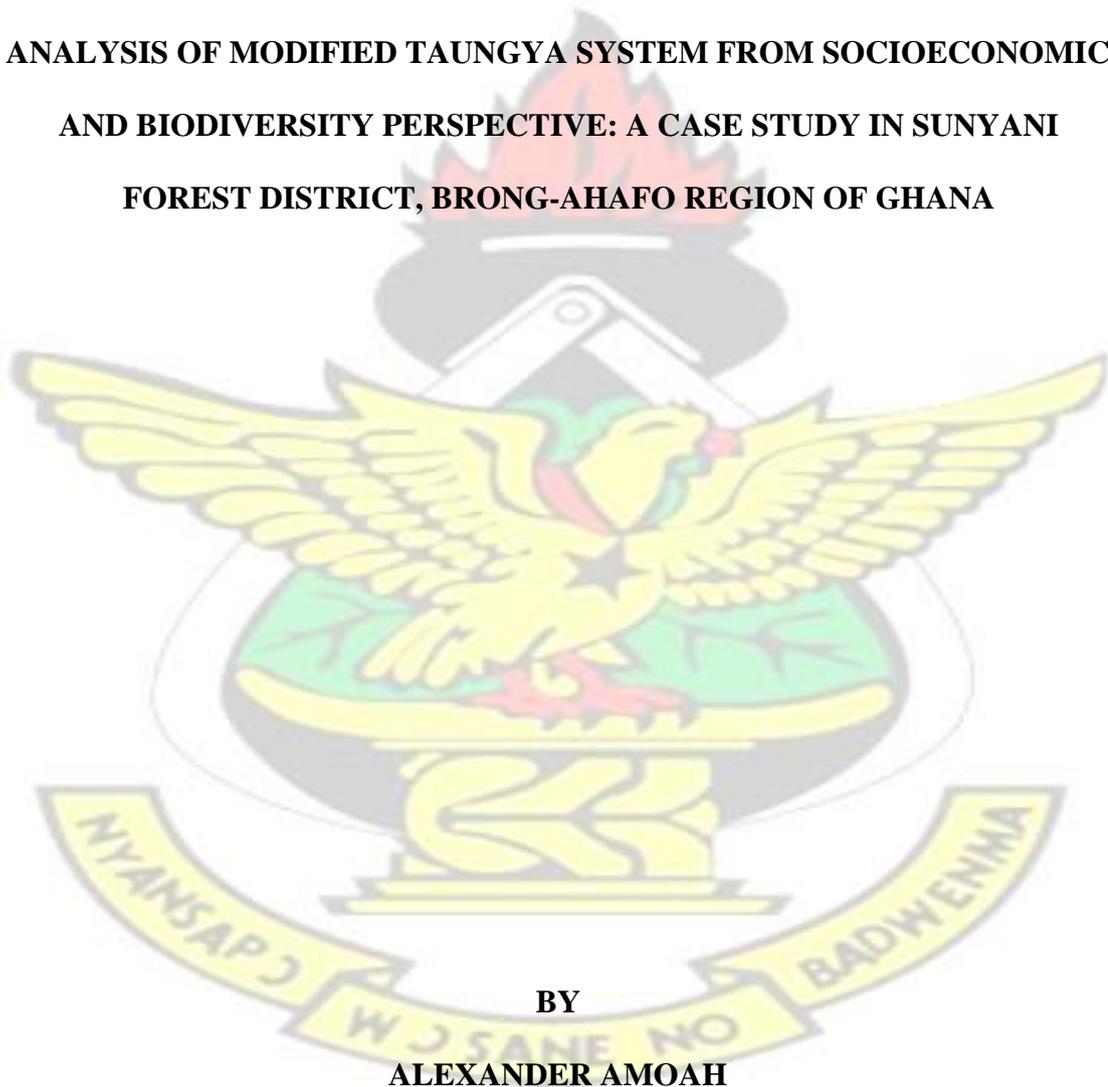


**KWAME NKRUMAH UNIVERSITY OF SCIENCE AND
TECHNOLOGY FACULTY OF RENEWABLE NATURAL RESOURCES
DEPARTMENT OF AGROFORESTRY**

KNUST

**ANALYSIS OF MODIFIED TAUNGYA SYSTEM FROM SOCIOECONOMIC
AND BIODIVERSITY PERSPECTIVE: A CASE STUDY IN SUNYANI
FOREST DISTRICT, BRONG-AHAFO REGION OF GHANA**



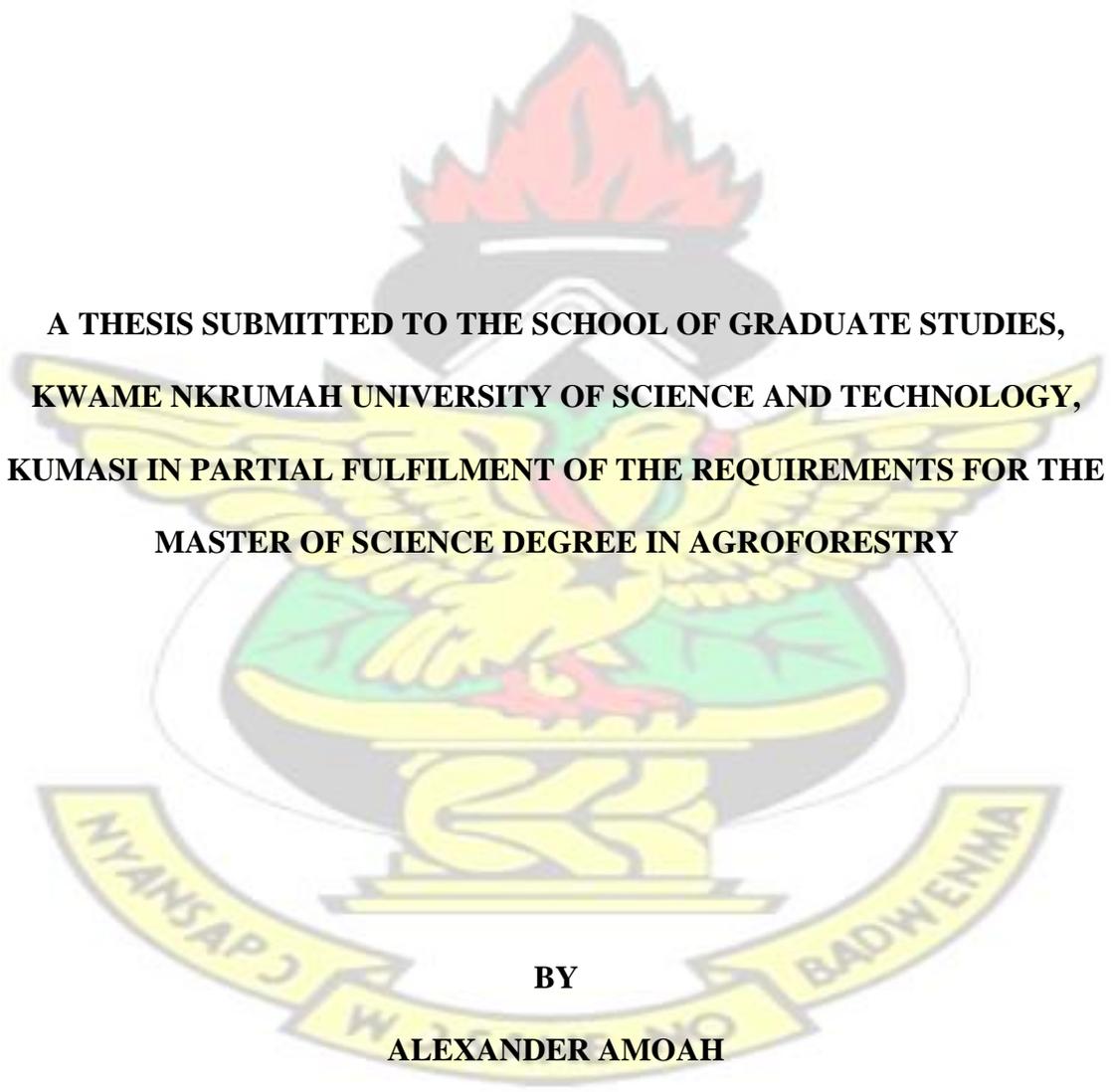
**BY
ALEXANDER AMOAH**

JUNE, 2009

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KNUST

**A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES,
KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY,
KUMASI IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE
MASTER OF SCIENCE DEGREE IN AGROFORESTRY**



BY

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BSc, NAT. RES. MGT. (KUMASI)

JUNE, 2009

DECLARATION

I do declare that except references of the other people's work which have been duly cited, the work submitted as a thesis to the Department of Agroforestry, Faculty of Renewable Natural Resources for the degree of Master of Science in Agroforestry is the result of my own research.

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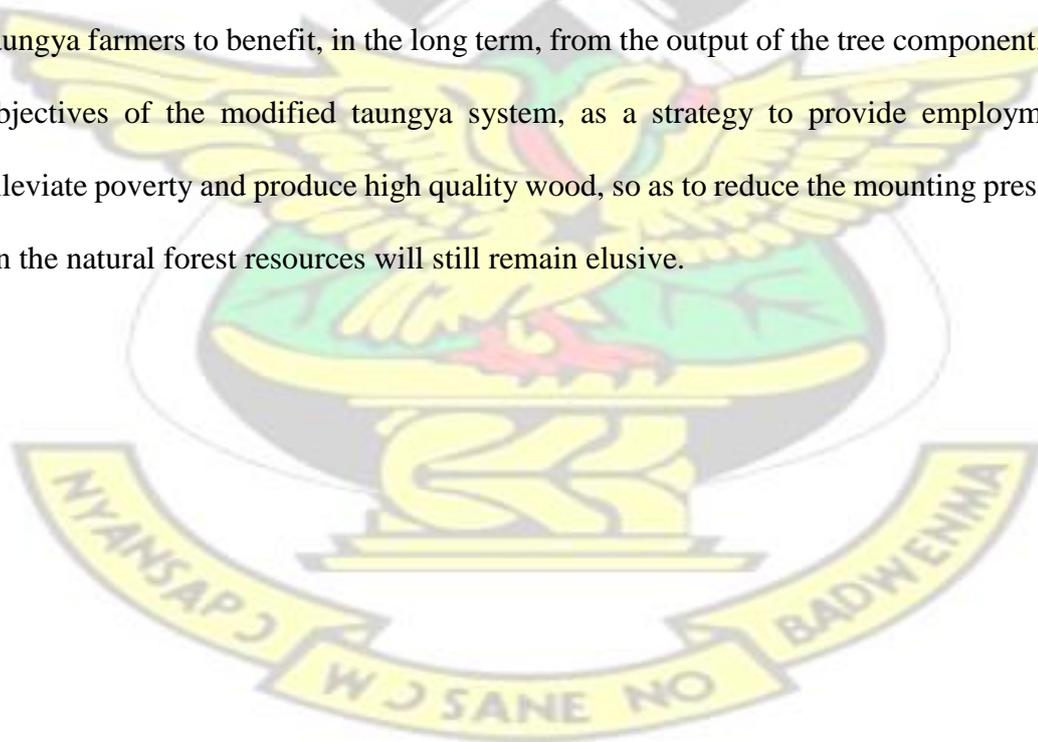
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ABSTRACT

Taungya plantation development schemes based purely on technical grounds and national economic criteria are bound to be unsuccessful, if the social and economic needs of the farmers are not incorporated into the taungya forest plantation development schemes. Failure of taungya plantation development has a much more negative impact on the environment and its biodiversity than even the incidence of fire. The forest reserves in the Sunyani Forest District are within the fire-prone forest/savannah transitional zone of Ghana, which exist in equilibrium with occasional fire incidence. The objective of the study was to assess the employment, income opportunities, biodiversity implications and problems of taungya plantations establishments in Sunyani Forest District. Data collected included consultations with staff of Sunyani Forest Service District, field visits, individual interviewing using semi-structured questionnaire and group discussions. The Sunyani Forest Service District taungya system operations offer employment to 180 labourers per year and 47 forestry staff to carry out the various operations in the taungya system. The average wage per manday over the years was GH¢1.20 which is below the current minimum wage of GH¢1.80 and hence insignificant when using taungya plantation development as one of the poverty alleviation strategies most especially in the rural communities. Between the periods 2005–2009 volume of teak wood extracted in the Sunyani Forest Services District was about 31,040 cubic meters with an estimated value of about GH¢4,345,600.00 accrued to the government and not to the taungya farmers. Thus, the socio-economic aspects of the taungya farmers are not considered as far as the tree component of the taungya system is concern. However, some farmers (22 %) benefit from firewood from teak branches and slabs from sawmill companies in the study area. Unfortunately, the farmers do not benefit from the timber/pole output of the taungya system. Within the farming system maize is the most preferred crop (31.88 %)

by farmers among the other staple crops. From the perspectives of the respondents (e.g. farmers, herbalists, hunters and forest technical officers) indicate that less number of different flora species grow in taungya plantations and these are the plant species that are mostly left standing in the course of land preparation for taungya plantations establishment. Again from the view points of the respondents inter alia farmers, herbalist, hunters and forest technical officers different fauna species commonly encountered in taungya plantations are abysmal. Transport for taungya operations in the study area was identified as one big constraint to successful taungya operations. Irrespective of the innovative move to improve taungya operations, partly to provide employment and alleviate poverty in the rural communities, if the Ghana Government Plantation Policy framework governing the National Forest Plantation Development Project (NFPDP), launched in September, 2000 is not fully implemented for the taungya farmers to benefit, in the long term, from the output of the tree component, the objectives of the modified taungya system, as a strategy to provide employment, alleviate poverty and produce high quality wood, so as to reduce the mounting pressure on the natural forest resources will still remain elusive.



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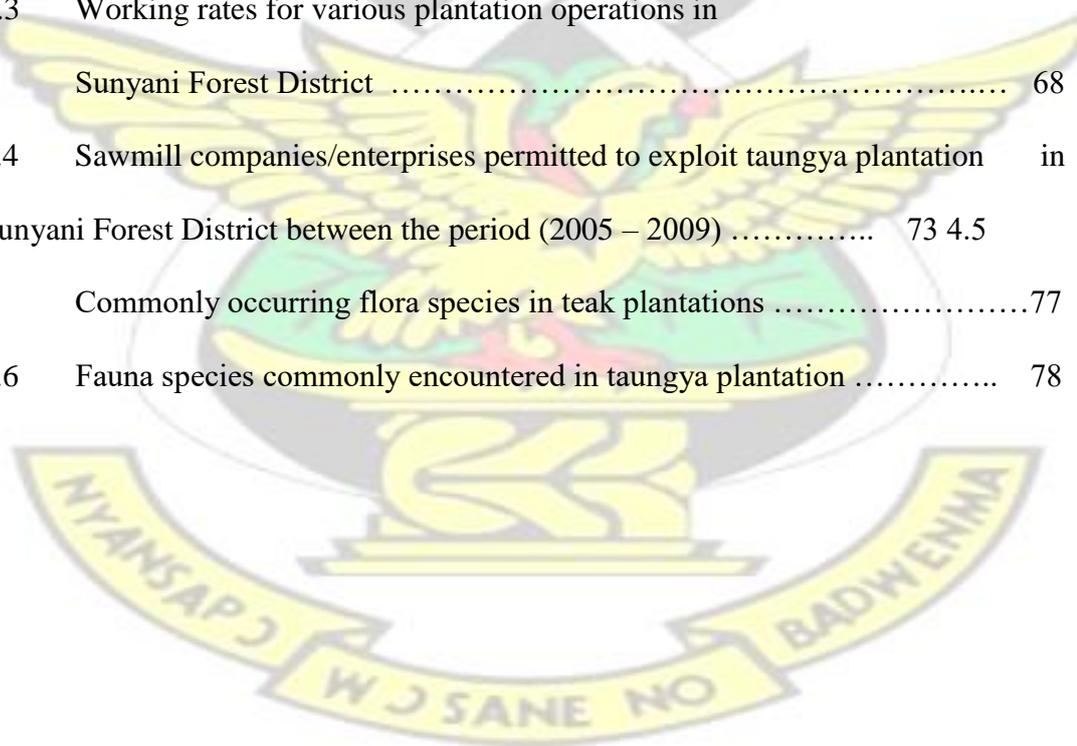
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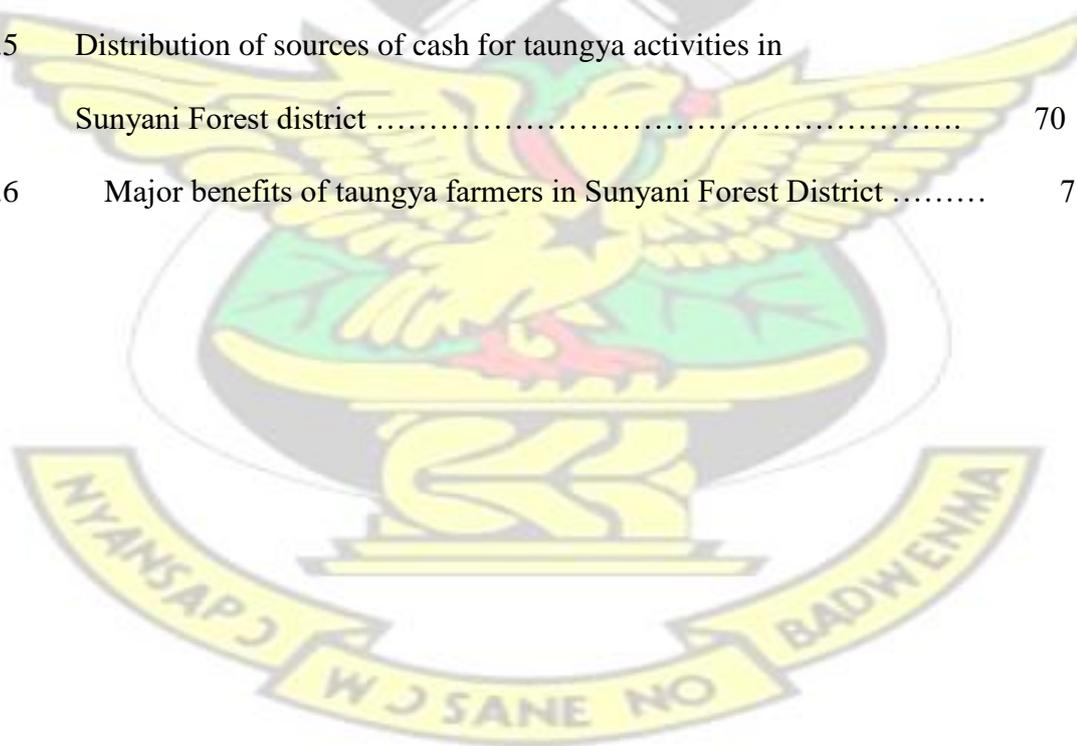
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CHAPTER ONE

1.0 INTRODUCTION

Taungya is a land use management system which consists of the raising of forest crops in conjunction with temporary agricultural crops in which a short phase of food crop production is used as a silvicultural method to ensure the establishment of timber trees (King, 1968; Evans, 1982; Wiersum, 1982; Okigbo, 1985).

Generally, the practice of taungya system involves some form of government intervention in the establishment and control of forest plantations (Ruthenberg, 1980). The original scheme was to give tribes, rural dwellers or farmers a piece of land that they could clear and cultivate for about 4-5 years while the trees are young. After the initial 4-5 year cropping period, the trees are managed as a mono-culture forestry unit (Enabor, 1975; Goswami, 1982; Watson, 1983), whereby the farmers are ordered, in accordance with the specifics of the taungya agreement, to discontinue cropping and maintenance of food crops in between the trees, most especially when there is closure of the tree canopy.

Wood production is the ultimate objective in the taungya system, the benefit in the short term of the farmer for practising it, as in shifting cultivation, is to produce food (Okigbo, 1985). Farmers did not benefit from the output of the tree component cared for by the farmers in the early stages of establishment through the cultural practices carried out by the farmers.

Several alternatives and improvements to taungya systems have been initiated in different places, most of them with the objective of providing better living and social conditions for the participating farmers. One of the most widely quoted examples is the

Forest Village Scheme in Thailand, which has generated several reports (Boonkird *et al.*, 1984) and also the Modified Taungya System in Ghana (Agyeman *et al.*,

2003). Although taungya system is intended to provide some relief to rural communities in Ghana, the system may benefit the legal landowners or the government.

1.1 Statement of the problem

It is widely known that in rural tropical areas, most economic development programmes have been largely exploitative, extractive and damaging, consisting, for example lumbering, mining and sand winning just to mention a few, with little or no reforestation. Even, if reforestation programmes were put in place after the exploitation, the needs of the local communities were not considered. Consequently, most national and international development programmes had not been sustainable or have failed, probably due to social, economic, cultural or political limitations. For example, the Green Revolution Technologies (Borlaug and Dowsell, 1988) was not sustainable because of the heavy demand placed on increased used of fertilizers and other expensive inputs that were beyond the reach of a large number of resource-poor farmers in the developing countries.

Ghana, like any other developing countries has developed a number of policies and strategies over the years to improve the standard of living of its citizenry. However, governments had failed to achieve this most especially in the rural communities because development schemes were based purely on technical expertise and national economic criteria. Such schemes are doomed to fail if the social, economic and environmental problems of the local communities are not taken into consideration (FAO, 1984). Particularly, in the taungya system, the only immediate benefit obtained by the taungya farmers was food production for a limited period on relatively fertile soil. The taungya farmers were forcibly ejected upon closure of the tree canopy with the management of the forest plantation exclusively under the domain of the then Forestry Department. Thus, little or no thought

appears to have been given to the practice of the taungya system, farms, farmers and their agricultural output. Also, the basic needs of the poorest of the poor, in particular, the rural poor, were neither considered nor adequately addressed (McNamara, 1973). Therefore, the local people showed little or no concern for the protection of the forest plantations against bush fire and illegal felling by chainsaw operators.

The problem is that within the context of tree crop output of taungya reforestation programmes in Ghana, the socio-economic and environmental improvement, both in the short and long term, of the rural poor is not adequately addressed. Undoubtedly, the exclusion of local communities from the benefits of the output of tree component of any form of taungya system will further contribute partly to widen the poverty gap between the urban centers and the rural communities and cannot be used as a poverty alleviation strategy both in the short and long term.

1.2 Justification of the study

Integrated forest management combines national objectives and community requirements and it is needed for further development and improvement of tropical rural areas (Eighth World Forestry Congress, 1978). In addition, the World Bank has announced a major shift in its support of forestry activities, and will now place more emphasis on the environment and rural forestry (Spears, 1982).

As a result of combined effect of over-exploitation of forest resources, unsustainable farming practices, logging, wild-land fires and mining activities the forest area has reduced and degraded. About 32 % of the reserved forests and over 70 % of forests outside reserves have been degraded (Ministry of Lands and Forestry, 1996; Dykstra *et al.*, 1996). However, according to FAO (2010) between 1990 –2010 Ghana lost an average of 125,400 ha or 1.68

% per year. In total, Ghana lost 33.7 % or around 2,508,000 ha of its forest cover between 1990 – 2010. The average density of many valuable indigenous trees is now low in these forests and some are sometimes less than one commercial tree per ten hectares in the ‘primary’ forests (Lamprecht, 1989). Continued forest loss at a current annual rate of 1.7%, (FAO, 2000) threatens the existence of these indigenous tree species and associated biodiversity through not only habitat loss, but also the potential lack of gene flow because of fragmentation (Novick *et al.*, 2003). Forest loss affects the livelihoods and the environment of particularly the rural poor in different ways. These include shortages of fuelwood, non-timber forest products, accelerated soil erosion and reduction in agricultural productivity (Stoorvogel and Smaling, 1990 ; Abeney and Owusu, 1999).

According to Bene *et al.*, (1977), the first priority of World Bank should be given to combined production system which would integrate forestry, agriculture and/or animal husbandry in order to optimize tropical land use. Currently, there is increasing attention for local community-based forest rehabilitation as an innovative response to meet the conflicting goals of livelihood improvement and sustainable forest management (Ministry of Land and Forestry, 1994; Chamshama and Nduwayezu, 2003; Castréu, 2005). Such community-based rehabilitation programmes have often included the promotion of the establishment of plantations (Evans, 1992; Siaw, 2001, Yirdaw, 2002). In order to reduce pressure on forests and avoid further degradation of forests, sustainable farming systems such as agrisilviculture where trees are grown together with agricultural crops are introduced in the forest rehabilitation initiatives (Pra,1997; Appiah 2001; Franzel and Scherr, 2002; Appiah, 2003).

Despite the increasing rehabilitation initiatives involving local communities only few of such initiatives can boast of being highly successful (Appiah, 2001; World Bank, 2002). This is due to lack of local people’s commitment which is as a result of poor partnership

approaches, absent of or poorly utilized incentives (Brown, 2003) or a mismatch about the perception of priority needs or benefits between project initiators and the local communities or a combination of these (Brown, 2002).

Most of the forest reserves in Brong-Ahafo Region are within the fire-prone forestsavannah transitional zone of Ghana. The forests had therefore been degraded partly by the frequent incidence of bush burning and partly by over exploitation of timber, non-timber forest produce, mineral ores and sand wining (Hall and Swaine, 1981; Swaine *et al.*, 1995; Ministry of Lands and Forestry, 1996; Dykstra *et al.*, 1996; FAO, 2000).

Deforestation in many developing countries has been due to colonial exploitation, rapidly increasing population, poverty, and inequity of forest resources (Sajise, 1991). Hence, leaving degraded forests for natural regeneration in the face of the high incidence of annual bush fires coupled with exploitation both legally and illegally will be a mirage.

