Population Status and Socioeconomic Importance of *Acacia senegal* Tree Species in Abderafi Woreda of North Gondar Zone

Tatek Dejene[1], Kibruyesfa Sisay, Behonegn Akalu, and Enyew Adgo[2]
[1]Gondar Agricultural Research Center. P.O. Box 1337
[2] Bahir Dar University P.O.Box

Abstract

In Ethiopia, A.senegal is widely distributed in the southern and north-western lowland dry forests. However, in spite of its wide distribution, few studies have been made to document its status and potential. Hence, the main focus of this study was to acquire information on the status of A.senegal (L.) Willd species in Abderafi woreda of North Gondar Zone and to provide baseline information for the development and utilization of the resource. Both primary (socio-economic survey and vegetation inventory) and secondary data sources were used for the study. Three sites were assessed for vegetation inventory and a total of 35 households were sampled and assessed purposively for the survey. The population status of A.senegal and associated tree species were examined by estimating dominance, density, abundance, frequency, importance value index and population structures. The findings of the socioeconomic survey revealed that all households living in and around the woodland somehow use the species for various purposes. However, more dependency was observed on the utilization of six main types of NTFPs. Nevertheless, the local communities have not been used to generate income as they are not aware of the economic importance of the species. This might be due to the presence of an alternative livelihood means i.e. agriculture. They only use its wood for making farm implements, fencing, charcoal, and fuelwood. The production of gum from A.senegal is not common by the locals. On the other hand, the diameter distribution indicated that indeed there is a possibility to start the production of gum arabic with the existing harvestable number of A.senegal trees in the area, and this will have the potential to supplement the income from agricultural production. The inventory of the woodland in the study area also indicated that, the density, frequency, dominance, abundance and importance value index for A.senegal is high in all the three sites as compared to the associated tree species. Moreover, the population structure of A.senegal showed large population in the lower size classes (good regeneration); however, small number of individuals existed in the upper higher size classes, this may be attributed to the continuous harvesting of matured trees for the purpose of firewood and charcoal production. In addition some trees missed in some diameter class of the associated species and the population structure assumed a J-shape which signals their instability. Therefore, if appropriate management measures are taken, then, to the stand, the nature of the population structure of most of the tree species including A.senegal will be stable.

Key words: Abderafi, Population structure, Acacia Senegal, Gum Arabic, Socio economic

1. Background and Justification

Drylands are parts of the earth's surface where rainfall is very low, erratic, and rates of evaporation are high. Such lands account for 54% of the globe and 61% of Africa's productive landmass (UNDP, 2005). Dry tropical forests, as the forests in these areas are referred to, encompass 42% of all tropical forests (Murphy & Lugo, 1986), and are the largest forest type in some African countries such as Ethiopia (Tefera et al., 2005). They contain a wealth of unique biodiversity (Janzen, 1988) and directly support the livelihoods of close to one billion people worldwide (UNDP, 2005). Nonetheless, dry forests are suffering from severe degradation due to anthropogenic pressures, for the reason that they are among the least managed and protected ecosystems (Janzen, 1970; Janzen, 1988).

Increasing human pressure in recent years in the Drylands and on dry forests is initiating the rapid advance of desertification. Furthermore, the effects of global climate change, which prevails in the dryland regions, are further intensifying problems - making them more arid, vulnerable and difficult for habitation (Williams, 2002 as cited by Mulugeta et al., 2004).

The *Combretum–Terminalia* and *Acacia–Commiphora* deciduous woodlands belong to the category of dry forests, and form the largest vegetation cover in the Horn of Africa and the Sudano-Sahelian zone (Friis, 1992). These forests mainly are composed of various species of *Acacia, Boswellia* and *Commiphora* that are known to produce commercial plant gums and resins such as gum arabic, frankincense and myrrh (Mulugeta & Demel, 2003), respectively. The wood and non-wood products from these species play a significant role in the livelihood of many people in the dryland regions of Africa.

Ethiopian natural vegetation resources are composed of several species of potential importance. For instance, the *Acacia-Commiphera* woodlands in the dry lands of the country that are dominated by *Acacia, Boswellia,* and *Commiphera* species are well known for their economically valuable products, largely oleo-gum resins such as gum arabic, frankincense, myrrh, and karaya (Abeje, 2002 ; Mulugeta etal ,2003; Tilahun ,1997; Wubalem etal,2004).

Acacia senegal (L) willd (family Leguminosae, Mimosoidea) is one of the promising multipurpose tree species in arid and semi-arid areas of Ethiopia, which can render various socioeconomic and ecological benefits. The species is highly valued for gum arabic production (Mulugeta et al, 2004) in which the gum exudates from trunks, branches and twigs. In Ethiopia natural stands of *A.senegal* found in the *Acacia-Commephora* woodlands in the western and southern lowlands of the country; West Tigray, Amhara, Benshangul, Shoa, Afar plane and Borena zone of Oromia (Azene, et al 1993; Vivero, 2002). Unfortunately, in spite of its wide distribution, few studies have been made to document the status and potential of the species. The fact that, on one hand, there is a growing demand, attractive international market, and considerable socioeconomic benefit from the resource and lack of information on the distribution and abundance of the resource on the other hand has triggered a great need for an assessment of the resource in North Gondar zone. These underline the purpose of this study.

2. Objectives

2.1. General objective

The main focus of this study was to acquire information on the status of *A. senegal* (L.) Willd Species in Abderafi woreda of north Gondar Zone

2.2. Specific objectives

- To investigate the population status of *A. senegal* land associated tree species.
- To assess the effect human encroachment on the population of *A. senegal* and the associated tree species;
- To investigate the socio economic importance of *A.senegal* tree species in the study area.

3. Materials and Methods

3.1. Study Site description

The study was conducted in north Gondar zone of Abderafi woreda which lies within an altitudinal range of 950 to1100m above sea level and with a mean annual rainfall of 885mm, and with and the annual mean temperature of 27.8 ºC. It has a unimodal rainfall and most of the rainfall is received during the months of July and August. The soils are predominantly black with some soils displaying vertic properties. Seasonal water logging, especially during the heavy rainfall months, is also high. The vegetation zone of the study area is categorized under the *Combretum–Terminalia* or Broad-Leaved Deciduous Woodland (Abeje, 2002; Ogbazghi, 2001).

3.2. Data Collection and Measurements

A reconnaissance survey was made across the woodland in the study area, in order to obtain a contemplation of the condition of the vegetation of the site. Then three sites, which represented three vegetation conditions namely intact, relatively intact (exposed to grazing), and partially farm fields were selected. The site considered as intact, relatively intact and partially farm field are referred in this paper as site one, site two and site three respectively.

After the selection of the sites, sample plots were randomly laid out on parallel transect lines of 200m apart from each other. On each transect line of the study sites, sample plots each with an area of 400m2(11.3 radius) and spacing of 200 meters were laid. A total of 21, 31 and 31 sample plots were taken from site one, two and three respectively. In each plot, the total number of individuals of *A. senegal* and other associated species were counted and recorded. The height and diameter at breast height (DBH) of each individual, with heights of 1.5 m or more, were measured using hypsometer and diameter tape, respectively. For individuals with a height of less than 1.5 m, their basal diameters and heights were measured using caliper and calibrated sticks (rods), respectively (Abeje et al., 2005).

