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Problems in afforestation of rural areas of Northern Ghana–community viewpoint

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The rate of disappearance of tropical forests is alarming with West Africa being the hardest hit by this trend. A survey was conducted in Yunyoranyiri and two surrounding communities to assess the perception of farmers on tree planting in the area. The objectives of the study were (1) Assess the perception of some communities in the East Mamprusi district on tree planting and (2) Compare the growth performance of *Azadirachta indica* (Neem) and *Senna siamea* (Cassia) in a pilot community plantation in Yunyoranyiri. The plantation was stratified based on plant species (Neem and Cassia). It was then divided into two stands based on year of planting. Twenty permanent sampling plots (105 m^2) were established systematically at 15 m apart. The height and diameter at breast height (DBH) of all trees situated within these plots were measured. A questionnaire was administered to the farmers in the community and two nearby communities which revealed that trees on their farms had reduced in number over time. It also revealed that they mostly depended on tree products for fuel, food and building materials. The farmers also expressed a desire to plant trees but cited challenges such as absence of seedlings and care of the trees as impeding their efforts. The diameter distribution showed that *Senna siamea* had higher diameters with no significant difference between the stands while *A. indica* had lower diameters with significant difference between the stands. Height distributions yielded similar results with *Senna siamea* out performing *A. indica.* It was recommended that organizations and the government focus on enabling these communities in the planting of trees by providing them with planting materials and training.

Key words: Tree cover, arid areas, plantations, Yinyoranyiri community.

INTRODUCTION

The savanna of Africa covers 54% of the continent and supports some 64% of its population (CIFOR, 2011). However, these forests are seriously under threat, mostly by anthropogenic factors (Poorter et al., 2004) and changing climate (Unmüßig and Cramer, 2008). The Northern part of Ghana is characterised by a savanna vegetation type which is dominated by grasses with varying admixtures of herbs, shrubs and trees. Generally in the savanna ecotype there is limited tree cover. The over dependence on trees as a source of energy in the form of firewood is therefore a major cause of vegetation lost. Current trends indicate that the 3% rate of vegetation lost in Ghana (IUCN, 2006) is by far greater than the rate of afforestation where it exist. Tree cover

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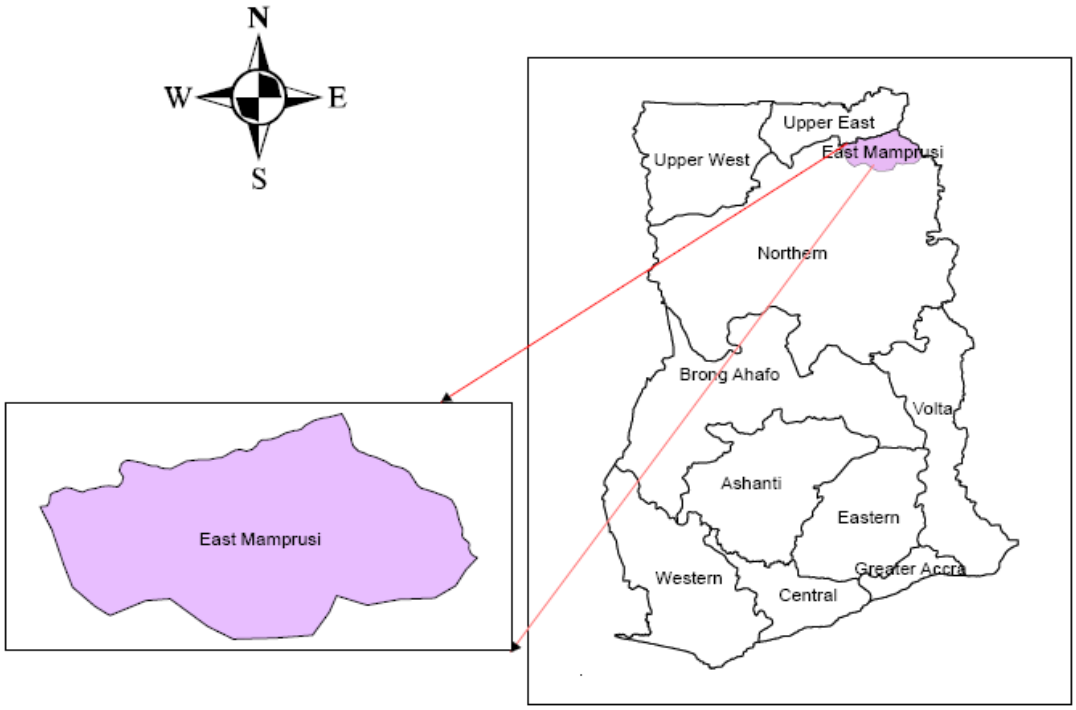

