ADOPTION OF AGROFORESTRY BY SMALL SCALE TEAK FARMERS IN GHANA - THE CASE OF NKORANZA DISTRICT

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ABSTRACT

The taungya system was introduced to the West African sub-region with the aim of addressing land hunger for forest fringe communities. In Ghana, teak (Tectona grandis) was adopted as the main tree species for the taungya system. However, there is a perception that teak degrades the land and excludes undergrowth vegetation. The aims of this study were to identify the extent of the adoption of agroforestry by farmers, despite the perception, and problems encountered by them. The study was carried out at Nkoranza, in the forest-savannah transitional zone of Ghana. All the teak farmers practiced some form of agroforestry. Majority of the farmers (74%) had only basic education. The natives of Nkoranza owned all the teak farms and ownership was mostly by the males. The spacing highly used was found to be 3.0 x 3.0 m, followed by 4.0 x 4.0 m and 2.0 x 2.0 m, with the percentages of farmers using the various spacing being 70, 26 and 4%, respectively. The trees were inter-planted with a mixture of food crops such as plantain, maize, yam, tomatoes, cassava and groundnuts. The reasons given for the intercropping were weed control, land suitability for crops, financial consideration, subsistence and soil fertility, with weed control being the most dominant reason. The problems enumerated by the farmers in a decreasing order were high maintenance cost, early canopy closure, dry weather, wildfires and insect pest. There was a report of decline in crop yield with stand development; and this can be attributed to early canopy closure, soil fertility decline and annual wildfires. However, the application of either inorganic fertilizer or organic manure, as well as the use of mounds ameliorated the decline in crop yield with stand development. To prolong cropping of the stands for food crops, wider spacing like 6.0 x 2.0 m and 4.0 x 4.0 m, and introduction of leguminous trees are recommended.

Keywords: Farmers' problems, food crops, intercropping, teak, taungya

INTRODUCTION

The forest cover of Ghana is depleting at a fast rate due to factors such as wildfires, land ownership systems, settlement development, shifting cultivation, illegal logging (*e.g.*, chainsaw activities), mining and livestock grazing. Since about 70% of the population engages in agriculture and the population is increasing at a faster rate, there is a sustained pressure on the release of increasingly more forestlands for agricultural purposes (Okali & Fasehun, 1997). This has led to serious land hunger. In an attempt to combat this situation, the *taungya* system, an agroforestry technology was introduced in the West African sub-region. This system is applied in places of high farming population where demand for farmland is high. The forestland is released to the farmers after it has been exploited of its economic timber species and canopy trees. Trees are then planted and as the farmers crop the land, they take care of the trees for three years after which the farmers are made to quit the land, leaving the trees. It is a way of having the forest

regenerated. As at 1985, about 400,000 hectares of land had been planted with trees through *taungya* in Nigeria (Ola-Adams, 1997).

Indiscipline and lack of effective supervision in Ghana partly led to a failure of the *taungya* system and large areas of natural forests laid waste with wild vegetation and/or food crops dominating. This led to the restriction of the system to a few areas by the Forest Services Division (FSD) of Ghana. A modified *taungya* system has come to replace the old *taungya* system. With the modified system, cultivation and harvesting of foods crops continue till such a time that the canopy closure of the growing trees makes it impossible for crop cultivation. The farmer continues to tend the trees to maturity after canopy closure (Forestry Commission (FC), 2005a). Two arrangements exist. In the first arrangement, the stakeholders, that is the FC, the farmer, the stool landowner and the forest fringe community are entitled provisionally to 40, 40, 15 and 5%, respectively, of the standing tree volume (STV) when harvested. The FC is to provide financial, management and technical inputs, the farmer is to provide labour for the establishment and maintenance of the plantation, the landowner is to guarantee access to the land and security of tenure for all parties concerned, while the forest fringe community is to assist in wildfire prevention as well as to prevent illegal activities within the forest estate (FC 2005b). The second arrangement concerns commercial plantation by private investors. The private investor, the landowner, the FC and the local community are entitled to 90%, 6%, 2% and 2% of standing tree volume of thinning and final harvest of tree crops, respectively. In lieu of 6% of the standing tree volume being paid to the landowner, an annual rent of US $ 2.00 per hectare as well as 2% of STV and final tree crops is paid by the investor to the landowner. The investor is to provide financial, management and technical inputs, while FC is to seek security of tenure of all parties concerned. The role of landowner and the local community is the same as that of the first arrangement (FC, 2005c).

