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Full length Research paper

Innovative approach for assessing sustainability of the medicinal plant-*Gardenia gummifera* Linn. F.

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Less known medicinal plants were studied in Bhopal and Sehore districts, M.P. India to suggest appropriate strategies for their sustainable management. The study area was rich in medicinal plants but due to their extensive uses and habitat degradation, these were less available. An innovative approach has been developed to assess the status of certain less known medicinal plants among which *Gardenia gummifera* was one. The approach comprise of six categories and 25 parameters namely: habitat (5 parameters), ecology (3 parameters), biology (6 parameters), use/trade (3 parameters), collection (4 parameters), and legal and institutional (4 parameters). These were arrived after study of relevant literature, discussion with the knowledgeable persons and field situation in the study area. All the parameters have been ranked into three scoring levels namely: low, medium and high with scoring of 1, 2 and 4 marks respectively. The species was studied and ranked as vulnerable based on these parameters. The primary source of data was field observations on the selected species and interviewing the stakeholders' that is, herbal practitioners, primary collectors, dealers and manufacturers. Attempts were made to know the degradation of natural habitats, biotic disturbances and exploitation. *G. gummifera* scored minimum marks (46%) which indicate its rareness in the area and over exploitation. Attempts have been made to suggest strategy for the conservation and sustainable utilization including training to build capacity of primary collectors.

Key words: Assessment, categories, parameters, threatened, medicinal plants, value addition.

INTRODUCTION

The people in India have tremendous passion for medicinal plants. In the oral tradition, the local communities in every ecosystem right from the Trans Himalayas down to the coastal plains have discovered the medicinal uses of thousands of plants occurring in their surroundings. They use them for a wide range of health related applications from common cold to memory

improvement, treatment of poisonous snakebites as cure for muscular dystrophy and enhancement for general immunity of the body.

There are several traditional rituals (ethno-botany) highlighting the importance of certain plants. On festivals the flowers or fruits are offered to the Gods or Deities. Some of these are- Paradise flower, Plants of Bible,

worship of Basil (Tulsi) or Lakshmi, the Goddess of prosperity on Lotus. Yet ethno-botany is generally taken as science of relationship of only primitive or aboriginal people with plants (Jain and Mitra, 1997). All traditional systems of medicine had their roots in ethno-botany (Jain and Mitra, 1997). The word ethno botany was applied to such knowledge by Harshberger (1895). India probably has one of the richest plant medicine cultures in the world. It is a culture that is of tremendous contemporary relevance because, it can on one hand ensure health security to millions of people and on the other it can provide new and safe herbal medicines to the entire world.

There are around 25000 plant based formulations used in folk medicine known to rural communities over India. Around 10000 formulations are available in indigenous medical texts, many of which are yet to be sufficiently tapped (Basu and Kirtikar, 1918). The science of traditional medicine flourished in India for quite a long time yet for the while it was subdued under the impact of modern medicine. The coming of chemical revolution in world and boom of synthetic products including the synthetic medicines, the faith in and the popularity of traditional herbal medicines gradually declined but now it is upcoming.

ASSESSMENT OF THREATS ON MEDICINAL PLANTS

Detailed studies on the distribution and utilization pattern of selected medicinal plant species was done in Sehore and Bhopal Districts of Madhya Pradesh, India. Efforts have been made to prioritize medicinal plants of conservation concern beginning with south India, and subsequently for northern and central India also, using conservation assessment and management planning (CAMP) methodology for assessment of threat status in accordance with the IUCN red list categories. The result of these CAMP workshops for South India enlists about 112 medicinal plant taxa under various degrees of threats ranging from "threatened" to "extinct in the wild". Similar threat assessment exercises were carried out for Northern India's medicinal plant species also. The CAMP workshops for high altitude Himalayan medicinal plants of Jammu and Kashmir and Himanchal Pradesh have assigned Red list categories to 42 taxa of temperate region.

The 1997 IUCN red list of threatened plants published by the IUCN Species Survival Commission presents a shocking picture of nearly 34000 species, or 12.5% of the world's flora, facing extinction. Using the same proportion for recorded medicinal plants, India's nearly 10000 native medicinal plant species are expected to fall the into threatened category. This indicates that special conservation measures are required for these plants failing which these are likely to become extinct and the world will be deprived of their usefulness.

The causes of decline

The cause of decline in the distributional area and the population of these plants may be natural such as extreme climatic conditions like drought, flood, cold, hot, diseases, problems in regeneration etc. More useful species are over exploited and become threatened.

Nearly 90% of medicinal plants used by the Indian Industry are collected from the wild. More than 70% of the collections involve destructive harvesting from the wild use of the parts like flowers, fruits, seeds, roots, bark, wood, stem and the entire plant (herbs). These pose definite threats to the sustainable survival of medicinal plants (Kotwal and Bhattacharya, 1999).

Due to popularity, drug companies (under the license) manufacture many of the Ayurvedic medicines. As a result there is increase in global demands for natural products over the last two decades or so. The entrepreneurs were under pressure to meet the demands for which they resorted to unsustainable practices. These include premature harvesting, destructive harvesting, over harvesting, lack of quality control, compromise on quality of raw material etc. All these contribute in making the Ayurveda medicinal practice un-popular.

The trade in medicinal plants

The demand for the raw material is much more than the availability. Due to either unavailability or less availability of some of the medicinal plants, which either have become extinct or have become rare, their cost has become quite high. The manufacturers find it difficult to use such species in formulation as the price of the medicine manufactured from rare/costly plant would be high. This compels the manufacturers to add a substitute, which is not prescribed in the texts. The substituting material may not be beneficial and at times may be harmful. Adulteration makes the medicines either less effective or ineffective (Ram, 2000).

Though Ayurveda specifies usage of 1200 to 1500 medicinal plants, contemporary Ayurvedic Industry consume around 550 to 600 medicinal plants, out of these around 90% are procured from wild areas mostly the forest land. Another category of medicinal plants consists of species which grow in wild as well as in agriculture lands. Some species are grown commercially on large scale to meet the demand of Ayurvedic industry. Medicinal plants procured from cultivated fields amount for less than 10% of total medicinal plants in trade.