Figure 1. Map of Ghana indicating study area.

loss is affecting the livelihood and environment of particularly the rural poor in various ways such as shortages of firewood and non-timber forest products and accelerated soil erosion (Stoorvogel and Smaling, 1990) which eventually affects agricultural productivity (Abeney and Owusu, 1999). There is therefore an urgent need to reverse this trend which is not only unsustainable but is of grave concern towards ensuring ecological security in view of recent climate change events. There are many alternative methods of reclaiming environment (Deji, 2007) and afforestation has been identified as an appropriate technique to rejuvenate degraded lands. Increasing tree cover particularly in degraded areas with the active involvement of local people (Blay et al., 2008) is therefore key in this crusade.

There is increasing popularity of local community-based afforestation as an innovative response to meeting the conflicting goals of livelihood improvement and sustainable forest management (Castre´n, 2005). The general aim of community forestry is to maintain healthy forests while providing the livelihood of local community. However, it may have multiple objectives such as forest protection, household use, or commercial production. These multiple objectives includes establishment of plantations (Siaw, 2001; Yirdaw, 2002), use of sustainable farming systems which incorporate growing of trees (Appiah, 2001; Appiah, 2003) with the active involvement of local folks.

Forest inventory and diversity assessments are essential to understand the tree population structure and diversity status of forests and to provide information for biodiversity recovery planning (Tilman, 1988; Appiah, 2013). The most important reason for measuring tree diameter and height is to estimate the quantity of timber, firewood or other forest products. Understanding post germination survival and growth rate of planted species would help resource managers to make more informed decision about their inclusion or otherwise in afforestation programs.

Studies in Ghana on community involvement in afforestation and forest management have been centered in the forest zones (Appiah, 2003; Blay et al., 2008; Appiah et al., 2009). This study aims to investigate the role local people in Northern Ghana could play in increasing tree cover on degraded lands which would help rejuvenate the soil as well as provide basic wood needs for rural people while contributing to the global carbon balance. The specific objectives of the study were: (1) Assess the perception of communities in the East Mamprusi district on tree planting, and (2) Compare the growth performance of Neem and Cassia on a pilot community plantation in Yinyoranyiri.

Study area

Yinyoranyiri is a small farming community near Nalerigu in the East Maprusi District of the Northern Region (Figure 1). The district lies in the interior woodland savanna belt and its common grass vegetation with trees

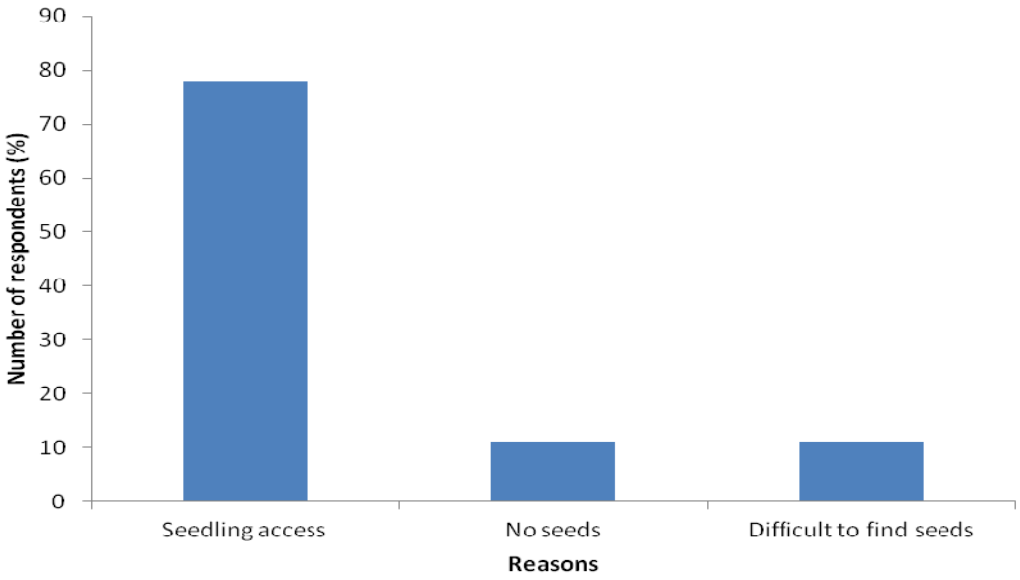

Figure 2. Reasons for not planting trees.

