist, cutting trees for fuel and to expand agricultural lands.

According to Dejene et al (1997:3), nutrient loss on arable land is significant in areas strongly affected by the nexus dynamic. Crop residue and manure, which were once a major source of enriching soil fertility, are being used as fodder and fuelwood. This considerable nutrient loss is reflected in the widening gap between the actual and potential yield for all the major food crops in SSA. Loss of soil productivity leads to reduced farm income and food insecurity, particularly among the rural poor.

Land shortage and poverty taken together, lead to non-sustainable land management practices, meaning the direct causes of degradation. Poor farmers are compelled to clear forest, cultivate steep slopes without conservation, overgraze rangelands, make unbalanced fertilizer applications, and the other causes noted above (FAO, 1994). These non-sustainable

management practices lead to land degradation. This leads to reduced land productivity: a lower response to the same inputs or, where farmers possess the resources, a need for higher inputs to maintain crop yields and farm incomes. This has the effect of increasing land shortage, thus completing the cycle. Case studies illustrating the interconnections of this cycle are given in Asian Development Bank (1991) cited in the FAO (1994). Figure 1 below represents the causal nexus of land degradation.

Figure 1: The Causal nexus of land degradation



Source: FAO (1994)

According to the FAO (1994), there are two ways to check this cycle, improved technology and reduction in population increase. Improved technology could be added as a third external force in Figure 1, divided into three elements:

- Land improvements (e.g. irrigation), which can reduce land shortage;
- Increases in productive technology, which can reduce poverty and pressure upon land;
- Better land resource conservation, which can reduce land degradation and, Ito a limited degree, reverse degradation.

A lot of efforts have been made, by individual farmers, national governments and through international development assistance, to counteract the cycle of poverty and land degradation by research and development of improved technology. Much success has been achieved, as in the spread of high-yielding crop varieties and use of fertilizers which was (optimistically) called the 'green revolution'. All of this effort will be nullified, and in places reversed, if it is not accompanied by a reduction in rate of growth of population. The existence of limited land resources cannot be substantially changed (FAO, 1994).

There have however been counter criticisms of the downward spiral hypothesis. Scherr (2000:481) says that the more controversial side of the critical triangle has been the poverty-environment interactions. According to Scherr, recent micro-scale and longitudinal research challenges this model. Studies have found a wide range of environmental outcomes under management by the poor and of welfare outcomes following environmental degradation. He argues that some studies have found that degradation resulted from natural forces rather than human mismanagement (Forsyth et al., 1998). A review of over 70 empirical studies in poor hill and mountain regions concluded that the effects of population growth on land and forest quality were indeterminate (Templeton and Scherr, 1999).

Other studies also document that over time, local people develop technical and institutional innovations in natural resource management to reduce risks and adapt to or reverse degradation, even as pressures increase. For example Tiffen et al (1994) document innovations in many fanning systems and ecozones in Kenya where degradation was reversed.

2.12.0 THE COST AND EFFECTS OF LAND DEGRADATION

From the FAO (2008), the Land Degradation Assessment in Drylands (LADA) estimates the annual global cost of land degradation at some US$40 billion. But, this estimate does not include degradation's hidden costs such as the need for increased fertilization when lands are damaged and the loss of biodiversity and unique landscapes. In addition to reduced productivity, land degradation leads to socioeconomic problems such as food insecurity, limited development and migration. According to IFAD (1992), the biomass available for grazing diminishes when land degrades in sub-Saharan Africa. Also, the supplies of wood for domestic fuel are reduced. The consequence is increased poverty. Land users are more vulnerable to years of low rainfall, the land becomes less productive and the need to purchase from outside increase. The livestock suffer; and is weakened.

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In Ghana, the unpredictability of rainfall and high temperatures are common features as reported by IFAD. For instance, studies by Ontoyin (1993) cited in IFAD (1992) points to the fact that there has been an increase in the average daily temperatures over the last 60 years while rainfall figures show declining rainfall totals.

A damaged land is costly to reclaim and, if severely degraded, its inability to provide ecosystem functions and services leads to a loss of environmental, social, economic and non--material benefits that are critical for society and development.

The most authoritative estimates of the extent of land degradation are contained if a report on South Asia prepared by UNDP, UNEP and FAO *(Land Degradation in south Asia: its severity, causes and effects upon the people,* Rome, FAO, 1994). This report analyses the effects of various forms of land degradation on the economies of countries in South Asia. It

states that water erosion is the most common form of degradation in the area, affecting 25 percent of agricultural land. Wind erosion affects 40 percent of the agricultural land in the dry zone. There is also a widespread decline in soil fertility and extensive waterlogging and salinization in irrigated areas. It concludes that land degradation is costing countries of the region at least US$ 10 billion a year, simply in terms of lost agricultural production. This is equivalent to 7 percent of South Asia's agricultural gross domestic product.

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2.12.1 Effects on Socio-Economic Conditions

Agriculture is an important contributor to the economic development of Ghana. It provides employment for about half of the labour force (Codjoe, 2006). Agriculture in Ghana has been a major source of food and cash security. However, for the past few years, is role has reduced due to deterioration in the soil status in most farming communities, a problem worsened by lack of resources for farmers to enrich their soils with fertilizers, and emergence of unfavorable climates.

A study conducted by the World Bank in 2006 titled "Country Environmental Assessment" reveals that the natural resources of Ghana which support much of the economic activity of the country and on which the livelihood of the population depend, are being depleted at an alarming rate. It further states that more than half of the original forest area has been converted to agricultural land. Tokle and Danso (2007:4) estimate the cost of environmental degradation to GDP to be one-third of Ghana's $1.5 billion annual overseas development assistance.

Diao and Sarpong (2007: 18) observed that while Ghana's economy has grown steadily over the last two decades, agriculture is still a major income source for the rural population, which

accounts for more than 50 percent of the total population. The agricultural sector, especially staple crops, is especially important for the rural poor as their income mainly derives from staple crops and such crops still constitute the dominant calorie and nutrition sources for poor individuals. For this reason, special attention should be devoted to the possible effects of agricultural soil loss on rural poor households.

According to Blay et al (2004:2& 3), the main consequences of land degradation which impact negatively on human livelihoods and on the environment are generally well-known: shortages of firewood and other wood; shortages of non-timber forest products; increased sediment deposits, floods and landslides; drying up of springs and water bodies; siltation of dams; increased incidence of water-borne diseases; loss of biodiversity; climate change; desertification. All these lead to loss of life, population displacement, reduced land productivity which affects food security. Cofie and De Vries (2002:4) maintain that nutrient depletion is the most biophysical limiting factor for rising per capita food production in most Africa small farms. Studies by Drechsel and Gyiele cited in Cofie and De Vries (2002:4) revealed that nutrient depletion is a significant basis of economic growth as it accounts for about 7% of the sub-continental AGDP.

The EPA-Ghana (2002:76) contends that low crop yield; caused by decreased agricultural productivity due to land degradation results in seasonal food shortages (hunger-gap), and widespread famine. Apart from these, degradation affects nutritional status and increase nutrition related diseases such as severe acute malnutrition (SAM). Children, who are the most vulnerable part of the population, suffer from malnutrition. Stunted growth of children is reported in several degraded parts of the country. The EPA's studies in Ghana reveal that

malnutrition among children between the ages of 0 - 5 years in communities with severely degraded soils increased from about 50% in 1986 to 70% in 1990. Famine also increases the need for relief programmes.

2.12.2 Effects on the Environment

Most studies of long-term experiments provide information only about biophysical degradation at the site of the experiment. The most important on-farm effects of land degradation are declining potential yields (Scherr and Yadav, 1996:5). There are also off-site environmental impacts of degradation. These may be at least as important as those on-site. They are predominantly due to soil erosion, but other physical effects contribute because they increase water run-off and so enhance water erosion. Chemical effects contribute to degradation because nutrients are leached from the soil and contaminate water supplies. Biological effects refers to the loss of organic matter, which weakens the strength of soil aggregates, increases the losses of nutrients run-off, and increases carbon dioxide and methane released to the atmosphere. Nutrient losses by leaching are most often observed where nitrogen fertilizers are being used injudiciously, and where organic manures are concentrated and the effluent arising is allowed to reach streams or rivers. Where irrigation systems are established it is suggested that proper attention is given to the inclusion of adequate drainage systems with methods to dispose of the saline drainage waters such that salinization does not become an environmental hazard.

Shorter fallows mean that less vegetation is able to regenerate between cropping periods. In turn, this means less protection for soil and thus greater potential for run-off erosion, Also, less vegetation is regenerated meaning there is less to bum at the end of the fallow and

consequently less carbon and nitrogen returns to the soil after the bum depicting lower fertility. There is also evidence that erosion was linked to annual crop production (IWMI, 2005:4 &5).

The washing of nutrients and organic matter, and of nutrient rich topsoils, into streams and rivers is a serious cause of eutrophication. The nutrients and organic matter cause a proliferation of water borne organisms which use oxygen in the water and deplete it at the expense of fish. The loss of fish in this way adds to the problems due to siltation and the decrease in flow rates. Until now there have been few studies in which a comprehensive attempt has been made to quantify fully the off-site effects of soil degradation.

2.13.0 MANAGEMENT AND REHABILITATI9N OF DEGRADED LAND

Sustainable land management practices (SLM) are the key to reducing agricultural soil loss and hence to overcoming the negative effect of land degradation on agricultural production. SLM can be implemented through both traditional and modem technologies (Diao and Sarpong, 2007:22). The International Water Management Institute (IWMI) in their December 2005 case-study *"Breaking the cycles of Land Degradation :A case study from Ban Lak Sip; Laos"* observed that Unsustainable farming practices in many regions are causing land resources to degrade threatening future food security as well as the livelihoods of poor rural people.

According to Hudson and Cheatle (1993:5), tackling soil conservation problems successfully requires acceptance of two key concepts when designing soil conservation programmes intended for small-scale farmers. First, that soil conservation practice should be 'farmer

friendly'. Second that soil conservation planning requires a farmer first approach. They must be carried out voluntarily by farmers as part of their day-day farming activities. Practices need to be easily adopted and offer tangible benefits-that is they are farmer friendly. This requires a bottom-up, farmer first approach involving farmers in identifying the problems and taking decisions as to how they are to be overcome.

Soil fertility can be restored through long fallow periods; however, fallow periods have drastically decreased in Ghana in recent years owing to population pressures and increases in the cost of land clearing, among other factors. The long fallow periods of 5 to 15 years or more associated with traditional shifting cultivation have now been reduced to 1 to 3 years (Diao and Sarpong, 2007:4).

A study by Diao and Sarpong (2007:22) found out that compound farming is common around houses that receive household refuse in the savannah region. Organic-poultry manure is used in the forest region and cow dung in the savannah region. Land and water management interventions, composting and usage of compost in farming systems and agro-forestry and establishment of woodlots are some of the practices applied to control soil degradation in Ghana. The effects of water and wind erosion are largely irreversible.

Mando (2000) cited in Diao and Sarpong (2007:22) asserts that stone bunding already in use in the savannah region to control erosion on slopping land if properly installed, can have a tremendous positive impact on soil properties and on crop production. For instance, it is estimated that in Burkina Faso, stone bunds alone could increase sorghum yields on very degraded soil from 350 kg/ha to 515 kg/ha and that yields could be further increased to 630

kg/ha by adding 1.7 ton/ha of organic manure, to 700 kg/ha by adding 150 kg/ha of inorganic fertilizers and to 850 kg/ha by adding both.

From the FAO (2005:3 7), the addition of organic matter to the soil usually increases the water holding capacity of the soil. This is because the addition of organic matter increases the number of microspores and macrospores in the soil either by "gluing" soil particles together or by creating favourable living conditions for soil organisms. Certain types of soil organic matter can hold up to 20 times their weight in water (Reicosky, 2005). Hudson (1994) cited in FAO (2005) showed that for each 1-percent increase in soil organic matter, the available water holding capacity in the soil increased by 3.7 percent.

Furthermore, the less the soil is covered with vegetation, mulches, crop residues, etc., the more the soil is exposed to the impact of raindrops. Plant residues that cover the soil surface protect the soil from sealing and crusting by raindrop impact. When a raindrop hits bare soil, the energy of the velocity detaches individual soil particles from soil clods. These particles can clog surface pores and form many thin, rather impermeable layers of sediment at the surface, referred to as surface crusts. These surface crusts hinder the passage of rain water into the profile; with the consequence that runoff increases. This breaking down of soil aggregates by raindrops into smaller particles depends on the stability of the aggregates, which largely depends on the organic matter content. Increased soil cover can result in reduce soil erosion rates close to the regeneration rate of the soil or even lower (FAO, 2005:37).

The FAO (2005: 16) also indicates that, one of the consequences of the green revolution was the replacement of indigenous varieties of species with high-yielding varieties (HYVs). These

HYV s often produce more grain and less straw, compared with locally developed varieties; the harvest index of the crop (ratio of grain to total plant mass above ground) is increased. From a production point of view, this is a logical approach. However, this is less desirable from a conservation point of view. Reduced amounts of crop residues remain after harvest for soil cover and organic matter, or for grazing of livestock (which results in manure). Moreover, where animals graze the residues, even less remains for conservation purposes.

Traditionally, a fallow period is used after a period of crop production to give the land some "rest" and to regenerate its original state of productivity. Usually, this is necessary in production systems that have drawn down the nutrient supply and altered the soil biota significantly, such as in slash-and-burn systems or conventional tillage systems.

Mulching, cover-cropping and contour vegetative barriers, on the other hand, are soil structure/soil fertility improvement measures. For example, mulching, which involves leaving either straw or some other organic matter on a field, is effective in improving soil physical properties that obstruct water runoff and increase water infiltration, and also protects the soil against heavy rains, preventing land crusting and contributing to soil organic matter and nutrients (Diao and Sarpong, 2007:23).

According to Bandyopadhyay (1997:44), agroforestry systems help in the maintenance of soil fertility through addition of organic matter and nutrients to the soil, reduction of leaching, and improvement of soil physical and biological conditions. For instance, the introduction of *Gliricidia Sepium* and *Leucaena Spp* as much is reported to have increased maize yield by 50% without application of inorganic fertilizers in West Africa (ibid).

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Since poverty and population pressure have been found to correlate positively with land degradation, poverty alleviation programmes and population control measure cannot be left out in efforts to control land degradation.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1.0 INTRODUCTION

This chapter covers the methods of the study. In the main, it deals with data collection and covers how data is derived from primary and secondary sources. The chapter also explains the approach used and conditions under which the various stages of investigations were carried out, and design of the main research instrument (questionnaire), which was used to collect the primary data. It further indicates how issues of validity and reliability were addressed through triangulation.

3.2.0 STUDY AREA

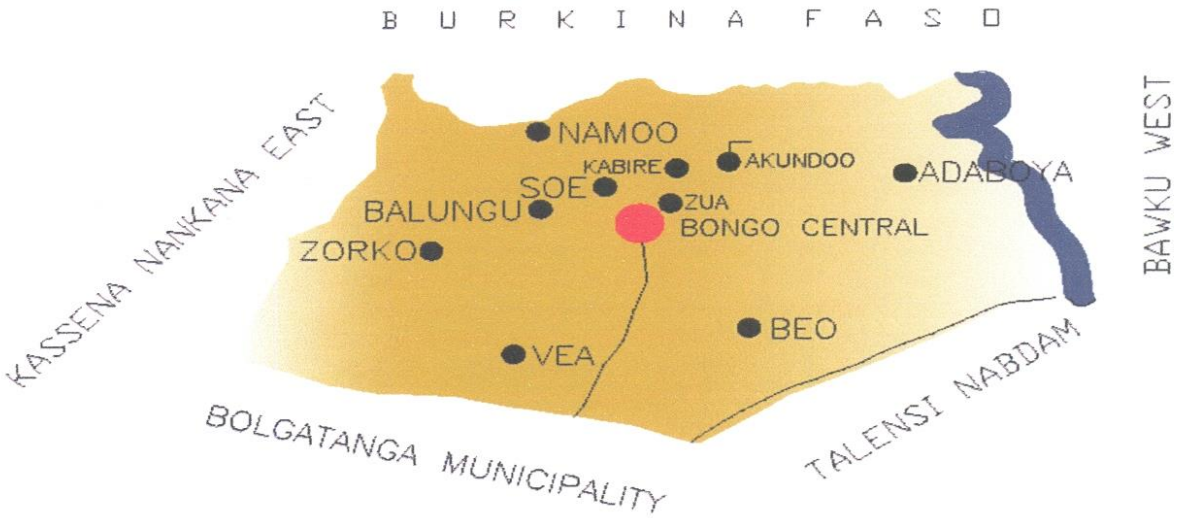
3.2.1 Socio-demographic Characteristics

The Bongo District which was carved out of the Bolgatanga Municipality in 1988 is one of the nine (9) districts in the Upper-East Region. It is the second smallest district (in terms of land area) with an area of 459.5 square km with 137 communities and bordered to the north by Burkina-Faso, to the east by the Bawku West, Talensi-Nabdam and Bolgatanga districts to the south and to the west by the Kassena-Nankana East District.

The Bongo District is predominantly rural and is characterized by large household size (9.2), high population density and high fertility rate. According to the Ghana Statistical Service (2000), the district has a population of 77,885 (36,299 males, 41,586 females) in an area of

459.5 square km. Thus the average population density is about 169 persons per square km as compared to the national population density of 79.30 persons per square km. The population growth rate of the district is 2.8%, giving a projected population of the district at 91,949 (46.7 % males and 53.3 % females) and population density of 200 persons per sq km as at 2006, (BDA, 2006). A map of the Bongo District is shown in Figure 2 below.

Figure 2: Bongo District map



Source: BDA (2006)

Historically, the people of Bongo trace their roots to the Mamprugu Kingdom in the Northern Region of Ghana especially those entitled to the Royal Skin. The district is a multi-ethnic one with two major ethnic groups – Bosis and Frafras. The Bosis are heirs to the Paramouncy and are enskinned by the Nayiri, the overlord of Mamprugu. Two major languages are spoken in the District, Bonni by the Bossis and Guruni by the Frafras. They live in communities with high communal spirit and this is translated into development projects.

The district comprises different religious groupings such as the traditional religion, Christianity and Islam. Over the years, Christianity has overtaken traditional religion as the preferred religion of the people, especially among the younger generation.

3.2.2 Soil characteristics

The Bongo group of soils is developed over granites. The land surface is characterized by numerous groves of baobab trees. The parent materials of the soils have been known to be very productive due to the high potash and phosphate content of the parent rock. Human population densities on these soils are high. Over wide expanses, very severe erosion has resulted in the formation of lithosols (BDA, 2006). About 40% of the land surface is covered by rocks.

According to the BDA (2006), the series of soils are moderately well drained coarse texture soils occupying larger tracts of land on middle and upper slopes and less frequently on summits. Lower slopes soils comprise Yorogo and Zorko series. The Yorogo series are ground water laterites consisting of shallow, pale coloured and very coarse sands (colluvia) lithosols occurring near valley edges and usually expose partly weathered rock. Dawidsorl and Nilson (2000:29) assert that laterites are prone to weathering and are a non-productive soil that quickly becomes incapable of sustaining plant growth if vegetation is removed or burned. Generally, the Bongo soils consist of about 3 inches of very slightly humus-stained, crumbly coarse sandy loam overlying reddish brown, fine blocky, very coarse sandy loam containing occasional incompletely weathered feldspar particles. It grades below into red, mottled pink and yellow coarse sandy clay loam of partially decomposed granite.

The soils are well drained, friable, and porous and possess good amounts of organic matter. Consequently, they have good water holding capacity. They are inherently fertile but for the most part farmed more or less continuously so that they are lacking in organic matter and nitrogen. The soils are rich in phosphate and support crops like millet, sorghum rice, maize, groundnut, cowpea, bambara beans and vegetables. Phosphate leaching to surface waters may however cause eutrophication, resulting in algal growth, loss of suitability for recreation and reduced biodiversity of aquatic vegetation.

3.2. 3 Ecology and Vegetation

The district lies within the Northern Savannah Zone with one rainy season in a year. According to MOFA (2007) it has an average of 600mm-1400mm of rain and 70 rain days. An intense drought precedes the rains with very high rates of evaporation that is estimated at 168 cm per annum. The vegetation is that of the Guinea Savannah type. Rivers and streams dry up during the dry season and the vegetation withers. Farming activities are halted and livestock starved culminating in severe loss of animal weight. The vegetation consists of short deciduous trees often widely spaced and a ground flora composed of different species of grasses of varying heights. Very little of the vegetation exists in its original form (BDA, 2006).

The few indigenous tree species are mainly those of economic value and include baobab, shea and dawadawa trees. There is the Red Volta Forest Reserve, which supports wild life namely baboons, monkeys, rats, mice, grasscutters, rabbits, dwarf buffalo, antelopes and guinea fowls.

3.2.4 Land-Use

The soils of the district exert great influence on the pattern of land-use. The soils are those derived from granites, sandstones and greenstones. The population in the district is high compared with its land area. This could be interpreted to mean that one person is occupying 0.01 sq km of land (BDA, 2006). The pattern of farming is therefore compound subsistence farming. In cultivating the soil located in the stony areas, the stones are shifted into control heaps against which terraces are formed. The high pressure of population and farming activities on the land have rendered the carrying capacity of the soil very low resulting into low soil fertility, low water holding capacity and susceptible to sheet erosion during the rainy season.

On the fields closest to the compound, farmers grow crops such as early and late millet *(Pennisetum americanum),* sorghum *(Sorghum bicolour),* bambara *(Vigna su~terranean),* beans/ cowpea *(Vigna uniguiculata)* and vegetables. Intercropping is the most common cultivation system, i.e. the growing of different crops together on the same fields. Millet, sorghum and cowpea grow in the same plot in a mixture over the fields. Because of the low soil quality most of the crops need fertilizers. Early millet and sorghum need manure, while late millet and groundnut *(Arachis hypogaea)* manage with a smaller amount of manure. Early millet is harvested in July-August, late millet in October and sorghum in the period between early and late millet. Vegetables are harvested continuously when needed. Farming methods predominantly involve the use of simple farm implements notably the hoe. The use of bullock ploughs is still widespread in the farms (MOF A, 2000).

