ORIGINAL ARTICLE

Woody Species Composition and Structure of the Gurra Farda Forest, Snnpr, South Western Ethiopia

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ABSTRACT

Deforestation have been taking place in Ethiopia for hundreds of years. The chief reasons given for reduction of the forest area are uncontrolled exploitation, shifting cultivation, forest fires and the expansion of permanently cultivated areas. So the assessment of these forests is the basis for meaningful planning to rationally utilize the remaining forest resources. Therefore, Woody species composition and structure of Gurra Farda forest was studied from November 2005 to September 2006. Thirty two sampling plots, each having sizes of 20 m X 20 m were laid in the forest based on their homogeneity. Diameter and height was measured for all trees and shrubs with DBH greater than 2 cm. Sixty six woody species belonging to 28 families were recorded in the forest. Moraceae was found to be the dominant family in the forest with 7 species comprising 10.6 % of the total species identified followed by Rubiaceae with 6 species or 9 % of the total woody species identified. From the identified plants five species were climbers, 32 shrubs and 29 trees. Tree density was 1373 individuals per hectare and the basal area was 90.6m2/ha. Most of the individuals were distributed in the lower DBH and height classes. Since this is forest is one of the remaining forests with wild populations of Coffea Arabica due attention has to be given to its conservation and sustainable utilization.

Key phrases*: Basal area, Diameter at Breast Heig*ht, Gurra Farda

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INTRODUCTION

In Ethiopia, environmental degradation and deforestation have been taking place for hundreds of years. Forests in the entire country declined from the original 35% to 16% in 1952, 3.6% by 1980, 2.6% by 1987, and an estimated 2.4% in 1992 (Sayer *et al.*, 1992).

The Primary cause of deforestation is cutting trees with the aim of opening up new agriculture land to feed the ever growing population. Deforestation is estimated to take place at the rate of 200,000 ha/year (EFAP, 1994). The Widespread use of fuel wood as energy has also contributed to the deforestation process. About 95 per cent of the total energy consumption in Ethiopia is composed of traditional biomass fuels, with only 5 per cent coming from modern energy sources (Ethiopia-UNCED, 1992).

In Ethiopia, presently most of the remaining forests are being confined to remnant patches in inaccessible areas. Of the remaining forests, 54 per cent are in the western regions of Illubabor (48%), Keffa, and Wellega. The woodland/Savannah region originally covered 371,900 sq. km (30 % of the country) in the semi-arid and sub- humid regions surrounding the highlands. Only 7.6 per cent of the total area is currently covered by this vegetation type (Ethiopia-UNCED, 1992).

The underlying factor responsible for the decline in forest areas of Ethiopia are the low living standard of the people and lack of other alternatives. This is expressed by increasing demands for crop and grazing land and wood for fuel and construction (Taye Bekele *et al.*, 1999). New settlements in forests are increasing and have resulted in the conversion of forestland in to agricultural and other land use systems.

The pressure from investors who are converting the moist montane forests of the southwestern part of the country in to other land use systems such as coffee and tea plantations at present, threatens the few remaining high forests (Taye Bekele *et al.*, 2001).

Thus, in order to maintain the ecological equilibrium and to meet the forest requirement of the population, scientific information is the basis. Without a full assessment of the properties of the various sites in a forest and their relation to vegetation growth the management of the forest will be severely handicapped. The assessment of these forests is the basis for meaningful planning to rationally utilize the remaining forest resources. There fore, the objective of this study is to identify the woody species composition of the forest and to documents its status that gives baseline information for developing the management plan of the forest.

MATERIALS AND METHODS

Description of the study area

Gurra Farda forest is located in Bench Maji zone of the SNNPR in the southwestern part of Ethiopia at a distance of approximately 600 km away from Addis Ababa. It is located at 6^0.81' N and 34^0.97' E and is one of the high forests designated as forest priority area for conservation (EFAP, 1994). The altitudinal range of the Gurra Farda woreda is between 800 to 1900 m above sea level. The mean annual temperature is 28^0 C and the mean annual rainfall is 1350mm (EMA, 1988).