such as baobab, acacia and sheanut trees. Grasses grow in tussocks and can reach heights of 3 m or more. The vegetation changes markedly, depending on which of the two prevailing climatic conditions (raining or dry season) is dominant at the time (EMDA, 2006). The Yinyoranyiri plantation was established in 2008 by the community with the help of GIZ. Community involvement has been and still is the key to the success of this project. The Yinyoranyiri community (from the chief to the people) has been very interested in planting trees and therefore provided land and labour for the project. It is understood that the resulting forest is community owned with GIZ playing an advisory role of educating the community on sustainable management of the forest.

METHODS USED

The plantation was established within two years with Neem (*Azadirachta indica*) and Cassia (*Senna siamea*). The species were selected based on the availability of seedlings, fast growth, soil nutrient requirement of species, evergreen nature and their adaptability to the local environment. Three rows of Cassia planted at 3 m × 3 m distance alternate with 3 rows of Neem planted at the same distance. Two rows of vertebrae grass were closely planted across the hill of the entire area to check erosion and conserve water for the propagation of the planted trees.

A total of 20 permanent sampling plots were established with dimensions of 15 × 7 m. Ten plots each for the 2008 and 2009 planted areas. Within each planted year group, five plots were located in Cassia planted areas and the other five in Neem planted areas. The first plot was located at random, and the subsequent ones were located at regular intervals of 15 m from each other. The tree heights of all trees in the sampled areas were measured using the Haga hypsometer. The diameter at breast height of all trees was also measured using the diameter tape at 1.3 m.

A total of fifty six questionnaires were administered to people in 56 households in Yinyonranyiri and two surrounding villages Zambiligu and Zogiligu to assess the perception of local people of tree planting. Information solicited included; (1) common uses of trees; (2) how far away from the community they have to travel to obtain tree resources in the past and present; (3) the reasons for planting trees and the problems faced in tree planting. Questionnaires responses most relevant to the objectives of this paper are presented.

Data analysis

Questionnaire responses most relevant to the objectives are presented. Descriptive statistics were used to analyse the data presenting results with graphs.

Data on tree height and diameter was subjected to Analysis of Variance (ANOVA) and differences among the parameters were determined with Duncan Multiple Range Test, using SAS 9.0 Statistical Package. *P*-values ≤ 0.05 was considered statistically significant. Comparison was made of height and diameters of trees in the two different planting years.

RESULTS

Seventy three percent (73%) of the respondents had previously planted trees with most of them planting trees for food (19), some planted trees for building materials e.g. rafters and poles (5), and some of them for firewood (5) and medicine (4).

Of the twenty seven percent (27%) of the people who had not planted trees before, the main reason they gave was due to their inavailability to get seedlings. Figure 2 illustrates the various reasons for the farmers not planting trees.