Livestock such as sheep, goat, guinea fowl, chicken and cattle exist in each village. In the non-Muslim area pigs too are held. According to Dawidson and Nilson (2000:34), the number of livestock determines the wealth of a person and cattle serve as the economic guarantee for the household. MOFA (2000) discloses that the problem associated with livestock keeping in the district is grazing areas, food for the animals during dry season, diseases, overstocking and lack of drinking water in some areas of the district. Overstocking and overgrazing increase the problem of soil erosion in the district.

Vea is the site of a large irrigation dam in the Bongo District, covering a gross area of 850 hectares. Approximately 2000 small-scale farmers are eligible to farm in the project area. The main irrigated crops are tomatoes, onions, beans, paddy rice, groundnuts, sorghum and millet (BDA, 2006).

3.3.0 THE RESEARCH DESIGN

The research design is the logic that links the data to be collected and the conclusions to be drawn from the initial questions of the study, it ensures coherence. In other words, it is an action plan for getting from the question to conclusion (Rowley, 2002: 18). The research design adopted for the study is the Descriptive Survey Research Design (Osuala, 2005:254 & 255). According to Osuala, survey research studies both large and small populations to determine the incidence, distribution, and interrelations of variables. It relies upon the questioning of a representative sample of a population and analyzing data in other to answer a hypothesis or describe set characteristics. Osuala (2005; 254 & 255) highlights the following as the advantages of surveys:

- They are particularly versatile and practical, especially for the administrator, in that they identify present conditions and point to present needs.
- They can provide information on which to base sound decisions.
- They do not merely uncover data, they interpret, synthesize and integrate these data and point to implications and interrelationships.
- There is ample opportunity for the researcher to display ingenuity and scholarliness in interpretations of data.
- The survey is more realistic than the experiment in that it investigates phenomena in their natural setting.

In the later stages of the investigation however, this strength becomes a weakness because the lack of control precludes a definitive test of crucial hypothesis (ibid). Oslon et al (2004:21) adds that the survey approach is advantageous in:

• Obtaining information on changing soil properties, management practices and land use histories for several fields that can be linked to other data such as soil sampling

••

• Obtaining data or household resources and other characteristics that affect soil management and

• The ability to statistically analyze the results.

In the light of the above, questionnaires were administered to both Governmental and Non governmental agencies (EPA, MOFA, Vea Irrigation Project-ICOUR, NADMO, FSB, BAFP, CECIK, World Vision Ghana, and Green Bongo for Sustainable Environment) who work in the district and individual land users on issues relating to population growth, land scarcity, land use competitiveness and degradation. Even though the cross- sectional survey is useful in

processing large amount of data, it fails to look at how trends may develop. Hence, information was sort on the trend of the situation from the non-formal institution, that is; traditional leaders and herbalist to augment the study in investigating the implications of high population pressureand land use competitiveness on the degradation in the district. The researcher's observation was selectively applied to capture information such as visible signs of erosion and other factors that was not captured by the questionnaire.

3.4.0 STUDY POPULATION

The study population here refers to the people who the researcher worked with for the purpose of the research. They are the people who were interviewed and whose opinions and ideas form the knowledge base of this research. The study population included individual land users, non-formal institution/NGO's, government agencies working or that have worked on environmental issues in the study area as well as the traditional leaders (Tindanas, Chiefs and Herbalists) in the study area.

3.5.0 SAMPLING TECHNIQUES AND SAMPLE SIZE

The study employed two main sampling methods used in research. These are probability sampling and purposive or non-probability sampling (Osuala, 2005:125). According to Osuala, probability sampling is where each element in a population is chosen at random and has a known non-zero chance of selection. This is ideal for estimating population parameters. In purposive sampling on the other hand, the chance of selection for each element in a population is unknown and for some element is zero; purposive sampling is ideal when developing interview schedules and other research instruments.

The sampling framework is a critical aspect of the research design as it needs to take both ecological and socio-economic variability into consideration. Various spatial sampling approaches are useful particularly to represent ecological variability which varies across space more predictably than socio-economic characteristics (Oslon et al, 2004). Care was therefore taken to ensure that the sample size was sufficiently large to capture variability with the spatial unit. The following methods of sampling were used in this study;

3.5.1 Stratified Random Sampling

The population was divided into meaningful strata on the basis of the study. Within each stratum, a separate sample was taken using the technique of randomization. From each stratum, the required sample size was then selected. The selected individuals combined for the entire sample size.

The district under study was divided into seven (7) administrative area councils (Strata) namely: Bongo Town Council, Balungu Area Council, Soe Area Council, Beo ea Council, Valley Zone Area Council, Zorko Area Council and Namoo Area Council. Out of these seven (7) strata in the district, three (3) Area Councils (strata) were randomly selected. A minimum of two (2) communities were then randomly selected from each of the three (3) selected area councils (strata). Twenty-five (25) land users were then randomly selected in each community, giving a total of 150 land users. Twumasi (2001) asserts that stratification is helpful in lowering variances in the population.

3.5.2 Purposive Sampling

Twumasi (1993:26) explains that respondents chosen through purposive sampling can be helpful in answering research objectives. In this regard, various traditional and non-traditional institutions (Chiefs, Tindanas, and herbalists), GO's and NGO's who have an interest in or have been working on environmental issues were identified with the purposive sampling technique.

3.5.3 Sample Size

From the selected communities, a minimum of twenty-five (25) household 1and users were randomly selected and interviewed from each community. Twenty (20) traditional leaders and herbalists who served as key informants were purposively identified and interviewed on the following areas:

- The implications of population pressure on land degradation in the Bongo District.
- The implications of land use competitiveness on land degradation in the Bongo District.
- The link between population pressure, land use competitiveness and land degradation in the Bongo District.
- Ways of conserving the land in spite of the growing population pressure and land use competitiveness.

The sample involved individual land users (150), NGO's (4) and Government agencies (5) working or having worked on environmental issues in the study area as well 20 traditional leaders (6 Tindanas, 7 Chiefs and 7 Herbalists). In all, 179 individuals and organizations were sampled. This number included male and female, young and old.

3.6.0 DATA COLLECTION TECHNIQUES

In agreement with Miller (1991), Millar and Apusigah (2004) and Oslon et al (2004:19), Participatory Rural Appraisal (PRA) tools such as focus group and group discussions, key-informant interviews, semi-structured and unstructured interviews and observation were used in the data collection to ensure triangulation. This was complemented with secondary data and information from population census, other government statistics and literature reviews.

3.6.1 Interview

Interviews with land users are important to gain an understanding of individual motivations and the rationale for particular courses of action or inaction (Stocking and Mumagham, 2001: 37). In the light of this, the unstructured interviews (in-depth interviews) approach was used in this study. In using this approach a framework comprising of issues to be discussed under the topic was developed and used to obtain information from key- informants (Chiefs, Tindanas and Herbalists) and small groups (men and women) to better understand the community's relationship and dependency on land resources and land management issues and their perception about the nature, cause, effect and possible solutions to land degradation and a whole range of additional information that would help meet the research objectives.

3.6.2 Key-informants

To get information on changes in key resources like medicinal plants, discussions were held with key informants like herbalist to note their experiences on the changes in abundance of species they use for traditional medicine. As Oslon et al (2004:22) put it, critical information may be obtained from local people concerning their impressions of the patterns of land use changes that occurred, and the reasons behind those changes, similar discussions with local

elders will give very useful information on the historic changes at landscape level in regards to land cover, general crop productivity, biodiversity and history of land use especially changes in crops planted.

3.6.3 Questionnaire

My choice of using a questionnaire was based on the fact that: the target respondents are literate and scattered over the geographical area. Hence, self-administered questionnaires were used to elicit information from heads of formal institutions (EPA, FSD, MOFA, NADMO as well as NGOs) in natural resource management. The questionnaire centered on causes of degradation, population and competitive land use and strategies which could be adopted by the increasing population.

On the other hand, interviewer-administered semi-structured questionnaire was also conducted on the non-literate respondents. This was to enable me ensure that the respondents are the persons sampled for questioning. The semi-structured questionnaire centered on:

- Implications of population pressure on land degradation
- Implications of land use competitiveness on land degradation
- Link between population pressure, land use competitiveness and land degradation and
- Strategies which could be adopted by the increasing population to minimize land degradation.

3.6.4 Observation

Zeeuw and Wilbers (2004:8) notice that observation is useful in obtaining picture of a situation more especially of things that are difficult to describe. It thus enriches insights into the research. The tool can also be useful in every phase of the research. The approach was thus used to pick information such as visible signs of erosion on farms and in the communities that could not be captured by individuals and groups interviewed

3.6.5 Secondary Sources

Review of secondary data is useful to get an initial picture of a situation of a target group and socio-economic and institutional context as well as to determine gaps and possible contradictions in available data (Zeeuw & Wilbers, 2004:8). Secondary data such as annual crop yield, annual mean rainfall and population of the district was reviewed from government agencies (Ministry of Agriculture, Population Council) and other stakeholders that matter in environmental issues. Besides this, information from journals, books, magazines and the internet were used.

3.7.0 METHOD OF DATA PROCESSING AND ANALYSIS

Rocheleau (1995) in Oslon et al (2004:20) indicates that the use of a variety of methods ensures more rigorous results and greatly improves interpretation. Mixing quantitative and qualitative information for example provides a better interpretation than either alone. While the qualitative analysis might not be wrong, it may represent only part of the system. Placing quantitative analysis results into a wider context to better interpret the results, often entails qualitative process type of approach such as historic narrative.

In line with the above, both qualitative and quantitative methods were used in the data analysis. The qualitative analysis involved descriptions while quantitative analysis involve the use of SPSS (Statistical Package for Social Scientists). Part of the data analysis was concurrent with data collection as farmers were made to analyze pertaining issues in the course of group discussions. This supports Hudson and Cheatle's (1993:91) rural people should be part of the analysis and ownership of information.

The quantitative analysis involved tabulating and processing simple quantitative operations from questionnaires using SPSS. Graphs, charts, frequencies, percentages and averages were given statistical considerations using SPSS. The overall data analysis was a combination of the two approaches (qualitative and quantitative). The qualitative analysis involved descriptions of land use types, land cover, land management and other issues that necessitated description.

CHAPTER FOUR

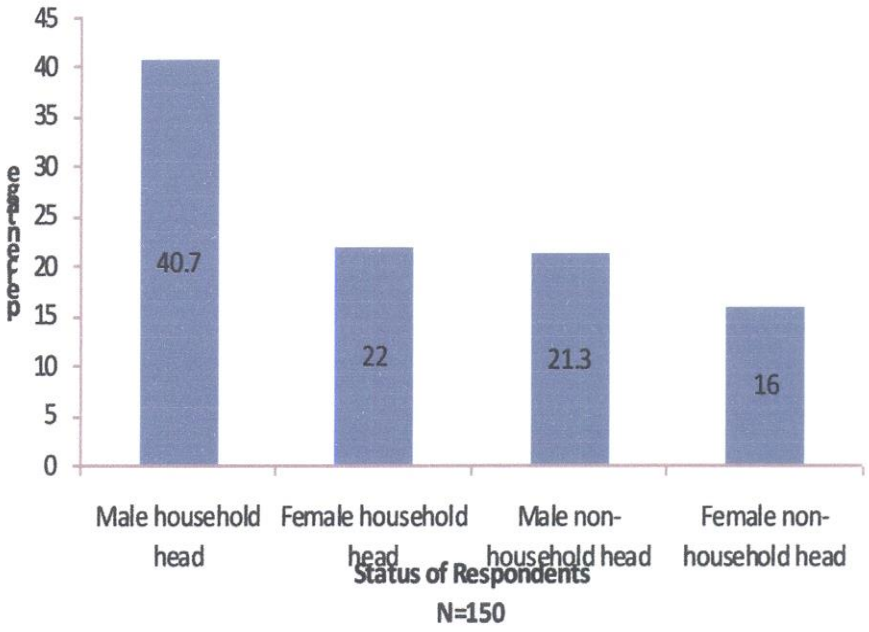
4.0 FINDINGS AND DISCUSSIONS

This chapter presents the findings of data and discussions of the implications of the findings Made. Descriptive statistical tools like frequency tables, histograms, pie and bar charts are used to present the results.

4.1.0: SOCIO-DEMOGRAPIDC CHARACTERISTICS OF RESPONDENTS

4.l.1: Household Status of Land Users

Figure 3: Status of land users



Source: Field survey data, 2010.

Fig. 3 shows the status of respondents (land users). The results indicate that, of the one hundred and fifty (150) respondents, about 40.7% were male household heads, 22% female

household heads, 21.3% were male non-household heads and 16% were female non-household heads. The results indicate that majority of the households are headed by males However, a significant number of the households are also headed by females. Hunt (1997:26 & 71) reveals that women who provide for subsistence needs have considerable expertise and knowledge of the state of the environment, and sustainable resource management strategies. The results may therefore suggest recognition of women in the area and the possibility of women taking part in decisions regarding land.

4.1.2: Status of Traditional Leaders

Table 2: Status of Traditional leaders

Status	**Frequency**	**Percentage**
Tindana	6	30.0
Chiefs	7	35.0
Herbalists	7	35.0
Total	**20**	**100.0**

Source: Field survey data, 2010

Table 2 presents the status of traditional leaders interviewed in the study. 1 total of 20 traditional leaders were interviewed. This consisted 6 (30%) "tindanas", 7 (35%) chiefs from Vea, Samboligo, Nyariga, Namoo, Bongo-Atapiisi, Sagbo and Gowrie communities. Herbalists from various communities within the study area were 7 (35%).

4.1.3: Personal Information of Governmental and Non-Governmental Organization

A total of six (6) governmental and three (3) non-governmental organizations were interviewed. These were the EPA, FSD, Vea Irrigation Project-ICOUR, MOFA, and

NADMO, Bongo Agro-Forestry Project (BAFP), World Vision Ghana, Green Bongo for Sustainable Environment and the Centre for Cosmo Vision and Indigenous Knowledge (CECIK). With the exception of World Vision Ghana, all the agencies have carried out interventions in relation to land degradation. All but Green Bongo for Sustainable Environment have worked in the district for more than a decade.

Interventions carried out by the agencies on land management included:

- Afforestation programmes
- Public sensitization and education on the prevention of indiscriminate tree felling and encouraging community tree planting.
- Anti-bush fire campaigns
- Erosion control campaigns
- Earth and Stone bunding
- Soil and water conservation through stone bunding and grass strips
- Protection of water bodies
- Rejuvenation of traditional sacred grooves

4.1.4: Age Distribution of Land Users

Table 3: Age of land use

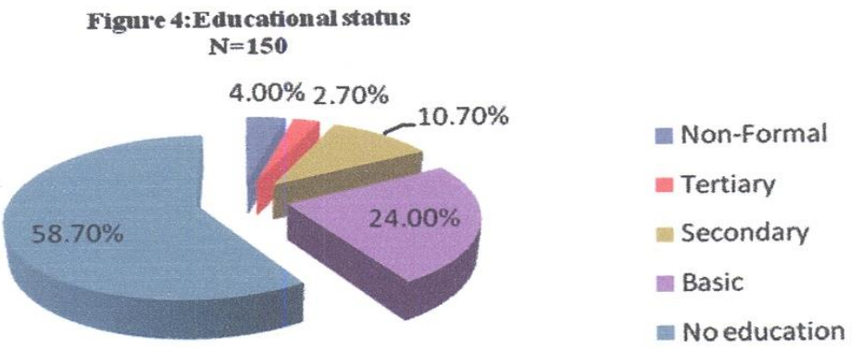
Age Group	Frequency (f)	Percentage
≤ 20	10	6.67
21-30	31	20.67
31-40	32	21.33
41-50	40	26.67
51-60	21	14.00
2:61	16	I 0.67
Total	150	100.00
Average= 40.77		

Source: Field survey data, 2010

Table 3 gives the age distribution of respondents.

The age distribution of respondents from the results obtained reveals that 6.67% of the respondents were less than 20 years of age while about I 0.67% of the respondents were above 61 years of age. In all about 89.34% of the respondents fell within the active working age category. The average age of the respondents was 40. 77 years. This suggests that the availability of labour for the implementation of appropriate land conservation technologies in the area may not be a challenge since most of the respondents (89.34%) were with the active working age.

4. 1.5: Educational Status of Land users



Source: Field survey data, 2010

Figure 4 presents the educational status of respondents (land users). Educational status refers to the number of years of formal education completed by respondents. The study results indicate a high illiteracy rate in the study area. About 58. 7% of the respondents are illiterate both in formal and functional education. About 24.0% have basic education] 10.7% high school education, 2.7% have tertiary education and 4.0% have non-formal education. The results reveal that majority of the people in this sector have no formal education. This does not augur well for the growth and development of the sector. Countries all over the world are turning to mechanized agriculture and a farmer needs education to be able to adopt to these technologies. According to Adugna (2005:44), as educational status of a household head increases, it is assumed to increase the transfer of relevant information and as a result increase farmers' knowledge about the cause, severity and consequence of land degradation. Education enables farmers to tackle land degradation using various ways of soil fertility improving practices, traditional and introduced soil conserving technologies. Education may increase

households understanding on the causes and impact of land degradation and the increase in the cost of rehabilitation.

The inability of farmers in the study area to turn their fortunes around might partly be blamed on their lack of formal education. Many people, especially the young, regard agricultural production as a 'job' for the uneducated. This may explain why the sector is not able to attract many of the educated. Although agriculture is studied in our schools, products of these schools prefer "white collar" jobs which are considered more prestigious and perhaps more 'decent'.

The results may therefore suggest a negative relationship between level of formal education and improvement in agricultural production and technology.

4.1.6: Major Occupation of Land Users

- **Figure 5: major occupation of land**

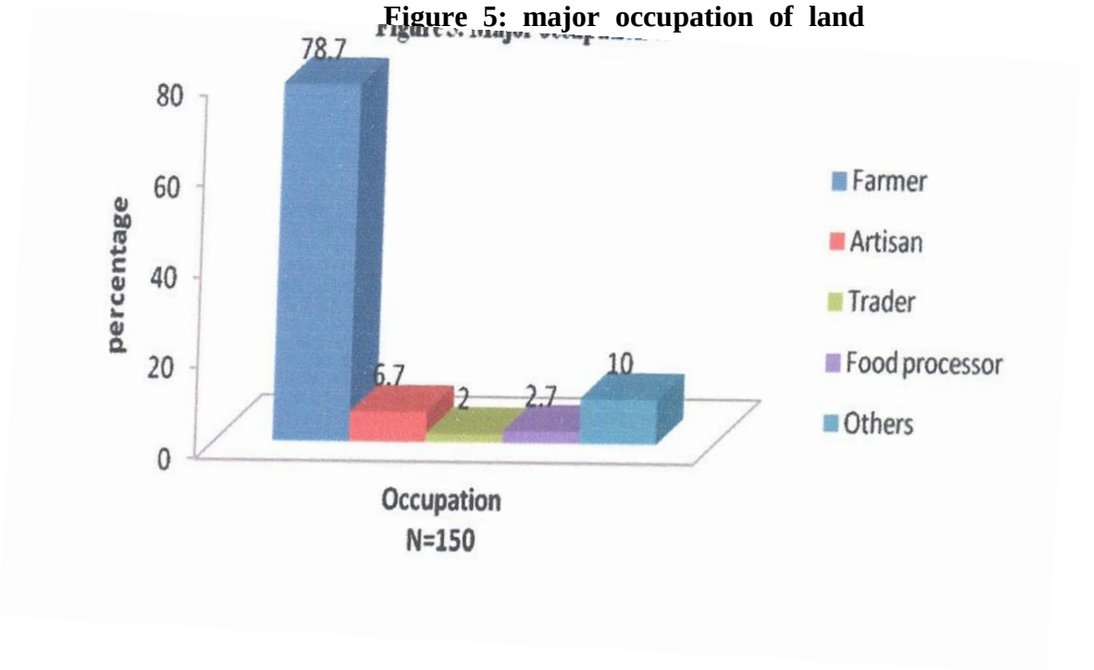


Figure 5 depicts the major occupation of the respondents (land users). The people of the area are pre-dominantly farmers. Out the 150 land users, 78. 7% were mainly engaged in farming,

6.7% artisans (basket weavers), 2% traders, 2.7% in agro-processing while 10% fell into the others category which included students and government workers such as teachers who were involved in farming. In line with the District Assembly, the results confirm that agriculture production is the main occupation that inhabitants of the study area are engaged in. The finding also supports Codjoe (2006) and MOFA (2001) that agriculture is the main economic activity of Ghana's population and Bongo District for that matter. However, contrary to Dawidson and Nilsson (2000:32) less than 90% of the respondents were mainly crop farmers. But since a larger proportion of the people's livelihood depend on agriculture, the problem of degradation is likely to have detrimental effects such as low soil fertility and low crop yields which will in tum lead to hunger and poverty of the people.

4.1.7: Household Size of Land Users

Table 4: Household size

Household Size(range)	Frequency(f)	Percentage	Cumulative Percentage
1-5	36	24.00	24.00
6-10	59	39.33	63.33
11-15	37	24.67	88.00
16-20	3	2.00	90.00
21-25	4	2.67	92.67
26-30	4	2.67	95.34
>30	7	4.67	100.00
Total	150	100.00	
Average = 10.28			

Source: Field survey data, 2010

Table 4 shows the household size of respondents (land users.) Household size refers to the number of people in each household regardless of sex and age. The average household size of 10 people agrees with earlier findings of the District Assembly that its population is characterized by large household size (9.2). From the findings, about 63.33% of the 150 respondents had household size of 1-10, 32.1 % had household size of 11-30 whiles 4. 7% had household size above 30. The average household size of the sampled population corresponds to 6-10 which also represents the modal household size. But Wagayehu and Drake (2003) found out that large number of family members with limited resource could affect land degradation. This is because they contribute to the increasing demand for food with limited land resource. The large household size of Bongo as revealed by this study and others, may contribute to land degradation as the increasing population may tend to cultivate fragile lands, reduce the use of fallow, increase the use of tillage and other potential results of intensification. In contrast, Demeke, (2003:30) believes that larger households will be able to provide the labour that might be required for maintaining conservation structures.

