

**THE POTENTIAL AND CONSTRAINTS OF AGROFORESTRY IN
FOREST FRINGE COMMUNITIES OF THE ASUNAFO DISTRICT-GHANA**

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This research has been done in the context of an interdisciplinary student project organized and financed by Tropenbos International Ghana (TBI-Ghana), using the educational model developed by the University of Amsterdam and supervised by lecturers of the Institute of Renewable Natural Resources and TBI-Ghana staff. The members of the research groups are mainly fresh graduates from different universities in Ghana and one from Suriname.



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PREFACE

This report is the result of a multi disciplinary study conducted by a group of students who just completed their first degree under the auspices of the Student Platform Project sponsored by Tropenbos International Ghana. The team was made up of seven Ghanaians and a Surinamese. The disciplinary backgrounds of the team were Natural Resource Management, Agriculture, Social Work, Geography and Resource Development, Economics and Agriculture Technology. The Ghanaian students were selected from the University of Ghana (UG), University for Development Studies (UDS), University of Cape Coast (UCC) and Kwame Nkrumah University of Science and Technology (KNUST) whilst the Surinamese participant was from the Anton de Kom University of Suriname (UvS).

The Student's Platform Project provides opportunity for young graduates to acquire practical skills and new concepts in research work and apply them in professional work.

The primary objective of the study was to identify the potentials, constraints and problems that hinder the farmers to fully benefit from agroforestry in the Asunafo District.

This study was conducted in 14 weeks, which involved training in proposal writing, data collection and data analysis, and final writing of the report. This report contains baseline data collected through observations, interviews using questionnaire and focus group discussions in six (6) communities selected.

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We also wish to express our sincere gratitude to the following organizations for their contributions to the success of the programme: Ministry of Food and Agriculture (MoFA), Forestry Services Division (FSD), German Technical Co-operation (GTZ), Rural Development and Youth Association (RUDEYA), Rural Initiators Motivators Development Association (RIMDA), Scanstyle Mim Limited, Crops Research Institute (CRI) and Forestry Research Institute of Ghana (FORIG)

We appreciate the time sacrificed by our respondents in making this study a success.

Finally, but most importantly, the team appreciates the assistance of the Asunafo District Assembly, the Assemblymen and the Chiefs from the studied communities.

To all those who contributed to the groups success in one way or the other, but whose name could not be mentioned, we say thank you.

ABSTRACT

The problem of population growth coupled with economic pressure has resulted in a high rate of deforestation of the country's natural resource base. An interest in Agroforestry (AF) has therefore become necessary in order to encourage sedentary agriculture and rejuvenate degraded soils.

The study was aimed at assessing the potential and constraints of agroforestry in the forest zone of Ghana with a view to making practical recommendation. The Asunafo District in the Brong Ahafo Region of Ghana was therefore used as the study area. The study area was done using random sampling of farmers after selecting six (6) forest fringe communities from three forest reserves. Primary data on agroforestry were collected using close-ended questionnaires, focus group discussion and field observations.

Secondary data on AF activities were also obtained from organizations working in the study area.

Results indicated that farmers practised agroforestry unconsciously as they have several species of tree stands on their farmlands with food crops and gives a high opportunity for the conscious introduction of agroforestry.

Traditional values like community taboos on tree planting are non-existent even though some communities had taboos on the rearing of animal species like goat.

Indigenous knowledge on trees and their importance by farmers both economically and ecologically is present since a high percentage of farmers knew the concept of the system and were willing to adopt an improved version when introduced.

Land ownership for crop production was largely by inheritance and various agricultural and agroforestry practices were undertaken since farmers tended tree species on the farms. Farmers in the area were also into cocoa and oil palm plantation establishment, which gives an indication of the practice of useful tree planting.

Fallow periods and yield of crops are declining in the area because of high population pressure on land for farming activities since farmers depend mainly on agriculture for their sustenance.

The promotion of some aspects of agroforestry including wildlife domestication by governmental and non-governmental organizations is underway in the study area and some communities already have small community woodlots and nurseries. Most of these

institutions, however, work indirectly on the adoption of agroforestry. Promotion of non-conventional animal species such as grasscutter rearing, snail keeping as well as capacity building are also undertaken by these organisations

The major constraints to agroforestry include crop destruction by felling timber species on farms. This is usually because of the scattered arrangement of trees on farmlands. Inadequate education on tree tenureship, lack of seedlings and inadequate knowledge on logging procedures as well as poor marketing system are also major setbacks to the conscious introduction of agroforestry in the study area.

The practice of agroforestry in Ghana needs policy recommendations to bring major changes to the agroforestry system in the study area. Research strategies and priorities, extension education, socio-economic factors, agroforestry training and education, and institutional issues are important and need to be addressed even though there is a policy on agroforestry in Ghana. The goal of this policy should be to harmonize and strengthen agroforestry research and development programmes through multidisciplinary and inter-institutional approach rather than by fragmented efforts that are usually characterised by competition and lack of coordination.

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LIST OF ACRONYMS AND ABBREVIATIONS

AF	Agroforestry
AFR	Ayum Forest Reserve
BFR	Bonkoni Forest Reserve
CFC's	Community Forest Committee
CRI	Crop Research Institute
D&D	Diagnosis and Design
FORIG	Forestry Research Institute of Ghana
FSD	Forestry Services Division
GFD	Goaso Forest District
GOs	Government Organizations
GTZ	German Technical Co-operation
IRNR	Institute of Renewable Natural Resources
KNUST	Kwame Nkrumah University of Science and Technology
MOFA	Ministry of Food and Agriculture
NCCE	National Commission on Civic Education
NGO	Non-governmental Organization
NRCD	National Redemption Council Decree
NTFPs	Non-Timber Forest Products
PTD	Participatory Technology Development
RIMDA	Rural Initiators Motivator Development Association
RMSC	Resource Management Support Centre
RUDEYA	Rural Development Youth Association
SFR	Subim Forest Reserve
SRA	Social Responsibility Agreement
TBI	Tropenbos International
UCC	University of Cape Coast
UDS	University for Development Studies
UG	University of Ghana
UvS	Anton de Kom University of Suriname

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of study

Farming is the predominant occupation in the forest zone of Ghana and many types of farming practices have evolved over the years. A lot of these farming practices involve the use of trees either simultaneously or sequentially with agricultural crops and are therefore agroforestry by definition. However, the conscious practice of agroforestry is not common in the forest zone of Ghana a situation that prevents farmers from exploring the full potential of this land use system.

Agroforestry is a dynamic, ecologically based natural resource management system that, through the integration of trees in farmland and rangeland, diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels (Leakey, 1996). The integration may either be a spatial mixture or in temporal sequence with both ecological and economic interactions between the woody and non-woody components of the system.

In Ghana, trees have been used in farming system unconsciously for maintaining soil productivity and to have favourable effects on crops (Amanor, 1996). However the increasing demand for fuelwood, fodder and timber has greatly affected the practice of leaving trees on farms resulting in deforestation. Also traditional fallow periods have reduced drastically leading to land degradation and lower agricultural yields. One way that appears suitable for providing a solution to the adverse effect of deforestation and reduced fallow periods is therefore the conscious introduction of agroforestry into traditional farming systems. It is against this background that the Government of Ghana adopted or initiated agroforestry as an approach to sustainable land use. The national agroforestry policy was initiated in 1986 to promote sustainable land use in Ghana (Terakawa, 2002).

The practice of agroforestry is usually with the intention of developing a more sustainable form of land-use that can improve farm productivity and the welfare of the rural community as a whole. The system, therefore, has a potential of mitigating deforestation and land depletion and thus help alleviate rural poverty. The promise of

nitrogen fixing trees for improving soil fertility in cropland and pasture is as important as has the resistance of some trees to drought, the role of windbreaks in protecting cropland and pasture, the contribution of high protein tree fodder to livestock production and the commercial potential of several kinds of tree crops. In addition to these numerous benefits, agroforestry practices are appropriate for a wide variety of places within the landscape, not just for cropland or pasture.

1.2 Justification for the study

Increasing pressure on limited land resources is a problem being faced in the rural areas of Ghana. Subsistence farmers in these areas practise traditional bush fallow, clearing and burning bush at short intervals to grow annual food crops. The problem of population growth coupled with economic pressure has resulted in a high rate of deforestation of the country's natural forests. Deforestation has also been on the increase due to the increasing demand for fuelwood, tree fodder, timber, poles and agricultural land. Soil erosion, shortage of fuelwood, land degradation, siltation of water bodies and lowering of agricultural production usually result from deforestation. Over-cropping by farmers has also resulted in loss of vegetation, which allows for easy soil erosion with its consequent depletion of soil fertility. This goes a long way to result in crop yield decline and thus leads to poverty and / or disease prevalence.

Currently in Ghana the area of closed forest is declining by an estimated 0.4% per year and the area of savanna woodland is shrinking by 0.5% a year (Terakawa, 2002). Approximately 112,000 ha of tree cover are lost yearly through improper farming practices and over exploitation of wood resources (Terakawa, 2002). Due to the small land area owned by most farmers in these forest areas there has been a problem of encroachment on forest reserves by farmers for agricultural activities which may result in excessive destruction of tree cover or vegetation. The traditional farming system is shifting cultivation and its productivity depends largely on the fertility of the soil, which is usually maintained by long fallow periods. Fallow periods have however been reported to have steadily reduced over the years from more than five years to less than two years (BIRD, 2001).

Alienation of communities from the natural resource base is certainly not the way to guarantee the future of the forests as the user groups' depend mostly on the forest for

their sustenance. With the depletion of communal forests and increasing pressures on the forest reserves, a better management system has to be found to reduce degradation even further, and guarantee the future of the existing forest reserve and it is for this reason that agroforestry as a better land use system has been suggested.

This work is aimed at gathering data on the constraints to and opportunities for agroforestry as a land use system since research has little or no information on the system for the study area. This study would therefore serve to improve the system as well as pave way for future research work in agroforestry and the study area in particular.

1.3 Objectives of the study

Overall objective

Explore the constraints and opportunities for promoting agroforestry in the Asunafo District.

Specific objectives

1. To identify the various agricultural land use systems and agroforestry practices in the communities.
2. To identify the perceptions of the people in the communities on the adoption of agroforestry as a farming practice.
3. To identify the constraints and problems that confront farmers in tapping the full potential of agroforestry.
4. To identify the conditions and local practices that favour the practice of agroforestry systems.
5. To assess the level of involvement of relevant stakeholders on the adoption of agroforestry.

1.4. Study Area

Asunafo District forms the base of the colonial Ahafo District, which was one of the first districts in present Brong Ahafo Region. The district dates as far back as 1912 and has her capital at Goaso; it lies between latitudes $6^{\circ}27^1\text{N}$ and $7^{\circ}00^1\text{N}$ and longitudes $2^{\circ}23^1\text{W}$ and $2^{\circ}52^1\text{W}$ (Figure1.1).

The district shares common boundaries with the Asutifi District to the north and east, Dormaa District to the northwest, Atwima District (Ashanti Region) to the southeast and Juabeso-Bia and Sefwi-Wiawso Districts (Western Region) to the west and south. The district has a total land area of 2,187.5Km² and has a generally low-lying topography (150-300m) with rugged ends towards north-east (Mim) and south-west (Abuom). The semi-deciduous forest vegetation is dissected by three rivers (Tano, Goa and Ayum). With a population of 171,794 the Asunafo district has a population density of 85 persons per Km². The female population constitutes 51% with male constituting 49% (BIRD, 2001).