The mandate of the Ghana government is to curb the high rate of deforestation by establishing 200,000 hectares of forest plantations of fast growing indigenous and exotic species over a 10-year period (Ministry of Lands and Forestry, 1996). Hence, there is a current drive of private plantation development on off-reserve areas where significant portions of forest cover is lost. *Tectona grandis* (teak) and *Cedrela odorata* (*Cedrela*) are among the fast growing exotic species selected for plantation development. The indigenous species are *Naulea dederrichi, Terminalia superba, Terminalia ivorensis, Ceiba pentandra* and *Triplochiton scleroxylon*. But the farmers have a higher preference for teak than *Cedrela*, because teak, which was used extensively in Ghana as electricity and telephone transmission poles, is now being utilised for lumber production. It is also among the heavily used timber species of high quality on the world market (Timber Export Development Board, 1995) and is being exported in large quantities. However, there is a perception that teak degrades the land and excludes under storey vegetation.

For a high quality timber production, teak is commonly planted at close spacing ranging between 1.8 x 1.8 m and 3 x 3 m. All these spacing lead to early canopy closure, thus suppressing growth of under storey vegetation. Since trees have long gestation period, there is the likelihood that not many farmers will take to tree planting. Therefore, there is the need to develop systems that will permit the harvesting of some intermediary products while maintaining the planted trees. Investigation should be conducted into how well the planting of teak has gone down with the farmers, how best teak could be grown to produce high quality wood and still allow them to co-exist with other plants to enhance biodiversity. Again, because of scarcity of land, it is important to know the extent of the adoption of agroforestry systems by farmers and the best spacing to enhance prolonged cropping of the same

piece of land for as long as practicable. The objectives of this study are therefore to identify the extent of the adoption of agroforestry and the problems encountered by the farmers.

MATERIALS AND METHODS

Study Area

The survey of teak growers was carried out in the Nkoranza District in the Brong Ahafo Region of Ghana, which is located on 7° 45'N and 1° 45'W. The District falls within the forest-savannah transitional zone of the country. Mean annual rainfall ranges between 1000 mm and 1500 mm. The major rainy season starts from the middle of April to the end of June, while the minor rainy season starts from August through to October. There are several small scale teak farmers in this District.

Survey of Teak Growers

One hundred farmers were randomly selected out of about 190 teak growers from five towns in the Nkoranza District. The towns were Brahoho (28 respondents), Bredi (8 respondents), Nkwabeng (32 respondents), Pinihini (22 respondents) and Sikaa (10 respondents). The unequal number of respondents is due to the size of the towns and number of teak growers in each town. The selected farmers were interviewed individually using a structured questionnaire. The questionnaire captured information on demographic characteristics, mode of land acquisition, type of food crops planted in the teak stand, agronomic practices, crop yield and problems encountered by the farmer.

Analysis of Results

The data acquired were grouped into demographic characteristics, mode of land acquisition, type of food crops planted in the teak stand, agronomic practices, crop yield and problems encountered by the farmer. The data were then analysed using descriptive and graphical methods.