4.1.8: Land Cultivated by Land users

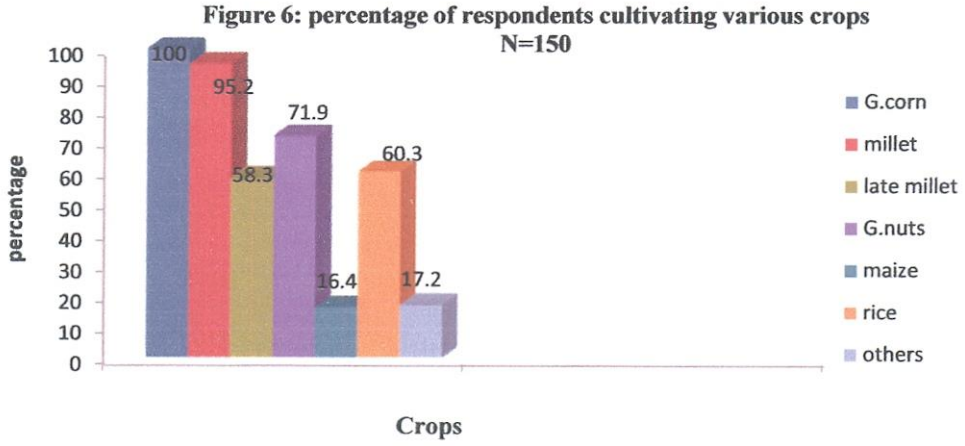
Table 5: Mean acres of cultivated land

Land Size (Acres)	**Number of land users**	**Percentage**
0-1	15	10.67
1-2	45	30.67
3-4	52	35.33
5-6	20	14.00
7-8	7	4.67
9-10	3	2.00
>10	4	2.67
Total	**146**	**100**
Average = 3.3		

Source: Field survey data, 2010

Table 5 shows the land size in acres and the corresponding number of land users. Out of the 150 respondents, 146 (97.3%) responded "yes" to having land. The other 4 (2.7'*) respondents, who said "No", used lands which belonged to other people. From the findings, the mean acre of land cultivated by respondents is 3.4 (1.36 hectares). Of the 146 respondents who indicated having land, 10.7% had lands less than one acre, 66.0% had lands ranging between 1 and 4 acres, 20. 7% had lands ranging between 5 and 10 acres whilst 2. 7% had lands greater than 10 acres. This finding agrees with Dawidson and Nilson (2000:32) who indicated that in the Upper East Region of Ghana, the average farmer has appropriately 1 hectare of land. Even though, the increasing population as seen in the large household size (Table 4) may have contributed to the fragmentation of land and the smaller plot sizes, the disclosure by the district assembly that about 40% of its land is occupied by rocks may also partly explain the small average size of the respondents' land.

4.1.9: Crops cultivated by Land Users



Source: Field survey data, 2010

Figure 6 indicates the percentage of respondents cultivating various crops. In line with Dawidson and Nilsson (2000:32), all the 146 respondents cultivated Guinea corn (sorghum) with about 95.2% cultivating millet and 71.9% cultivating groundnuts. About 60.3% cultivated rice, 16.4% maize whilst 16. 7% of them cultivated others which included Bambara beans, soya beans and cowpea. Bambara beans, soya beans and cowpea were generally intercropped with other crops, notably millet and guinea corn. Guinea corn is the most cultivated crop probably because of its resistance to drought, its importance to the local "pito" brewing industry and its significance in the preparation of porridge-a common Ghanaian breakfast. Thus in a way, it is an "economy crop". Moreover, it is of cultural significance (sacrifice). Millet and groundnuts are also required in the preparation of the daily meals of the people and are thus the most cultivated. Maize is the least cultivated crop probably because it is not of socio-cultural importance to the people of the area. It does not play any role in the performance of funerals or traditional festivals and sacrifices. Furthermore low soil fertility and the inability of farmers to access fertilizers may partly explain why maize was least cultivated.

Table 6: Mean Acres of land used/or crops

4.6 Mean Acres of Crops

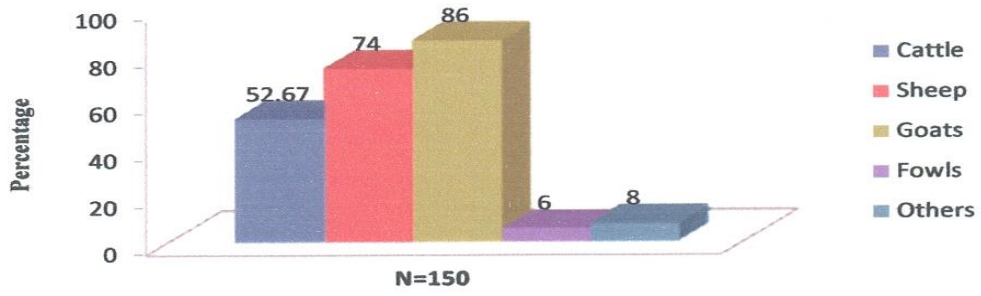
Mean Acres of Crop	
Crop type	**Mean acres**
Guinea corn	2.01
Millet	1.95
Late millet	2.18
Groundnut	1.86
Maize	1.83
Rice	190
Others	2.46

Source: Field survey data, 2010

Table 6 indicates the mean acres of land used in cultivation of the various crops. It is noticed that more land (6.14) is put under the cultivation of late millet, Millet and Guinea com. These three crops are of socio-cultural significance to the people and that might explains why land users put greater proportions of their lands for the cultivation of these of crops. Large areas of land (2.46) were also used for the cultivation of "others"; these included cowpea, soya beans, bambara beans and vegetables. These "other crops" are normally cultivated by the sides of the farms or intercropped with the main crops but they are very necessary for the survival of households such that almost every farmer cultivates them. Maize is the crop with the least average proportion of land (1.83) put for its cultivation. The reasons that might be assigned for this phenomenon are the same as given under figure 6 (low soil fertility and the inability of farmers to access fertilizers to obtain the desired output for the crop).

4.1.10: Percentage of land users rearing various Animals

Figure 7: Percentage of land users rearing various animals



Source: Field survey data, 2010

Figure 7 shows the percentage of respondents rearing various Animals. Out of the 150 Respondents, 86% rear goats whilst 74% rear sheep. Contrary to Dawidson and Nilsson

(2000:32), only 52.7% of the respondents rear cattle. Only 6% were found to be rearing fowls and 8% of them having animals in the other category which includes donkeys, etc. From the findings, most respondents rear for socio-economic benefits. The ruminants and chickens are sold and serve the purpose of immediate cash generation in times of cash shortage.

In traditional African societies, livestock are often an indicator of wealth. Also, farmers with a large number of livestock may have more animal dung to improve soil fertility and more capital to invest in soil conservation practice. This affects the use of soil fertility measures positively (ILRI, 2003:20). More specialization into livestock away from cropping may however reduce the economic impact of soil erosion, and/or increase the availability of cow dung to counter the process of nutrient depletion, and thus lower the need for soil conservation (Bekele and Holden, 1998). However, livestock rearing most of the time creates burden on community grazing land and is particularly disastrous as it may lead to overgrazing which results in desertification.

Furthermore, the FAO (2005: 17) reveals that cows, draught animals and small ruminants graze on communal grazing areas and on roadsides, stream banks and other public land destroying the most palatable and useful species in the plant mixture reducing the plant cover density and thereby increasing erosion hazard and reducing the fertility of land . The mean number of various animals that were reared by respondents is presented below.

Table 7: Mean number of animals reared by respondents

Mean number of Animals	
Animal type	**Quantity**
Cattle	4.7
Sheep	4.9
Goats	5.2
Fowls	11.9
Others	4.7

Source: Field survey data, 2010

Table 7 shows the mean number of different animals reared by respondents. The results from the study indicate that the mean number of cattle reared was 5 whilst small ruminants (sheep and goats) were 5 and 6 respectively. The mean number for poultry was 12 whilst other animals which included donkeys, turkeys, pigs and rabbits had a mean of 5. It is observed from the results that fowls had the highest average which implies that greater numbers of fowls are kept by farmers as only 6% (in fig 7) of respondents reared fowls. However compared to the mean number of fowls, farmers were found to keep fewer numbers of Cattle (average of 5), Sheep (average of 5) and Goats (average of 6). Fowls are required in sacrifices, preparation of meals on special occasion and also they are easily sold out for money in times of need. This might explain why farmers kept larger numbers of fowls.

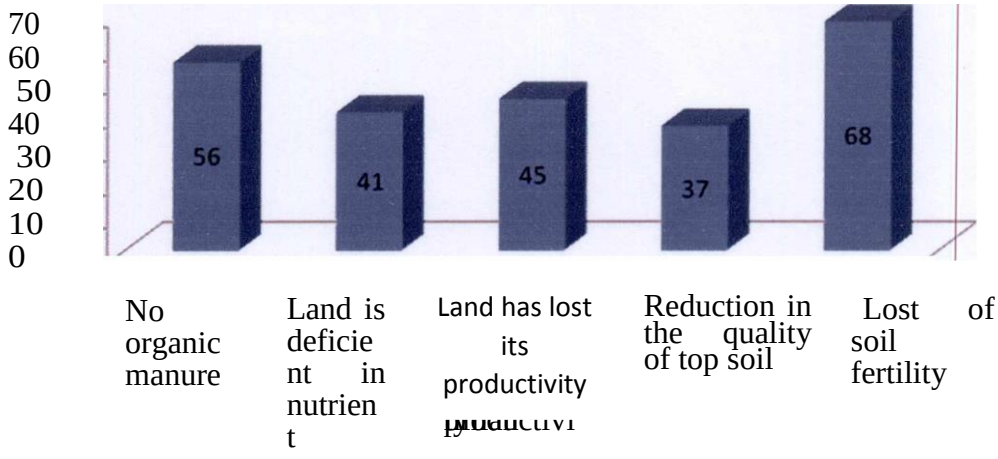
In the study area where land is scarce and where farmers depend on communal grazing lands because family grazing lands are non-existent, the numbers of animals kept by the farmers

can have both positive and negative effects on the land. The animal droppings can be used by the farmer to fertilize the land. On the other hand, the animals may over graze the land, leaving it bear and exposed to erosion.

4.2.0: THE CAUSES AND EFFECTS OF DEGRADATION

4.2.1: Land Users' Perception of Degradation

Figure 8: land users' perception of degradation
N=150



Source: Field survey data, 2010

Figure 8 presents land users' perception of Degradation. Loss of soil fertility d68%), loss of organic matter (56%), low yields (45%), and soil erosion (37%) were cited by respondents as indicators of land degradation in their communities. Their explanation centered on indicators because, although farmers may be aware that degradation exist, the process of degradation cannot be acknowledged by mere observation until there are clear signs of the effects. This was based on their perception and interpretation of indicators that reveal certain conditions regarding crop and pastureland. In other words, to the local farmer, degradation is

synonymous to its effects and this confirms the FAO (2008) finding that most people perceive land degradation as a threat only when it affects their livelihoods. The results also agree with Dejene et al (2010) that farmers are aware that soil degradation, in various forms, is taking place on their farms as well as in the surrounding areas.

4.2.2: Traditional leaders' understanding of the concept of land degradation

The generally held perception of land degradation by the traditional leaders was

"Lost of fertility of land rendering it incapable of supporting plant growth"

"Low crop yield resulting from inability of land to support plant growth"

A few others also mentioned were *"continuous cropping without application of organic/inorganic manure"* and *"drought, deforestation, sand winning and top soil being carried away by rain water".* As observed, the respondents' main perceptions were not biophysical characteristics, confirming Stocking and Murnaghan's (2001: 10) finding that degradation is socially constructed and does not encompass the biophysical environment.

4.2.3: Concept and Causes of Degradation by Agencies

Respondents' concept of land degradation was not different from physical evidence of land degradation. They generally stated physical signs such as excessive tree felling, long drought, bush fires, improper land tillage and gullies of erosion as the evidence of degradation. Some of them described it as the loss of vegetative cover due to human activities making productive land become unproductive. A comprehensive definition given by the interviewee of MOFA was *human and animal activities which have led to the deterioration of the physical and nutrient composition of the soil thus rendering it unproductive.* Their concept of the causes of land degradation in the district was mostly that of man- made rather than natural. Poor/erratic

rains, torrential rains which lead to heavy runoffs and gullies and high climatic temperatures were mentioned as the natural causes of degradation. The main causes of degradation enumerated by the agencies are summarized below.

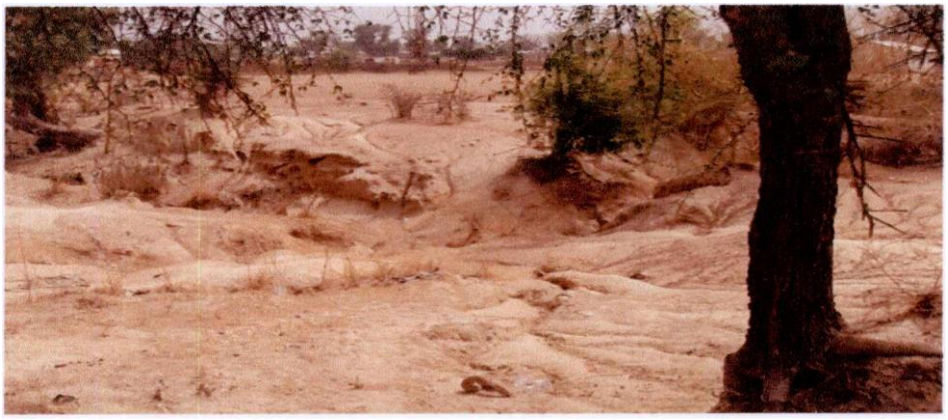
- Bad farming practices
- Indiscriminate tree felling and bush burning
- Continuous/over cropping on the same piece of land and overgrazing by free range animals
- Human settlement and road constructions
- Breakdown of traditional systems and inappropriate interventions from central government as people are not held accountable to their actions.

4.2.4 Degradation in Community and Farm Lands

The findings reveal that all 150 sampled respondents have some form of knowledge of land degradation. About 94.7% indicated the existence of degradation in their communities while 90.5% of them confirmed experiencing degradation on their farm lands. The features that led respondents to acknowledge there was degradation on their farms were generally low crop yield as a result of declining soil fertility and visible signs of erosion such as gullies and bare land. The results confirm the work by Dawidson and Nilsson (2000:30) which indicates that the Upper East Region (Bongo District not an exception) suffers from enormous soil erosion. Quansah in Cofie and Penning (2002:3) did notice that 70% of the country is subject to moderate to severe sheet or gully erosion and that about 40% of this land was in the savanna areas of which the study area is part. (See figure 9 which shows evidence of degradation in the study area).

Figure 9: Evidence of degradation in study area

a. bare land full of rocks



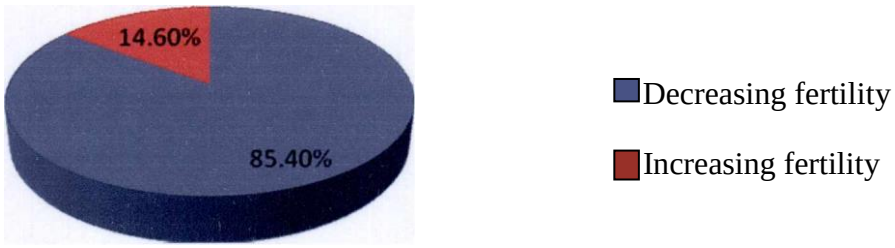
b. bare land with signs of erosion

Source: Field survey, 2010

Picture 'a' shows a sloping land which is exposed to erosion. This is evident in that there are stone bunds on the farm, signifying that the farmer trying to manage the erosion. Also, a large proportion of the land is occupied by rocks reducing the land available for farming, this might compel farmers to continually cultivate the same land. Picture 'b' depicts a seriously degraded land full of gullies and which out of production because of its state.

4.2.5 Changes in Fertility of Cultivated Land

Figure 10: Fertility of cultivated lands
N=123



Source: Field survey data, 2010

One hundred and twenty-three (82%) of the land users reported changes in the fertility of their cultivated lands. From Figure 10, out of the one hundred and twenty-three land users, 85.4% indicated a declining fertility with 14.6% reporting an increasing fertility on their cultivated lands. The results seem to confirm earlier findings by EPA-Ghana (2002:46) that nutrient depletion in Ghana is widespread in all the agro-ecological zones. According to the EPA-Ghana, these deficiencies are even more pronounced in the Coastal, Guinea and Sudan Savanna zones where the organic matter content is low and the annual burning and removal of crop residues further prevent the build-up of organic matter. Similarly, the results confirm findings by Dejene et al (1997:22) that most soils in SSA have a low nutrient content and a low level of soil organic matter. Soil degradation results in the depletion of these nutrients and loss of soil organic matter. This has consequences for food and livelihood security. The land users cited stunting of their crops and the general decline in crop yield as the features which signify fertility decline. The 14.6% respondents who reported increase fertility reported using fertility improvement methods such as compost and manure.

4.2.6: Crop Yield of Land Users

Table 8: Changes in Crop Yield

Changes In Crop Yield							
Yes						**No**	
Increasing		**Decreasing**		**Total**		**No. of respondents**	**%**
				No. of respondents	**%**		
No. of respondents	**%**	**No. of respondents**	**%**	141	94	9	6
17	12.06	124	87.94				

Source: Field survey data, 2010

Out of the 150 land users interviewed, 141 (94%) reported changes in crop yield. About 87.9% of this proportion reported a decreasing trend in their crop yield. Crop residue and manure, which were once a major source of enriching soil fertility, were being used as fodder and fuelwood. This resulted in considerable nutrient loss reflected in their lop yield. In agreement with Cofie and Penning (2002:4), low soil fertility was cited as the main reason by 70 % of the respondents for their declining crop yield.

The phenomenon of decreasing yields is observed by farmers because when the land is degraded, it is no longer able to produce good yield as expected by the farmers. It is only when the necessary interventions are made that the crop yield can improve. This was the reason for

the increase of crop yield of 17(12.1 %) of the respondents who applied fertilizers and compost on their farms. Erosion (8%), erratic rainfall patterns and lack of manure (5.3% each), drought (4.7%) and disease (2%) [See Table 9] represent other reasons given by respondents' for their declining crop productivity.

Table 9: Land users' reasons for changes in crop productivity

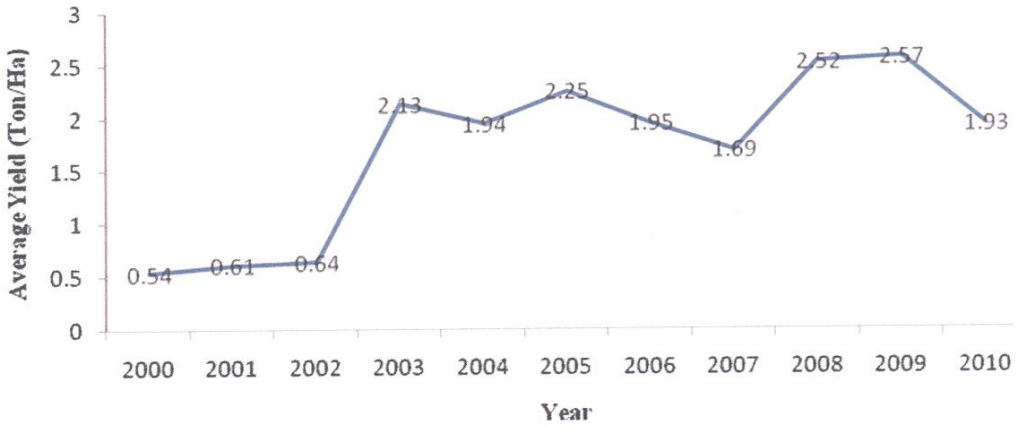
Respondents' reasons	**Frequency**	**Percentage**
Low fertility	105	70.0
Erratic rainfall patterns	8	5.3
Manure is not added	8	5.3
Droughts	7	4.7
Diseases	3	2.0
Erosion	12	8.0
Others	7	4.7
Total	**150**	**100.0**

Source: Field survey data, 2010

The other reasons given for the declining yields included weed infestation and late weeding of farm lands and these were given by 4. 7% of the respondents. Farmers demonstrated the knowledge of the presence of plant species on farm lands that signify a decline in the fertility of the soil as about 78.7% of the respondents agreed to knowing such plant species. The names of the plant species were predominantly "wiini" or *Striga hermothrica*, "somia" or *Vertiveria zizanoides* and "Sahinganindaale" or *Foetid cassia* (also known as Negro coffee). They indicated that weeds compete with the crops for both space and nutrients and this explains the

reduction in yields of the crops. They further indicated that when weed infestation is severe it might lead to total crop failure.

Figure 11: Average annual yield of major crops (Ton/Ha)



Source: MOFA, 2011

Figure 11 gives the annual total average yield of some major crops (Maize, Rice, Millet, Guinea corn, Groundnuts, Cowpea, Sweet potato and Soya beans).