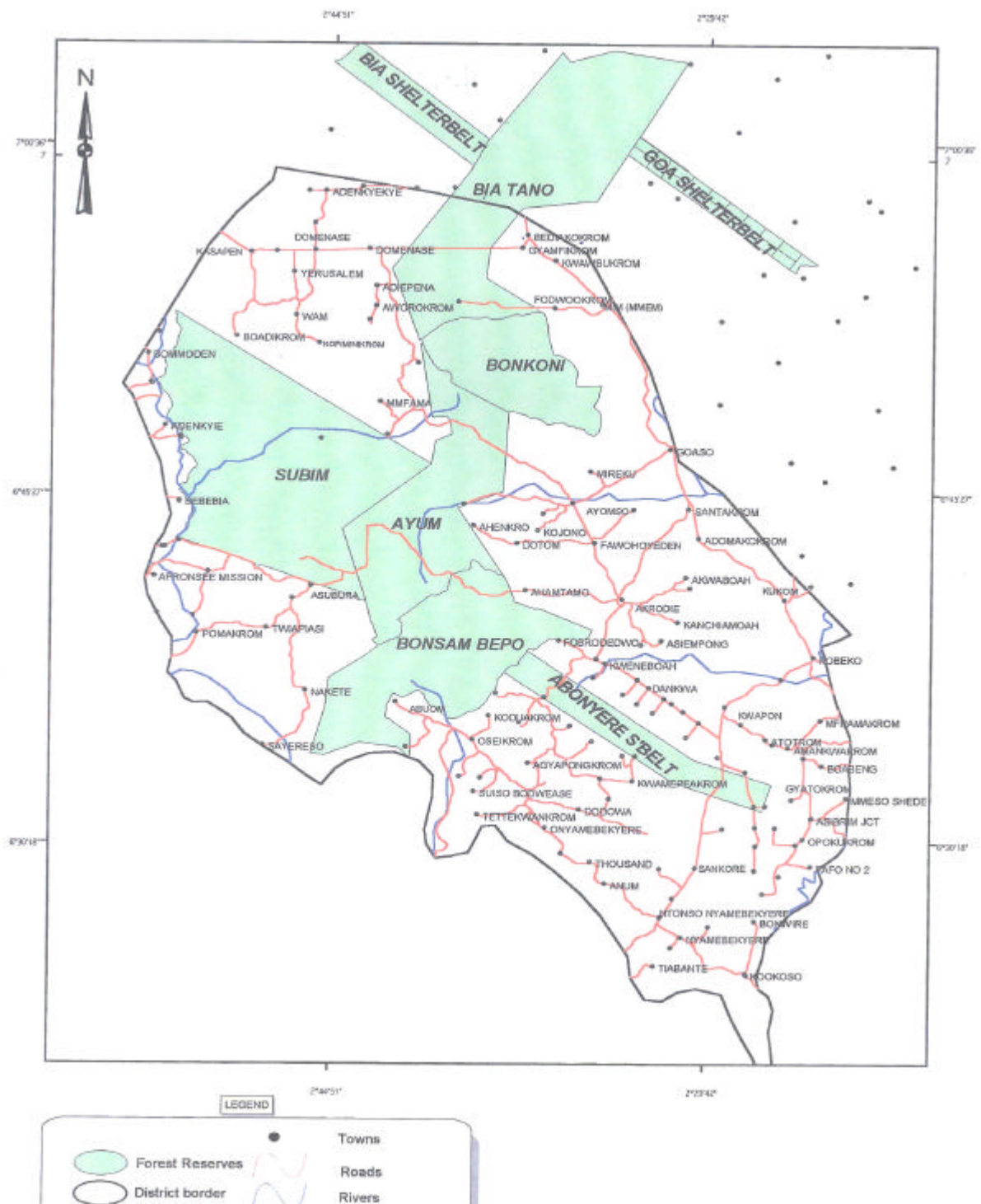


Figure 1.1 Map of Asunafo District in the Brong Ahafo Region of Ghana

1.4.1 Climate

Asunafo District, which falls under the moist semi-deciduous rainforest of Ghana, receives 1200 to 1500 mm of rainfall annually (Oduro, 2003). The high total rainfall results from higher monthly totals and the area has a two-peak type of rainfall pattern with maximum in May-June and September-October. The forest zone has two or fewer dry months and evapotranspiration is 1000-1250 mm (Oduro, 2003).

Temperature variation in the zone is very slight. The mean monthly maximum temperature is 31°C to 33°C, and the mean monthly minimum is 19°C to 21°C (Oduro, 2003).

1.4.2 Soil

The soil in the study area has a characteristic of the rainforest soil. It has forest oxysols, which are highly leached, yellowish, very acidic and nutrient poor, and forest ochrosol, which are less, leached, reddish, slightly acidic to neutral and better supplied with nutrients (Hall and Swaine, 1964).

1.4.3 Vegetation

The Asunafo District has vegetation, which is of the moist semi-deciduous type and falls in the tropical high forests zone of Southern Ghana (Oduro, 2003). Human activity has contributed to the degradation of the vegetation and only few trees of economic value are being retained. The most common tree species in the district are the *Triplochiton scleroxylon* (wawa), *Enthandrophragma cylindricum* (sapele), *Celtis spp* (esa), *Ceiba pentandra* (onyina), *Anitiaris toxicana* (kyenkyen), *Chrysophyllum albidum* (akasa) and *Aningeria robusta* (asafena).

1.4.4 Crops

The major crops grown in the area are cash crops such as cocoa and oil palm, food crops like plantain, cocoyam, cassava, maize and rice along the riverbanks and some fruits and vegetables.

The average sizes of farms compare favourably with figures as found in most forest zones (Ghana Statistical Service, 1996).

The farmers practise traditional system of farming which has been referred to as shifting cultivation, rotational bush fallow or slash and burn .The agricultural practice in the area is rain-fed and the productivity is dependent on the fertility of the soil. Fallow periods have been reduced from an average of 5 years to less than 2 years.

Problems associated with fallow period reduction in the forest zone of the country include deforestation, severe soil erosion and decline in soil fertility (Benneh and Agyapong, 1990).

CHAPTER TWO

2.0 METHODOLOGY

2.1 Preparatory Phase

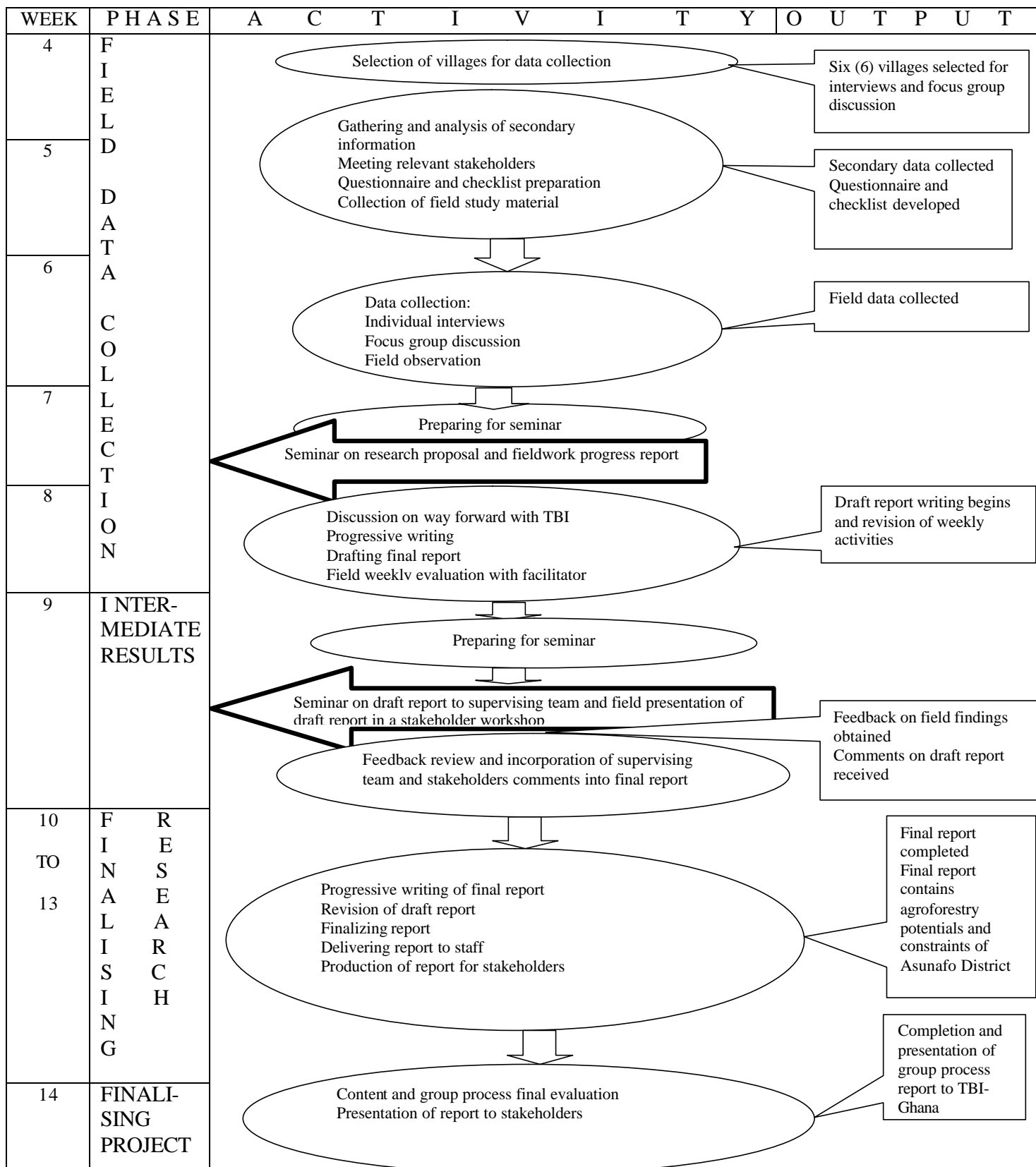
A one day reconnaissance survey of the Asunafo District (study area) was carried out by the team in order to familiarize itself with the study area, to gain a first hand understanding of farmers problems and also to assist the group in planning of the group survey and the selection of the study villages. To arrive at the intended results (outputs) a general field study plan was used as presented in Table 2.1 (next page).

2.2 Sampling of Population

Following a reconnaissance survey of the Goaso Forest District (GFD) two villages each were selected from three existing forest reserve areas. A total of six villages were therefore sampled for the study. The villages were Nyamebekyere, and Asuadae from the Bonkoni Forest Reserve (BFR), Fawohoyeden and Ayomso from the Ayum Forest Reserve (AFR), and Asumura and Anyimaye from the Subim Forest Reserve (SFR). The criteria for the selection of the villages were based on their closeness to the forest reserves, time, resources available and accessibility.