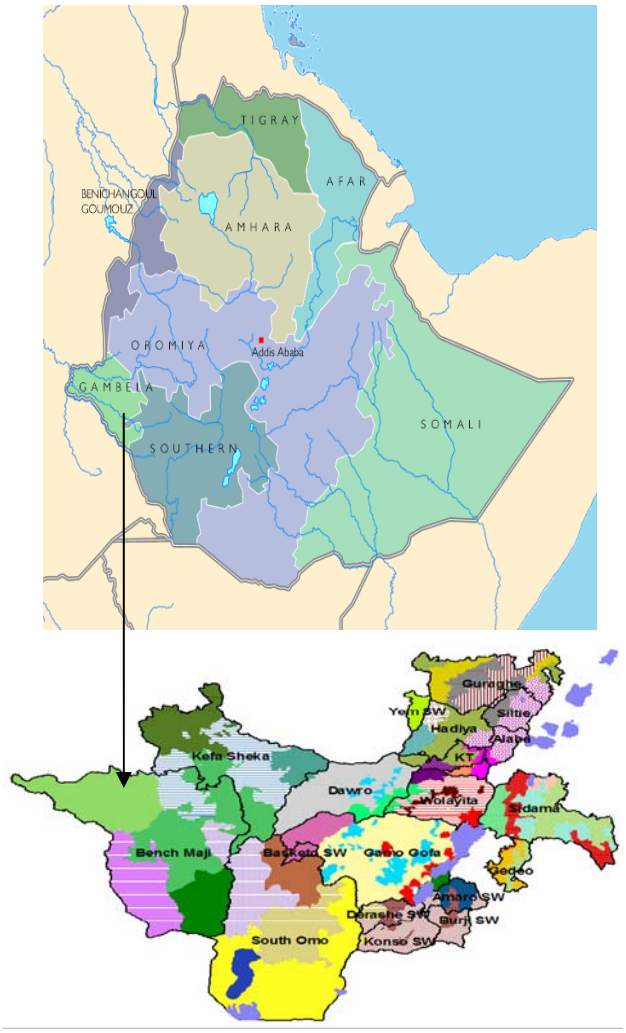

Fig.1. Map of the study area

Vegetation Data Collection and Plant Identification

A reconnaissance survey and data collection trips were made to the study area from November 2005 to June 2006. Based on the reconnaissance survey three sites were selected in the Gurra Farda forest with different level of human interference. In each site 20m X 20m quadrats were laid considering homogeneity of the forest.

Plant species in each quadrat were recorded and voucher specimens collected, numbered, pressed and taken to Jimma University herbarium, for drying, identification and storage. Trees and shrubs with DBH >2 cm were counted. The

diameter at breast height (DBH) of all trees with DBH greater than 2 cm was measured using a diameter tape. Height was also measured by using Sylva Hypsometer. The altitude of each quadrat was recorded by using altimeter.

Identification of plant specimens was conducted in Jimma University Herbarium by comparing with identified plant specimens. Keys and descriptions of taxa in the Flora of Ethiopia and that of East Africa were used to verify the identification that has been made by comparison with authenticated specimens. Nomenclature follows that of the published volumes of the Flora of Ethiopia and Eritrea.

Method of Data Analysis

From the woody species (trees and shrubs) identified only species with DBH greater than 2 cm or density greater than 3 individuals/ha were used in the analysis of structural features (height, density, diameter and basal area).

Tree density was computed by converting the count from the total quadrats into a hectare basis. DBH was classified into 5 classes and the percentage distribution of each tree was computed for each species. Tree height was classified into 8 classes and the percentage distributions of trees in each class were computed for each species. Basal area was computed by using the formula:

Basal area = $(DBH/2)^2$ *3.14. (Müller-Dombois and Ellenberg, 1974)

RESULT AND DISCUSSION

Floristic composition of the forest

A total of 66 woody species belonging to 28 families were identified from the Gurra Farda forest. Moraceae was found to be the dominant family in the forest with 7 species comprising 10.6 % of the total species identified followed by Rubiaceae with 6 species or 9 % of the total woody species identified. Only one of the species identified was a Gymnosperm and all the remaining were Angiosperms. From the identified woody species five species were climbers, 32 shrubs and 29 trees. *Coffea arabica* is the most important understory shrub and wild coffee is still harvested extensively. The tall, open canopy consists of *Pouteria adolfi-friedrichii*, and Olea *welwitschia.* Trees with *Aningeria* and *Olea* being dominant are typical of eastern Africa (Kingdon 1989).

