THE DISAPPEARING GENETIC RESOURCES: BIODIVERSITY CONSERVATION:

The Study of Flora and Fauna of Ajenjua Bepo Forest Reserve.

By

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DECLARATION

I declare that I have wholly undertaken the study herein under the supervision of Professor Kwadwo Yeboah-Gyan and that except for the portions where references have been duly cited, this dissertation is as a result of my own research.

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ABSTRACT

In terms of biological diversity, the destruction of primary moist tropical forest could cause the extinction of vast numbers of animal and plant species. The conservational status of Ajenjua Bepo Forest Reserve may be tenuous due to factors such as slash-and-burn, nomadic agriculture, lumbering and quite recently exploration for surface mining. The present study was carried out to quantify and compare the relative abundance of plant and animal species in the natural forests, secondary forests and the degraded forest areas of Ajenjua Bepo Forest Reserve. The aim of the study was to provide baseline data for management, longterm monitoring and project impact assessment. The flora and fauna populations were quantified in a randomly distributing quadrats in the study areas. Butterflies were trapped using the baited trap technique. Visual survey technique was used for determining the populations of amphibians and reptiles. Small mammal populations were determined using the method described by Hutterer and Happold (1983). Questionnaire survey was used to assess the conservational status of tree species in the study areas. The results of the study demonstrated that slash-and-burn agriculture could significantly affect the floristic composition of semi-deciduous tropical forest such as Ajenjua forest Reserve. Animal life could be equally affected. Farmers should be educated to approach the natural forest with a gentle hand, attempting to do no more than thin the canopy to introduce a tree of their choice to replace the original forest. Such farms will endure and the soils will remain unchanged.

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CHAPTER ONE

1.0 INTRODUCTION

In 1990, the total world forest cover amounted to 4,499 million ha, however in 2000, it was estimated that the total forest cover globally was 3.9 billion ha, 95% natural and the remaining 5% in plantations (FAO (1993), Forest Resource Assessment 1990 in Tropical Countries). Africa contains about 650 million hectares of forests, corresponding to 17% of the world's total. According to the FAO paper, Africa has about one-quarter of all tropical rain forests. Africa contains the second largest contiguous area of tropical forest in the world. This forest contains diverse assemblage of plants and animals, including over 10,000 plant species of which 3,000 are endemic (FAO 1993, Forest Resource Assessment of 1990 in Tropical Countries).

In Ghana, the two main vegetation types are the closed forest and the savanna vegetation types. The latter is characterized by an open canopy of trees and shrubs with a distinct ground layer of grass. The Ghanaian forests are part of the Guineo-Congolean phytogeographycal region. The classification by Hall and Swaine (1981) recognizes seven vegetation types within the closed forest, each with distinct associations of plant species and corresponding rainfall pattern and plant species.

Wet evergreen forest occurs in the extreme south-western corner of the country and enjoys the highest annual rainfall (1500-2100 mm). It is floristically rich. Timber species logged from this forest type include *Piptadiniastrum africanum* (Dahoma), *Lophira alata* (Kaku) and *Lovoa trichilioies* (Walnut), (Owusu et. al., 1989).

The moist evergreen forest is transitional between the wet evergreen and moist semi deciduous forests. Although not as rich as wet evergreen forest, it has a great floristic diversity and a greater number of commercial timber species (Hall and Swaine, 1981). The annual rainfall of the moist evergreen forest is 1500-1700mm.

The moist semi-deciduous forest has the Kwahu and Mampong scarps and hills of western Ashanti as prominent features. Rich forest soils and annual rainfall of 1200-1800mm give rise to tree heights which often exceed 50m and are the tallest in the Ghanaian forests (Hall and Swaine, 1981). This forest type occupies about 40 per cent of the closed forest zone and is considered the most important for timber production. It is characterized by such species as utile *Entandrophragma utile*, African mahogany *Khaya ivorensis* and wawa *Triplochiton scleroxylon* (Owusu et. al., 1989).

The dry semi-deciduous forest type is found as peripheral band around the moist forest types to the south and is adjacent to the Guinea savanna zone to the north (Hall and Swaine, 1981). This forest type has lower tree heights and receives rainfall in the order of 1250-1500mm per annum.

The upland evergreen forests occur as outliers from the main evergreen forest block on the high ground of the Atewa Range, Tano Ofin Forest Reserve and Mountain Ejuanema near Nkawkaw. Although they are surrounded by moist semi-deciduous forest, they are floristically similar to the moist evergreen type. The most characteristic species are herbaceous rather than woody, with epiphytes and ground ferns being both abundant and diverse (Hall and Swaine, 1981).

The southern marginal forest type is found as a narrow band from west of Cape Coast to Akosombo. Precipitation is relatively low at 1000-1250mm per annum.

Forests occur in isolated patches as most of the land has been converted to thickets; farms and savanna (Hall and Swaine, 1981). Trees are sparse and small in nature.

The south-east outliers represent the driest of forest types. Annual rainfall is 750-1000mm and is the least extensive (Hall and Swaine, 1981). This is found on the Accra plain, for instance Shai hill Game Production Reserve. It is characterized by low floral diversity and trees with low canopies. Within this forest type, there are several very rare tree species and a few commercial timber species.

All forests have both economic and ecological values, and are especially important in global economy. They are the source of much of the world's biodiversity, providing habitat for numerous species. Forests serve as protection against natural hazards such as snow avalanches, rock falls, shallow landslides, debris flows, surface erosion and floods. They also function as carbon sinks and hence are positive agents against climate change.

From an anthropocentric view point, they are the source of several resources useful and often profitable to humans: wood as well as other products such as meat from forest animals, fruit, nuts, rubber and plants used as medicines. The United Nations Forum on forests estimates that forests provide subsistence and income to about 350 million people worldwide.

Forests also play important roles in people's cultural and spiritual well-being. They are increasingly becoming important ecotourism destinations, often due to the nature of the species they contain. Natural and wild landscapes are aesthetically pleasing and provide opportunities to get away from human-dominated landscapes. They also provide opportunities for recreational activities such as hiking, canoeing, bird watching and nature photography (Erlich and Erlich, 1992).

Forest also provides critical indirect benefits to humans. These benefits encompass ecosystem services, such as air and water purification, climate regulation, and the generation of moisture and oxygen. Natural communities maintain proper gaseous concentrations in the atmosphere and prevent rapid climatic changes. Vegetation helps recycle moisture into the atmosphere and therefore has a crucial role in the hydrologic cycle. Natural ecosystems also help absorb the wastes we create and render them nontoxic. We often depend on rivers to flush away and break down the sewage and effluent that we put into them, which depends on an array of small and large organisms that decompose wastes (Erlich and Erlich, 1992).

1.1 Scope of the Present Study

It has been reported that each year about 8 million hectares of tropical forest succumb to the chainsaw and machetes of developers and farmers in search of more lands (FAO 1993. Forest Resource Assessment of 1990 in the tropical countries). At that rate half of the still remaining tropical forest will have disappeared by the end of the century.

In Ghana the heaviest demand on the country's forest has been for fuel and shifting cultivation. However, in very recent times, mining activities particularly surface mining are rapidly denuding the land of forest over wide areas.

Despite the significant potential for negative impacts on biodiversity from operations, there is a great deal that companies can do to minimize or prevent such impacts in areas identified as being appropriate for mining. Being proactive in the assessment and management of biodiversity is an important tool for both new and existing companies.

The present study sought to determine the floristic composition and also assess the conservational status of tree and some animal species in forests in the Ajennua Bepo Forest Reserve where surface mining may threaten the survival of tree species. The data gathered, it is hoped, will provide baseline data for management, long-term monitoring and project impact assessment.

The objectives of the study were to determine:

- The major causes of degradation in the Ajenjua forest reserve.
- Local knowledge of plant and animal species and their uses.
- Relative abundance of tree and some animal species in the high forest, secondary and degraded forests.
- Perception of the local communities on impacts of mining on the forest ecosystem.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Causes of Deforestation

2.1.1 Population Growth

When needs for food and other agricultural products increase due to increase in agricultural societies, it is necessary to either increase the output of land currently under cultivation or to increase the cultivated area. Since yield increase is difficult to achieve, more land is rather cleared. This is often done at the expense of forests or wooded cover (UNEP, 1992). Shifting cultivation results in situations which can lead to permanent nutrient loss and degradation to ecosystems.

2.1.2 Logging

Logging is one of the major causes of deforestation. Over 80% of the world's ancient forests have been destroyed or degraded by logging (Greenpeace, 2001). A major problem with selective logging is that large areas of land and forests are damaged and destroyed. Through selective logging, chopping down one tree can fatally damage up to seventeen other trees (Waste.org, 1994). With this practice, up to 70% of the rainforest in a selective logged area is destroyed for small amounts of logs (Waste.org, 1994). A combination of removing the trees from the forest and the heavy machinery used in the timber industry accounts for extensive damage on such a fragile environment. However, with selective logging there is a slight chance that the forest will regenerate (Revington, 1992). After a tree is cut, it falls to the ground at a rapid speed (RIC, 2000). The heavy machinery and fallen trees cause the ground to be heavily compacted. By packing the soil tight together, the forest's chance for regeneration is reduced.

2.1.3 Agricultural Expansion

Shifting agriculture (slash and burn) is a major cause of deforestation. It has been estimated that, if present trends continue, more than 90% of land currently under forest will be cropland, fallow or secondary forest. It was estimated in 1996 that about 200 to 500 million people were practicing slush and burn agriculture. Also, it has been estimated that about 150 million hectares of forests are being cleared for agriculture annually in the tropics. Slush and burn agriculture exposes the soil to higher temperatures and lead to heavy loss of nutrients required for vegetation growth from the soil (FAO, 1993). Due to nutrient problem, lands are often abandoned and this results in migrants settleling elsewhere and carrying out further deforestation.

Forest conversion for growing commercial monocrops is another example of agricultural expansion that has a negative impact on natural forests (FAO, 1993). Such negative effects include destruction of soil fertility and species richness (ITTO, 2002). Forest modification also leads to habitat fragmentation into isolated, smaller habitat patches (Saunders *et al.*, 1999). This situation promotes species invasion a id render abundant species to rare or extinct levels (de Sousa and Brown, 1994).