The socio-economic survey involved various data collection techniques, such as informal discussion, semi-structured questionnaire survey, focus group discussions and observations. Before the survey began, local people were contacted to explain the purpose of the survey and to develop trust. For the questionnaire survey, 35 sample households were purposively selected. Using the criterion of dependency on the woodland for NTF products, a semi-structured questionnaire was developed and pre-tested, and interviews were finally undertaken with the selected households. During the interview, the objective of the study has been made clear for the informants. Moreover, informal discussions and focused group discussion were held with individuals, offices and local elders. During the selection of elders for group discussion, consideration was given to age.

3.3. Data Analysis

3.3.1. Vegetation

The status of populations of *A. senegal* and associated species was examined by estimating dominance, density, abundance, frequency, importance value index (IVI) and population structure.

Density was calculated by the number of individuals of a species per unit of area (Abeje et al., 2005). Abundance is defined as the number of stems per plot. Two sets of abundance values were calculated, i.e., average abundance per plot were calculated by dividing the sum of the number of stems per species from all plots by the total number of plots (maximum frequency). Local abundance was calculated as the ratio of the total number of stems of a species divided by its absolute frequency (Tadesse, 2003). Frequency is defined as the presence or absence of a given species in sample quadrants (Lamprecht, 1989). Absolute frequency of a species was obtained by counting the number of plots in which the species was recorded (Kent and Coker, 1994; Tadesse, 2003). Relative frequency of a species was done by calculating the ratio of the absolute frequency of the species to the total number of study plots (which is equal to maximum frequency) (Getachew, 1999; Tadesse, 2003*)*. Importance Value Index (IVI) allows a comparison of the ecological significance of species in a given forest type and depicts the sociological structure of a population in its totality in the community (Lamprechet, 1989). Therefore, it is a good index for summarizing vegetation characteristics and ranking of species (Kindeya, 2003). The IVI was calculated as the sum of the relative dominance (%), relative abundance (%) and relative frequency (%) of *A. senega*l and associated species (Lamprecht, 1989). The IVI of each species was converted in to a 100 per cent scale (Kindeya, 2003).

The term dominance refers to the degree of coverage of a species as an expression the space it occupies. Dominance is usually expressed by stem basal area. This may be expressed as the absolute dominance (=the sum of the basal areas of the individuals in m2 per ha) and relative dominance (= the percentage of the total basal area of a given species out of the total measured stem basal areas of all species) (Lamprechet, 1989). Basal area is the cross sectional area of a tree trunk measured at diameter breast height (DBH, 1.3m). Basal area was calculated for

G*rewia ferruginea, Balanytes aegyptica*, Zana and *Dalbergia melanoxylon* tree species. In terms of abundance, *A. senegal* is the most abundant in site one, followed by site two and site tree. In addition, *A. senegal*, is known to hold multipurpose including high economic significance is observed to dominate the abundance, and own highest density in all study sites. In general, site one has higher regeneration of woody plants than the remaining sites. *A. senegal* is the most frequent and ranked first in all the study sites. The remaining tree species vary in their frequency and rank accordingly in each study sites (Table 1). This may be linked to the preference of other trees by local people for their forage, charcoal making and fuel wood uses. So individuals of the species are purposely made to have large size, which make it to be dominant in most of the sites (Site 1 and 3).

Acacia senegal rank first in IVI in all sites (Table 1). This shows that *A. senegal* is the most ecologically important tree species in the study area. In fact, each tree species has different total IVI in each study site. This indicates that each species has different ecological importance in different ecosystem. Stands that yield more or less the same IVI for the characteristic species indicate the existence of the same or at least similar stand composition, structure, site characteristics and comparable dynamics (Lamprechet, 1989).
Population structure data have long been used by foresters and ecologists to investigate the regeneration characteristics of tropical trees. Since it is difficult to determine the age of tropical trees, studies on population structure are based on size class–distributions. Most analysis of these groups has found that tropical tree populations are characterized by a limited number of different size class–distributions (Peters, 1996). The height and diameter class (Distribution of the population) which in turn defines the population structure which refers to the regeneration status as well as past and recent regeneration patterns of the species (Demel, 1996). Population structure is an extremely useful tool for orienting management activities and, perhaps most importantly, for assessing the impact of resource extraction (Peters, 1996).

Table 1. Density, abundance, frequency, dominance and importance value index (IVI) of the tree species in the Abderafi Woreda.

Site No. 1											
No	**Species**	**D/ha**	**RD (%)**	**N**	**%N**	**LN**	**F**	**%F**	**Do**	**% Do**	**IVI (%)**
1	*A.senegal*	317	78.5	12.7	78.7	12.7	21	42	1.1	19	66
2	*A.Seyal*	17	4.2	0.7	4.1	2.8	5	10	1.2	22	6
3	Chamda	6	1.5	0.2	1.5	1.3	4	8	1.6	28	4
4	*Diorostachys ginerea*	4	1.0	0.1	0.9	1.0	1	2	0.1	2	1
5	Kitrite	15	3.7	0.6	3.8	6.5	2	4	0.0	1	4
6	*Grewia ferruginea*	6	1.5	0.2	1.5	2.5	2	4	0.0	0	2
7	*Balanytes aegyptica*	10	2.5	0.4	2.4	2.7	3	6	1.3	24	4
8	Zana	11	2.7	0.4	2.7	1.5	6	12	0.1	2	6
9	*Dalbergia melanoxylon*	18	4.5	0.7	4.4	2.5	6	12	0.1	2	7

Site No. 2

No	Species	D/ha	RD (%)	N	%N	LN	F	%F	Do	% Do	IVI (%)
1	*A.senegal*	158	70.22	6.32	70.25	6.32	31	52.5	0.90	31	64
2	*A.Seyal*	21	9.33	0.84	5.21	5.20	5	8.5	0.51	18	8
3	Chamda	10	4.44	0.42	2.61	2.17	6	10.2	0.26	9	6
4	*Diorostachys ginerea*	9	4.00	0.35	2.20	1.83	6	10.2	0.23	8	5
5	Kitrite	10	4.44	0.39	2.41	12.00	1	1.7	0.03	1	3
6	*Grewia ferruginea*	8	3.56	0.32	2.00	3.33	3	5.1	0.11	4	4
7	*Balanytes aegyptica*	5	2.22	0.19	1.20	3.00	2	3.4	0.82	28	2
8	*Dalbergia melanoxylon*	4	1.78	0.16	1.00	1.00	5	8.5	0.03	1	4

Site No. 3

No	Species	D/ha	RD (%)	N	%N	LN	F	%F	Do	% Do	IVI (%)
1	*A.senegal*	100	65.8	4.00	66.0	8.3	15	38	0.52	12.89	56
2	*A.Seyal*	33	21.7	1.32	8.2	3.4	12	30	1.10	27.34	20
3	Chamda	2	1.3	0.06	0.4	1.0	2	5	0.15	3.83	2
4	*Diorostachys ginerea*	5	3.3	0.19	1.2	3.0	2	5	0.03	0.78	3
5	Kitrite	4	2.6	0.16	1.0	1.3	4	10	0.69	17.11	5
6	*Balanytes aegyptica*	7	4.6	0.29	1.8	2.3	4	10	1.45	36.09	5
7	*Dalbergia melanoxylo*	1	0.7	0.03	0.2	1.0	1	3	0.08	1.95	1

No = No of species; D = Density per ha; RD = Relative Density; N = Average abundance per plot; % N = Relative abundance of the species; LN = Local abundance; F = Absolute Frequency; % F = Relative frequency; DO = Absolute Dominance (m2 ha–1); % DO = Relative Dominance; and IVI = Importance Value Index.