Structure of the forest
Density

The density of trees and shrubs with DBH greater than 2 cm in the Gurra Farda forest was 1373 individual /ha. As indicated in table 1, analysis of the density indicates that, from the 66 species of trees and shrubs identified from the forest only ten species comprised more than 69 % (937) of the total and the remaining 56 species comprises only 31% of the total. *Lepidotrichilea volkensii* was the dominant species in the forest comprising 10% (136 individuals/ha) followed by *Celtis africana* (9%) and *Olea welwitschia* (9%).

Table 1. Density of the ten dominant trees and shrubs in Gurra Farda forest, 2006.

		> 2 cm	
	Species	Individuals/ha	%
1	*Lepidotrichlia volkensii*	136	10
2	*Celtis africana*	121	9
3	*Olea welwitschia*	121	9
4	*Aningeria adolfi-friedrichi*	92	6.7
5	*Diosporyus abyssinica*	86	6.3
6	*Allophlus sp*	85	6.3
7	*Viperis danielli*	81	6
8	*Mimosopus kumel*	80	5.8
9	*Manilkara butugi*	71	5.3
10	*Croton macrostachyus*	64	4.7
		937	69

Examination of density of trees and shrubs with DBH less than 10 cm was 740 individuals /ha which is about 54% of the total density in the forest. This indicates the dominance of small sized trees and saplings in the forest. Density of trees with DBH greater than 10 cm was about 46 % (633 individual/ha) and that of DBH greater than 20 cm was 499 individuals. The ratio of density of individuals with DBH greater 10 cm to density greater than 20 cm is taken as the measure of the density of different size classes (Grubb, et al., 1963). The density of individuals with DBH >10 cm and DBH> 20 cm were 633 and 499 in the Gurra Farda forest respectively and the ratio of the former to the latter was 1.26 indicating the dominance of small sized individuals. This ratio for Masha Andracha moist montane forest (Kumilachew Yeshitila and Taye Bekele, 2003) 2.4 indicating that in the Masha Andracha Forest small sized individuals are much higher than the Gurra Farda forest.

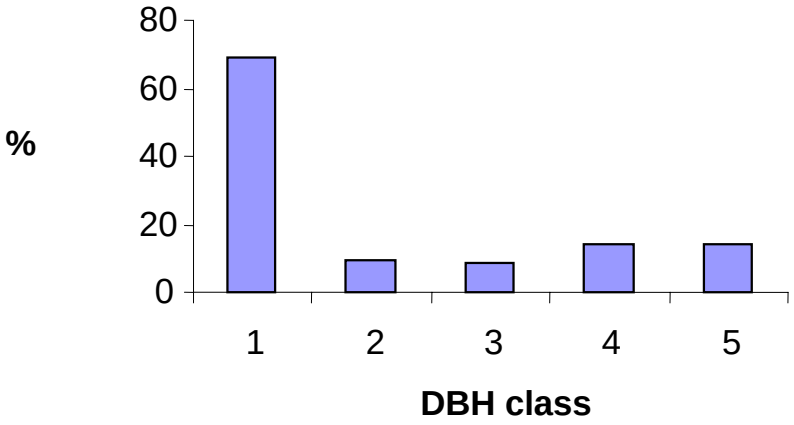

Figure 2. DBH class distribution in Gurra Farda forest, 2006.
1= 2-10cm; 2= 11-20; 3= 21-30; 4= 31-40, 5= > 41.

The distribution of individuals in the various size classes shows irregular pattern. The density of trees with DBH between 11 and 30 cm is low as compared to those above and below it indicating the existence of selective cutting at these diameter classes because this size is suitable for different house hold construction and farm implements. Kumilachew Yeshitila and Taye Bekele (2003) also reported the same trend of irregular distribution in Masha Andracha forest, south western Ethiopia. About 80% of the individuals are found in the size classes less than 20 cm in DBH indicating the predominance of small sized individuals in the forest. For the density of tree with DBH greater than 40 cm about 53% was contributed by (*Lepdotrichilia volkensii* (10.5%), *Celtis africana* (16.3%), *Diospyros abyssinica (*5.3%) *Aningeria adplfi-friedrichi* (6.8) and *Olea wewitschia* (14%).

Height distribution

Regarding the height distribution of trees in the Gurra Farda forest more than 45% have height less than 10 m and only less than 15 % have height above 35 m. Density of individuals decreased as the height increases.