2.1.4 Demand for Fuel wood

Fuel wood collection is yet another problem directly related to deforestation. During 1998, in 63 developing countries, approximately 2.2 billion people could not get enough fuelwood to meet their basic energy needs or were forced to meet such needs by using wood faster than it was being replenished (Miller, G. Tyler Jr., 2000). Unfortunately, the rainforest pay the price of fuelwood consumption as more poor people search for wood. In developing countries, almost 40% of a poor family's

earnings is used to buy fuel wood (Miller, G. Tyler Jr. 2000). Those who cannot afford fuelwood , an estimated 800 million people, burn dried animal feaces and crop residues to meet their basic demands (Miller, G. Tyler Jr. 2000). As the dried animal feaces are burnt, it no longer has the ability to decompose and fertilize the land, further degrading the soil (Miller, G. Tyler Jr. 2000). In Africa, wood is depended upon for up 58% for all energy requirements. In many savannah areas, depletion for wood supplies far exceeds population growth. This is a major cause of depletion fuelled by population growth. Since fuel wood comes almost exclusively from natural ecosystem with very little from plantations and woodlots, wood resources will become increasingly scarce in areas outside forest reserves, while pressure for wood within forest reserves will continue to intensify (Owusu et al., 1989).

2.1.5 Introduction of Exotic Species

The degree to which ecosystems respond to species invasion has been a major challenge to many ecologists (Lavorel et al., 1995). Plant species invasion is defined by Hall, (2003) as those species that are likely to spread into native plant communities causing environmental harm by developing self sustaining populations and disrupting other systems. In general, site disturbances including mining activities that changes habitat conditions and/or disrupt resource availability of ecosystems is known to facilitate or pre-dispose ecosystem to species invasion (Perrings et al., 2002).

2.1.6 Vegetation Clearance

Vegetation clearance is one of the most significant threats to biodiversity conservation. It is estimated that about 40% of the global terrestrial vegetation had been exchanged for mineral exploration, exploitation and infrastructural development (Myers et al., 2000). In Ghana, mining together with other anthropogenic activities is responsible for an annual loss of 22,000 hectares of the existing forest cover (EPA, 1996).Vegetation clearance exposes the soil to higher temperatures and depletes the soil nutrient levels required for vegetation growth (FAO, 1993).Vegetation clearance also promotes species distribution by creating the opportunity for species invasion, promoting previously inferior species to dominant levels as well as demoting species from supposedly abundant to rare to extinction.

2.1.7 Other Factors

Civil conflict and war have also led to significant ecological damage and biodiversity losses in and outside protected areas, as well as to the marginalization of environmental

management institutions and conservation programs. By 1991, the wildlife populations of National Parks and Reserves in Angola had been reduced by civil war to only 10 per cent (Huntley and Matos, 1992). Localized causes of deforestation include extensive cultivation resulting from migration of cocoa farmers and the mining of mineral resources.

2.2 Conservation of Forest/Important species

Sacred grooves in Ghana are indications of indigenous protected systems within rural communities. Three indigenous strategies have been identified to conserve biodiversity. These are strategies that protect particular ecosystems or habitats, such as sacred grooves, those that protect particular animal or plant species (tabooed species) and those that regulate exploitation of natural resources. These are often enshrined in religious or cultural beliefs and superstitions and enforced by taboos which have no legal backing, but beliefs are strong enough to make people obey regulations (Ntiamoah-Baidu, 1995).

Two systems govern protected areas in Ghana: The indigenous Protected Area system, where small patches of forests nearer to settlements were set aside as sacred lands that cannot be touched. These areas are usually dedicated as shrine, ancestral forest or burial grounds (Ntiamoah-Baidu et al., 1995).

The other system is the Forest Reserves which was introduced by the Forestry Department in 1927. Although the primary purpose of most reserves in Ghana seems to be timber production at the moment, the maintenance of environmental and ecological stability was a major objective in forest management. Thus reserves were established along the forest/savanna borders to prevent the advancement of savanna vegetation into the forest zone, hilly areas were reserved to protect headwaters of major rivers. Reserves were scattered throughout the forest zone to maintain hydrological and climatic conditions.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 The Study Area

The study was conducted in the Ajenjua Bepo Forest Reserve in the Birim North District of the Eastern Region of Ghana. It is located within the Wet Semi-Equatorial climatic zone of Ghana. It is characterized by a double maxima rainfall pattern occurring from March to July and September to mid-November. The rainfall in the area has an annual peak regime between 1600mm-1700mm (SGS 2004). The peak of the major rains occurs around June and the second peak occurs around October during the minor season from late September to mid-November.

3.2 Vegetation of Ajenjua Bepo Forest Reserve

The vegetation of the area is semi deciduous moist forest and the plant communities closely represent the natural forest types of the region. The few patches of the forest are between 35 to 40 meters high, dominated by *Celtis mildbraedii, Milicia excelsa, Ceiba pentandra and Antiaris toxicaria.* Common undergrowth species are *Leptaspis cochleata, Olyra latifolia* and several species of fern.

3.3 Determination of sample size for questionnaire survey

The respondents were selected from the following communities: Afosu, New Abirem, Old Abirem, Mamanso, Adausina, Hweakwae and Yaw Tano. The rest are Ntronang, Yayaso and all the hamlets within 5km radius of the forest reserve. The selection was based on population and accessibility.

The population of the nine villages and hamlets was 16,372 (Birim North District Assembly: 2000 census). One hundred people were interviewed in all. Twenty persons each from Afosu and New Abirem, ten each from Ntronang, Mamanso, Old Abirem, Adausina

and Hweakwae, while five each were interviewed from Yayaso and the Hamlets. Each respondent was selected from different household, thus ensuring a wide representation of each community. All respondents were interviewed individually on a one to one basis and answers recorded by the researcher.

The questionnaire was composed of closed and open-ended questions, allowing both qualitative and quantitative data to be generated. The questionnaire comprised four sections. The first section related to general information about the respondents and his/her household. The second was concerned with the relationship between the communities and the forest reserves. The third section related to people's knowledge with respect to some important forest tree species and their conservation. The last section was concerned with views of the people on mining and other activities on the conservation of the forests.

3.4 Field Survey

3.4.1 Reconnaissance survey

A reconnaissance survey was carried out by taking a general walk through the forest, with the help of a forest guard/a forest officer to characterize the vegetation types and to select sampling sites.

3.4.2 Selection of the Sampling Sites

Since the forest was not uniform in terms of vegetation, three areas were selected at various points to assess the present status of the vegetation.

One of the study areas was located in the area of the forest where natural stands abound and the second was located in the area where some degradation has occurred. The third study area was an area which originally was occupied by virgin forests but which has lost its vegetation through farming.