The Government of India banned export of some 29 species of medicinal plants. Various studies being done over a period has indicated risk of extinction of valuable species due to high industrial demand. The results of a series of conservation assessment and management planning workshops (CAMP) held in various parts of the country to assess the threat status of important medicinal

plants are alarming. Several species were found in endangered category. This signifies that the distribution range and population of most of the useful plants have critically reduced and if conservation efforts are not strictly implemented then these are likely to become extinct. The turnover of the Indian herbal drug industry was Rs. 2300 crore during 1997 and reached around Rs. 4000 crore by year 2000. The total estimated quantity of exports was 36200 tones in the year 2000. It is estimated that this can be raised to Rs. 3000 crore by 2005 and to Rs. 10000 crore by 2010 as per estimates of Planning Commission (2000). At present the share of India in world Herbal Market is quite insignificant due to the lack of organizations both at cultivator / collector as well as industry level (Bisen, 2001).

Sustainable harvesting

Sustainability is very important aspect particularly in production and harvesting of medicinal plants. Most of the medicinal plants growing in nature are over exploited. Without doubt some of the high value herbs are threatened with extinction in the wild. There are several medicinal herbs, which are considered as economically profitable in harvesting from the wilderness. Some are relatively abundant, whereas many others are moderately available and few important species are concentrated only in certain pockets, which are mostly threatened. Several species are in high demand by the traders. Competition has resulted in the early and over harvest of few species from the more accessible sites. The bulk is picked when plants are only 2/3 or even half of their potential age and size. The optimal time of harvest for most species is immediately after the seeds reach maturity. Harvesting of mature plants in appropriate extent and by proper method would result in more yield of better quality. Despite these benefits, collection frequently takes place much earlier. Competition between collectors is one of the main causes of pre mature harvesting on open access land that is, forest. Large scale harvesting before maturity reduces the size of population (density) of exploited species.

The study site

The study was conducted in Bhopal and Sehore districts of Madhya Pradesh, India. Bhopal is capital of the state and situated on 23° 16' north latitude and 77° 25' east longitude. The total area of the district is 2778.0 sq. km and the reported human population is 1836784. Sehore is the parent district of Bhopal, which was formed much later, then its formation as the state capital. It is about 35 km West of Bhopal. The area of Sehore district lies between latitudes 23° 33' to 23° 38' 52' N and longitudes 76° 36' to 76° 59'. The total area of the district is 6563.68 sq. km. Both districts have tropical dry deciduous forests

(Gazetteer, 1999).

Objectives of the study

1. To study the traditional uses of less known medicinal plants.
2. To suggest appropriate strategies for research development and sustainable management.

METHODOLOGY

At the initial stage it was very difficult to precisely decide the names of less known plants of the study area from which detailed studies were made.

A list of important medicinal plants of the study area was prepared. This was based on frequent field visits, study of literature (Hains, 1916) and discussion with herbal practitioners. Thereafter the species for detailed studies were selected. The criteria for selection were based on occurrence of the species in different habitats, their importance and relatively less known for traditional uses in the area. The web site of Google (Internet web site) was searched on the internet for all the important medicinal plants of the study area. The number of searches was categorized in three categories namely:

- 1) Less known = up to 1000
- 2) More known = 1001 to 3000
- 3) Most known ≥ 3000

The "rapid vulnerability assessment" (RVA) method (Jennifer et al., 2001) collects information to identify species, resources and sites that may be at risk of over exploitation. Although it was very difficult to elicit the required information from the local herbal practitioners, still attempts were made to get some information on various aspects of relatively less known medicinal plants of the study area. A questionnaire and data format was specially developed for the study covering following aspects: Local, vernacular and botanical names, description, geographical distribution, habitat suitability and habitat specificity, biotic disturbances, distribution and abundance of selected medicinal plant, growth, flowering, fruiting, regeneration, pests and diseases, use and trade, collection related aspects, legal and institutional aspects. Suggestions are given for research development and sustainable management. For assessing sustainability of medicinal plant, the following six categories were recognized (Table 1).

- A. Habitat - 5 parameters (Habitat suitability, habitat specificity, climate (rainfall, temperature), biotic disturbances (Grazing, fire), protection level).
- B. Ecology - 3 parameters (Occurrence, distribution and abundance).
- C. Biology - 6 parameters (Growth, flowering, fruiting, seeding, regeneration, pests and diseases).
- D. Use/trade - 3 parameters (Plant parts used, other uses (wood, tannin, fiber etc.), Use/trade).
- E. Collection - 4 parameters (Collection stage, collection extent, collection method, collecting people).
- F. Legal and institutional - 4 parameters (Legal protection, institutions (Societies), awareness, capacity building).

Thus a total of 25 parameters were identified covering all aspects to assess the sustainability. These were arrived after study of relevant literature, discussion with the knowledgeable persons and field situation in the study area. All the parameters have been ranked into three levels of scoring namely: low, medium and high with

Table 1. Parameters for assessing sustainability of *Gardenia gummifera*. Scoring: Low = 1, Medium = 2 and High = 4.

S/N	Parameters	Low (1 mark)	Medium (2 marks)	High (4 marks)
A. Habitat				
1	Habitat suitability	Less suitable	----	----
2	Habitat specificity	Specific	----	----
3	Climate (Rainfall, temperature)	----	----	Normal
4	Biotic disturbances (grazing, fire)	---	Frequent	----
5	Protection level	----	Good	----
Sub-Total		2	4	4
Habitat 10 marks out of maximum 20 (50.0%)				
B. Plant ecology				
6	Occurrence	Wild	----	----
7	Distribution	Fragmented	----	----
8	Abundance	Scanty	----	----
Sub-Total		3	----	----
Scoring 3 marks out of 12 (25.0%)				
C. Plant biology				
9	Growth	Poor	----	----
10	Flowering	----	Good	----
11	Fruiting	----	Good	----
12	Seeding	Poor	----	----
13	Regeneration	Poor	----	----
14	Pests and diseases	----	----	Few
Sub- Total		3	4	4
Scoring 11 marks out of 24 (45.8%)				
D. Use/Trade				
15	Plant parts used	----	Gum –Bark , terminal buds	----
16	Other uses (Wood, tannin, fiber etc.)	----	----	1use
17	Use/trade	----	Localised	---
Sub-Total		----	4	4
Scoring 8 marks out of 12 (66.7%)				
E. Collection				
18	Collection stage	----	Sub- Mature	----
19	Collection extent	----	----	Least
20	Collection method	----	Partly destructive	----
21	Collecting people	----	Un-Organised	---
Sub-Total		----	6	4
Scoring 10 marks out of 16 (62.5%)				
F. Legal, institutional				
22	Legal protection	Poor	----	----
23	Institutions (Societies)	Few	----	----
24	Awareness	Scanty	----	----
25	Capacity building	Least	----	----
Sub-Total		4	----	----
Scoring 4 marks out of 16 (25.0%)				

scoring of 1, 2 and 4 marks respectively. The species were studied and ranked according to these parameters. Based on these

considerations 10 species were selected for detailed study among which *Gardenia gummifera* was one.