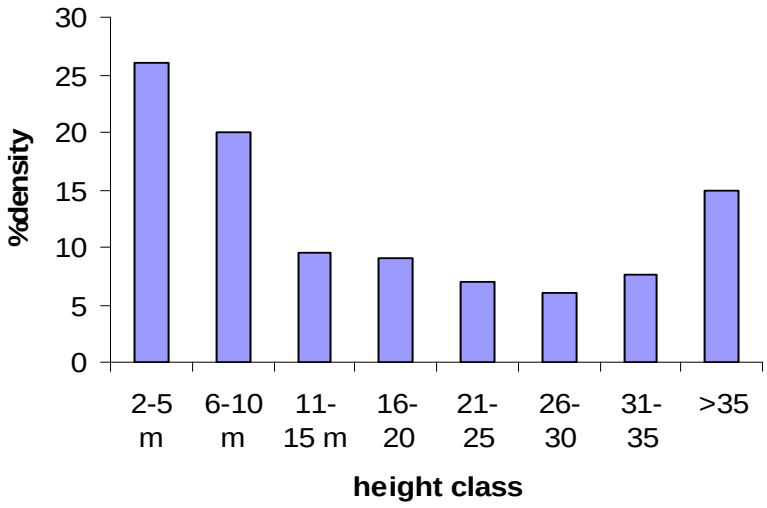

Figure 3. Height class distribution of trees and shrubs in Gurra Farda forest, 2006

Density of trees in the height class between 20 m and 30 m is low as compared to the lower and upper classes and this may be caused possibly due to selective removal of individuals in these height classes.

Basal area

The basal area for Gurra Farda forest was 64 m^2/ha and about 35% of the basal area was contributed by *Aningeria adolfi-friedrichi* and 9% by *Olea welwitschia*.

Table 2. Basal area of selected trees in the Gurra Farda forest, 2006.

	Species	Basal Area
1	*Lepdotrichlea volkensii*	1.5
2	*Celtis africana*	3.8
3	*Olea welwitschia*	5.8
4	*Aningeria adolfi-frierichi*	22.03
5	*Allophlus sp.*	3.24
6	*Ficus sychomous*	1.52
7	*Cordia africana*	2.15
8	*Morus mesozygia*	2.76
9	Ficus vasta	6.7
	total	29.33

From the total basal area in the Gurra Farda forest 45.8% was contributed by only 9 tree species from the total woody species identified.

CONCLUSION AND RECOMMENDATIONS

The Gurra Farda forest is one of the few remaining moist forests in Ethiopia. The composition of the forest shows that it harbors important tree species such as *Aningeria, Olea, Cordia* and different species of the family Moraceae. It is also one of the remaining forests with wild populations of *Coffea Arabica*.

But the forest is in great threat from settlement and investment activities that are occurring just inside the forest. Therefore for the conservation of the forest to be effective the following recommendations are put forward:

- Demarcating certain part of the forest as nature reserve to ensure survival of the forest considering that it is home for forest coffee
- Developing management plan for the forest for its conservation and sustainable utilization
- Resettlement and investment activity in the forest should take in to consideration the conservation of the forest.
- Further research on community types and regeneration of potential in the forest.

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Appendix I.

List of Plants Identified from Gurra Farda Forest

No.	Botanical name	Family	Habit
1	*Acanthus eminens* C.B.Clarke	Acanthaceae	Shrub
2	*Albizia gummifera* (J.F.Gmel) C.A. Sm	Fabaceae	Tree
3	*Allophylus abysinicus* (Hochst) Radlk.	Sapindaceae	Tree/shrub
4	*Allophylus macrophylla* Gilg.	Sapindaceae	Tree
5	*Aningeria adolfi-friedrichi* Rob. & Gilg	Sapotaceae	Tree
6	*Aningeria altisma* (A. Chev.) Aubr&Pellegr.	Sapotaceae	Tree
7	*Anitaris toxicaria* Lesh.	Moraceae	Tree
8	*Bersema abyssinica* Fres.	Melianthaceae	Shrub
9	*Blighia unijugata* Bak.	Sapindaceae	Shrub
10	*Brucea antidysitrica* J.F. Mill.	Simaroubiaceae	Shrub
11	*Calpurina aurera* (Lam.) Benth	Fabaceae	Shrub
12	*Celtis africana* Brum. F.	Ulmaceae	Tree
13	*Celtis toka* (Forrsk.) Hepper &J.R.I. Wood	Ulmaceae	Tree
14	*Clausenia anisata* (Wild.) Hook. F.ex Benth.	Rutaceae	Shrub
15	*Coffea arabica* L.	Rubiaceae	Shrub
16	*Combretum molle* R.Br. ex G. Gon.	Combertaceae	Shrub
17	*Combretum paniculatum* Vent.	Combertaceae	climber
18	*Cordia africana* Lam	Boraginaceae	tree
19	*Croton macrostachyus* Hochst. Ex A.Rich	Euphorbiaceae	Tree
20	*Diospyros abyssinica* (Hiern.) White	Ebenaceae	Tree