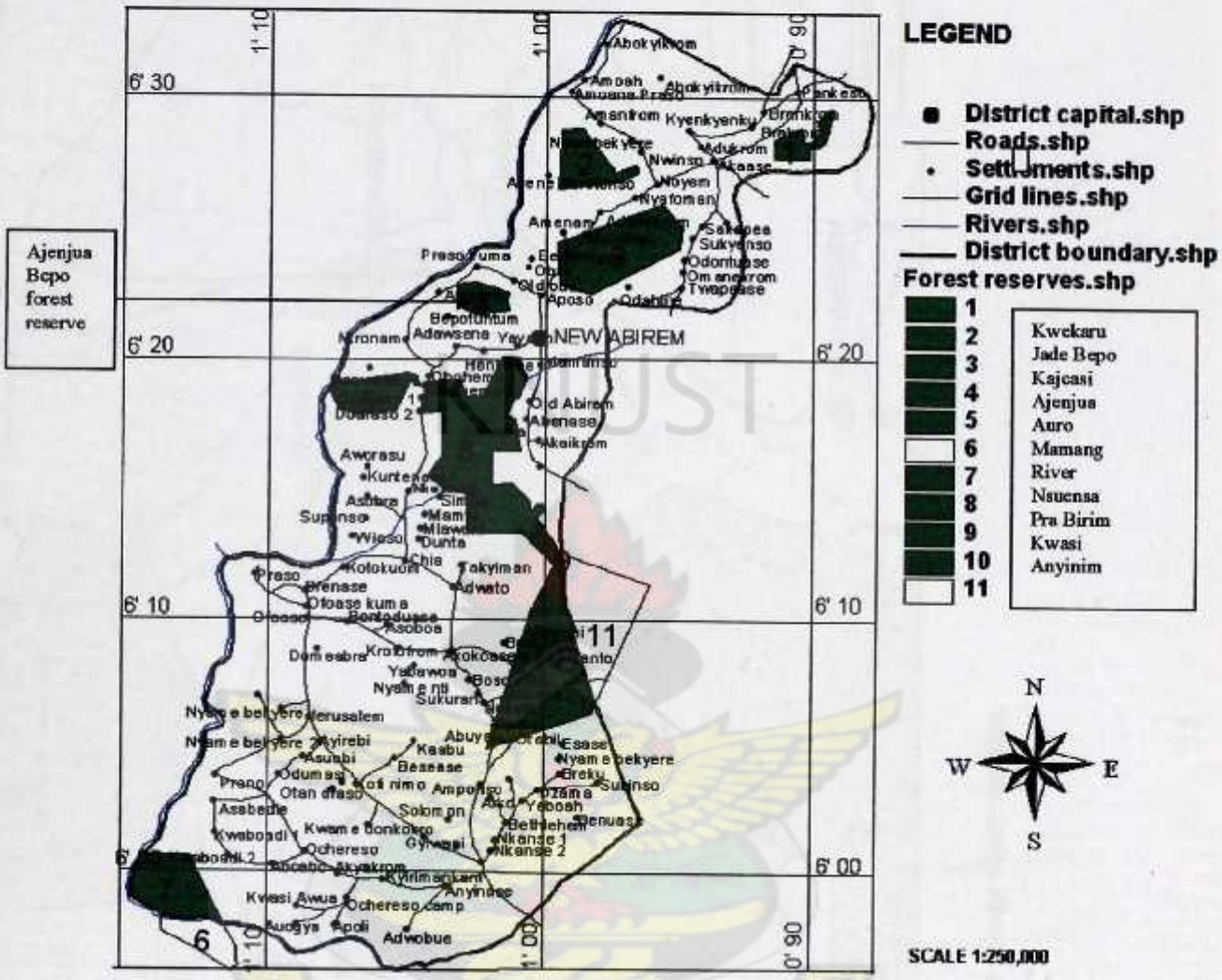


Figure 3.1: Forest Reserves in the Birim North District

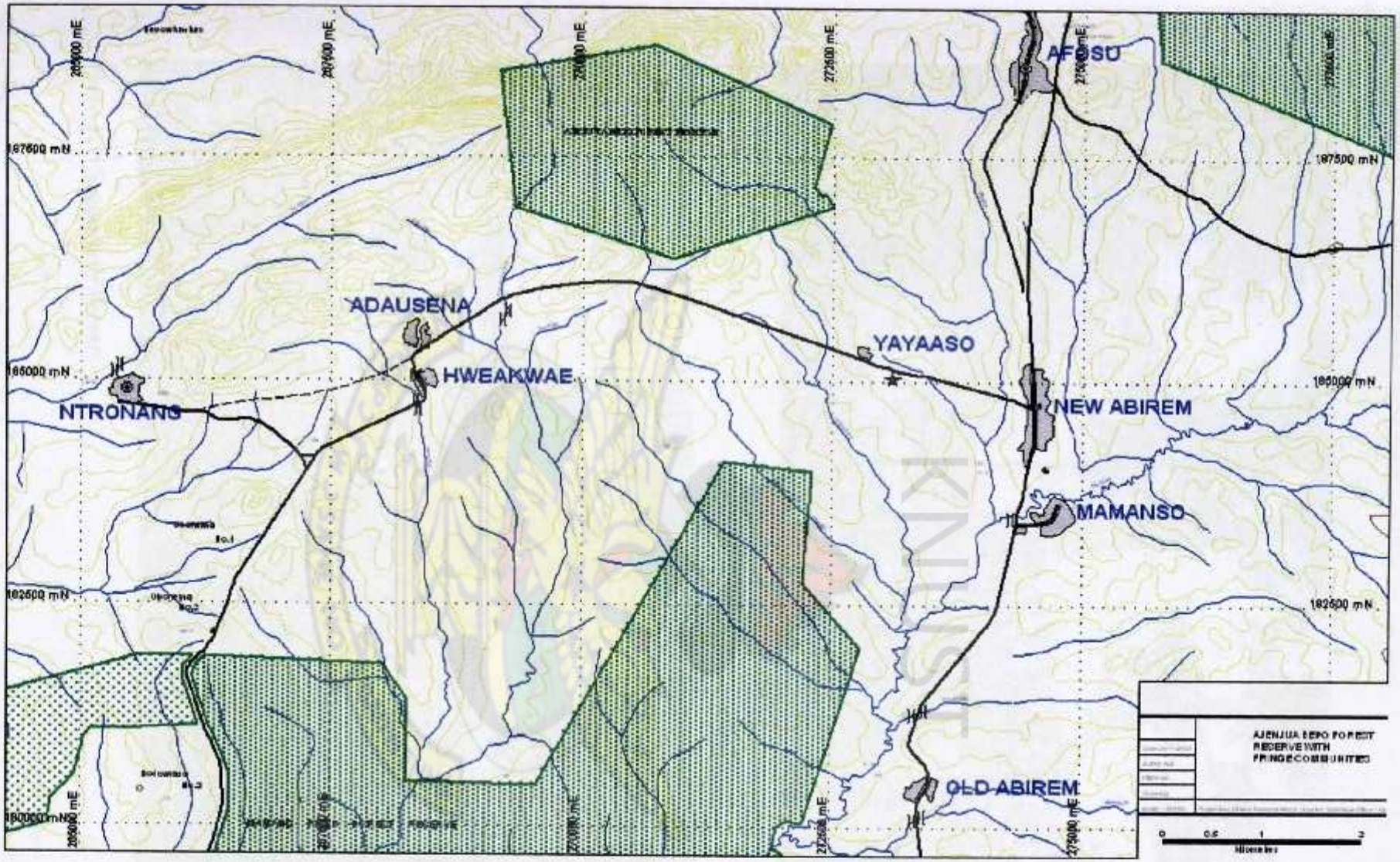


Fig. 3.2: Ajenjua Bepo Forest Reserve with fringe communities.

Plate 3.2: High forest.

Plate 3.3: Secondary forest.

Plate 3.4: Degraded forest area.

3.4.3 Determination of the relative abundance of plant species

The abundance of plant species was quantified using the frequency method of vegetation analysis. In each study area, three one hectare plots were delimited at each location and the absence or presence of plants species were recorded in ten 10m x 10m randomly distributed quadrats. The frequencies and the relative abundance of each species were calculated according to the formulae by Grig-Smith (1964).l;..

$$\text{Frequency (X)} = \frac{\text{Number of quadrats with species X}}{\text{Total number of quadrats used.}}$$

$$\text{Percentage (\%) Relative Abundance (X)} = \frac{\text{Frequency of species X}}{\text{Sum of frequency values of all Species.}} \times 100$$

Percentage relative abundance was then expressed as domin values as indicated below:

4.1% — 5%	=	5 (constantly present)
3.1% — 4%	=	4 (mostly present)
2.1% — 3%	=	3 (often present)
1.1% — 2%	=	2 (seldom)
0%—1%	=	1 (rare)

3.4.4 Identification of plant Species

The individual plant species were identified as far as possible to their respective species by referring to the standard floras, and books such as field guide to the forests trees of Ghana (Hawthorne, 1990), Hand book of West Africa Weeds (Akobundu and Agyakwa, 1998) and Herbs of Ghana (Dokosi, 1998). Also the Herbarium of Botany Department, University of Ghana, and the Herbarium of the Department of theoretical and applied Biology, Kwame Nkrumah University of Science and Technology were used to identify some of the plants species.

3.5 Fauna Survey

3.5.1 Butterflies

The butterflies were trapped using the bait-trapping technique which is considered a standard method for studying fruit-feeding butterfly community (Pineiro and Ortiz, 1995; Beck and Schulze, 2000). Van Someren-Rydon traps (DeVries, 1987) baited with fermented mashed banana were used for the trapping. Traps were set and baited a day prior to the actual collection of the butterflies. Such traps often bring in species that are rarely captured with nets (Larsen, 2003). A 100 meter long transect was set at each sample site and ten traps at 10 meters interval were set along the transects. The traps were hanged on shrubs and glue was applied on the string that hangs the trap to prevent any insect attack on the trapped butterflies. Trapped species were disabled and collected with featherweight forceps into glassine envelops. Taxonomic treaties available in Ghana (Emmel and Larsen, 1997; Larsen, 2003, in press) were used to aid in the identification of the species. The specimens identified were compared with already identified species at the insect museum of the Forestry Research Institute of Ghana (FORIG).

3.5.2 Amphibians and Reptiles

The visual surveys technique (Crump and Scott, 1994) was used. This involved visual scanning of the whole sample site, refuge examination such as lifting rocks and logs, peeling away bark and scraping through leaf litter.

3.5.3 Small Mammals

The method used in surveying small mammals followed the one described by Hutterer and Happold (1983). A 200 meters trap line was set in all the three sample sites. Five clusters of Sherman traps, baited with peanut butter, were place at 10meters intervals along each trap line. Thus a total of 20 trap stations and 100 traps were obtained for each sample site.

Tomahawk traps were randomly placed to trap larger species of small mammals. Traps were inspected the following morning and captured species were identified based on Hutterer and Happold (1983).

3.5.4 Large Mammals

Direct and indirect survey methods were employed. Some of the animals were observed directly during the flora survey while some were based on signs (footprints and dung). Observation points included heavily fruiting trees, tree-fall gaps with a flush of new foliage and areas with regular signs of tracks. Three transects (each 100meters long) were set in each of the three sample sites, along which observations were made for either direct encounter of the animals or their signs. Two hunters from Yayaso village also gave a list of game usually haunted for and species which used to be in the forest but can no longer be found. Species identification followed Meester & Setzer (1971) and Reeder (1993).

CHAPTER FOUR

4.0 RESULTS

4.1 Introduction

The methodology described in chapter three generated a wide range of both qualitative and quantitative data concerning various aspects of the key stakeholders and their relationship with the reserved forests. The major results have been extracted and represented in this chapter.

4.1.1 Age, Gender, Marital Status of Respondents

The results in Table 4.1 show that most of the respondents (Fig.4.1) were above the age of 35. This implies that majority of the respondents were matured. Majority (Fig.4.2) of the respondents were males and 66% (Fig 4.3) were married.

4.1.2 Educational Background of Respondents

The results indicated most of the respondents have had very little education with about 63% having primary school education (Fig. 4.4).

4.1.3 Occupation of Respondents

The major occupation of the respondents was farming (Fig.4.5) followed by trading. Other occupation such as teaching and hunting were practiced by few respondents.