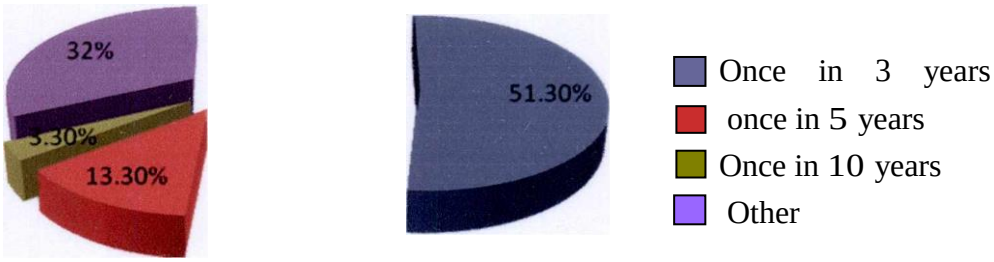
Analyzing Figure 11, it is evident that the output or yield trend of the district has been inconsistent. The average yield per ton increased from 2000-2003 (0.54 – 2.13 Tons/Ha) peaking at 2003 (2.13 Tons/Ha). This was immediately followed by a decline in 2004(1.94 Tons/Ha) and again an increase in 2005(2.25 Tons/Ha). The years 2006 and 2007 experienced sharp declines (1.95 and 1.69 Tons/Ha respectively). The district again witnessed an increment in 2008 (2.52Tons/Ha) with a marginal increment in 2009(2.57Tons/Ha) which was followed

by another sharp drop in 2010. The year 2009 recorded the highest yield (2.57 Ton/Ha) whiles the year 2000 recorded the lowest average yield of 0.54 Tons/Ha.

The inconsistency in the yield of crops has implications for food security and the livelihoods of people in the district, in that, low yields can lead to hunger, starvation and malnutrition, as well as poverty.

4.2. 7: Poor/Erratic Rainfall and Hunger

Figure 12: poor rain and hunger in study area



Source: Field survey data, 2010

Figure 12 presents land users responses on the frequency of drought and hunger in the District. From the results it is more evident that the study area is drought prone as about 51.3% of respondents indicated that they experience poor/erratic rains and hunger once every three (3) years. This conforms to Mortimore (1993:15) who argued that environmental destruction has kept people from growing or getting enough to eat. Data from the Bongo District Assembly indicated that, an intense drought precedes the rains with very high rates of evaporation that is estimated at 168 cm per annum. The vegetation of the District is that of the Guinea Savannah type. The only irrigation scheme in the district is mainly accessed by respondents in Vea and its environs where the irrigation project is located. Otherwise all the respondents mainly depended on rain-fed agriculture for livelihood and this is determined by

-

the timing of rains and intraseasonal rainfall patterns which ultimately determine the success or failure of their crops. Failure of the rains therefore implied imminent hunger for the respondents.

The study reveals that there is scarcity of fuel wood (used by only 20% of the respondents) in the area (See figure 19). The problem of drought in the area may therefore be the result of desertification. Crops are particularly reliant on the upper horizons of the soil which are the most vulnerable to erosion by water and wind. Soil erosion/land degradation is often enhanced during periods of drought consequent upon the drying out of topsoil and effective loss of soil structure and aggregation. In this condition, topsoil is easily blown away as a result of the erodibility of the soil and the erosive nature of wind and rainfall. The most serious impact may however be its threat to the sustainability of agricultural productivity, which/results from on-site damage, which it causes.

Respondents coping mechanisms for the poor/erratic rain and hunger included: sale of assets such as animals for ready cash, irrigation, basket weaving, borrowing from friends/relatives to buy food and adjustment of diet to include more vegetables notably "Bito" also known as *Hibiscus cannabinus.* The respondents' coping strategies are presented in the Table below.

Table 10: Respondents' coping strategies during drought and famine

Coping strategy	Frequency
Pray to God for rain	72
Sell animals to buy food	74
Practice minor irrigation farming	38
Weave baskets to buy food	38
Wait patiently for rain	38
Resort to eating only vegetables and wild food	43
Borrow food from friends and relatives	61
Manage with what we have	41

Source: Field survey data, 2010

Although respondents had all these coping mechanisms in place, the ACC/SFN (2010:6) reveals that they are more vulnerable to livelihood insecurity, seasonal hunger/food insecurity and under nutrition. This is because their entitlements and means to absorb nutritional shocks were inadequate. The vulnerable group particularly, children under five (5), pregnant and lactating women and the elderly were thus more at risk of malnutrition.

Table 11: Rainfall Figures of the District

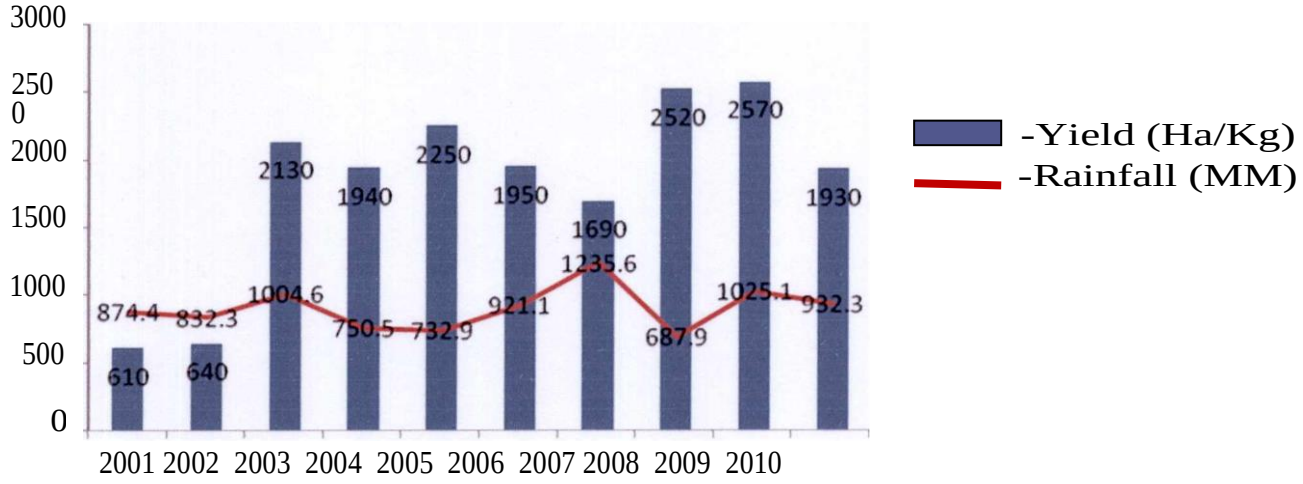
RAINF ALL(MM)											
Year	**Feb.**	**March**	**April**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Yearly Total**
2001	0	15.0	5.1	44.0	170.8	89.5	387.9	122.2	39.9	0	874.4
2002	0	0	23.5	101.1	127.4	190.9	184.5	118.8	83.1	3	832.3
2003	0	0	20.4	109.1	129.6	185.3	320.0	205.1	35.1	0	1004.6
2004	0	0	133.7	86.2	115.5	164.3	175.4	67.9	7.5	0	750.5
2005	1.6	1.4	42.5	11.6	178.6	154.9	201.9	119.9	20.5	0	732.9
2006	0	5.0	35.1	127.2	138.9	206.3	129.4	207.8	71.4	0	921.1
2007	0	0	90.6	93.6	107.6	264.8	510.6	129.6	38.7	0.1	1235.6
2008	0	16.6	17.8	80.7	56.3	191.9	187.6	100.0	37.0	0	687.9
2009	17.9	12.6	51.5	59.8	176.1	185.8	248.8	217.7	54.9	0	1025.1
2010	5.0	0	54.1	36.9	105.1	188.7	296.7	144.4	100.8	0.6	932.3

Source: MOFA, 2011

The Table 12 presents the rainfall figures of the study area.

Analyzing Table 12 the rains in the district have been erratic. The 2007 experienced the highest rainfall whiles 2008 also experienced the lowest rainfall. The figures confirm the MOFA, 2007 which states that the annual rainfall of the district falls between 600mrn-l400mm. However the figures in this study fall above the minimum and below the maximum figures given by MOFA. Although the Vea irrigation dam exists, rain is the main source of water for the crops of land users in the study area. But the timing of these rains and quantity of the water it gives is very important in determining the success of crops. Too little rain leads to drought whilst too much of it might result in flooding and erosion. Both phenomena result in poor crop output.

Figure** 13: **Total rainfall versus average yield (Ton/Ha)

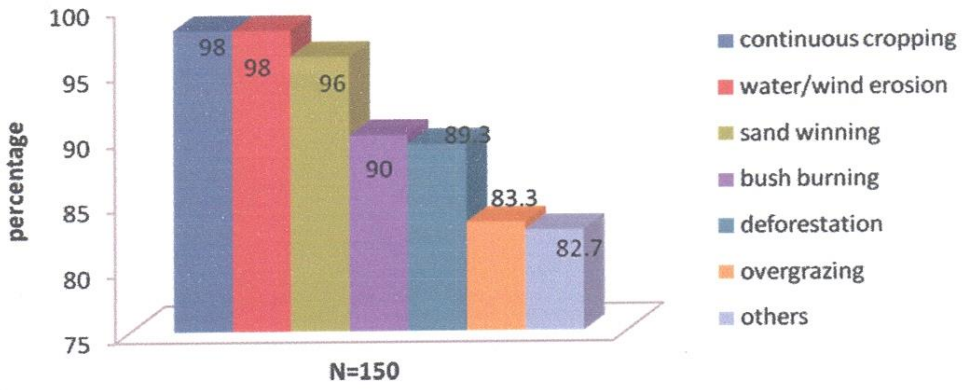


Source: MOFA, 2011

The growth of the yield shows peaks in 2008 and 2009. An assessment of the rainfall pattern from Table 12 reveals that 2008 and 2009 recorded moderate rainfalls between the months of March and October. Even though the year 2007 recorded the highest rainfall; a sharp decline in yield was recorded. From Table 12, one can observe that the year 2007 recorded much rainfall between April and October with the month of August 2007 recording the highest rainfall figure (510.6MM) of all The general pattern observed from Figure 13 and Table 12 is that moderate rainfalls for the year were accompanied with increasing yields.

4.2.8: Land Users' Perception of the Causes of Degradation

Figure 14: Causes of degradation



Source: Field survey data, 2010

- Respondents' perceptions of the causes of land degradation are presented in Figure 14. Ninety-eight (95 %) of respondents mentioned continuous cropping and erosion as the cause of degradation. Other perceived causes of degradation that were mentioned include sand winning (96%), bush burning (90%), deforestation (89.3%) and overgrazing (83.3%). In the others category, about 82. 7% of the respondents mentioned climate change as a cause of degradation. Their perceptions about the causes of degradation were in line with the causes mentioned by FAO (1994), Stocking and Murnaghan (2001) and Nyssen et al (2008). The land users' perceptions on whether the causes of degradation were human or natural are presented in Table 12.

Table 12: Human and natural causes of degradation

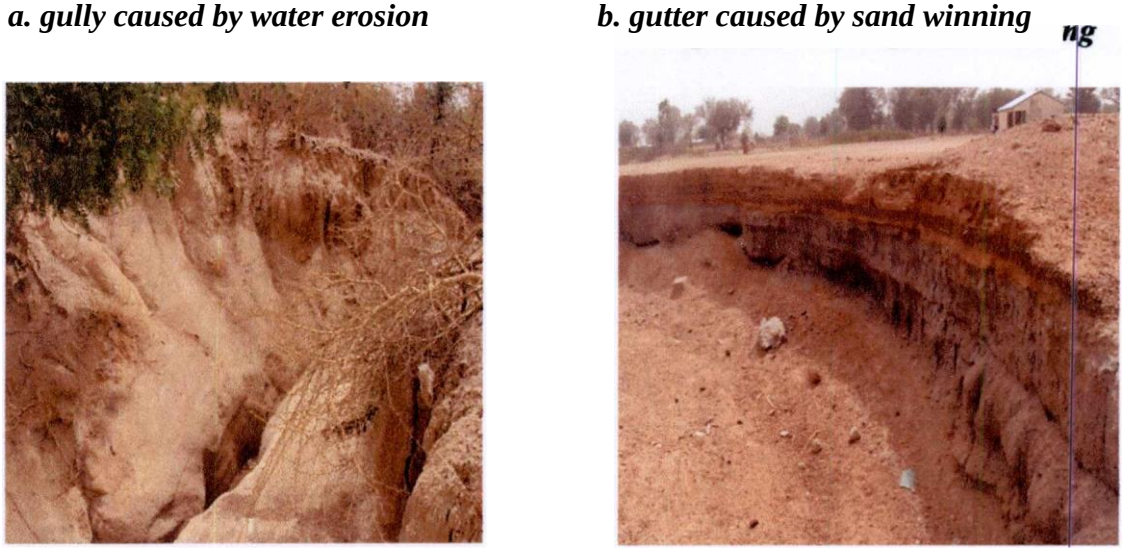
Cause	Human Cause	Natural Cause
	Frequency	Frequency
Bush burning	133	2
Continuous cropping	131	16
Deforestation	133	1
Overgrazing	122	3
Climate change	29	95
Sand winning	119	25
Water/wind erosion	7	140

Source: Field survey data, 2010

With the exception of water/wind erosion and climate change, the respondents generally agreed that bush burning, deforestation, overgrazing, sand winning and continuous cropping are human causes of degradation. From the table above, respondents' perceptions were in conformity with Nkonya et al (2008: 1) assertion that human activities influence and catalyze the natural causes of degradation. About 51.3 % (77) of the respondents confirmed using fire as part of their land management practice. Out of this proportion, about 9 .1 % used fire in clearing of new land whiles 90.9% used it in clearing of weeds on already existing and cultivated land. Figµre 15 presents signs of erosion caused by water and sand winning in the study area.

Figure 15: Erosion and sand winning in study area

a. gully caused by water erosion ***b. gutter caused by sand winning***



Note: Pictures taken by author during observation of some farms in the study area.

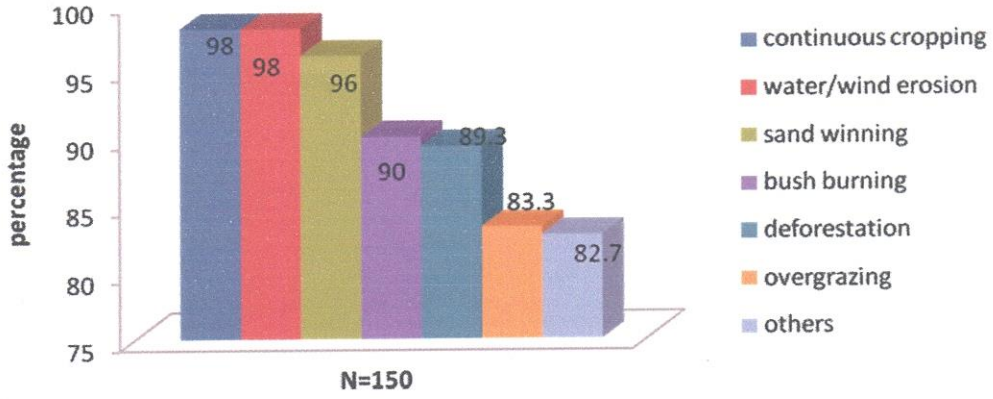
Source: Field survey, 2010

4.2.9: Traditional Leaders Understanding of the Causes of Land Degradation

These category of respondents mentioned poor and erratic rainfall, strong winds and erosion as the main natural causes of land degradation. Indiscriminate felling of trees, continuous cropping and unsustainable farming practices were widely held as the main man-made causes of land degradation. Other perceived causes mentioned were "galamesy" and quarrying and *"refusing to abide by traditions such as stoppage of drumming during September which leads to storms that destroy crops"*. The respondents' understanding of the man-made causes of degradation was generally supportive of the FAO (1994) assertion of the direct causes of land degradation which include deforestation, overgrazing, improper crop rotation and unbalanced fertilizer use.

4.2.10: Perceived Effects of Land Degradation by Land Users

Figure 14: Causes of degradation



Source: Field survey data, 2010

Figure 16 above presents land users perceived effects of land degradation. The perceived effects of degradation by land users are presented in a descending order in the histogram above. The effects mentioned by the respondents in their descending order are reduced yields (94.7%), reduced pastures (91.3%), increased cost of production (84.7Yo), reduced vegetation (79.3%), loss of productive land (65.3%), drought (60.7%) and other (10%) . The effects cited in the 'others' category generally referred to poverty, migration of youth to the south, school dropout and increased crime and promiscuity. About 94. 7 % of the land users noted reduced yield as the main effect. Respondents' perceived effects of degradation conform to the FAO (2008) findings that land degradation results in socioeconomic problems such as food insecurity, limited development and migration. Respondents' perceptions were also in line with Scherr and Yadav (1996:5) who observed that the most important on-farm effects of land degradation are declining potential yields. Furthermore, Blay et al (2007=f&3) finding

that the resultant effect of degradation is population displacement and reduced land productivity was ascertained.

4.2.11: Traditional Leaders' Understanding of the Effects of Land Degradation

Respondents' school of thought was generally that, land degradation leads to low crop yield which consequently leads to poverty and hunger. Unavailability of medicinal plants, migration of youth to the south for greener pastures and a disincentive to farming were a few of the other effects mentioned. The table 13 captures the effects of degradation as perceived by respondents. In agreement with Mortimore (1993:15) and Nkonya et al (2008:1), thirteen (13) out of the 20 traditional leaders mentioned poverty and hunger as an effect of degradation, Also, their perceptions were supportive of Blay et al (2004:2&3) assertion that land degradation leads to loss of bio-diversity- unavailability of medicinal plants.

Table 13: Traditional leaders' perception of the effects of land degradation

Perceived effects of degradation	**Frequency of occurrence**	**Percentages**
Leads to poverty and hunger	13	23.6
Results in low crop yield	9	16.4
Unavailability of medicinal plants	8	14.15
Migration of youth to south for greener pastures	5	9.1
Disincentive to farming	5	9.1
Increased cost of production	5	9. 1
Storms that destroy crops and houses	5	9. 1
Promotes growth of witch weed	3	5.5
No pasture for grazing	2	3.6
Total	**55**	**100.0**

Source: Field survey data, 2010

4.3.0: LAND USE, COMPETITIVENESS AND DEGRADATION

4.3.1: Changes in Size of Cultivated Land

Out of the 150 respondents, 41 (27.3%) indicated a change in the size of their cultivated land. And out of the 41 (2 7. 3 %), 18(4 3. 9%) indicated an increment in size of their cultivated land and 23 (56.1 %) indicated a decline in their cultivated land size. Respondent who reported a decline in cultivated land generally cited increasing population and subsequent scrabble over available land as the cause of the diminished size of their land. Land users who indicated an increment in their land size revealed inheriting more land whilst others expanded to forest land. For the respondents with an increased land size; about 55.5% (10) had the productivity of their new cultivated lands virtually the same as their previous land, 38.9% (7) had their lands been more productive whiles 1(5.6%) respondent had his land being less productive.

Land users with new cultivated lands, journeyed an average distance of 8.6 km to their farms. This was related to land accessibility and availability. With this expansion to distant lands, the ecosystem would be disturbed as fragile lands would not be spared. Farmers whose plots were nearer to their residence were more likely to apply organic matter to substitute soil nutrient loss and soil conservation structure to minimize soil erosion, because the time, and energy spent is lesser for nearer plots than distant plots.

4.3.2: Land Security

Land tenure refers to the terms and conditions under which natural resources re held and used. The concept of ‘tenure’ is a social construct that defines the relationships between individuals and groups of individuals by which rights and obligations are defined with respect to control and use of land (ECA, 2004:21).

In compliance with the FAO (1994) revelation of commonly good relationship between landlords and tenants, 86% of the 150 land users were secured with the lands they cultivated. This was because customary land tenure authority is vested in local leaders; this made a majority of farmers feel secure about the land they cultivate. It is not subject to regulation and can be held in perpetuity by farmers, and thus has not been an impediment to investing in land. Indeed, most farmers have invested in, or improved their land in terms of tree planting and the use farmyard manure. The lack of investment in the land for farmers who did not was more influenced by poverty rather than unwillingness to invest because of any insecurity of tenure.

Although the remaining 14% felt insecure with their cultivated land, only 11 3% of this proportion had conflict regarding ownership of their cultivated lands. Furthermore, 26. 7% (40) of the respondents experienced conflict over grazing rights. Out of this proportion, about 22.5% was in relation to pastoralists. A majority (77.5%) of the conflicts however involved other farmers. Conflict over land was generally resolved by the chief or "tindana". The feeling of insecurity among farmers is a disincentive to their improvement of farm lands. This will eventually lead to a decline in the productive capacity (degradation) of the land and its intended effects on the people.

4.3.3: Mean Duration of Land Use

Table 14: Duration of land use

Duration (years)	Number of land users	Percentage
0-1	6	4.23
1-2	5	3.52
3-4	1	0.70
5-6	3	2.11
7-8	3	2.11
9-10	3	2.11
≥ 10	121	85.21
Total	**142**	**100**

Source: Field survey data, 2010

Table 14 shows the duration of land use in the area. The acute shortage of land in the study area was reflected in the continuous cultivation of the same plot. This explains why on the average, farmers cultivated their plots for 9.5 years. The results confirm the finding that the practice of fallowing is virtually absent in all villages (Codjoe 2006:645; Dejene et. al 1997:23; Nkonya et. al, 2008:9). Without external inputs for soil replenishment and in the absence of soil conservation practices to restore and maintain soil fertility, the lack of fallowing results in over cultivation and soil fertility decline.

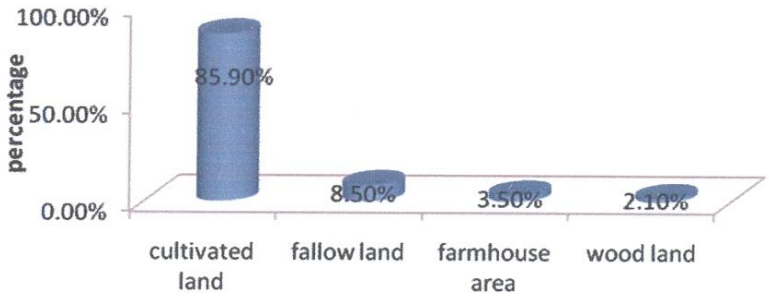
Continuous cropping means that less vegetation is able to regenerate between cropping periods. In turn, this means less protection for the soil, and a greater potential for run-off erosion. And since less vegetation will be regenerated, there will be less nutrients returned to the soil thus leading to lower fertility. Shorter fallows and continuous cropping also mean that more weed seeds remain viable than would have been after a long period under a dense cover

of vegetation. More frequent cropping can also favour the appearance of hardier weed species able to tolerate disturbance which makes weeding even more difficult. This may be the reason why some of the respondents observed the appearance of plant species such as: "winii" known also as *Striga hermothica*, "somia" or Vertiveria *zizanoides* and *digitalia horizontalts* to signify a decline in soil fertility.