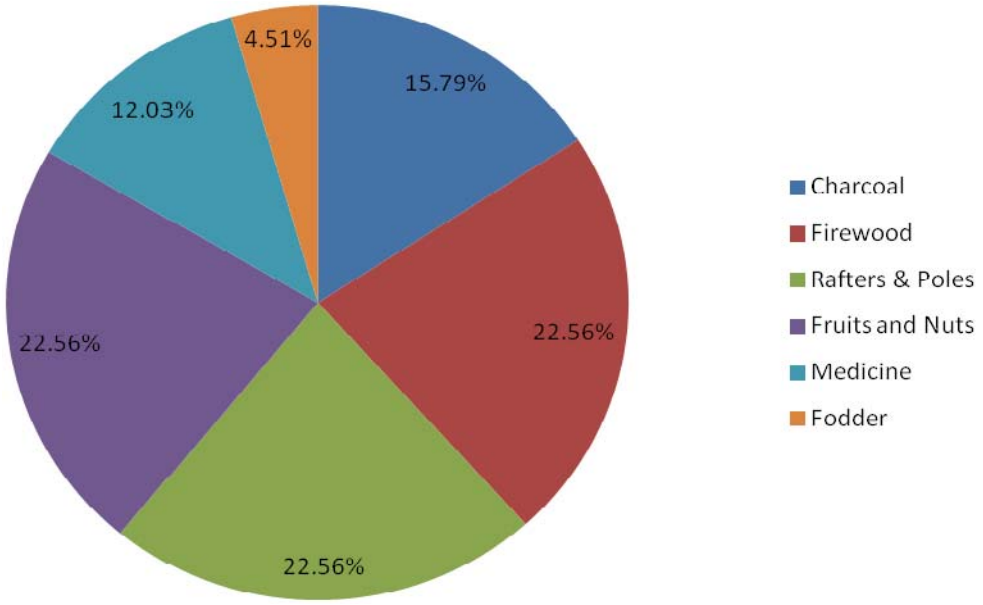

Figure 3. Household uses of trees.

Perception of farmers on tree planting

Tree population on farm lands

According to the respondents with a mean farming duration of 22 years, the population of trees on the farms was reducing from the initial number that was on the land when the farmers started farming activities. This was because the few trees on the farms and around are the only source of wood for the people. Ninety three percent of respondents alluded to the fact that tree populations had decreased over the years while seven percent thought otherwise.

Utilization of tree products

The results also indicated that, the most common uses of trees were for fruits and nuts (22.6%), firewood (22.6%), rafters and poles (22.6%). However, the farmers had to travel an average distance of 4.3 miles in order to fetch wood for fuel. Figure 3 illustrates the common tree products used by the farmers.

Farmers desire to plant trees

Almost all the farmers expressed the desire to plant trees. The most prevailing reason for wanting to plant trees was for food, followed by fruits and nuts. Only one respondent expressed the lack of desire to plant trees. Figure 4 shows the farmers' various reasons for wanting to plant trees.

Problems faced in tree planting

Respondents indicated that, protection of the trees after planting was a huge problem they faced. The labour requirements of land preparation and maintenance of the trees were other problems they faced, especially fulfilling the energy requirements (food) of labour. Seedling care (11) was a difficult task they also faced; especially making sure the tree was properly established and safe from predators. Getting the seedlings (5) to plant was another problem for the farmers. Figure 5 shows the various problems faced by farmers in tree planting.

Plantation species growth

Diameter (DBH) distribution

Cassia in the 2008 stand had 18.18% of the trees in the 2 to 3.9 cm DBH class, 60.61% within the 4 to 5.9 cm class, 16.67% in the 6 to 7.9 cm class and 4.54% of the trees in the 8 to 9.9 cm class. The stand had a mean DBH of 5.1 cm. The bulk of the population fell within the 4 to 5.9 cm class. It had equal number of trees in the 2 to 3.9 and 6 to 7.9 cm classes. The remaining population fell within the 8 to 9.9 cm class. Cassia in the 2009 stand had 1.49% of the trees in the 0 to 1.9 cm class, 19.40% in the 2 to 3.9 cm DBH class, 58.21% fell within the 4 to 5.9 cm class and 20.9% of the trees in the 6 to 7.9 cm class. The bulk of the stand population fell within the 4 to 5.9 cm class with very few falling within the 0 to 1.9 cm class.