RESULTS AND DISCUSSION

Survey of Teak Growers at Nkoranza District Ownership

Of all the teak farmers interviewed the youngest was 35 years of age whilst the oldest was 65 years, with the mean age being 48 years (± 1.97 SE). The percentage of teak farms owned by women and men were 8% and 92%, respectively (Figure 1). The results indicated that a far greater percentage of men go into teak farming than women. This may be due to the fact that in most cases it is a joint venture between married couples but since it is accepted that the man is the head of the family, the man tends to claim ownership rights over the planted trees. Besides, in many parts of Africa, land ownership is mostly vested in men. Hence, women can plant their desirable crops on a parcel of land only when it is given to them as gift (Chavangi & Raintree, 1987). This might have resulted in the great imbalance in the gender ownership. However, in Kenya, some sectors of the rural development community have recognized the need to improve women's access to and control of productive resources (land, water, capital, and information) to enable them to increase and/or stabilize production on their own behalf. Where women already have access to such resources, development efforts are required to help safeguard their customary rights rather than erode them through external intervention (Rocheleau & Raintree, 1987).

All the individual teak farmers were natives who owned the land, which was acquired either from parents or family. This indicates that indigenous people are more likely to go into tree plantation projects than non-indigenous people because of security of tenure. Customarily, planting of trees on any parcel of land implies ownership, thus debarring settler/migrant farmers from undertaking such a venture. Land privatization in Mbeere, Kenya, has been a key factor in tree planting (Brokensha, 1987). In parts of Western Nigeria, the rights over hired land do not necessarily include the right to plant trees (Francis, 1987). In a

study conducted in Sri Lanka on tenure and land use, Steel *et al.*, (1998) recorded that with vegetables and homesteads there seemed to be no problem with tenure. However, with tree crops, it was privately owned lands that were mostly covered. It was therefore inferred in the study that private farmers are more likely to grow trees than tenant farmers. Malla *et al.*, (1988) suggested that private tree planting could reduce pressures on the common forest resource but its benefits to the poor in the society are likely to be limited and therefore advocated for equity; but this should ~~not~~ be seen as a supplement rather than an alternative to planting on common lands.

Educational Background

None of the farmers had any tertiary educational background. Only 8% had secondary education whereas those with no formal education were 18%. However, those with primary education (74%) far outnumbered all the others (Figure 2). For many years farming has been restricted to illiterates and semi-literates in the West Africa sub-region. Interest in farming shown by literates in general is quite recent. It is therefore not very surprising to note that none of the farmers had had tertiary education and even those with secondary education were the least (8%). It is believed that this trend may change in the near future since many people with formal education are increasingly showing interest in farming in Ghana.

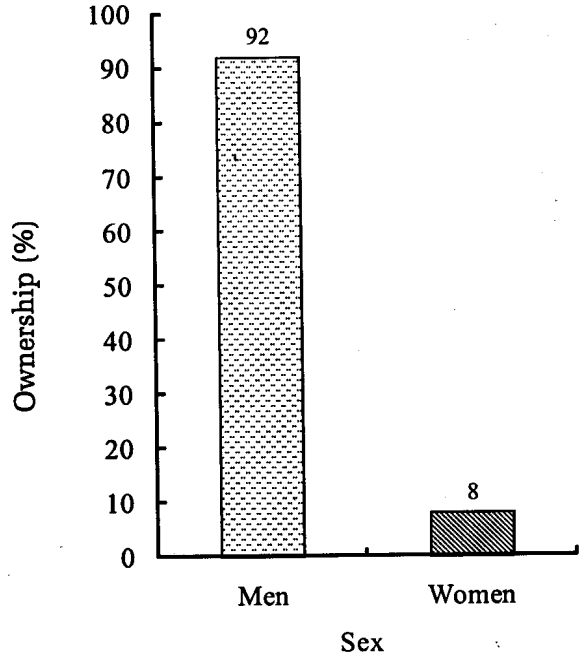

Figure 1. Ownership of small cale teak farms by gender in the Nkroanza District, Ghana