4.3.4: Land Use Types

Figure 17: Land use types

N=146



Source: Field survey data, 2010

From the results, fallow lands have been greatly reduced as only 8.5% of the respondents' had their lands fallowing with 85.9% lands permanently under cultivation. This donfirms the finding that fallow periods are on the decline (Codjoe, 2006:645, Dejene et. al l997:23 and Nkonya et. al, 2008:9).

Farm houses and woodlands are not common in the area as only 3.5% and 2.1 % had their plots as farm houses and wood land respectively. This agrees with Asabere- Ameyaw et al;

(2008 :26) who noted that high population growth rate has led to the depletion of forests to expand agricultural land to produce food for the ever-increasing population, and logging to provide wood for export and domestic use-fuel wood and charcoal production.

4.3.5: Land Tenure and Acquisition ***Table 15: Land tenure and acquisition***

Land Tenure			**Land Acquisition**		
Tenure type	**Frequency**	**Percentage**	**Acquisition**	**Frequency**	**Percentage**
State owned	9	6.0	Inherited	139	92.7
Communal/ family ownership	139	9.7	Received	11	7.3
Sharecropping	2	1.3			
Total	**150**	**100**	**Total**	**150**	**100**

Source: Field survey data, 2010

The table 15 presents the types of land tenure and the mode of acquisition of such lands in the study area.

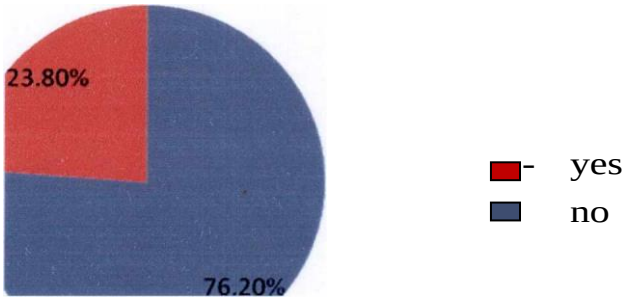
As seen in Table 15, 92.7% of respondents farmed on lands that were communal or family owned. Sharecroppers were only 1.3% whilst people who said the farmed on lands owned by the State were 6%. It was expected that as most (92. 7%) of the farmers owned their land, land conservation and management would improve with degradation on the low side. However, though most of the farmers did some invested in their land in terms of tree planting and using farmyard manure, there were still visible signs of erosion on farms. The persistence of degradation of the farms despite farmers' efforts could either be that their efforts are not enough or their strategies are not appropriate. The failure of some of the farmers the combat

the problem on their plots was more influenced by poverty rather than their unwillingness to invest in conservation measures because of any insecurity of tenure.

4.3.6: Availability and Access to Pasture by Land Users

Figure 18: Access to pasture

N=l50



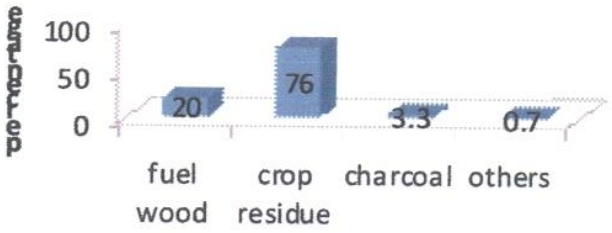
Source: Field survey data, 2010

Figure 18 indicates land users access to pasture land. Although a majority (76.2%) of the respondents had access to pasture land, only 43.8% of this proportion had access to sufficient pasture. About 57.46% of the land users grazed their pasture land by rotation. Insufficiency of pasture was the main reason why land users grazed their pasture land by rotation. Respondents who grazed their livestock by rotation had shepherds who took care of their livestock commonly cattle and sheep. Due to the growing population and land scarcity in the area, the grazing land has considerably reduced in favour of cropping land. Consequently, crop residues and hay are important sources of animal feed. The residues from crops were also not sufficient for the livestock to graze as most (64.8%) of the respondents used it as cooking fuel. The livestock therefore fed on the remaining residues denying the land of vital organic matter.

Respondents who did not graze their livestock by rotation generally had their livestock commonly goats and sheep on free range.

4.3. 7 Fuel Source of Land Users

Figure 19: Source of Fuel
N=150



Source: Field survey data, 2010

Respondents' fuel source is indicated in Figure 19. Most (76%) respondents used crop residue as fuel and as observed by Dejene et al (1997:3), this results in a considerable nutrient loss which is reflected in the widening gap between the actual and potential yield for all the major food crops in SSA. It also confirms Blench (1999:26) finding that the principal substitute for fuel wood is cereal stem and dung in the Upper East Region. Fuel wood which was expected to be the predominant fuel source was a scarce commodity used by only 20% of the respondents and this can be attributed to the emergence of desertification in the emergence of desertification in the area. About 89.3% of the respondents indicated that they face fuel shortage; this explains why they resorted to the usage of their crop residue as a principal substitute. Out of a total of 134 respondents, 68 (50.7%) cited poor crop yield, 24 (17.9%) indicated limited trees to cut for fuel wood, 21(15.7%), mentioned scarcity of land whiles 21(15.7%) cited bush burning, over grazing and population growth as the main reasons for the fuel shortage they experienced.

4.3.8: Traditional Leaders' Understanding of Land Use Competitiveness and Degradation

Twelve (60%) of the 20 traditional leaders explained land use competitiveness as *'Struggle for land by so many people for farming, grazing and construction".* Six (30%) of the respondents also saw land use competitiveness as *"Land scarcity due to overpopulation resulting from high birth rates".* The remaining 2 (10%) respondents had no idea about land use competitiveness, portraying some level of ignorance by the respondents about competitive land use.

On the links between competitive land use and degradation, respondents' predominant perception was that, *continuous cropping resulting from competitive land use causes degradation.* Others had the notion that competitive usage of land leads to *destruction of sacred grooves and forest reserve with consequent deforestation.* As revealed by Azam et al. (2008:56), Asabere-Ameyaw et al. (2008:26-31) and Foley (1991:23), neither of these perceptions was wrong. The two respondents who had no idea about competitive land use could not also establish any link between competitive land use and degradation. Significantly, the ignorance portrayed by some (10%) of the respondents could have direct effects on land degradation in their respective communities since as traditional leaders they should lead intervention efforts against degradation in their communities.

4.3.9: Agencies' Perception of Population and Competitive Land Use

All respondents of the agencies answered yes to population having an influence on land degradation. The respondents were more Neo-Malthusian in their views with regards to

population and competitive land use. Generally, they stated that the increasing population density in the district puts pressure on the already less available natural resources. In addition, inhabitants have cultivated the same piece of land continuously over the years; this has definitely put stress on the land making it lose its productivity. On their experience with regards to degradation, they observed that there is general destruction of vegetation, overgrazing, fragmentation of land for cropping and housing units and inability of farmers to adopt conservation agricultural practices.

4.4.0: FARMING PRACTICES

4.4.1: Tillage practices of Land Users

Figure 20: Tillage practices
N=150

Source: Field survey data, 2010

Figure 20 presents the tillage practices of land users in the district.

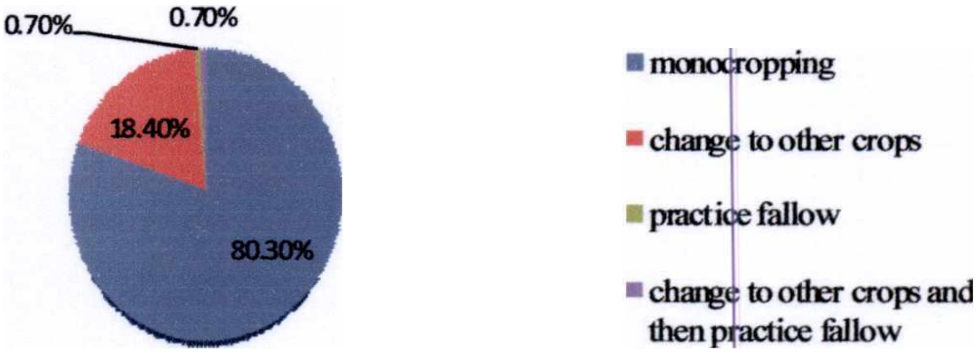
Tillage methods and soil surface management affect sustainable use of soil resources through their influence on soil stability, soil resilience, and soil quality. According to PACA (2010:3), tillage practices also cause degradation more directly; when soils are excessively tilled; soil structure is destroyed, adversely affecting their capacity to retain and transmit water. From the results, about 48.6% of the respondents used hand labour to till their land. About 43.0% tilled

their land with drought power whilst less than 1 % employed tractor service. The FAO (2005: 19) asserts that ploughing or discing such as the drought power used by respondents could exacerbate the pulverization of the soil, causing the soil surface to crust more easily, leading to greater water runoff and erosion. This is exacerbated by reduced soil surface roughness, which leaves few depressions for temporary storage of water during intense storms. The effect of tillage was however expected to be minimal as a cumulative majority of the respondents either used hand labour or practiced zero tillage.

The hoe remains most important farming tool in the study area, but drought power/bullock farming (4 3. 0%) is becoming more popular, as a result of the efforts of organizations working in the district. Even though the hoe was used for land tillage by respondents who used hand labour for tillage, it was a common tool for weeding and loosening the earth by all the respondents. Actually, it is more than a farming tool. It is a symbol of masculinity and it is an important aspect of the culture of the people. Although poverty remains one reason why respondents used the hoe for tillage, it is worth noting that most of the respondents preferred using this tool because it is better worked with. It slides through the soil easily and digs up only the fertile soil (which is thin) where as a plough would go so deep and dig up the infertile soil, which would be bad for the crops.

Azam et al (2008:56) contends that zero tillage as practiced by 7.8% of the respondents can reduce or eliminate surface crusting, increase filtration, lower bulk density, improve porosity and soil strength and consequently reduce surface runoff and soil loss whiles increasing crop yield.

4.4.2: Cropping System



Source: Field survey data, 2010

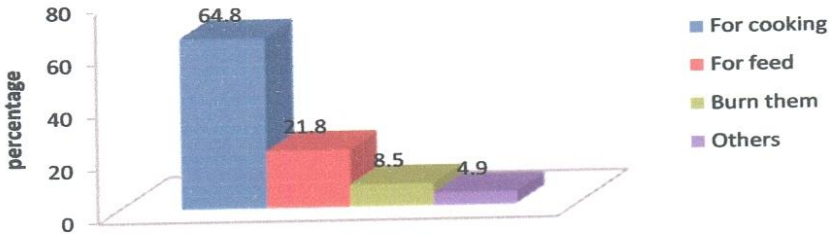
The figure 21 depicts the cropping system practiced by land users.

Continuous monocropping of millet is the usual practice and fallowing is rarely practiced. More than 80% of the respondents were engaged in monocropping of millet or sorghum. The millet is usually grown in two stages, the early millet grown around April/May and the late millet planted around August/September. Land users reported that because of' high soil erosion and degradation of cultivated land, the yield per hectare of all crops has declined as compared to what they obtained ten years ago. Less than 1 % practiced fallowing and about 18.4% switched from the usual crops they cultivated to other crops. As noted by Azam et al (2008:56), any type of cropping system does have effects on the soil quality (i.e.; chemical, physical and biological soil properties and processes). The effects can be either favourable or unfavourable, enhancing or deteriorating the soil properties. The continuous monocropping of millet and sorghum may therefore have severe degradation consequence on the farms.

About 24.5% of the respondents had farm lands that were out of crop productibn. On the average, 3 acres of farm land was out of crop production.

4.3.3: Usage of Crop Residue by Land Users

Figure 22: Uses of crop residue



Source: Field survey data, 2010

The figure 22 presents how respondents use crop residue.

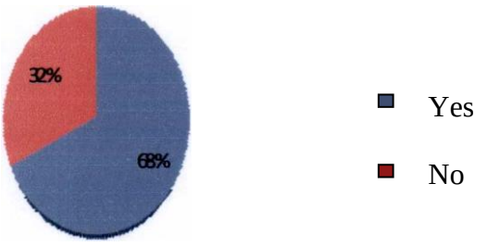
Much of the crop residue of the farmers was not left to decompose and replenish soil nutrients as most (64.8%) of the famers used the crop residue from their farmlands as fuel for cooking at home. About 21.8% used the residue as feed for livestock. Again, 8.5% of the respondents burnt the crop residue on their farms during land preparation. Only 4.9% put their farm crop residue into other uses, such as compost preparation for soil fertility improvement. Most rural communities in the District would have depended mainly on wood for fuel as they do have access to other sources such as charcoal and gas. And even where they can access them from neighboring Bolga District, they are not able to purchase because of their low economic status. Thus the shortage of fuel wood influenced the shift to the use of crop I residue. But

respondents' removal of crop residue as noted by the FAO (2005: 17) impoverishes the soil as it is no longer possible to recycle the plant nutrients present in the residues. This possibly led to a reduction in the fertility of the land which respondents experienced. The results also confirm the finding that population growth is associated with reduced use of manure and compost, probably because population pressure increases demand for manure as a fuel (*ibid*)

4.5.0 LINKS BETWEEN POPULATION PRESSURE, COMPETITVE LAND USE AND DEGRADTION

4.4.1 Population Pressure

Figure 23; Population Pressure
No. = 150



Source: Field survey data, 2010

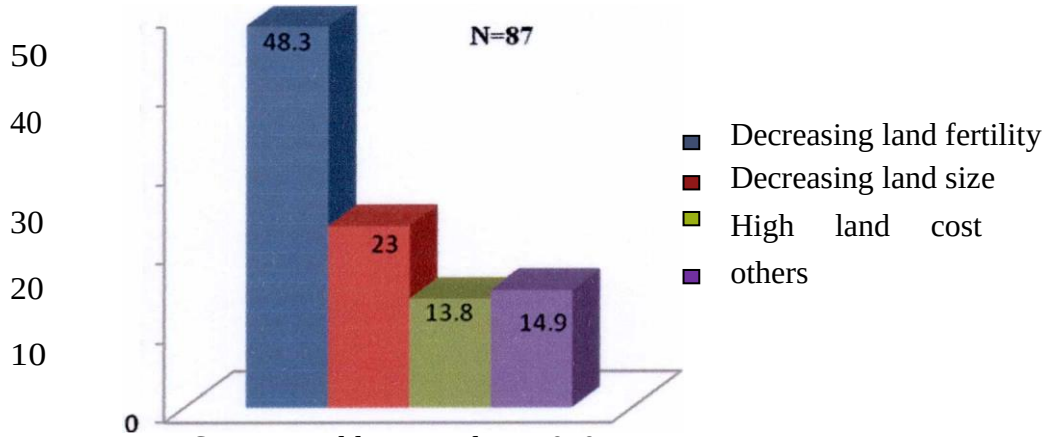
As shown in Figure 23, a majority (68%) of the land users confirmed increasing population pressure in their communities. The results were in line with the provisional results of the Ghana Population Census 2010 which indicates that there is an increasing pressure on land by population. The population density almost doubled from 52 in 1984 to 102 persons per square kilometer in 2010. In the Upper East Region, the population density increased from 77 in 1984

to 117 persons per square kilometer in 2010. About 75.6% of the land users also acknowledged that population pressure had implications for land use. Furthermore, about 67.3% of the respondents revealed there was competition for land usage in their various communities. The land users generally cited increasing population pressure for the competition for land in their communities. This explains the respondents' smaller farm sizes observed in Table 5, the continuous cropping, the lack of fallow periods as observed in Figure 18 and fuel shortage experienced by the respondents.

4.5.2 Population Pressure and Degradation

Majority (58%) of the land users agreed that there was a link between the increasing population and land use that results in degradation. About 48.3% of the respondents who stated that there was a link between population and land degradation mentioned decreasing soil fertility as the main effect. This confirmed Azam et al (2008:56) findings that increasing pressure on land has led to marked losses in soil fertility and soil organic matter which leads to the degradation of soil structure. The other effects enumerated by respondents as the effects of population on land were decreasing land size (23%), increasing cost of land (13.8%) and others (14.9%). The effects in the others category included increased felling of trees (deforestation) and migration of youth in search of greener pastures from the south. The land users' opinion about the effects of population pressure on competitive land use and degradation are demonstrated in the histogram below.

Figure 24 Effects of population increase on Land



Source: Field survey data, 2010

4.5.3 Traditional Leaders' Perception of How Population and Land Degradation are linked.

Respondents' widely held perception was *"continuous cropping on a parcel of land and indiscriminate and increased felling of trees as a result of population increase"*. Respondents' perceptions of the linkages are presented in Table 18 (below).

Table 16: linkages between population and land degradation

Respondents perception of linkage	Frequency of occurrence	Percentage
Continuous cropping on a parcel of land	8	40.00
Indiscriminate and increased felling of trees as a result of population increase	6	30.00
Intensive land usage	3	15.00
Increase in population means more herbs cut down resulting in degradation	3	15.00
Sand winning and increases with population resulting in degradation	3	15.00
Destruction of sacred grooves and forest	1	5.00

4.6.0 STRATEGIES TO COPE WITH LAND DEGRADATION

4.6.1 Land Users Soil Erosion Control Strategies

Table 17: soil erosion control

Control strategy	Frequency	Percentage
Terracing	8	5.3
Strip cropping along contour	4	2.7
Bunding and terracing	19	12.7
Vegetative cover and terracing	42	28.0
Tree planting and others	29	19.3
Compost/manure	148	32.0
Total	**150**	**100**

urce: Field survey data, 2010

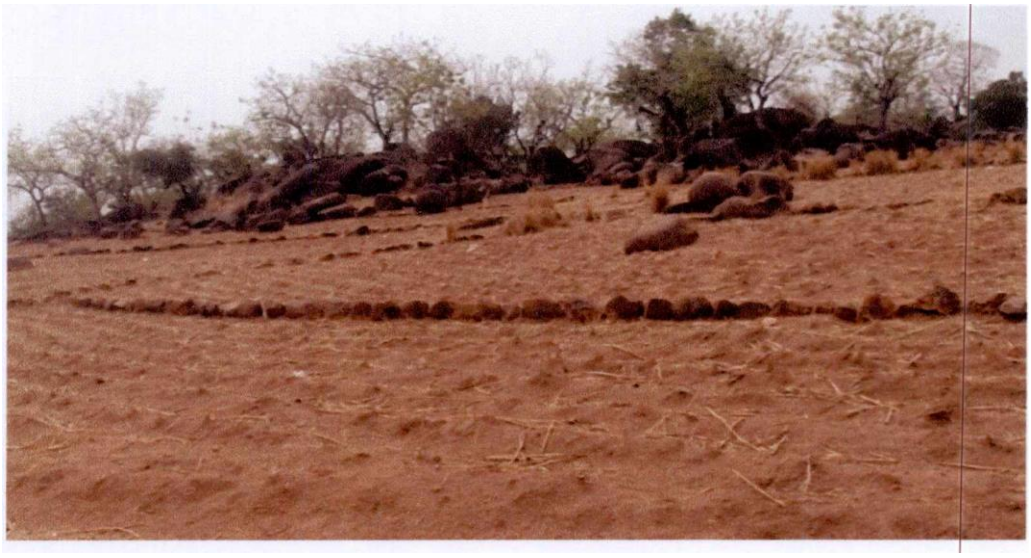
Source: Field survey data, 2010

Table 17 indicates the strategies land users adopted to curb degradation on their farms. Most (32%) of the respondents used compost and manure in their efforts to curb erosion on their farms. The manure respondents applied was generally droppings from livestock such as sheep, goats and cattle. Although a few of the respondents prepared compost from crop residue for application on their fields, compost was not common with the respondents as much of the crop residue was used as fuel at home. But according to the FAO (2005:37), the compost and manure applied could improve fertility and the water holding capacity of their soil

The vegetative cover utilized by 28% of the respondents was predominantly cowpea which was intercropped with millet and guinea corn. The FAQ (2005:38) and Diao and Sarpong (2007:23) contend that this strategy can reduce soil erosion rates close to the regeneration rate of the soil or even lower. About 19.3% of the respondents planted trees, mostly mango and a

few neem trees on their farms. Even though the trees were mostly for food and shade Bandyopadhyay (1997:44) states that the trees can help in the maintenance of fertility through addition of organic matter and nutrients to soil. In accordance with Gebreegziabher et al (2010:1), respondents augmented their income through sales of fruits and wood products from trees on their farms. Bunding and Terracing was another strategy employed by some respondents (123%) to curtail erosion on their farms. Bunding was commonly done by lining up stones along the contour. Terracing though not common was used to farm hilly grounds and was done with graduated steps. The stone bunding was not only for checking erosion but gaining access to the land to cultivate as much of the land is occupied by rock. The figure 25 (below) depicts some strategies used by farmers to cope with the problem of degradation. Strip cropping along contours was used by only 2. 7% of the respondents and involved planting crops in rows across slopes.

Figure 25: Stone bunding on a farm



Source: Field Survey, 2010

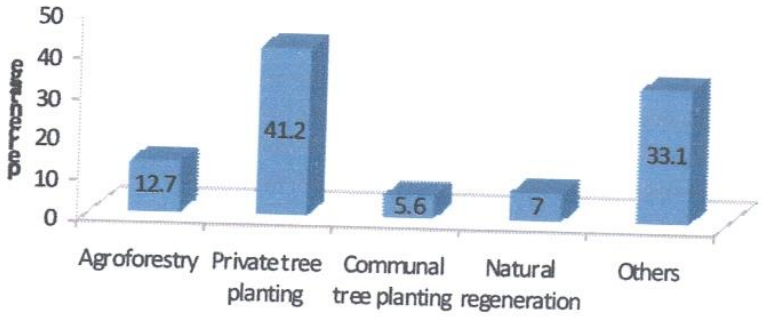
Figure 25 shows the strategies a farmer is using to combat degradation. Since a large proportion (about 40%) the land is covered by rocks, the farmer has no choice but to cultivate

in-between rocks and on a sloppy land. The land user is seen to employ stone bunding,

ploughing along contours and leaving crop residue on farm to replenish soil nutrients.