The vegetation population structure of the study sites showed Group I distribution both in their diameter and height (Figure 1 & 2) except little irregularity is shown in the height distribution of site two. Moreover, good regeneration is seen in site one and site three as compared to study site two. Conversely, it is indicative of good status of progressing towards stable population structure (Tefera et al., 2005) and a healthy population (Banda et al., 2006). Moreover, in these sites

4.2. Population Structure

Smaller numbers of individuals are present as we move to higher classes both in the diameter and height distribution class. This shows that there is high extraction of trees for fuel wood, charcoal, and other purposes which are common in the area. Generally the vegetation structure of the three study sites showed that good regeneration and good status for populations in site one as compared to site two and three this may be due to the difference in absence as well as presence of interference from human activities in the study area.

Acacia senegal shows an approximately Group I size class–distribution in both diameter and height in all three sites. The remaining tree species show an approximately Group I size class–distribution and Group II size class (Irregular) in both diameter (Figure 3 - 8). Generally, a Group I size class–distribution (as the groups are described in the materials and methods section) is indicative of good regeneration status progressing towards stable population structure (Tefera et al., 2005) and a healthy population (Banda et al., 2006).

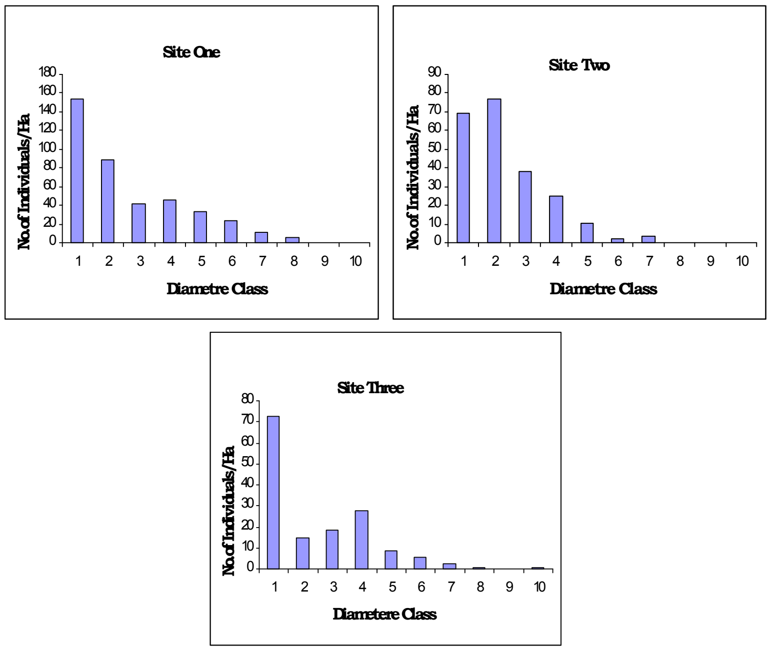


Figure 10. Distribution of trees in different diameter classes of the three sites of Abderafi woreda **6**

(Diameter Classes: Class 1 = 0 – 4cm; Class 2 = 4 – 8cm; Class 3 = 8 – 12cm; Class 4 = 12 – 16cm; Class 5 = 16 – 20cm; Class 6 = 20 – 24cm; Class 7 = 24 – 28cm; Class 8 = 28 – 32cm; Class 9 = 32 – 36cm; Class 10 = >36).

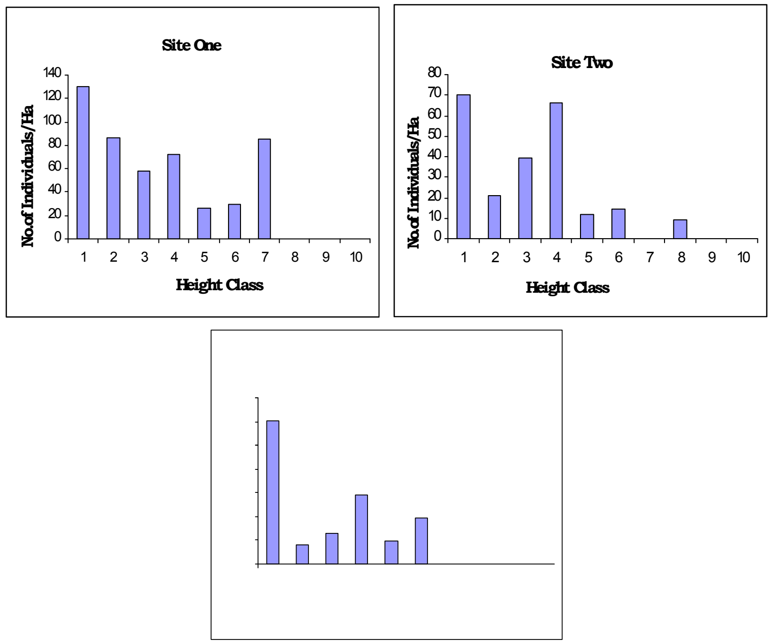


Figure 2.11 Distribution of trees in different Height classes of the all three sites in Abderafi Woreda 7

But as seen in the histograms of the present study, even though there is a positive regeneration for the species that show Group I size class–distribution, small number of individuals existed in the higher diameter and height classes for some tree species due to the reasons discussed at the population structure of the vegetation. Thus, urgent action is needed to maintain acceptable number of individuals at higher diameter and height classes to use them for the desired end–use like NTFPs and environmental benefits. Therefore there is a need for in depth study on their regeneration mechanisms and environmental factors affecting their population, and to devise appropriate methods and following management actions to facilitate and increase their regeneration.

7 (Height Classes: Class 1 = 0 – 2m; Class 2 = 2 – 4m; Class 3 = 4 – 6m; Class 4 = 6 – 8; Class 5 = 8 – 10; Class 6 = 10 – 12; Class 7 = 12 – 14; Class 8 = 14 – 16; Class 9 = 16 – 18; Class 10 = >18).