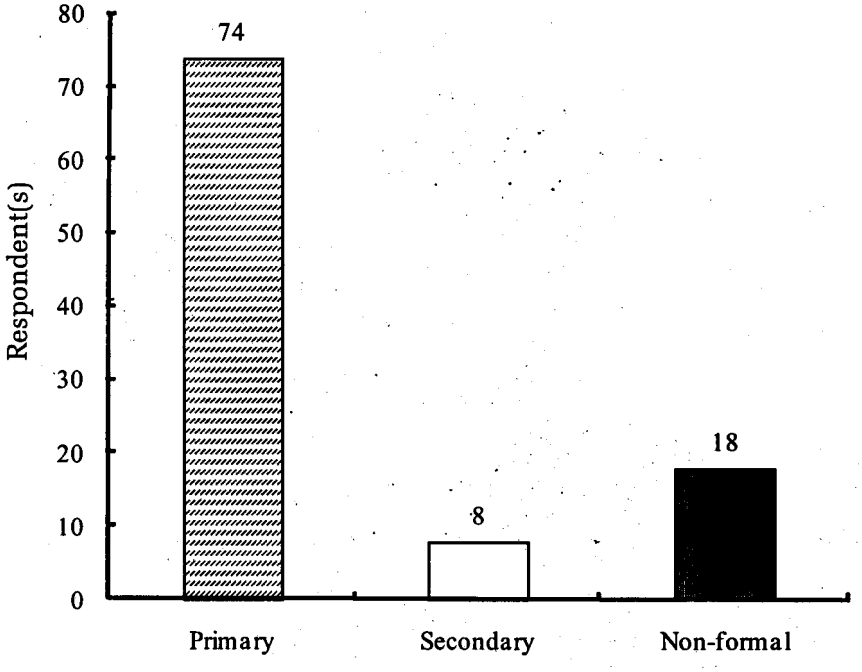

Figure 2: Education background of small scale teak farmers in the Nkoranza District, Ghana

Agronomic Practices

Spacing

The age of the plantations ranged from three years to 16 years with the size ranging between 0.4 ha and 3.6 ha. Figure 3 shows that 70% of the farmers planted the teak trees at a spacing of 3.0 x 3.0 m while 26% and 4% of the farmers planted at a spacing of 4.0 x 4.0 m and 2.0 x 2.0 m, respectively. Initial spacing of teak stands varies considerably from place to place. A spacing of 1.8 x 1.8 m is adequate for drier areas. Wider spacing is adopted for a variety of reasons. On good sites with rainfall above 1500 mm per annum, a spacing of 2.5 x 2.5 m or 2.7 x 2.7 m produces rapid growth rate and faster canopy establishment (Tewari, 1992). In Kerala State of India the traditional spacing of 2.0 x 2.0 m is prescribed. As teak plants are susceptible to weed infestation, especially the grasses, weed control becomes a very important management activity, particularly during the initial two to three years of establishment (Tewari, 1992).

Intercropping

No pure stand of teak (i.e. without food crops) was encountered. All the farmers were practising agroforestry. According to the farmers, this is a means of maximising land utilization for economic benefits. The economic results of intercropping coffee with pineapples and bananas at a farm in Butuan Agusan del Sur (Phillipines) and the benefits of intercropping coffee with *Acacia* species, bananas and black pepper (*Piper nigrum)* were found to be beneficial (Pava, 1993). Lalramnghinglova & Jha (1996) reported a very successful practice of intercropping *Oryza sativa* (paddy) with *Tectona grandis* (teak). Tree growth and crop yield from this system were economically and ecologically sound. Rachadi (1981) described the silvicultural and socio-economic advantages of intercropping food crops with teak in Indonesia and advocated for intensification of its use.

Majority of the farmers (82%) followed the normal cropping practises of indigenous farming by planting as many as two or more different types of crop on the same piece of land. However, a few of them planted single crops under their teak stands. The proportion of farmers who planted single and multiple crops under their teak stands were 18, 52 and 30% for one crop, two crops and three or more crop types, respectively (Figure 4). Types of food crops planted included plantain, yam, maize, cassava, groundnuts, cowpea and tomatoes.