4.6.2 Land Users' Strategies to Curb Degradation on Land

Figure 26: strategies to curb land degradation



Source: Field survey data, 2010

The predominant strategy (41.2%) land users adopted on their farms to curb degradation was private tree planting. Agroforestry and communal tree planting were 12.7% and 5.6% respectively. About 33.1% of respondents employed other strategies such as the application of manure/compost and the use of mulching. Manuring and mulching are effective in replenishing soil nutrients (FAO, 2005:35-37; Diao and Sarpong; 2007:23 and Azam et al. 2008:56). Natural regeneration in the form of fallowing was the other strategy land users adopted on their farms to improve soil fertility (FAO: 37-38). Respondents' strategies in curbing degradation on their farms are presented in Figure 26.

4.6.3 Traditional Leaders' Perception of Coping Strategies That Could Be Adopted to Prevent Degradation on Arable Land

The predominant perception of respondents on coping strategies that could be adopted were manure/compost application, tree planting in the farm , growing grass to check erosion and avoidance of bush burning. Respondents' perceptions of coping strategies which could be adopted are represented in the Table 20.

Table 18: Coping strategies which could be adopted to prevent degradation on arable land

Respondents' perception	Frequency of occurrence	Percentage
Avoidance of bush burning	15	75.0
Manure /compost application	11	55.0
Growing grass to check erosion	8	40.0
Avoidance of tree felling and planting trees in the farm	6	30.0
Peeling instead of cutting medicinal plants to prevent extinction	1	5.0
Crop rotation	5	25.0
Stop people from drumming during September	1	5.0
Community bye-laws that prevent people from cutting down trees and bush burning	1	5.0

Source: Field survey data, 2010

Note: Percentages add to more than 100% since each respondent had 1 or 2 different perceptions.

4.6.4 Traditional Leaders' Perception of Coping Strategies That Could Be Adopted on Already Degraded Lands

Respondents mentioned utilization of crop residue as compost/manure or application of organic manure as the strategies which could be adopted. This was however contrary to results from the land users where about 64.8 % of them utilized the crop residue as cooking fuel instead of compost/manure as seen in Figure 23. Other strategies mentioned were tree planting to check erosion, fallowing, crop rotation and good farm practices.

4.6.5 Agencies Perspective on Coping Strategies

On coping strategies land users could adopt to conserve land, the agencies recommended:

- Fertility improvement innovations such as the use of compost
- Physical erosion control measures such as stone and grass budding and ploughing along slopes.
- Reclamation through terracing and agro forestry
- lntercropping in place of the continuous monocropping
- Cultivation of cover crops

Their recommendations for already degraded lands were not different from their recommendation on coping strategies land users could adopt to conserve land.

4.6.6 Land Users' Soil Fertility Enrichment and Management of Degradation

The maintenance of soil organic matter levels and the optimization of nutrient cycling are essential to the sustained productivity of agricultural systems. About 88 % of the land users confirmed using soil fertility enrichment methods on their farms. The predominant

enrichment method used by famers (61.3%) was application of organic manure to farms. As noted by the FAQ (2005:35), and Diao and Sarpong (2007:22) organic matter influences the physical conditions of a soil in several ways. About 21.1 % of the land users applied mulch/compost. Respondents' enrichment methods are presented in Table 21.

Table 19: Soil enrichment methods

Management method	Frequency	Percentage
Use of fertilizer	15	10.6
Use of manure	87	61.3
Intercropping	3	2.1
Mulch or compost	30	21.1
Agro forestry	2	1.4
Others	5	3.5
Total	**142**	**100**

Source: Field survey data, 2010

The FAO (2005:30) indicates that mulching adds organic matter to the soil, reduces weed growth, and virtually eliminates erosion during the period when the ground is covered with mulch. Although very few people (2.1 %) employed intercropping, Azam et al (2008:56) contends intercropping could protect the land against soil erosion.

4. 7.0: Findings of Focus Group Discussion

Group discussions were organized to obtain more information on the problem of degradation in the District. The discussion involved both men and women but they were put into different groups. This was done because the author was of the view that people would feel more comfortable to speak out their views and not be intimidated if they were in the midst of their fellow males or females. The discussion basically centered on their understanding on the causes and effects of degradation, land use competitiveness, the linkage between population and degradation, coping strategies and recommendations on how the problem could be solved. The results of the discussions are presented in the table 20.

Table 20: Results of focus group discussion

Focus Group l (Male)	**Focus Group 2 (Female)**
Concept and causes of degradation: A degraded land is one that does not have nutrients to support plant growth and good crop yield.	***Concept and causes of degrada1on:*** A land is said to be degraded when it does not support good crop yield
Causes: •Continuous cropping •Bad land preparation such slash and burn •Indiscriminate felling of trees •Sand winning and fetching of gravel for building	***Causes:*** •Burning of plant residues •Felling of trees •Bush burning •Poor and erratic rains
Effects of degradation: The group arrived at poverty and hunger as the main effect of land degradation. Others effects identified were:	***Effects of degradation:*** The group also identified poor harvest and hunger as the main effect. The other effects identified were:

• Disincentive to fanning • Increased cost of fanning • Migration of youth to the south • School dropout as a result of poverty	• Loss of production land • Reduced pasture • Reduced vegetation
Land use competitiveness: Struggle for land for various uses such as grazing, farming and building was identified as competitive land use.	*Land use competitiveness:* The group concluded that competitive land use involves sharing the least available land with many people for fanning and building as the population increases.
Linkage between population and degradation: Fallow periods have been eradicated as increased population competes for the available land. It has also resulted in deforestation as more forest is cut down for fanning.	*Linkage between population and degradation:* Population increase has result in increased felling of trees for fanning and nstruction and the fanning of marginal and grazing lands resulting in degradation.
Competitive land use and degradation: Land is put under intensive use and not allowed to fallow resulting in fertility loss, erosion and subsequently degradation.	*Competitive land use and degradation:* Leads to cutting down of trees for farming and building, this results in deforestation and degradation.
Coping strategies on degraded lands: The group identified the following coping strategies: • Planting of grass at the edges of the land to check erosion • Composting and application of animal dropping such as cow dung • Crop rotation.	*Coping strategies on degraded lands:* The group also identified the following coping strategies: • Open up water paths to ~low easy water flow • Composting • Farm yards manure application

Strategies to prevent degradation on arable land: Their recommendation on the topic was not much different from the coping strategies they identified for already degraded lands. They however identified avoidance of bush burning and tree felling as an important factor.	***Strategies to prevent degradation on arable land:*** In addition to the coping strategies for already degraded lands, the group also identified : Ploughing across the contour or slope to reduce runoff and water erosion.
Recommendations: The group recommended soil fertility improvement programmes and advocacy on land degradation	***Recommendations:*** The group also recommended soil fertility improvement programmes and support to famers

Although the two groups had their separate views on the issues, some views were common to both sides. For instance, on the causes of degradation, both groups agreed that felling of trees and bush burning contribute to the problem of degradation. Again both groups were of the view that increase in population has resulted in an increase in deforestation leading to degradation. Both groups identified the application of compost as a coping strategy that land users could use to deal with the issue of degradation. The groups both recommended soil fertility improvement programmes as a solution to the problem. However as the men's group further recommended advocacy programmes, the women's group recommended that various forms of support be given farmers to combat degradation.

Both groups had different views on the effects of degradation on their families and communities. While the female group mentioned effects such as loss of productive land, reduced pastures and reduced vegetation, all of which have a direct bearing on the/ land and availability of food for the family, the views of the male group centered on how degradation

- affects them as land users (increased cost of farming and disincentive to farming) and their youth (migration of youth to the south and drop out of children from school as a result of poverty). Their views agree with those of Ontoyin (1993) cited in IFAD (1992) that when a land is severely degraded, its inability to provide ecosystem functions and services leads to a loss of environmental, social, economic and non-material benefits that are critical for society and development.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1.0 SUMMARY OF CHAPTER ONE

Rapid population growth and low economic standards of living have had consequences for agricultural land resources in Ghana (Codjoe, 2006:645). Fallow lands have been reduced or eliminated. Asabere-Ameyaw et al (2008:29) indicate that the high population growth rates have increased the demand for housing. This together with other developmental projects like road construction and both conventional and unauthorized mining activities has led to serious land scarifications.

The FAO (1992:30) states that lack of control over resources, population growth, lack of alternative avenues of livelihood and inequity are all factors contributing to the degradation of natural resources. In turn, environmental degradation perpetuates poverty as the poorest attempt to survive on a diminishing resource base. The World Bank (1992:3&7) emphasizes that rapid population growth exacerbates the mutually reinforcing effects of poverty and environmental damage. According to the World Bank, poor families who have to meet short term needs mine the natural capital by excessive cutting of trees for firewood and failure to replace soil nutrients. The poor are both victims and agents of environmental damage,

Agriculture is the main stake of the Bongo District. The district is characterized by large household size, high population growth and high fertility rate. Despite the increasing population in the district, there are no substantial areas of usable, unused land i the district.

The scarcity of land in the district is aggravated by the presence of rocks on about 40% of its land surface (BDA, 2006). These two primary forces (limited land resources and increase in population pressure) combine to produce land shortage and competitive use of the existing land. The increasing pressure on land, resulting in small farms, low production person and increasing landlessness in the district cannot be understated. A consequence of landlessness is the next element poverty (FAO, 1994).

The problem that attracted the focus of this research is land degradation in Bong1 District as a result of increased population, land scarcity and competitive use arrangements. The study basically delved into the linkages between Population Growth, Land Scarcity and competitive use in Bongo District.

Land degradation leads to decrease in yields and eventually hunger and poverty, there is the need to find ways to mitigate the problem. The study seeks to contribute to existing knowledge on interactions between population growth, land scarcity and competitive use with a focus on the Bongo District of the Upper East Region of Ghana. The study involved people and organizations with a stake on land use. It is that the opinions and views gathered during the research process would be of immeasurable value in policy formulation, implementation and development process in general. The study which involved the use of the participatory Rural Appraisal (PRA) tools is expected to help the increasing population adopt coping strategies to minimize the problem of land degradation.

5.2.0 SUMMARY OF CHAPTER TWO

The chapter reviewed the previous works and studies of different scholars that are relevant to the subject of degradation under study and thus obtained some facts that provided the context within which this study was made more comprehensive.

Dei Congressi (2009:5) contends that landlessness and land fragmentation are growing worldwide and the FAO (2008) asserts that land use is a major driving force of land degradation.

According to Giller et al (2008:1), competing claims on natural resources become increasingly acute, with the poor being most vulnerable to adverse outcomes of such competition. They contend that land use is largely influenced by a number of factors, the main ones being climate, socioeconomic (culture and population dynamics) and government policies. Many authors argue that the growing population requires increasing area for agricultural production and hence, large areas of forest land are opened up. Population pressure also cause farmers to abandon conservation measures. There have been counter arguments against the population-poverty hypothesis. For example, Tiffen et al (1994) argues that increasing population growth has led to the rehabilitation and profitability of degraded, unproductive lands.

Malthus hinted a relation between population growth and impoverishment. According to Malthus, population is reaching the point when the food supply is reaching exhaustion. Malthus says the extra people have to die. Boserup argues that under pressure of numbers, with more mouths to feed, people put more labour and more intense effort into feeding themselves. They cultivate the land more intensively; they add extra manure, extra fertilizer, extra water and improve their crops. They invent their way out of the Malthusian crisis.

5.3.0: SUMMARY OF CHAPTER THREE

The Bongo district is predominantly rural and is characterized by large household size (9.2), high population density and high fertility rate. According to the Ghana Statistical Service (2000), the district has a population of 77,885 (36,299 males, 41,586 females) in an area of

459.5 square km. Thus the average population density is about 169 persons per square km as compared to the national population density of 79 .30 persons per square km. The population growth rate of the district is 2.8% (BDA, 2006).

The research design adopted for the study is the Descriptive Survey Research Design. The survey entailed the use of questionnaire and PRA tools such as interviews, key-informants, observation and focus group discussions. Both qualitative and quantitative methods were used in the data analysis. The qualitative analysis involved descriptions while quantitative analysis involved the use of SPSS (Statistical Package for Social Scientists).

5.4.0: SUMMARY OF CHAPTER FOUR

- The findings of the study revealed that majority of households were headed by males but there was a developing phenomenon of female household heads indicating the recognition of women in the area and the possibility of women taking part in decisions regarding land.
- The Modal age of respondents was 41-50. However majority of farmers fell within the active working group suggesting the availability of labour for the implementation of land conservation technologies.
- There is high illiteracy rate among farmers. The farming sector in the study area is not able to attract the educated. This may be due to the negative perception that farming is for the uneducated. Though this perception may be changing, it is picking up rather slowly. Given the general perception that there is a positive relationship between levels

of education and the adoption of innovation, this revelation affects /the sector negatively.

- Average household size in the study area was found to be 10 people, average size of cultivated land was 3.4 acres (i.e. 1.36 hectares), and the most cultivated crop was the guinea corn. The goat was the most reared animal.
- The study revealed that the problem of degradation affected all farmers (94.7%) and also was prevalent in the District. Continuous cropping, erosion, sand winning, bush burning, deforestation and overgrazing were the perceived causes of degradation.Farmers reported a decline in the fertility of their soils. Also, most farmers were engaged in continuous monocropping of millet or sorghum. Monocropping may be a contributing factor to the decline in the fertility of the soil. Land users mentioned reduced yields, reduced pastures, increased cost of production, reduced vegetation, loss of productive land and drought as the effects of degradation. Low fertility, erosion, erratic rainfall pattern, lack of manure, disease infestation and weed infestation (*striga hermonthica)* attributed for the poor yields.
- The main land use type was cultivated land with fallow periods almost eliminated as the land users cultivated their plots continuously for an average of 9.5 years. This also gave an indication of land scarcity. The continuous cropping on their plots led to the emergence of harder weed species such as *striga hermothica*, *Verttveris zizanoides*, and *digitalia horizontalis* which made weeding of their plots more difficult and which also caused the fertility of the land to decrease.
- The study found that the area experienced poor/erratic rainfall and hunger. This may be an indication of environmental destruction. Furthermore, the poor/erratic rains could signify desertification in the area. This could also mean that the study area is drought

prone. Although respondents had coping mechanisms which included: sale of assets such as animals for ready cash, small scale irrigation, basket weaving, borrowing and adjustment of diet to the prevailing food insecurity situation, respondent were still nutritionally insecured as their strategies (coping mechanisms) were inadequate to absorb nutritional shocks. This placed the vulnerable group particularly children under five, pregnant and lactating women and the elderly more at risk.

- With regards to land tenancy and acquisition, most respondents acquire their land through inheritance. Tenancy arrangements such as sharecropping and state owned lands were few. It was observed that plot ownership arrangement had influence on land users with regard to land management. The extent to which farmers were willing to apply fertilizer and make other investment on the land was to some extend determined by ownership. Farmers who owned their plots felt better secure than those who were sharecropping or renting. When the farmer feels insecure, the household operating the plot may have less incentive to invest in land improvement.
- Majority of land users (86%) felt secured with the lands they cultivated. this may be partly because in customary land tenure, authority is vested in local leader; this made a majority of farmers feel secure about the land they cultivate. It is not subject to regulation and can be held in perpetuity by farmers, and thus has not been an impediment to investing in land. Indeed, most of these farmers had invested in, or improved their land in terms of tree planting and application of compost or manure. The lack of investment on soil improvement strategies for some of these farmers on their plots was more influenced by poverty rather than their unwillingness to invest because of any insecurity of tenure.

- A rather few land users felt insecure with regards their cultivated land. Another small proportion of land users confirmed they had conflict regarding ownership of their

cultivated lands or over their grazing rights. Conflict over land was generally resolved by the chief or the "tindana" (land priest).

- A large number (76.2%) of the land users had access to pasture land, however, only 43.8% of this proportion had access to sufficient pasture land. This implied that grazing land has dwindled in favour of crop land and thus crop residue hay were important sources of animal feed.
- Many respondents (76%) use crop residue as fuel and this contributed considerably to nutrient loss which reflected in the widening gap between the actual yield of crops.
- Fuel wood which was expected to be the predominant source of fuel was used by only 20% of respondents. This phenomenon can be attributed to the emergence of desertification in the area. This was confirmed as majority of respondents (89.3%) faced fuel shortage. Shortage of fuel wood and other woods and desertification among others are the main consequences of land degradation which impact negatively on human livelihoods and on the environment.
- The study revealed an increasing population pressure in the study area. Respondents acknowledged that population pressure had implications for land use which include expansion of agriculture into fragile areas and reduction or elimination of fallow periods.
- The use of manure and other fertilizers, intercropping, mulching, composting and agroforestry were mentioned as methods that could be used to mitigate degradation.

- Some Governmental and Non-Governmental Organizations have already carried out some work on land management and environmental issues in the study area. These included afforestation programmes, public sensitization and education on effects of indiscriminate tree felling and importance of community tree planting projects, erosion control campaigns, soil and water conservation through earth and stone bunding and grass stripes, protection of water bodies and rejuvenation of sacred groves.

5.5.0: REVISITING RESEARCH QUESTIONS, OBJECTIVES AND PROBLEM

- The first research objective *"To identity the natural and man-made causes as well as effects of degradation"* relates to the research question, *"What are the causes and effects of degradation?"* From the findings, respondents revealed that bad farming practices, indiscriminate tree felling and bush burning, continuous cropping and overgrazing by animals on free range, deforestation, sand winning, poor and erratic rainfall pattern, climate change, human settlement and road constructions, breakdown of traditional systems and inappropriate interventions from central government as people are not held accountable for their actions were the main causes of degradation in their communities. With the exception of climate change and continuous cropping, all others causes of degradation were attributed to human factors.

The effects of degradation were given as disincentive to farming, increased cost of farming, reduced yields, loss of productive land, reduced pasture and vegetation, unavailability of medicinal plants, growth of weeds, drought, storms that destroy crops and houses, migration of youth to the south for greener pastures, and school dropout as a result of poverty.

- The second research objective *"To assess the implications of population pressure on land degradation* "links with the question *"What are the implications of population pressure on land degradation?* From the study, majority of land users (68%) confirmed increasing population pressure in their communities. From reduced land size, reduced or eradication of fallow periods, losses in s matter, destruction of sacred grooves and forest and increasing cost of land (plots) were mentioned as the implications of population pressure on land.

- The third research Question, *"What are the implications of land use competitiveness on land degradation?"* relates to the objective *"To assess the implications of land use competitiveness on land degradation"*. From the results of the study, respondents' predominant perception was that continuous cropping resulting from competitive land use causes degradation. Others had the notion that competitive usage of 1and leads to soil infertility, the destruction of sacred grooves and forest reserves with consequent deforestation. Thus conclusively, competitive land usage has implications on the degradation of land.

- The fourth research Question, *"Is there any link between population pressure, land use competitiveness and land degradation?"* links the research objective *"To establish the link between population pressure, land use competitiveness and land degradation"*. From the findings, this objective was achieved. It was established that there is a link between population pressure, competitive land use and land degradation. Increasing population with fixed land size (land does not increase or grow) results in competitive use of the land resource that in tum causes decrease in individual or family farm size, continuous cropping (leading to infertility), reduced vegetation and pastures, the use of

crop residue for fuel (resulting in nutrient depletion), clearing of forest for farms and buildings with the end result being degradation.

- The fifth and last research Question, *"How can land degradation be minimized with the increasing population?"* Relates to the research objective *"To identify coping strategies that could be adopted by the increasing population to minimize land degradation"*. Respondents mentioned the following as coping strategies that could be used to minimize land degradation: Planting of grass at the edges of the land to check erosion, composting and application of animal dropping such as cow dung on farms to replenish lost nutrients, crop rotation, open up water paths to allow easy water flow so as to prevent erosion and the practice of agro-forestry.

5.6.0: RECOMMENDATIONS

This section presents the recommendations given by some of the stakeholders; their views on what they think if done could help solve the problem of land degradation in their communities. Also recommendations based on the findings of the research are also presented.

5.6.1: Recommendations by Traditional Leaders

- *The traditional leaders recommended that GO 's and NGO 's working in Bongo as well as opinion leaders should carry out intensive sensitization and advocacy in communities on the causes and effects of land degradation:* It is believed that some people of the district are either ignorant or have down played the gravity of the problem. Land degradation can go unnoticed until there are rills and gullies on farms and lands. This is the stage when land users release the existence of the problem. Besides this, the behaviour of people makes the land vulnerable to degradation;

cultivation along slopes, bush burning, sand winning and deforestation. Sensitization of the people is therefore necessary if any headway is to be made in curbing the problem.

- *Empowerment of traditional leaders to enforce bye-laws that prevent destruction to the environment:* The traditional believed that because of western education, Christianity and Islamic religions, Africa spiritual and socio-cultural structures are broken down. As a result of this traditional institutions are no more respected. Also the perception that Government should be in charge of the enforcement of laws in a modem society leaves traditional leaders powerless. It is therefore necessary for government to empower traditional leaders to enable them enforce laws regarding the environment. This if done will provide an effective strategic against bush burning, deforestation and others that contributed greatly to land degradation.
- *Agricultural conservation programmes and support from organizations that would enable their people to enrich their lands and thus increase yield:* The traditional leaders also recommended that organizations in the district should institute land conservation programmes as well as give other forms of support e.g. fertilizers and credit to land users to enable them to improve the fertility of their lands and thus increase yields.
- *Encouragement of communities to embark on massive tree planting programs:* The district been in the savanna zone coupled with the increased need for fuel wood with the increased population has led to the felling of more trees compounding the problem of fewer trees. Trees play a significant role in the maintenance of the carbon cycle, retention of soil moisture, soil fertility improvement, providing shade as well as food (fruits) and keeping the environment cool. The presence of trees is therefore necessary

for the survival of humans. It was in the light of this that the traditional leaders recommended that GO's and NGO's working in the district should help them encourage communities in the district to embark on massive tree planting.