Neem in the 2008 stand had 9.84% of the trees in the 0

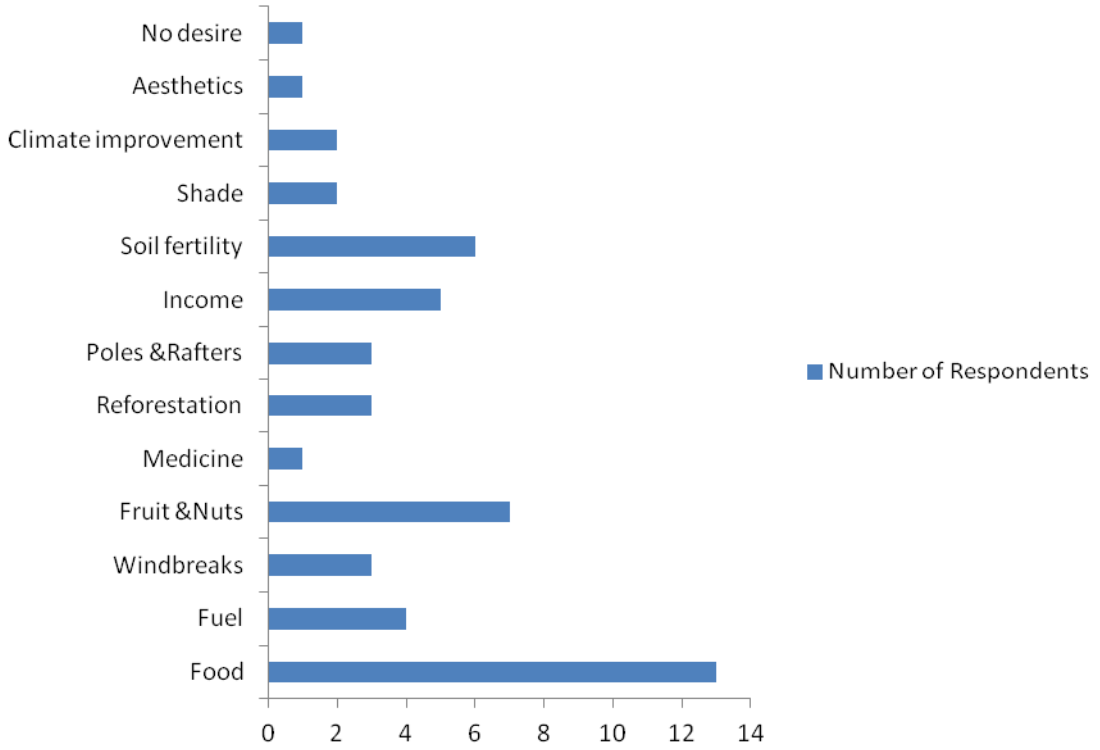

Figure 4. Farmers' reasons for wanting to plant trees.

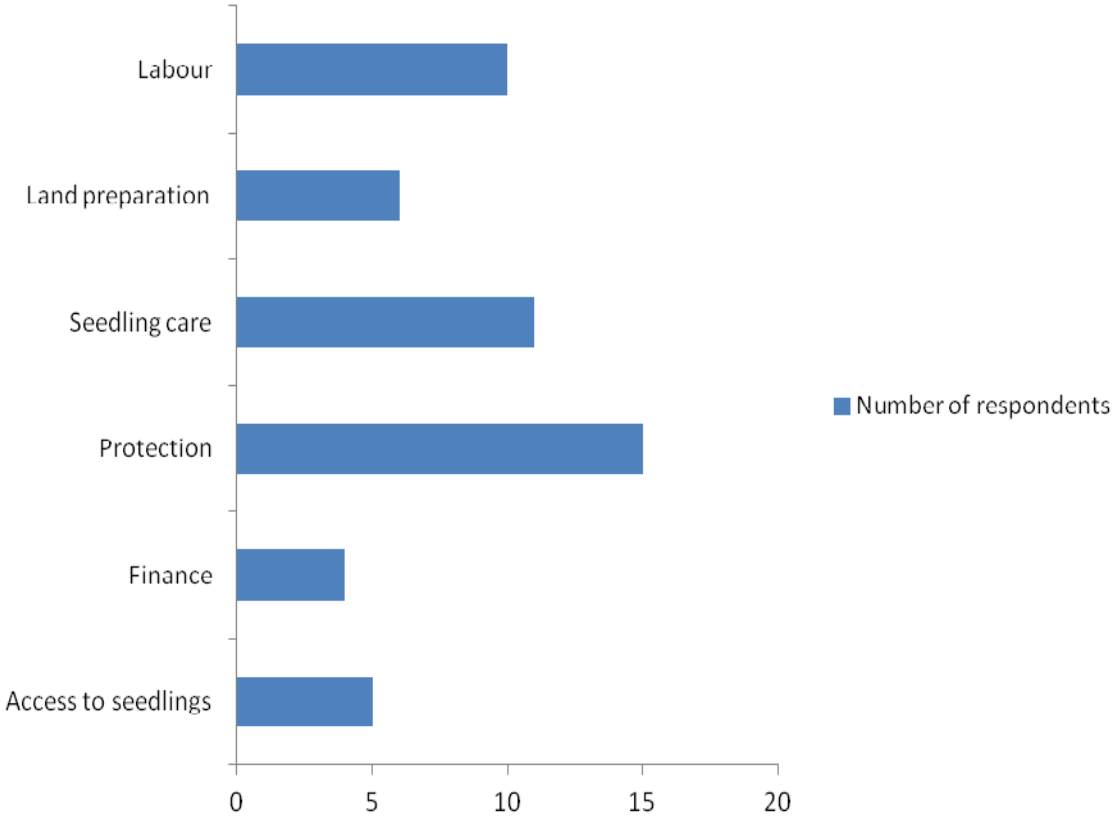

Figure 5. Problems faced in planting trees.