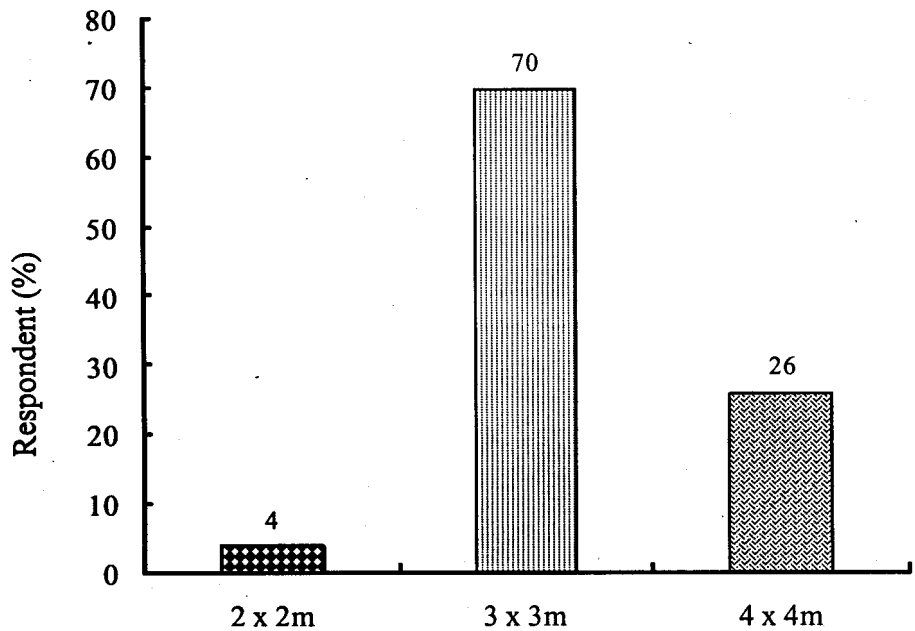

Figure 3: Percentage of farmers using different spacings in their Teak plantations

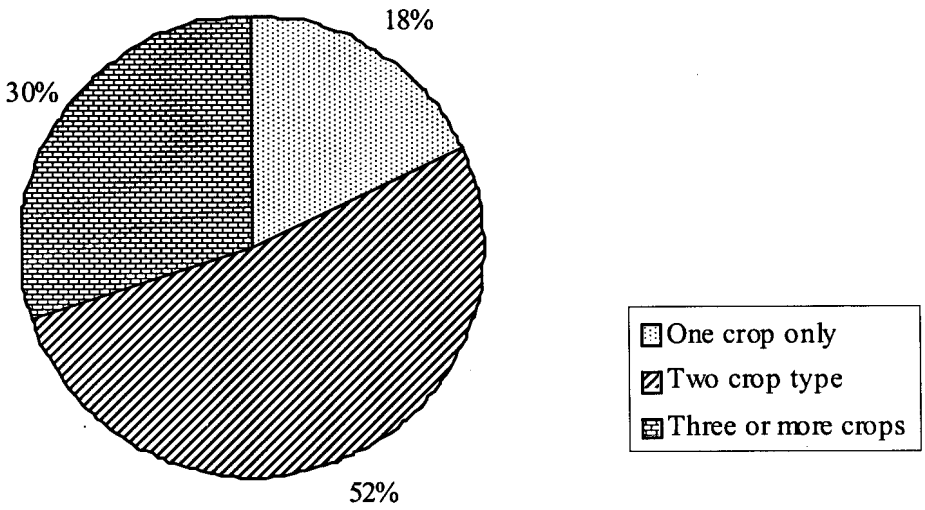

Figure 4: Farmers using different crop combinations in their teak farms in the Nkoranza District, Ghana

Reasons for Intercropping

Some farmers intercropped teak with food crops for either a single or a combination of reasons. The reasons given by farmers for intercropping were land suitability, weed control, financial consideration, subsistence and soil fertility (Table 1). Weed control alone, and in combination with the other reasons, is the most prevalent reason assigned for intercropping teaks stands with food crops.