It will require the adoption and implementation of a ‘Farmer First Scheme Taungya Plantation Scheme’ for successful forest rehabilitation and management. Other than that farmers will not be encouraged to actively participate in forest plantation establishment, protection and check against illegal exploitation and encroachment of the natural forest and the established forest plantations. The adoption of a “Farmer First Taungya Plantation Scheme” directed towards solving the current and future socio-economic and environmental problems especially in the rural communities is prudent. This will ensure sustainable development whereby the needs of the present generation will be met without compromising the ability of future generations to meet their own needs.

Previous studies (Kiss, 1991; Opole, 1992; CFMU, 2000) and current on-going development projects worldwide indicate that local communities will actively participate in projects if they are assured that they will gain from every aspect of the project.

Generally, it is known that in tropical countries like Ghana, people living in or near the forest fringe communities are usually poor and the least powerful of the stakeholders during resource allocations. They are socially and economically marginalized and face escalation of socio-economic stress due to lack of education, legal or political support (World Bank, 1982). It will therefore be in the right direction if the socio-economic needs of the farmers are addressed, both in the short and long term in all taungya plantation development programmes. This should be considered because several million people live in forest fringe communities and most are small farmers or farm labourers and about half of them are either under-employed or unemployed. Such lower social conditions place great pressure on forestlands to commit forestlands for food crop farming, livestock raising, water resources, forest products and human settlement. For example, the annual growth rate of population in Ghana has been estimated at 3.3 % while the current standard of living has risen (Ghana Statistical Service, 2000). Hence, forest policy should not emphasize only on management of forest areas for the production of timber and commercial non-timber forest products. It should also be directed at increasing employment opportunities, rural development and poverty alleviation on sustainable basis (Atmosoedardjo and Wahyudi, 1980; Wirjodarmodjo and Bratamihardjo, 1984). However, colonial taungya plantation development as practiced in Burma and other places including Ghana in the 20th century is unsatisfactory for dealing with modern day socio-economic problems (Gajaseni, 1988).

In Ghana, industries and social services are fast growing. It has experienced rapid transformation over the last two decades at the expense of forestry and the agricultural sectors. According to Jordan *et al.*, (1992), the relatively slow progress in the forestry and agricultural sectors is due to the fact that most of the accessible forests have been exploited and their natural regeneration in the near future is doubtful. Irrespective of the problems, the

largest opportunity for economic expansion is in forestry and agriculture. To realize economic gains, effective planning is of utmost importance. Hence, forestry, agriculture and social policies must be well coordinated in order to device management strategies that will result in sustainability of production, environmental amelioration and poverty alleviation most especially in the rural communities.

1.3 Objective

The general objective of the study is to assess the socio-economic and biodiversity conservation of taungya plantations development in forest fringe communities in Sunyani Forest Service District. The specific objectives are:

- (i) to assess the employment, income as well as livelihood opportunities of taungya plantation development in Sunyani Forest Service District;
- (ii) to assess the impact of taungya plantation on bio-diversity conservation from the perspectives of the local people; and
- (iii) to identify the problems and constraints associated with taungya system in Sunyani Forest Service District.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 The taungya system

Kio (1972) described taungya system as a system of plantation establishment in which willing shifting cultivators are engaged to establish and tend tree crops together with temporary agricultural crops. However, it is worth noting that taungya system and shifting cultivation are essentially two different land use systems both in time and space. While shifting cultivation is a sequential system of growing woody species and agricultural crops, taungya consists of the simultaneous combination of the two components during the early stages of forest plantation establishment.

Taungya system was however considered as a low-cost mechanism of governments for forest plantations development that engaged farmers who are willing to plant and care for forest crops whilst being allowed to grow food crops in between the young tree crops for three to four years (Enabor, 1975; Goswami, 1982; Watson, 1983;). Thus, Taungya is a land use system in which peasants are allowed to cultivate agricultural crops for the first few years between the planted seedlings of forest plantations.

Taungya is a land management system which consists of the raising of forest crops in conjunction with temporary agricultural crops in which a short phase of food crop production is used as a silvicultural method to ensure the establishment of timber species (King, 1968; Evans, 1982; Wiersum, 1982; Okigbo, 1985).

According to Ford-Robertson (1971), taungya was a common practice in medieval Europe and has been developed into a mechanism for reforestation, and praised as a panacea to solve problems of shifting cultivation in many parts of the tropics. Again, taungya system was promoted in Burma in 1855 by Sir Dietrich Brandis to arrest the destructive effects of shifting cultivation (von Hesmer, 1966), and Annual reports on forest administration in Burma showed that teak plantations began in 1863 in Burma (MacGillivray, 1990). Today

the Taungya system is known by different names, some of which are also used to denote shifting cultivation (Okigbo, 1985). Blanford (1958) reported that the word Taungya originated and practiced in Myanmar (Burma) and means hill (Taung) and cultivation (ya). Taunyg system is therefore, essentially a modification of the traditional shifting cultivation, but various forms can be found in different parts of the tropics (Nair, 1984).

Gorman (1969) mentioned that evidence from excavations at Ban Chieng, Northeastern Thailand, indicated that people have cultivated plants in the area for centuries. The system involved combinations of trees, root crops and seed crops.

In Africa, it was reported to have been first introduced in Kenya as early as in 1920's. Taungya system has been employed to establish plantations successfully at low establishment costs in South East Asia, East Africa, and West Africa including Ghana.

Taungya system is considered to be one of the low-cost forms of government compensatory forest plantation establishment which enlists farmers who are willing to plant and care for forest crops in return for being allowed to grow food crops for 4-5 years while the trees are young (Enabor, 1975; Goswami, 1982; Watson, 1983). Biologically and economically the taungya system has proven to be a successful partial integration of food crops and tree husbandry. While taunyg has been tried in Africa (Lowe, 1987; Nwonwu, 1987) and the America (Weaver, 1989), it is practised most extensively in Southeast Asia.

As such, recent improvements in taunyg plantations have occurred principally in South Asia. According to (King, 1968), the origin of taungya system can be traced back to the 1850s in Burma, where the system was used as a means of replanting teak on badly degraded land. In 1806, U. Pan Hle, a Karen in the Tonze forests of Thararrawaddy Division in Myanmar (Burma), established a plantation of *Tectona grandis* by using the taungya system that the Governor, Sir Dietrich Brandis considered the method of the taungya system as the most

efficient way of planting teak (Blanford, 1958), and Tran (1983) also reported that U Pan Hle, a Karen tribesman, might have first used the taungya system for the establishment of teak plantations as early as 1856. However, the original idea of taungya plantations is often attributed to Dietrich Brandis of the Indian Forest Service. Taungya was introduced in Thailand in 1911, Malaysia in 1950 and Indonesia in 1873, (Awang, 1985).

Taungya, according to Tejwani (1987) begun in India in the 19th century as a means to exploit the cheap labour of landless peasants in establishing plantations of economically valuable trees, especially Sal (*Shorea robusta*) and Teak (*Tectona grandis*), and today, taungya is practiced in several region of India whereby different kinds of agricultural crops are integrated with the tree crops (Table 2.1).

According to Hailey (1957), taungya system became widespread and was introduced into South Africa as early as 1887. Again, in 1890, taungya system was taken from Burma to the Chittagong and Bengal areas in colonial India (Raghavan, 1960). Most of the forest plantations established in the tropical world, particularly in Asia and Africa, owe their origin to the taungya system (von Hesmer, 1966, King, 1979).

According to Brookman-Amisshah (1978), taungya system was introduced in Ghana as a silvicultural mechanism of improving the stocking of forest reserves deficient in economic species due to over-exploitation and poor natural regeneration.

Table 2.1 Spread of taungya and crops integrated in India

State	Tree crops	Associated agricultural crops
Uttar Pradesh	<i>Shorea robusta</i> <i>Tectona grandis</i> <i>Acacia catechu</i> <i>Dalbergia sisoo</i> <i>Eucalyptus spp.</i>	Maize, paddy, sorghum, pigeon pea, soybean wheat, barley, chickpea, oilseed rape.

Andhra Pradesh	<i>Populus spp.</i>	Hill paddy, groundnut, sweet potato
	<i>Anacardium occidentale</i>	
	<i>Tectona grandis</i>	
	<i>Bombax ceiba</i>	
Kerala	Bamboo	Paddy, Manihot spp., ginger, tumeric
	<i>Eucalyptus spp.</i>	
	<i>Tectona grandis</i>	
	<i>Bombax ceiba</i>	
Assam	<i>Eucalyptus spp.</i>	Paddy
Tamil Nadu	<i>Shorea robusta</i>	
West Bengal	<i>Tectona grandis</i>	Paddy, Maize, millets, turmeric, ginger, ladies fingers pineapple, hemp
	<i>Shorea robusta</i>	
	<i>Schima wallichii</i>	
	<i>Cryptomeria japonica</i>	
	<i>Quercus spp.</i>	
	<i>Michelia doltsopa</i>	
	<i>Acacia nilotica</i>	
	<i>Acacia mearnsil</i>	
	<i>Ceiba pentandra</i>	
	Cashew	
Rubber		
Maharastra	<i>Shorea robusta</i>	Sunhemp, jute, mesta, sunflower, castor
Andaman	<i>Pterocarpus dalbergoides</i>	Sugarcane, maize

Source: Tejwani (1987)

2.2 The development of taungya system in Ghana

In Ghana, taungya system was introduced as far back as in 1928 when the then Forestry Department was charged with the responsibility of establishing forest plantations for the production of wood in the long term and also to meet the needs of farmers for fertile land in areas where farm land outside the national permanent forest estate was infertile and limited (Brookman-Amissah, 1978). This was in the right direction, because in most tropical countries, people living in forest fringe communities are usually part of the poorest and least powerful of the stakeholders. They are socially and economically marginalized and face escalation of socio-economic stress due to lack of education, legal or political support. So, interested farmers were, however, given new land to continue the taungya system.

According to Forestry Department (1991) taungya practice started as early as 1929 in the Brimso forest reserve with *Senna siamea* as the major tree species. However, in Upper Sawsaw forest reserve, *Cedrella odorata* and *Terminalia ivorensis* species were used to establish taungya plantations in 1937 and covered 120.5 hectares by 1990. The Forestry Department now Forest Service Division (FSD) provided assistance in the form of pegging the farm and planting the seedlings. The farmers were required to care for them indirectly when carrying out any cultural practices on the food crops. Forestry Department (1991) indicated that the extent of forest plantations development through taungya system is more than twice as compared to that of industrial plantations development and about 33,954.4 hectares of forest plantations were established through taungya system while 16,021.9 hectares were through industrial plantation strategies.

In all the ten regions of Ghana, according to Forestry Department (1991), BrongAhafo region is ranked as the most successful in terms of taungya plantations development.

This success is attributed to the farmers' commitment and patronage. In BrongAhafo Region, taungya plantation development was initiated in Bosomoa forest reserve in 1941 with much success covering about 6500 hectares. Teak constituted the main tree species used in taungya plantations in Brong-Ahafo Region.

Taungya plantation establishment intensified in Ghana between 1969 and 1985 (FD, 1985) as part of the Operation Feed Yourself Programme. Despite the supposed advantages of the taungya system, it has not been widely adopted and has virtually come to a halt. In Ghana, the traditional taungya and the departmental taungya systems that were introduced came to a halt, and in many cases, the local people or farmers still suffer hardships due to socio-economic difficulties with the taungya system. The system has therefore not realised its full potential from an agronomic, forest management and environmental point of view. This is probably because of several inherent limitations that are mainly social, economic and political in nature.

Under the traditional taungya arrangements governing the taungya scheme, Ghanaian taungya farmers were not entitled to any rights of benefits accruing from the planted tress apart from the produce from the agricultural crops at the initial stages of the plantation establishment (Milton, 1994). They were also not involved in decision-making processes in any aspect of forest management (Birikorang, 2001)

The tendency for taungya farmers to pay more attention to their agricultural crops to the neglect of the tree crops made the system unreliable in the past that resulted in its discontinuation in 1985. Other reasons for the suspension of the taungya system included the inability of the Forestry Department, now Forest Services Division of the Forestry Commission, to provide effective supervision, inadequate financing mechanism, abuse of power by public officials, especially in land allocation and lack of an equitable benefit-

sharing framework among stakeholders (Agyeman *et al.*,2003). These reasons led to the abuse of the system by the participating farmers, which included:

- (a) Farmers deliberately killed planted seedlings to extend their tenure over portions of land since a successful plantation meant the discontinuation of cultivation on allocated plots. The only incentive for the taungya farmers was their continued access to the allocated land for farming purposes thus the successful establishment of the planted tree seedlings posed a threat to their incentive.
- (b) Farmers failed to weed around the planted tree seedlings thereby retarding their growth.
- (c) Illegally farmed other areas in forest reserves, degraded or not, which were not allocated for taungya.
- (d) Farmers planted for crops, which were not compatible with the tree crops.
- (e) Farmers cleared more land for plantation development than needed for the available tree seedlings.
- (f) Farmers did not practice this principle of agroforestry on their own land outside the reserves suggesting that the taungya system had not had the desired impact on the participating communities.
- (g) Corrupt practices on the part of the Forestry Department staff, especially in plots allocation and the general abuse of power by the officials created fertile grounds for the failure of the system

Irrespective of the problems with the failed traditional taungya system, forest fringe communities still viewed the taungya system as one of the most beneficial forest tenure systems and requested the Ghana Government to re-introduce it albeit with changes to make

it more efficient. The Ghana Government has therefore re-introduced the taungya with modifications termed as Modified Taungya System (MTS).

2.2.1 The Modified Taungya System

Under the Modified Taungya System (MTS), being operated in Ghana, taungya farmers are now fully involved in the establishment and maintenance of the plantations. The farmers tend food and tree crops that are planted in a mixture on the same plot until such a time that the canopy closure of the growing trees makes it impractical to continue with crop cultivation. After canopy closure, the taungya farmers continue to tend the trees until maturity. Other essential features of the Modified Taungya System are as follows:

- (a) Farmers will essentially be owners of the products with the Forestry Commission, landowners and forest fringe communities as shareholders. The rights of taungya farmers are guaranteed under the Timber Resources Management Amendment Act, 2002 (ACT 617), which states that “no timber rights shall be granted in respect of land with private plantation; or land with any timber grown or owned by any individual or group of individuals”. However, under the previous taungya system, the Forestry Commission was the owner with landowners as the only beneficiaries. Farmers benefited from the food crops but did not receive any benefits from the tree crops.
- (b) Farmers will carry out most of the functions, including pruning, maintenance and tending, while the Forestry Commission will be responsible for training the farmers to carry out the taungya functions efficiently. The Forestry Commission will also be responsible for supply of equipment and tools, stock inventory and auctioning or marketing of taungya products.

Farmers are therefore eligible for a share of the benefits accruing from the plantation according to the benefit-sharing framework, which ensure greater benefit flows to participating farmers (Agyeman *et al.*, 2003).

2.2.2 Contribution of taungya plantations to the socio-economic development in Ghana

Taungya plantation development has for a long time been identified as one of the important strategies required to meet the demand for wood resources in Ghana, where the rate of forest cover loss remains high at 1.7 % per year since 1990 (FAO, 2000). Taungya system is an agroforestry system which combines production of forestry tree crop and agricultural crops on the same plot. It is often employed by governments, like that of Ghana, to establish plantations on degraded forest lands as a means of forest rehabilitation. Taungya system tends to satisfy a social need for land cultivation and establishment of plantation at cheap cost to the government (Nair, 1989; Schlonvoigt and Beer, 2001)

Currently, the Forest Services Division of the Forestry Commission have about 40,000 hectares of productive plantation in country. Of these, 38,000 hectares in High Forest Zone within the Ashanti and Brong-Ahafo Regions, 1,5000 hectares in the three Northern Regions and 1,4000 hectares in the Volta Region. However, it is estimated that more than 50 % of these plantations have a stocking less than 300 good stems per hectare. Only about a third of these plantations have a basal area in excess of 18 m² ha⁻¹ probably because the plantations were not neither pruned nor thinned until recently when there was an upsurge in the demand for poles (Agyeman *et.al.*, 2003), for electrification and other purposes.

The National Forest Plantation Development Programme under the Modified Taungya System offered 83,068 and 80,884 job opportunities to local communities in 2002 and 2003 respectively. The contribution made by the project towards increased food production in the country and job opportunities for the rural communities over the years were quite remarkable (Agyeman *et.al.*, 2003).

Taungya plantations facilitate the amelioration of the environment as well as the improvement in the livelihood of the rural communities. Taungya system provide revenue during the long gestation period before the first commercial thinning or the final harvest. Taungya plantation development also ensures the people's active participation in the forest management in accordance with the 1994 Ghana Forest and Wildlife Policy (FAO, 2002)

2.3 Forms of taungya system

2.3.1 The Shamba System

The Shamba System is a highly developed form of taungya system practiced on state forest land in Kenya where there is considerable integration of the cultivators into the Forest Department (Mburu, 1981; and Nair, 1984). According to Oduol (1989) the Shamba system is a form of agroforestry system which has been popularly used in agricultural areas of Kenya since the early 1900s to establish forest plantations. He added that Shamba system was meant to establish exotic forest plantations with minimum establishment cost, and it continued fairly successfully mainly because of the following factors; (a) availability of sufficient cultivable land

- (b) presence of a willing land-hungry farming population
- (c) availability of a market for surplus food produced
- (d) security or protection against wild animals.

According to Evans (1982) and Lowe (1987) Shamba system features were adapted later in Nigeria and Trinidad respectively. The Shamba system when properly practiced could allow sustained, optimum production of food crops along with forestry species from the same piece of land and thus meet most of the social and economic needs of the farmers. The economic implications of Shamba system are derived from the sale of agricultural products.

The system also provides more or less full-time employment to most Shamba farmers who have no other sources of income. For the Forestry Department, Shamba System is a cost-effective method of tree establishment. Apart from providing a weed-free area for tree planting, it also ensures weeding around young trees for 2-3 years so that tree survival rates increase. In addition to the weeding benefits, fire control is also an important reason for inter-planting agricultural crops with tree crops in taungya system (White, 1985). Other social benefits provided by the Forestry Department in the specifics of the Shamba system agreement included free housing, medical facilities, schools, welfare and infrastructural development (Wanyeki, 1981). The Shamba system seems to be the most appropriate land-use-system for rural development and poverty alleviation programmes. The combination of agriculture and forestry when properly implemented reduces environmental degradation and also provides means of reconciling the often conflicting interest of tropical foresters and farmers. The system also satisfies most social and economic needs of subsistence farmers who participate in it, and save the forest from the destruction caused by shifting cultivation (White, 1985). Irrespective of the enormous benefits associated with Shamba System, it is also characterised by a number of drawbacks.

Wanyeki (1981) found out that;

- (a) about 40% of the reported forest fires in Kenya originated as a result of Shamba practice, mostly at the time of clearing.
- (b) the possible damage to crops by wild animals such as elephants, buffaloes discourages some participants, particularly in remote areas
- (c) the cultivation of grasslands in the forest areas has reduced grazing land for both livestock and wild animals
- (d) it requires high levels of supervision, otherwise the laid-down regulations would not be followed, thereby affecting tree growth adversely
- (e) in some areas the number of participants far exceeds the available land, thus leading to illegal clearing.

2.3.2 Forest Village System

Forest Village System is practiced in Thailand and combines the advantage of reforestation and subsistence agriculture. The original Burmese colonial taungya system considered improvement in social forestry in which there is intensive use of labour. This employment increases income and community stability (Segustron, 1976; Gregersen, 1982). There are many opportunities for workers to earn wages (Table 2.2) in the Forest Village system and since majority of the rural people have few assets other than their capacity to work, they seem to benefit from the Forest Village System.

Gajaseni (1988) noted that weeding was an important activity in teak plantation that children up to 10-12 years of age performed. In addition, there are at least three thinnings that need to be carried out during a single rotation of teak. Finally labour is required during final harvest of teak. Income from the Forest Village taungya system operations is important in sustaining rural families and keeping them in the countryside.

The Forest Village System has been tried successfully in various countries such as Kenya, Gabon, Uganda, India, Nigeria and Cambodia. Although it is more expensive than other forms of taungya system it is particularly suitable for countries with a large natural forest resource and high number of shifting cultivators and other landless people. The system envisages the sustainable use of forestland for food production by landless people who would otherwise be engaged in forest destruction. This approach is viable alternative to resource depletion, environmental degradation and shifting cultivation. With appropriate technological back-up and infrastructure improvement, the system can prove itself to be quite acceptable and adaptable under other situations with comparable land-use problems and socio-economic constraints (Nair and Fernandes, 1984; Nair, 1986)

Forest Village system tries to solve the problems of land degradation, lack of land for peasants, and the need for reforestation of valuable timber species. The objective of the Forest Village system is to provide degraded forest lands to farmers, and to assure a source of labour for plantation work (FIO, 1988).

Table 2.2 Opportunities for waged labour in teak reforestation in Thailand

Task	Wages paid (US\$ per hectare)
Establishment	189.51
Weeding in year 3	51.23
Weeding in years 4 and 5 (each)	47.30
Weeding in years 5-10 (each)	18.63
First thinning	33.36
Second thinning	36.70
Third thinning	40.36

Source: Forest Industry Organization of Thailand (1988)

This system actually differ from the old taungya system in the wage benefits, land utilization rights, and socio-economic improvement schemes such as provision of permanent settlement, water, electricity, and education and health care. Each family is allotted 1.6 ha of land each year. The land is cleared and planted with forest trees, and cultivation of agricultural crops is permitted between the tree seedlings. In addition, an additional 0.16 hectares of land in the village is given for a dwelling and backyard gardening (FIO, 1988). Farmers actively involved in the Forest village system are given financial support. A quota of two labourers from each family is recruited to work in plantation activities. This employment adds substantially to the income of the family as the family is given a reward of US\$8.00 for every 0.16-hectare that is planted.

Also, if any family stays with the Forest Village system for three consecutive years and plants over 4.8 hectares, a bonus of US\$60.00 is paid. After the third year, a family that remains and continues to plant 1.6 hectares per year receives an extra bonus of US\$48.00. Daily wages constitute a very important portion of total income per family per year for the various regions in Thailand (Table 2.3).

In the Forest Village System, combinations of trees and agricultural crops differ from village to village and from region to region due to differences in climate, soil fertility and market conditions as well as skills and preferences of the cultivators (FIO, 1988). The taungya agricultural systems change and are improved depending on the market demand and productivity.

Table 2.3 Income in US\$ derived from forest village system in Thailand

Regions in wages	No. of Families compensation	Source of income				Total	Total income family/year	Thailand
		Daily bonuses	Taungya income	Taungya	Agro-crop			
North	899	415567	15336	4615	195788	631306	702..23	
East and Northeast	743	206787	3701	74884	129052	414424	557.77	
West and South	302	237567	6597	22329	73077	339570	1124.40	
Total	1944	859921	25634	101828	397917	1385300	2384.40	
		(62.08%)	(1.85%)	(7.35%)	(28.72%)			

Source: Forest Industry Organization (1988)

Irrespective of the lots of benefits associated with the Forest Village System, King (1968) identified the following weaknesses and constraints:

- (a) enforcing the policy of forest reserves becomes difficult and expensive where forestland is still plentiful. Shifting cultivators are still able to operate illegally and it is difficult to induce them to settle in a Forest Village.
- (b) the initial years in a Forest Village can be hard and frictions can arise with other families in the village, which even compounded by a cash-flow problem since payments of rewards, bonuses are not made till the end of the first year of participation.
- (c) Some forest villagers find the pay and other financial incentives low, resulting in their deserting the Forest Village and seeking employment elsewhere.

- (d) Setting up large numbers of Forest Villages with free electricity, water, schools, medical facilities and other financial incentives can be expensive.
- (e) often funds are not available because of misunderstanding about the inclusion of social welfare expenditures in reforestation projects.
- (f) Some selfish politicians and unscrupulous businessmen undermine the concept of Forest Villages in order to ensure the availability of cheap labour for themselves.
- (g) some reforestation sites are on steep slopes and the forest villagers find it difficult to cultivate and harvest their crops. Also some soils are very poor and this results in low yield of agricultural crops.
- (h) there is a scarcity of capable managers in forestry, agriculture, administration and sociology to take charge of Forest Villages.

2.3.3 Tumpangsari

This is a system of taungya employed by the Forestry Estate Enterprise in Indonesia for reforestation, especially teak (Siregar, 1990) in areas with a pronounced dry season, and the expectation is for an 80-year rotation.

In Tumpangsari, a contract is made between individual farmers and the Forestry Estate Enterprise. The contract specifies the area to be planted, the period of agricultural cultivation, and the kind of crops to be planted as well as the amount of money to be paid for tree planting and tending. In this system, each family is allotted 0.25-hectare plot to be inter-cropped with the planted tree seedlings for two years, and the agricultural crops include dry land rice, maize, pepper, peanuts soybeans. Under certain conditions cassava also is permitted. On sloping land, erosion control structures are built with stones or dead trees and branches. Other control measures include drainage ditches, and planting along contours (Wiersum, 1982).

Income from Tumpangsari is important in sustaining rural families and keeping them in the countryside. For example, in Indonesia, annual crops from modern taungya (Tumpangsari) contribute only 20% of household revenue but farmers can sustain their families from related plantation activities such as logging operations and collection of forest product, and under-employment is less for those who participate in Tumpangsari (Kartasubrata, 1986).

2.3.4 Intensified taungya cultivation

Increasing use of high-yielding agricultural crop varieties and modern cropping practices were incorporated in the taungya system in Indonesian agricultural enterprise in the 1960. In 1972 the Indonesian State Forest Enterprise tested the feasibility of such agricultural improvement for the taungya system that proved successful with dry land rice production by increasing yield of rice from 700 kg to 3740 kg per hectare (Wiersum, 1981).