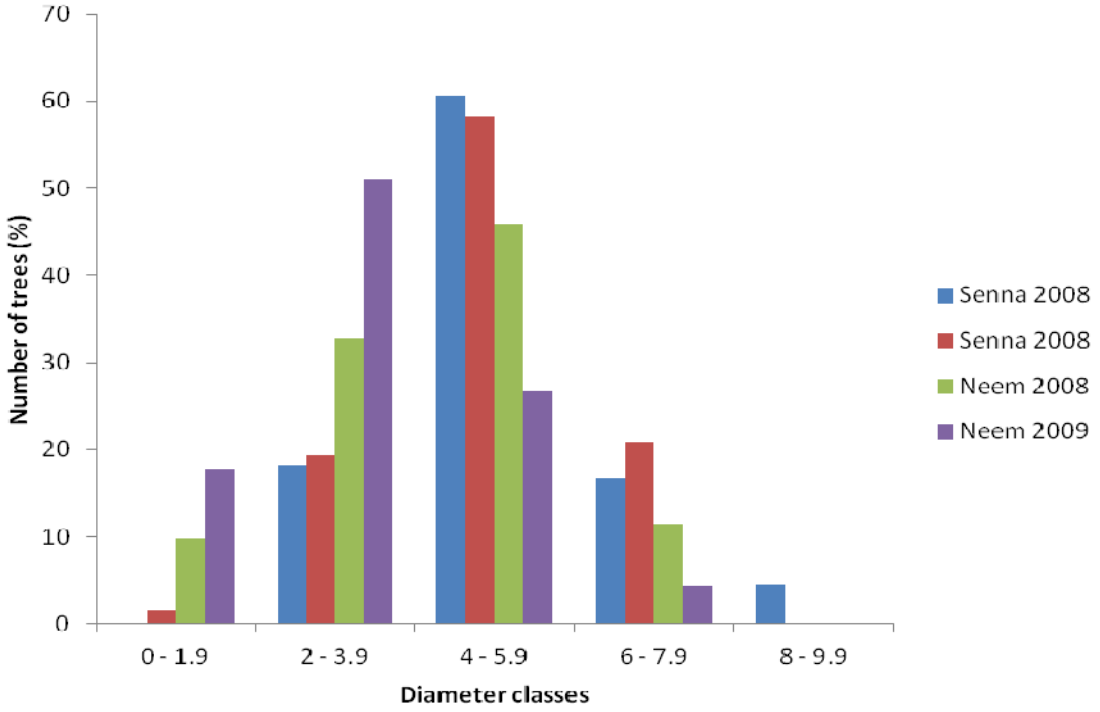

Figure 6. DBH distributions of each species in the two age groups.

Table 1. ANOVA of height and diameter of *Azadirachta indica* in the two planting years (2008/2009).

ANOVA for height of *A. indica* in the two planting years					
Source of variation	d.f	s.s	m.s	v.r	F.pr.
Treatment	1	6.1974	6.1974	7.54	0.007
Residual	104	85.5198	0.8223		
Total	105	91.7172			
ANOVA for diameter of *A. indica* in the two planting years					
Source of variation	d.f	s.s	m.s	v.r	F.pr.
Treatment	1	17.498	17.498	7.02	0.009
Residual	104	259.396	2.494		
Total	105	276.894			

to 1.9 cm class, 32.79% in the 2 to 3.9 cm DBH class, 45.9% within the 4 to 5.9 cm class and 11.47% of the trees in the 6 to 7.9 cm class. The mean DBH of the stand was 4.06 cm. The distribution of trees fell within the lower DBH classes of between 0 to 5.9 cm with majority of the trees falling in the 4 to 5.9 cm class. Neem in the 2009 stand had 17.78% of the trees in the 0 to 1.9 cm class, 51.11% in the 2 to 3.9 cm DBH class, 26.67% within the 4 to 5.9 cm class and 4.44% of the trees in the 6 to 7.9 cm class. The stand exhibited the least mean DBH of 3.24 cm. Most of the trees fell within the 2 to 3.9 cm class. Figure 6 shows the diameter distributions in the two plantation year stands.

There was no significant difference between the diameters of the Cassia trees in both the 2008 and 2009 stands. Neem however, showed significant difference in the diameters of the 2008 and 2009 stands (Table 1). The 2008 stand showed a higher mean than the 2009 stand.