Table 2.1: GENERAL FIELD STUDY PLAN

WEEK	P H A S E	A C T I V I T Y	O U T P U T
1	I N T R O D U C T O R Y	<p>Orientation and familiarization Settling in logistics, accommodation and transportation</p> <p>Training on: Working in interdisciplinary group Conflict resolution Research methods Literature search Approaching stakeholders</p> <p>Meeting relevant stakeholders</p>	<p>Students to get to know each other</p> <p>Understanding of TOR and 'D & D' option for agroforestry research</p>
2	R E S E A R C H P R O P O S A L D E V ' T	<p>Reconnaissance survey of study area Field visits Stakeholder meetings Formulation of individual and concept group proposal Training on interviews</p>	<p>More understanding of TOR and familiarization of geographical study area Draft proposal prepared</p>
3	F I N A L I S I N G R E S E A R C H P R O P O S A L	<p>Training on seminar presentation skills More literature search</p> <p>Preparing for seminar</p> <p>Seminar presentation on research proposal and work plan to supervising team and TBI staff</p> <p>Incorporation of stake holder's comments/ suggestions into research proposal</p>	<p>Learning of items necessary for a good seminar presentation</p> <p>Research proposal presented to supervising team Comments on proposal received</p>



2.3 Methods of Data Collection

Data collection for the selected villages was done by the following methods:

2.3.1 Primary Data Collection

Questionnaire

In each of the selected villages, a total of forty (40) farmers were randomly interviewed using close-ended questionnaires (Appendix 1). This gave a total of 240 respondents.

Focus Group Discussion

Focus group discussions were held in each of the selected villages using a checklist (Appendix 2). During these discussions results from individual interviews were validated. This was done by using a checklist of questions for the groups. Apart from Ayomso where focus group discussions could not take place due to organizational problems, focus group discussions were held in the rest of the villages.

Field Observations

Field visits were undertaken to observe farming practices on farms. The selection of farmers' farms was randomly done.

2.3.2 Secondary Data Collection

Apart from the above methods used to collect primary data, secondary data were also obtained from relevant organizations such as Rural Development Youth Association (RUDEYA), the Forestry Services Division (FSD), Scanstyle Mim Limited, Ministry of Food and Agriculture (MoFA), and German Technical Co-operation (GTZ). These secondary data were used to supplement, and in some cases to compare with the primary data collected from the field.

2.4 Data Analysis

Primary data collected from the respondents were coded and built on Statistical Package for the Social Scientist (SPSS). The data were then analyzed at both village and forest reserve level and presented in tables and graphs. Chi-square test was used at a significance level of 0.05 for all the analysis.

CHAPTER THREE

3.0 RESULTS AND DISCUSSION

The results presented below were obtained from data collected using questionnaire, focus group discussion, and field observations. The analyzed results from questionnaire were considered at two levels i.e. fringe communities of the forest reserve and all the fringe communities in the three forest reserves.

3.1 Socio-economic Characteristics of the Study area

Education

The general information on the villages shows that there were significant differences (at 0.05 level) among the number of respondents formally educated and those otherwise. Majority, 76.3% of the respondents had at least basic education. Similar trend was observed at the reserve level.

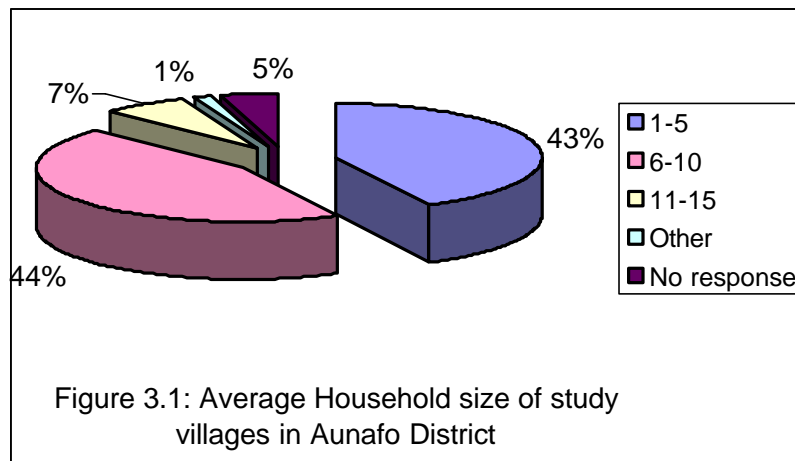
There is a positive correlation between formal education and productivity of labour; therefore, level of productivity of farmers is expected to improve, given extensive knowledge in farm management. This is especially the case in Asumura and Anyimaye, where 35% and 30% of the respondents had at least secondary school education respectively as shown in Table 3.1.

Age

In all the villages, the available information indicated that, with the exception of Asuadae, an average of 69.28% of the respondents were in the age class of 18-49 years (economical active group, Table 3.1). At the reserve level the age distribution was similar to the village level. With an average of 39.64% of the respondents representing the 50 years and above class, the economic implication is that there is not so much dependency, of the aged, on the youth since economically the dependent age groups are 1 to 17 years and 65 years and above. The dependency ratio of this class, which indicates the level of burden on this age group, is therefore insignificant in the villages with respect to the aged.

Household size

There was not much significance (0.05 level) in the differences in the household size (Table 3.1) between the villages and the reserves. The majority of the households were in the categories of 1-5 (42.5%) and 6-10 (45%) members, which is illustrated in Figure 3.1. In Ghana, according to Owusu 1993, a farm family normally consists of two adults and their children and the older children who could help on the farm are in school during most of the year. Agroforestry, which generally is more labour intensive than agriculture, based on high external input, practices such as hedgerow establishment and maintenance, require substantial labour (Owusu, 1993). The average household size of eight persons in the study area therefore implies that there would be labour for carrying out the various activities of the system when adopted.



The large household sizes (category 6-10) have serious implications on the farm families. As the younger members of the household grow older, the demand for farmland may increase, and this may lead to agitation to encroach on the forest reserve for farming activities, as most farmers did suggest that arable land is scarce and they would want part of the forest reserve to be released for farming during the focus group discussions. Large household sizes would also mean more mouths to feed that may extend pressure on demand for harvest of Non-Timber Forest Products (NTFPs) from the reserves. Table 3.1 gives an overview of the household sizes.

Other illegal activities, such as poaching may also increase in the reserves.

TABLE 3.1: DEMOGRAPHIC DATA ON STUDY AREA						
<i>Village</i>	<i>Age</i>		<i>Education</i>		<i>Household size</i>	
Asumura	18-49	82.5%	Basic	37.7	1-5	53.8%
			Secondary	35		
	>50	17.5%	Tertiary	7.5	6-10	41%
			Illiterate	20	11-15	5.1%
Animaye	18-49	63.2%	Basic	37.5	1-5	55.3%
			Secondary	30		
	>50	36.8%	Non Formal	2.5	6-10	34.2%
			Illiterate	30	11-15	7.9%
					Other	2.6%
Ayomso	18-49	67.5%	Basic	65	1-5	28.9%
			Secondary	7.5		
	>50	32.5%	Tertiary	2.5	6-10	65.8%
			Illiterate	27	11-15	2.6%
					Other	2.6%
Fawohoyeden	18-49	70%	Basic	75	1-5	50%
			Secondary	12.5		
	>50	30%	Tertiary	2.5	6-10	41.7%
			Illiterate	10	11-15	8.3%
					Other	
Asuadae	18-49	52.8%	Basic	50	1-5	48.7%
			Secondary	15.8		
	>50	47.2%	Non Formal	5.3	6-10	41%
			Illiterate	28.9	11-15	7.7%
					Other	2.6%
Nyamebkyere	<18	2.6%	Basic	52.5	1-5	30.8%
			Secondary	15.8		
	18-49	63.2%	Non Formal	5.3	6-10	59%
	>50	34.2%	Illiterate	28.9	11-15	10.3%
					Other	
P- value	14.36		40.871		16.984	
Level of significance	0.05		0.05		0.05	

Economic characteristics

From the economic related information on the villages, there were significant differences among the various categories of alternative income-sources besides farming at a significance level of 0.05. It was evident that the average farmer was involved in trading (42.9%). However, 23% stated that they were engaged in only farming. Other sources of income were teaching (5.8%), weaving (0.8%), and 17.5% were involved in soap making, carpentry, and tailoring.

Percentage average of 51.25% of the respondents in the six villages stated that their produce was predominantly sold at the farm gates and at low prices. The Bonkoni Forest Reserve had a significant higher number of respondents that sold their produce at the farm gate (88.75%) compared to the Subim and Ayum Forest Reserves (52.50% and 77.50% respectively). This is likely to be due to the long distance and the bad nature of the road linking the area and the district capital, which serve as the main market center.

Since agricultural markets are now liberalized, farmers have the sole responsibility of marketing their produce.

The preferred solutions for better marketing by farmers were:

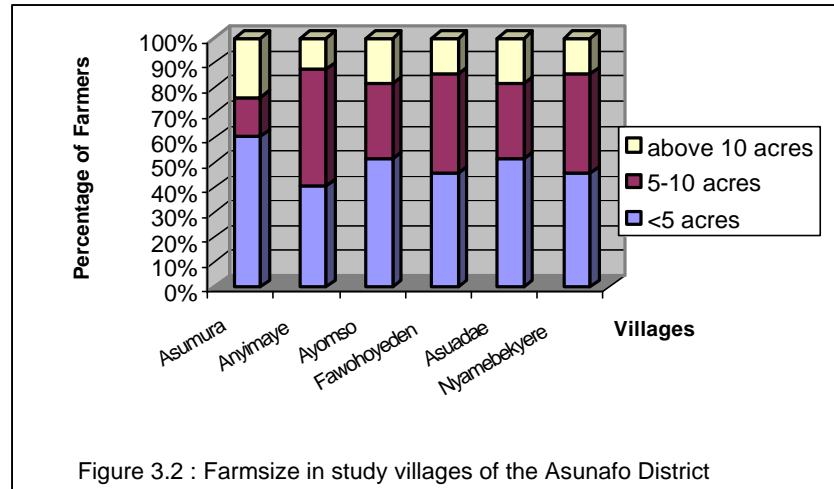
- Traders should come to the village to buy the produce,
- Better transportation for carting of produce,
- Uniform pricing
- Guaranteed buying of the produce and
- Introduction of marketing companies

Other constraints of the marketing system are lack of credit facilities, and lack of storage facilities.

To obtain the full potential of agroforestry, which include improved income, better marketing option must be guaranteed for all outputs from the system before promoting it. This is because some previous attempts in introducing cashew and sunflower at the district failed due to poor marketing of the produce. The farmers are therefore skeptical when it comes to cultivation of new crops, as well as adoption of new technologies.