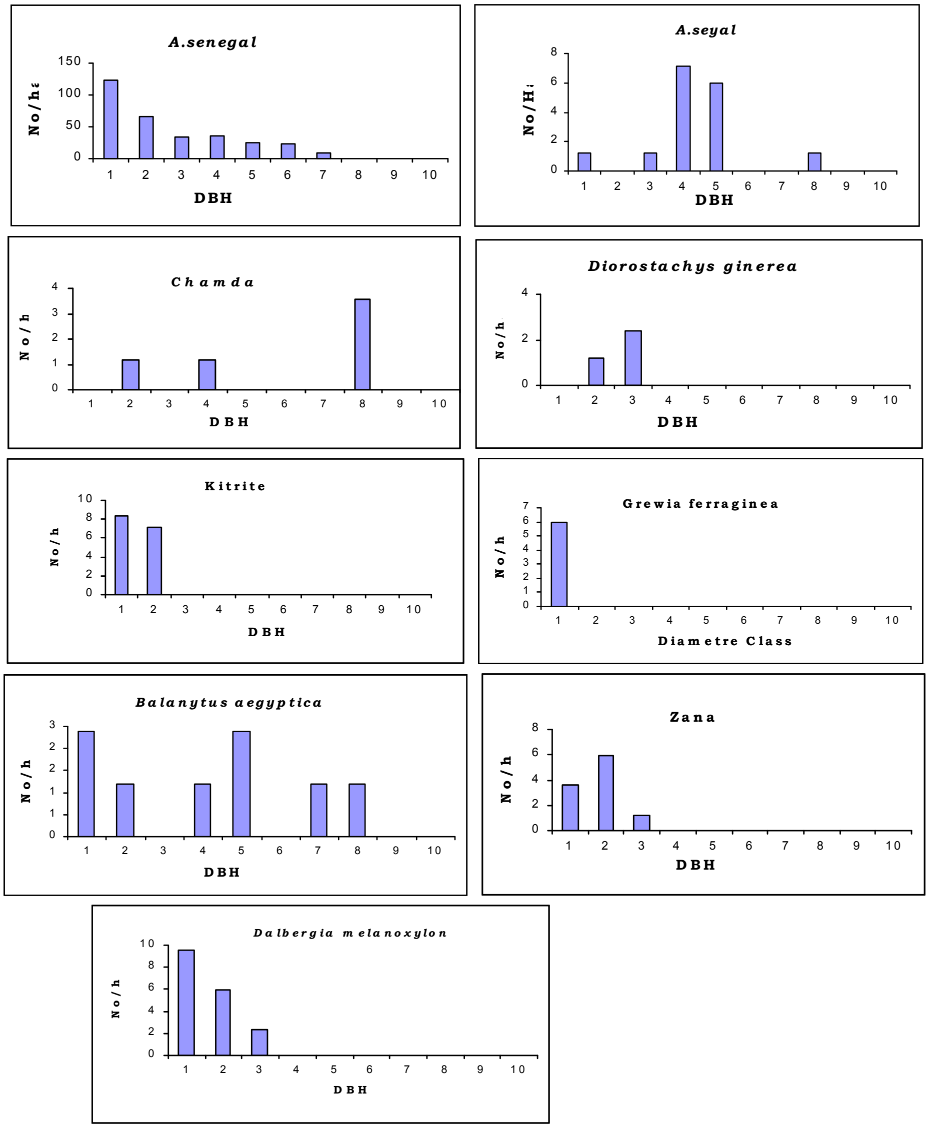
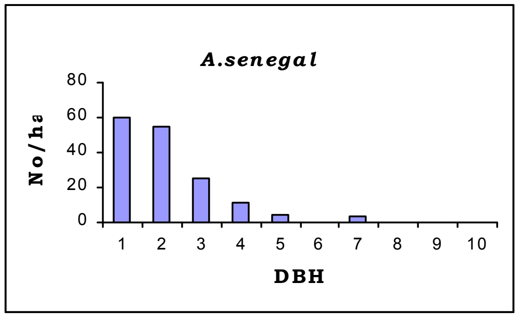
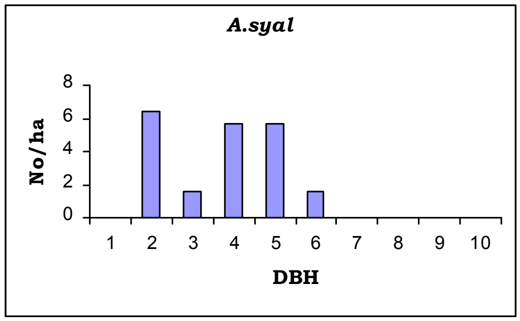
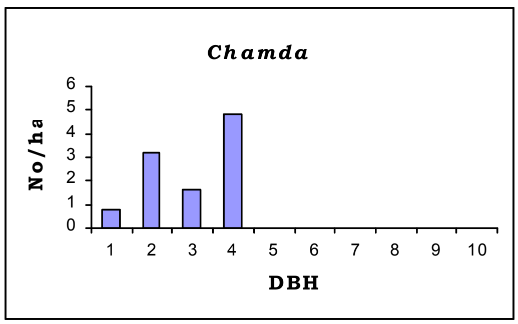


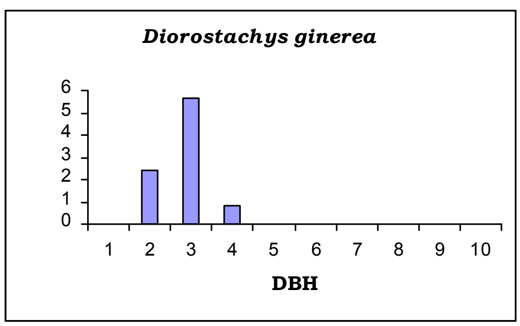
Figure 3. Distribution of different tree species in different diameter classes at site one[8]

[8] Diameter Classes: Class 1 = 0 – 4cm; Class 2 = 4 – 8cm; Class 3 = 8 – 12cm; Class 4 = 12 – 16cm; Class 5 = 16 – 20cm; Class 6 = 20 – 24cm; Class 7 = 24 – 28cm; Class 8 = 28 – 32cm; Class 9 = 32 – 36cm; Class 10 = >36.


A.senegal
No/ha
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10
DBH


A.syal
No/ha
8
6
4
2
0
1 2 3 4 5 6 7 8 9 10
DBH


Chamda
No/ha
6
5
4
3
2
1
0
1 2 3 4 5 6 7 8 9 10
DBH


Diorostachys ginerea
6
5
4
3
2
1
0
1 2 3 4 5 6 7 8 9 10
DBH

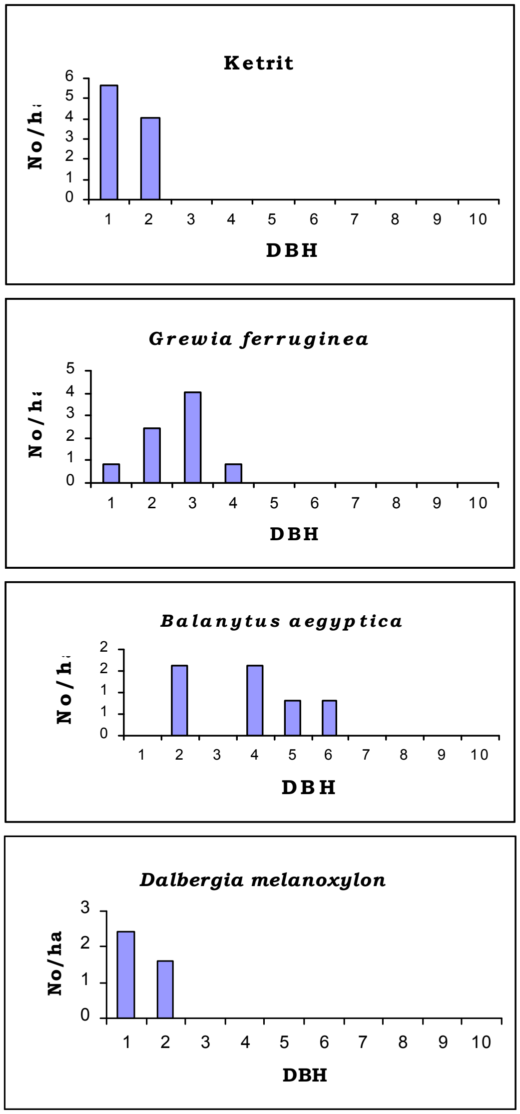
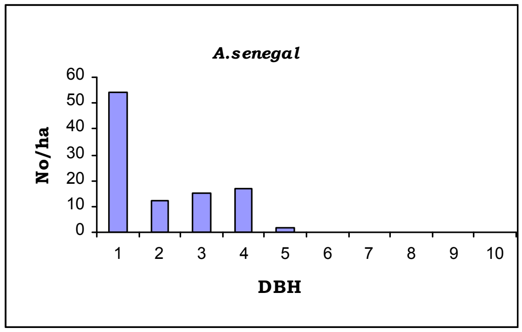
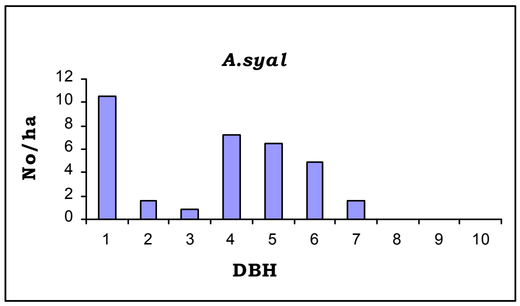
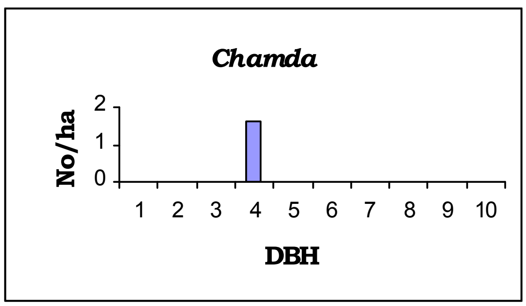