Height distribution

The Cassia in 2008 stand had 13.64% of the trees in the 3 to 4.9 m height class, 54.55% within the 5 to 6.9 m class, and 30.30% of the trees in the 7 to 8.9 m class and

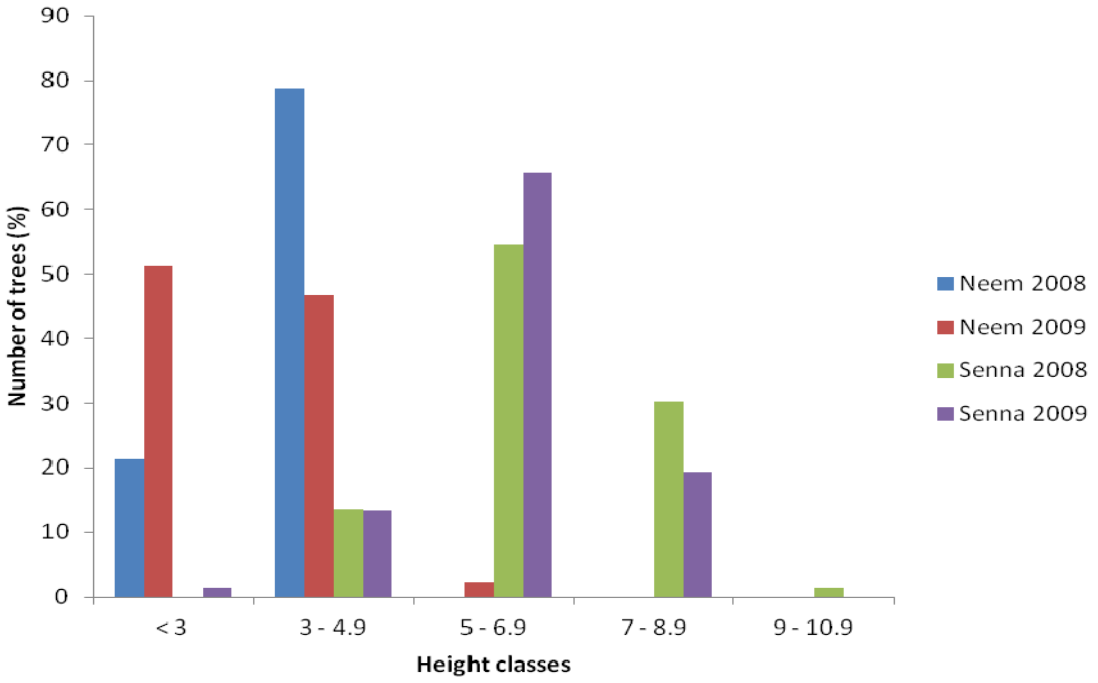

Figure 7. Height distributions of each species in the each age group.

the remaining 1.52% in the 9 to 10.9%. The stand exhibited the highest mean height of 6.14m with the trees falling in a range of 3 to 9 m. In the 2009 stand, Cassia had 1.49% of the trees less than 3 m in height, 13.43% of the trees were in the 3 to 4.9 m class, 65.67% fell within the 5 to 6.9 m class and 19.4% of the trees within the 7 to 8.9 m height class. The trees had a height range of 2.5 to 8.2 m and a mean height of 5.80 m which was the second highest recorded.

Neem in 2008 stand had 76.69% of the trees in the 3 to 4.9 m height class with the remaining 21.31% having a height less than 3 m. The mean height of the stand was the least at 3.5 m with tree heights falling in a range of 1.3 to 4.6 m. The Neem in the 2009 stand had 51.11% of the trees less than 3 m in height class, 46.67% within the 3 to 4.9 m class and the remaining 2.22% in the 5 to 6.9%. The mean height of the stand was 3.0 m with the trees falling in a range of 1.3 to 5.2 m.

Figure 7 shows the height distributions of the two tree species in the two plantation year stands. Cassia showed no significant difference in heights between the two age stands. Neem however showed significant difference between the two age stands with the 2008 having a higher height mean (Table 1).

DISCUSSION

Perception of the farmers

The farmers confirmed the rapid loss of trees as stated by FAO (1993) in the farming areas with 93.33% answering in the affirmative when asked whether the number of trees on their farms had reduced from the initial number. Results showed a dependence of the people on forest products for their household needs especially for building and fuelwood. Increasing agricultural output to meet subsistence needs is known to cause 50% deforestation in tropical forest (Barraclough and Ghimire, 2000; Appiah, 2001).