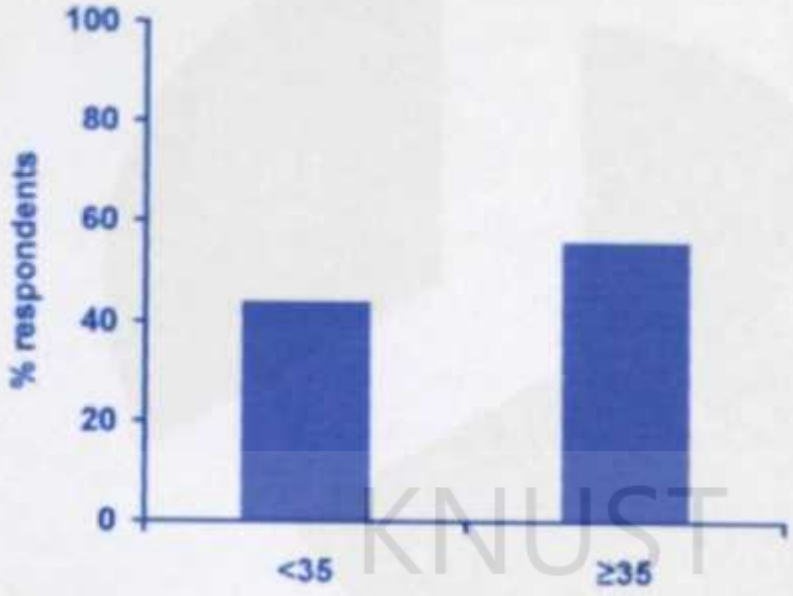


Fig. 4.1: Age of respondents

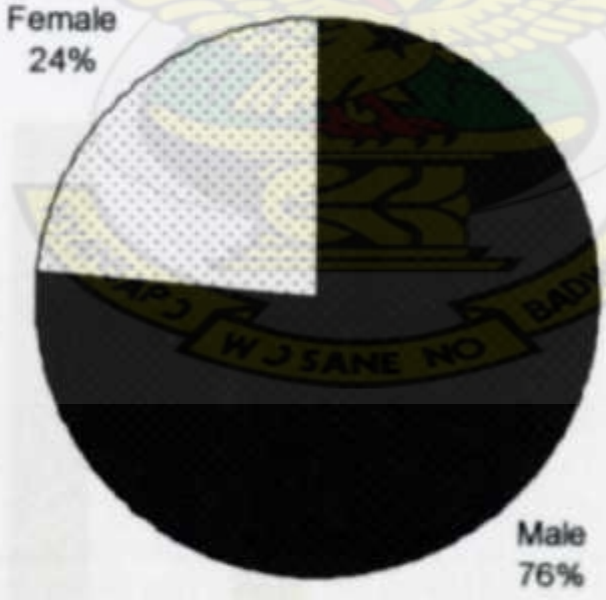


Fig.4.2: Gender of respondents

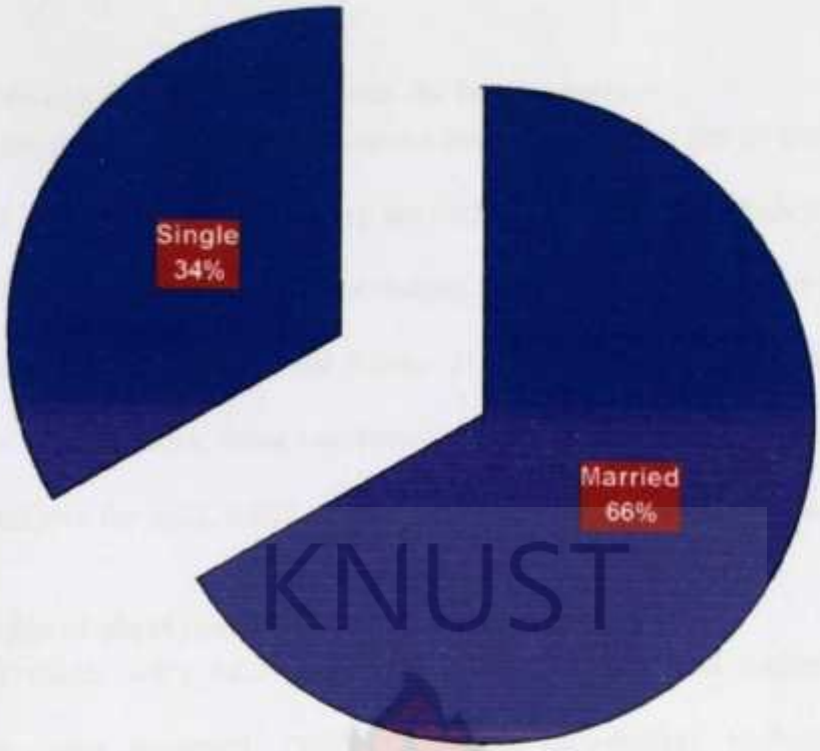


Fig.4.3: Marital Statuses of respondents

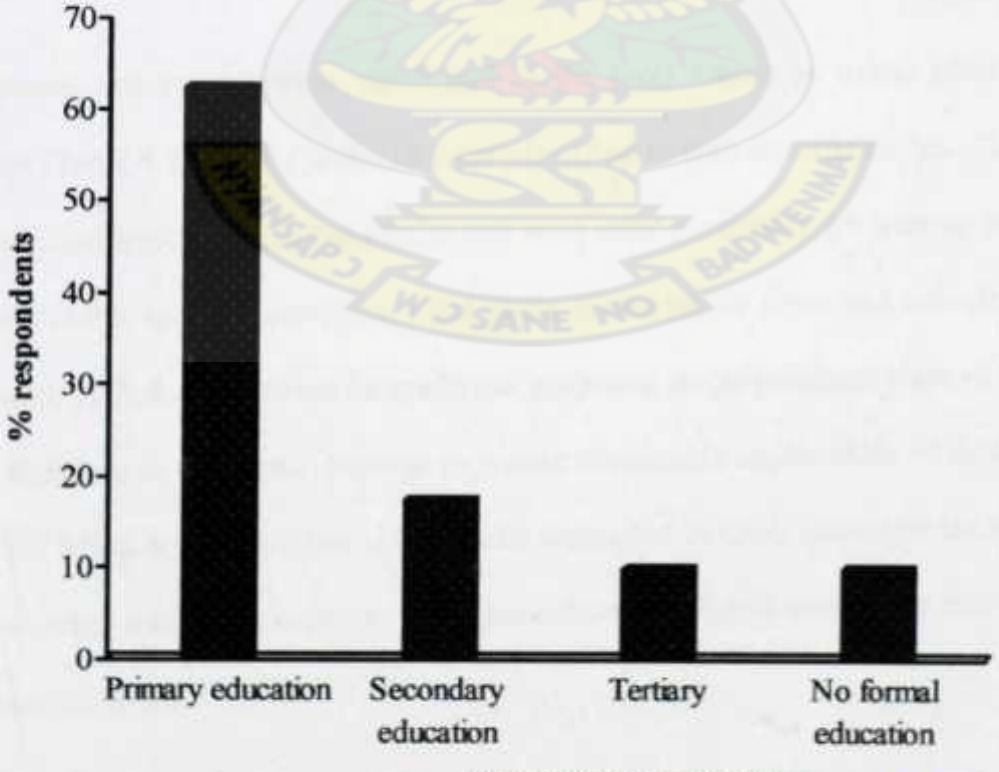


Fig.4.4: Educational qualifications of respondents

4.1.4 Relationship between the communities and the forest reserve

Some of the communities derived their names from the forest or the rivers/streams in the forest, for instance Yayaso which means they are settled on the Yaya stream which takes its source from the forest. Four other streams mentioned to take their source from the forest.: Adenkyerensu, Akwasi-Akwasi, Adetosu and Afosu. These serve as major source of water for these villages. For several years, these communities have relied on the trees, plants and wildlife of the forest reserve for food, medicine and the survival of their cultural beliefs.

4.1.5 Local knowledge of plant species

Several forest plants were held sacred in all the villages and hamlets studied. Examples were: The forest emergent 'Odii' (*Okoubaka aubrevillei*), Nufuten (*Kegelia africana*) and 'Ahomakyem' (*Spiropetelum heterophyllum*). These species were held like 'gods' and were believed to execute instant judgment on offenders. The 'Odum' tree (*Milicia excelsa*) used to be sacred but has lost its traditional value due to its demand on the timber market.

Nineteen tree species were mentioned in the local names as useful plants in the communities (Table 4.2). Out of these 16 were identified to their specific names. The plants were of medicinal importance to the people and were used commonly for treating important diseases such as fits, anemic conditions, waist pains, severe bodily aches and convulsion.

In spite of their exploitation for medicinal purposes, the respondents claimed that they were very common in the forest. Perhaps to ensure sustainable exploitation of these plants, they were not felled or uprooted but various parts were used in small quantities for medicinal purpose and other traditional customs. Thus portions of the forest containing these species were not over exploited.

Table 4.2 Sacred/Important tree species from the respondents

Biological Name	Local Name	Type of benefit	Current Status
Alstonia boonei	Nyamedua/Sinuro	For the treatment of measles and making of stools	Common
Baphia nitida	Edwene	For dispersing soldier and red ants	Common
Cordia milleni	Tweneboa	For the making of palace drums	Common
Griffornia simplicifolia	Kegya	For the treatment of general pains	Common
Funtumia elastica	Ofuntum	Use to make linguist staff	Common
	Atoa	For the expulsion of retained placenta	Common
	Metwa	For curing elephantiasis	Common
Kaya ivorensis	Mahogany		Common
Kegelia africana	Nufuten	For the treatment of convulsion	Common
Okoubaka aubrevillei	Odii		Common
Pycnanthus angolense	Otie	For curing anemic conditions	Common
Rauvofia vomitoria	Kakapenpen	For the curing of stomach ache	Common

Table 4.2 continued

Solanium erientum	Pepediawuo	For the treatment of piles	Common
Spiropetelum heterophyllum	Ahomakyem	For curing fits and swells on the body	Common
Tetrapleura tetraptera	Prekese	As food spice and treatment of different ailments	Common
Trichilia monodelpha	Otanduro	For treatment of waist pains and anemic conditions	Common
	Anya	Enhances quick recuperation	Common
Zanthoxylem gilletii	Ekuo	For the treatment of general body pains	Common