According to Wiersum (1981), the system was developed further, based on research carried out by the Forest Faculty of the Gadjah Mada University. Kartasubrata, (1997) and Wiersum (1982) mentioned that the system for intensive taungya system was developed with the following characteristic features:

- (a) utilization of selected high-yielding varieties of the main food crops;
- (b) better practices for land preparation and soil tillage;
- (c) minimum use of fertilizers;
- (d) control of pest and diseases
- (e) correct timing of planting and fertilizing with respect to the rainfall

According to Sumitro (1990), the Forest Service encouraged the taungya farmers to embarked on the intensive taungya system on a wider scale in almost all the districts in Indonesia with the following objectives:

- (a) to contribute to the national food production;
- (b) to provide more employment opportunities to under-employment farmers;
- (c) to increase the income and welfare of the forest fringe communities;
- (d) to safeguard forest plantations;
- (e) to maximize returns of the land which is the most scarce production factor in the forest fringe communities.

Again, Sumitro (1990) recognized that the objectives of the intensified taungya system when compared with that of the traditional taungya system, the priority is no longer for the efficient establishment of valued timber species plantations, but increased attention is given to the socio-economic development of the local people. It is therefore recognized that in forest management, a balance should be achieved between the needs for local community development and efficient timber production for commercial needs.

Intensified taungya system yielded appreciably good results and was gradually applied over many other areas. With the use of selected superior crop varieties and fertilization together with insecticides, yield of dry-land rice improved from about 700-1500 kg ha⁻¹ to 2000-3000 kg ha⁻¹ and maize from between 1000-1500 kg ha⁻¹ to over 2000 kg ha⁻¹. In addition, the intensified taungya system required more labour (around 230 man-days ha⁻¹) than the traditional taungya practices. Thus, the system actually contributes to lowering of rural under-employment. Although the intensive cropping practices require relatively high inputs and investments, the agricultural production increases so much, that such intensification is highly profitable to farmers (Wiersum, 1981; Sumitro, 1990).

The Forest Service in Indonesia stimulated the farmers to apply the intensive cropping practices not only through the provision of extension services, but also credit facilities to purchase the necessary inputs. The farmers repay only 70% of the credit for hybrid seeds

fertilizers and insecticides, because it assumed that 30% of the inputs benefits the tree crops. Wiersum (1981) therefore reported that the application of fertilizer significantly increased tree growth, although data on its long-term effects are still lacking. The credit facilities provided to farmers by the Forest Service under the intensive taungya cultivation, undergone series of changes. Now the Forest Service only provides credit free of interest to farmers for buying hybrid seeds and pesticides. For a few years the Forest Service supplies fertilizers provided the farmers had taken adequate measures for soil and water conservation on the allotted plots. But under the present policy of decreasing government subsidies, taungya farmers now have to buy the fertilizers themselves.

Other forms of taungya also exist in other places such as Kaingin in the Philippines; Ladang in Malaysia; Chena in Sri Lanka; Kumri, Jhooming, Ponam, Taila, and Tuckle in different parts of India; Parcelero in Puerto Rico; Consorciarco in Brazil (King, 1968).

2.4 Taungya plantations establishment and biodiversity conservation

Biodiversity is commonly understood to include the number, variety and variability of organisms living on earth. Biodiversity is a fundamental characteristic of life on earth and encompasses the “whole range of variation in living organisms” (Wilson, 1993). In Africa, environmental crisis presents complex economic and social problems of dimensions unlike those seen anywhere else in the world. The problems have many aspects, some interrelated, others caused or worsened by ill-conceived solutions, with a net result that there is now an accelerated depletion of Africa’s natural resources with concomitant deterioration of living standards of the people especially in the rural communities (Shiva, 1992).

Human activity has always had an impact on biodiversity, but in recent centuries this impact has intensified to a position where we are in danger of undermining the primary functions of natural systems and to an extent that could ultimately threaten our own future (Larsen *et al.* (2005). Losses of biodiversity have resulted from the destruction of natural habitats, over-exploitation of resources, pollution and changes in the composition of ecosystems due, for example, to the accidental or deliberate introduction of non-native species.

The need to conserve biological diversity is perhaps of utmost importance in Africa where the lives of humans are intricately linked to the environment in a symbiotic relationship in which each species cannot survive without the essential contributions from the whole (Balick *et al.*,1996). Biodiversity depletion triggers a chain reaction (Shiva, 1992). The disappearance of a species is related to the extinction of many other species and in most cases threatens the life-support systems and livelihoods of people in the third world countries. The greatest threat to the protection of biodiversity is the biphasic issue of poverty and affluence which separately and through their interaction continue to cause rapid depletion of biological diversity. Poverty and the destruction of the environment are readily traceable to poor management of the natural resources and adoption to changed environment.

According to Shiva (1992), the primary causes of destruction of biological diversity in Africa include a combination of factors. Habitat destruction due to pressure on land to accommodate increased industrial demand for cheap tropical plants, and the cultivation of cash crops in place of subsistence farming. Invariably, the land preparation for taungya plantation establishment also involves clearing and burning of natural vegetation cover just as shifting cultivation which destroys biological diversity. In taungya system, the natural vegetation cover is replaced by a mixture of food crops planted between rows of planted tree

seedlings. After the initial 4–5 year cropping period, the trees are managed as a monoculture forestry unit (Enabor, 1975; Goswami, 1982; Watson, 1983). Mono-culture taungya plantation unit is susceptible to insects and pest attack which may result in destruction of other species.

The broad leaves of teak plants usually fall and cover the ground. The teak leaves which cover the ground have very low rate of decomposition, and therefore serve as mulch and prevent other plant species to grow under teak plantations. The slowly decomposing teak leaves dry up in the dry season and serve as fuel. This increases fire incidence in teak plantations, accelerated erosion and habitat destruction.

Increased pressure on land to produce greater quantity to achieve previous level of incomes. Taungya farmers often demand for large track of land with the intention to increase food production and hence income for better standard of living. The dependence on the forest land for food production and commercial taungya plantation establishment will continue to increase in the future due to increase population, poverty, decrease farm sizes and lack of alternative employment in the rural communities (Emerton, 1991). Commercial flora species in most forests in Africa had dwindled and will continue to dwindle. For example, in most forest in Ghana, the average density of many valuable indigenous tree species is now low and some are sometimes less than one commercial tree per ten hectares in even the “Primary” forest (Lamprecht, 1989). The survival of tropical forest is therefore in a state of jeopardy due to exponential population growth in the tropical and sub-tropical regions. Coupling with growing mass poverty have created pressure on land which has engendered governments to commit land previously under natural ecosystems for human use. It is predicted that if current trends continue, most tropical forests will either be severely degraded or completely gone by the year 2020 (Kamugisha, *et al.*, 1997). Taungya plantation establishment and management

will be therefore intensified to meet the demand for wood resources in Ghana, where the rate of forest cover loss remains high at 1.7 % per year (FAO, 2000). The resultant effect will be loss of biodiversity conservation.

Introduction of homogenous system of agriculture and replacement of diverse plant species and races with monoculture affect biodiversity. Taungya plantations, and particularly single species plantations, are at much greater risk of catastrophic insect and disease losses than natural forests. This is based on the observation that the introduction of exotics tends to alter natural balances that serve to keep pathogenic organisms in check in ecosystems. Taungya plantations are incapable of supporting biodiversity characteristics of native forests. The typical high stocking density and lack of structural diversity are the reasons for low species diversity within taungya plantations (Howe, *et al.*, 2005). Hence, less plant and animal diversity exist in taungya plantation forests than native forests within the same region. However, taungya plantations play positive role in the restoration of biodiversity to an impoverished landscape or marginal lands.

Pure teak stands have been associated with the deterioration of soil and erosion. This is usually the case when teak is planted on steep slopes where undergrowth has been systematically cleared or where excessive burning has taken place. Evidences of such environmental degradation under teak plantation in Ghana are common (Odoom, 2002).

Biodiversity loss has implications for the social and economic well-being of humanity. The natural forests contribute to the food needs of rural communities directly in the form of fruits, seeds, nuts and protein from bush-meat. The bush-meat sector employs about 300,000 hunters at the local community level who produce between 220,000 to 380,000 tons of bush-meat valued at between US\$210 million to US\$350 million for domestic consumption annually. In addition, the value of animal and plant products from the forest

used in traditional medicine and cultural practices are estimated at US\$13 million per year (Ankudey, 2002). If plant diversity is being reduced over time, due to taungya plantation expansion, then the consequences of this extend beyond the destruction of natural ecosystem alone. The establishment of taungya plantations on land that already carries natural forest will exacerbate deforestation rather than reducing it. (ITTO, 2000). Nevertheless, it is also true that plantations will play an increasingly important role in the global supply of cellulose fibre. Larsen et al. (2005) had demonstrated that lower plant diversity leads to less primary productivity, less carbon storage and greater leaching of nitrates.

2.5 Socio-economic implications of taungya Systems

Inter-cropping not only gives the farmers an income, its also controls the weeds which otherwise compete with the tree seedlings. In addition to the weeding benefit, fire control is also an important reason for inter-planting (White, 1985).

Several million people live in villages surrounding forest areas. Most of them are small farmers or farm labourers, and about half of them are under-employed or unemployed. Such social conditions place great pressure on forestlands. Hence, forest policy should not emphasize only on management of forest areas for the production of timber and commercial non-timber forest products, but be directed at increasing employment opportunities, rural community development and poverty alleviation (Atmosoedardjo and Wahyudi, 1980; Wirjodarmodjo and Bratamihardjo, 1984).

Wiersum (1982) iterated that taungya gradually evolved in response to changes in socio-economic conditions and was included in the forestry regulation as an obligatory technique for teak plantations establishment. Taungya system is adjusted in areas of high population density to meet current socio-economic conditions.

According to Becking (1928) and Beckman (1948), introduction of taungya system in an area is based on several reasons including;

- (a) decreasing the establishment costs of teak plantations
- (b) obtaining an additional income from agriculture during the juvenile stage of tree plantations
- (c) achieving better maintenance of the young tree stands
- (d) reclaiming waste lands using agriculture before the establishment of tree plantations
- (e) contributing to solving local shortages of good agricultural lands.

Hellinga (1953) also reported that taungya was mainly considered as an effective means of reforestation, and its contribution to improving the welfare of the local people was subsidiary to the successful establishment of timber plantations. Again, he stated that a prerequisite of taungya is forestry and the primary objective of the forest enterprise may not be hindered by increased food production.

The use of taungya was very profitable for the Forest Service as it decreased labour costs for planting from 86-116 man-days per hectare for planting techniques involving clearing line and making planting holes to 62 man-days per hectare. The other 58 man-days per hectare needed for taungya cultivation were contributed free-of charge by the taungya farmers in exchange for their right to agricultural produce.

There are certain socio-economic conditions which give rise to taungya, and that the development of the systems independent to a certain extent, of the population density, amount of arable and forested land, and degree of development (Wiersum, 1982).

He also iterated that in region where taungya is being practiced have certain common socio-economic characteristics such as;

- (a) large economic gains attained through illegal harvesting of indigenous timbers, and consequently there is a need to control the harvested lands
- (b) a need for reforestation activity
- (c) large human resource with need for subsistence and employment.

Taungya systems incorporate secure terms of use and access for rural communities to pursue farming as well as forest plantation development over the long term. While taungya system has been used most widely in humid and sub-humid areas, it might also be applied in dryland Africa for the rehabilitation of grazing lands or the establishment of woodlots.

It could be useful in any situation where deforestation and land degradation can be treated by a mixture of temporary cropping with tree establishment (Rocheleau *et. al.*, 1988).

2.6 Tree spacing in taungya system

Huxley (1983) has noted that optimal planting distance, and combinations of agricultural crops and trees are frequently site specific and therefore characterized by greater variability from place to place. Again, it markedly depends on the following factors:

- (a) local environmental conditions such as edaphic factors, slope, topography, and climate;
- (b) local economic or market demand;
- (c) preferred agricultural tradition; (d) land ownership regulations.

One of the most critical decisions for silvicultural prescriptions in plantation establishment is the spacing. Tree spacing in taungya system is varied and largely depends on the objective of the plantation establishment, the type of tree species as well as prevailing environmental conditions. It is widely known that tree spacing varies from place to place even within the same climatic conditions. Many different tree spacing in taungya

systems have been adopted for various reasons in the tropics (Table 2.4). However, taungya farmers would prefer the widest, least dense spacing of trees possible, so as to give advantage to agricultural crops. In contrast, for successful forest regeneration and recovery of wasteland, closer and dense spacing is recommended (Huxley, 1983).

In the Forest Village taungya system teak was planted to 4m x 4m spacing but spacing was increased to 8m x 8m (Gajasen and Jordan, 1990) with the intention to incorporate a greater diversity of species and of structure that has a longer period of production of food crops for the socio-economic improvement of the farmers. Cultivators prefer the widest, least dense spacing of trees possible, to give advantage to crop growth and performance.

Table 2.4 Common tree spacing used in plantation in the tropics

Spacing per tree	Growing space per hectare (m)	No. of trees	Example (m ²)
2 x 2	4.00	2500	<i>Terminalia ivorensis</i> in Nigeria
2 x 3	6.00	1667	<i>Eucalyptus grandis</i> in Aracouz, Brazil
3.05 x 2.13	6.50	1538	<i>Pinus carbaea</i> in Fiji
2.74 x 2.74	7.51	1332	<i>Pinus patula</i> in Swaziland
3 x 2.50	7.50	1333	<i>Araucaria cunninghamii</i> in PNG
4 x 2.0	8.00	1250	<i>Albizia falcataria</i> in Philippines
3 x 3	9.00	1111	<i>Pinus caribaea</i> in Queensland
4 x 2.25	9.00	1111	<i>Pinus caribaea</i> in Fari, Brazil
4 x 3	12.00	833	<i>Pinus caribaea</i> in Philippines
3.5 x 3.5	12.25	816	<i>Gmelina arborea</i> in Brazil
4 x 4	16.00	625	<i>Eucalyptus delglupta</i> in Phillipines
4.5 x 4.5	20.25	494	<i>Eucalyptus delglupta</i> in Papua New Guinea

Source: Evans (1982)

According to Blanford (1925) spacing for teak plantations were originally 4m x 4m (625 trees ha⁻¹). However, experiment on spacing of 2m x 8m has been tried with the objective to make the taungya system better adapted to agricultural crops. This resulted in the same density of trees, while allowing easier cultivation of agricultural crops. This modification of tree spacing was made to delay early canopy closure. A number of spacing has been adapted elsewhere in the world. For instance spacing in Thailand is wider than the 1.8m x 1.8m intervals used in Burma to establish teak plantation (Blanford, 1925).

2.6.1 Tree spacing and its implications in the taungya system

Spacing of trees in taungya system is central to the conflict between farmers and foresters. Wider spacing encourages growth of grasses such as *Imperata cylindrica*, *Pennisetum spp.*, e.t.c. These compete with the trees for nutrients, growing space and also make the plantations prone to fire, which can severely damage or kill the trees if burnt. Again, growth of these weeds demand weeding for many years to reduce competition and prevent fire hazards and that increases establishment cost before final rotation period of the tress

Economically, van der Hout (1984) suggested that period of inter-cropping in taungya system could be extended to 4 years by increasing planting distance to 6m x 1m. He added that such planting distance could increase the net income of farmers by at least 60% and at the same time, wood production for financial returns to the forest enterprise at final harvset would hardly be affected. However, such spacing would reduce yields of thinnings, and the tree form. It could be maintained by pruning, while soil protection could be assured by using

double rows of cover crops instead of single rows. However, the planting density in taungya system depends upon the purpose of the plantation establishment (van der Hout, 1984).

Generally, tree-crop spacing levels affects plantation maintenance costs, revenue and the output of the food crops. Again, wider spacing reduce the number of trees per hectare hence the total volume of the wood, especially in long rotation periods. In this situation, benefits are reduced as the site is under utilized for the period the site is not yielding.

Although wider spacing increase the mean diameter of the tree species at breast height (dbh), it may or may not depend on the market demand, because wider spacing tends to increase stem taper which eventually may reduce the percentage conversion at final harvest (van der Hout, 1984). In broadleaf stands, wider spacing usually results in trees of poorer form with larger crowns and less strong apical dominance. In addition wider spacing culminates in fewer final standing trees to be selected.

However, close tree spacing lead to early canopy closure and may be efficient in weed suppression most especially grasses. Generally, soil moisture and nutrients may be limited resulting in intense competition between planted tree seedlings and food crops. For better utilization of site in taungya system there should be greater diversity of species of crops and of structure which will ensure longer period of productivity of food crops (Gajaseni and Jordan, 1990).

2.7 Socio-economic problems with taungya

2.7.1 Lack of permanent settlement

According to Harris (1972), the major problem with taungya system in most regions is that the land remains under the ownership of the government or commercial enterprises. The farmers' desire for outright land ownership is often frustrated.

In Burma, other social and economic problems associated with taungya are the reluctance of nomadic tribes to give up their traditional way of life. From the foresters' point of view, their reluctance to work is a problem and most of them prefer to have six days of rest and the seventh of labour (FAR, 1917). Owning a piece of land and achieving permanent settlement is the ultimate goal of most taungya farmers in an agriculturally based society. This gives the taungya farmers an intimate relationship with the land.

However, agreement if any defines the benefit of land and tree ownership to the taungya farmers (Enabor *et al.*, 1982). The sole benefit of taungya to the peasant farmers is that it allows the farmers access to fertile agricultural land without any title of tree ownership. Taungya as practiced in the past, according to (Enabor *et al.*, 1982) will never achieve a goal of permanent farm settlement for rural communities. It will remain merely the cultivation of food crops and trees at early stages, and later evolution to pure plantation forest whilst the farmer is thrown out of site. Again, rural life is considered as dull and uninteresting, compared to that in the urban areas. This perception often increases the tendency of youth to migrate to urban centers and the perceived existence of better employment opportunities. Gajasen (1988) observed that lack of permanent settlement, under-employment, and low productivity are problems for the rural poor which cannot be solved by the earlier approaches to taungya. He also reported that some of the problems have been partially overcome by the modern Forest Village taungya in Thailand, in which rural farmers live in houses subsidized

by the government and private industries. The farmers are permitted to cultivate food crops during the early years of the plantations, and are given wages for silvicultural labour.

2.7.2 Employment

World Bank (1982) reported that under-employment is the main problem in the developing countries. Under-employment, a condition in which irregular work of low productivity result in extremely low levels of earnings and consumption, accelerate seasonal migration of rural people from the countryside for job in urban areas during the non-growing season. This migration compounds urban problems, since it becomes difficult to reduce urban unemployment if under-employment and low earnings force rural people to seasonally migrate to the cities for jobs (World Bank, 1982). However, modernization, and urbanization are proceeding at an alarming rate in many tropical countries, and for rural people to obtain good employment satisfaction in modern cities require them to have formal education. It is therefore extremely difficult for rural poor to be competitive for jobs in urban areas because of lack of education and modern skills. As a result, they become urban slum dwellers and according to FAR (1917) report, such a situation creates problem of obtaining labour for the establishment of plantation in the taungya systems. He added that labour problems still remains and would be necessary to discover adequate and suitable measures for coping with the situation. Shortage of labour has always been the major obstacle in plantation development in many parts of the world. Taungya system when uncontrolled causes greater and more lasting damage than wild fires.

Gajaseni (1988), however, suggested a solution to significantly increase under-employment and reduce unemployment, as well as rural-urban migration through widespread adoption of new development scheme that ensure employment opportunities

throughout the year. He mentioned that most rural people or workers would be happy to remain in the rural areas provided there are employment opportunities in agriculture, forestry or other rural occupations.

According to Segustrom (1976) and Gregersen (1982), one of the social benefits of forestry projects as currently practiced elsewhere is the intensive utilization of labour. In addition, such employment increases income and community stability. However, in FAR (1917) report, it was indicated that the greatest constraints that prevented Forestry Department from achieving targets of acreage coverage per year in taungya plantation was labour requirement. The opportunities for rural people to earn wages in the Forest Village Taungya system is high (Table 2.5).

Weeding is an important activity in teak plantations for children between 10-12 years of age. Besides, three thinning are required during a single rotation of teak. Ultimately, labour is needed during the final harvest of the teak (Segustrom, 1976; Gregersen, 1982). Kartasubrata (1986) also observed that income from taungya plantation activities play an important pivotal role in sustaining rural families in the countryside. He also said, in Indonesia, annual crops from tumpangsari-modern taungya contribute only 20% of household revenue, but peasants can be sustained from related taungya plantation activities such as logging operations and collection of forest products. In addition, underemployment is less for rural people involved in modern taungya.

Table 2.5 Labour requirements for forest village taungya in Thailand

Type of plantation	Labour required (man-days per hectare)
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Teak		
First year		124.44
Second year	<u>45.06</u>	Total 169.60

Non-teak		
First year		142.25
58.06		Second year
Total		<u>200.31</u>

Source: Forest Industry Organization (FIO) of Thailand (1988)

2.7.3 Productivity in taungya systems

Gajaseni (1988) reported that shifting cultivation in Thailand is more productive than taungya. He added that unless there are definite socio-economic advantages of taungya over shifting cultivation, conversion of shifting cultivation to taungya is unlikely to succeed in attracting farmers.

Under taungya, a farmer will produce a quantity of grain that has a caloric value which can sustain about 5 individuals for one year. In contrast, under shifting cultivation, a single farmer can produce the caloric requirements of about 10 individuals for one year (Gajaseni, 1988). However, Cuc (1988) reported that productivity is high in a combination of rice and *Manglietia glauca* in Vietnam.

Trees have long gestation or rotation period. This means that after initial year or two of agricultural crop cultivation, the land under taungya plantations does not produce any income until thinning for poles and final timber harvest which may not occur for 15-20 year and 30-60 more years respectively (Harris, 1972).

2.7.4 Socio-cultural aspects of taungya

Observation made by Endicott (1979) indicated that Rural Development Programmes frequently encounter groups of rural people who possess cultural beliefs and values quite different from the implementers or the people who originally designed the development programmes. Many government-organized rural development schemes are not encouraging, because of the incompatibility between the traditional cultural values of the people. However, Gajasen (1990) experienced that Forest Village taungya was compatible with the prevailing local values and customs.

He also ascertained that three major improvements are required for the system to be permanently successful. These are;

- (i) ensuring permanent settlement
- (ii) increasing income earning opportunities
- (iii) developing supportive facilities such as school and health centers

Success in establishment of taungya may be related to cultural tradition (Jordan, 1990). He added that a strong hierarchical, authoritarian tradition of government as exist in Thailand, and a religion such as Buddhism which places less importance on material acquisition, may provide a setting in which taungya may be more easily facilitated. In contrast, in the Philippines with a tradition of laissez faire capitalism, and Christianity which is often interpreted as putting man above nature, taungya plantation establishment may be more difficult (White, 1967).

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CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Locations

Forest fringe communities involved in taungya plantations establishment in Sunyani Forest District in Brong-Ahafo Region constitute the study area. The Sunyani Forest District is located between latitude $07^{\circ} 05' N$ and Latitude $07^{\circ} 40' N$; Longitude $02^{\circ} 45' W$ and Longitude $02^{\circ} 05' W$. The Sunyani Forest District has seven forest reserves covering total area of about 909.29 square kilometers (or 350.45 square miles) and covers other administrative districts, Berekum and Wenchi districts (Table 3.1)

The selected communities for the study are Nsuatre, Odomase, Tromeso, Bowohomodien, Kyeraa, Atronie, Amaakrom and Kwamemensakrom. They are located in the Dry Semi-deciduous Forest Zone in Ghana (Figure 3.1).

3.2 Climate

The rainfall pattern in the study area is bimodal. The major rainy season extends from the month of March to July and the minor rainy season from September to November. The dry seasons commence from the end of July to the end of August and from the end of November to February. The seasons are characterised by hot or warm, draughty and fairly humid weather conditions.