***Gardennia gummifera* Linn. F. (Family Rubiaceae)**

Other names for *G. gummifera* Linn. F. are *Hing patri*, *Dikamali*, *Gurudu*, *Cambi gum tree*, *Kamarri*, *Manchi bikki*, *Tella – manga*, *Kambili ppicin*, and *Cittubikke* for Sanskrit, Hindi, Oriya, English, Gujarati, Telgu, Tamil and Kanada, respectively. Distribution of *G. gummifera* Linn. F. occurs throughout India in Tropical Natural Forests. In Madhya Pradesh state it is one of the constituent species of natural forests and found in almost all the districts. In the study area it was observed in Samardha, Berasia, Budni and Bhopal forest ranges.

Habitat

The plant is a small tree or shrub and grows in rocky areas in slightly undulating terrain along with other species. It occurs in specific habitats having well drained shallow soil with exposed rocks at places usually on plateaus, which are not too dry. It has specific habitat requirements as mentioned previously. Normal range of maximum and minimum temperature and rainfall in the area is quite suitable for the species. The deficit rains has resulted in drying of some plants during peak of summer. Some plants were partly dried and re-sprouted during rainy season. The plant grows only in natural forests, which are mainly managed by Government. The biotic disturbance in the form of accidental forest fires, livestock grazing and illicit cutting of trees is of common occurrence in the study area. Since the species grows only in natural forests and therefore it gets some protection better than those growing in wastelands.

Plant ecology

Under this heading are three parameters of occurrence, distribution and abundance of the species are considered. The plant grows only in the natural forests and not cultivated. However it has a very good potential for growing in gardens because of its beautiful white fragrant flowers beside medicinal value for its gum after which it derives its scientific name. The distribution of the species is fragmented at least within the study area. It can be seen in specific areas only and not found for a considerable distance indicating its fragmented distribution. The extent of occurrence is scanty because it can be seen only at few places.

Plant biology

A large handsome shrub with white bark, sub-sessile shining simple leaves which are apposite and decussately arranged. Leaf size is 3 to 8 cm long, and 12 to 16 pairs of secondary nerves. Flowers are large (2 to 3 cm) with white fragrant. Fruit is ovoid (2 to 4 cm) with fleshy mesocarp, and is edible. Flowering occurs during June to July. The plant flowers every year during onset of monsoon rains. However sporadic flowering takes place during other months of the year. Fruiting is during August to October. The fruiting medium has 20 to 40 fruits per bush.

Seeding is medium in extent. Some fruits dry pre-maturely owing to very hot and dry weather conditions. The regeneration is usually by seeds, which are spread by birds that feed on the fruits. Some times mature fruits fall on the ground releasing seeds, which germinate under favorable conditions. Growth is slow. In the study area most of the plants were in bushy form.

Use/ trade

Only gum resin is medicinally useful which comes on the tip of the branches. Other parts of the plant do not have any specific use except the flowers. However, the local people along with other

similar material collect the dried plants as fuelwood.

Collection

The gum resin at the tip of branches is collected by breaking the terminal bud usually by hand. In the study area the collection was negligible. In the event of collecting the gum resin, the terminal buds are affected. The gum resin from main stem is also collected.

The method of collection is partly destructive affecting the terminal buds and sometimes the main stem in case of collection on large scale. Only some local people sponsored by local herbal practitioners collect gum resin. Un-organised local people make collections. In the study area commercial collection does not take place probably because of less availability of plants.

Legal, institutional

The species has no specific legal protection as in case of other species listed in Wildlife (Protection) Act, CITES, negative list of export etc. However, the habitat has some level of protection because it grows in Government forest. Most of the people are not much aware about the importance and use of this species. There are no societies specifically for collection of this or any other medicinal plant. At present there are no efforts towards any capacity building measures for sustainable collection and utilization of medicinal plants.

Therapeutic properties and uses (Parts used- gum)

Local use

It is useful in excretion of intestinal parasitic worms. When given orally with local cow urine for hook worms, 1 g of gum + 6 g cumin + 20 g and cow urine excretes the worms.

Other uses

The gum locally known as Dinkamali (*G. gummifera*) is used to treat stomach ailments in humans. In the market it costs 50 rupees for 100 g. Dinkamali is also used as spray on soybean crops to combat *Heliothis armigera* and on vegetable crops such as cauliflower, tomato and cabbage to combat other small insects. The process of preparation is the same as for asafetida, except that the mixture is boiled for 25 to 30 min (CSIR, 1986) (Figure 1).

Gardenia flowers are not raised by the Indian floriculturists, although some species are found in gardens. The young shoots of *G. gummifera* are the source of Dikamali gum, used to rub on the gums of infants when teething. The gum is antiseptic, carminative, expectorant, sore, spasm, stimulant, vermifuge, repellent (Figure 2).

RESULTS AND DISCUSSION

Detailed observations on 25 parameters of medicinal plant are given in Table 2.

The species has scored 46 marks out of 100. It has scored fewer marks under habitat, plant ecology, collection, use and legal, institutional parameters based on the scoring it is ranked as vulnerable.

Habitat

Habitat is the home of living organisms. The medicinal



Figure 1. *Gardenia gummifera* – A plant.



Figure 2. *Gardenia gummifera* – A flower.

plants are affected by the habitat. The *G. gummifera* has scored 50% marks, which indicates the causes of it being so rare. Because of its medicinal values, it is in demand, due to which it is over exploited. It is difficult to meet the demand only from the wilderness. Cultivation of the species is the alternative but standard methods of commercial cultivation not readily available.