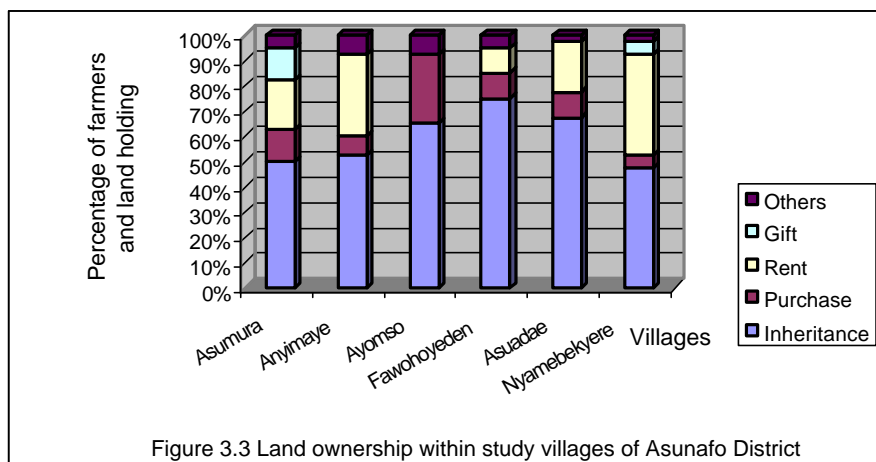
3.2 Land Tenureship and Farm size

Farm sizes in the study area as shown in Figure 3.2 are predominantly less than 5 acres (49.5%), followed by 33.5% (5 and 10 acres), and only 17% exceeding 10 acres.

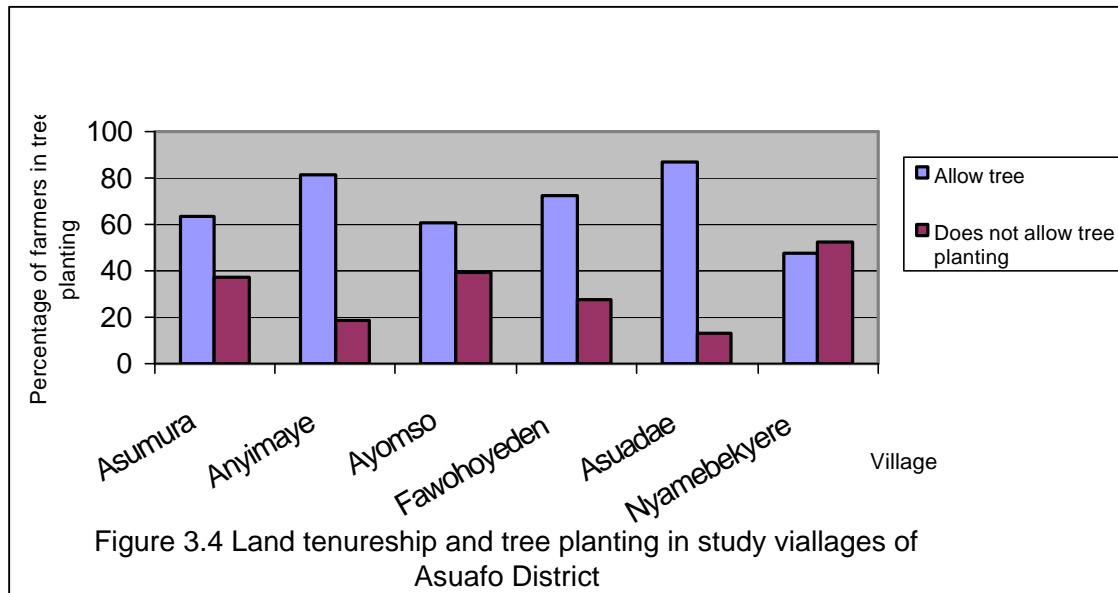


The land tenureship as in Figure 3.3 below shows inheritance (average of 59.5%), followed by rental (20.3%). The remaining 20.2% included purchasing, gifts from friends, and relatives. Majority of the respondents via inheritance, purchasing of land or as gifts from relatives or friends, owned land in the area.

Owusu 1993, reported that land tenure and land security are crucial issues for the success of any agroforestry or tree-planting project. In a study, Owusu (1993), realized that in the Akuapim North District of the Eastern Region of Ghana farmers who established the best of demonstration plots were those who owned or had secure rights to the land the cultivate since other farmers were reluctant to plant trees because their tenancy was not secured.



Throughout the total sampled villages, an average of 68.4% of the respondents stated that land tenureship allowed for growing trees. Figure 3.4 shows the relationship between land tenureship and tree planting in the communities. The main reason for planting or allowing tree stands on farms, was that majority of the respondents owned land (87%). Those who did not grow trees, gave as reasons that, they would have to ask permission from the landowners, who could be either the landlord, or co-heirs or, because of the limitations of the agreement (did not have provision for the growing of trees 8%). However, in Nyamebekyere only 47.5% of the respondents indicated that land tenureship permitted growing of trees, which is possibly because 40% practiced share-cropping (Abunu and Abusa as referred to locally).



3.3 Agricultural and Agroforestry Land use Systems

The Agricultural and Agroforestry Land use Systems identified in the study area were:

- Home gardens
- Perennial plantations
- Shifting cultivation
- Mixed cropping
- Animal rearing

a. Home Gardens

Home gardens are important for additional food supply (cassava, plantain), fruits (mango, orange, guava), medicinal uses (konkroma - *Morinda lucida*), fuelwood (*Acacia*), fodder for livestock (*Acacia*), shading and ornamental or fencing function. Observations within the villages showed that there are areas reserved for grazing livestock (goat, sheep, cattle). Plate 3.1 below depicts a typical home garden in the study area.



Plate 3.1:A typical home garden in Asuadae of the Asunafo District

It is expected that when attempts are made for improving the existing agroforestry system, supplementary components should be added to the already present ones. As such, trees must have multiple benefits, and have the ability to adapt to the soil and local climate.

b. Perennial Plantation

The most common perennial plantations in the study area were cocoa and oil palm plantations. Cocoa plantations were combined with shade trees, where as oil palm does not have provision for trees at all. However, farmers said that during the first three years of the oil palm plantation establishment, mixed cropping with food crops is possible. The cash tree crops are very important in the sampled villages, and farmers claim that they

continued to harvest them, until the trees die, and eventually harvested as fuelwood. Plate 3.2 below shows an oil palm plantation, where the crops have already been harvested.



Plate 3.2: Oil palm plantation in Asuadae of the Asunafo District

It was observed at Nyamebikyere that farmers, who own land, established teak plantations especially for the production of poles. Taungya system is adopted, which allows crops to be cultivated during the first three years. In Nyamebikyere and Asuadae the communities considered wood plantation as preferred investment, as such a football-playground had been converted into a teak plantation as shown in plate 3.3.

Windbreak

Trees and shrubs are planted to protect areas from strong winds and to prevent soil erosion. Teak is popularly planted as a windbreak in the communities of the study area.

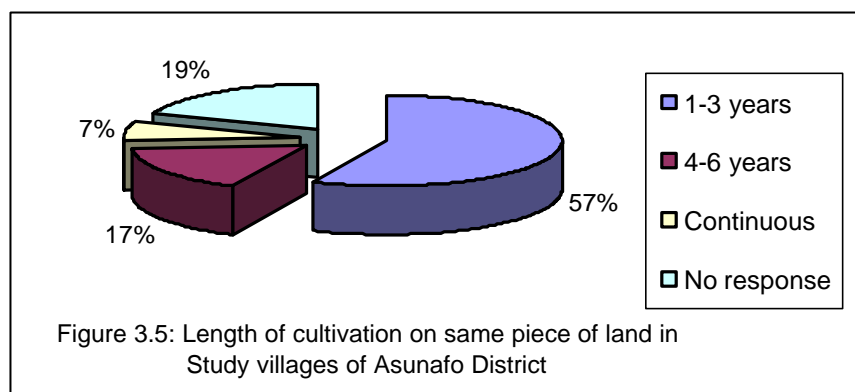
In Nyamebikyere and Asuadae farmers are consciously planting trees to serve as windbreaks in their communities. With the presence of a small nursery in Asuadae, farmers of this community can become a model for other villages in the adoption of agroforestry.



Plate 3.3: Teak plantation in Nyamebekyere of the Asunafo District

c. Shifting cultivation

The traditional cropping sequence known as shifting cultivation is the main farming system in the study area, which starts with clearing primary/secondary forests. The predominant land preparation method for the 6 villages was slash and burn (88%). As Figure 3.5 below shows, most farmers cultivated the same piece of land for 1-3 years before moving to another. This is usually because after this period the soil loses its fertility. Cultivating the same piece of land for about 6 years, or continuously was practised by 24% of the respondents.



Farmers preferred to restore soil fertility through land fallow (62%), while 9% considered leaving organic material on the land, 7% used chemical fertilizers, and 5% combined fallowing with fertilizer. The other 5% however does not use any measure to restore the fertility of the soil.

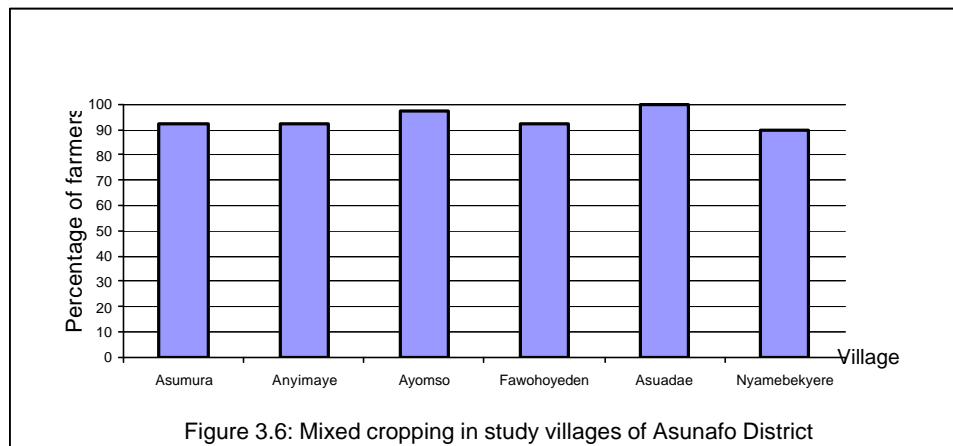
Farmers claimed that the yields of crops were declining, which causes them to abandon the land for more fertile soils.

These results indicate that the pressure on land resources is increasing, and with the introduction of an improved agroforestry system, measures should be considered for extending the cultivation time or improving the fallow period.

The major food crops under this system are: cassava, cocoyam, plantain, maize, and yam, whereas the minor food crops are fruit trees (avocado pear, and citrus) and vegetables.

d. Mixed cropping

Mixed cropping constitutes the main agricultural land use practice in the study area, (94% of the respondents were engaged in the practice) as indicated by Figure 3.6.



Most farms contain both food crops and woody perennials, which is commonly referred to as agrosilvicultural system. These farms have multistrata layout, with several tree layers (fruit and timber tree species) and different species, which are simultaneously grown on the same unit plot. These farmers have a multi-cropping system, which is known as the oldest crop production strategy, and provide farm stability, and the efficiency in the use of land and labour, as well as ensure food security.