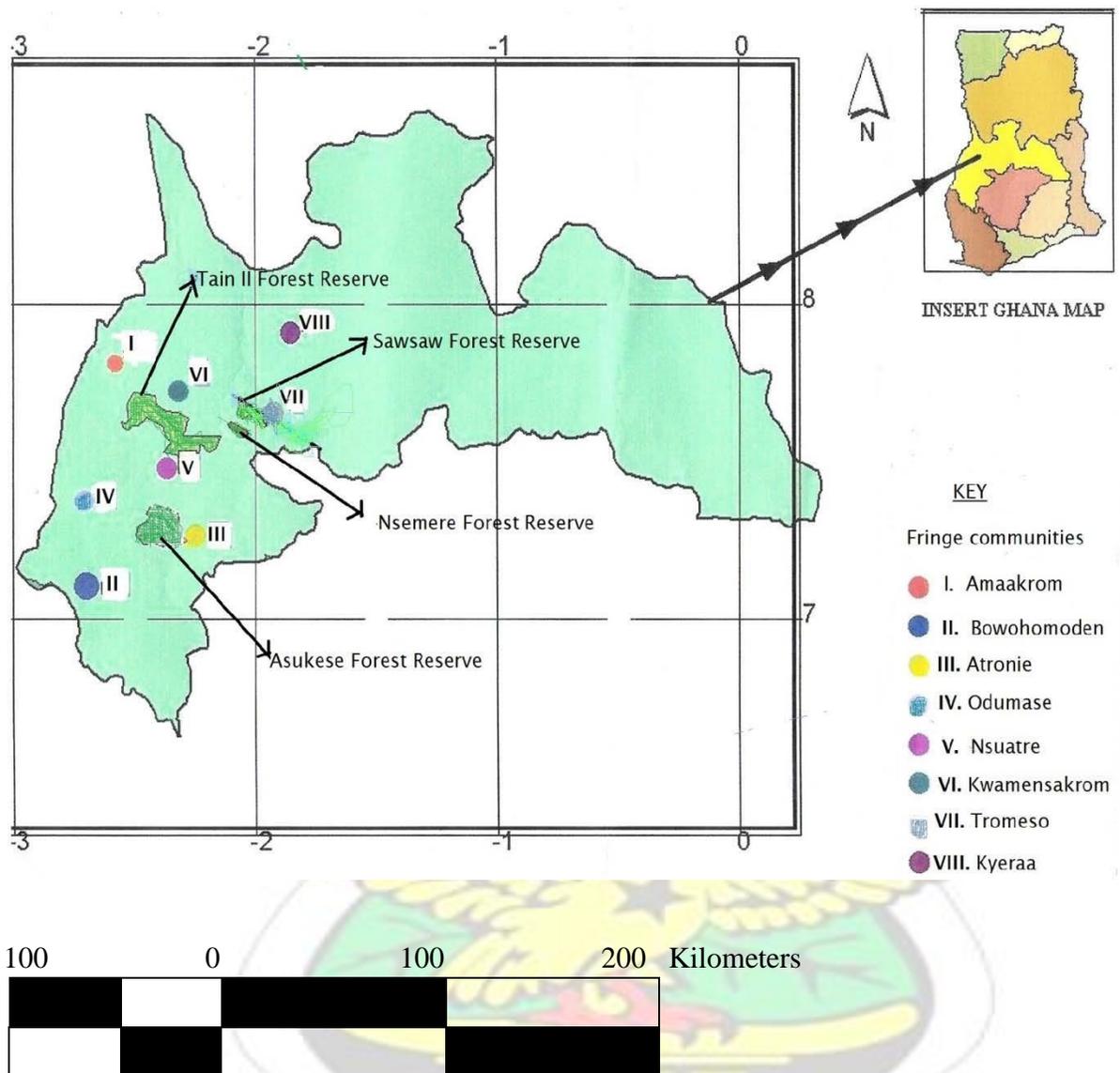


Figure 3.1 Map showing the forest fringe communities studied in the Sunyani Forest District

Table 3.1 Location of forest reserves in Sunyani Forest District with fringe communities selected for the study

		Geographical location		Name of forest fringe

Name of forest reserve	Area coverage of forest reserve (Ha)	Between Lat.	Between Long	Administrative districts covered by forest reserve	community
Tain II	435.12	07° 40' N and 07° 30' N	02° 45' W and 02° 20' W	Sunyani Berekum	Nsuatre, Odumasi,
Sawsaw	52.36	07° 40' N and 07° 35' N	02° 15' E and 02° 10' E	Sunayni, Wenchi	Tromeso, Bowohomodén,
Nsemre	18.13	07° 35' N and 07° 30' N	02° 15' W and 02° 10' W	Sunyani, Wenchi	Amaakrom Kyeraa
Asukese	270.14	07° 03' N and 07° 14' N	02° 24' W and 02° 37' W	Sunyani	Atronie, Kwamemensakrom,

Source: Adapted from Hall and Swaine, 1981.

The mean annual rainfall for Sunyani over the past ten years is about 1182 mm. and the temperatures are relatively constant throughout the year ranging between mean monthly figures of 32.3 °C to about 21.2 °C.

The relative humidity of the study area, based on data collected from Meteorological Service department shows a fairly constant high humidity throughout the year. A monthly maximum mean of about 70.4 % and minimum mean of about 22 % were recorded at 0600 and 1500 GMT daily respectively for the ten year period. The relative humidity being as low as 20 % in some dry days of the dry season indicate, that the Sunyani Forest District experiences hot or warm weather conditions throughout the year.

3.3 Vegetation

The study areas are in the Dry Semi-deciduous Forest Zone in Ghana. Principally, all the forest reserves: Asukese, Yaya, Amama, Sawsaw, Ndemire, Tain I and Tain II in Sunyani Forest District are typical of Dry Semi-deciduous Forest type and include most of the areas of *Antiaris-Chlorophora* Association (Taylor, 1969) that exist under a wider range of environmental conditions than any other type.

The dry semi-deciduous forest is generally well developed with more or less discontinuous upper canopy, but at a lower height than that of the Moist Semi-deciduous forest type (Hall and Swaine, 1981). On the average the tallest trees are between 30m - 45m in height. The Dry Semi-deciduous has two subtypes, the Fire and Inner Zones.

The Fire Zone within the Dry Semi-deciduous forest zone is between the Inner Zone to the south and the sub-Saharan Guinea Savannah of Northern Ghana. The Fire Zone is characterised by sparse woody under-storey with few large lianas, and has a patchy canopy with many tangled gaps. Consequently, the forest floor of this subtype is well illuminated, carrying dense weedy forbs and grasses.

According to Hall and Swaine (1981), the Fire Zone lies at the northern frontier of the forest zone adjacent to the savannah region and has a long history of fires which are responsible for maintaining the vegetation characteristics. In addition, this zone is characterised by patches of grasses scattered throughout the forest where the soil is rocky or shallow.

The Inner Zone is, however, between the moist semi-deciduous forest zone to the south and the Fire Zone. Structurally, the Inner Zone subtype closely resembles the Moist Semi-deciduous Forest, with the tallest trees being only a little shorter than those of the Moist Semi-deciduous forest type (Hall and Swaine, 1981).

Generally, the vegetation zone in the Sunyani Forest District is threatened by fire incidence that can result in accelerated soil erosion and flooding, of which the rippling effects can assume national dimension. Southward expansion of savannah vegetation, environmental degradation, erosion of biodiversity conservation, famine, socio-economic stress on government, increase in rural–urban migration, loss of life and properties are also some of the effects of the threats of the vegetation by fire incidence in the study area.

Plant medicine is a broad category of medicaments. They include drugs used in traditional systems of medicine, folklore and ethno-medical products, and drugs discovered from plants having no documented therapeutic use (Wijesekesa, 1991). In Africa, herbal therapy has for many years formed the basis of treatment of many diseases. The flora of Ghana is replete with plant species that can be used or are being used in treatment of a wide spectrum of diseases (Ayitey-Smith, 1989; Abbiw, 1990). Plants provide about a quarter of the medicine in Ghana, and they could provide much more if a careful search were made (Findersen and Laird, 1991). Such medicinal plants are under serious threats by the annual fire incidence in the forest- savannah transitional zone of the dry semi-deciduous forest in the Sunyani Forest Service District. This will eventually affect the health, socio-economic, environmental and livelihood conditions of the people more especially the forest fringe communities. Undoubtedly, medicinal plants and drugs derived from them constitute great economic and strategic value for the African continent (Mahran, 1967; Anon, 1988).

3.4 The history and status of taungya practice in Sunyani Forest District

Taungya plantation development started in Sunyani Forest District in 1969 during which the taungya farmers were not actively involved in most of the various activities associated with taungya operations. The farmers only cleared the land for the then Forestry Department to do the pegging and planting. However, the farmers cared for the tree crop

indirectly by weeding around their food crops but occasionally cut and/or uproot some of the tree crops to allow their food crops more growing space and also prevent early canopy closure so that food crop cultivation can continue for many years. Taungya farmers were not allowed to cultivate some of the staple food crops such as maize, cassava and perennial crops like cocoa, coffee and oil palm. Thus, the old approach to taungya system in Sunyani Forest District was initiated without much consideration of the taungya farmers and their basic needs. The basic needs of the taungya farmers, the poorest of the poor were neither considered nor adequately addressed in the practice of the taungya system

The old or colonial system of taungya practice in which the government relies on the exploitation of farmers labour for forest plantation development, in Sunyani Forest District, declined gradually and come to a stoppage in 1985. However, in 2000 the Modified Taungya System (MTS), was introduced which is now operational in Ghana. Unlike the traditional and the departmental taungya systems, the modified taungya system involves farmers fully in the establishment and maintenance of the plantations. What is left to be done to address the socio-economic needs of the participating farmers is the implementation of the benefit sharing framework suggested by Agyeman *et al.*, (2003).

3.5 Methodology employed during the survey

As a result of the multiplicity and the diverse nature of the socio-economic and biodiversity issues of taungya system to be surveyed, a number of procedures and strategies were used to gather information possible to address the objectives and for that matter the problems of this study. The procedures used were:

- (a) Consultations with the staff at Sunyani Forest Service Division District as well as chiefs in the selected communities
- (b) Field visits
- (c) Individual interviewing using semi-structured questionnaire (d) Group discussions

3.5.1 Pre-sampling activities

Consultations were made with the Sunyani Forest Service Division District, Ministry of Agriculture, Town and Country Planning and Department of Feeder Roads offices for information on the,

- (a) number of forest reserves in Sunyani Forest Service District, forest fringe communities as well as farmers involved in taungya farming
- (b) road network in the Region and
- (c) cultural values and taboo days of the forest fringe communities.

The information obtained was used to produce a guide map of the study area with the assistance of the personnel at the Sunyani Forest Services Division District, Town and Country Planning Department.

3.5.2 Selection of forest reserves

Four out of the seven major forest reserves in Sunyani Forest Service District were selected by the use of random numbers. These reserves selected included Asukese, Nsemre, Tain II and Sawsaw (Figure 3.1)

3.5.3 Selection of farming communities involved in taungya plantations

List of all farming communities (Table 3.1) fringing the four selected forest reserves were sought with the assistance by the Forest Service District, Regional Extension Office of the Ministry of Food and agriculture; Town and Country Planning of Sunyani. The information collected was used to produce a guide map of the study area with the assistance of the personnel at the Sunyani Forest District and Town and Country Planning Department. Two of the farming communities that fringe each of the four selected forest reserves were randomly selected by the use of random numbers. In all, eight (8) farming communities were selected for the study.

3.5.4 Field visits

Preliminary visits were made to the selected towns or villages, in the course of which the relevant opinion leaders, chiefs and elders, assemblymen, the Forest Officer and the Agricultural Extension Officer in-charge of the area were contacted, and the purpose of the study was explained to them and sought for their cooperation and support. A thorough familiarization was made with them and their cultural values and taboo days were noted. During the field visits a list of active participating taungya farmers was obtained from the forest officers, agricultural extension officers and the taungya headmen of the study area. The list of taungya farmers obtained during thr field visits was used to update the one obtained from the Sunyani Forest Service Division District. Most of the forest officers and the agricultural officers in-charge of the study area served as contact and guide persons, helped in the arrangement and setting up appointment times with the respondents.

3.5.5 Selection of farmers involved in taungya plantation

Names of farmers (both males and females) involved in taungya plantations in each of the eight farming communities were sought through contacts with the Sunyani Forest District Office. The list was updated during the preliminary visits from the opinion leaders, the chiefs, and some farmers.

By using stratified random sampling, twenty (20) farmers (consisting 10 males and 10 females) in each of the eight villages or towns were selected by the use of random numbers. In all 160 farmers were selected.

3.5.6 Selection of sawmill companies/enterprises

Contacts were made with the Forest District Office, Sunyani to get access to the list of sawmill companies and enterprises that have exploited or are still exploiting taungya plantations with permits within the Sunyani Forest District.

Twenty (20) of these sawmills were randomly selected and contacted for study to find out find out the volume of teak exploited and number of jobs offered to people.

3.6 Data collection

Information on various activities of taungya farmers sawmill companies, hunters and herbalists that depend on taungya plantations as a source of livelihood, and species diversity were collected during the survey.

3.6.1 Information on taungya system operations

Information on aspects of taungya system activities in the selected farming communities involved in taungya plantations were collected using semi-structured questionnaire (Appendix II). In all one hundred and sixty (160) farmers were selected for interviewing. Besides individual interviewing, group discussions involving 13 people were carried out.

Data were collected on:

- (a) Social issues such as family size, source of labour, standard of living
- (b) Economic issues such as employment, income, productivity, energy sources.
- (c) Farmer awareness on taungya system activities
- (d) Benefits of taungya
- (e) Problems and constraints
- (f) Improvements needed in taungya system

3.6.2 Sawmill companies and enterprises

Data was collected on the operations of the six selected sawmill companies that exploited or are exploiting taungya plantations by using the semi-structured questionnaire. Information obtained on the operations of the sawmills included:

- (a) Volume of teak exploited
- (b) Market information both export and domestic markets
- (c) Their initiative in taungya plantations development
- (d) Number and categories of sawmill workers employed and their range of salary scale
- (e) Infrastructural development and other benefits provided to the community.

3.6.3 Herbalist and Hunters

Herbalists and hunters were also contacted. Semi-structured questionnaires were used to collect data on biodiversity from the perspectives of herbalists and hunters respectively.

Information collected included;

- (a) Plant species that have medicinal properties in taungya plantations and other land use systems
- (b) Wildlife animals often encountered in taungya plantations and other land use systems.

3.6.4 Survey of plant species commonly found under taungya plantations

Data on other plant species apart from teak, animals that are often found in taungya plantations were collected from the farmers view point to ascertain and estimate the species composition

3.6.5 Problems encountered during data collection

The major problem encountered was that of transportation apart from the reluctance on the part of the Sawmill Companies to give detailed information on their operations.

Some of the communities selected for the study are remote from the Sunyani Metropolis where I reside. Going to the far away communities required strong vehicle. The vehicle used for the data collection occasionally developed faults. The problem was overcome by either trekking some distance or waiting for a car that might ply the road to get the communities.

3.6.6 Data analysis

The 160 taungya farmers were selected and their household level of education, income sources, occupation, livestock keeping, preferred crops, labour requirement, sources of funds,

level of knowledge of flora and fauna commonly found in taungya plantation, problems associated with taungya system and suggestion for taungya improvement were solicited for and the data subjected to analysis by the use of descriptive statistics (Pie chart, percentage, mean, standard deviations) through the application of Statistical Package for Social Sciences (SPSS).

Information on flora and fauna commonly found in taungya plantation were also solicited for from some foresters, farmers, herbalists and hunters to complement the species might have been not encountered by the taungya farmers and comparative analysis made.

The monetary value of the total volume of teak stems exploited by Sawmill Companies/Enterprises was estimated using GH¢140.00 per m³ of teak wood. This is the unit price for 1 m³ of teak wood used at the Sunyani Forest Services District. to calculate for the cost of volume of teak stems allocated to Sawmill Companies/Enterprises for exploitation.

CHAPTER FOUR

4.0 RESULTS

4.1 General socio-economic characteristics in Sunyani Forest District

Over 70 % of the people in the Sunyani Forest Service District are mostly farmers. The agricultural practice being carried out by farmers is mainly shifting cultivation. Most of the farmers do practice mixed cropping with land holdings less than 1.0 hectare per head. Land cultivation is carried out mostly by hand with simple farm implements like cutlass, hoe, cutting and digging axes. Major food crops cultivated include maize, yam, cassava, cocoyam,

plantain, as well as vegetables in an inter-cropping system. Cash crops like cocoa, oil palm, cashew and citrus are cultivated on a large scale. Usually, apart from the cash crops, most farm production is mainly subsistence.. However, during years of bumper harvests, surplus foods are sold to obtain income for the upkeep of the household.

The Sunyani District which forms part of the Sunyani Forest Service District has well developed market facilities and the quality of the produce are also very good. Therefore, very little produce is sold in nearby communities since most of it goes to the

Sunyani District.

Livestock production forms a component of the general land use systems in the study area. The animals most commonly kept are sheep and goats as well as poultry. Each livestock farmer keeps an average of 2-20 goats/sheep and/or up to 15 chickens.. However, few commercial farmers keep cattle. Most of the animals are usually allowed to graze in a free range system around settlements. Some of them are however penned or tethered to prevent them from destroying neighbouring farms. It is worth noting that most farmers keep these animals as form of security and they only sell them in times of financial crisis within the household to generate money for critical use (Personal communication with MoFA, Sunyani). Usually, able-bodied persons work on the household farm especially during peak labour demand periods such as the sowing season and weeding around crops. Besides, it is also a common practice for the neighbouring families to agree on communal labour exchange in farm operations. (Personal communication with MoFA, Sunyani).

4.2 Educational levels of households of taungya farmers identified in Sunyani Forest District

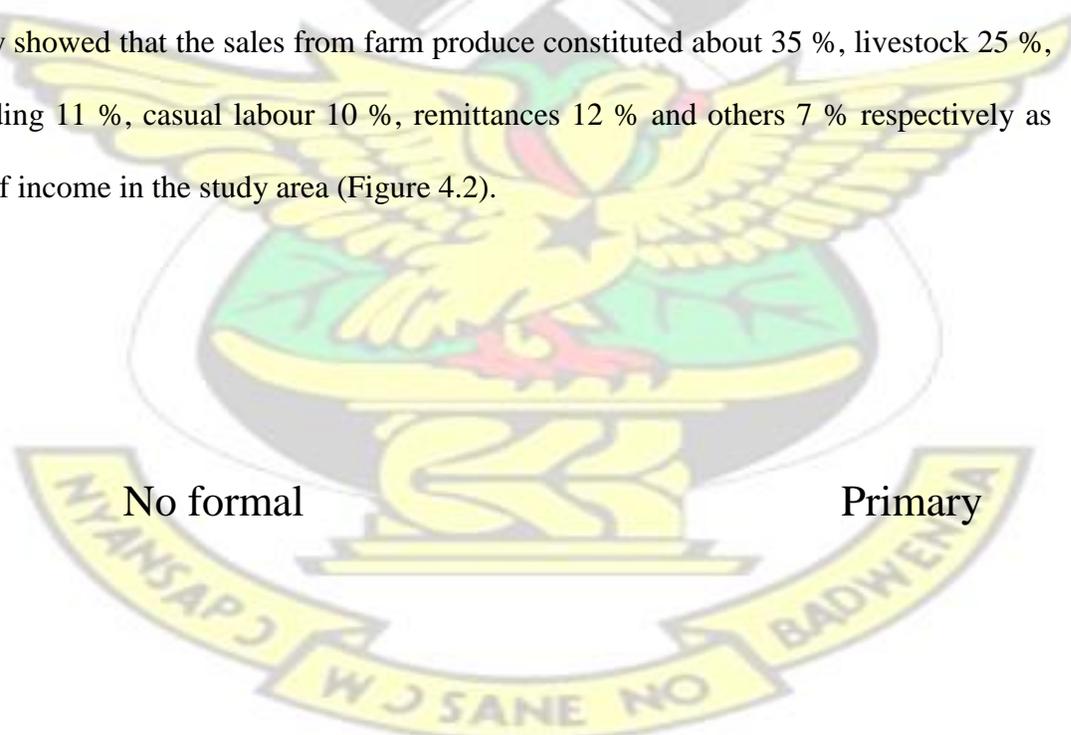
The levels of education identified in the households of the taungya farmers interviewed portray low standard of education in the eight selected communities in the study area (Figure

4.1), and in most households no one managed to attain tertiary level of education (Appendix III). Generally, more people attended the basic level of education primary (25 %), Junior High School (25 %) whilst 17 % and 7 % of the respondents households managed to go through the secondary and the tertiary level of education respectively. However, the percentage of people who had not had formal education is the highest (26%).

4.3 Sources of income in Sunyani Forest Service District

A summary of the sources of income in each of the eight communities selected in the study area indicated that the major source of income of the taungya farmers is sales from farm produce whilst few depend on other sources such as petty trading, casual labour, sales of livestock and remittances for income.

The study showed that the sales from farm produce constituted about 35 %, livestock 25 %, petty trading 11 %, casual labour 10 %, remittances 12 % and others 7 % respectively as sources of income in the study area (Figure 4.2).



No formal

Primary

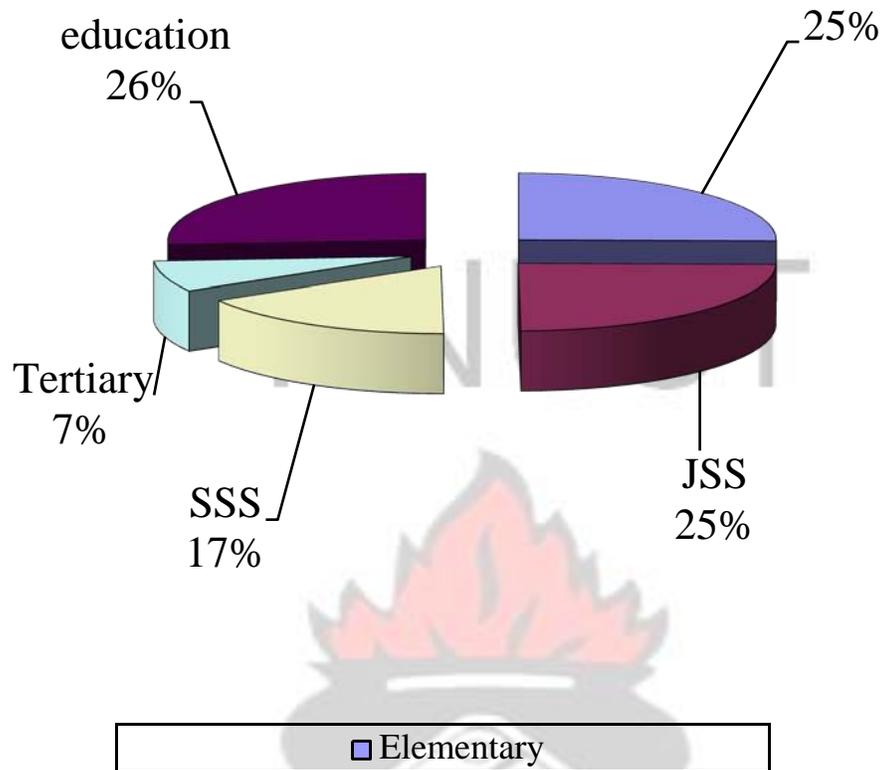


Figure 4.1 Educational levels of taungya farmers' households in Sunyani Forest District



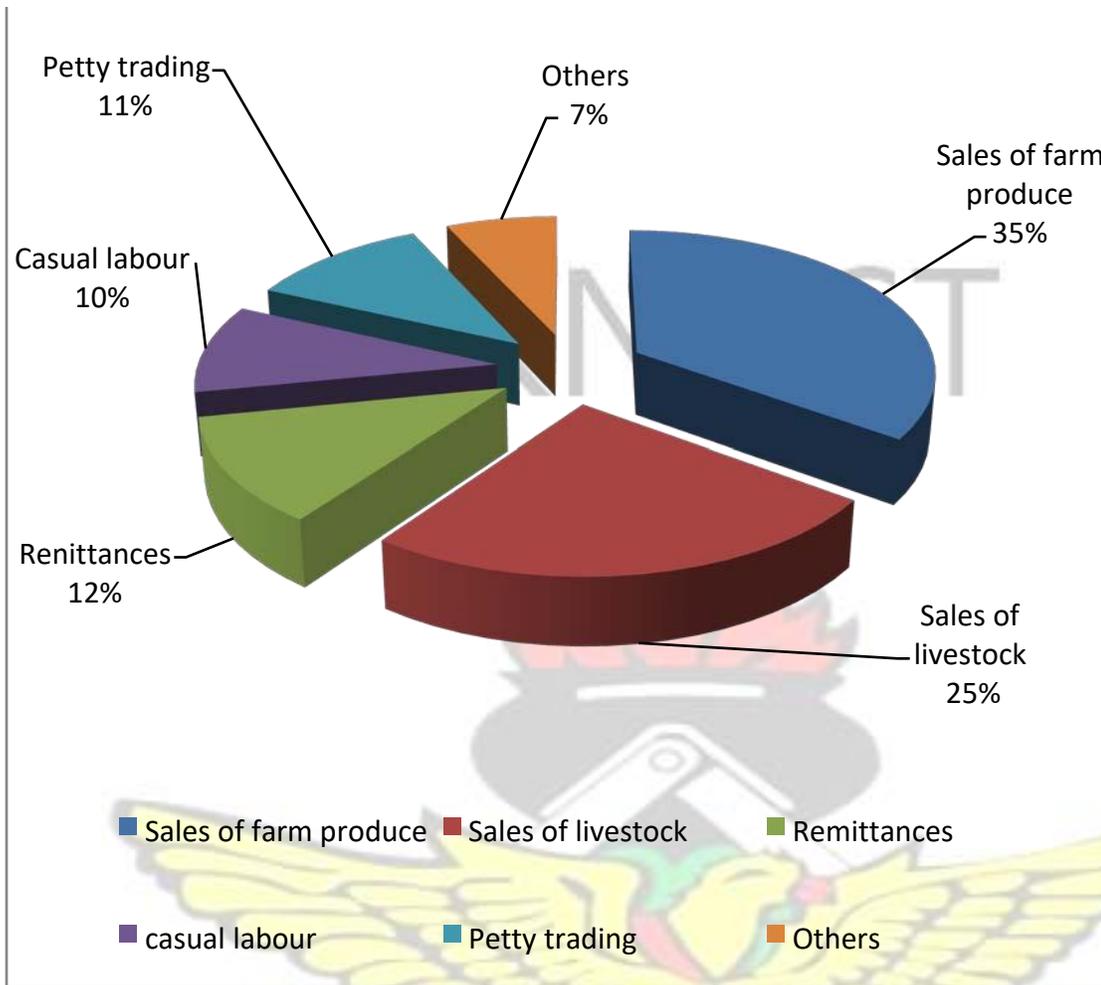


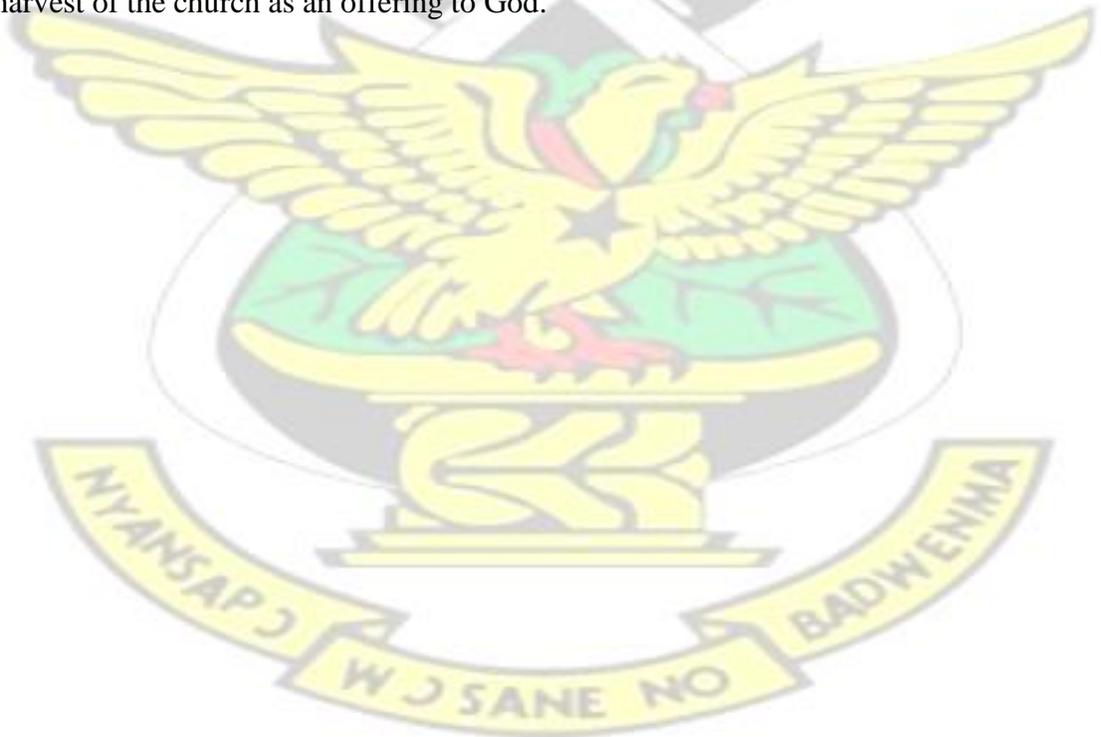
Figure 4.2 Sources of income distribution of taungya farmers in Sunyani Forest District

4.4 Taungya farmers and livestock keeping

Figure 4.3 indicates the estimated livestock population being kept by taungya farmers in the study area. The kinds of livestock being kept include sheep, goat, poultry and/or cattle. Sheep constituted about 19 %, goats 18 %, poultry 62 % and cattle 1 % of the total number of livestock being raised by taungya farmers. The study also showed that poultry keeping is

much predominant and majority of taungya farmers do not keep cattle in the Sunyani Forest District.