Table 4.3: Plant Species known to be in the forest by respondents

Scientific Name	Local Name	Family
Afrosesalisia afzelii	Abako nini	Sapotaceae
Aidia genipiflora	Otwensono	Rubiaceae
Albizia adianthifolia	Pampena	Mimosaceae
Albizia ferruginea	Awiemfosamina	Mimosaceae
Albizia zygia	Okoro	Mimosaceae
Alstonia boonei	Onyamedua	Apocynaceae
Aningeria altissima	Asanfena bere	Sapotaceae
Aningeria robusta	Asanfena nini	Sapotaceae
Amphimas pterocapoides	Yaya	Caesalpinaceae
Anophyxix klaineana	Kokote	Rhizophoraceae
Anthocleista vogelii	Aworabontodie	Loganiacae
Anthonotha macrophylla	Totoro	Caesalpinaceae
Antiaris toxicaria	Kyenkyen	Moraceae
Aulacocalyx jasminiflora	Ntweson	Rubiaceae
Baphia nitida	Edwen	Papilionaceae
Baphia pubenscens	Odwenkobiri	Papilionaceae
Blighia sapida	Akye	Sapindaceae
Blighia unijugatha	Akye biri	Sapindaceae
Blighia welwitschii	Akyekobiri	Sapindaceae
Bredilia atroviridis	Opamkotokrodu	Euphorbiaceae
Bombax buonoposenze	Akonkodie	Bombaceae
Bussea occidentalis	Kotoprepre	Caesalpinaceae
Calpocalyx brevibracteatus	Atrotre	Caesalpinaceae
Canarium schweinfurthii	Bediwonua	Burseraceae
Carapa procera	Kwakuobese	Meliaceae
Cedrella odorata	Cedrella	Meliaceae
Ceiba pentandra	Onyina	Bombaceae

Table 4.3 continued

Celtis adolfi-friderici	Esakosua	Ulmaceae
Celtis milbraedii	Esa	Ulmaceae
Celtis zenkeri	Esakoko	Ulmaceae
Cola nitida	Bese	Sterculiaceae
Chrysophyllum subnudum	Adesaa	Sapotaceae
Clausena anisata	Samanobi	Sapindaceae
Cola gigantea	Watapuo	Sterculiaceae
Cleistopholis patens	Ngonenkyene	Annonaceae
Cola millenii	Anansedodowa	Sterculiaceae
Cordia milleni	Tweneboanini	Boraginaceae
Corynanthe pachyceras	Pampenama	Rubiaceae
Cyclodiscus gabunensis	Denyo	Mimosaceae
Diopyrous canaliculata	Otwabere	Ebenaceae
Diospyros gabunenses	Kusibiri	Ebenaceae
Diospyros kamerunensis	Menewa	Ebenaceae
Diospyros monbutensis	Atwere nantin	Ebenaceae
Discoglypremna caloneura	Fetefre	Euphorbiaceae
Distemonanthus benthamianus	Bonsamdua	Caesalpinaceae
Dracaena arborea	Ntonme	Agavaceae
Entandrophragma angolense	Edinam	Meliaceae
Entandrophragma cylindricum	Penkwa	Meliaceae
Erythrina vogelii	Sore	Papilionaceae
Erythrophleum ivorensis	Potrodum	Caesalpinaceae
Ficus exasperate	Nyankyere	Moraceae
Ficus mocuso	Bumbra	Moraceae
Ficus capensis	Nwadua	Moraceae
Funtumia africana	Okae	Apocynaceae

Table 4.3 continued

Funtumia elastica	Ofumtum	Apocynaceae
Glyphaea brevis	Foto	Tiliaceae
Hannoa klaineana	Fotie	Simaroubaceae
Harunguna madagascariensis	Kosowa	Guttiferae
Hymenostigia afzelii	Takorowa	Caesalpinaceae
Lecanioidiscus cupanioides	Dwindwera	Sapindaceae
Leptonychia pubenscens	Fotonua	Sterculiaceae
Macaranga barteri	Opam	Euphorbiaceae
Macaranga hurifolia	Opamfufuo	Euphorbiaceae
Mareya micrantha	Dubrafo	Euphorbiaceae
Microdesmis puberula	Ofema	Pandaceae
Milicia excelsa	Odum	Moraceae
Millettia rhodantha	Tetetoa	Papilionaceae
Monodora myristica	Wedeaba	Annonaceae
Monodora tenuifolia	Motokuradua	Annonaceae
Morinda lucida	Konkroma	Rubiaceae
Musanga cecropiodes	Odwuma	Moraceae
Myrianthus arboreus	Nyankoma	Moraceae
Marianthus libericus	Nyankomanini	Moraceae
Nauclea diederrichi	Kusia	Rubiaceae
Nesogodonia papaverefera	Danta	Sterculiaceae
Newbouldia laevis	Sesemasa	Bignoniaceae
Petersianthus macrocarpus	Esia	Lecythidaceae
Phyllocosmos africanus	Akokorabeditoa	Ixonanthaceae
Psydrax subcordata	Tetiapon	Rubiaceae
Pterygota macrocarpa	Kyere	Sterculiaceae
Pycnanthus angolensis	Otie	Myristicaceae

Table 4.3 continued

Rauvolfia vomitaria	Kakapenpen	Apocynaceae
Rinoria oblongifolia	Mpawutumtum	Violaceae
Rothmania longiflora	Samankube	Rubiaceae
Spathodia campunulata	Akuakuo nisuo	Bignoniaceae
Sterculia rhinoptela	Wawabema	Sterculiaceae
Sterculia tragacantha	Sofo	Sterculiaceae
Stombosia glauscecens	Afena	Olaceae
Tabernaemontana africana	Obonawa	Apocynaceae
Terminalia ivorensis	Emire	Combretaceae
Terminalia superba	Ofram	Combretaceae
Tetrochidium didymostemon	Anenedua	Euphorbiaceae
Treculia africana	Ototim	Moraceae
Trema orientalis	Sesea	Euphorbiaceae
Trichilia monadelpha	Tanuro	Meliaceae
Trichilia prieureana	Kakadikro	Meliaceae
Triplochiton scleroxylon	Wawa	Sterculiaceae
Zanthoxylem gilletii	Okuo	Rutaceae
Zanthoxylem lemairei	Okuonini	Rutaceae

4.1.6 Forest Protection

Currently, some community members were part of the community forest committee (CFCs) which was set up by the District Forestry Department. They were to patrol the forest and report any illegal activities to the Forestry Department. They were motivated by being given one-third of the money generated from prosecuting offenders.

4.1.7 The Communities' perception of impact of mining activities on the forest reserves

The respondents were not sure of the future of the forest reserve since exploration for surface mining of gold was going on in the forest. The entire forest could be lost within some few years to come if they do not take strict measures to conserve certain portions of the forest. According to the respondents any industrial development, such as surface mining would affect their way of life. Along with the communities, a diverse ecosystem would also be destroyed.

4.1.8 Modes of Conservation

The single most effective conservation strategy, according to the respondents was the observation of traditional laws and customs. Some also responded to other conservation methods such as home garden and seed storage (Fig. 4.6).

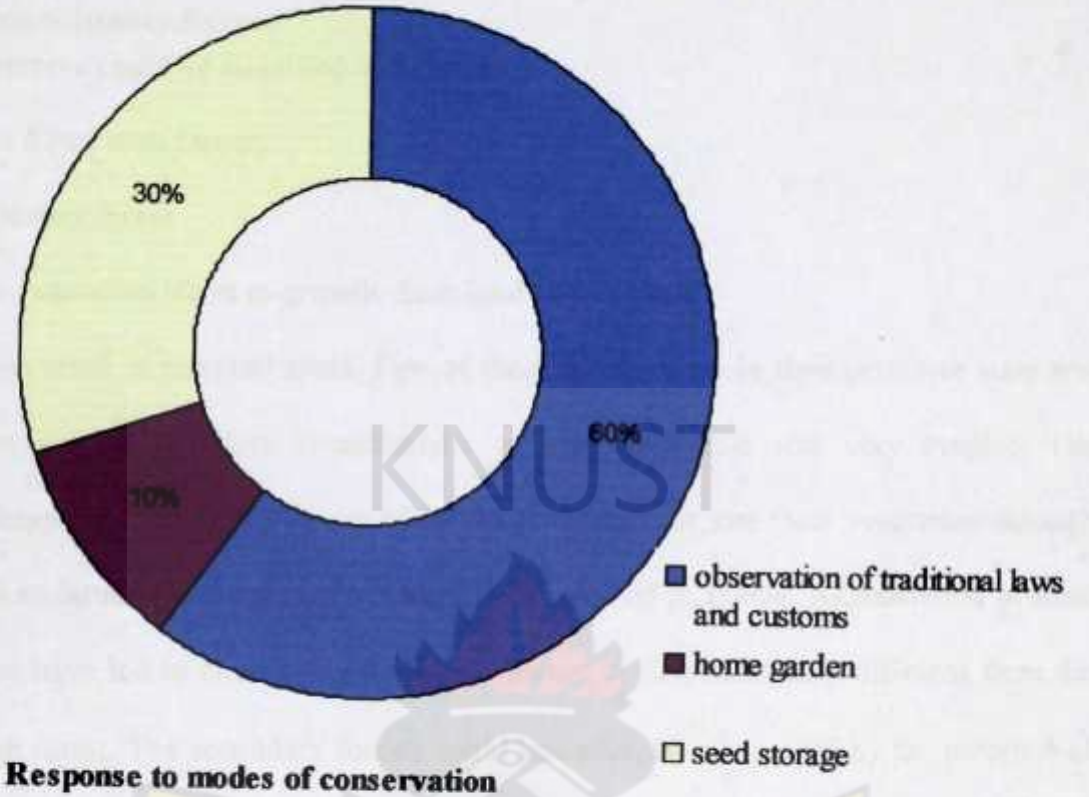


Fig. 4.6 Response to modes of conservation

4.1.9 History of the Forest Reserve

According to the available information at the District Forestry Office at Kade, the Ajenjua Bepo Forest Reserve was established in 1929 and classified as Hill Sanctuary. It was under the Adausina and Afosu stool land. The total area of the reserve is 580.60 hectares (ha). Out of this area, 87.35ha consist of admitted farms while 70.97ha consist of *Cedrella odorata* plantation which was established between 1975 and 1985 through a 'thaunga' farming system. Another 18.25ha consisting of *Terminalia superba* and *Cedrella odorata* was established between 2004 and 2005 through afforestation programs. However, there have been illegal activities such as logging and farming over the years which call for some management measures. Offenders are prosecuted to deter them from going back to the forest.