However, the reducing number of trees has led to a scarcity of trees from which these products can be obtained causing the farmers to travel an average distance of 4.3 miles in order to find trees which can supply these products. The farmers also showed a desire to plant trees to help satisfy their needs especially to supplement their nutritional requirements. Blay et al. (2008) reports about 70% of people in ten forest zone communities had planted trees before while 100% of farmers interviewed were very interested in planting trees. This also confirms research in other African countries that majority of people participate in afforestation activities if they are able or expect to get important livelihood sustaining products from the forests such as firewood and fodder (Victor and Bakare, 2004; Maraga et al., 2010). This also generally supports research that community-based agroforestry practices is an important way to achieve forest rehabilitation and sustainable forest management (Appiah, 2001; Maikhuri and Rao, 2002; Russell and Franzel, 2004; Appiah et al., 2009).

The major reason cited by the farmers for not planting

trees was their inability to acquire seedlings for planting. Other problems cited by the respondents in planting trees were the difficulty in protecting the seedlings, caring for them and maintaining the plantation area.

Plantation species growth

The selection of Neem and Cassia was informed by the availability of seedlings, fast growth, soil nutrient requirement of species, evergreen and their adaptability to the local environment. The apparent difference in the DBH of the stands can be attributed to the difference in ages of the plantations. The 2008 stand had a mean of 5.1 cm greater than that of the 2009 stand with 4.93 cm; however there was no significant difference ($p > 0.05$) between the two stands. Mainoo and Ulzen-Appiah (1996) recorded DBH of 5.80 cm in Kumasi (forest zone) Ghana.

Neem in the 2008 stand had majority of the trees (45.90%) in the 4 to 5.9 cm DBH classes while the trees in the 2009 stand had the majority (51.10%) of the trees in the 2 to 3.9 cm DBH class. This falls within mean diameters in Nigeria after four years of growth which were 5.14 cm (Verinumbe, 1991). There was significant difference ($p < 0.05$) between the diameters of the two stands (Table 1) with the 2008 stand showing the higher mean of 4.06 cm and the 2009 stand with a mean of 3.24 cm. The lower DBH of the 2009 stand could also be attributed to the rocky nature of the plantation area as well as the age of the stand.

Cassia in the 2009 stand had a higher mean height of 5.80 m than the 2008 stand which had a mean height of 5.34 m. The 2008 stand had more trees (30.30%) in the 7 to 8.9 cm class than the 2009 stand which had 19.40%. The 2009 stand however had more trees (65.67%) than the 2008 stand (54.55%). The mean height of the 2008 and 2009 were 6.14 and 5.80 m respectively however, there was no significant difference ($p > 0.05$) between the two stands. Nyadzi et al. (2002) observed means of 3.60, 4.53 and 5.05 m at one, two and three year aged trees respectively in Tanzania which are lower than the values recorded. However, Mainoo and Ulzen-Appiah (1996) recorded tree heights of 9.16 m in four year Cassia plants in Ghana.

The 2008 stand had 76.69% of the trees within the 3 to 4.9 m height class with the remaining 21.31% less than 3 m in height as compared to 46.67% in the 3 to 4.9 m class and 51.11% less than 3 m in the 2009 stand. The 2009 stand had 2.22% of the trees in the 5 to 6.9 m class. There was a significant difference ($p < 0.05$) between the two stands (Table 1) with the 2008 having a greater mean of 3.5 m and the 2009 stand having 3.0 m. Andrew et al. (2004) showed that mean heights of *A. indica* stands can vary as much as 3.8 m. However, Streets (1962) recorded 3.6 and 7.5 m in 2 and 5 years stands in Northern Ghana.

CONCLUSION AND RECOMMENDATION

The study has confirmed farmers are interested in taking part in tree planting activities with the majority of them already having planted trees. However, they were unable to do this on a large scale due to their inability to acquire seedlings, the difficulty involved in protecting them and the amount of labour required to establish the trees. The people of Yinyoranyili are willing to expand their plantation areas year by year. It is however recommended that more communities be encouraged to go into community plantations. The study revealed that growth in *Senna siamea* was more consistent with no significant difference between age stands as compared to *A. indica.*

Conflict of Interests

The author(s) have not declared any conflict of interests.

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