The taungya farmers in the study area do not combine the livestock directly with the established taungya plantations but rather raise and keep them in the house, some in fenced structures or in kraals made of teak slaps from sawmills. Occasionally, the livestock when released go to nearby taungya plantations and graze the under-story weeds in the plantations. Grazing the under-story weeds helps check the incidence of fire hazards to some degree by reducing the volume of flammable herbaceous plants. The livestock occasionally serve as source of protein for the household and also as additional source of income for the participating families. 19 % of the 160 farmers interviewed depend on the sales of livestock to carry out their taungya activities. Some farmers also present livestock to church during annual harvest of the church as an offering to God.



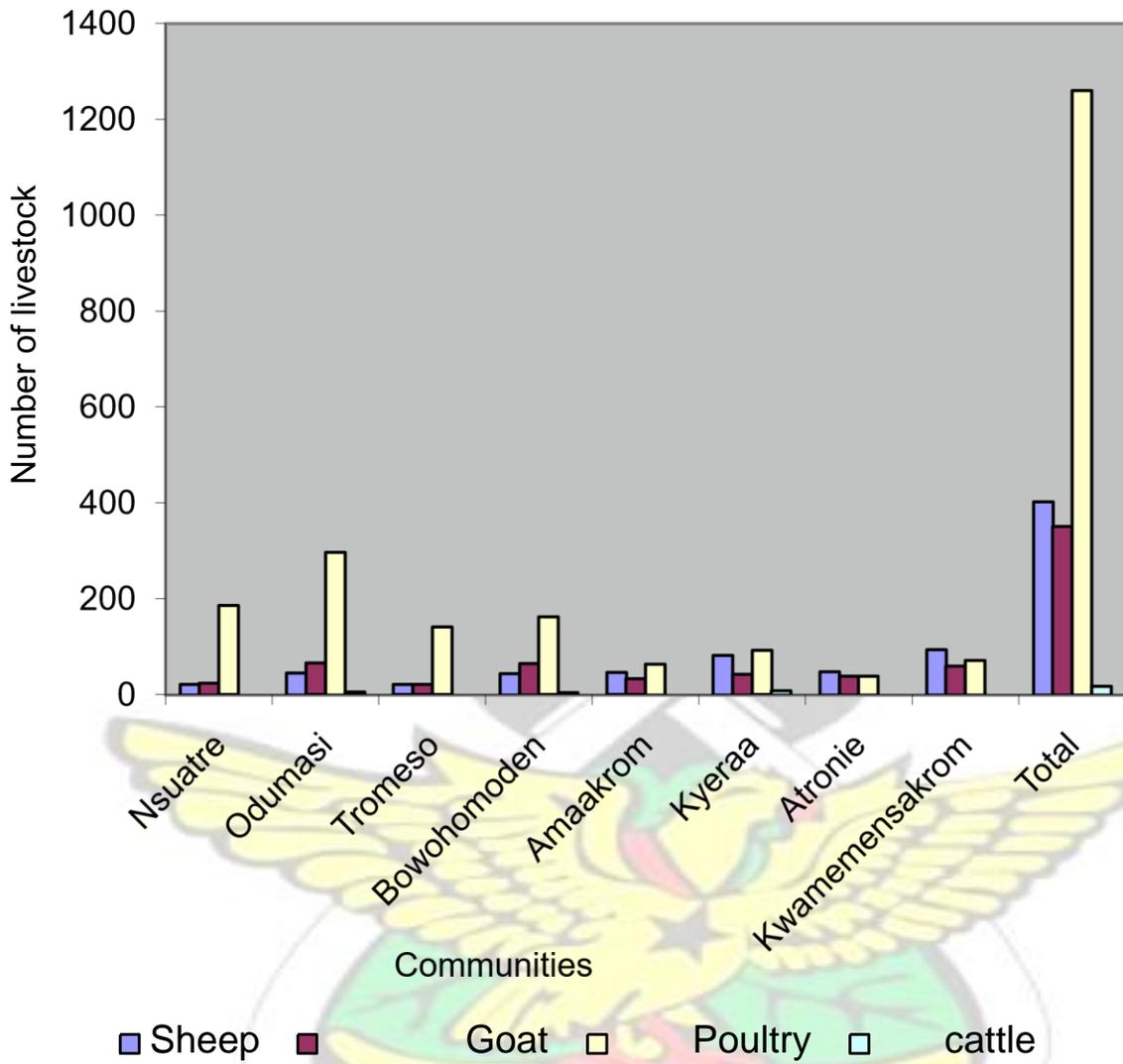


Figure 4.3 Estimated livestock distribution among taungya communities Sunyani Forest District

4.5 Farmer awareness of taungya system

4.5.1 Level of knowledge of farmers associated with taungya system

The level of knowledge of farmers in taungya system on gender basis in the communities selected for the study is shown in (Table 4.1). The results of the use of t-test on the data revealed that there is no significant difference ($P < 0.05$) on gender basis as to the level of knowledge in taungya system.

Table 4.1 Community level of knowledge in taungya on gender basis

Community	Gender			
	Male		Female	
	No	Yes	No	Yes
Nsuatre	5	6	7	2
Odomasi	4	6	8	2
Tromeso	4	3	6	6
Bowohomodén	5	3	6	4
Amaakrom	7	6	7	3
Kyera	7	3	8	2
Atronie	4	5	7	3
Kwamemensakrom	7	4	5	5
($P < 0.05$)	5	6		

$$- 4.255 \leq t \leq 1.84$$

4.5.2 The taungya agreement

Of all the 160 taungya farmers interviewed during the survey in the selected farming communities, 149 confirmed that the Forestry Officers did explain the content of the taungya agreement before their involvement in the taungya practice while 11 did not. The agreement as mentioned by the Taungya farmers included the following:

- (a) Forest Services Division (FSD) responsible for land demarcation, plot allocation, provision of seedlings, pegging and planting
- (b) initial clearing/land preparation by farmers
- (c) ownership of food produce by farmers and that of the tree component by the FSD
- (d) Farmers leaving the land after 2-3 years of cultivation
- (e) Farmers responsible for weeding around the planted seedlings in conjunction with their agricultural crops.

However, on the suitability of the taungya agreement, the farmers expressed certain aspects as been unsuitable. Those aspects that farmers felt unsuitable included the following;

- (a) restrictions on the kinds of staple food crops to be integrated with the taungya system
- (b) farmers not having a share in the final tree crop output

4.5.3 Farmer-felt alternatives to the formal taungya agreement

Suggestions based on the unsuitability of the formal taungya agreement were made by the taungya farmers as better alternatives to the formal taungya agreement (Appendix V) of which they believe would help alleviate them both in the short and long term from poverty.

These included;

- (a) provision of transport to the farmers by the government
- (b) clearing/land preparation by the farmers with assistance in areas of felling and cross cutting the big standing trees using the chainsaw machine
- (c) peg cutting by the farmers to be paid by the government
- (d) farmers assisting in pegging and planting
- (e) farmers maintaining old farms until total canopy closure
- (f) taungya farmers having a share in the tree crop output
- (g) farmers weeding around the tree component till complete canopy closure.
- (h) farmers carrying out fire precaution and preventive operations till final tree harvest.

4.6 Agricultural crops in the farming system

4.6.1 Preference of agricultural crops on farmers own farmlands

The study also identified the various agricultural crops preferred and grown by farmers on their own farmlands in each of the selected communities in the study area. On the farmers own farmlands, the most preferred agricultural crops were expressed variously by the taungya farmers (Figure 4.4). The result shows that 15.62%, 16.87%, 14.38%, 31.88%, 13.75%, and 7.50% of the 160 taungya farmers mostly preferred plantain, cassava, cocoyam, maize, yam and vegetables on their own farmlands, respectively.

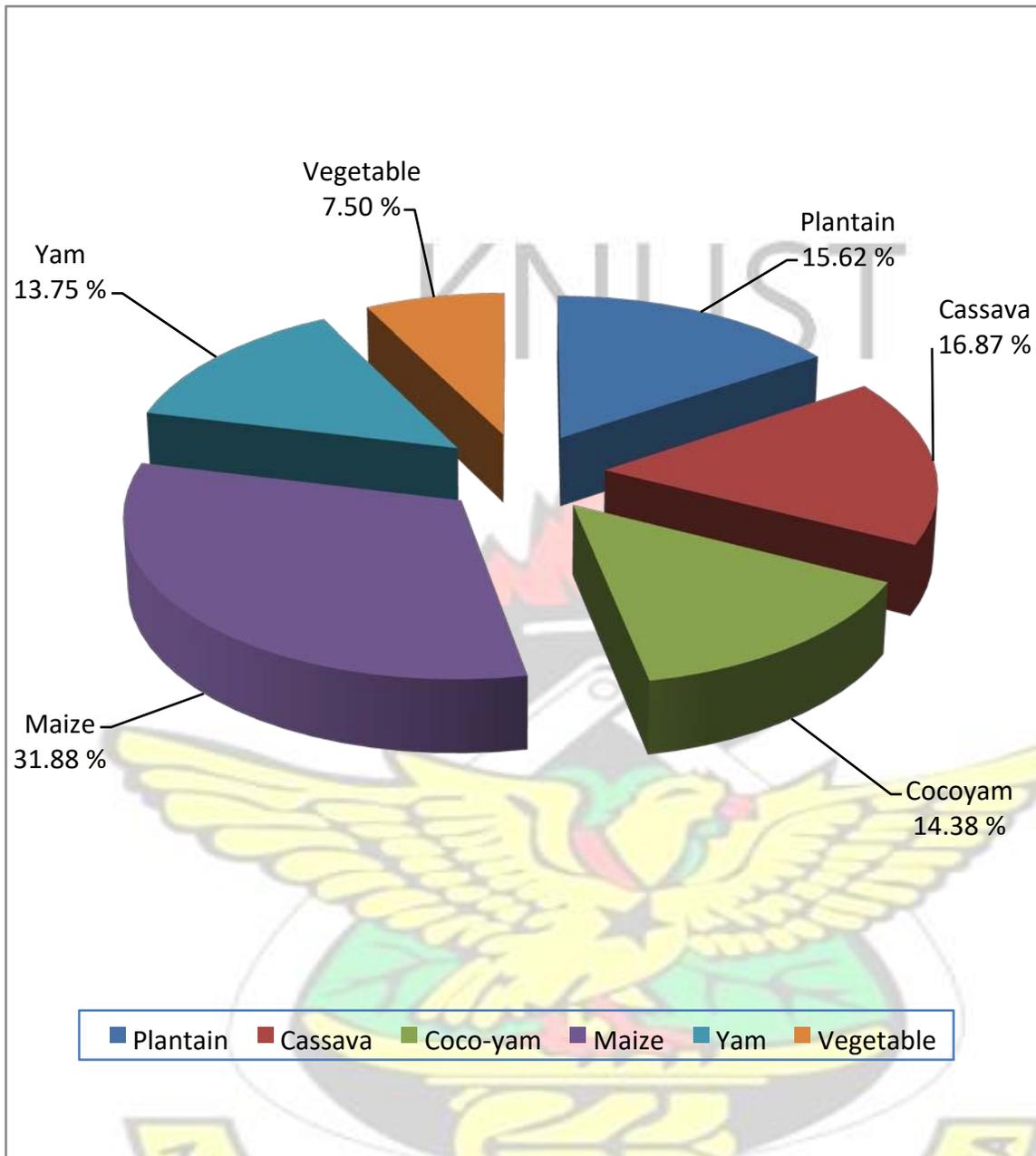


Figure 4.4 Most preferred agricultural crops on farmers' own farmland in Sunyani Forest District

4.7 Labour requirement in taungya system

4.7.1 Nature of labour

The taungya farmers in the study area do rely on various sources and kinds of labour for taungya practice. Labour could be provided by the farmer him/her-self or obtained by hiring. Use of family labour or by communal labour exchange is also common in the area (Table

4.2). However, some taungya farmers do combine various sources and kinds of labour to carry out their taungya activities as and when considered necessary. It is usually based on the kind, intensity and the quantum of work to be carried out within a specific time frame vis-à-vis the prevailing climatic conditions.

Labour provided by the farmers themselves constitutes 0-15% , self/hired labour 15-20%, hired labour 5–20%, family/hired labour 5-15%, self/family labour 0-15%, self/family/hired labour 0–15%, communal labour exchange 15-35%, and others 0-5%. Most of the taungya farmers who usually result to combinations of the various sources of labour do so for numerous reasons:

- (a) Enormity of work and time consuming associated with the initial clearing and land preparation
- (b) Felling of the very big standing trees
- (c) Planting of food crops over a vast area
- (d) Harvesting large quantity of food crops that are easily perishable due to unfavourable climatic conditions.

Table 4.2 Nature of labour for taungya operations in Sunyani Forest District

Community	Labour source							
	S	SH	H	FH	SF	SFH	CLE	Others
Nsuatre	5%	20%	20%	10%	10%	15%	20%	-
Odumasi	-	15%	5%	15%	10%	15%	35%	5%
Tromeso	10%	15%	20%	10%	-	15%	25%	5%

Bowohomodén	10%	15%	15%	5%	5%	20%	30%	-
Amaakrom	10%	20%	15%	5%	15%	20%	15%	-
Kyeraa	15%	20%	20%	5%	10%	-	25%	5%
Atronie	15%	15%	15%	10%	5%	5%	30%	5%
Kwamemensakrom	15%	15%	20%	5%	5%	15%	25%	-
Percentage range (%)	0-15	15-20	5-20	5-15	0-15	0-15	15-35	0-5

S-Self labour

SH-Self and hired labour

H-Hired labour

FH-Family and hired labour

SF-Self and family labour

SFH-Self, family and hired

CLE-Communal labour exchange

4.7.2 Sources of cash for payment of labour required in taungya practice

The study identified that the taungya farmers depend on different sources of income to support their taungya operations (figure 4.5). Out of the 160 taungya farmers interviewed those who rely on income from sales of farm produce to carry out their taungya activities constitute about 58%, sales of livestock 19%, loans from local money lenders 10%, loan from bank 5% and others 8% in Sunyani Forest District.

4.8 Development of taungya system in Sunyani Forest Services District

Forest plantation development using the taungya method started in 1969 in Sunyani Forest District. Less education was initially given at the time to the taungya farmers in the 1969 taungya plantation development. However, for almost the past 2-4 years the approach to the taungya system has been collaborative in which the farmers form part of the management process. Farmers are educated on the knowledge and skills in taungya practice as well as field practical exercises, during which the taungya rules, regulation are made crystal clear to the interested farmers who have been enlisted to take part in the development of forest plantation through the taungya system.

There has been some improvement in taungya system at the Sunyani Forest District. Records available at the Sunyani Forest District Office indicate that the forest fringe community members who are interested in taungya plantation development are involved in almost all the stages in the following operations in a more participatory approach than before.

Such activities carried out by the Sunyani Forest District include:

- (a) training and encouragement of communities to collect viable seeds
- (b) practical training of communities in nursery establishment and management
- (c) encouragement of communities to produce quality seedlings to be purchased by FSD, NGO's, Institutions, and individuals.
- (d) land demarcation and clearing (e) Cutting of pegs, pegging and planting (f) protection of plantation from fire.

Apart from the engagement of taungya farmers in the various taungya activities, individuals are recruited as casual labourers to help in those activities. Recruitment of casual labourers depends on the enormity of work and the dictates of the prevailing climatic conditions. Calendar for activities of taungya plantation operation in the study area is shown in Appendix IV.

4.9 Working rates for taungya plantation operation in the study area

The survey identified the wage per man-day for casual labourers over the years required for the various operations both at the nursery and plantation sites in the establishment and management of taungya plantations in Sunyani Forest District (Table 4.3)

Available record indicates casual labourers of 183 constituting 41% male and 59% female as at 2008, and the average wage per man-day over the years was GH¢1.20

4.10 Major benefits of taungya system to farmers

Figure 4.6 indicates the major benefits obtained by farmers who participated in taungya system in the study area. The benefits include food stuff (78 %), and firewood (22 %) from teak branches and slabs from sawmill companies in the study area. Unfortunately, the farmers do not benefit from the timber/pole output of the taungya system.

Table 4.3 Working rates for various taungya operations in the study area

Operation	Working rate
Filling of polypots	500/manday

Arrangement of polypots	1000/manday
Transplanting of seedlings	1000/manday
Direct sowing	-
Watering	10,000 seedlings/manday
Weeding of nursery	-
Construction of nursery beds (1m x 10 m)	4 beds/manday
Re-arrangement of polypots	- Beating-up 500 seedlings/manday
Nursery cleaning	-
Forking of nursery beds	-
Stumping of seedlings	1000 seedlings/manday
Collection of Teak seeds	1 maxi bag/manday
Collection of Cassia seeds	1 margarine tin/manday

Operation	Working rate
Collection of Millitia seeds	4 margarine tins/manday
Site survey, demarcation and pillaring	12 mandays/km
Site preparation	
(a) Clearing	15 mandays/ha
(b) Felling, debris clearing	15 mandays/ha
Cutting and transporting of pegs	4 mandays/ha
Pegging	4 mandays/ha
Planting	6 mandays/ha

Survival survey	2 mandyas/ha	Table 4.3
Beating-up	1.2 mandays/ha	
Tending	15 mandays/ha x 3	
Ride maintenance	6 mandays/ha	
Fire patrolling	0.4 mandays/ha	
Seedling procurement	300/seedling	
Construction of green firebreak (Continued)	50 mandays/ha	

Source: Sunyani Forest Services Division District Office (2003)

- Not available



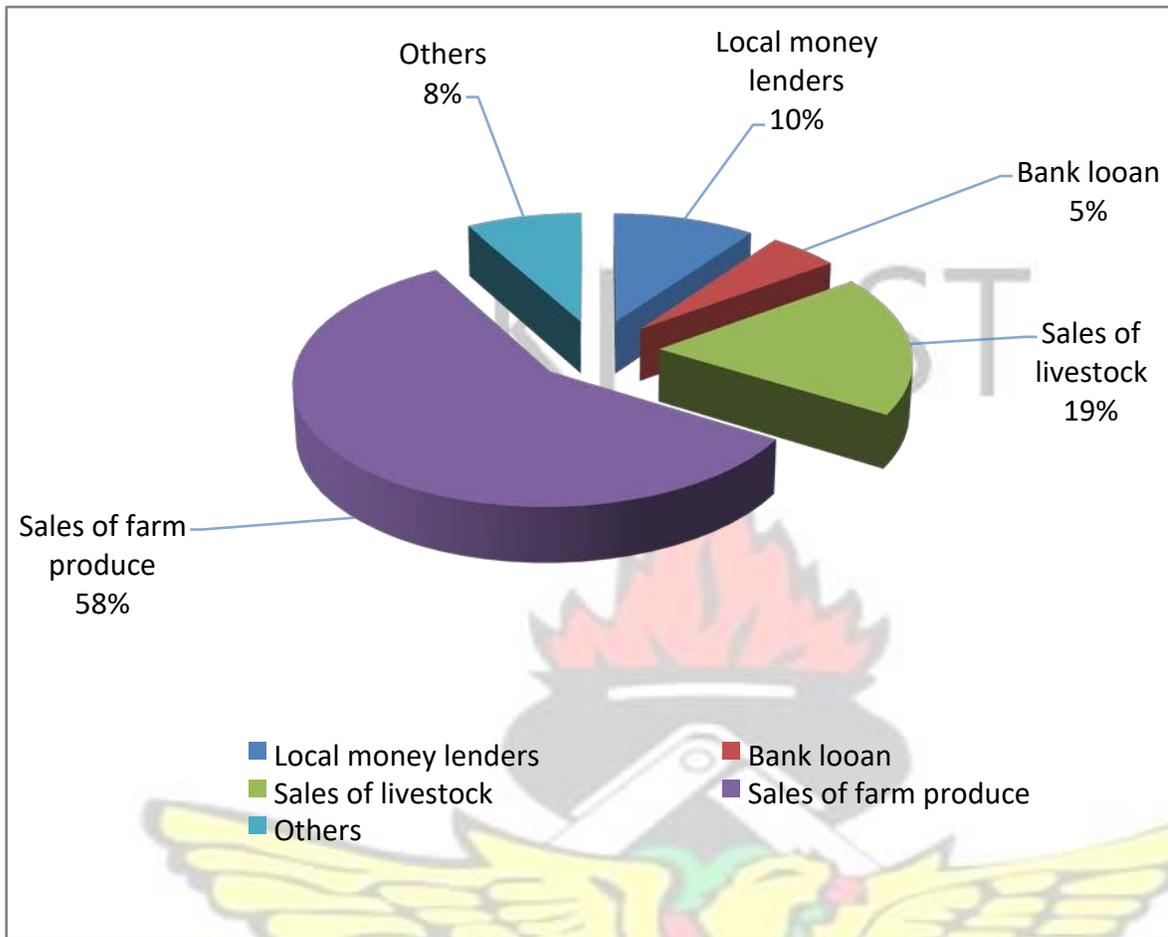


Figure 4.5 Distribution of sources of cash for taungya activities in Sunyani Forest District.

Firewood

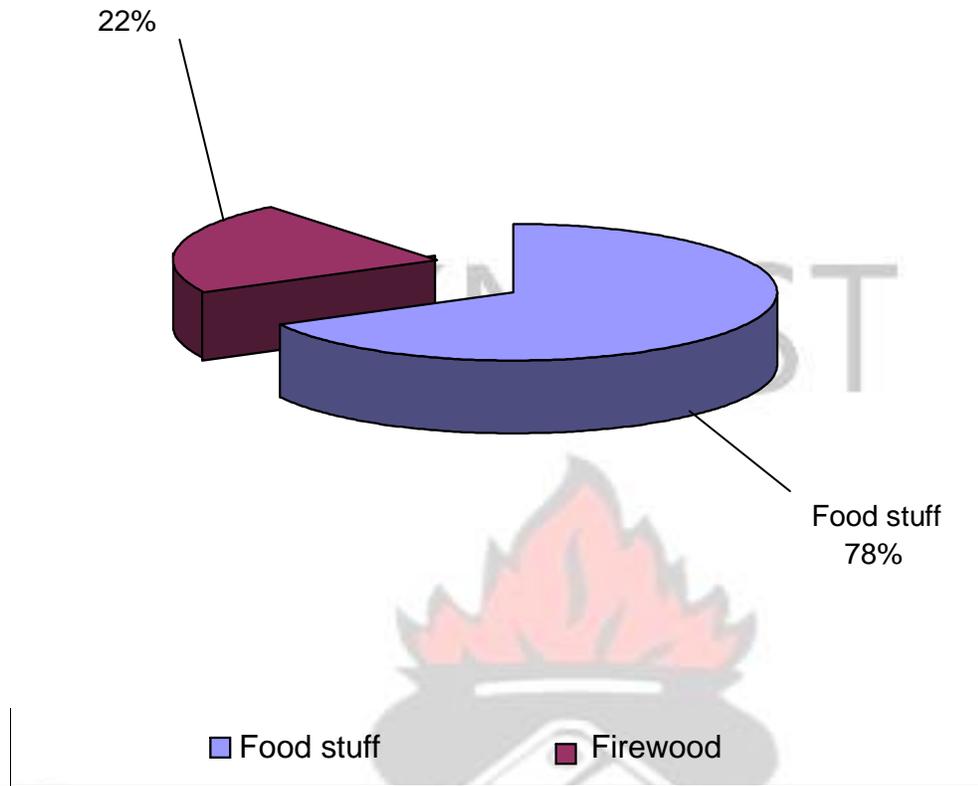


Figure 4.6 Major benefits of taungya farmers in Sunyani Forest Services District

4.11 Sawmill companies/enterprises benefits from existed taungya plantations in Sunyani Forest District

Available records at the Sunyani Forest Services Division Office indicated that more than 60 sawmill Companies/Enterprises had benefited by exploitation of teak in established taungya plantations, (Table 4.4). Those Sawmills Companies/Enterprises that were permitted to exploit teak (*Tectona grandis*) plantations established through the taungya methods are not only located in the Sunyani District or even the Brong-Ahafo Region alone but also from

other Regions within the southern sector of the country as well. Between the period 2005–2009 the records also indicated that total number of teak stems allocated to the Sawmill Companies/Enterprises was within the neighbourhood of 73711 constituting about 34,850 cubic metre of wood allocated. Of these, total number of teak extracted was 73,034 constituting 31,040 cubic metre of wood with estimated value of GH¢4,345,600.00. The percentage of teak stems extracted (99.1 %) from the total number of teak stems allocated was higher than those there were not extracted (0-9 %) after allocation. However, some Swmill Companies/Enterprises extracted more teak stems than the number allocated to them.