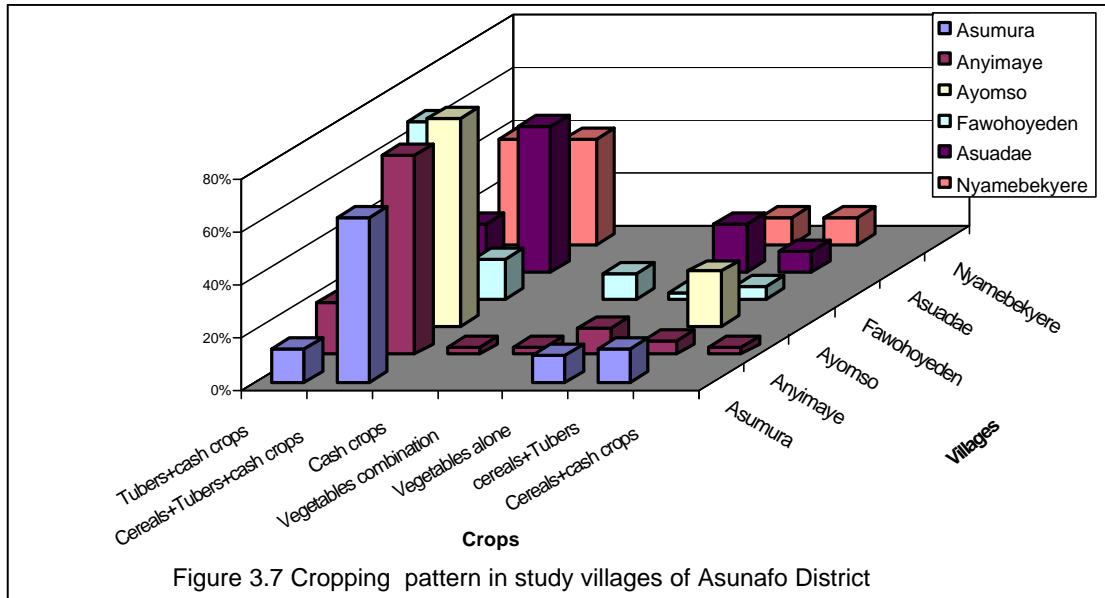
Cereals (rice and maize), roots and tubers (yams, cassava, and cocoyam), plantain, and vegetables (tomatoes, garden egg, cabbage, and pepper) were the common food crops.

The overall preferred combination of crops under this farming system were:

- Cereal, roots and tubers, and cash crops;
- Roots and tubers, and cash crops;
- Cereals and Tubers;

- Vegetables;
- Vegetables with other crops;
- Cereals and cash crops.

These crop type combinations are presented in Figure 3.7 below.



In general it was observed that food crop production was only on subsistence level while cash crops (mainly cocoa) and oil palm are cultivated on a large scale in combination with food crops and some woody perennials. However no major study has been carried out on tree-crop interactions within the cocoa, and the oil palm production systems. Any attempt at designing agroforestry systems for this area should consider the possibilities of improving upon the crop production system.

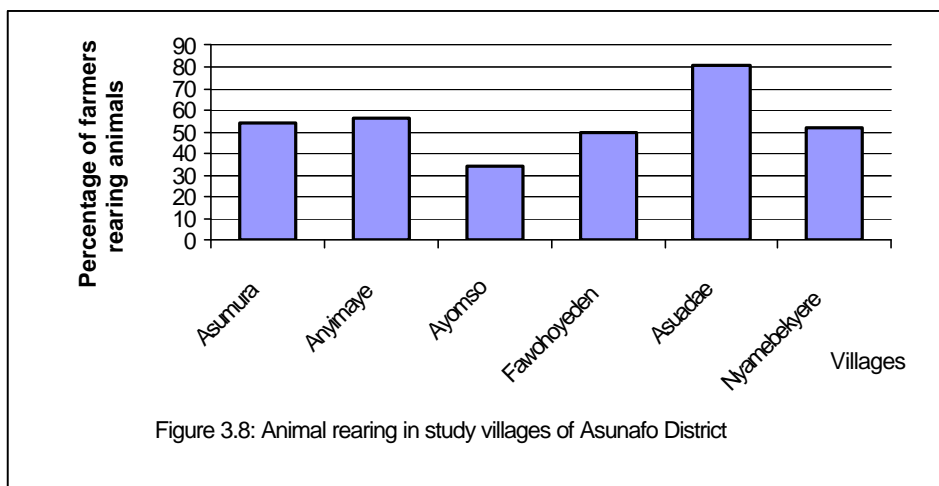
The government has currently embarked on a mass cocoa-spraying programme to combat diseases and pests in cocoa farms in the study area.

However, plantain in the area has sigatoka disease that affects the yields. Crops are manually planted, harvested, and transported to the villages, and in some cases manually processed such as cassava into gari.

Mixed cropping system provides several mechanisms of food security, when certain pests, or diseases occur. It is therefore very important that recommended agroforestry systems also make use of mixed cropping. Species that cannot only improve the soil fertility, but also serve as fodder, or other usage can be incorporated.

e. Livestock rearing

Except Ayomso, and Fawohoyeden, 54.5% of the rest of the villages reared goats. This is because it is a taboo to rear goats in these two communities. Communities in the study area however kept a large variety of animals (goat, sheep, cattle and pigs). However, the number of animals reared was very low, two or three per family; this low number indicated that animal rearing was mainly on subsistence basis. Farmers also claimed that diseases among the animals were the main reason for the low number of animals kept. Figure 3.8 below indicates the level of animal rearing in the study communities.



At present more farmers are getting interested in the rearing of non-conventional animals, such as grass-cutter and snails, which have very attractive prices on the market.

Animals in the villages were predominantly fed with fodder (15.66%), kitchen waste (16.23%), and combination of fodder with kitchen waste (61.23%). Free-range system of animal rearing was common in the villages. Plate 3.4 below shows a backyard animal ranch in the study area.



Plate 3.4 Animal rearing in Asuadae in the Asunafo District

Charcoal burning

Majority of the respondents answered that firewood was used as fuel for cooking (60%), followed by the combination of charcoal with firewood (5.8%). In Nyamebkyere one charcoal burner was interviewed as in Plate 3.5 below.



Plate 3.5 Charcoal burning in Nyamebkyere in the Asunafo District

Through interviews with charcoal burners in one community (Mim), additional data were collected on species that are suitable for charcoal production. These were: Odum (*Milicia excelsa*), Okure (*Trilepisium madagascariense*), and Esa (*Celtis milddraedii*). The burners were interested in growing tree- seedlings, but encounter difficulties in terms of

land availability and accessibility. Logs for producing the charcoal were obtained from the local sawmills.

Since fuel for cooking mainly comes from firewood, and charcoal, there is the need for regulating charcoal burning, which should result in minimizing the risk for bush fires, as well as the level of felling trees. Charcoal burners should be given incentives for growing of trees, as well as establishing woodlots.

3.4 Perception of farmers on Agroforestry Systems

Perceptions about agroforestry in the villages were diverse. Generally, agroforestry is seen by the respondents to have a potential of solving their fuelwood needs, improve the soil fertility, and provide favourable climate for crops. Farmers have indigenous knowledge on the usage of trees in farming systems as well as some environmental uses (especially at Anyimaye), such as watershed protection and climate moderation. The reduction in amount of rainfall was attributed to felling of trees during a focus group discussion.

Some villages had taboo days, which means that farmers are not allowed to work on their farms on those days. For the Bonkoni reserve this was Wednesday, the other two reserves had Thursday as their taboo-day.

Generally an appreciable number of farmers (62.5%) already knew what agroforestry was, while 68.3% of the farmers interviewed were willing to adopt the agroforestry system. The main reason for adopting the system was because of the multiple benefits the farmers gain from the crop-tree combination. Some other conditions for adopting the system were; if land was available, and if tree would be separated from crops, or if the crops would not be damaged or affected by the tree growth. Some respondents mentioned the use of trees for fuelwood.

Those who were not willing to adopt agroforestry (8.3%) justified their opinion, by mentioning the fact that benefits from agroforestry are only noticed after a long time, which is not their intention in farming. Contractors would also destroy their farms by felling timber species, and the limited availability of land in the study area were some of the reasons also mentioned.

In addition, 65% of the respondents believed that they would be able to manage the several components of system because the system requires the same attention like their

current farming system. Also with accurate planning, farmers said that the agroforestry system was also manageable since pruning and/ or weeding was sufficient to maintain the system. Three farmers needed extra labour to be able to manage the system whilst three also said that they could manage only on a small scale.

Farmers were skeptical on keeping timber species on their farms because of crop destruction caused by timber contractors during felling. They also have the impression that the system was aiming at preventing them from entering the forest.

During focus group discussions, farmers made mention of some tree species, which they believe were not suitable to cultivate in combination with crops. Examples mentioned were Wawa (*Triplochiton scleroxylon*), Nyankyerene (*Ficus exasperata*), Neem (*Azadirachta indica*), Teak (*Tectona grandis*), Sesedua (*Christiana africana*), Ofram (*Taminalia superba*), Esia (*Petersianthus macrocarpus*), Sweet orange (*Citrus sinensis*) and Mango (*Mangifera indica*) trees.

Onyina (*Ceiba pentandra*), Kumnini (*Lannea welwitschii*) Odum (*Milicia excelsa*) were also mentioned as favourable species for crops.

The farmers' perception on agroforestry implies that:

- Timber species should be separated from farm lands to prevent crop destruction during felling
- The arrangement of tree/crop should be in such a way that minimal or no damage will be done to crops, during harvesting of trees
- Tree species, which are preferred by the farmers should be considered, these include those of multiple benefits, including medicinal value
- In integrating animal component in the agroforestry, the existing taboos should be taken into consideration.

3.5 Constraints and problems of Agroforestry Systems

Agroforestry as an alternative land use system in the study area is bedeviled with a lot of factors. Notable ones among these factors are enumerated below.

a. Lack of knowledge on logging regulations/ procedures

It was noticed that majority of the respondents lacked adequate knowledge on tree tenureship, logging regulations, and procedures on rights to compensation caused by tree felling. As a result, timber contractors and chainsaw operators exploit the farmers

to their disadvantage. A lot of timber species on farms are felled, without the consent of the farmers. Due to these, a lot of farmers are not motivated to either leave such trees or plant them on their farms

b. Farm size

Even though the concept of agroforestry and its importance was well understood among the respondents, the size of the land available to the farmers, served as a limiting factor. Most of the farmers complained that their farm sizes were too small to allow for the integration of trees. They also complained that such attempt would result in shading of their crops and in result lower yields. As much as 47.5% of the respondents were therefore not willing to fully and consciously adopt this system because of small size of land.

c. Lack of seedlings

Lack of seedlings serves as another constraint to the adoption of agroforestry in the study area. The Forestry Services Division (FSD), which initially provided free seedlings for planting by farmers, has however stopped. Farmers are therefore interested in the planting of trees on their farms but do not have access to seedlings.

Amanor (1996), documented that the main reasons why farmers do not plant trees (outside ownership issues and lack of land) include;

- Lack of a tree planting culture and knowledge of which species to plant and how to plant them and
- Lack of seeds

d. Seasonal occurrence of plant and animal diseases

The seasonal occurrence of plant and animal diseases in the study area is a threat to agroforestry. Focus group discussions held in all the villages indicated that there was prevalence of animal diseases during certain periods of the year. The veterinary services division of Ministry of Food and Agriculture (MoFA), which is mandated to prevent and control some of these diseases seemed not to be up to the task in the study area as farmers complained that majority of the animals died during these periods. Thus, the respondents were not motivated to rear animals.

The prevalence of sigatoka disease of plantain was also observed. If the positive interaction between trees, crops and for animal is to be achieved then solution to these problems are necessary for effective adoption of AF systems.

e. Inadequate compensation for destroyed crops.