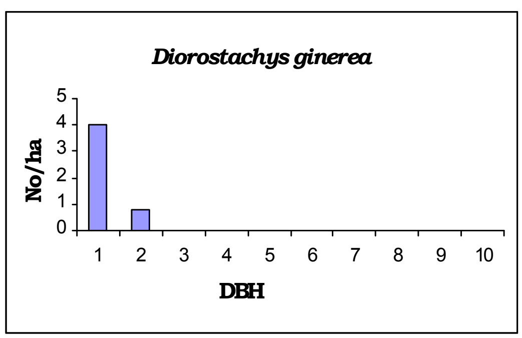
Figure 4. Distribution of different tree species in different diameter classes at site two[9]

[9] Diameter Classes: Class 1 = 0 – 4cm; Class 2 = 4 – 8cm; Class 3 = 8 – 12cm; Class 4 = 12 – 16cm; Class 5 = 16 – 20cm; Class 6 = 20 – 24cm; Class 7 = 24 – 28cm; Class 8 = 28 – 32cm; Class 9 = 32 – 36cm; Class 10 = >36.


A.senegal
No/ha
60
50
40
30
20
10
0
1 2 3 4 5 6 7 8 9 10
DBH


A.syal
No/ha
12
10
8
6
4
2
0
1 2 3 4 5 6 7 8 9 10
DBH


Chamda
No/ha
2
1
0
1 2 3 4 5 6 7 8 9 10
DBH


Diorostachys ginerea
No/ha
5
4
3
2
1
0
1 2 3 4 5 6 7 8 9 10
DBH

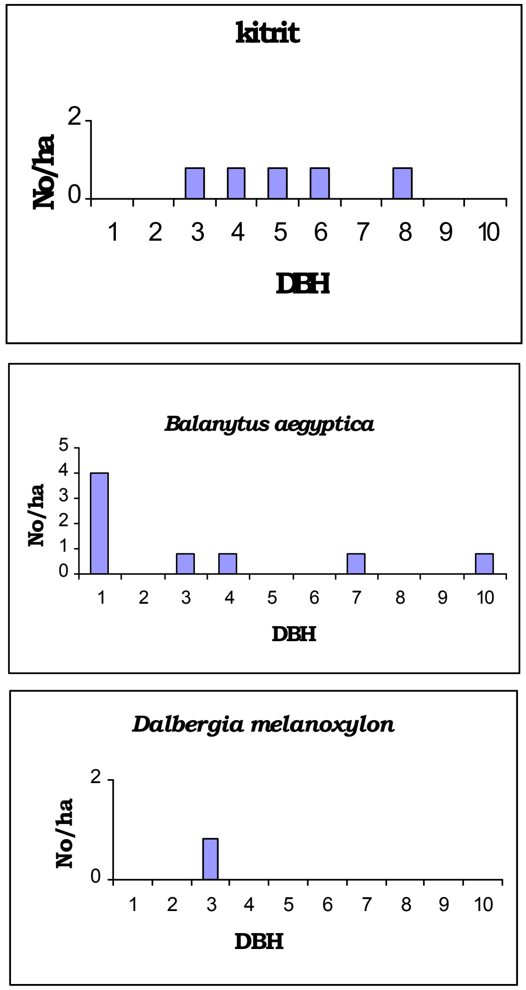
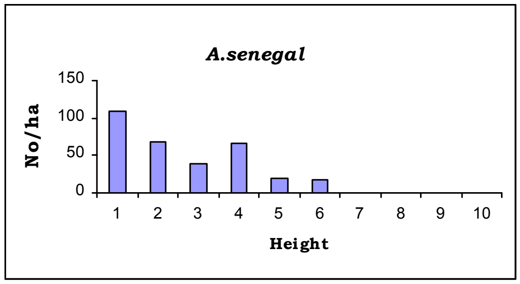
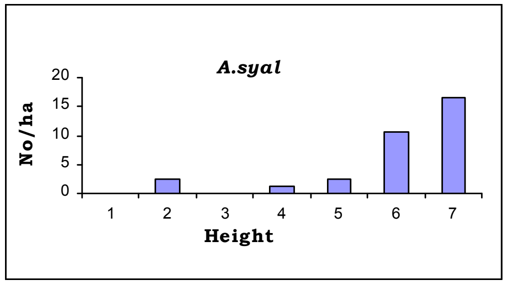
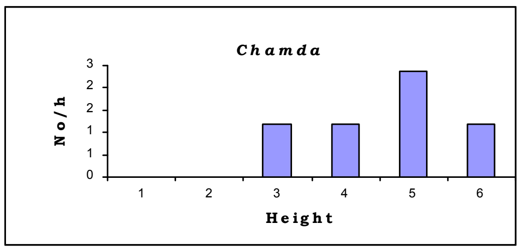


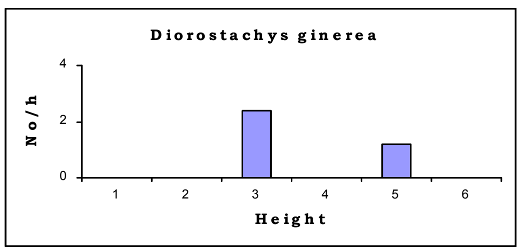
Figure 5. Distribution of different tree species in different diameter classes' at site three[10]

[10] Diameter Classes: Class 1 = 0 – 4cm; Class 2 = 4 – 8cm; Class 3 = 8 – 12cm; Class 4 = 12 – 16cm; Class 5 = 16 – 20cm; Class 6 = 20 – 24cm; Class 7 = 24 – 28cm; Class 8 = 28 – 32cm; Class 9 = 32 – 36cm; Class 10 = >36.