4.12 Other flora and fauna in taungya plantations

Tables 4.5 and 4.6 show the flora that are left to stand on the land during land preparation and fauna species commonly encountered in teak plantations from the view points of the farmers, hunters, herbalists and forest technical officers in Sunyani Forest District. According to the respondents, these are mostly some of the tree species often left to stand, in the course of land preparation, which are less in diversity than what pertains in the natural forests.

Table 4.4 Sawmill Companies/Enterprises permitted to exploit taungya plantations in Sunyani Forest District between the period 2005 – 2009

Sawmill company allocated	Forest reserve allocated	Compartment (Series) removed	Numbers of stems removed	Volume of stems (m ³)	Number of stems	Volume of stems (m ³)
Anthony Fofie Enterprise	Tain II	181 & 234	5,715	-	4,528	1,796.400
Scanstyle Mim Limited	-	152	-	-	1,034	277.680

Saoud Brothers & Sons	Tain II	106	254	-	254	101.600
Chiraa Forest Mill	Tain II	Abronye	1,350	-	872	348.800
Akwasi	Pamu-Berekum	Kofiasua	-	-	1,341	412.400
Acheampong Company	Tain II	Amanfoso	-	-	381	152.400
	Tain II	Amanfoso	-	-	329	-
	Tain II	Amanfoso	-	-	410	Tain II
228	-	-	747	298.80	-	-
Comboat. Company Ltd	Pamu-Berekum	Nkyenkyemamu	3,164	2,088.24	3,486	1,908.32
Jokumak Company Ltd.	Tain I	5	-	-	2,570	730.64
Anthony Fofie Enterprise	Tain II	181 & 234	-	-	1,451	580.400
Soloyeb Ltd.	Pamu-Berekum Compt.. (8)	Farm 4,	1,319	-	520	260.283 Company

Table 4.4 (Continued)

Sawmill company allocated	Forest reserve allocated	Compartment (Series) removed	Numbers of stems removed	Volume of stems (m ³)	Number of stems	Volume of stems (m ³)
Soloyeb Company Ltd.	Tain I	21 & 15	1,915	656.400	1,994	643.300
Niefort Company Ltd.	Tain II	Abronye & Mbotoase	1,283	513.200	1,270	464.726

Asuo Bomosadu & Sawmil	Pamu-Berekum	Nsenie/Taforo	6,992	2,195.488	2,663	1,840.989	Timber
Amakof Timber Ltd.	Pamu-Berekum	Misasuo Fententaa	1,633	468.671	1,242	393.315	
Akwasi Acheampong Company	Pamu-Berekum	Dwene I-198 Dwene II-228 Asunsu III- 624 Koradaso- 689	1,739	795.100	1,500	596.452	
Kwabena Owusu Timbers	Tain II	Adoye	930	293.880	930	292.682	
Asaboakye Global Ltd.	Tain II	259 & 260	2,170	590.672	1,899	617.631	
Daufina Company Ltd.	Pamu-Berekum	15 & 16	1,354	346.102	1,254	3,88.68	
Frekapson Enterprse	Tain II	278	855	357.985	875	266.753	
Nakod Timbers	Tain II	280	1,141	331.69	1,145	335.882	
Jefak & Sons Company Ltd	Tain II	Adoye "A"	2,173	1,216.88	1,520	481.649	

Table 4.4 (Continued)

Sawmill company allocated	Forest reserve allocated	Compartment (Series) removed	Numbers of stems removed	Volume of stems	Number of stems	Volume of stems
				(m ³)		(m ³)

Gentle Jesus Timber Ltd	Pamu-Berekum	Jinijini	3,012	1,624.48	2,598	996.941
Oti Yeboah Complex Ltd	Pamu-Berekum	Ghana-Cote D'Ivoire boundary	4,617	6,071.355	4,617	6,050.54
Asuo Bomosadu Timber & Sawmill	Pamu-Berekum	Ghana-Cote D'Ivoire Boundary	2,961	2,242.224	2,958	2,238.746
Mfansi Enterprise	Tain II	1 & 4	1,759	473.12	1,691	428.967
Asaboah Enterprise	Pamu-Berekum	51 & 57 Abrikasu Taungya Series	698	306.422	338	128.750
Amakof Timber Ltd.	Tain II	228, 229 & 234	1,960	474.270	1,872	472.594
Scanstyle Mim Ltd.	Tain II	153	5,715	1,691.640	5,630	1,692.012
Niefert Company Ltd.	Pamu-Berekum	39 & 40 Ntaabene Taungya series	1,534	555.308	575	200.104
Niefert Company Ltd.	Pamu-Berekum	Danyame	1,218	364.184	1,218	364.185
Dupual Wood Treatment	Tain II	158, 159, 161 & 181	454	111.287	460	119.344
Fortuna Ft. (GH) Ltd/ Sawmill	Tain II	231, 232, 279, 299 & 300	9,815	2,310.020	9,818	2,310.218

Table 4.4 (Continued)

Sawmill company allocated	Forest reserve removed	Compartment (Series) removed	Numbers of stems	Volume of stems	Number of stems	Volume of stems
---------------------------------	------------------------------	------------------------------------	---------------------	--------------------	--------------------	--------------------

			(m ³)	(m ³)		
	Masacher Enterprise	Tain II	141 & 185	668	140.120	
				598	129.429	
I. K. Baffoe Ltd.	Tain II	96	-	301.264	803	185.675
Amakyewaa Awua Memorial Enterprise	Tain II	94	457	140.800	352	141.812
Fort Williams Co Ltd.	Amama	Boundary teak trees	-	813.636	1,514	816.889
	Asukese	-	131.712	157	129.888	
Daufina Company Ltd	Pamu-Berekum	33 & 34	1,998	427.527	1,237	3,94.915
Amakof Timber Ltd.	Tain II	Kotaa Compt 22	863	181.230	800	170.346
Gentle Jesus. d	Pamu-Berekum	22 & 23 Dabaabi taungya series	886	293.990	662	252.526 Timber Lt
George Grant & Sons Company Limited	Tain II	Boundary teak trees	454	233.356	454	233.356
Fort Williams Co Ltd.	Pamu-Berekum	Abirikasu	655	393.000	655	393.000
Total number of stems allocated:			73711			
Total volume of stems allocated				34,850 m ³		
Total number of stems removed					73,024	
Percentage of teak stems extracted					(99.10 %)	
Total volume of stems removed:						31,040 m ³
Unit prize per cubic volume of wood = GH¢140.00						
Amount from total volume of stems removed						= GH¢4,345,600.00

Source: Adapted from Sunyani Forest Services District (2010) -

Not available

Table 4.5 Commonly occurring flora species in taungya plantations

Species	Family name	Local name
<i>Ceiba pentadra</i>	Bombacaceae	Onyina
<i>Newbouldia laevis</i>	Bignoniaceae	Sesemasa
<i>Rauvolfia vomitoria</i>	Apocynaceae	Kakapenpen
<i>Cola caricifolia</i>	Sterculiaceae	Ananseaya
<i>Albizia zygia</i>	Mimosaceae	Okro
<i>Cola gigantea</i>	Sterculiaceae	Watapuo
<i>Alstonia boonei</i>	Apocynaceae	Sinuro
<i>Millettia zechiana</i>	Papilionaceae	Fafraha
<i>Holarrhena floribunda</i>	Apocynaceae	Sese
<i>Lecaniodiscus cupanoides</i>	Sapindaceae	Dwindwera
<i>Baphia nitida</i>	Caesalpiniaceae	Odwen
<i>Baphia pubescens</i>	Caesalpiniaceae	Odwenkobiri
<i>Albizia ferruginea</i>	Caesalpiniaceae	Awiemfosamina
<i>Mallotus oppositifolius</i>	Euphorbiaceae	Anyanyanforowa
<i>Blighia sapida</i>	Sapindaceae	Akye
<i>Morinda lucida</i>	Rubiaceae	Konkroma
<i>Bombax rhodognaphalon</i>	Sterculiaceae	Akala
<i>Doispyros monbuttensis</i>	Ebenaceae	Atwerenantin
<i>Sterculia oblonga</i>	Sterculiaceae	Ohaa

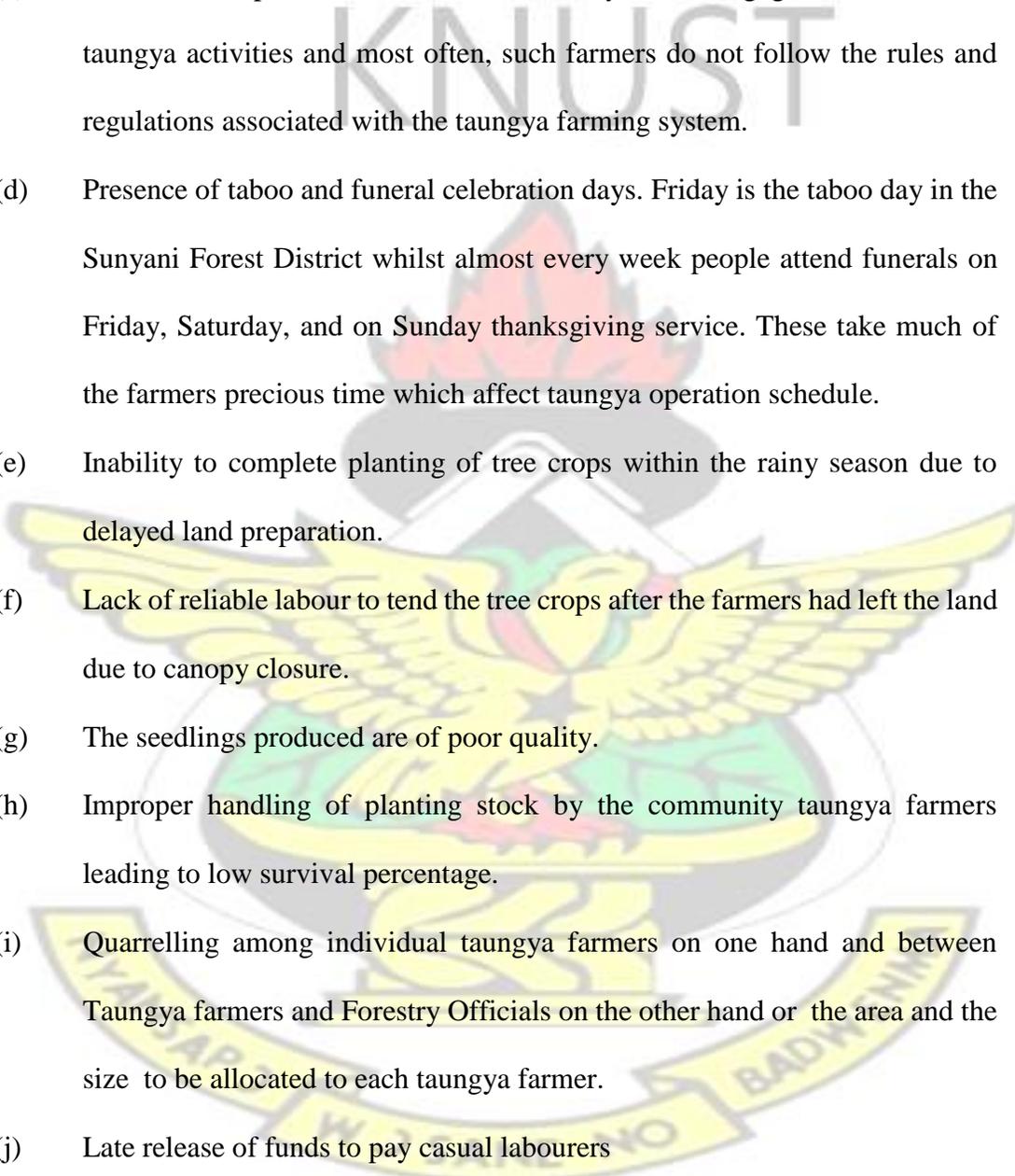
Table 4. 6 Fauna species commonly encountered in taungya plantations

Scientific name	Common name	Local name
<i>Xerus erythropus</i>	Ground squirrel	Amoakua
<i>Tragelaphus scriptus</i>	Bush buck	Wansan
<i>Cricetomys gambianus</i>	Giant rat	Okusie
<i>Thrynomys swinderianus</i>	Grass cutter	Akrantie
<i>Animalurus peli</i>	Pelii flying squirrel	Oha
<i>Dendrohyrax dorsalis</i>	Tree hyrax	Owea
<i>Phacochoerus aethiopicus</i>	Warthog	Kokote

4.13 Problems/constraints of taungya plantations development from the foresters' perspective

The survey identified a number of drawbacks associated with taungya plantation development operations in the Sunyani Forest District. These were:

- (a) Some farmers crop only maize and after harvesting, abandon the land for the tree crop to be out grown by weeds thereby becoming vulnerable to bush fires.

- 
- (b) Requisition of large track of lands by some taungya farmers who are unable to clear on time and therefore, pegging and planting are delayed to take advantage of the rainy season.
 - (c) Pressure from political leaders to the Forestry staff to engage their relatives in taungya activities and most often, such farmers do not follow the rules and regulations associated with the taungya farming system.
 - (d) Presence of taboo and funeral celebration days. Friday is the taboo day in the Sunyani Forest District whilst almost every week people attend funerals on Friday, Saturday, and on Sunday thanksgiving service. These take much of the farmers precious time which affect taungya operation schedule.
 - (e) Inability to complete planting of tree crops within the rainy season due to delayed land preparation.
 - (f) Lack of reliable labour to tend the tree crops after the farmers had left the land due to canopy closure.
 - (g) The seedlings produced are of poor quality.
 - (h) Improper handling of planting stock by the community taungya farmers leading to low survival percentage.
 - (i) Quarrelling among individual taungya farmers on one hand and between Taungya farmers and Forestry Officials on the other hand or the area and the size to be allocated to each taungya farmer.
 - (j) Late release of funds to pay casual labourers
 - (k) Lack of transport to convey labourers to the plantations sites. The Sunyani Forest Service District is less resourced in terms of transport facilities.

Private transports (Plate 4.1 and Plate 4.2) are hired to supplement what the District has (Plate 4.3) to convey workers to and from the plantation sites.

- (l) Inadequate provision of protective clothing to labourers and FSD staff to enhance their operations.
- (m) Unrealistic targets in terms of acreage set for the Sunyani Forest District.
- (n) Farmers refusal to move to new plantation sites
- (o) Delayed clearing of site for early pegging and planting
- (p) Planting of unauthorised food crops.
- (q) Poor land preparation
- (r) Difficulty in paying labourers because of untimely release of funds
- (s) Poor weeding and/or small area weeded per man-day by casual labourers.
- (t) Inadequate forestry staff strength for effective supervision of the various taungya operations.





Plate 4.1 Some taungya plantation workers on board of hired private vehicle and others waiting for the next vehicle at the Sunyani Forest District Office

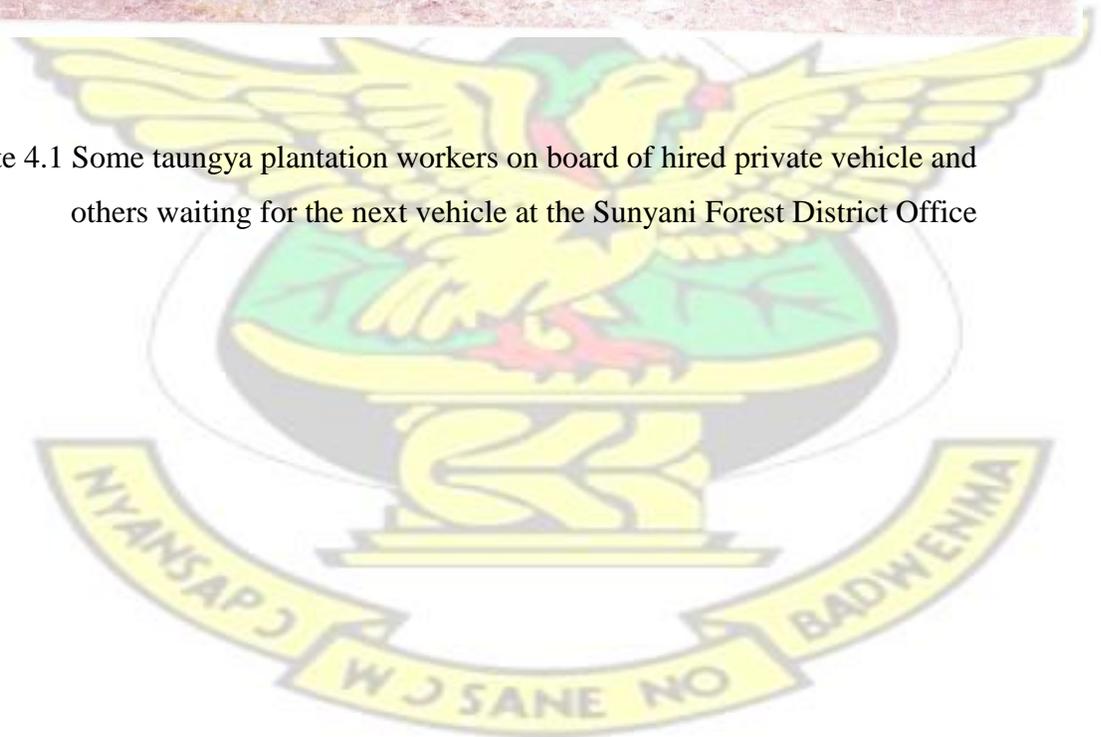




Plate 4.2 Plantation workers on board of hired vehicle

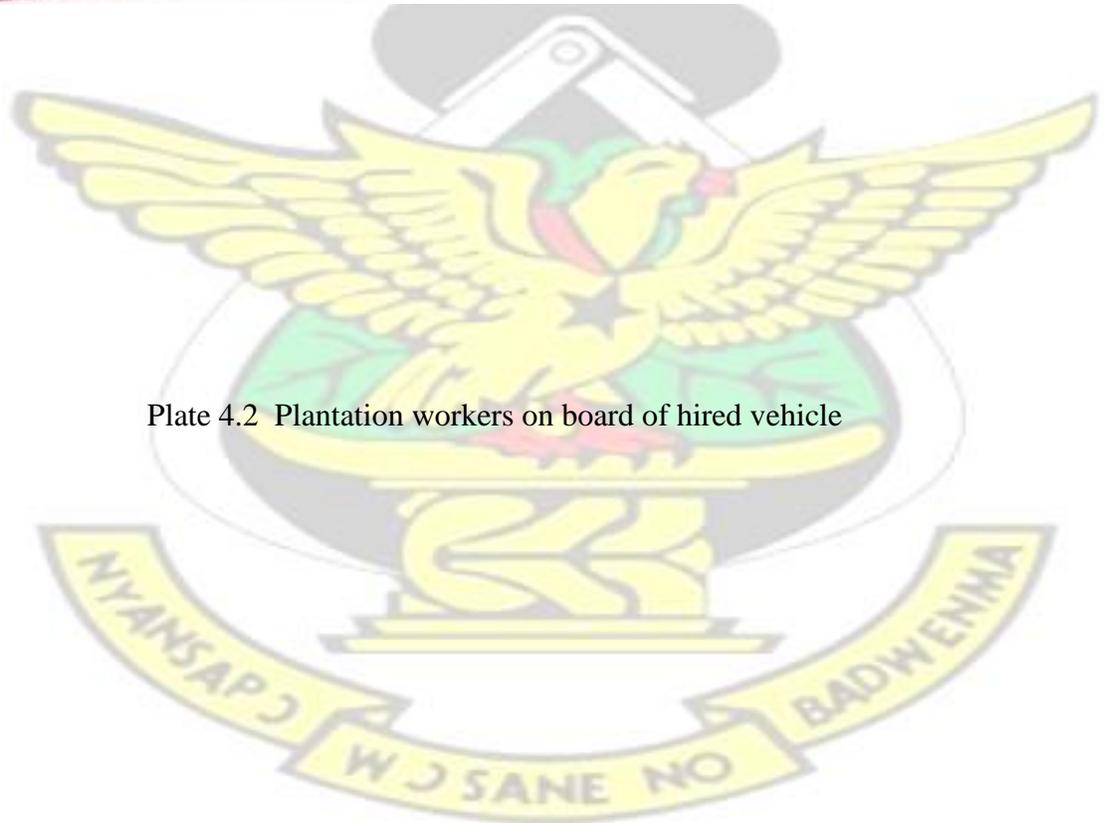




Plate 4.3 Sunyani Forest District's vehicle to pick plantation workers

4.14 Problems/constraints of taungya plantations development from farmers' perspective

The survey identified, from farmers' perspective, the problems that are associated with taungya plantations development and management in Sunyani Forest District. are:

- (a) Stealing/pilfering of planting stock and farm produce among farmers
- (b) Delayed burning of debris

- (c) Late demarcation and allocation of plots
- (d) Late provision of the tree seedlings
- (e) Destruction of food crops by foresters
- (f) The government interferences in the taungya operation at any time.
- (g) Some farmers who are closely related to taungya headmen and official of FSD get their plots first (the better plots/site supposed to be more fertile)
- (h) Farmers do not have any right to trees planted and do not own the land.
- (i) Farmers are compelled to leave their farm after 2-3 years even when there are some food crops on the farm
- (j) Lack of tree and land ownership deter farmers from applying fertilizer
- (k) Low income from taungya as compared to the traditional shifting cultivation
- (l) High cost of land clearing deters some farmers from getting involved in taungya activities.
- (m) No good sources of water at the taungya plantation sites which compel some farmers to leave their farms early during the day's work.
- (n) No transportation and some farmers have to walk over long distances to the taungya plantation sites.
- (o) Farmers are unable to do pruning properly.
- (p) Close spacing of tree crops shade off and reduce food crop yield.

4.15 Suggested improvements needed in taungya operations

A number of suggestions were expressed both during the individual interviews and the group discussions in the study areas. These suggestions made were

deemed very necessary if the taungya plantations are to be improved quantitatively and qualitatively in Sunyani Forest District.

4.15.1 Suggestions from Foresters' view point needed to improve taungya plantation development

The survey identified the following suggestions from foresters which when considered and implemented by Forest Service Division would ultimately improve taungya plantations development in Sunyani Forest District. The foresters suggested that,

- (a) the government should make funds available on time for the various taungya operations.
- (b) the enormously unattainable acreage coverage targets set for the Sunyani Forest District should be reduced to an achievable targets to ensure qualitative development of taungya plantations.
- (c) practical training programmes should be organised for the taungya farmers regularly on the various taungya operations.

4.15.2 Suggestions from Taungya Farmers' view point needed to improve taungya plantation development

The survey also identified the following suggestions from the farmers which when factored into the operations of taungya plantation development and management would ultimately improve taungya plantation development in Sunyani Forest District. The taungya farmers suggested that;

- (a) demarcation of land should be executed early enough to enable taungya farmers do clearing on time to facilitate subsequent pegging and planting.

This will give the opportunity for the farmers to cultivate their agricultural crops on schedule to avoid inconveniences and damaging effects.

- (b) sharing of taungya system outputs in terms of both the agricultural crops and the tree crops should be clearly specified. The survey identified range of percentages on the benefit of the tree crop. Out of the 160 respondents interviewed, they suggested that between 10 - 50 % of the tree proceeds should be given to the taungya farmers. According to the taungya farmers, this when done would encourage the farmers' active participation in the management of the taungya plantation till harvesting of the final tree crop component.
- (c) taungya farmers association should be formed to enable them access credit facilities for taungya operations.
- (d) provision of cutlasses, Wellington boots
- (e) cassava should be allowed to be integrated into taungya system.
- (f) taungya farmers should be given free medical care.
- (g) any credit facilities arranged should be given to the taungya farmers timely to start land preparation early enough.