4.2 Vegetation Survey

4.2.1 Reconnaissance Survey

The forest reserve could be classified as follows:

- High forest with canopy
- Secondary forest
- Low vegetation (farm re-growth, farm land and swamp)

The forest occurred in reserved areas. Few of these forests were in their primitive state and the complex vertical structure characteristic of tropical forests was very evident. The secondary forest was originally occupied by virgin forest but lost their vegetation through factors such as farming and logging but have been allowed to fallow. Regeneration process was found to have led to climax forest which was not at first noticeably different from the adjacent high forest. The secondary forests could however, be recognized by the presence of certain plant species not found in the high forest. The dominant plant species were: *Trema orientalis, Ceiba pentandra* and *Psydrax subcordata*. The low vegetation may be classified as farmlands that have been left to fallow and were relatively in early stages of succession. Some of the farms had tall trees including important timber species.

4.2.2 Conservation Strategies

According to the forestry officials, the management plans were afforestation and plantation programs. The community members were involved in the management of the forest by serving on the Community Forest Committee (CFC), a body set up by the Forestry Department, to report on any illegal activities in the forest. There was a monthly meeting schedule for these members. According to the forestry officials, participation was not encouraging and always constituted of men. These men were considered to have very low

status in their communities because they had only primary or no formal education, they fell within the 50 years and above age group.

The most popular extension activity was advocacy of taunga farming followed by control of forest depletion, with little or no attention given to conservation campaign. Forestry officials had the upper hand in determining any extension activity.

4.2.3 Relative Abundance of Species

The woody flora of the three study sites sampled and their relative abundance are indicated in Table 4.3. A total of 109 different species were identified in the degraded area, secondary forest and the virgin forest. The highest number (92) was recorded at the virgin forest followed by the secondary forest (64) and the degraded area (60).

The following plant species which were present in the high forest areas were not found in the secondary forest or the degraded area: *Albizia ferruginea, Alconia cordifolia, Aula cocalyx jasminum, Blighia sapida, Carapa procera, Carpolobia lutea, Chrysophyllum perpulchrum, Cyliscodiscus gabunensis, Corynanthe pachyceras, Diosspyros mombotensis, Entandrophragma angolense, Entandrophragma cylindricum, Erythrophleum ivorensis, Ficus recurvata, Ficus varifolia, Funtumia africana, Glyphea brevis, Hannoa klaineana, Mansonia altissima, Macaranga hurifolia, Marantochloa congensis, Marantochloa leucantha, Monodora Myristica, Monodora tenuifolia, Nauclea diederrichi, Newbuldia laevis, Palisota barteri, Palisota hirsute, Piper guinensis, Penianthus patulinervis, Phyllocosmos africanus, Spathodia campunulata and Zanthoxylem lemairei.*

However *Lantana camara* and *Peuraria phaseloides* were relatively more abundant in the secondary and the degraded forest areas than in the natural forest areas, infact it was not recorded in any of the quadrats located in the natural forest areas.

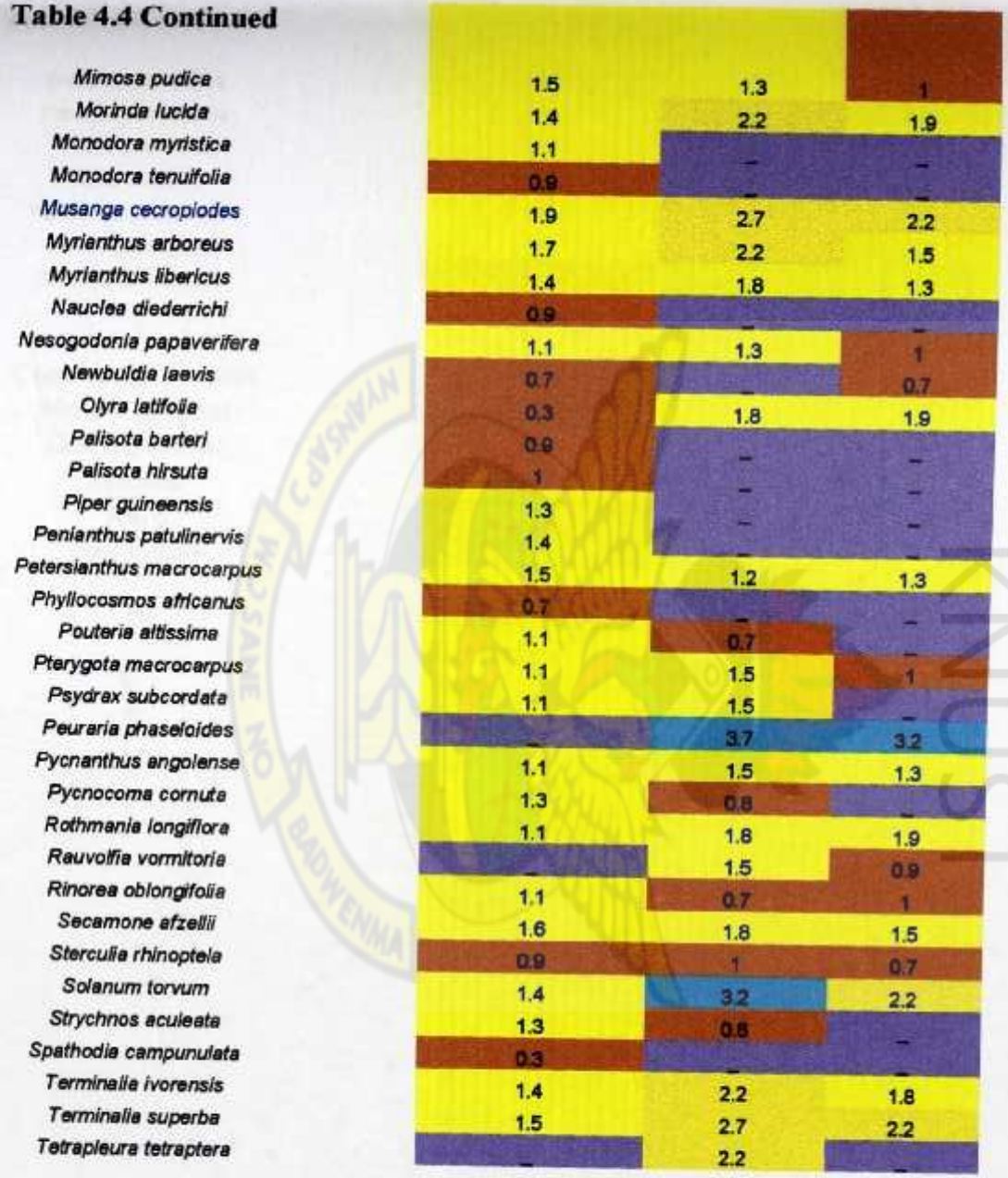
Table 4.4 Relative Abundance of plant species in the study area

Species	N	S	D
Alafia barteri	0.7	2.9	2.2
Aldia genipiflora	1.1	0.7	1.8
Albizia adianthifolia	0.9	0.3	1.3
Albizia ferruginea	–	–	0.6
Albizia zygia	0.9	0.3	1
Alconia cordifolia	1.1	–	0.7
Alstonia boonei	1.1	1.2	1.8
Amphimas pterocarpus	0.7	0.4	1
Anthocleista vogelii	1.3	1	1.5
Anthonotha macrophylla	1.2	1.5	–
Aningeria altissima	0.3	–	–
Antiaris toxicaris	0.8	1.2	0.7
Aulacocalyx jasminum	0.7	–	0.6
Baphia nitida	1.4	1.3	1.9
Baphia pubenscens	1.2	1.5	1.5
Blighia sapida	0.6	–	0.7
Blighia unijugatus	0.6	0.6	0.7
Bombax buonoposenze	–	–	0.6
Bredilia occidentalis	0.3	–	–
Carapa procera	1.4	–	–
Carpolobia lutea	1.8	–	–
Cardiospermum grandiflora	1.1	0.3	–
Calpocalyx brevibracteatus	0.9	0.3	2.1
Calycobolus africanus	1	0.7	1.2
Cedrella odorata	–	2.5	2.1
Celtis adolfi-fredirici	0.7	0.6	0.6
Celtis mibraedii	0.7	2.2	1.2
Ceiba pentandra	1.5	1	1.5
Chrysophyllum perpulchrum	1.5	–	–
Chrysophyllum subnudum	0.9	0.7	1.2
Cyliscodiscus gabunensis	0.4	–	–
Cleistopholis patens	1.1	0.6	1.3
Corynanthe pachyceras	0.4	–	–
Cola gigantia	0.6	0.7	1

Table 4.4 Continued

Cola nitida	–	1.5	1.6
Chromolaena odorata	0.7	2.7	2.2
Dalbergia oblongifolia	1.4	0.3	0.7
Discoglypremna caloneura	0.4	0.1	–
Diospyros canalicuta	1.3	1.5	1
Diospyros kamerunensis	0.7	0.4	0.4
Diosspyros mombutensis	0.7	–	–
Distemonanthus benthamianus	1.1	1.3	0.7
Elaeis guineensis	–	–	2.9
Erythrina vogelii	–	1	0.7
Entandrophragma angoiense	1.2	–	–
Entandrophragma cylindricum	0.4	–	–
Erythrophleum ivorensis	0.6	–	–
Ficus exasperata	0.7	0.9	0.4
Ficus recurvata	0.8	–	–
Ficus sur	–	0.7	–
Ficus variifolia	0.6	–	–
Funtumia africana	0.9	–	–
Funtumia elastica	–	1.2	0.7
Glyphaea brevis	0.9	–	–
Grifonia simplicifolia	1.1	1.5	1.8
Hannoa klaineana	0.7	–	–
Hymenostegia afzelii	0.9	0.9	–
Hyselodelphys poggeana	1.1	1.8	1.5
Lantana camara	1.4	3.7	3.9
Mansonia altissima	0.7	–	–
Manniophyton fulvum	0.9	–	–
Macaranga barteri	0.7	0.7	–
Macaranga hurifolia	1.2	–	–
Marantochloa congensis	1.1	–	–
Marantochloa leucantha	0.9	–	–
Microdesmis puberula	1	1.5	–
Milicia excelsa	1.4	0.7	1.3
Millettia chrysophylla	0.7	2.2	2.9