Farmers in the study area do not receive adequate compensation for crop destruction caused during harvesting of timber species by contractors. Sometimes their crops destroyed are not commensurately compensated. This situation has resulted in a number of farmers destroying seedlings of timber species on their farms to avoid future destruction of their crops during felling.

f. Lack of credit facilities

Farmers in the study area indicated that credit facilities were not also available for expansion of their farm size as well as the purchase of other farm inputs. Credit is said to be a major concern both to project implementation and to farmers and it is for this reason that Owusu (1993), cautioned that for project implementation to be very successful cash needs of farmers should be met.

g. Tree tenure

Most farmers were not aware of ownership right concerning the growing of trees on farms and so were not willing to plant trees. Fortman 1985, stated that agroforestry depends on peoples right to plant and use trees and these rights in turn depend on the prevailing system of land and tree tenure.

Concerning leaving trees on farms, farmers do not see the need for leaving or tending for trees on their farms whilst they do not own them but the government does and even compensation for damaged crops during felling is not satisfactory. This therefore calls for education on tree tenureship in the communities.

Amanor 1996 suggested that an ethical framework of right and ownership that reflects the labour and knowledge invested in management of forest outside forest reserve should be developed. This is because farmers managed most of the soil resources in the forest zone of Ghana, since the ultimate destiny of trees and forest resources depends upon their management strategies.

f. Others

The transportation network linking the villages to the market centers, and lack of storage facilities will reduce the impact of AF when introduced, as transport of produce would be a limiting factor. A lot of farm produce deteriorates during bumper harvest due to the aforementioned problems as well as the perishability nature of some produce.

3.6 Conditions and Local practices that favour the adoption of Agroforestry

The following are the identified local conditions that favour the adoption of agroforestry/ opportunities:

- *Farmers leave trees on farms:* This is an old practice, which is some form of agroforestry, hence farmers are likely to adopt an improved version of this system since they are already familiar with the importance and benefits of trees. Amanor, 1996, recounts that soil and crop enhancing role of trees is recognized by farmers as most farmers preserve some trees to maintain the soil structure, enhance soil fertility and soil nutrient cycling and the exhibition of favourable interaction with crops. One therefore needs to simply educate and encourage farmers to utilize the full potential of this system. In the study area there is no taboo against tree planting. When agroforestry is introduced in the communities, it is likely that the introduced tree species will be accepted, as far as the usage and benefits of these trees are explained.
- *Taboos:* There exist no taboos regarding the planting of trees in the study area.
- *Practice of mixed cropping:* Depending upon the components, mixed cropping can be agroforestry. An example is the practice of integrating maize, cassava, and other food crops with cocoa trees as observed in the fields.
- *Willingness to rear animals in all the villages:* Animals are reared in all the villages and farmers are ready to increase the number being reared currently. The introduction of this system with an aspect to control the spread of animal diseases is therefore important.
- *Knowledge on tree importance:* Trees are used for firewood, shade, windbreaks, fodder, and charcoal in the communities, which implies that local uses of the

woody perennial already exist and it is in a high demand. Dead trees are the most common source of domestic fuel for the people in the study area. However, pressure on these trees has rendered extinction of some useful tree species such as Esa (*Celtis mildbraedii*) for fuelwood. Farmers have complained of shortages of fuelwood since women who are responsible for fetching firewood walk long distances to obtain some. It is therefore expected that the community will be able to obtain readily available source of fuel when agroforestry is practiced. Farmers have also identified some trees, which can be used as fodder, as Nyankyerene (*Ficus exasperata*), Sesea (*Trema orientalis*), and cassava (*Manihot esculenta*), avocado pear (*Persea americana*) leaves. Farmers have also identified tree species that are suitable in combination with food crops. They include Onyina (*Ceiba pentandra*), Kumnini (*Lannea welwitschii*), and Odum (*Milicia excelsa*).

In Anyimaye it was observed that farmers had knowledge of trees as a protection of watershed. Because of the knowledge already present in some communities on the importance of water regulation system, the adoption of growing trees for a better watershed management/weather is expected to happen in an easier way. It is therefore expected that future interventions to improve upon the agroforestry systems can receive the support of farmers.

It was also observed that fruit trees are grown in both the home gardens and the agricultural fields.

Farmers identified Wama (*Ricinodendron heudelotii*) and others trees as medicinal plants, which indicates that the farmers recognize the value of these tree species.

- *Live Fencing of homes and demarcation of boundaries:* In nearly all communities live fencing was observed, which indicates that this form of agroforestry is already present. Trees are also used, as demarcation of land units and farmers know the importance of using tree species for this purpose.
- *Presence of nurseries:* Knowledge on raising tree seedlings is in existence in some villages. It is likely that some facilities for establishing nurseries can be obtained and nurseries could be encouraged in the whole community.

- *Favourable climate for tree and crop growth:* Apart from the decline of the amount of rainfall, farmers have not mentioned other climatic or environmental constraints, which affect the growth of either the crops or trees.
- *Existence of NGOs:* In nearly all the villages NGOs are supporting the community by educating farmers, which can eventually supplement the practice of agroforestry.
- *Fruit trees for subsistence and income:* Farmers grow fruit trees not only within the vicinity of their community, but also in the field. This practice is seen as very favourable when future attempts are made for combining food crops with non-conventional tree species (timber species). Mango (*Mangifera indica*), avocado pear (*Persea americana*), and Sweet orange (*Citrus sinensis*) are the common fruit trees being cultivated in the area even though on a small scale.
- *Farmers' interest in bee keeping, mushroom and snail farming:* The farmers' interest can be beneficial when improved agroforestry systems are recommended.
- *Knowledge of decline in soil fertility:* Farmers complained about declining food production, due to reduced soil fertility. One important advantage that farmers can derive from agroforestry is increased productivity through the maintenance of soil fertility and having favourable effects on plants (Amanor, 1996). The decline in soil fertility creates an opportunity for the introduction of agroforestry to the communities since some agroforestry trees such as Luecaena, Glyricidia Cassia, Calliandra and Alchornea according to Rao e tal (1990) are known to enhance soil fertility. Traditionally farmers consider fallowing as a means to maintain and restore soil fertility and sustain the productivity of the farming system. When introducing agroforestry systems, it is likely that farmers will adopt measures recommended (e.g. improved fallow systems) to improve upon the soil fertility.
- *Regeneration of tree species on farmlands:* On farmlands farmers allow the stumps of cut trees to regenerate freely. This occurrence can benefit the agroforestry systems, which include indigenous tree species.
- *Costs of farm inputs:* Since farmers cannot afford the high costs of farm inputs, such as fertilizer and pesticides, introduction of low- input demanding system like agroforestry will be a relief to them. Tenkorang 2003, assessed the cost of agricultural infrastructure, fertilizers, and pesticides as being higher and beyond

the reach of most farmers. It was therefore suggested that agroforestry is in the greater potential stability of responding to drought and heat stress, nutrients cycling and improved moisture balance and in the greater variety of products it yields.

3.7 Stakeholder involvement in Agroforestry

Several governmental and non-governmental organizations are involved in the practice of agroforestry either directly or indirectly.

a. Governmental Organizations

Governmental organizations (GOs) involved in the practice of agroforestry in the study area include: Ministry of Food and Agriculture (MoFA), Forestry Services Division (FSD) and Land Valuation Board.

Ministry of Food and Agriculture (MoFA)

The ministry is responsible for dissemination of agricultural information in the study area.

Food and fodder crops under the agroforestry department, which was responsible for the promotion and adoption of agroforestry in the study area, is no more in existence.

The extension department is however responsible for educating farmers on agricultural activities such as animal rearing and food crop production. This department even though in operation, farmers in the study area experienced disease outbreaks within their livestock and crops. The veterinary services department which is responsible for advising farmers on animal husbandry and treatment of animal diseases are however absent in the study area.

Forestry Services Division (FSD)

The division is responsible for forestry issues. Forestry Services Division undertakes education on tree tenure, farmers right to compensation on crop destruction during timber felling, conservation of forest resources and timber species on farmlands, and training of communities on forest management. The FSD, which used to provide tree seedlings free for planting by farmers has stopped but rather sell the seedlings in the regional capital (Brong Ahafo Region).

Land Valuation Board

The Land Valuation Board is responsible for the estimation of the extent of damage to crops caused by felling of trees on farmlands by timber contractors and the necessary compensatory measures farmers are entitled. The activities of the board in the study area can however generally be described as absent as farmers lack knowledge on compensatory procedures that exist.

b. Non-Governmental Organizations

Non-Governmental organizations into forestry and agroforestry related issues in the study area include: Rural Development Youth Association (RUDEYA), Tropenbos International-Ghana (TBI-Ghana), German Technical Development Co-operation (GTZ), and a timber company Scanstyle Mim Limited.

Rural Development Youth Association (RUDEYA)

The organization is involved in capacity building and education of farmers on forest policies and other related issues.

In forest management RUDEYA in collaboration with Forestry Services Division formed Community Forest Committees (CFCs), which would help in the education against bush and forest fires, illegal timber logging, poaching and unsuitable farming practices in the study area.

Education of farmers on forest policies such as the Social Responsibility Agreement (SRA) between the community and the timber contractor is being pursued by RUDEYA. The community right to certain facilities, and the development of Non-Timber Forest Products (NTFPs) like snails, mushrooms, grasscutter etc are also activities undertaken by this organization.

Tropenbos International Ghana (TBI-Ghana)

TBI-Ghana works towards the provision of scientific inputs into the sustainable management of forest resources through local and international cooperation.

The organization is involved in research and training, design and testing of methods, promotion of the uptake and application of research results and collaboration with other

stakeholders. The project undertaken currently is however under the auspices of TBI-Ghana.

German Technical Co-operation (GTZ)

GTZ works with other organizations in the development and application of improved farming systems. GTZ in collaboration with MoFA have initiated Participatory Technology Development (PTD) concept of research into some communities. This approach is considered by the organization to help in building farmers' capacity to experiment and thus adjust to changing environment. The PTD activities in the villages are mainly on issues like land use, bushfire control and marketing of produce.

The organization is also involved in animal production systems and especially its integration into the overall farming system.

GTZ is also undertaking activities like the post harvest handling of produce especially on solar drying of vegetables and gari processing as well as improved maize cribs and market oriented storage of yams in other communities.

The promotion and domestication of some Non-Timber Forest Products (NTFPs) like grasscutter rearing, snail keeping, mushroom cultivation, etc are underway in the study area.

Scanstyle Mim Limited

Scanstyle Mim Limited is a timber company, which is involved in the production and export of furniture. The firm has concessions in the Subim forest reserve. Even though the company has started the taungya system of agroforestry in other concession areas this has not yet been experienced in the fringe communities of the Subim forest reserve under study.

CHAPTER FOUR

4.0 CONCLUSION

Farmers in the communities have indigenous knowledge on trees and their importance, since a high percentage of the farmers interviewed already knew the concept of agroforestry and were ready to adopt the system based on its multiple benefits.

Crop destruction by felling scattered timber species on farms poses a lot of problems to farmers as whether to maintain or cut down tree seedlings on farms. It has therefore been suggested that proper arrangement of trees on croplands should be done in order to reduce crop damage during felling. When introducing tree species, however, farmers have suggested multi-purpose species adaptable to their locale.

Traditional values such as taboos regarding tree planting are absent in the communities, but however, goat rearing is a taboo in some communities. In the introduction of tree and animal species community values and perceptions should not be overlooked.