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CHAPTER FIVE

5.0 DISCUSSIONS

5.1 Educational levels and socio-economic features in Sunyani Forest District

The survey has shown that there is generally low standard of education in Sunyani Forest District. The percentage of people in the households of the taungya farmers interviewed in the selected communities, who had not had formal education is the highest (26 %) and that of tertiary education the lowest (7 %). Such low standard of education is usually a characteristic feature of most rural communities in the developing countries. The effect is

under-employment. in the study area. This has resulted in the occasional migration of some of the rural people in the study area to the southern sector of the country and other places to search for non-existing jots. This situation is in agreement with what World Bank (1982) reported that under-employment is the main problem in the third world countries. FAR (1917) also observed that modernisation and urbanisation are proceeding at an alarming rate in many tropical countries and for rural people to obtain good employment satisfaction in modern cities require them to have a formal education and non-rural skills. Farming is therefore the major occupation which serves as the major source of income for the upkeep of the households in the study area.

In addition, the survey has confirmed farming as the major occupation in Sunyani Forest District due to the fact that the major source of income of the 160 taungya farmers interviewed is the sale of farm produce followed by that of livestock.

5.2 Socio-economic impact of taungya plantations development in Sunyani Forest

Services District

5.2.1 Modified Taungya System in Sunyani Forest Services District

Approach to taungya practice in Sunyani Forest District has assumed new dimension in recent years. The modified taungya system employs the participatory approach whereby the taungya farmers are involved in some of the decision-making processes. The current approach to taungya practice in Sunyani Forest District follows the approaches of Eighth World Forestry Congress (1978). The World Bank has therefore placed more emphasis on environment and rural forestry development (Spears, 2009). In addition, the participatory involvement of taungya farmers in the various taungya activities in Sunyani Forest District

is an attempt to mimic or approach the characteristic features of the Shamba System operations in Kenya where there is considerable integration of the taungya farmers into the Forestry Department, Mburu (1981) and Nair (1984). Lowe (1987) and Evans (1982) reported that the features of the Shamba System in Kenya are being gradually adapted in other areas.

However, according to Agyeman et al (2003) the current management approach to Modified Taungya System, which involves resource-owning communities in planning, does not go far enough to devolve responsibility for management of some key activities to local communities and grass-root level organization. They therefore called for government to consider making farmers the principal driving force in the Modified Taungya System with government agencies playing supporting roles. And Owusu (1999) calls for a multidisciplinary inter-agency approach to the provision of these supportive services, even though it appears that a strong commitment is required to achieve a true integration of plans and actions of the several ministries and government agencies involved in reforestation.

There have been some other impressive improvements in modified taungya system in Sunyani Forest District, because apart from the engagement of taungya farmers in the various taungya activities for payment, individuals, groups are recruited as casual labourers who earn additional income for their livelihood. Gajasen (1988) reported that few socioeconomic improvements have been achieved by peasants and business enterprise in adopting taungya systems. It could still be considerably improved to contribute more toward both short and long term rural development and poverty alleviation. This is achievable if a pragmatic scheme is developed so that taungya farmers are considered in terms of the benefits of the final tree crop in addition to that of the food crops. Such a scheme will make the taungya farmers feel as being part of the whole plantation development programme and deem the

plantations developed through the modified taungya system as property of their own. This, when done could encourage the farmers to participate actively in the forest plantation development in the degraded forest reserves in Brong-Ahafo Region, and also offer maximum protection against bush fires and illegal chainsaw operators.

5.2.2 Major benefits from taungya system

The study revealed that the major benefit obtained by the taungya farmers is the food production though they occasionally depend on teak branches for firewood. Agyeman (1998) reported that more than 80 % of the local inhabitants living inside and near forest reserves had not benefited from reservation and wanted the Government to initiate local community-friendly forest management policy frameworks. The study has also shown that establishment and management of forest plantations through the taungya method involves a series of year round operations in Sunyani Forest District. Segustron (1976) and Gregersen (1982) asserted that taungya plantations development provide a wide array of opportunities for workers to earn more income and community stability. Sumitro (1990) pointed out that taungya system is meant to contribute to national food production, provide more employment opportunities, increase income and welfare of the forest fringe communities. Thus, taungya system satisfies both social and economic needs of people who participate in it (White, 1985).

The study shows that most taungya farmers in the study area rely more on communal labour exchange (26%) to carry out taungya activities than other nature and combinations of labour. Advantage of such arrangements could be taken to facilitate the formation of taungya groups for successful taungya plantations establishment and development in the study area. Again, social cohesion in the taungya communities will be enhanced through formation of communal group for labour.

Although the Sawmill Companies/Enterprises could not or refused to provide statistics on the volume of teak exploited, invariably, these sawmills provide employment almost all over Ghana. The refusal of the Sawmill Companies/Enterprises to provide information on the volume of teak exploited could be attributed to the fact that most sawmill companies/enterprises are involved in illegal exploitation of teak both in the study area and elsewhere in Ghana. The study revealed inconsistencies in record keeping on the forest reserves, compartment/series, numbers of teak stems allocated, volume of teak allocated, number of teak stems extracted and volume of volume of teak stems extracted at the Sunyani Forest District Office. This situation could again be attributed to the fact that some forest officials connive with some Timber Companies/Enterprises to do illegal logging. World Bank (2001) reported that illegal exploitation is a major threat to global forest plantation and has serious negative economic, environmental and social impacts. No hard numbers exist but the various illegal and corrupt activities and their accompanying tax evasion are estimated to cost billions of dollars in foregone government revenues and market value each year Other impacts include environmental degradation and socioeconomic effects such as large-scale job losses and reduced access to materials that provide food and income for people living in the vicinity of the forest plantation (ContrerasHermosilla, 2001). The availability of illegally harvested wood also reduces the profitability of legally harvested wood and the industries that depend on legally harvested wood. The ecological fallout of illegal logging is reflected in the erosion of biodiversity and other environmental values. The financial cost to governments in foregone revenue is enormous (ITTO, 2002).

However, the study revealed that between the periods 2005–2009 volume of teak wood extracted in the Sunyani Forest Services District was about 31,040 cubic meters with an estimated market value of about GH¢4,345,600.00 accrued to the government and not to the

taungya farmers. Thus, the socio-economic aspects of the farmers in the taungya system both in the short and long term are not considered. This might be one of the causes of illegal exploitation of teak plantations. Agyeman (1998) reported that more than 80 % of the local inhabitants living inside and near forest reserves had not benefited from reservation and wanted the government to initiate local community-friendly forest management policy frameworks. Borlaug and Bowswell (1988) recognized that national and international development programmes had not been sustainable or failed because of social, economic, cultural or political limitations..

5.2.3 Preference of agricultural crops in farming practices

The study has shown that taungya farmers have wide range of preference for agricultural crops on their own farmland for subsistence and commercial purposes that enhance their livelihood sustenance. The farmers mostly prefer to plant agricultural crops of their choice on their own farmland. However, planting of those staple food crops on taungya plots are restricted to crops that do not retard the growth of the forest trees drastically. This situation is in contradiction to what Tejwani (1987) observed in India where different kinds of agricultural crops were integrated with the tree crops.

Again, the farmers not allowed to integrate agricultural crops of their choice in the taungya system is in contradiction to what FIO (1988) prescribed for the Forest Village System in Thailand where combinations of trees and crops in the Forest Village System differ from village to village and from region to region due to differences in climatic, soil fertility and marketing conditions as well as skills and preferences of the participating taungya farmers. Considering the study area as whole, farmers preference to integrate agricultural crops with tree components of the taungya system should not be overlooked.

The restriction of the taungya farmers to cultivate staple food crops of preference for their livelihood is, however, observed by McNamara (1973). He reported that little or no thought was given to the farmers, their agricultural output, as well as their basic needs.

None-the-less the cutting or destruction of food crops that are not permitted or planted very close to tree crop by Foresters is in line with what Hellinga (1953) observed. He reported that taungya was mainly considered as an effective means of reforestation, and its contribution to improving the welfare of the local people was subsidiary to the successful establishment of timber plantations. Again, he stated that a prerequisite of taungya is forestry and the primary objective of the forest enterprise should not be hindered by increase food production.

5.2.4 Farmers' sources of cash for taungya farming activities in Sunyani Forest

District

The farmers major sources of cash to carry out their farming activities in taungya system largely come from the sales of previous year's farm produce (58%), sales of livestock (19%), local money lenders (10%) and others (8%), but access to bank loan (5%) for taungya activities by farmers is rare in the study area. These percentages are indication of the fact that the major occupation in the study area is farming.

The lack of credit facilities to farmers to purchase the necessary farm inputs as it pertains in Indonesia where taungya farmers were provided with credit facilities to buy farm inputs to increase food production so as to be profitable to farmers (Wiersum, 1981).

5.3 Biodiversity conservation in taungya plantations

From the perspectives of the respondents (e.g. farmers, herbalists, hunters and forest technical officers) indicate that less number of different flora species grow in taungya plantations and these are the plant species that are mostly left standing in the course of land preparation for taungya plantations establishment. The few flora species commonly found in taungya plantations could be attributed to the fact that land preparation methods for the establishment of taungya plantations are almost the same as the traditional shifting cultivation in which the land is prepared by the slash- and-burn method whereby useful trees and shrubs are left to stand on the land.

Again from the view points of the respondents inter alia farmers, herbalist, hunters and forest technical officers different fauna species commonly encountered in taungya plantations are abysmal. Aln (1974) and Lal *et al.*, (1975) reported that activities of organisms and natural biological cycles are affected by clearing and burning of vegetation. There was small number of different fauna and flora species commonly found in taungya plantations. Shiva (1992) observed that biodiversity depletion triggers a chain reaction. It was observed that the disappearance of a species is related to the extinction of many other species. This might have caused the small number of different species of fauna and flora commonly found in taungya plantations. (ITTO, 2000) also reported that establishment of taungya plantations on Land that already carries natural forest will exacerbate deforestation rather than reducing it.

5.4 Problems/constraints with taungya plantations development in Sunyani Forest District

Some taungya farmers cultivate maize only on their taungya plot and abandon the plot three months after harvesting their maize. Such a practice on the part of the farmers makes the tree

crop to be taken over by weeds thereby subjecting that area to incidence of bush fires. This practice does not optimise land-used. Bene et al, (1977) reported that the first priority of World Bank favours combined production system that integrate forestry, agriculture and/or animal husbandry in order to optimise tropical land-use. Again, abandoning the land in the first year of cropping and harvesting only maize is against the fundamental principal of the original taungya scheme for the practice of taungya system. Enabor (1975). Goswami (1982), and Watson (1983), They found out that the original taungya scheme was to allow farmers to clear and cultivate the land for about 4 – 5 years while the tree crops are young. After the initial 4-5 year cropping period, the tree component are managed as a mono-culture forestry unit whereby the farmers are ordered, in accordance with the specifics of the taungya agreement, to discontinue cropping the land and maintenance of food crops especially when the canopy closes.

In addition, the act of cultivating only maize and abandoning the land must be discouraged. White (1985) and Gajaseeni (1988) observed, that apart from the weeding benefits obtained from taungya farmers, fire control is an important reason for interplanting agricultural crops with tree crops in taungya system. They further noted that weeding is an important activity in teak plantation by the taungya method.

Large track of most of the forest reserves in Sunyani Forest District has been degraded due to over-exploitation and annual bush fires. As a result, there has been intensive forest plantation establishment through the taungya method by Nation-wide Forest Plantation Development programme. Targets set for the District have been increased accordingly from 50 hectare in 2003 to 100 hectares in 2004. Blanford (1958), King (1968), and Jordan et al., (1992), observed that most of the accessible forests have been degraded and their natural

regeneration is doubtful in the near future. Taungya system is the cost-effective means of replanting teak on badly degraded lands.

Transport for taungya operations in the study area was identified as one big constraint to successful taungya operations. Therefore, private transports are hired to augment what the district has to convey workers to and from the plantation sites. The problem of transport has been identified by Agyeman *et al.*, (2003) in the taungya operations. They realized that the number of official vehicles or trucks available for the Modified Taungya System operations are inadequate to cope with workload. This has therefore contributed to the hire cost of the project.

Requisition of large track of land by farmers who are unable to clear on time, pressure from political leaders to employ their favourites in taungya operations, quarreling among individual taungya farmers on one hand and between taungya farmers and some forest officers on other hand, improper handling of planting stock by taungya farmers and casual labourers, late release of funds to carry out the various taungya operations have been identified by King (1968) and Wanyeki (1981), in Shamba and the Forest Village taungya systems. There is the need to enforce the rules and regulations and ensure high level of supervision of taungya operations to ensure successful plantations development..

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CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS 6.1 Conclusion

The study has shown that establishment of forest plantations through the old taungya system in the Sunyani Forest Service District has metamorphosed into the Modified Taungya System, which is in time and space, still being refined socioeconomically and transitioned to become more farmer and rural community oriented than before.

Unlike the Old Taungya System, the Modified Taungya System appreciate the involvement of forest fringe community members who are interested in taungya plantation development in some of the decision-making process as well as the various activities associated with the Modified Taungya System in a more participatory approach than before. However, there is more to be done to make the taungya farmers as well as the forest fringe rural communities to actually benefit from the tree component of the taungya plantations.

In Sunyani Forest District taungya system operations offer employment to 180 casual labourers per year and 47 permanent workers to carry out the various operations in the taungya system. The average wage per manday for casual labourers over the years was GH¢1.20 with a range of GH¢0.50 to GH¢2.25). The average wage per manday over the

years is below the current minimum wage of GH¢1.80. It is very insignificant when using taungya plantations development as one of the poverty alleviation strategies most especially in the rural communities. Between the period 2005–2009 the Sawmill Companies/Enterprises extracted 31,040 cubic metre of teak wood with estimated value of GH¢4,345,600.00 accrued to the government and not to the taungya farmers whose labour were exploited to establish the taungya plantations. For the taungya farmers, the economic implications of taungya system are derived from the sale of agricultural products which account for 58 % of their sources of income.

The study has revealed from the respondents' perspectives that biological diversity improvement and conservation is under threat from taungya plantations development and expansion in Sunyani Forest District. However, there is the need for further studies to ascertain this observation of the respondents.

Execution of the activities associated with taungya system for the establishment and management of taungya plantations in Sunyani Forest District are constrained by social, economic, cultural, religious, political, climatic or anthropogenic factors.

Besides, the Sunyani Forest Services Division District is under resourced in term of transport facilities for taungya operations. Private vehicles are therefore hired to augment the situation to facilitate the execution of taungya operations.

Taungya system when properly implemented would serve as one of the most appropriate land use systems and poverty alleviation strategies for rural development both in the short and long term programmes especially when taungya farmers are made to benefit in the final tree component of the taungya system.

6.2 Recommendations

The results of the study showed that taungya plantation development in the Sunyani Forest District is constrained by a combination of factors that are social, economic, cultural, political or anthropogenic in nature. There is the need for further work to be done in the following areas to ensure effective and sustainable taungya plantations development and management to address problems in the rural communities.

These include:

- (i) Strengthening close co-operation between the forest officials, taungya farmers, permanent and casual workers through a process of trust building between the foresters and the local people
- (ii) Education of the participants of taungya plantations development on the relevant knowledge and skills associated with nature of taungya system through training and extension programmes. The training programmes should also incorporate environmental education, family planning, welfare, supportive livelihood technology and skills to eventually alleviate the local people from poverty.
- (iii) Development of measures through research that can increase and extend crop production to benefit the farmers to alleviate poverty.
- (iv) Determination of how best to integrate the local communities into the forestry work.
- (u) Development of “A Farmer First Taungya Plantation Establishment Scheme” taking into account the tree ownership as a poverty alleviation strategy in the rural communities. This will require a full scale implementation of the

suggestions made by Agyeman *et al.*, (2003) on the benefit sharing formulae under the Modified Taungya System.

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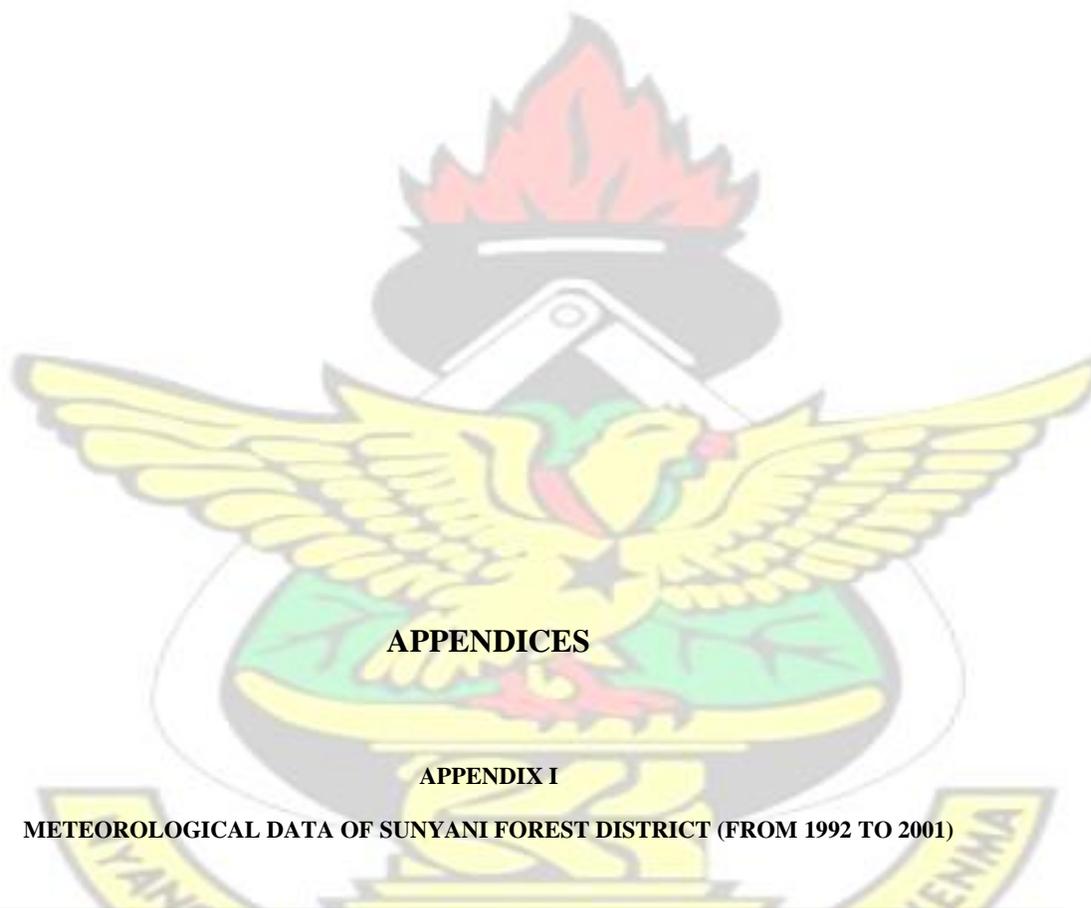
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APPENDICES

APPENDIX I

METEOROLOGICAL DATA OF SUNYANI FOREST DISTRICT (FROM 1992 TO 2001)

Years Months	1992					1993				
	Rainfall (mm)	Temperature °C		Relative Humidity %		Rainfall (mm)	Temperature °C		Relative Humidity %	
		Max	Min	Max	Min		Max	Min	Max	min
January	0.0	32.4	18.3	98	11	0.0	33.0	17.6	100	12
February	10.3	35.1	21.7	97	13	61.0	35.3	22.1	97	13
March	17.7	34.6	23.0	100	23	79.0	33.2	21.4	100	19
April	188.5	32.7	22.2	100	46	112.7	33.2	22.4	98	41
May	157.4	31.2	22.4	100	51	245.7	32.0	22.7	100	56
June	147.0	29.2	21.7	100	64	154.0	30.2	21.9	100	63

July	83.8	26.8	21.0	99	66	19.8	28.2	21.6	99	65
August	1.5	27.1	20.5	100	58	18.0	28.0	21.3	100	59
September	203.6	28.8	20.9	100	48	186.2	29.3	21.4	100	59
October	138.5	30.1	21.7	100	58	151.1	30.8	21.7	100	59
November	54.3	30.3	20.5	100	39	44.3	31.4	22.2	100	58
December	0.5	31.1	20.3	100	21	8.3	31.2	19.7	100	17
Annual Total	1003.1	369.4	254.2	1194	498	1080.1	375.8	256.1	1194	521
Annual Monthly Mean	83.6	30.8	21.2	99.5	41.5	90	31.3	21.3	99	43

Years		1994					1995				
Months	Rainfall (mm)	Temperature °C		Relative Humidity %		Rainfall (mm)	Temperature °C		Relative Humidity %		
		Max	Min	Max	Min		Max	Min	Max	Min	
January	14.2	33.4	19.6	100	11	0.0	34.1	17.3			
February	24.6	35.2	22.0	95	13	32.0	36.1	21.2	97	12	
March	71.5	35.1	22.6	98	27	144.0	34.3	22.4	98	37	
April	100.8	32.9	23.0	100	44	268.7	32.8	22.6	100	46	
May	116.6	31.7	22.3	100	51	155.5	32.1	22.3	100	51	
June	29.9	21.9	100.5	156.3	30.4	22.0	100.5	16.2	29.0	21.7	
July	108.7	29.0	21.8	100	59	100.5	28.9	21.9	100.6	5	
August	201.1	29.3	21.8	100	63	22.9	29.8	21.6	100	60	
September	190.2	29.1	22.0	100	62	201.1	29.3	21.8	100	63	
October	100.60	150.6	30.2	21.6	100	60					
November	47.8	30.9	20.8	100	41	39.5	31.2	21.5	100	46	
December	Trace	32.1	18.1	100	22	41.9	30.6	20.3	100	23	
Annual Total	962.7	378.0	257.0	1191	498	1401.6	379.0	256.7	1193	531	
Annual Monthly Mean	80.2	31.5	21.4	99	41	116.8	31.6	21.4	99	44	

Years		1996					1997				
Months	Rainfall (mm)	Temperature °C		Relative Humidity %		Rainfall (mm)	Temperature °C		Relative Humidity %		
		Max	Min	Max	Min		Max	Min	Max	Min	
January	0.0	32.6	21.2	100	25	24.5	32.1	21.0	100	17	
February	159.8	33.6	21.8	100	27	0.0	35.6	20.0	100	11	
March	96.1	32.7	22.6	100	35	57.8	35.0	23.3	100	11	
April	135.1	32.1	22.5	100	54	59.2	32.8	22.3	100	40	
May	113.4	31.7	22.5	100	54	130.2	31.3	22.2	100	55	
June	224.5	29.8	21.8	100	58	219.1	29.3	21.9	100	58	
July	128.6	28.7	21.4	100	63	94.9	28.0	21.5	98	60	
August	125.6	28.1	21.7	100	65	53.7	27.8	21.4	100	64	
September	62.1	28.5	21.6	100	61	83.2	29.0	22.1	100	62	
October	186.2	29.6	21.3	100	53	165.1	31.1	22.0	100	50	
November	14.8	32.1	21.3	100	34	17.6	31.7	22.3	100	48	
December	11.6	30.3	21.5	100	34	18.6	32.0	21.4	100	16	
Annual Total	1257.8	369.8	261.2	1200	563	923.9	375.7	261.4	1198	492	

Annual Monthly Mean	104.8	30.8	22.7	100	47	76.99	31.3	21.8	100	41
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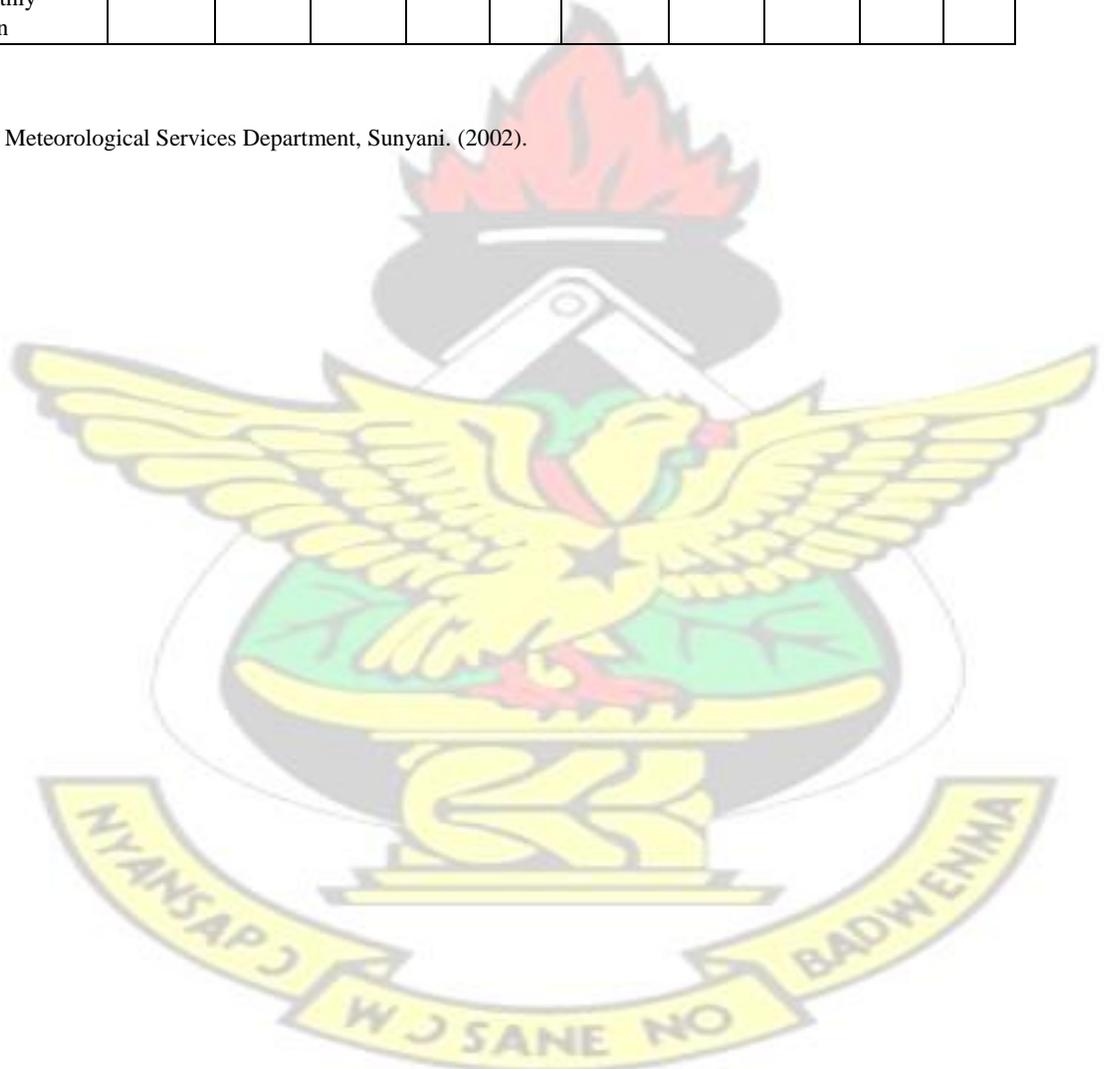
Years Months	1998					1999				
	Rainfall (mm)	Temperature °C		Relative Humidity %		Rainfa ll (mm)	Temperature °C		Relative Humidity %	
		Max	Min	Max	Min		Max	Min	Max	min
January	5.6	34.5	19.4	98	12	20.5	33.7	21.3	99	14
February	4.9	35.9	22.0	98	12	74.1	33.8	21.1	98	11
March	35.6	37.3	24.4	98	8	152.4	33.5	22.4	100	35
April	137.0	33.8	23.3	99	49	140.1	31.9	22.2	100	53
May	58.6	32.4	23.1	100	52	163.0	31.6	22.1	100	56
June	195.4	30.7	22.0	100	55	129.8	30.5	21.9	100	61
July	57.1	28.6	22.0	100	62	24.7	29.1	21.7	100	57
August	45.1	28.7	21.4	100	55	83.7	28.4	21.2	100	56
September	165.7	29.5	21.8	100	60	156.8	28.3	21.3	100	59
October	243.2	30.4	21.8	100	59	136.7	29.0	21.1	100	59
November	6.5	32.5	22.4	100	48	86.5	30.6	21.4	100	57
December	23.7	32.0	21.2	100	19	0.0	31.4	19.5	100	19
Annual Total	977.4	386.3	264.7	1193	491	1178.3	371.8	257.2	1197	537
Annual Monthly Mean	81.5	32.2	22.1	99	41	98.2	31.0	21.4	100	45