Plant ecology

A minimum of 41.7 marks were scored by *G. gummifera*.

The species occurs only in wilderness areas and not cultivated in the study area. It has fragmented distribution and scanty occurrence in specific habitats.

Plant biology

The intrinsic factors within the plant body play important role in growth. These are flowering, fruiting, seeding, regeneration and resistance to pests and diseases. The species under reference was studied in respect of these parameters. *G. gummifera* scored 45.8% marks. The

Table 2. Scoring of marks for sustainability of *Gardenia gummifera* under various parameters.

Category	Parameters	Total marks	Marks scored	%
A	Habitat	20	10	50.0
B	Plant ecology	12	5	41.7
C	Plant biology	24	11	45.8
D	Use/Trade	12	8	66.7
E	Collection	16	10	62.5
F	Legal, institutional	16	4	25.0
Total	---	100	46	---

Ranking; Critical = 25, Vulnerable = 25 to 50 and Not vulnerable = > 50.

species has poor regeneration due to different reasons. The species occurs only in wilderness areas and not cultivated. Only few mature fruits fall on ground and the natural regeneration is poor.

Use/trade

Various parts of plants have different uses. In some species only one part is useful while in others more parts are useful. The species has scored a 66.7% marks due to use of only one part on local scale only.

Collection

Useful plants and plant parts are collected. There are three main aspects under this. These are stage of collection, extent of collection and method of collection. The score of the species is 62.5%, which is slightly more, then limits of vulnerability. It is because of less availability of the required material and collection at local level only.

Legal institutional

This is also a very important parameter that affects various aspects of the medicinal plants. Certain species that come under threatened categories of IUCN, in appendices of CITES, listed in negative list of export and in Wildlife (Protection) Act have legal protection with provisions of punishment. *G. gummifera* has no such legal status. The species has scored 25% marks due to no effective legal protection.

RESEARCH DEVELOPMENTS

The natural regeneration of the species is poor. It has slightly specific type of habitat requirements. Very little can be practically done in its natural habitat on these aspects except reduction of biotic disturbances:

1) The species has slow growth because of intrinsic factors. It produces few mature seeds, which are the only

means of regeneration. The fruits are eaten by birds and thus an attraction for them. It does not propagate in nature by vegetative means. Looking to the medicinal importance and also aesthetic value the plant has the potential for growing in gardens and in that eventuality other means of propagation can be developed.

2) Some awareness can be created among the people about its use and importance. It will be worthwhile to organize the local people in the form of societies for sustainable utilization of medicinal plants.

Conservation and sustainable utilization

It is necessary to develop appropriate programme for conservation and sustainable utilization of medicinal plants particularly for the health care of rural poor and also to help in their livelihoods. For the state of Madhya Pradesh 35 species of medicinal plants and 16 species of aromatic plants has been prepared as priority list and a business plan has been developed for these species (Government of Madhya Pradesh, 2002).

Attempts have been made to suggest strategy for the conservation and sustainable utilization. Suggestions for training to build capacity of primary collectors in terms of time, methods and quantity to be collected. It has been observed that poor returns to dependant population also accelerate over exploitation of the useful species. Ethical approach may lead to sustainable utilization.

The medicinal plants are the principle health care resources for majority of the people living in rural areas. Their demand is increasing day-by-day. Most of the material is harvested from wilderness areas, mainly the forests. Only few species are cultivated. The unregulated collection and trade of medicinal plants has serious implications on the survival of many species, which are threatened. Beside, it is also important to develop appropriate harvesting standards based on scientific studies (FRLHT, 1997, 1999).

Techniques for commercial cultivation of prioritized species that are in high demand but short supply from wilderness also need to be developed and the technology should be transferred from lab to the land for wider use. There is need to emphasize *in-situ* conservation of

medicinal plants and their sustainable harvesting involving local people. Some of the Joint Forest Management Committees may be motivated for this.

It is very important to impart necessary training to the concerned local people for technical issues pertaining to conservation, cultivation, value addition and marketing of medicinal plants. Value addition is very important aspect for fetching better returns to primary collectors. The values of processed products may increase by 8 to 10 times than the raw products.

Marketing a medicinal plant is ticklish due to poor storage, poor transport and lack of definite consumers/purchasers. Due to uncertainty of marketing, some medicinal plants are not collected. Some of the manufacturers do not prefer to purchase processed material due to apprehension of adulteration. The buyers dictate marketing.

The deterioration in quality leads to poor marketing. The manufacturers and other stakeholders in the sector need to ensure "quality standards" in collection, value addition, transport, storage and processing of end products to ensure the efficacy of Ayurvedic medicines. Attempts should be made to develop standards for certification of medicinal plants as "Organic or Natural products". Similarly, cultivation of medicinal plants should also be done without use of pesticides or chemical fertilizer so as to ensure their medicinal properties and standard quality.

Conclusion

The utilization of medicinal plants in the remote past was sustainable. The traditional ethics were followed which imposed several restrictions on time of collection, method of collection, extent of collection etc. The practitioners followed the traditional ethics, and as such, the natural habitats were maintained and the natural regeneration was ensured with continued availability of medicinal plants.

But in the recent times the traditional ethics are not followed possibly due to high demand and the greed. This has reversed the situation from plenty to scanty. This is the situation with respect to most of the natural resources. Therefore appropriate strategies covering aforementioned parameters need to be developed and implemented. The innovative approach of assessment of all parameters for each species is quite holistic covering all the aspects. This has the potential to assess weaknesses and gaps in the present position and practices with definite indications for sustainable management of medicinal plants.