Land for crop production in the area is largely by inheritance and allows for tree planting. Home gardens, perennial plantations, mixed cropping and shifting cultivation are the various systems under which land is used agriculturally in the area. The sustainable use of land for agricultural activities is therefore important for higher yields of crops. The introduction of agroforestry in the area would however not be a new idea since on their farms, farmers have been practicing the act of keeping trees together with food crops. Also the practice of growing cocoa and other plantation species makes the system not entirely new. With the fairly large household size (eight persons per family) of the communities labour for management of the components of the system is assured.

The study conducted indicated that there is a high opportunity for the conscious introduction of agroforestry in the study area. However, the inadequate education on tree tenure ship and logging as well as the poor marketing system and road networks are possible threats to the realization of the full benefit of the system.

Lack of inputs serves as limiting factors to the adoption of agroforestry in the study area since farmers interested in tree growing are constrained by these. Farmers also undertake animal rearing which is also a component of the system but disease outbreak limits the number of animals being kept.

High population pressure and land tenure holding systems as well as the dependence on agriculture for household income is resulting in short fallow periods and subsequent reduction in yield levels of crops in the study area.

The study revealed the presence of certain governmental organizations (Ministry of Food and Agriculture, Forestry Services Division, and Land Valuation Board) in the communities, which are very necessary for the development of the agroforestry system. Despite these organizations responsibility to see to the smooth running of certain activities for the benefit of farmers there are conflicts on timber felling, crop and animal disease outbreak and inadequate knowledge on certain government policies on timber logging and improved knowledge of farming in general is lacking.

Non-governmental organizations (NGOs) are also present in the area, however there is little or no collaboration between them. The institutions are pursuing agroforestry and related issues indirectly and in certain cases on very small scale. They are also involved in capacity building and livelihood promoting activities even though much is still expected from them by the communities. Duplication of work by NGOs should however be looked at to help in the faster growth of the area. Conspicuously, timber extraction firms are working in these areas and in certain forest reserves but little is seen of them with respect to agroforestry and community development projects in general.

CHAPTER FIVE

5.0 RECOMMENDATIONS

Policy recommendations are crucial to bring major changes in agroforestry practice in Ghana. Even though there is an agroforestry policy in Ghana, research strategies and priorities, extension strategies and packages, socio-economic factors, agroforestry education and training, and institutional issues are all important to be addressed or reviewed. The goal of this policy should be to harmonize and strengthen agroforestry research and development programmes, through multidisciplinary and inter-institutional approach rather than by fragmented efforts that too often are characterized by competition, overlapping and lack of coordination.

1. Education Programme

An education programme should be designed and carried out with the purpose to promote the practice of agroforestry and improve the system where it already exists.

From data collected, it was observed that farmers in the study area needed education on several aspects of agroforestry and essential legislation and procedures that can be beneficial when adopting or improving the system.

The Forestry Services Division in collaboration with the Community Forestry Committees (CFCs), and other relevant stakeholders will have to prepare an awareness programme with specific attention given to tree tenureship and the rights of farmers and communities with regards to tree logging. It is also suggested that the community be made aware of the Social Responsibility Agreement (SRA) and what they ought to benefit from it; they appear not to know much about the SRA.

This education programme must be an integral part of the government's forest policy. There is also the need to channel the information to the stakeholders, whenever laws are revised or changed.

Since education programmes can be very expensive, it is recommended that the FSD make an inventory of all the relevant stakeholders who are directly or

indirectly involved in the agroforestry sector to incorporate them where possible. The agroforestry policy has been laid out, and it is expected that other players can, according to their field of operation, be integrated. As such, the following programme in Table 5.1 can be drafted and executed.

TABLE 5.1: EDUCATION PROGRAMME IN STUDY VILLAGES OF ASUNAFO DISTRICT			
Organization	Activities	Frequency	Remarks
FSD with relevant stakeholders	<ul style="list-style-type: none"> Draft Extension programme 	1x in 5 years	On district level
FSD/ Land Valuation Board/CFC/NCCE	<ul style="list-style-type: none"> Educate on forest policy/legislation and procedures/Social Responsibility Agreement/Tree tenure/Compensation for crops damaged 	1x per year	In selected communities within the Forest Fringe communities
FSD/MoFA/CFCs/RUDEYA/TBI/FORIG/RMSC/CRI	<ul style="list-style-type: none"> Education on tree-crop interactions Benefits from AF components Trees with short gestation period 	1x per year	In selected communities within the Forest Fringe communities
MoFA/RUDEYA/TBI /FORIG/RMSC/CRI	<ul style="list-style-type: none"> Animal/Plant diseases Monitoring of movement of animals Animal Husbandry 		

2. *Strengthening of stakeholders collaboration*

Even though, many NGOs are involved in agriculture and forestry, their collaboration is very poor. In order to allocate resources efficiently, there is the need for adequate collaboration between all stakeholders in the Asunafo District who are supporting or benefiting from the agroforestry practices. MoFA and FSD

should complement each other's efforts and try to achieve the goals set out in the policy for agroforestry.

After having educated the farmers on the benefits, the regulations and the compensations for crops damaged, there might be an increasing interest in practicing agroforestry. As such, the stakeholders that are already involved in the education should draft a detailed training programme. In order to carry out the training programme, the organizations will have to prepare project proposals for specific topics, and seek funding to implement them. The training programme may include:

Establishment of Nurseries

For the entire 3-forest reserve fringe community's nurseries should be established. As part of the training programme, selected farmers should be trained in plant propagation, and seed collection. The people's interest lies in:

- Plantation: Teak is most preferred by the communities
- Fruit trees: Fruit trees for both subsistence and commercial purposes (Avocado pear, Citrus, Mango, etc.)
- Firewood: Species that are suitable for firewood and charcoal are also needed
- Fodder trees: Farmers mentioned Nyankyerene (*Ficus exasperata*), avocado, pear, and cassava leaves as suitable fodder for livestock.

The farmers should be trained in establishing a nursery, maintenance and marketing of plant material. The project should have a participatory character, whereby farmers' own initiatives are supplemented by assistance from NGOs.

NGOs who work in this field, such as GTZ, TBI or RUDEYA should assist in seeking for funds for implementation of the project. This project should have a sustainable character in order to support future agroforestry attempts.

It is necessary to consider the prospect of producing seedlings of those indigenous/local species, which farmers found suitable in combination with crops, in the nursery.

These include: *Albizia zygia* (Okoro), *Lannea welwitschii* (Kumnini), and *Milicia excelsa* (Odum).

Establishment of demonstration/experimental fields

A demonstration site should be established where selected farmers from the communities would get practical training in AF system.

Different combinations of tree (timber/fruit) species and food crops (such as cassava, and yam) can be tried out with leguminous tree as boundary, or as shading for cocoa.

It is recommended that the training include methods for land clearance, and preparation, to the actual planting, tending and harvesting of the crops, as well as soil conservation measures.

Training in Animal Husbandry

MoFA should carry out training in animal husbandry in collaboration with other stakeholders. They should design a training programme for the community. Such training should be centered on disease control, feeding, housing of animals, and marketing of produce.

3. *Research*

The government and other research institutions, such as TBI-Ghana should undertake demand-driven research, and crop extension services. Such researches should delve into tree species with short gestation period as well as into plant and animal diseases.

It is therefore of great importance that research is conducted in especially the use of some indigenous tree species in combination with food/cash crops, which were mentioned by the farmers. Particular emphasis should be placed on research of indigenous species, their tolerance to pest and diseases and their multiple usages, such as soil fertility enhancement, use for fodder, and fuelwood.

There is also need for research on the plant and animal diseases farmers encounter in the field. Crop Research Institute could assist in an in-depth research into plantain diseases of the study areas with a view of providing solution.

Since land is limited and farmers are forced to consider continuous cropping and short fallow period (up to 3 years), it is important that research is carried out on possibilities of intensifying the cultivation period, without depleting the soil fertility completely. Such research can exploit the various AF options available to find out the most suitable one for the area.

4. *Improved fallow*

Traditional fallow take several years to restore soil fertility, as natural vegetation is slow to establish and to reach a peak of biological productivity. As such, multi-purpose tree species, which mature quickly, and enhance soil fertility, by providing green manure, and fixing nitrogen, can be introduced into fallow systems in the communities to improve soil fertility and thus improve productivity of land.

This can be done in two ways:

- System in which planted tree fallows alternate with crops and,
- Rotational hedge-row intercropping systems, in which a period of hedge row intercropping is followed by a period of uninterrupted hedge growth without crops

Also indigenous species such as, *Lannea welwitschii* (Kumnini), and *Albizia Zygia* (Okoro) and others which farmers indicated as having positive effects on crop yields as in Appendix 2 can be considered.

Exotic species, (*Gliricidia spp*, *Sebania sesban*, etc) which have been tested and proven to be appropriate for use in improved fallows, can be considered. However, it is necessary to find out tolerance to local conditions, and farmers' willingness to adopt those species.

5. *Promotion of fruit trees as an Agroforestry component*

Apart from oil palm, and cocoa (as cash crops), the cultivation of fruit trees is mainly on subsistence level. Combination of indigenous species with high hybrid seedlings is highly recommendable. Feasibility studies should be carried out on efficient marketing opportunities regarding fruit species. As such further

recommendations can be made in integrating these trees in the agroforestry system already existing in the area.

6. *Co-operative formation*

Co-operative, as a traditional system in the Ghanaian economy, should be formed in the communities under discussion. Co-operatives ought to be formed to overcome the defects and limitations of the capitalist economy, by improving competition and enlarging the area in which competitive pricing is effective. Such co-operative should extend the ownership and control of domestic business, help to develop managerial and administrative abilities, facilitate capital formation, expand employment opportunities, as well as promote equitable income distribution.

Moreover, they can deal with sellers of agricultural inputs for credit purchases so that after the sale of the produce, they can make payments to the input sellers.

Co-operatives of cassava, plantain, and yam growers can be formed and such enterprises can purchase members' produce for onward sale at bigger markets in the cities.

Additionally, co-operatives can be used as a means of achieving the goals and objectives of our national economic policy, namely:

- a. Rapid economic growth based on expanded production base.
- b. Full employment
- c. The promotion of national economic independence, self reliance in food, and other essential services
- d. The maintenance of external balance and
- e. Price stability

7. *Credit facilities*

The provision of funds, for the farmers to develop their farms, is a matter of great importance. The ideal solution to farmers' lack of funds would be to finance their operations from their own resources by trying to increase the amount of their capital reserves. However, in the circumstances of the communities under discussion, they have to turn to the state for funds or guarantees for bank loans. It is recommended

that, firstly, such loans be channeled through the rural banks and similar institutions set up to assist rural and small-scale producers, and secondly, government should induce other banks to give support to farmers' organizations just as the co-operative sector already enjoys income tax exemption under National Redemption Council Decree (NRCD) 5 (1975) and annual subvention. Such credit facilities available would, for example, enable farmers to buy agroforestry inputs.

TBI-Ghana can assist in providing seed money for the establishment of a revolving fund, from which community members can obtain loans, against low interest, especially for purchasing of farm inputs. In such a way, the fund will continue growing, and the community can benefit in a wider range. The fund should be managed by a legally recognized organization, and the board should represent both the community members, and the community leaders.