5.6.2: Recommendations of Agencies

- *A collective voice, effective collaboration and networking by organizations on issues of land degradation:* There is a biblical saying that "one will chase a thousand but two ten thousand". Literally meaning that when people collaborate or work together, their output or achievement will be greater than what they would have achieved if they worked as individuals. The fight for the land and against the problem of degradation will be more effective if organizations working in the district to help solve the problem worked together. It was recommended by the agencies that both GO's an NGO's in the district should collaborate and network effectively as well as have a collective voice on issues of land degradation for greater and positive outcomes.
- *Awareness creation and sensitization programmes for land users:* The agencies recommended that government and its partners should establish awareness creation and sensitization programmes for land users on the causes, effects and control of the problem of land degradation as well as how serious the problem is in the district. It is believed that constant education and reminder of the people on the issue is very necessary in solving the problem. Also, anti-bush burning clubs/committee should be formed in every community, equipped and motivated to work. Government in collaboration with the traditional leaders should institute an award scheme for the best conserved community to encourage land users as well as non-land users to work at conserving their environment.

- *Adequate financial and technical support for grass-root organizations which could enable intervention programmes achieve the desired impact:* It was recommended that government and her partners give adequate financial and technical support for grass-root organizations involved in carrying out intervention programmes in the Bongo district. This would enable them work effectively as well as expand their scope for the desired impact to be achieved.
- *Support for sustainable agricultural practices:* It was again recommended that government and its partners provide support in the form information on farming methods that sustain the environment or in other words that are 'environmentally friendly'. Training and motivation of land users to adopt conservation farming practices such as earth bunds, stone bunds, live fences, grass stripes, terracing among others. Also support in the form of bullock or tractor should be given to help reduce the time and energy that would be spent by farmers in carrying out these activities manually which may eventually lead to its failure. Government was encouraged to subsidize agricultural inputs e.g. fertilizers, pesticides and ensure that farmers really benefit.
- *Sensitization and support for the use of improved fuel-saving coal pots and cooking stoves:* Improved low cost cooking stoves are more efficient in terms of fuel usage than the traditional or conventional stoves. These stoves are made locally with earth being the raw material and they help reduce the time and labour spent by women in collecting firewood. Since it saves fuel, it means less fuel wood will be required and so deforestation will be reduced. It is therefore important that government and its partners promote the use of this stove as well as provide support for it to be manufactured and sold at a very affordable price for every household to be able to acquire and use it.

5.6.3 Research Recommendation

Reducing the pressure on available land: The research revealed that majority of the respondents (land users) depend on the land for their livelihood. With increasing population and scarcity of land, there is pressure on the land leading to degradation and decreasing yields. There is therefore the need to find ways of reducing the pressure by encouraging the people to find alternative or additional sources of livelihoods. Encouraging more land users to go into off farm work such as trading and weaving of baskets is solution. Again the cultivation and sale of vegetables which has an increasing market in nearby regional capital, Bolga and other markets in the region another opportunity that the Bongo District Assembly, MOFA and other organizations should be encouraging land users to embrace. There is the need for government to help improve the market for the market for these products.

Control of population growth: Research shows that Bongo has a high population growth rate (2.8%).The district being rural and without any major economic activities, there is likely to be no significant in-migration. This therefore suggests that, the high growth rate is due to high birth rates and low mortality rates. It is therefore recommended that B.D.A, Ministry of Health and other interest groups should through education, encourage families to have fewer children.

REFERENCES

Abdulai, A., Owusu, V. and Goetz, R. (2010). Land tenure difference and investment in land improvement measures: Theoretical and empirical analysis; J. Dev. Eco. (2010).

ACC/SCN. (2010). Climate change: food and nutrition security implication. No. 38. Early-2010. ISSN IS64-3743.

Adugna, G. (2005). Determinants of land degradation in the Lake Tana Basin and its implications for sustainable land management. The case of Angereb and Gish-Abbay Water Sheds. Msc. Thesis, Alemaya University (Dec. 2005). A Thesis submitted to the department of Agric. Economics, School, of Graduate Studies.

Agersnap, H. and Funder, M. (2001). Conservation and Development. New Insights & Lessons Learnt. Environment and Development Network.

Asabere-Ameyaw, A., Anamuah-Mensah, J. & Raheem, K. (2008). Human impacts on the environment. SACOST, University of Education, Winneba, Ghana.

Ashford, L. S. (2007). Addressing Population in Poverty Reduction Strategies. POPULATION REFERENCE BUREAU. 1875 Connecticut Ave., NW Suite 520, Washington, DC 20009 USA.

Austrian Agency for international Development (AUAID), (1997). Land and Environment: Environment. GENDERNET practice notes. Retrieved o the 29th of January 2011 from: http: www.oecd.dac/gen

Azam, M. G., Zoebisch, M. A. and Wickramarachchi, K. C. S. (2008) Effects of cropping system on selected soil structural properties and crop yields in the Lam Phra

Phloeng Watershed- Northeast Thailand. Asian Institute of Technology, Thailand Journal of Agronomy 7(1). Asian Network for Scientific Information.

Baidu-Forson, J. (1999). Factor influencing adoption of land-enhancing technology in the Sahel: Lessons from a case study in Niger. *Agricultural Economics, Institutes for Natural Resources in Africa.* Accra, Ghana.

Ballayan, D. (2000). ESCAP Environmental Statistics Course. FAO Chapter biodiversity and land degradation. Draft February 2000.

Bandyopadhyay, A.K. (1997). A Textbook of Agro Forestry with Applications. Vikas Publishing House PVT Ltd.

Baumer, M. (1990). Agroforestry and desertification. Technical Centre for Agricultural and Rural Cooperation. Wageningen, Netherlands.

Berhanu, G. and Swinton, S. M. (2003). Investment in soil conservation in northern Ethiopia: the role of land tenure security and public programs. *Journal of Agricultural Economics*, 29 Michigan State Universities. USA.

Blay, D., Bonkoungou, E., Chamshama, S.A.O. and Chikamai, B. (2004). Rehabilitation of degraded lands in Sub-Saharan African: Lessons learned from selected case studies. Forestry Research Network for Africa (FORNESS), IUFRO- SPDC.

Blench, R.M. (1999). Agriculture and the environment in Northeastern Ghana: A comparison of high and medium population density areas. Circulation draft. Working paper: "partnerships and policies for change". (Online) *Available at www.rogerblench.info/.../***Ghana***/ODI/***Northern***%20***Ghana***%20-***agriculture***.pdf*

Bongo District Assembly, (2006). Sourced from: http://ghanadistricts.com/districts/?r=8& =103&sa=4944 on 13/08/2011 at 2:20GMT.

Boserup, E. (1965). The Conditions of Agricultural Growth: *The Economics of Agrarian Change under Population Pressure.* Ruskin House Museum Street, London.

Boserup, E. (1976). Environment, Population and Technology in Primitive Societies. Population and Development Review, vol. 2, No. 1.

Boserup, E. (1981). Population and Technological Change. Chicago: University of Chicago Press.

Boyce, J.K. (1994). "Inequality as a Cause of Environmental Degradation" *Ecological Economics,* 11(3).

Canagarajah, S. and Portner, C.C. (2003). Evolution of Poverty and Welfare in Ghana in the 1990s: *Achievements and Challenges.* Africa Region Working Paper Series No. 61 October, 2003.

Central Intelligence Agency's world Fact Book, (2011). Ghana GDP-composition by sector. From: http://www.indexmundi.com/ghana/gdp_composition_by_sector.html on 14th August.2011

untries: Proceedings of the United Nations/Institutnational d'etudes demographiques Expert Group Meeting, 23-26 August 1988, New York. United Nations, (ed. Taylor and Francis) pp. 161-190.

Commoner, B. (1992). Population, development and the environment: trends and key issues in the developed countries. Paper presented at United Nations Expert Group Meeting on Population, Environment and Development, 20-24 January 1992, New York.

Cruz, M.C.J. (1994). Population pressure and land degradation in developing countries. In population environment and development. United Nations Population Information

Network (Online) Available at **http://www.un.org/popin/fao/land/land.html**

Dawidson, E. and Nilson, C. (2000). Soil organic carbon in Upper East Region, Ghana. Measurement and Modeling. Department of physical geography. Lund University, Solvegata 13, S-22100, Lund Sweden.

De Writs, P. (2003). Land use. Planning for sustainable development. Vijverstraat, 29, Dessel Belgium. National science foundation Flanders-Belgium, Geography Department, University of Gent, Belgium.

Dejene, A., Shishira, E. K., Yanda, P. Z. and Johnson, F. H, (1997). Land Degradation in Tanzania. Perception from the village .World Bank Technical paper N0.370.

Demeke, A. B. (2003). Factors influencing the adoption of soil conservation practices in Northern Ethiopia. Discussion papers No.37 Institute of Rural Development, University Of Goettingen.

Diagana, B. (2003). Land degradation in Sub-Saharan Africa; What explains the widespread adoption of unsustainable farming practices? Draft working paper, department of agricultural economics and economics, Montana State University, Bozema, MT, USA.

Diao, X. and Sarpong, D.B. (2007). Cost implications of agricultural land degradation in Ghana. An economy wide, multimarket model assessment. Ghana strategy support programme (GSSP). Background paper no. GSPP 003

Dittoh, S. (2008). Poverty Alleviation in Northern Ghana: Fantasy or Realism. Presented at the 2008 Harmattan School on the Theme: "Poverty and Northern Ghana". Bolgatanga, Upper East Region, Ghana. 1 st-2nd February 2008.

Duraiappah, A. (1996). Poverty and Environmental Degradation: a Literature Review and Analysis. CREED Working Paper Series No 8, October 1996. International Institute for Environment and Development, London and Institute for Environmental Studies, Amsterdam.

Economic and Social Commission Human Population and the Global Environment of Western Asia-ESCWA, (2007). Land Degradation Assessment and Prevention:

Selected Case Studies form the ESCWA Region. United Nation.NW 13th Sept. 2007.

Ehrlich, P. (1968). The Population Bomb. New York: Ballantine.

Ehrlich, P. and Holdren, I. (1971). The Impact of Population Growth. Science, Vol. 171, pp. 1212-1217.

Ehrlich, P. and Holdren I., (1974). The Impact of Population. American Scientist, Vol. 62, pp. 282-292.

Environmental Protection Agency-Ghana. (2002). National Action Combat Drought and Desertification. Accra, Ghana. April 2002.

FAO. (1990). The conservation and rehabilitation of Africa lands - An international scheme. ARC/90/4. FAO, Rome.

FAO. (1992). Findings and recommendations for the tropical zone. Forest Resources Assessment. 1990 project. FAO, Rome.

FAO. (1994). Land degradation in south Asia: Its severity causes and effects upon the people. M-51 ISBN 92-5-103595-4. Retrieved on the 15th of April 2011 from: http://www.fao.org/docrep/V4360E/V4360E00.htm.

FAO. (1994). World Soil Resources Reports. Food and Agriculture Organization of the United Nations, Rome, 1994. M-51.

FAO. (2001). Socio-economic and gender analysis programme field handbook.

FAO. (2005). The importance of soil organic matter. Key to drought-resistant soil and sustained food production. FAO soils Bulletin 80.

FAO. (2008). Land Degradation Assessment in Drylands (LADA). Assessing status, causes and impact of land degradation. FAO, Rome. Retrieved on 14th April 2011 from http:// www.gm.unccd.org/FIELD/Multi/GEF /Global/Lada.htm.

Fitsum, H. and Holden, S. (2003). Tenure security, resource poverty, risk aversion public programs and household plot level conservation investment in the highlands of northern Ethiopia: Retrieved on the 21st of May 2011 from: http://www.arts .cornell.edu/econ/75devconf/papers/hagos doc

Folly, A. (2000). Erosion risk assessment in Northern Ghana through the sensing and GIS: Preliminary studies. PhD student, institute of geography, university of Copenhagen, Oster Voldgade 10, 1350k, Denmark.

Ftikhar, U.A. (2003). *NASSD Background Paper: Population, Poverty and Environment.* IUCN Pakistan, Northern Areas Programme, Gilgit.

Fullen, M. A. and Catt, J. A., (2004). Soil management problems and solutions. Oxford Univ. Press Inc. New York.

Gebreegziabher, Z., Mekonnen, A., Kassie, M. and Kohlin, G. (2010). Household tree planting in Tigrai, Northern Ethiopia. Tree species, Purposes and Determinants. Environment for Dev't. Discussion paper series. Jan (2010) EFDP/10/01.

Ghana Statistical Service. (2000). 2000 Population and Housing Census. Report on final results. Accra-Ghana. Ghana universities press, Ghana.

Ghana Statistical Service. (2010). 2010 Population and Housing Census Summary report on final results. Accra -Ghana. Ghana Universities Press, Ghana.

Giller, K. E., Leeuwis, C., Andersson, J. A., Andriesse, W., Brouwer, ., Frost, P., Hebinck, P., I., van Ittersum, M. K., Koning, N., Ruben, R., Slingerland, M., Udo, H., Veldkamp, T., van de Vijver, C., van Wijk, M. T. and Windmeije, P. (2008). Competing claims on natural resources: what role for science? *Ecolo and Society* 13(2): 34. Retrieved on the 12th of August from: http://www.ecologyandsociety.org/voll3/iss2/art34/

Gordon, D. (2005). Indicators of Poverty & Hunger. Expert Group Meeting on Youth Development Indicators, United Nations Headquarters, New York 12th - 14th December 2005.

Greenland, D.J. (1998). Management of Degraded Soils in Southern an East Africa. Proceedings of the First Meeting of the FAO Network on Management of Degraded Soils in Southern and East Africa, Harare, Zimbabwe, 8-11 Dec. 1998 :6-48 (under publication).

Harrison, P. (1992). The Third Revolution: Environment, Population and a sustainable world. London and New York: i. B Tauris & Company Ltd.

Hogan, D. (1992) The impact of population growth on the physical environment. European Journal of Population, Vol. 8, pp. 109-123.

Hudson, and Cheatle, R. (1993). Working with farmers for a better land husbandry. Intermediate Technology Publications in Association with World Association of Soil and Water Conservation.

IFAD. (1992). *Soil and Water Conservation in Sub-Saharan Africa: Towards Sustainable Production by the Rural Poor.* A report prepared for the International Fund for Agricultural Development, Amsterdam.

IGOS. (2007). Integrated Global Observation of Land. An IGOS-P lheme.14-bis IGOS Partners' Meeting, Item No. 3.0 .Cape Town, South Africa, 27 November, 2007 [online] Available at http://www.cryos.ssec.wisc.edu/docs/**theme** **r**eports/IGOL_land_draft.doc

International Livestock Research Institute. (2000). Policy for Sustainable Land Management in the Highlands of Ethiopia. May 22-23, 2000. Addis Ababa, Ethiopia.

International Monetary Fund (2011).Ghana's Population. Retrieved on the 13th of August 2011 from:http://www.tradingcconomics.com/ghana/population-imf-data.html

International Water Management Institute (IWMI). (2005). Breaking the cycles of land degradation; A case study from Ban Lak Sip, Laos. Retrieved on the 18th of April 2011 from: WWW./IWMl/.cgiar.org/Pubs/rrindex.htm on the 21/01/2011.

Malthus, T. (1798 republished 1960). An Essay on the Principle of Population, as it affects the Future Improvement of Society *(with Remarks on the Speculations of Mr. Godwin, M Condorcet, and Other Writers.)* London Printed for J. Johnson, in St. Paul's Church-Yard 1798. © 1998, Electronic Scholarly Publishing Project. [Online] Available at *www.esp.org/books/malthus/population/malthus.pdf*

Marquette, C. (1997). Population and Environment Relationships in Developing Countries: A Select Review of Approaches and Methods. Working Paper WP 1997: 15. Bergen, October 1997.

McNicoll, G. (1997). Population and Poverty : A Review and Restatement. Policy Research Division, Population Research School of Social Sciences Australian National University, Canberra.

Millar, D. and Apusigah, A. A. (2004). Participatory training techniques using participatory rural appraisal tools. A manual for trainers and for the training of trainers. A farmer project publication.

MOFA. (2001). Agriculture Census Report, 1992-2000. Accra, Ghana.

Mortimore, M. (1993). Population growth and land degradation. Geojournal, springer Netherlands. Vol 31, No. 1 . pp 15-21.

Nayak, P. (2004). Poverty and Environmental Degradation in Rural India: A Nexus. Paper presented in the annual conference of NEEA held at Dibrugarh, Assam in February 2004.

Nkonya, E., Pender, J., Kaizzi, K. C., Kato, E., Muarura, S., Ssali, H. and Muwonge, J. (2008). Linkages between land management, land degradation and poverty in Sub-Saharan Africa. The case of Uganda. International Food Research Institute

Norbu, C., Baillie, l.C, Dema, K., Jamyangi, D.Y., Tamangi, H.B., Tshering, K., Turkelboom, F. and Norbu, S. (2003). Types of land degradation in Bhutan. Journal of Bhutan Studies (in press).

Nyssen, J., Getachew, S. and Nurhussen, T. (2008). An upland farming system under transformation: proximate causes of land use change in Bela- Welleh catchment (Wag, northern Ethiopian Highlands. Soil and Tillage Research. Elsevier.

Oldeman, L.R., Hakkeling, R. T. A. and Sombroek, W. G. (1991). World Map of the Status of Human-Induced Soil Degradation. An Explanatory Note. Global Assessment of Soil Degradation (GLASOD). ISRIC in cooperation with UNEP.

Oslon, J. M., Misano, S., Campbell, D., Mbonile, M. and Mugisha, S (2004). A research framework to identify the root causes of land use change leading to land degradation and changing biodiversity. LUCID Project Working Paper 48. June 2004.

Osuala, E.C. (2005). Introduction to research methodology. Third Edition. Africana First Publishers limited. Africana Academic Books.

Otsuka, K. (2001). Population Pressure, Land Tenure and Natural Resource Management in Selected Areas of Africa and Asia. *Foundation for Advanced Studies on International Development.*

POSTNOTE, UK Soil Degradation, July 2006, Number 265. Parliamentary Office of Science and Technology. Retrieved on the 8th of September 2011 from Http://Www.Parliament.Uk/Documents/Post/Postpn265 .Pdf.

Professional Alliance for Conservation of Agriculture-PACA. Agricultural practices that cause degradation. May 2010. Retrieved on the 18th of March, 2011 from: www.conserveagri.org/EduSoil%203 .pdf.

Rockefeller Foundation. (2002). Soil fertility degradation in Sub-Saharan Africa: leveraging lasting solutions to a long term problem. Conclusions from a workshop held at the Rockefeller foundation .Bellagio study and conferences centre. March 4th – 8th 2002.

Rowley, J. (2002). Using case studies in research. Management research news, Vol 25. Edge Hill College of Higher Education. Ormskirk, Lancashire, England.

Scherr, S. J. (2000). A downward spiral? Research Evidence on the Relationship between Poverty and Natural Resource Degradation. Agricultural and Resource Economics Department, 2200 Symons Hall, University of Maryland

Scherr, S. J. and Yadav, S. (1996). Land Degradation in the Developing World: Implications for Food, Agriculture, and the Environment to 2020. Food Agriculture, and the Environment Discussion Paper 14. International Food Policy Research Institute 1200 Seventeenth Street, N.W. Washington, D.C. 20036-3006 U.S.A.

Scherr, S. J. (1999). Poverty-Environment Interactions in Agriculture: Key Factors and Policy Implications. Paper prepared for the United Nations Development Programme (UNDP) and the European Commission (EC) expert workshop on Poverty and the Environment, Brussels, Belgium.

Shaw, P. (1989a). Paradox of population growth and environmental degradation. Paper presented to the American Association for the Advancement of Science Annual Meeting (AAS), 14- L 9 January, San Francisco, California.

Shaw, P. (1989b). Population, Environment and Women: an Analytical Framework. Paper prepared for 1989 United National Population Fund (UNP A). Inter-Agency Consultative Meeting, March, New York.

Shaw, P. (1989c). Rapid Population growth and environmental degradation: ultimate verses proximate factors. Environmental Conservation, vol. 16, No. 3.

Shaw, P. (1992). The Impact of Population Growth on Environment: the debate Heats Up. Environmental Impact Assessment Review.Vol.12, No. 1. Pp 11- 3. February 1992.

Shaw, P. (1993). Book Review: The Third Revolution: Environment, Population and a Sustainable World by P. Harrison. Population and Development Review. Pp 169-192.

Simon, J. L. (1980). Resources, Population, Environment: An Oversupply of False Bad News. *Science*, New Series, Vol. 208, No. 4451. (Jun. 27, 1980), pp. 1431-l437.

Stocking, M. and Murnaghan, N. (2001). Handbook for the field assessment of land degradation. Earthscan publications Ltd.

Tiffen, M. and Mortimore, M. (1994). Malthus Controverted: The Role of Capital and Technology in Growth and Environment Recovery in Kenya. *World Development,* Vol. 22, No. 7, pp. 997-1010, 1994, Elsevier Science Ltd.

Tiffen, M., Mortimore, M. and Gichuki, F. (1994). More people, Less Erosion. Environmental Recovery in Kenya. Overseas Development Institute.

Tokle, S. and Danso, E. Y. (2007). Joint Evaluation of the GEF Small Grants Programme. Country Program case study; Ghana. GEF Evaluation Office and UNDP Evaluation Office.