Conflict of Interests

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

REFERENCES

- Basu BD, Kirtikar KR (1918). *Indian Medicinal Plants (Revised)*, Reprint 1984.
- Bisen SS (2001). *Marketing of forest based crude drugs and herbs*. Mimeograph. Tropical Forest Research Institute (TFRI), Jabalpur.
- CSIR (1986) *Useful plants of India*. Council of Scientific and Industrial Research, New Delhi.
- FRLHT (1997). *Medicinal plants of India. Guidelines for National Policy and conservation Programmes*. FRLHT, Bangalore.
- FRLHT (1999). *The key role of forestry sector in conserving India's medicinal plants – concepts and operational futures*. P. 26.
- Gazetteer (1999). *Bhopal and Sehore districts*. Govt. of Madhya Pradesh.
- Government of Madhya Pradesh (2002). *Business plan for Medicinal and Aromatic plants of Madhya Pradesh*. Dept. of Biodiversity and Biotechnology and M.P. State Forest Produce Federation. P. 48.
- Hains HH (1916). *Descriptive list of important trees, shrubs and economic herbs of Southern circle, Central provinces*. The Pioneer Press, Allahabad.
- Harshberger JW (1895). *Some new ideas*. Philadelphia Evening Telegraph.
- Jain and Mitra (1997). *Contribution to Indian Ethnobotany 3rd revised edition*. Edtd. By S. K. Jain. Scientific Publishers India. Jodhpur. P. 322.
- Jennifer LG, Wong K Thornber N, Baker N (2001). *Resource assessment of Non-wood forest products- Experience and Biometric principles*. F A O Rome.
- Kotwal D (2002). *Ethno-botanical research development of less known medicinal plants of Bhopal and Sehore Districts*. Ph. D. thesis, Barkatullah University, Bhopal. India.
- Kotwal PC, Bhattacharya P (1999). *Management strategies for conservation, cultivation and utilization of medicinal plants*. Reading material for Management Development programme (MDP). Indian Institute of Forest Management (IIFM), Bhopal, Madhya Pradesh.
- Ram P (2000). *Unsustainable extraction of Bio- diversity raises question on future of Indian system of medicines*. IIFM New latter Vol. III (3), September 2000.

Full Length Research Paper

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 m²) 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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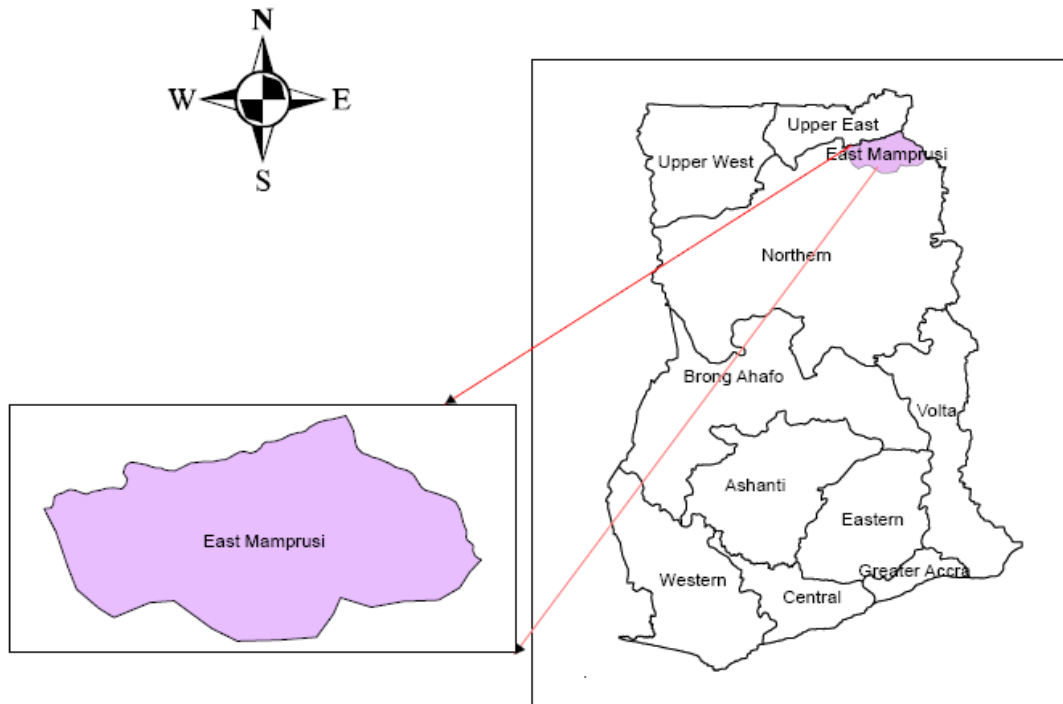


Figure 1. Map of Ghana indicating study area.

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 Mamprusi District of the Northern Region (Figure 1). The district lies in the interior woodland savanna belt and its common grass vegetation with trees

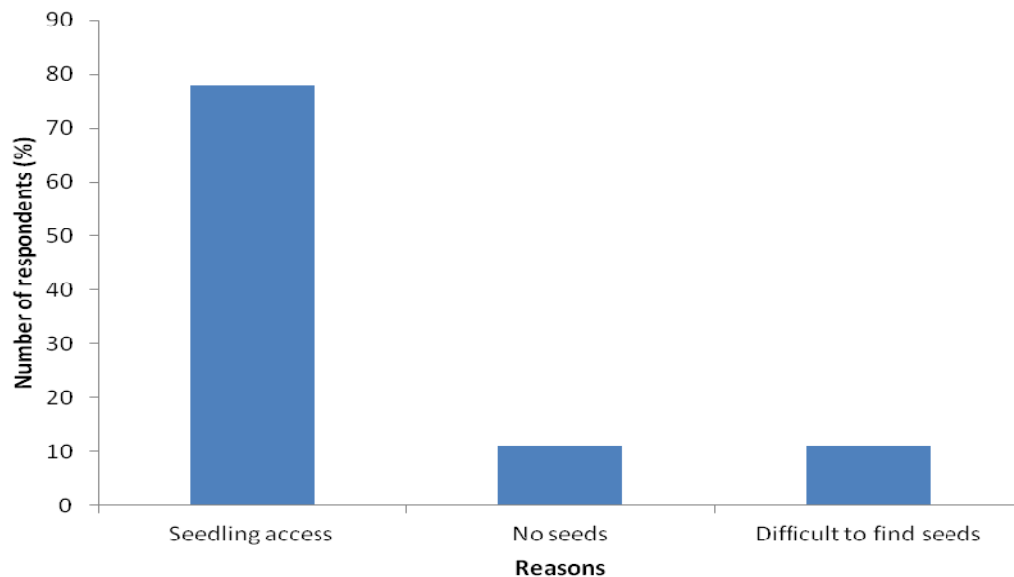


Figure 2. Reasons for not planting trees.