Arifin (1983) indicated that intercropping of teak trees with food crops in a *taungya* system in Indonesia with spacing 3.0 x 1.0 m delayed weed

growth. It is strongly believed that majority of the farmers, planted the crops in order to derive some short-term benefits from land until there is total canopy closure. Gordon & Williams (1988) reported that black walnut (*Juglans nigra*) grown for veneer logs and intercropped with maize would increase the value of a 16 hectare farm by US$800,000. The economic results of intercropping coffee with pineapples and bananas at a farm in Butuan Agusan del Sur and the benefits of intercropping coffee with *Acacia* species, bananas and black pepper (*Piper nigrum*) were found to be beneficial (Pava, 1993). Hu and Wang (1990) indicated that the income per 0.067 ha during intercropping of edible fungi with mulberry in Jiangyin, increased by 52.1%, compared with monoculture of mulberry.

Soil Improvement Strategies

The farmers interviewed adopted various soil improvement strategies. Whereas 60% of farmers were not applying any fertilizer, 30% had been applying inorganic fertilizers like NPK and NH_4. Out of this group 8% reported a constant crop yield (Figure 4).

The farmers who had been applying organic fertilizer like cow dung formed 6% of the respondents and all reported improvements in crop yield.

Four percent of the farmers who applied fertilizer as well as forming mounds; reported improvements in crop yield. This can be attributed to the fact that the formation of the mounds, which generally involves the heaping of topsoil, might have concentrated nutrients in the soil and enhanced soil aeration leading to improvement in crop yield.

Problems Encountered by Farmers

The farmers complained of combinations of problems. Greater percentage of the farmers (24%) complained of high cost of maintenance and early canopy closure leading to decline in food crop yield (Table 3). The high maintenance cost is alleviated through the economic returns from the food crops inter-planted in the teak stands.

Table 1: Reasons for intercropping Teak with food crops

Reason/Combination of Reasons	Respondents (%)
Land suitability for crops	32
Weed control + financial consideration	28
Subsistence + weed control + financial consideration	20
Weed control	10
Land suitability for crops + weed control	8
Soil fertility	2
Total	100

The high maintenance cost is alleviated through the economic returns from the food crops inter-planted in the teak stands. Some of the maintenance cost is the normal cost associated with cultivation of food crops. Canopy closure leads to low light penetration to the forest floor hence, the decline in crop yield. Planting teak at close spacing ranging between 1.8 x 1.8 m and 3 x 3 m may definitely lead to early canopy closure. Low crop yield due to canopy closure can be attributed to the fact that most of the crops are light demanders. They may need enough light to complete both their vegetative and reproductive life cycles. Bells (1973) reported that early canopy closure leads to suppression of growth of under storey vegetation.

The Nkoranza District falls within the forest-savannah transition zone, which experiences erratic rainfall. The relatively long spell of dry season, coupled with the fact that Teak leaves decompose slowly, lead to a heavy pile of dried leaves on the forest floor. Consequently, in times of fire outbreak, which occurs annually, the dried teak leaves serve as fuel for wildfire (Bells, 1973). The dry weather, with its annual wildfire was therefore of concern to seven out of the nine groups of farmers, who also complained of decline in crop yield. After a fire outbreak, the soil surface becomes exposed to the sun and rain. This results in erosion and loss of nutrients leading to soil degradation during the rainy season.

Insect pest attack was not a major problem to the farmers (4%). Over 180 species of insects are reported to be associated with teak (Mathur, 1960; Mathur & Singh, 1960); however most of them are minor pests. Those that cause serious damage are white grubs in nurseries, sapling borer in young plantations, trunk borer in older plantations and defoliators (Sen & Thapa, 1981; Day *et al.*, 1994). In nurseries, white grubs (*Holotichia* spp.) eat the roots of the seedlings causing wilting and subsequent death (Oka & Vaishampayan, 1981). The sapling borer, *Sahyadrassus malabaricus*, is a problem in young plantations with dense weed growth (Nair, 1987). In young plantations in Kerala, India, the defoliator, *Hyblaea puera,* causes repeated serious defoliation in early part of the growing season resulting in loss of 44% of potential volume increment (Nair, 1988). The skeletonizer, *Eutectona machaeralis,* on the other hand, causes defoliation later in the season and has no significant impact (Nair *et al.*, 1996). The bee bole borer, *Xyleutes ceramica*, is a serious pest in Myanmar and Thailand (Beeson, 1941). It riddles the tree trunk with borer boles severely degrading the quality of wood (Chalerempongse *et al.*, 1990; Hutacharern, 1990). *Cossus cadambae* causes similar problems in the southern states of India, but the incidence is limited to pockets where the trees are subjected to repeated lopping (Beeson, 1941). However, Adu-Bredu *et al.* (2008) noted that despite isolated cases of teak tree dieback and stem borers, teak in West Africa has not been attacked by insects and diseases that are prevalent in its native land of South Asia.