Years Months	2000					2001				
	Rainfall (mm)	Temperature °C		Relative Humidity %		Rainfall (mm)	Temperature °C		Relative Humidity %	
		Max	Min	Max	Min		Max	Min	Max	min

January	27.4	32.8	21.2	100	15	0.0	33.8	19.5	100	9
February	0.0	34.4	19.1	97	10	10.1	35.5	21.0	97	10
March	62.3	35.6	22.9	98	14	134.2	34.9	22.5	100	18
April	243.1	32.4	22.1	100	47	398.6	31.9	21.8	100	47
May	104.8	31.7	22.3	100	47	76.3	31.4	22.2	100	55
June	124.5	29.7	21.6	100	58	311.3	30.1	21.7	100	61
July	101.6	28.1	21.0	100	59	56.4	28.9	21.4	100	62
August	118.5	27.6	20.8	100	61	31.5	27.2	21.2	100	61
September	75.0	28.5	21.4	100	62	112.3	28.1	20.9	100	55
October	59.3	30.0	21.6	100	45	70.6	30.5	21.4	100	59
November	101.1	31.0	21.9	100	55	26.1	31.5	22.1	100	40
December	0.0	31.5	19.9	100	23	10.7	32.6	21.9	100	22
Annual Total	1017.6	373.3	255.8	1195	496	1238.2	376.4	257.6	1197	499
Annual Monthly Mean	84.8	31.1	21.3	100	41	103.2	31.4	21.5	100	42

Source: Meteorological Services Department, Sunyani. (2002).



APPENDIX II SAMPLE OF QUESTIONNAIRE ADMINISTERED DURING THE SURVEY DEMOGRAPHIC DATA

- D1. Name of Respondent:.....
- D2. Age:.....

- D3. Place of Birth:.....
- D4. Gender: Male [] Female []
- D5. Town/Village:..... D6.
Administrative District:.....
- D7. Ethnicity:.....
- D8. Hometown:.....
- D9. Religious affiliation: (a) Catholic (b) Pentecostal (c) Protestant
(d) Islam (e) Other (Specify)
- D10. Marital Status: (a) Single (b) Married (c) Separated (d) Divorced (e) Widowed
- D11. Number of Wives:.....
- D12. Level of education of Respondent: (a) Nil (b) Primary School (c) Middle School
(d) Secondary School (e) Sixth form (f) Tertiary (g) Others(Specify).....
- D13. Immigration Status: (a) Indigenous (b) Migrant
- D14. How long have you been in this village/town?.....years.

DATA ON CHILDREN

DC1(a) How many children do you have?

DC1(b) DETAILS OF CHILDREN

NO.	FULL NAME	SEX M/F	AGE	WORKING			EDUCATION LEVEL	IN SCHOOL
				ON FARM	OFF FARM	NON WORKING		
1								
2								
3								

APPENDIX II (CONTINUED)

SOCIO-ECONOMIC DATA

- SE1. What is the total number of persons in your household?
- SE2. What is the average number of persons in a room in your household?
- SE3(a) Gender of household head (a) Male (b) Female

SE3(b) Relationship with household head (a) Self (b) Parent (c) Uncle (d) Spouse
(e) Others(specify).....

SE4 What is your major occupation? SE5
What is your minor occupation?

SE6 How long have you been farming? (a) < 5 years (b) 5-10 years (c) 11-15 years
(d) 15+ years (Specify).....

SE7(a) What is your major source of income?.....

SE7(b) Please list your other sources of income. (i).....(ii).....

SE8. Land tenure system (a) Freehold (b) Leasehold (c) Shareholding (d) Usufruct
(e) Others (specify).....

SE9(a). How many farmlands /plots do you have?.....

SE9(b). What is the average plot size ?.....

SE10. What agricultural practices are you actively involved? (a) Cash crops (b) Poultry
(c) Livestock (d) Fish farming (e) Others (specify).....

SE11(a).What type of agricultural crops do you cultivate for cash?

(Please rank as 1st, 2nd, etc.)

(a)..... (b)..... (c)..... (d)..... (e)..... SE11(b)

Which of the cash crops do you prefer most?

Why? (i).....

SE11(c) Could you estimate your total annual cash income from the most preferred cash
Crop? ₦.....

SE12(a) What kind of livestock do you rear ? (Please specify the quantity owned)

(a).....(b)(c).....(d) (e)

SE12(b) Which of the livestock do you prefer most?....

Why? (i).....

DATA ON TAUNGYA ACTIVITIES

TA1 When did you get involved in Taungya Systems?

TA2 Were you given permanent settlement? (a) Yes (b) No

TA3 How many years did you get involved in Taungya System? Specify the years.....

TA4(a) Were there arrangements for farmers to get access to new land/area opened for
taungya system after ordering them to stop cultivating on the previous land?.

(a) Yes (b) No

TA4(b) If yes, how many plots did you get access to? TA4(c)
 Please fill the table below.

No. of Plots	Size/Acre	Year Acquired	Year forced to move to new land	Food crops allowed to be grown by farmers in the taungya system
1.				
2.				
3.				
4.				

TA5 What was the average number of years that you worked on each plot before you were forced to move to the new area opened for taungya system?.....years TA6
 What food crops did you plant that were not allowed?

(a).....(b)(c).....(d)

TA7(a) Did you realise an increase in food crop production in the taungya system as against shifting cultivation? (a) Yes (b) No TA7(b). If yes, explain.

(i).....

(ii).....

TA7(c).If no, explain.

(i).....

(ii).....

APPENDIX II (CONTINUED)

TA8. Can you compare the yields of the various agricultural crops in the taungya system with that of the shifting cultivation practice when you got involved in taungya plantation establishment?

Type of Food Crop	Taungya System (Yield/Acre)			Shifting Cultivation (Yield/Acre)		
	Quantity (Specify unit)	Unit Cost (¢)	Total cost (¢)	Quantity (Specify unit)	Unit cost (¢)	Total cost (¢)
Maize						

Plantain						
Cocoyam						
Cassava						
Yam						
Others (Specify)						

TA9 What are your reasons for getting involved in taungya?

- (i)
- (ii)
- (iii).....

TA10(a) Did you receive any assistance from the then Forestry Department.? (1) Yes
(2) No

TA10(b) If yes, what kind of assistance did you receive? (a) Seedlings (b) Tools
(c) Cash grant (d) Loan (e) Technical Advice (f) Others (specify)
.....

TA11 What factors might have caused the discontinuity of the taungya system?
(Please list them)

- (i)
- (ii)

APPENDIX II (CONTINUED)

TA12 What benefits did you get from taungya system?

- (i).....
- (ii).....

TA13 Did you obtain a share in the final tree crop? (1) Yes (2) No

TA14 (a) Did you involve yourself in the protection of the plantation against bush fire and illegal activities after you were forced to move to a new area upon canopy closure?

(1) No (2) Yes

TA14(b). If no,

why?(i).....(ii).....(iii).....

TA14(c) If yes, why? (i)..... (ii).....
(iii).....

TA15(a). Have you been practicing taungya on your own land since it was discontinued?

(i) Yes (2) No

TA15(b). If yes, why? (i)

(ii)

(iii).....

TA15(c). If no, why? (i)

(ii)

(iii).....

TA16 What conditions would you have liked to be included in specifics of the taungya agreement? (Please list them)

(i)

(ii)

(iii)

TA17(a) Do you like that a certain percentage/proportion of the output of the tree crop be given to the farmers? (1) Yes (2) No

APPENDIX II (CONTINUED)

TA17(b). If yes, What percentage/proportion of the output of the tree crop do you suggest should be given to the farmer(s)?%

TA17(c). Why? (i).....

(ii).....

(iii).....

TA17(d) Assuming you are given this percentage of the tree crop output, what role can you play in the management of the taungya plantation? (Please list them).

(i)

(ii)

TA18(a).Do you want taungya the system to be restarted nationwide? (1) Yes (2) No

TA18(b).Why?

(i).....

(ii).....

TA19(a) Which tree species do you prefer to integrate with your food crops?

(a).....(b)..... (c)

TA19(b). Which of the tree species do you prefer most? TA20(a).At

what spacing would you have preferred to plant your most desired tree species?

TA20(b) Why do you prefer this spacing? (Please give reasons)

(i).....

(ii).....

TA21 Desired food crops to integrate with the desired tree species, and food crops that grow well; those that do not grow well upon canopy closure

Desired food crops	Desired tree species	Shade tolerant crop?	Shade intolerant crop?	No of years crop can reproduce under canopy

APPENDIX II (CONTINUED)

TA22(a). Were you given any compensation when ordered to quit from the taungya plantation upon canopy closure? (a)Yes (b) No TA22(b).

If yes, state the type of compensation.

(i).....

(ii).....

(iii).....

TA22(c) If no, could you give reasons?

(i).....

(ii).....

(iii).....

TA24 (a).Were you having food crops growing on the plot when ordered to move to the new area/land ? (a) Yes, (b) No

TA24 (b).If yes, list/name the food crops still growing on the plot when you were forcibly displaced. (i) (ii) (iii) (iv) (v)

TA25(a).Did you experience decline in crop yield during the cropping period?

(i) Yes (ii) No

TA25(b) If yes, what might have caused the decline in yield of those crops?

(i)(ii).....

(iii)..... (iv).....

TA26. List those food crops that declined in yield rapidly with time.

(i) (ii) (iii) (iv) (v)

TA27. List those food crops that maintained their yield with time or were still reproducing when you were asked to move to new land.

(i) (ii) (iii) (iv) (v) (vi) TA28 (a).

Were you still harvesting some food crops after being asked to move to new area?

(i) Yes, (ii) No

TA28 (b) If yes, what food crops were you harvesting? (i) plantain (ii) yam (iii) cocoyam (iv) cassava (v) maize (vi) others (specify).....

APPENDIX II (CONTINUED)

DATA ON LABOUR ASPECTS

DL1. What is the source of labour for you in the taungya system? (a) Owner

(b) Family (c) Hired (d) Reciprocal labour exchange (e) Piece rate/task payment

DL2. If family labour is used, what farm activities are reserved for:

Men	Women	Idren	
		Ch	
		Boys	Girls

DL3. For what operation do you have labour? (a) Initial clearings (b) Felling of trees
(c) Planting of crops (d) Weeding around crops/trees (e) Harvesting
(f) Other (Specify).....

DL4 Cost of labour per day or month (in Cedis) for the various operations in taungya system.

Years	Clearing	Felling of trees	Planting of crops	Weeding around crops/trees	Crop harvesting	Beating-up / Replacement	Singling/ Pruning	Others (specify)		
1940-1950										
1951-1960										
1961-1970										
1971-1980										
1981-1990										
1991-2000										
2001+										

APPENDIX II (CONTINUED)

DL5. What is the source of cash for cost of labour?

- (a) Income from previous year's farm activities
- (b) Sales of livestock
- (c) Loan from local money lenders
- (d) Loan from bank
- (e) Other (Specify).....

FARMER AWARENESS ON TAUNGYA SYSTEM

FA1. Were you given enough knowledge and skills associated with taungya system?

(i)Yes (ii) No

FA2 (a). Were you given details of the nature of taungya system? (1) Yes (2) No

FA2 (b). If yes, explain.

FA3 (a). Were you given reasons why certain food crops were not to be incorporated in the taungya system? (1) Yes (2) No FA3 (b). If yes, what were the reasons?

(i).....

(ii).....

FA4(a). Did the Forestry Department Officers explain fully the specifics of the then taungya agreement to you? (a) Yes (b) No

FA4(b).If yes, what were the specifics of the taungya agreement?

(i).....

(ii).....

FA5(a). Were all the specifics of the taungya agreement suitable to you? (a) Yes (b) No

FA5(b). If no, could you state the aspects of the taungya agreement that you felt were unsuitable? (i).....

(ii).....

FA6. What do you consider to be the better alternatives to those agreement that you felt unsuitable? (i).....

(ii).....

APPENDIX II (CONTINUED) DATA ON BIO-DIVERSITY

BD1. What other plant species (both woody and herbaceous) do you often encounter in taungya plantations? (Please List).

Plant Species	Plant Species	Plant Species	Plant Species

NB: Please mark M against plant species known to have some medicinal properties.

BD4. Which wildlife species do you often encounter in taungya plantations? (Please List).

Animal Species	Animal Species	Animal Species	Animal Species

SM1. DATA ON SAWMILL COMPANIES THAT EXPLOIT TAUNGYA PLANTATIONS

Name of Sawmill Company	Name of Taungya Plantation Forest	Volume of Teak exploited	No. of logs	Unit price per log or	No. of teak poles harvested	Unit price per teak	Year of exploitation

NOTE: Please, specify any other species apart from teak.

SM2. MARKET INFORMATION ON SAWN TEAK

Year	Export (vol./m)	Domestic Market (vol./m)

3 3

APPENDIX II (CONTINUED)

SM4(a) Has your Sawmill Company embarked on taungya plantations? (a) Yes)b) No
 SM4(b) If yes please fill the table below.

Year	Acreage/Hectare	Tree species	Total No. of workers	Gender		Categories of staff		Monthly salary(€)	
				No of male	No of female	No. of Unskilled workers	No. of Skilled workers	Minimum	Maximum

DATA ON TAUNGYA SYSTEM PROBLEMS/CONSTRAINTS

TSP1 What are the taungya problems due to farmers?

(i).....

(ii).....

TSP2 What are the taungya problems due to management?

(i).....

(ii).....

TSP3 What are the taungya problems due to politics?

(i).....

(ii).....

TSP4 What are the taungya problems due to culture/tradition of the people?

(i).....

(ii).....

TSP5 What are the taungya problems due to ownership?

(i).....

(ii).....

TSP6 What are the taungya problems/constraints due to labour ?

(i).....

APPENDIX II (CONTINUED)

TSP7 What are the silvicultural problems associated with taungya?

(i).....

(ii).....

TSP8 What are the social problems associated with taungya?

(i).....

(ii).....

TSP9 What are the economic problems associated with taungya?

(i).....

(ii).....

TSP10 What are the taungya problems due to land tenure?

(i).....

(ii).....

(iii).....

TSP11 What are other taungya problems? (Please specify)

(i).....

(ii).....

Information on taungya plantations at Sunyani Forest District.

Name of Taungya Plantation Forest	Year of exploitation	Volume of Teak exploited	No. of logs	Unit price per log/m ³	No. of teak poles harvested	Unit price per teak pole

What problems did you encounter?

- (1) Lack of finance (2) Lack of equipment/tools (3) Land tenure/acquisition
- (4) Bush fire (5) Lack of rain (6) Poor seedling quality
- (7) Insect attack (8) Lack of technical advice (9) Forced ejection
- (10) Other (Specify)

APPENDIX II (CONTINUED)

Sawmill Companies/Enterprises that have been given to exploit taungya plantations.

Name of Sawmill Company	Location	Name of Plantation Forest Exploited

Comments/Suggestions on improvements needed in taungya system

- (1).....
- (2).....
- (3).....

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APPENDIX III: LEVELS OF EDUCATION IDENTIFIED IN HOUSEHOLDS OF TAUNGYA FARMERS IN THE STUDY COMMUNITIES
NSUATRE HOUSEHOLD

Household Size	Elementary	JSS	SSS	Tertiary	No formal education
10	3(1)*	1	2	1	3
17	8(4)* 4 3	- 2	10	4 - 1 (2)*	3
16	12(6)*	(1)* 2	- 1	12	7(2)* (3)*
- (1)*	1 14	8(6)*	(1)* 3(1)*	- 2	
21	11(8)*	3	(2)*	(1)*	4
9	4	2	-	2	1
Total	109	57(27)*	15(5)*	13(3)*	7(4)*
Average	14	7(3)*	2(1<)*	2(1<)*	1(1<)*

ODUMASI HOUSEHOLDS

	Household Size	Elementary	JSS	SSS	Tertiary	No formal education
	5	1	0	2	0	2
	14	2	1	6(4)*	2(1)*	3
	6	0	3	2	0	1
	6	1	3	1	1	0
	7	2	2(1)*	1	0	2
	15	2	2	0	0	1
	5	0	2(2)*	2(1)*	1	0
	16	3(2)*	2	2	3(1)*	6
Total	74	11(2)*	15(3)*	16(5)*	7(2)*	15
Average	9	1(1<)*	2(1<)*	2(1<)*	1(1<)*	2

()* Still in school

APPENDIX III (CONTINUED)

TROMESO HOUSEHOLD

	Household Size	Elementary	JSS	SSS	Tertiary	No formal education
	10	6(4)*	0	2	0	2
	12	5(3)*	3	2	2(1)*	0
	5	0	2(1)*	0	0	3
	3	1	0	2	0	0
	7	2	1	3	1	0
	2	1	0	0	0	1
	5	1	3	0	0	1
	11	2	5(1)*	0	0	4
Total	55	18(7)*	14(2)*	9(4)*	3(1)*	11
Average	7	2(1<)*	2(1<)*	1(1<)*	1<(1<)*	1

BWOHOMODEN HOUSEHOLD

Household Size	Elementary	JSS	SSS	Tertiary	No formal education	APPENDIX III
						(CONTINUED)
9	1	2	2(1)	0	4	AMAAKROM HOUSEHOLD
11	0	3(1)*	3(2)*	0	5	
8	2	2	1	1	2	
15	4(1)*	5(3)*	4(3)*	(1)*	1	
9	2	3(2)*	1	0	3	
14	6(4)*	3	(2)*	0	3	
6	0	2(1)*	3	0	1	
9	1	1	1	2	4	
Total	81	16(5)*	21(17)*	17(8)*	4 (1)*	
Average	10	2(1<)*	3(1<)*	2(1<)*	1< (1<)*	3

()* Still in school

Household Size	Elementary	JSS	SSS	Tertiary	No formal education	
8	1	1	2(1)*	1	3	
11	0	3(1)*	3(2)*	0	5	
8	2(2)*	2	1	0	3	
15	0	5(3)*	4(3)*	(1)*	5	
1	0	3		9	2	
					3(2)*	
13	8(6)*	(1)*	1(1)*	-	3	
7	1	2(1)*	2	0	2	
16	4	1	3	2	6	
Total	87	18(8)*	19(5)*	17(3)*	4(1)*	30
Average	11	2(1)*	2(1<)*	2(1<)*	1< (1<)*	4

KYERAA HOUSEHOLD

Household Size	Elementary	JSS	SSS	Tertiary	No formal education	
5	2	0	0	2(1)*	1	
10	1	4(3)*	(1)*	2	2	
7	2	2(1)*	1	1	1	
10	3(1)*	2(1)*	2	1	2	
12	3(1)*	4(3)*	0	2(1)*	3	
4	1	(2)*	0	0	1	
9	1	3(1)*	1	1	3	
10	2(2)*	5(4)*	(1)*	1	1	
Total	67	15(4)*	22(15)*	6(2)*	10(2)*	14
Average	8	2	3(2)*	1<(1<)*	1(1<)*	2

()* Still in school

APPENDIX III (CONTINUED)

ATRONIE HOUSEHOLDS

Household Size	Elementary	JSS	SSS	Tertiary	No formal education	
6	1	(2)*	2	0	1	
10	1	3(1)*	1	1	4	
5	0	2	0	1(1)*	2	
12	2	4(2)*	1	1	4	
14	(3)*	4	3(2)*	2(1)*	2	
5	0	(2)*	0	0	3	
14	2	4(2)*	3(1)*	(1)*	4	
4	1	(2)*	0	0	1	
Total	70	10(3)*	23(11)*	10(3)*	6(3)*	21
Average	9	1(1<)*	3(1)*	1(1<)*	1<(1<)*	3

KWAMEMENSAKROM HOUSEHOLD

Household Size	Elementary	JSS	SSS	Tertiary	No formal education	
5	0	(2)*	0	0	3	
8	1	2	2	(1)*	2	
12	2	2(1)*	2(1)*	1	5	
6	1	1	(2)*	0	2	
9	2	(1)*	(2)*	(1)*	3	
8	1	2(1)*	1	0	4	
3	0	1	0	0	2	
6	1	(2)*	(1)*	0	2	
Total	57	8	13(6)*	10(6)*	3(2)*	23
Average	7	1	1(1<)*	1(1<)*	1<(1<)*	3

()* Still in school



APPENDIX IV CALENDAR OF ACTIVITIES FOR FOREST ESTABLISHMENT PLANTATION AND DEVELOPMENT
APPENDIX V

FORM OF AGREEMENT BETWEEN HEAD TAUNGYA FARMERS AND THE FORESTRY DEPARTMENT FOR

ACTIVITIES	MONTH								
	JAN	FEB	MAR	APRI	MAY	JUN	JUL	AUG	SEP
SEED COLLECTION	■	■	■	■	■				
SITE DEMARCATION/ SURVEYING/PILLARING/MAPPING	■	■	■						
SITE PREPARATION	■	■	■						
NURSERY OPERATIONS	■	■	■	■					
PEGGING			■	■	■				
PLANTING OUT				■	■				
TENDING/WEEDING							■	■	■
SINGLING/PRUNNING									■
SURVIVAL SURVEY							■	■	
BEATING UP									■
FIRE RIDE CONSTRUCTION									
FIRE RIDE PETROLS	■	■	■						
GREEN BELT ESTABLISHMENT				■	■	■	■	■	
ASSESSMENT									

TAUNGYA FARMING

I, the undersigned, the Head Taungya Farmer ofrepresenting the group taungya farmers of the said area, resolve to undertake farming

of.....Hectares in the Forest Reserve and agree to abide by the following rules:-

- (1) All clearing and burning will be done thoroughly by the farmers to the satisfaction of the Technical Officer and will be completed by the end of February.
- (2) Due care will be taken to prevent fire from spreading into surrounding forest or grass area.
- (3) Saplings, poles and medium sized valuable trees Mahogany, Cedars, Wawa, etc found on the plot not to be cut back or burnt.
- (4) Farmers will at least cut 400 pegs, 3' long, per hectare from the plot or its surrounding for pegging out the plots, by the end of February.
- (5) No Planting or sowing of food crops will be permitted until pegging has been done.
- (6) No permanent crops such as cocoa, Coffee, Sugar-cane, Cassava or pineapple will be permitted.
- (7) No plantain or cocoyams will be planted within 6 feet of a peg and no other crop within 3 feet of a peg. Any food crops interfering with a planted tree will be removed by the Forestry Department.
- (8) Farmers are permitted to cultivate the coupe for 3 years during which time they will keep the planted trees free of weeds and climbers. Harvesting of crops ripening after the expiry of this agreement will be permitted, but no further cultivation.
- (9) Farmers shall assist the Forestry Department during pegging and planting by conveying pegs and distributing planting stock. (10) Farmers shall also assist during beating up
- (11) Failure to comply with any of these rules, damage to the planted trees or obstruction to any employee of the Forestry Department in the execution of his duties will result in the withdrawal of the agreement and the forfeiture of the food crops. It will also be taken into consideration in the granting of coups in future years

.....
(Head Taungya Farmer)

.....
(Witness to Signature/Mark)

Dated atthisday of,19.....

APPENDIX VI GUIDE MAP SHOWING ROADS LEADING TO THE SELECTED FOREST FRINGE COMMUNITIES

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