Table 4.4 Continued



Mimosa pudica	1.5	1.3	1
Morinda lucida	1.4	2.2	1.9
Monodora myristica	1.1	–	–
Monodora tenuifolia	0.9	–	–
Musanga cecropiodes	1.9	2.7	2.2
Myrianthus arboreus	1.7	2.2	1.5
Myrianthus libericus	1.4	1.8	1.3
Nauclea diederrichi	0.9	–	–
Nesogodonia papaverifera	1.1	1.3	1
Newbuldia laevis	0.7	–	0.7
Olyra latifolia	0.3	1.8	1.9
Palisota barteri	0.9	–	–
Palisota hirsuta	1	–	–
Piper guineensis	1.3	–	–
Penianthus patulinervis	1.4	–	–
Petersianthus macrocarpus	1.5	1.2	1.3
Phyllocosmos africanus	0.7	–	–
Pouteria altissima	1.1	0.7	–
Pterygota macrocarpus	1.1	1.5	1
Psydrax subcordata	1.1	1.5	–
Peuraria phaseloides	–	3.7	3.2
Pycnanthus angolense	1.1	1.5	1.3
Pycnocoma cornuta	1.3	0.8	–
Rothmania longiflora	1.1	1.8	1.9
Rauvolfia vomitoria	–	1.5	0.9
Rinorea oblongifolia	1.1	0.7	1
Secamone afzellii	1.6	1.8	1.5
Sterculia rhinoptela	0.9	1	0.7
Solanum torvum	1.4	3.2	2.2
Strychnos aculeata	1.3	0.8	–
Spathodia campunulata	0.3	–	–
Terminalia ivorensis	1.4	2.2	1.8
Terminalia superba	1.5	2.7	2.2
Tetrapleura tetraptera	–	2.2	–

Table 4.4 Continued

Triclisia dictyophylla	1.3	1.5	
Trichilia monadelpha	1.6	1.9	1.3
Trichilia prieureana	1.2	1.5	1.2
Trema orientalis	0.9	2.2	1.5
Triplochiton scleroxylon	1.6	2.3	1.9
Zanthoxylem gilletii	1.5	2.1	0.7
Zanthoxylem lemairei	0.7		

Constantly present
Mostly present
Often present
Seldom
Rare
Not found

N Natural Forest
S Secondary forest
D Degraded forest

4.3 Fauna Survey

4.3.1 Butterflies

A total of 63 individual butterflies belonging to 18 species were trapped in the three sample sites species. From the survey, the degraded area had the most species (46.03%); followed by the secondary forest (40%) (Fig. 4.7) and the natural forest had the least occurring species (28.57%). In all the three sites, the species that occurred most was *Bicyclus madetes madetes* forming a total of 17 followed by *Eurytela dryope dryope* with a total of 9.

Table 4.5 Butterfly species recorded in the study area

Species	Natural forest	Secondary forest	Degraded area	Total
Aterica galena	x	1	x	1
Bebearia cocalioides	x	x	1	1
Bicyclus grauerii	x	1	x	1
Bicyclus martius	4	x	2	6
Bicyclaus madetes madetes	6	5	6	17
Bicyclaus sandace	x	2	x	2
Bicyclus zinebi	1	x	2	3
Charaxes numenes aequitorialis	x	x	2	2
Cymothoe aramisaramis	x	x	1	1
Cymothoe caenis	2	x	x	2
Cymothoe wemeri	1	x	x	1
Euphaedra medon	2	1	1	4
Euphaedra perseis	1	x	x	1
Euriphene amicia	x	1	x	1
Eurytela dryope dryope	x	1	8	9
Gnophodes betsimena	1	x	3	4
Hamanumida daedalus	x	1		1
Melanitis leda	x	3	3	6
Total	**18**	**16**	**29**	**63**

X = Not found

4.3.2 Amphibians and Reptiles

A total of 3 species each of the following animals were recorded: amphibians, lizards and snakes (Table 4.6). The amphibian species included *Ptychadena bibroni*, *Ptychadena pumolio* and *Leptopelis hyloides*. Reptile species (snakes) included *Python regius* (Royal python), *Bitis gabonica rhinoceros* (Gabon viper) and *Bitis arietans* (Path adder). Other reptiles (lizards) were *Hemidactylus brooki* (Brook's Gecko), *Mabuya perotetii* (African skink) and *Riopa fernandi* (Togo Fire). Table 4.6 indicates the sites each species was spotted.

4.3.3 Small and Large Mammals

A total of twenty-eight small mammals (Table 4.7) was recorded in the three sites with the degraded area recording the highest (19) followed by the secondary forest (5) and the natural forest (4) (Fig. 4.8).

Table 4.6 Species of Lizards, Amphibians and snakes recorded during the survey

Species	Common name	N	S	D	Total
Lizards					
Mabuya perotetii	African skink	x	1	7	8
Riopa fernandi	Togo fire	x	x	1	1
Hemidactylus brooki	Brook's gecko	1	x	x	1
Amphibians					
Ptychadena bibroni		x	x	1	1
Hyperolius baumanni		x	x	1	1
Phrynomantis microps		x	x	1	1
Snakes					
Python regius	Royal python	1	x	2	3
Bitis gabonica	Gabon viper	x	1	1	2
Bitis arientans arientans	Path adder	x	x		1
Naja melanoleuca	Forest cobra	x	x	1	1
Total					**20**

Key

N	Natural forest
S	Secondary forest
D	Degraded area
X	Not found

Table 4.7 Small Mammals recorded in the study area

Species	Common Name	N	S	D
Grammomys dolichochurus		0	0	3
Lophuromys Flavopunctata	Brush-furred mice	0	0	1
Praomys tullbergi	Soft-furred rat	0	0	3
Crocidura bicolor		0	0	1
Paracroccidura spp.	Rodent Shrew	1	0	0
Euxerus erythropus	Stripped ground squirel	2	2	2
Funisciurus anerythrus	Redless squirrel	0	2	4
Galago senegalensis	Galago	0	0	1
Helogale parvula	Dwaf mongoose	0	0	2
Civettictis civetta	African civet	0	0	1
Eidolon helvum	Straw-coloured Fruit bat	0	0	1
Thryonomys swinderianus	Grasscutter	2	0	0
Total		**5**	**4**	**19**

Key
N=Natural forest, S=Secondary forest, D=Degraded forest

CHAPTER FIVE

5.0 DISCUSSION

5.1 Socio-Economic Survey

From the survey, the youth and the middle aged formed the majority group, and their educational background was not high enough to offer them alternative source of livelihood other than farming. As a result, given the relatively large younger generation, increasing levels of unsustainable resource use might be anticipated. Farming remains the single most important source of income being it subsistence or commercial. Most of the traders also trade in one farm product or the other. This could account for the rapid degradation of the forest reserve since more land was being demanded for cocoa and oil palm plantation coupled with the fact that slash and burn was the major farming practice.

The low educational background could also contribute to difficulty in implementing conservation strategies. They actually did not appreciate why the forest or certain species should not be exploited in the name of conservation. To them, the forest has been there since time memorial and would remain intact without any management practices that will deny them access to their 'property'. The higher number of the respondents being married could also be a factor for higher dependency on the forest resource. This is because families which are tied by marriage and other family bonds find it difficult to migrate. Thus there will always be a higher demand on the same resources with increasing family members.

5.2 Conservation Strategies

The low educational qualification of members of the communities had contributed to the difficulty in implementing management strategies. Meetings organized by forestry officials were patronized by almost illiterate people who were just in search of any source of living rather than having interest in forest conservation. Such meetings were also limited to men because the women were occupied with to domestic chores. Due to inadequate publicity, community members were not being participatory and could not suggest any kind of management plans other than that suggested by the forestry officials. Also, due to lack of activities such as conservation education, many people were not sensitized on the essence of forest conservation and other areas such as establishment of woodlot plantation for firewood, thereby easing tension on the forest resource. Thaunga farming was found to be less effective since people were just focusing on source of food in the short term. In general, it was very important to involve the communities in decisions concerning the management of the forest since they had their own way and understanding of conserving certain species.

5.3 Relative Species Abundance

Though the respondents indicated that most of the important species were locally common, analysis of the percentage relative abundance (Table 2) identified most of the species were locally rare, even at the area where natural stands abound. Their lack of knowledge of the dwindling nature of the resource might be due to lack of conservation education/awareness. To them, once one tree of a particular species was accessible, that species was common. Anthropogenic activities such as illegal timber operators, farming and recently exploration for surface mining activities had contributed to felling of many trees and hence the difference in species composition.

However, it was obvious that any major land clearing activity such as surface mining will lead to the disappearance of many species.

5.4 Fauna Survey

5.4.1 Butterflies

Because the degraded area contained high diversity of butterfly host plants species which could be probably due to the presence of food crop farms, there was a high diversity of butterflies. The butterfly species Bicyclus *madetes madetes* was common in all the study sites. This means that it is not limited to only one type of habitat. They can therefore easily relocate in an event of any environmental disturbance.

5.4.2 Reptiles

Reptiles were generally rare and consisted of only few species.

5.5.3 Small Mammals

Only two shrews were captured and according to Kingdom (1997), these animals do inhabit all vegetation types and altitude. In the present study *Crocidura bicolor* was found in the degraded forest and *Paracrocidura species* was observed in the natural forest areas. The only bat, *Eidolon helvum*, captured at the degraded area, was a typical forest species. The low diversity and number of bats species could be due to the absence of fruits, flowers and nectar. In addition, the changing land-use might have caused the decline of the small mammals' population and diversity. Rodents were the most abundant species with the majority occurring at the degraded area which is characterized by farmland. Agricultural crops provide abundant source of food for mammals, therefore it was not surprising that small mammal species were abundant in the degraded area.