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 Yinyoranyiri 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.

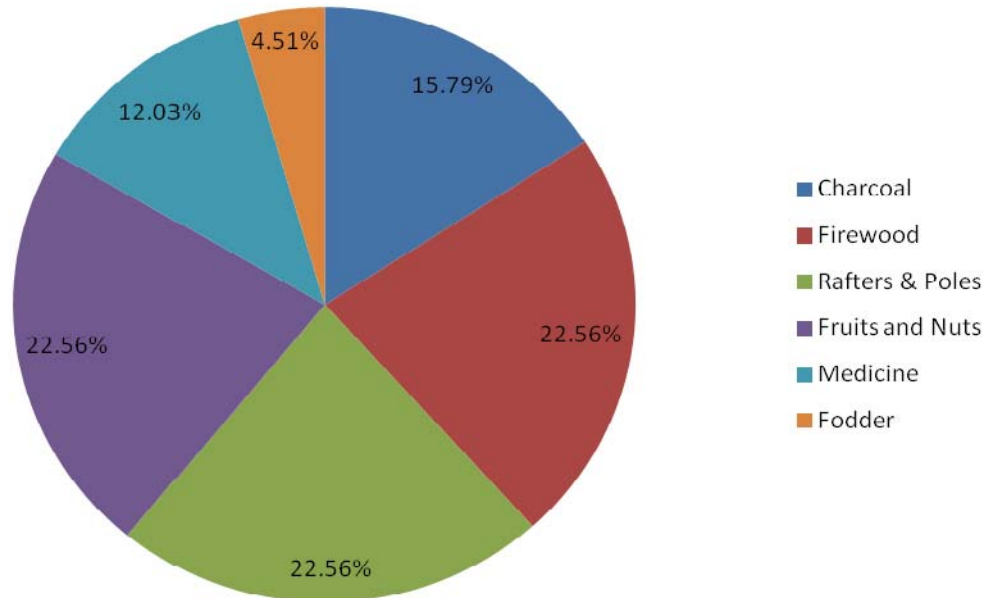


Figure 3. Household uses of trees.

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

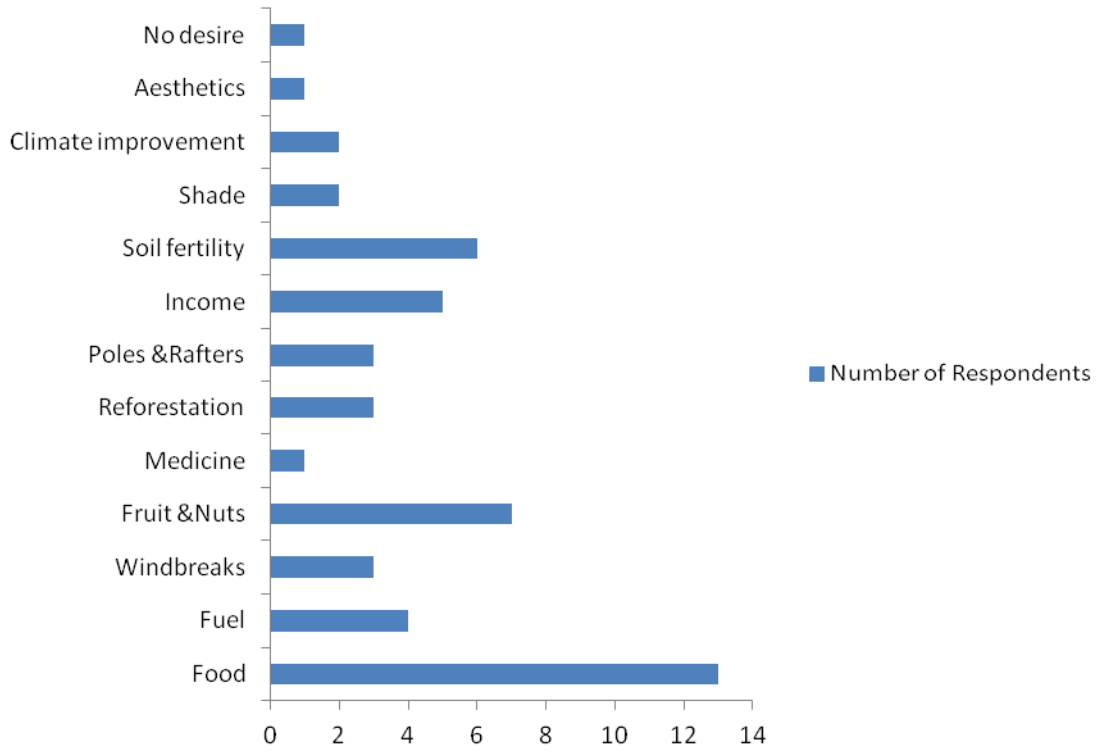


Figure 4. Farmers' reasons for wanting to plant trees.