Trainer, F. E. (1985). Abandon Affluence! Zed Books, London

Tukahirwa, (2002). Policies, People and Land Use Changes in Uganda. A case study in Ntungugamo, Lake Mburo and Sango Bay Sites. LUCID working Paper series No. 17. September 2002.

Twumasi, P.A. (1993). Social Research in Rural Communities (Second edition). University press. Ghana.

U.S. Census Bureau. (2011). Population Division, 1-866-758-1060. Revised: June 29, 2011 [Online] Available at www.census.gov/main/www/popclock.html

UNFPA, UNEP and IUCN. (1998). Report of the International workshop on Population-Poverty-Environment Linkages. Key Results and Policy Actions 23-25 September 1998, IUCN Headquarters Gland, Switzerland

USAID. (2008). Guide to Focus Group Discussions. Micro Report number 138. December 2008.

Vost, S. and Reardon, T. (1997). Introduction: The critical triangle of links among sustainability, growth and poverty alleviation. In Vosti and Reardon, eds *Sustainability, Growth and Poverty Alleviation: A Policy and Agroecological Perspective.* Baltimore: The Johns Hopkins University Press, pp. 1-18.

Wagayehu, B. and Drake, L. (2003). Soil and Water Conservation Decision Behavior of Subsistence Farmers in the Eastern highlands of Ethiopia: a case study of the Hunde-Lafto area. Department of Economics, Swedish University of agricultural Sciences, Uppsala, Sweden.

World Bank. (1992). World Development Report, 1992 (Washington: World Bank)

World Commission on Environment and Development (1987). *Our Common Future.* Oxford university press.

Yohannes, L. (1992). "The Effect of Conservation on Production in the Anti-Tid Area, Ethiopia." In: kebede Tato and Hurni, H. (eds): Soil Conservation for Survival. Ankeny: Soil and water conservation society. Iowa Atate University Press, Ames

Result and Discussion

Zeeuw, H. D. and Wilbers, J. (2004). Resource centre on urban agriculture (RUAF). April 2004.

APPENDIX

APPENDIX 1

UNIVERSITY FOR DEVELOPMENT STUDIES

MPhil DEVELOPMENT STUDIES

A: QUESTIONNAIRE FOR LAND USERS TO ASSESS LAND, POPULATION AND COMPETITIVE USE IN THE BONGO DISTRICT.

INTRODUCTION

This study is being conducted to find out the relationship between Population and Competitive Use of land and its implication for agricultural production. It aims at contributing to knowledge as well as helping to find a solution to the problem. I appeal to you to kindly answer the following questions as candidly as possible. The survey is for MPHIL thesis.

Dear respondent, your confidentiality is guaranteed. Thank you in advance for your cooperation.

Code No: ..... Name of community: .....

I. Respondents' Personal Information

1. Name of House .....

2. Name of Respondent: .....

3. Status of respondent (1) Male household head ☐ (2) Female household head ☐ (3) Other male ☐ (4) Other female ☐

4. Age of Respondent (i) 15-20 ☐ (ii) 21-30 ☐ (iii) 31-40 ☐ (iv) 41-50 ☐ (v) over 50 ☐

5. Level of education (i) No formal education ☐ (ii) Basic ☐ (iii) Secondary ☐ (iv) Tertiary ☐ (v) Non formal ☐

6. Major Occupation (i) Farmer ☐ (ii) Artisan ☐ (iii) Trading ☐ (iv) Food processor ☐ (v) Others (specify) ……

7. How many people live in your household? (i) 1 ☐ (ii) 6- ☐ (iii) 1 ☐ 15 (iv) 1 ☐ 20 (v) 21-25 ☐ (vi) 26-30 ☐ (vii) Above 30 ☐

8. Do you have land? (i) Yes ☐ (ii) No ☐

9.If yes what is the total area of your cultivated land (Ha)? (i)> ☐ (ii) 1 ☐ (iii) 3 ☐ (iv) 5-6 ☐ (v) 7-8 ☐ (vi) 9-10 ☐ (vii) >10 ☐

10. Which crop or livestock enterprises are you engaged in (Use table below?)

CROP	Number of acres	LIVESTOCK	Number

MAJOR ISSUE: The Causes of Land Degradation (both natural and man-made)?

11. What does land degradation mean to you? ……

……..

12. Do you experience the problem of degradation in your community? (i) Yes ☐ (ii) No ☐

13. Do you experience degradation on your farm? (i) Yes ☐ (ii) No ☐

14. If yes, what features lead you to believe that such problem exists on your land?

(i) .....

(ii) .....

(iii) .....

15. Do you think the fertility of your cultivated land is changing? (i)Yes ☐ (ii) No ☐

16. If yes, has it been: (i) Increasing ☐ (ii) decreasing ☐ (ii) Unchanged ☐

17. What features leads you to believe that?

(i) .....

(ii) .....

(iii) .....

18.Do you observe change in the level of crop yield on your cultivated land? (i) Yes ☐ (ii)No ☐

19. If yes, has it been increasing or declining? (i) Increased ☐ (ii) Declined ☐

20. If declining, what are the major reasons why it is so?

(i) .....

(ii) .....

(iii) .....

20. Do you observe appearances of plant species that signify decline in soil fertility?

(i) Yes ☐ (ii) No ☐

21. If yes, what are the names of these species?

Local Name /Scientific Name

(i) .....

(ii) .....

(iii) .....

22. How often have you experienced drought and famine in this area?

(i) Once in 3 years ☐

(ii) Once 5 years ☐

(iii) Once in 10 years ☐

(iv) Other (specify) ☐

23. What measures do you take in times of drought and famine?

……

……...

24. What do you think are the causes of land degradation?

Cause of degradation	Response: Yes=l, No=2	Source: Natural=l, Human=2	Explain why you say so
Bush burning			
Continuous cropping			
Deforestation			
Overgrazing			
Climate change			
Sand winning			
Water/wind erosion			
Others specify			

25. Do you use fire as part of your land management practices? (i) Yes ☐ (ii) No ☐

26. If yes, name the type of use. (i) Clearing of new land ☐ (ii) Clearing of weeds ☐

(iii) Pasture regrowth ☐

27. What type of Tillage practice by do you use? (i) Hand labour ☐ (ii) Drought power ☐

(iiij) Tractor ☐ (iv) Zero tillage ☐ (v) Others (specify) .....

28. What do you think are the Effects of Land Degradation on you and your household?

Effects of Degradation	Response: Yes=l, No=2	Kindly explain why you say so
Loss of Production land		
Reduced yields		
Increased Production cost		
Reduced pastures		
Reduced Vegetation		
Drought		
Other (specify)		

MAJOR ISSUE: Implications of Population on Land Degradation.

29. Has the size of your cultivated land changed? (i) Yes ☐ (ii) No ☐

(If no, continue from Question 35)

30. If yes, has it: (i) Increased ☐ (ii) Declined ☐ (iii) Remained the same ☐

31. What are the reasons for your choice of response? …….

……

……

32. If your cultivated land has expanded, is the newly cultivated land as productive as the previous one? (i) Same ☐ (ii) More productive ☐ (iii) Less productive ☐

33. How far is this newly cultivated land from your home? ……..

34. Do you feel secure that the land you cultivate belongs to you? (i) Yes ☐ (ii) No ☐

35. If no, what are the reasons? .....

……..

36. Have you ever had conflict regarding the ownership of the land you work on? (i) ☐s (ii) No ☐

37. Have you experienced conflict over grazing rights? (i) Yes ☐ (ii) No ☐

38. If yes, who did it involve? (i) Pastoralist ☐ (ii) farmer ☐

39. How did you solve the problem? ……..

……..

Major Issue: Implications of land use competitiveness on land degradation

41. If you remember, how long have you used this plot? (i) > 10 ☐ (ii) 1-2 ☐ (iii) 3-4 ☐ (iv) 5-6 ☐ (v) 7-8 ☐ (vi) 9-10 ☐ (vii) >10 ☐

42. What is your type of land use? (i) Cultivated land ☐ (ii) Fallow land ☐

(iii) Grazing Land ☐ (iv) Farm house area ☐ (v) wood land ☐

43. What type of tenure system do you use? (i) State owned ☐ (ii) Own ☐ (ii) Sharecropping ☐ (iv) Gift from some one ☐

44. How did you acquire the plot/land (i) inherent ☐ (ii) Received from Tinda ☐ (iii) rented- in ☐ (iv) Sharecropped or contract ☐

45. Which of the following do you practice?

(i) Plant the same crop each year ☐

(ii) Change to other crops ☐

(iii) Practice fallow ☐

(iv) Change to other crops and then practice fallow ☐

46. What are the serious problems in the plot(s) at present/ in rank?

(Use a range of 1-8, 1 for most serious, 2 the next etc.)

Number of Plots	The plot is too small	Very poor soil fertility	Affected by erosion	Too far from homestead	Water logging	Difficult to plough	Steep slope	Any other
< 1								
1-2								
3-4								
5-6								
7-8								
9-10								
>10								

47. Do you have farm plot that is out of crop production? (i) Yes ☐ (ii) No ☐

48. If yes, estimate that land in hectares.

Plot number (Acres)									
1	2	3	4	5	6	7	8	9	10

49. Do you have access to pasture lands? (i) Yes ☐ (ii) No ☐

50. If yes, is the pasture land sufficient for your use? (i) Yes ☐ (ii) No ☐

51. Do you graze your pasture land by rotation? (i) Yes ☐ (ii) No ☐

52. If no why? …….....

……..

52. What is the primary source of your fuel? (i) Fuel woo☐ (ii) crop resi☐

(iii) dung ☐ (iv) Kerosene ☐ (v) Other (Specify) ☐ .

53. Do you face fuel shortage? (i) Yes ☐ (ii) No ☐

54. If yes, what are for the

shortage? .....

Major Issue: Link between population pressure, competitive use of land and land degradation

55. In your view, is population in your community increasing? (i)Yes ☐ (ii) No ☐

56. If yes, why do you think so? .....

57. In your opinion, do you see any link between population increase and land use competitiveness resulting in land degradation? (i)Yes ☐ (ii) No ☐

58. If yes, in your opinion what do you think are the effects on the land?.....

Major Issue: Strategies that could be adopted by the increasing population to minimize land degradation

59. Do you use some kind of practices to maintain or enrich soil fertility of your cultivated land?

(i) Yes ☐ (ii) No ☐

60. If yes, which of the following do you used?

(i) Use of fertilizer ☐ (ii) use of Manure ☐ (iii) intercropping ☐ (iv) Mulch or compost ☐

(v) Agroforestry ☐ (vi) other (specify) ..... .

61. What strategy do you take to deal with degradation on your land? (i) Agroforestry

(ii) Private tree planting ☐ (iii) communal tree planting ☐ (iv) natural regeneration ☐

(v) Other (specify) ..... .

62. Do you grow tress on your farm? (i) Yes ☐ (ii) No ☐

63.What do you do with crop residue? (i) Bum them ☐ (ii) Use them for cooking ☐

(iii) Use them for feed ☐

UNIVERSITY FOR DEVELOPMENT STUDIES

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B. QUESTIONNAIRE FOR GOVERNMNETAL AND NON-GOVERNMENTAL ORGANIZATIONS INTERVIEW ON LAND, POPULATION, AND COMPETITIVE USE IN THE BONGO DISTRICT.

INTRODUCTION

This study is being conducted to find out the relationship between Population and competitive Use of land and its implication for agricultural production. It aims at contributing to knowledge as well as helping to find a solution to the problem. I appeal to you to kindly answer the following questions as candidly as possible. The survey is for an MPHIL thesis.

Dear respondent, your confidentiality is guaranteed. Thank you in advance for your cooperation.

Organization's personal information

1.Organization's name .....

2.How long have you been working in the district. ....

3. Have you carried out any interventions on land degradation (i) Yes ☐ (ii) No ☐
4. If yes, what are the interventions? .....

Major Issue: Causes of degradation

5. What are your experiences on the concept of degradation in the district? ..... .

6. From your experience, what do you think are the causes (both natural and man-made)

……

.....

Major Issue: Population and competitive land use

7. Do you have any experience on population and land? (i) Yes ☐ (ii) No ☐

8. If yes, what are your experiences?**.....**

……..

9.What are your experiences on land competitiveness? ……..

……

Major Issue: Coping Strategies by the growing population to minimize degradation

10. In spite of the growing population, what coping mechanisms would you advice land users to adopt in other to conserve the land? …….....

……**.....**……

11. For already degraded lands, what would you recommend for land users?

…….....

12. What are your recommendations for government and its agencies on the subject matter?

……

13. What are your recommendations for NGO's working on the environment with regards land degradation? ……

……

14. Do you have any further comments/recommendations on the subject matter (land, population and competitive use)?**.....**

……

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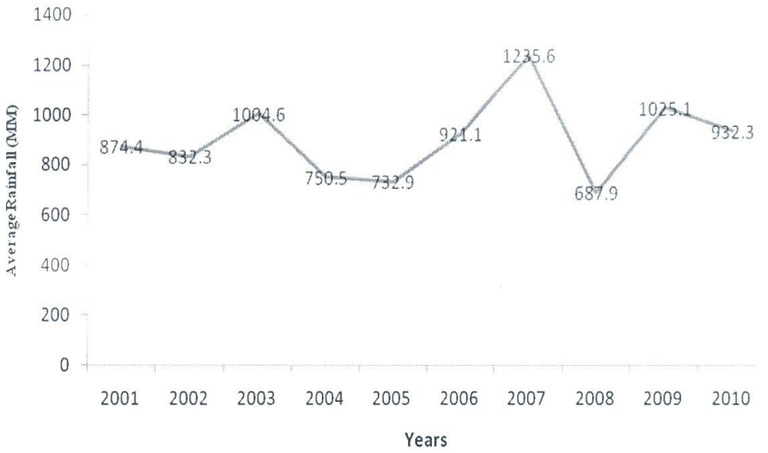
C. CHECKLIST FOR FOCUS GROUP DISCUSSIONS AND PERSONAL INTERVIEWS WITH HERBALIST AND TRADITIONAL LEADER

1. The community's understanding of the concept of land degradation
2. Their understanding of land use competitiveness
3. Perception about how population is linked to land degradation
4. Perception about how competitive land use is linked with land degradation
5. Community's understanding of how both nature and man contribute and degradation
6. Coping strategies which they adopt on already degraded land.
7. Strategies they adopt to prevent degradation on arable lands

APPENDIX 2

a. ANNUAL TOTAL RAINFALL (MM) FIGURES OF THE DISTRICT



Source: MOFA, 2011

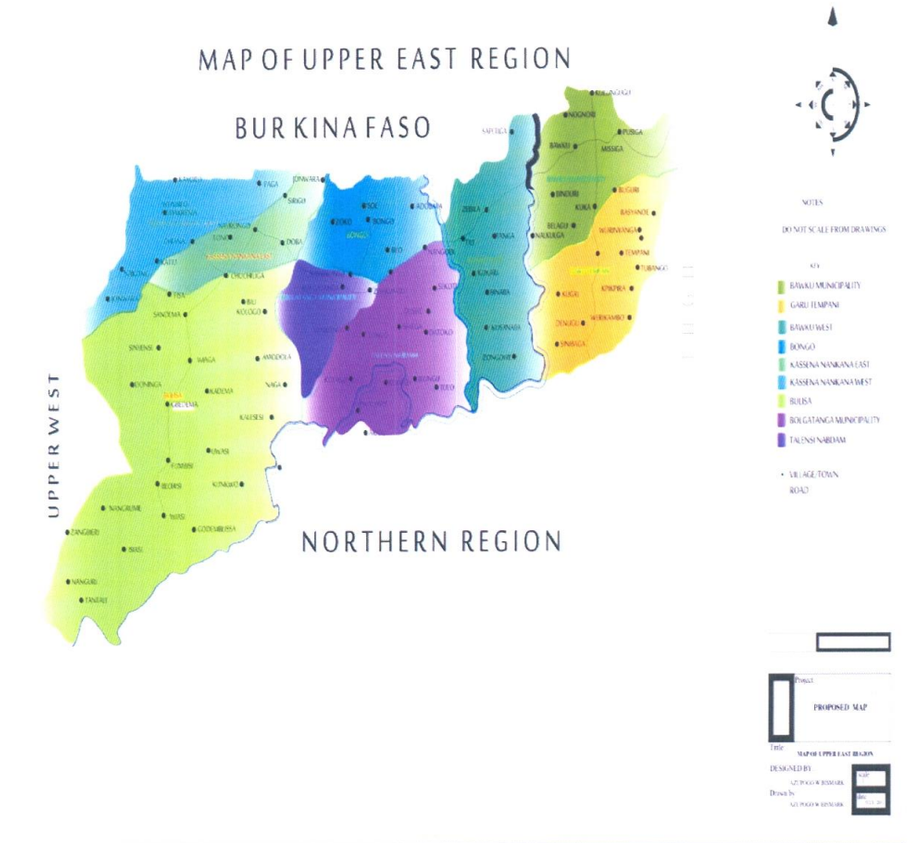
b. Mean annual crop yields of land users in Bongo District

Yield (Ton/Ha)									Average yield of the crops (Ton/Ha)
Year	Maize	Rice	Millet	Guinea corn	Groundnut	Cowpea	Sweet potatoes	Soya bean	
2000	0.00	1.80	0.72	0.94	0.85	0.00	0.00	0.00	0.54
2001	0.00	2.00	0.62	0.86	1.40	0.00	0.00	0.00	0.61
2002	0.00	2.00	0.97	1.06	1.06	0.00	0.00	0.00	0.64
2003	0.00	4.00	1.00	1.10	1.08	0.40	8.95	0.50	2.13
2004	0.00	1.12	0.61	0.67	0.68	0.40	11.50	0.52	1.94
2005	1.35	1.76	0.61	0.97	0.97	0.40	11.45	0.48	2.25
2006	1.80	1.10	0.60	1.00	0.90	0.46	9.00	0.70	1.95
2007	0.62	2.10	0.33	0.62	0.50	0.35	8.56	0.46	1.69
2008	1.32	2.42	0.96	1.06	1.04	0.68	12.10	0.60	2.52
2009	0.90	3.61	1.08	1.03	0.53	0.62	11.65	1.11	2.57
2010	1.20	2.70	0.90	0.96	0.98	0.60	7.20	0.90	1.93

Source: MOFA, 2011

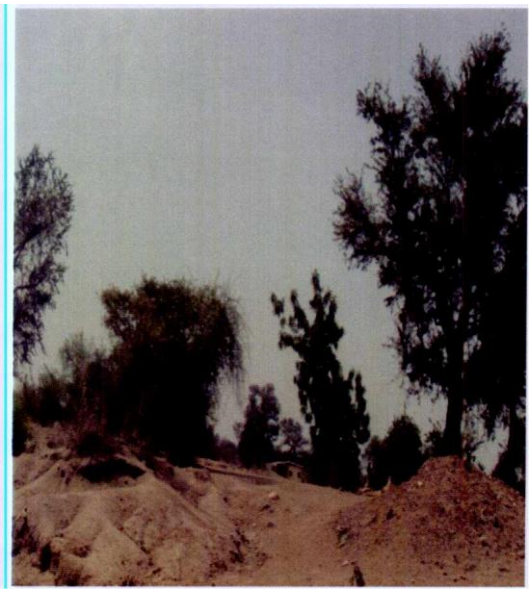
APPENDIX 3: MAP OF UPPER EAST REGION OF GHANA

www.udsspace.uds.edu.gh

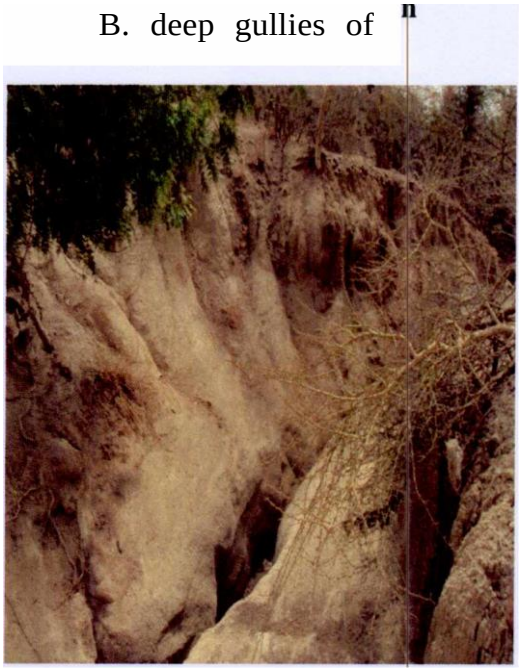


APPENDIX 4: Physical signs of degradation in study area

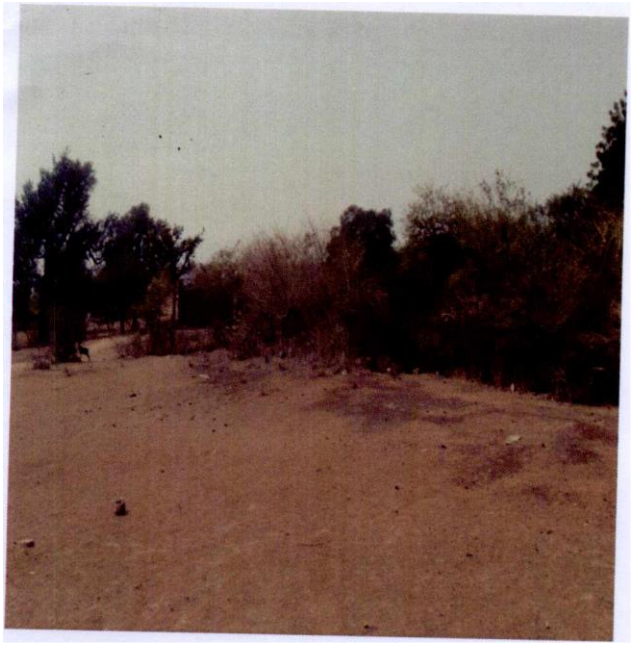
A. bare eroded land



B. deep gullies of erosion



c. bare land with gullies of erosion



d. vast track of bare land