A.senegal
No/ha
150
100
50
0
1 2 3 4 5 6 7 8 9 10
Height


A.syal
No/ha
20
15
10
5
0
1 2 3 4 5 6 7
Height


Chamda
No/h
3
2
2
1
1
0
1 2 3 4 5 6
Height


Diorostachys ginerea
No/h
4
2
0
1 2 3 4 5 6
Height

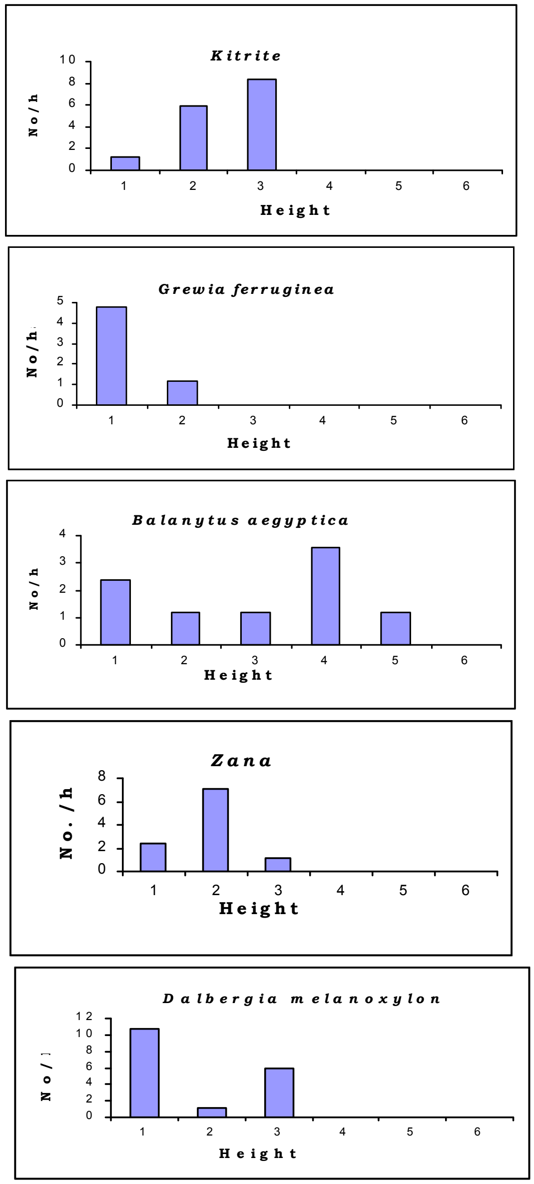
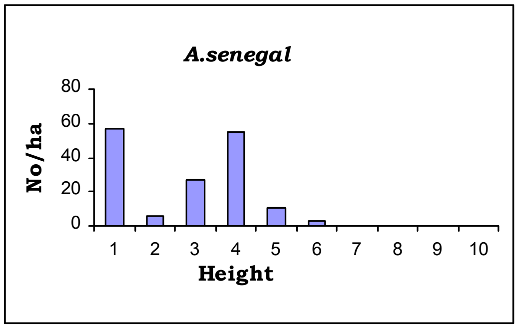
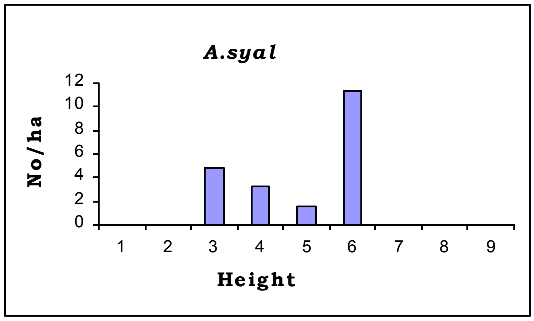
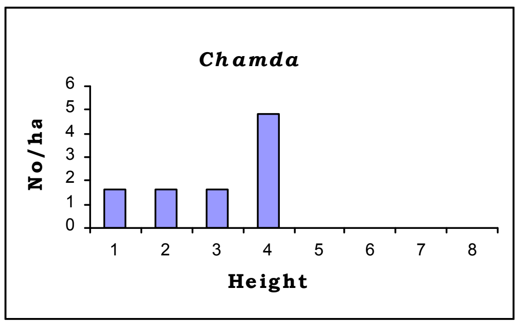


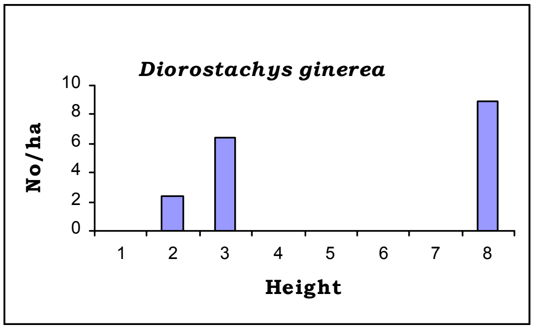
Figure 6. Distribution of different tree species in different height classes at site one[11]

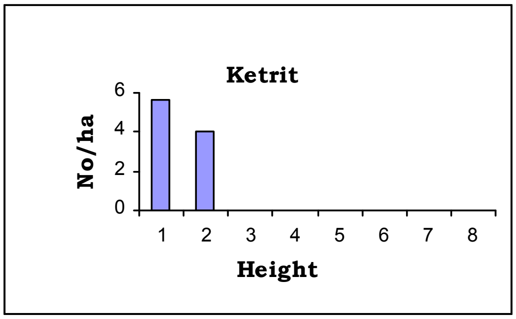
[11] Height Classes: Class 1 = 0 – 2m; Class 2 = 2 – 4m; Class 3 = 4 – 6m; Class 4 = 6 – 8; Class 5 = 8 – 10; Class 6 = >10