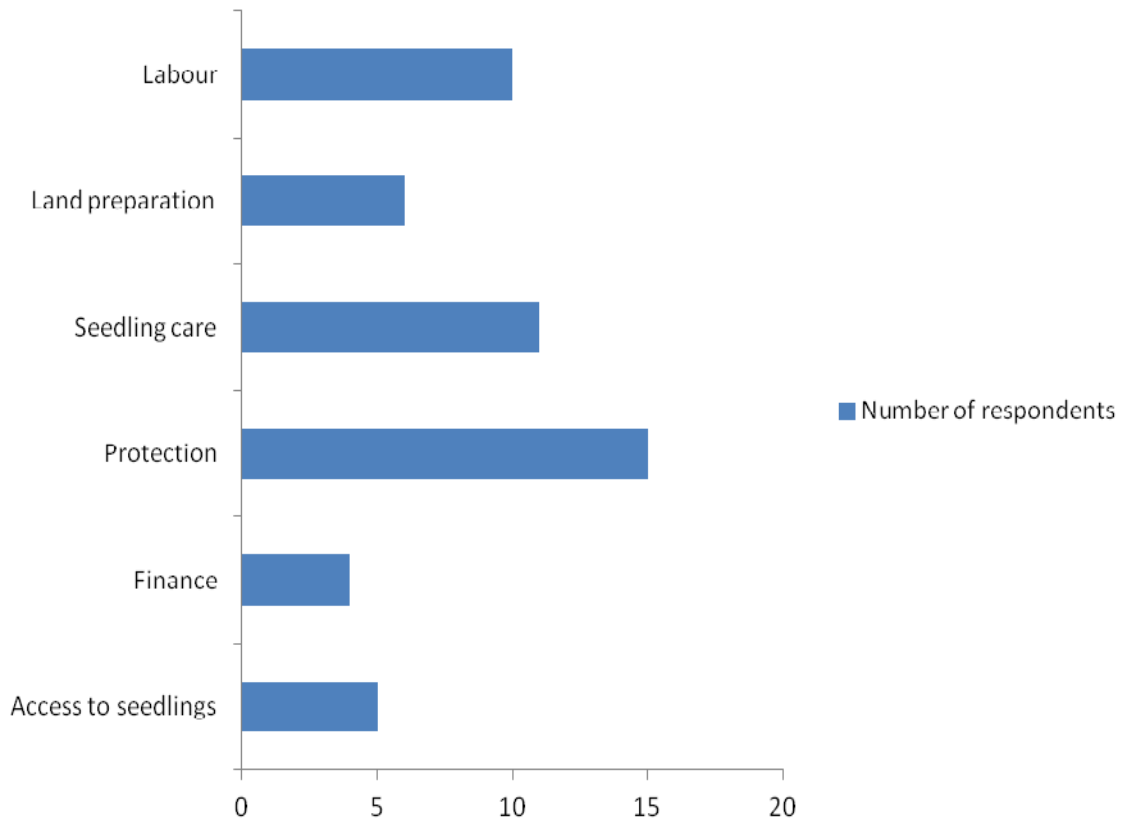


Figure 5. Problems faced in planting trees.

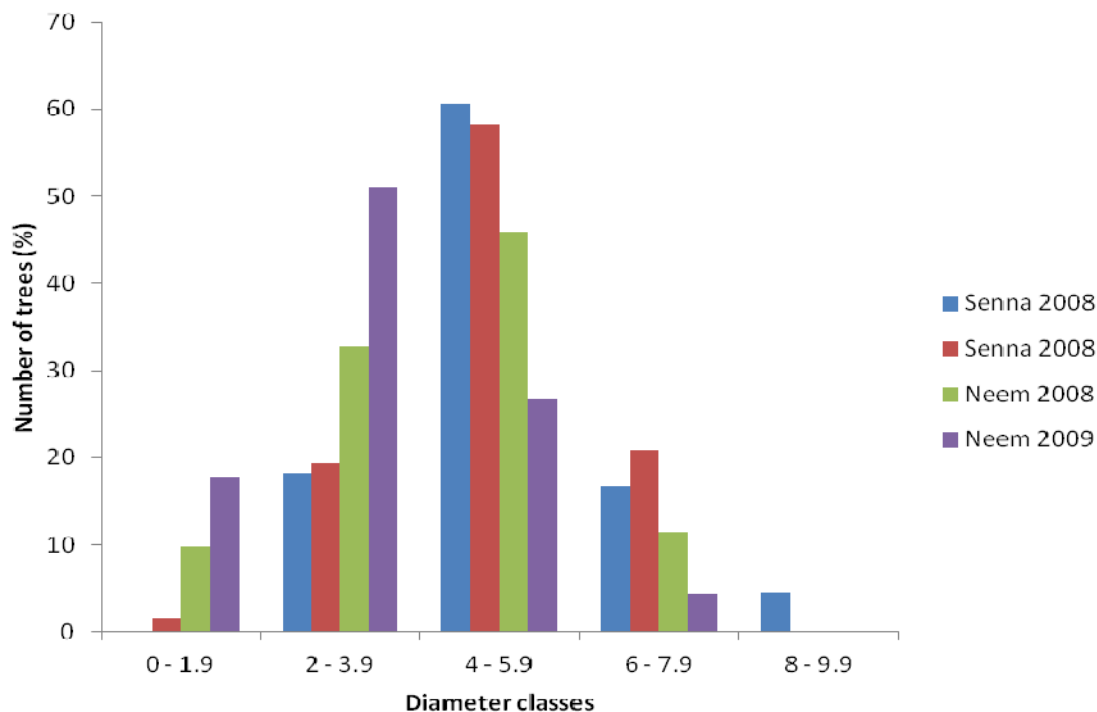


Figure 6. DBH distributions of each species in the two age groups.

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

ANOVA for height of <i>A. indica</i> 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 <i>A. indica</i> 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

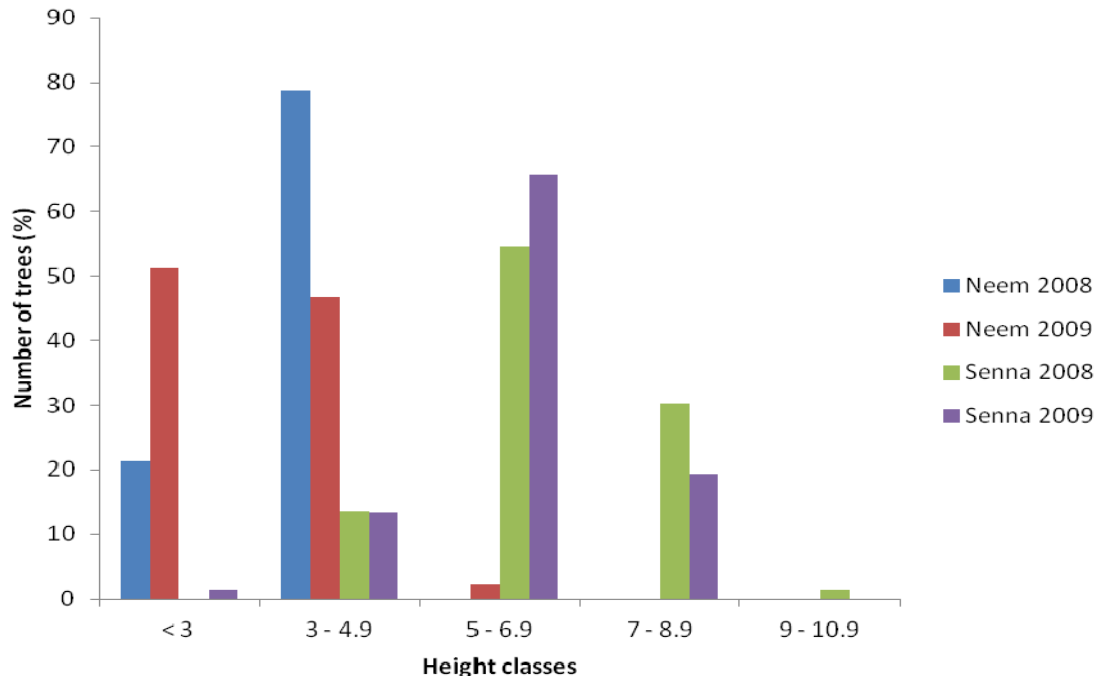


Figure 7. Height distributions of each species in the each age group.