8. Guaranteeing Minimum Prices

In order that the rural farmers may reap the full benefit of their endeavours, it will be a better policy to provide incentives by guaranteeing minimum prices, rather than subsidize inputs. This is because, while subsidies on farm inputs tend to reach only those who enjoy the confidence of the organization through which they are provided, price-supports for various kinds of agricultural products will benefit all farmers who are prepared to work hard to improve their production. Thus, the pricing policies in Ghana should be consistent with agricultural and rural development, rather than favouring manufacturing and processing industries, while keeping food prices low in the urban areas. The farmers' equivalence to the income or salary commissions (such as the Tripartite Committee) for wage and salary increases for workers, in the modern sector, should be provided. In short, the government should maintain/ continue sound macro-economic policies, that intensify the implementation of reforms aimed at bolstering market efficiency, notably in agriculture.

9. Produce processing

There should be the promotion of the processing of farmers' produce. Such economic practices would add value to the produce, thereby ensuring that throughout the year

incomes flow. For example, a basket of oil palm fruits sold versus its use as palm oil plus palm kernel oil, cassava processed to get dough, gari, starch, and flour.

Added to the above is the need to provide storage facilities to house the excess produce of farmers to ensure an all year round production of food in the country. This will promote the rural farmers to a group of independent (of middlemen) entrepreneurs capable of taking risks in increasing their incomes through mass production.

10. Revision of timber law

The timber law should be revised in order to make provision for the payment of compensation fee at the FSD. In doing so the Land Valuation Board should survey the farm and estimate the number of crops that would be destroyed by logged timber trees and make the contractor pay before felling. This procedure can secure the farmer of compensations. The current timber law only makes mention of the consent needed from farmers, and the community before logging trees. There is the need for giving incentives to the farmers' to grow trees on their farms. As such, government and NGOs should consider introducing compensation for farmers for their efforts to nurse, and tend the trees. For every tree seedling planted, farmers could be given a fee. Presently, farmers are only compensated for damage caused to their crops, and since the compensations are not according to the realistic values, they are not willing to combine cocoa with timber species, and other crops.

11. Promotion of Taungya system

Degraded land in the community can be allocated for a community based taungya system, where crops could be cultivated during the initial years of the woodlot or wood plantation. NGOs can together with the FSD support the farmers with the supply of seedlings.

There is also room for granting concession to timber contractors, who in collaboration with farmers establish taungya systems. The timber contractors should then supply the farmers with seedlings, and other farm inputs, while they grow and tend for the trees.

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APPENDICES.

APPENDIX 1

QUESTIONNAIRE FOR FARMERS IN THE ASUNAFO DISTRICT

TROPENBOS INTERNATIONAL-GHANA

THE POTENTIAL AND CONTRAINTS OF AGROFORESTRY IN FOREST FRINGE COMMUNITIES OF THE ASUNAFO DISTRICT.

Name of Interviewer: _____

Date of Interview: _____

A. Demographic Data

1. Name of Village: _____
2. Age of respondent:
(a) below 18 ; (b) 19-49 ; (c) above 50
3. Gender of respondent: M / F
4. Educational status:
(a) Basic ; (b) Secondary; (c) Tertiary ; (d) Illiterate
(e) Non Formal
5. Marital status: (a) Married ; (b) Single ; (c) Divorced ; (d) Widowed
6. Household size: _____

B. Socio-economic information.

Land Tenureship

7. How do you acquire land for farming?
(a) Rent ; (b) Inheritance ; (c) Purchase ; (d) Others
- 8.a. Does the land tenureship allow for planting or keeping trees on farms?
Yes / No
- 8b. If Yes/ No, Give reasons _____

Land use system

9. What types of crops do you grow?

Cereals	Tubers & Roots	Cash crops	Others

- 10a. Do you intercrop?
Yes / No

- 10b. If Yes, list them:

11a. Do you rear animals?
Yes / No

11b. If Yes, list them

12. What is the source of feed for the animals?

- (a) Fodder ; (b) Kitchen waste; (c) Industrial feed ;
(d) Other _____

13. What is your farm size?

	Animal #	Crops
Farm Size		

14. How long have you been farming?

- (a) 0-5 years ; (b) 6-10 ; (c) 11-15 ; (d) Other _____

15a. Do you plant the trees on your farm?

Yes / No

15b. If Yes/ No, why _____

16. How do you prepare your land for farming / cultivation?

- (a) Slash and burn ; (b) Mechanical preparation ; (c) Manual without
burning ; (d) Chemical ; (e) Others _____

17. What do you do to maintain the productivity of the land?

18a. How long do you farm on the same piece of land ?

- (a) 1-3 years; (b) 4-6 years ; (c) 7-9 years; (d) 10-12years ;
(e) Other _____

18b. Why _____

19a. Do you have a land, which has not been used for farming?

Yes/ No

19b. If Yes/ No why _____

20a. Do you know anything about agroforestry?

Yes / No

20b. If Yes, where did you hear of this practice for the first time?

21a. Do you think the AF system must be adopted?

Yes / No

21b. If Yes/ No, why _____

22a. Are you willing to release your land for the practice of AF system?
(Refers to question 7)

Yes / No

22b. If Yes/ No, why _____

23a. Do you think you can encourage other farmers to adopt this system?

Yes / No

23b. If Yes / No why _____

24a. If you are to adopt this system, can you manage all the components?

Yes / No

24b. If Yes/ No, why _____

Household income

25. What are your other sources of income aside farming?

(a) trading ; (b) hunting ; (c) weaving ; (d) palmwine tapping ;

(e) others _____

26a. Do you sell your farm produce?

Yes / No

26 b. If Yes/ No, why _____

27. How do you market these products?

(a) at the farm ; (b) at the local market ; (c) Other _____

28a. Do you suggest any better way of selling your products?

Yes / No

28b. If Yes, how?

29. What is your main source of fuel for cooking?

(a) firewood ; (b) charcoal ; (c) gas ; (d) other _____

30. If trees from the forest are used, which species do you normally prefer for firewood of to produce fuel?

APPENDIX 2:
Checklist for Focus Group Discussion in the Communities

Land tenure

1. Who owns the land?
2. Which are the major problems to land acquisition?
3. Are there any institutions that assist farmers to obtain land?
4. Which are the procedures for acquiring land?

Land use

5. What type of land use is usually tolerated when land is rented?
6. Who owns the trees, when they are already present on the farm?
7. If you planted trees on your farm who owns them?
8. Which are the major constraints for planting trees?
9. Is the community in favour of planting trees?
10. Are water sources sufficient for growing trees/crops or for other AF combinations?
11. Have you identified any threats to the practice of AF systems?

Agroforestry

12. When did you learn of agroforestry in this community?
13. What species of tree, animal, and crops are common in this area?
14. If you compare the yields in the present with the past, which was better?
15. Which constraints have you identified in the agroforestry system?
16. Which types of trees do you combine with the food crops/cocoa? And why.
17. Do you have leguminous trees, like Leucaena, Glyricidia, Acacia etc?
18. Which types do you prefer and why?
19. Do you consider fallow periods? Why?
20. Which tree spp. do you leave on the farm, when preparing land for cultivation?
21. What is the pattern of planting trees on the farm?

Marketing

22. Would you like to process your products before marketing?
23. Do you get attractive prices for you products throughout the year?
24. If not, which are the main factor for price droppings?

Energy

25. What is the main source of fuel for cooking in the community?
26. How do you obtain your sources of fuel?
27. If you use trees from the forest, which species of trees do you use?
28. Would you have preferred other means of fuel? Why?

Perception

29. Do you go to the farm everyday?
30. Do you have any specific traditions or taboos concerning farming?
31. Does your community have any specific beliefs or customs concerning tree planting or cutting?
32. What do you think about tree cutting in the community?

Involvement of organizations

33. Do other people or organizations help in the practice of the AF system?
34. In which way do these people or organizations help?
35. What additional role would you like these stakeholders to play?
36. How would you like to benefit from AF?

APPENDIX 3.

Farmers Views on Usage of Trees on Farmlands in the Asunafo District

Good for Cocoa plantation	<i>Ficus anomani</i> (Odoma), <i>Pycnanthus angolensis</i> (Otie), <i>Ceiba pentandra</i> (onyina).
Not good for Cocoa plantation	<i>Celtis mildbraedii</i> (Esa), <i>Triplochiton scleroxylon</i> (Wawa), <i>Ficus exasperata</i> (Nyankyerene), <i>Trichilia monadelpha</i> (Tanuro).
Beneficial to food crops growing around it	<i>Ficus anomani</i> (Odoma), <i>Newbouldia laevis</i> (Sesemasa), <i>Ceiba pentandra</i> (onyina), <i>Alstonia booneii</i> (Nyamedua), <i>Albizia zygia</i> (Okuro).
Detrimental to food crops growing around it	<i>Ficus exasperata</i> (Nyankyerene), <i>Triplochiton scleroxylon</i> (Wawa), <i>Nesogordonia papaverifera</i> (Danta), <i>Terminalia superba</i> (Oframo), <i>Terminalia ivorensis</i> (Emire), <i>Celtis mildbraedii</i> (Esa), <i>Cola gigantea</i> , (Watapuo), <i>Cola nitida</i> (Bese), <i>Trichilia monadelpha</i> (Tanuro), <i>Christiana africana</i> (Sesedua), <i>Mangifera indica</i> (Mango), <i>Citrus spp.</i> , <i>Milicia excelsa</i> (Odum), <i>Ricinodendron heudelotii</i> (Wama), <i>Pycnanthus angolensis</i> (Otie), <i>Cylicodiscus gabunensis</i> (Denya).
For Fuelwood	<i>Celtis mildbraedii</i> (Esa), <i>Terminalia superba</i> (Oframo), <i>Antiaris toxicaria</i> (Ntedua), <i>Corynathe pachyceras</i> (Pamprama), <i>Trilepisium madascariense</i> (Okure), <i>Pycnanthus angolensis</i> (Otie), <i>Piptadeniastrum africanum</i> (Dahoma), <i>Margaritaria discoidea</i> (Pepea), <i>Alstonia booneii</i> (Nyamedua), <i>Rauvolfia vomitoria</i> (Kakapenpen).
Charcoal	<i>Milicia excelsa</i> (Odum), <i>Entandrophragma spp.</i> , <i>Celtis mildbraedii</i> (Esa), and all redwoods.
Traditional Medicine	<i>Entandrophragma angolense</i> (Edina), <i>Khaya spp.</i> (Mahogany), <i>Lannea welwitschii</i> (Kumanini), <i>Azadirachta indica</i> (Neem), <i>Trichilia monadelpha</i> (Tanuro), <i>Ricinodendron heudelotii</i> (Wama), <i>Zanthoxylum leprieurii</i> (Oyaa), <i>Treculia africana</i> (Ototim), <i>Pycnanthus angolensis</i> (Otie), <i>Bombax buonopozense</i> (Akata), <i>Newbouldia laevis</i> (Sesemasa).
Fodder for Livestock	<i>Ficus exasperata</i> (Nyankyerene), <i>Manihot esculenta</i> (Cassava), <i>Persea americana</i> (Avocado Pear).
Fencing	<i>Jatropha carcas</i> (Nkrangyedua).