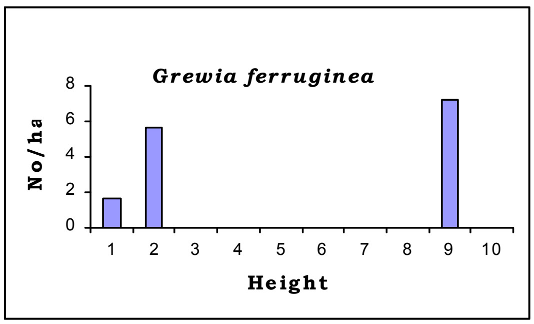

A.senegal
No/ha
0
20
40
60
80
1 2 3 4 5 6 7 8 9 10
Height

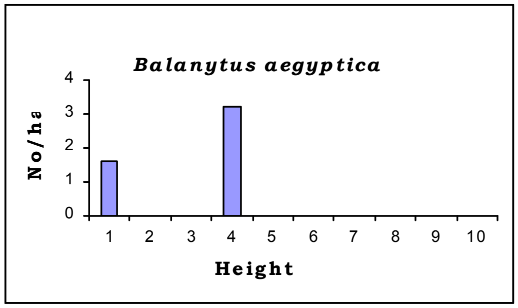

A.syal
No/ha
0
2
4
6
8
10
12
1 2 3 4 5 6 7 8 9
Height


Chamda
No/ha
0
1
2
3
4
5
6
1 2 3 4 5 6 7 8
Height


Diorostachys ginerea
No/ha
10
8
6
4
2
0
1
2
3
4
5
6
7
8
Height


Ketrit
No/ha
6
4
2
0
1
2
3
4
5
6
7
8
Height


Grewia ferruginea
No/ha
8
6
4
2
0
1
2
3
4
5
6
7
8
9
10
Height



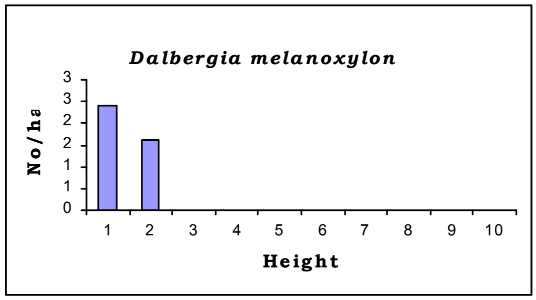
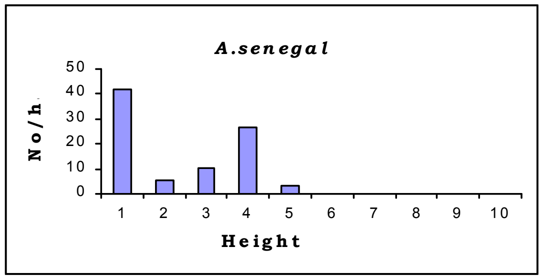
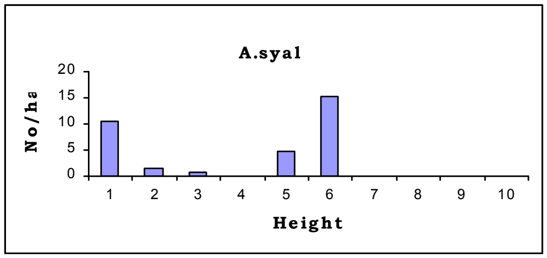
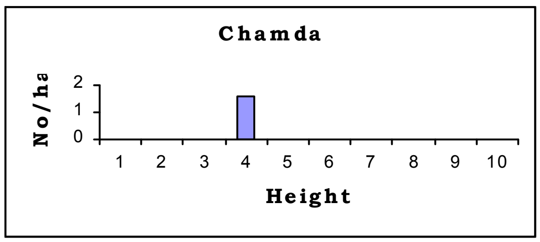


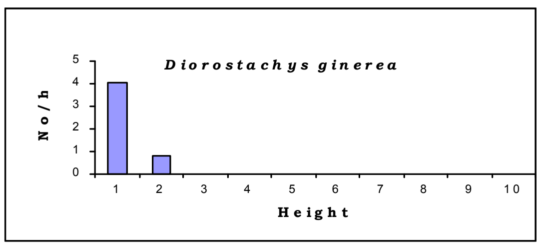
Figure 7. Distribution of different tree species in different height classes at site two**12**

[12] Height Classes: Class 1 = 0 – 2m; Class 2 = 2 – 4m; Class 3 = 4 – 6m; Class 4 = 6 – 8; Class 5 = 8 – 10; Class 6 = >10


A.senegal
No/h
50
40
30
20
10
0
1 2 3 4 5 6 7 8 9 10
Height


A.syal
No/ha
20
15
10
5
0
1 2 3 4 5 6 7 8 9 10
Height


Chamda
No/ha
2
1
0
1 2 3 4 5 6 7 8 9 10
Height


Diorostachys ginerea
No/h
5
4
3
2
1
0
1 2 3 4 5 6 7 8 9 10
Height

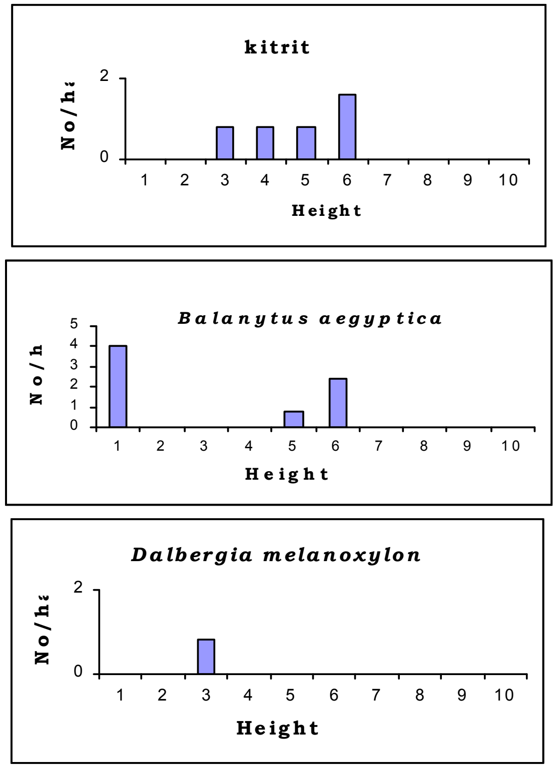


Figure 8. Distribution of different tree species in different height classes of site three[13]

From the height structure of the tree species presented above it is easily observed that *A. senegal* exhibits Group I size class–distribution and some tree species exhibits the normal J shape structure (*A.syal,* kitrit and Zana). This may be associated to the different factors affecting the populations of the species through time. Therefore, periodic monitoring of population structure of a species can be used to assess the ecological health of a tree population and to guarantee the long–term sustainability of NTFPs (Peters, 1996).

4.3. Potential of **A.senegal** *tree stands for Gum production*

Acacia senegal trees can tapped beginning from smallest size class, less than 5 cm diameter, by making incisions in the stems and branches by stripping away the bark to accelerate exudation of gum arabic (Mohamed, 2005). To determine harvestable number of

[13] Height Classes: Class 1 = 0 – 2m; Class 2 = 2 – 4m; Class 3 = 4 – 6m; Class 4 = 6 – 8; Class 5 = 8 – 10; Class 6 = >10

A. senegal trees for gum arabic production in the study area, trees having diameter greater than and equal to 4 cm are counted. Harvestable number of *A. senegal* trees per hectare in the study area are 194, 98 and 46 in site one, two and three respectively. This number is less as compared to the number of harvestable size of *A.senegal* trees of the central rift valley region which is ranging from 12 – 209 per hector this due the inclusion of individuals at diameter class of greater than or equal to 2cm for harvesting of gum arabic from the stand. Even though, this study excludes those individuals with diameter class of less than 4cm from harvestable size class, still the stand of the *A. senegal* in the study area indicated that there is sufficient number of trees to launch commercial harvesting of gum arabic from the study area. There fore, it is encouraging to start the gum arabic business in the area.

4.4 Socio Economic Importance

The socio economic survey result showed that most of the inhabitants were farmers and growing cash and food crops, rearing animals, trading and daily labour were their main sources of income.

Crop production is the major source of income for the local people. Large portions of the population grew cash and food crops. Sesame and cotton are the main cash crops grown in the study area of which sesame is an exportable crop. Previously, shifting cultivation was the common traditional farming system practiced by almost all individuals. The main reasons for shifting cultivation were weed problem, reduction in soil fertility and the need to grow sorghum.

All households living in and around the wood land area of Abderafi used the woodland in one or other ways. However, more dependency was observed on the utilization of six main types of NTFPs. These are, honey, fuelwood, farm implements, gum, traditional medicines and household utensils. No villager generated income from the sale of forest products. This might be due to the presence of an alternative livelihood means in the study area i.e. agriculture. Locals were not aware of the economic importance of *A.senegal* tree species. Hence, they have not been using the tree economically. They only used its wood for making farm implements, fencing, charcoal, and fuelwood. The production of gum from *A.senegal* is not common by the locals. Lack of awareness in the production system and marketing of gum arabic were mentioned as the major constraints in the study area. However, some people from the neighboring country (Sudan) regularly harvest gum arabic from the *A.senegal* stand near the Ethio-Sudan boarder.

The presence of large grazing lands including the woodland encourages the locals to rear large sizes of livestock. Livestock are kept as a source of animal power, to diversify income source and to use it at the time of crop failure and sickness. Also, the size of a livestock herd is a mark of social prestige and a mark of economic well-being. Draft power is used for ploughing, collecting and transporting fuelwood, fetching water, transporting food and other materials to and from markets, etc. Free grazing is the most common practice at study site in which the woodland is the main grazing area for livestock. But, due to annual burning of the vegetations and the introduction of large cattle population size, shortage of animal feed during the dry season is common.