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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REFERENCES

- Abeney EA, Owusu JGK (eds.) (1999). Workshop for media personnel on forestry and wildlife reporting proceedings, Institute of Renewable Natural Resources, UST, Ghana, P. 95.
- Andrew SM, Maliondo SMS, Mtika J, Msanga HP, Nsolmo VR (2004). Growth performance of *Azadirachta indica* provenances in Morogono, Tanzania. *J. Trop. For. Sci.* 16(3):328-335.
- Appiah M (2001). Co-partnership in forest management: The Gwira-Banso Joint Forest Management Project in Ghana. *Environ. Dev. Sustain.* 3(4):343-360.
- Appiah M (2003). Crown characteristic in four Iroko (*Milicia excelsa*) provenances grown in the dry semi-deciduous forest zone in Ghana. *Ghana J. For.* 11:20-29.
- Appiah M, Blay D, Damnyag L, Dwomoh FK, Pappinen A, Luukkanen O (2009). Dependence on forest resources and tropical deforestation in Ghana. *Environ. Dev. Sustain.* 11:471-487.
- Appiah M (2013). Tree population inventory, diversity and degradation analysis of a tropical dry deciduous forest in Afram Plains, Ghana. *For. Econ. Manage.* 295:145-154.
- Barraclough SL, Ghimire KB (2000). Agricultural expansion and tropical deforestation. London: Earthscan.
- Blay D, Appiah M, Damnyag L, Dwomoh FK, Luukkanen O, Pappinen A (2008). Involving local farmers in rehabilitation of degraded tropical forests: Some lessons from Ghana. *Environ. Dev. Sustain.* 10:503-518.
- Castre'n T (2005). Ownership and incentives in Joint Forest Management: A survey. *Dev. Policy Rev.* 23(1):87-104.
- CIFOR (2011). Distribution and Characteristics of African Dry Forests and Woodlands. In: Chidumayo EN and Gumbo DJ (Eds) *The Dry Forests and Woodlands of Africa Managing for Products and Services*, London, Washington, DC, P. 288.

- Deji OF (2007). Community Socio cultural factors Associated with the participation of Rural women's association in Rural community development projects in Niger. *J. Soc. Sci.* 2:1-6.
- EMDA (2006). East Maprusi District Assembly profile.
- FAO (1993). Forest Resources Assessment 1990: Tropical Countries, FAO Forestry paper 112. Rome.
- IUCN (2006). Forest landscape restoration to meet Ghana's deforestation Challenges, IUCN. (<http://www.IUCN.org/en/news/archive/2006/newfebruary06.htm>).
- Maikhuri RK, Rao KS (2002). Rehabilitation of degraded land, land-use and land-cover change impacts and strategies in the Indian Himalaya Mountains. *Newsletter of the International Human dimensions Programme on Global Environmental change.*
- Mainoo AA, Ulzen-Appiah F (1996). Growth, Wood yield and Energy characteristics of *Leucana leucocephala*, *Gliricidia sepium* and *Senna siamea* at age four years. *Ghana J. For.* 3:69-79.
- Maraga JN, Kibwage JK, Oindo BO (2010). Factors determining community participation in afforestation projects in River Nyando basin, Kenya. *Afr. J. Environ. Sci. Technol.* 4(12):853-859.
- Nyadzi GI, Otsyina RM, Ong CK (2002). Growth and Water Resource Utilization of *Acacia crassicarpa*, *Senna siamea* and *Leucaena pallid* Established in the Rotational Woodlots Agroforestry System in Western Tanzania. Presented at the 12th ISCO Conference, Beijng.
- Poorter L, Bongers F, Lemmens RHMJ (2004). West African forests: introduction. In: Poorter L, Bongers F, Kouamé FYN', Hawthorne WD (Eds) Biodiversity of West African Forests, An Ecological Atlas of Woody Plant Species. CABI Publishing, Oxon and Cambridge UK and USA, P. 521.
- Russell D, Franzel S (2004). Agroforestry, markets and the African smallholder. *Agroforet. Sys.* 61:345-355.
- Siaw DEKA (2001). State of forest genetic resources in Ghana, Forest genetic resources working papers (FGR/17E). Forest Resources Division, FAO, Rome Italy.
- Stoorvogel JJ, Smaling EMA (1990). Assessment of soil nutrient depletion in Sub-Saharan Africa 1983-2000. 28, Wageningen: The Winand Staring Centre for Integrated Land, Soil. Water Res. (SC-DLO).
- Streets RJ (1962). Exotic forest trees in the British Commonwealth. Clarendon Press, Oxford. P. 765.
- Tilman D (1988). Plant strategies and the dynamics and structure of plant communities. Princeton University Press. Princeton, New Jersey.
- Unmüßig B, Cramer S (2008). Africa in Climate Change" GIGA, P. 2.
- Verinumbe I (1991). Agroforestry development in northeastern Nigeria. *For. Ecol. Manage.* 45:309-313.
- Victor AJ, Bakare Y (2004). Rural Livelihood Benefits from Participation in the Taungya Agroforestry System in Ondo State, Nigeria. *Small-Scale For. Econ. Manage. Policy* 3(1):131-138.
- Yirdaw E (2002). Restoration of the native woody-species diversity, using plantation species as foster trees, in the degraded highlands of Ethiopia. Ph.D. dissertation, University of Helsinki Tropical Forestry Reports. 24:61.



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