No.	Botanical name	Family	Habit
21	*Embelea schimperi* Vatke	Myrsinaceae	Climber
22	*Ehertia cymosa* Thonn.	Boraginaceae	Shrub
23	*Ficus sychomorus* L.	Moraceae	Tree
24	*Ficus thoningii* Bl.	Moraceae	Tree
25	*Ficus vasta* Forsk.	Moraceae	Tree
26	*Galineria saxifraga (Hochst.)Bridson*	Rubiaceae	Shrub
27	*Grewia bicolor* Juss.	Tiliaceae	Shrub
28	*Grewia ferrugnea* Hochst.	Tiliacea	Shrub
29	*Ilex mitis* (L.) Radlk.	Aquafoliaceae	Tree
30	*Jasmium abyssinicum* Hochst. Ex D.C.	Oleaceae	Climber
31	*Lepidotrichlea volkensii* (Guerke)Leroy	Meliaceae	Tree
32	*Maesa lanceolata* Forsk.	Myrsinaceae	Shrub
33	*Manilkara butugi* Chiov.	Sapotaceae	Tree
34	*Maytenus gracilipes* (Welw. Ex Oliv.) Excell	Celasteraceae	Shrub
35	*Maytenus arbutifolia* (A.Rich.) wilczek	Celasteraceae	Shrub
36	*Maytenus senegalensis* (Lam.) Excell	Celasteraceae	Shrub
37	*Maytenus undata* (Thunb.) Blakelock	Celasteraceae	Shrub
38	*Milicia excelsa* (Welw) C.C. Berg.	Moraceae	Tree
39	*Milletia ferrugnea* (Hochst.) Bak.	Fabaceae	Tree
40	*Mimosops kummel* Bruce ex DC	Sapotaceae	Tree
41	*Morus mesozygia* Stapf.	Moraceae	Tree
42	*Olea capensis* L.	Oleaceae	Shrub
43	*Olea welwetschia* (Knobl) Gilg& Schellenb.	Oleaceae	Tree
44	*Oxyanthus speciosus* DC.	Rubiaceae	Shrub
45	*Pittosporum viridiflorum* Sims.	Pittosporaceae	Tree
46	*Phoenix reclinata* Jack.	Arecaceae	Shrub
47	*Phytolaca dodecandra* L' Herit	Phytolacaceae	Shrub
48	*Rhus glotinosa* Hochst ex Rich.	Anacardiaceae	shrub
49	*Polyscias fulva* (Hiern.) Harms	Araliaceae	Tree
50	*Prunus africana* Hook F.	Rosaceae	Tree
51	*Psychotria orophila* Petit	Rubiaceae	Shrub
52	*Rothmannia urcelliformis* Bullock ex Robyns	Rubiaceae	Shrub
53	*Rubus apetalus* Poir.	Rosaceae	Climber
54	*Rubus steudneri* Schwinef	Rosaceae	Climber
55	*Rytigynia neglecta* Robyns	Rubiacea	Shrub
56	*Sapium ellipticum* (Hochst.) Pax.	Euphorbiaceae	Tree
57	*Schefleria abyssinica* Harms	Araliaceae	Tree
58	*Strychnos mitis* S. Moore	Loganaceae	Shrub
59	*Solanecio mannii* (hook f.) C. Jeffery	Asteracea	Shrub
60	*Syzigium guinensee* (Wild) D.C.	Myrtaceae	Tree
61	*Teclea nobilis* Del.	Rutaceae	Shrub
62	*Trilepisium madagascariense D.C.*	Moraceae	Tree
63	*Venonia amygdalina* Del.	Asteraceae	Shrub

No.	Botanical name	Family	Habit
64	*Vernonia auriculifera* Hiern.	Asteraceae	Shrub
65	*Vernonia dalettiensis* Mesfin	Asteraceae	shrub
66	*Vepris dainellii* (Pichi-Serm.) Kokwaro	Rutaceae	Shrub