The most common species of rodents encountered were *Euxerus erythropus* and *Funisciurus anerythrus*. These species were also reported by SGS Environment (1998) to occur in the secondary and degraded forests.

5.5.4 Large Mammals

Only one Bushbuck (*Tragelaphus scriptus*) was observed in the Natural Forest. This is in accordance with the low observation made by SGS Environment, 1998 that the number of large and conspicuous mammals may be relatively small in Tropical humid forests.

CHAPTER SIX

6.1 CONCLUSION

6.1.1 Loss of forest

The results of the study have clearly demonstrated that slash-and-burn agriculture could significantly affect the floristic composition of semi-deciduous tropical forest such as the Ajenjua forest reserve. It was observed that the secondary forest areas, like the degraded areas, which were originally occupied by virgin forests but which had lost their vegetation through slash-and-burn agriculture, was noticeably different from the adjacent high forest. Although the secondary forest areas have been left fallow and allowed to undergo regeneration process leading to climax forest, some forest species were conspicuously missing.

Animal life was also not abundant in both the natural and degraded forest areas. The loss of tropical forest cover can have far-reaching effects, including changes in climate (especially rainfall) patterns, changes in biological productivity, accelerated rates of soil erosion, disruption of water stability and increasing emissions of green house gases. In terms of biological diversity, the destruction of primary moist tropical forest causes the extinction of vast numbers of species. Most of the species lost are unknown. Their inherent and aesthetic value, and their potential agricultural, pharmaceutical or silvicultural values vanish with them.

6.1.2 Invertebrate loss

Abundant as they are, terrestrial invertebrates are also more prone to extinction than most of other groups of organisms as was also observed in the present study. Many species of invertebrates have been found to be highly specialized with respect to food, habitat or other environmental requirements and thus are subject to extinction as a result of even relatively

small scale environmental degradation. Alterations of habitat at the Ajenjua forest reserve as a result of factors such as slash-and-burn agriculture and exploration for surface mining could result in far greater incidence of invertebrate species loss than would similar alterations in temperate regions.

6.2 Concluding Remarks

In Ghana, under existing practice of slash-and-burn agriculture, some trees including timber species are felled or poisoned causing further disappearance of plant species. Farmers should be educated to approach the forest with a 'gentle' hand, attempting to do no more than thin the canopy to introduce a tree of his choice in place of the original forest trees. Such farms will endure and the soils will remain virtually unchanged and gradually a new organic regime will supplement the old one with a slower loss of fertility.

References:

Akobundu, I.O. and Agyakwa, C.W. (1998). A Handbook of West African Weeds (2nd edition). International Institute of Tropical Agriculture, Ibadan, Nigeria.

Beck, J. and Schulze, C.H. (2000). Diversity of fruit-feeding butterflies along a gradient of tropical succession in Borneo with some remarks on the problems of "Pseudoreplicates". Trans. Lipid. Soc. Japan. 51(2); 89-98

Brown, K. and David W. P. (1994). The Causes of Tropical Deforestation. Vancouver: UCB Press

Crump, M. L. and N.J. Scott. (1994). Visual Encounter Surveys. Pp. 84-92 in Measuring and monitoring biological diversity: standard methods for amphibians, eds. W.R. Heyer, M. A. Donnerly, R. W. McDiarmid, L. C. hayek, and M. S. Foster. Smithsonian Institute Press. Washington D.C.

DeVries, P.J. (1987). The butterflies of Costa Rica and their Natural History. Princeton University Press. Pp.327.

Dokosi, O. B. (1998). Herbs of Ghana, CSIR, Ghana University Press, Accra: 746.

Emmel, T. C. and Larsen, T. B. (1997). Butterfly diversity in Ghana, West Africa. Tropical Lepidoptera. 8 (3), 1-13.

EPA (1996). Environmental Protection Agency at a glance. EPA, Accra, Ghana.

Erlich, P.R. &Erlich, A, H. 1992. The value of biodiversity. 219-226
Geldenhuys, 1996. The state of the Environment. 2-4

FAO (1993), Forest Resources Assessment of 1990 in tropical countries, United Food and Agriculture Organizations, *FAO forestry paper* 112:61, Rome

Ghartey, Edward E..(1987). "Devaluation as a Balance of Payments Corrective. Measure in Developing Countries: A Study Relating to Ghana" Applied Economics. v19, p. 937-947.

Greenpeace, 2001. Amazon Introduction. http://greenpeace.org/.

Grieg-Smith, P. (1964). Quantitative Plant Ecology. Second Edition London 315 pages.

Hall, J.B. and Swaine, M.D. (1981). Distribution and ecology of vascular plants in tropical rainforest, Forest vegetation in Ghana, W. Junk publications, The Hague.

Hall, M. (2003). Invasive plants and the nursery industry. Center for environmental studies, Brown University, USA.

Huntley and Matos, 1992. Africa Biodiversity.

Hutterer, R. and d.c.d. Happold. 1983 The shrews of Nigeria. Bonner Zoologisch Monographien, 18:1-79. Indoldby, C.M. 1929. O n the mammals of Gold Coast. Annals and Magazineof Natural History, 10:511-518.

ITTO (2002). Management strategies for degraded and seed ecology of relevance to management of tropical forest wildlands in Rainforest regeneration and management, UNESCO, Paris: 137-157.

Kingdom, J. 1997. The Kingdom fiel guide to African mammals. Academic Press, San Diego, London, Boston, xviii + 464 pp.

Larsen, T.B. (2003). Butterflies. Interim Report of Ghana Rapid Assessment Programme. Hanoi, 20th November.

Lavorel, S., Prieur-Richard, A. H, and Grigulis,k. (1999). Invasibility and diversity of plant communities: from patterns to process. Diversity and Distributions 5:41-49.

Meester, J. A. and Setzer, K. (1971). The Mammals of Africa: an identification manual, The Smithsonian Institute, Washington, D.C. USA.

Miller,G. Tyler Jr., 2000. Living in the Environment, eleventh edition. Brooks/Cole Publishing Company, Boston, p 643-679.

Myers, N., Mittermeier, R. A., Mittermeier, C. G., da Fonseca, G.A.B. and Kent, J. (2000). Biodiversity hotspots for conservation priorities. Nature 403:853-858.

Ntiamoah-Baiden, Y. 1995. Conservation education in threatened species management in Africa. Bird Conservation International.

Owusu, J.G.K., Manu, C.K., Ofosu, G.K and Ntiamoa-Baidu, Y. (1989) Report of the working group on Forestry & Wildlife prepared for the EPC, Accra, Ghana.

Pineiro, C.E.G. and Ortiz, J. V. C. (1995). Communities of Fruit-Feeding Butterflies along a vegetation gradient in Central Brazil. J. of Biogeography. 19, 505-511.

Rainforest Information Centre Education Supplement (RIC), 2000A. The Causes of Rainforest Destruction. http://forests.org/ric/background/causes.htm.

Reeder, D. M. (1993). Mammal species of the world. Ataxonomic and geographic reference. 3rd Edition Smithsonian Institution Press, Washington, D.C.

Revington, J. (1992.) The Causes of Tropical Deforestation. http://www.ru.org/32defore.html.

Saunders, D. Margules, C. and Hill, B. (1999). Environmental indicators for state of the environment reporting- biodiversity, Department of Environment, Canberra.

SGS (2004). Environmental Impact Assessment in the Ajenjua Bepo Forest Reserve.

UNEP. (1992). The world environment 1972-1992. Two decades of challenge (M.K. Tolba et al., eds.). London, Chapman and Hall.

APPENDICES

Appendix 1

QUESTIONNAIRE TO STUDY THE POSSIBLE EFFECTS OF THE EXPLORATION ACTIVITIES ON THE FOREST RESERVE (LOCAL COMMUNITIES)

A. Socio-Economic Information

1. Community/Cottage/Hamlet.....

2. Age (years)

   [] <35 [] ≥35

3. Gender

   [] Male [] Female

4. Marital Status

   [ ] Married [ ] Single

5. What is your educational background?

   [ ] Primary [ ] Secondary [ ] No formal education [ ] Tertiary

6. What is your occupation?

   [ ] Farming [ ] Trading [ ] Teaching [ ] Hunting [] Unemployed

B FOREST CONSERVATION

1. What is the relationship between your community and the forest reserve?

   .....

2. Mention tree species held sacred either traditionally or medicinally in your community

   .....

3. Mention mammals known to exist in the forest reserve

   .....

4. What measures does your community take to protect the forest?

   .....

5. Has your community expressed any concern about the future of the forest reserve?

   [] Yes [] No

6. If yes, what are the concerns and how do you hope to mitigate them?

   .....

7. Which of the following modes of conservation will you consider most effective in your community?

   [] Observation of traditional laws and customs [] Home garden [] Seed storage

8. What kind of impact would industrial development have on the forest reserve and your community?

   .....

APPENDIX 2

A STRUCTURED QUESTIONNAIRE TO STUDY THE CONSERVATION/MANAGEMENT STRATEGIES OF THE AJENJUA BEPO FOREST RESERVE (DISTRICT FORESTRY OFFICER)

HISTORY OF THE FOREST RESERVE

1. Which type of forest description does the reserve fit?

.....

2. When was it declared a forest reserve?

.....

3. What is the total area of the forest reserve?

.....

4. The forest reserve falls under which stooland?

.....

5. What kind of illegal activities go on in the forest?

.....

MANAGEMENT STRATEGIES

1. What management plans are in place?

.....

2. Do you have a scheduled meeting for the communities to discuss management issues?

   [] Yes [] No

3. What are the demographic characteristics for those willing to attend such management meetings?

4. Which of the following extension activities is promoted most with regards to your management strategies?

   [] Conservation campaign [] Control of forest depletion [] Supply of tree seedlings [] Advocacy of taunga farming

5. Which party determines extension activities?

   [] Forestry Officials [] Community Leaders [] Both forestry officials and community leaders.