5. Conclusion

The population status of tree species of Abderafi woreda generally shows the presence of good regeneration. However at higher size classes the number of individuals dramatically falls probably due to high rate of harvest taking place in the area. In addition some trees unfortunate in some diameter class and showed the normal J-shaped structure which is the sign of their instability in the stand of *A.senegal* in the study area. Nonetheless, *A. senegal* is found to have higher density, good regeneration, and high IVI in the three sites where the inventory were done. If appropriate management activities are applied, the nature of the population structure of most of the tree species including *A. senegal* will take stable type. Indeed, there is a possibility to start the gum arabic business with the existing harvestable number of *A. senegal* trees, as this could supplement the income from agricultural production in the study area. There is a possibility of recruiting harvestable number of *A. senegal* trees in the near future since there is very high regeneration of *A. senegal* trees in the area. The socio economic survey also indicated that farmers use different tree species for different purpose, however, the population structure of each species depicted that there is selective cutting of trees at a certain diameter class in the stand. This adversely affects the status of each species which will have impact to the over all status of the stand.

6. Recommendations

- Improved management of the woodland is needed to improve the vegetation structure of the study area.
- Study on soil seed bank and regeneration potential of the associated tree species should be done to see the main cause of their irregularity in their structure.
- Yield study should be followed in order to determine weather the amount of gum arabic produced from the area satisfies for commercialization purpose.
- Market studies should go hand–in–hand with the development of the countries' *A. senegal* resource base for gum arabic production.
- Assessments of other gum bearing tree species in the study area are needed.

7. References

Abeje Ashete, 2002: Regeneration status, soil seed banks and socio-economic importance of B. papyrifera in two Woredas of Northern Gonder Zone, Northern Ethiopia. M.Sc thesis, Swedish University of Agricultural Sciences, Sweden

Abeje Eshete, Demel Teketay and Hulten, H., 2005. The Socio–Economic Importance and Status of Populations of Boswellia papyrifera (Del.) Hochst in Northern Ethiopia: The Case of North Gondar Zone. Forests Trees and Livelihoods, Vol 15; pp 55–74. A B Academic Publishers, Great Britain.

Azene, Bekele-Tesemma, Birnie, A. And Tengnas, B. 1993. Useful Trees and Shrubs for Ethiopia. Identification, Propagation and Management for Agricultural and Pastoral Communities. Regional Soil Conservation Unit, SIDA, Nairobi.

Banda, T., Schwartz, M. W. and Caro, T. 2006. Woody Vegetation Structure and Composition along a Protection Gradient in a Miombo Ecosystem of Western Tanzania. Journal of Arid Environments, Article in press.

Demel Teketay, 1996. Seed Ecology And Regeneration in Dry Afromontane Forests of Ethiopia. Ph.D. Thesis, Swedish University of Agricultural Sciences, Umeå. 36 pp.

Friis, i. 1992. Forests and forest trees of northeast tropical Africa. Kew Bulletin Additional Series XV: 1-396.

Getachew Eshete, 1999. The Impact of Different Land use Types on Structure, Regeneration and Soil Properties of Abernosa Acacia woodland, Eastern Shoa, Ethiopia. Ethiopian MSc in Forestry Programme Thesis Works, Report No. 1999:41, Swedish University of Agricultural Sciences, Skinnskatteberg.

Janzen, D.H., 1970. Herbivores and the number of tree species in tropical forests. The American Naturalist 104: 501-528.

Janzen, D.H., 1988. Tropical dry forests: the most endangered major tropical ecosystem. In: WILSON, E.O., PETER, F.M. (eds.), Biodiversity. National Academy Press. Washington, DC. USA. pp. 130-137.

Kent, M. and Coker, P., 1994. Vegetation Description and Analysis. A Practical Approach. John Wiley & Sons Ltd. England. 363 pp.

Kindeya Gebrehiwot, 2003. Ecology and Management of Boswellia papyrifera (Del.) Hochst. Dry Forests in Tigray, Northern Ethiopia. Doctoral Dissertation submitted for the degree of Doctor of Forest Sciences of the Faculty of Forest Sciences and Forest Ecology. Georg–August–University of Göttingen, Göttingen 2003.

Lamprecht, H., 1989. Silviculture in the Tropics. Tropical Forest Ecosystems and their Tree species – Possibilities and Methods for their Long–Term Utilization. Institute for Silviculture of the University of Göttingen. Technical Cooperation–Federal Republic of Germany, Berlin. 296 pp.

Mohamed, A. G., 2005. Improvement of Traditional Acacia senegal Agroforestry: Ecophysiological Characteristics as Indicators for Tree–Crop Interaction on Sandy Soil in Western Sudan. Academic Dissertation. University of Helsinki. Helsinki.

Mulugeta Lemeneh And Demel Teketay, 2003: Frankincense and myrrh resources of Ethiopia: I Distribution, production, opportunities for dryland development and research needs. Sinet: Ethiop. J. Sci., 26(1):63–72.

mulugeta lemenih and demel teketay, 2004. Natural Gum and Resin Resources: Opportunity to Integrate Production with Conservation of Biodiversity, Control of Desertification and Adapt to Climate Change in the Drylands of Ethiopia. Paper Presented to the First National Workshop on Conservation of Genetic Resources of Non Timber Forest Products (NTFPs) in Ethiopia, 5–6 April 2004. Addis Ababa.

Murphy, P.G., Lugo, A.E., 1986. Ecology of tropical dry forest. Annual Review of Ecology and Systematic 17: 67-88.

Ogbazghi, Woldeselassie, 2001: The distribution and regeneration of Boswellia papyrifera (Del.) Hochst. In Eritrea. PhD Thesis. Tropical Resource Management Papers No. 35, Wageningen University, The Netherlands.

Peters, C. M., 1996. The Ecology and Management of Non–Timber Forest Recourses. World Bank Technical Paper 322, Washington.

Tadesse Woldemariam Gole, 2003. Vegetation of the Yayu Forest in SW Ethiopia: Impacts of Human Use and Implication for in situ Conservation of Wild Coffea arabica L. Populations (Ed. Vlek, Paul L.G.). Ecology and Development Series, No. 10. Göttingen.

Tefera M., Demel T., Hulten, H. and Yonas Y., 2005. The Role of Enclosures in the Recovery of Woody Vegetation in Degraded Dryland Hillsides of Central and Northern Ethiopia. Journal of Arid Environments, Vol. 60; pp 259–281.

Tilahun, G., 1997: Boswellia papyrifera (Del.) Hochst. From Western Tigray: opportunities, constraints and seed germination responses. MSc thesis. Report No. 1996: 12. Swedish University of Agricultural Sciences. Faculty of Forestry, Sweden. 58 pp.

Vivero Pol, J. L., 2002. Forest Is Not Only Wood: The Importance of Non–Wood Forest Products for the Food Security of Rural Household in Ethiopia. In: Forests and Environment (Eds. Demel Teketay and Yonas Yemishaw). Proceedings of the Fourth Annual Conference, Forestry Society of Ethiopia, 14–15 January 2002, Addis Ababa. pp 16–31.

Wubalem Tadesse, Sisay Feleke And Teshome Eshete 2004. Comparative study of traditional and new tapping method on frankincense yield of Boswellia papyrifera. Ethiopian Journal of Natural Resources 6, 287–299.

Web based references http://www.undp.org/drylands/what-are.htm