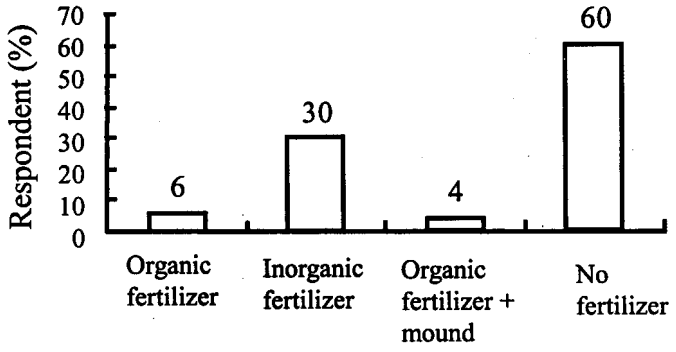

Figure 5: Soil improvement strategies adopted by small scale teak farmers in Nkoranza District, Ghana

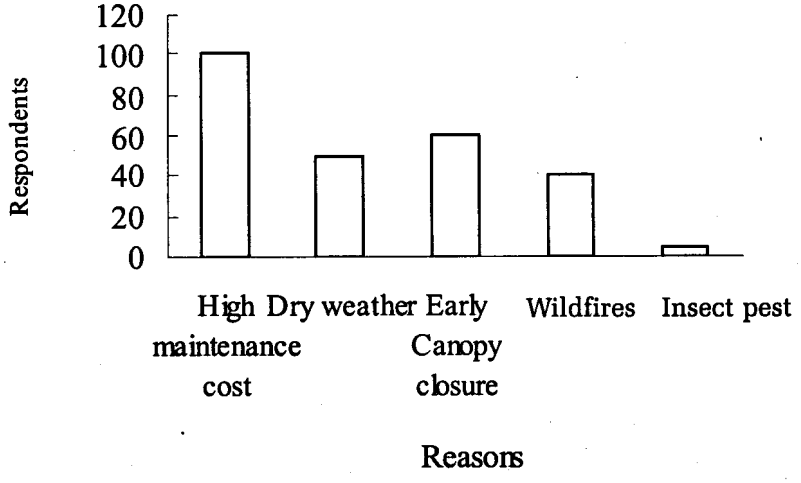

Figure 6: Problems encountered by small scale teak farmers in Nkoranza District, Ghana

CONCLUSIONS AND RECOMMENDATIONS

The study showed that, at Nkoranza older people engaged in teak farming. The Forest Plantation Board's provision of varying sums of money as start up capital should stimulate the youth into plantation establishment. Identifiable youth groups could acquire some degraded compartments of forest reserves under the on-going National Plantation Development Programme so as to create wealth for themselves in future.

All the farmers practice agroforestry. Problems encountered by the farmers included high maintenance cost, early canopy closure leading to decline in crop yield, dry weather and periodic wildfire occurrence. Due to early canopy closure, it would be advisable to plant at 6 x 2 m spacing if one would want to enjoy good food crop yields from the plot for quite a longer period. In a study conducted by Djagbletey (2002), planting of food crop (i.e. pepper and maize) under teak trees at spacing 6 x 2 m gave higher yield than 3 x 3m. However, weed infestation would be greater at this spacing necessitating more frequent weed control. Fire trails or breaks should be created around farm boundaries and should be cleared of all forms of debris to keep the frequency of wildfire menace in the area in check.

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