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Diversity and Abundance of Woody Plant Species of Assosa Forest Field Gene Bank, Benishangul Gumuz Regional State, Western Ethiopia

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Abstract
The study was carried out to investigate the diversity and abundance of woody plant species of Assosa forest gene bank. An intensive inventory was made to collect the required data. Sample plot of size 20 × 20 m quadrant was used for this particular study. Sixteen quadrats of sample plot were systematically laid down with an interval of 100 m along four transect lines. Shannon-Wiener index was applied to quantify species diversity, richness, and evenness. Total of 44 woody plant species representing 26 families of were identified. Besides, from 44 identified woody plant species 938 number of individual plants were counted and recorded. Most of the woody plant species identified from the gene bank were belongs to Combretaceae family. The current study reveal that Assosa forest field gene bank has more diverse (H=3.49), unevenly distributed (E=0.0037) and unrelated abundance of all individuals of plant species.
Keywords: Woody species, diversity, field gene bank, richness, evenness

INTRODUCTION

Ethiopia is endowed with rich flora and fauna, due to its' physical and climatic diversity. The total number of vascular plants is estimated to be more than 6500 species out of which an estimated 10% are endemic and about 14% are used as medicinal plants. Vegetation types in Ethiopia also highly diverse, varying from Afroalpine and Sub Afroalphine to Riparian and swamp vegetation (Friis and Sebsebe Demissew, 2001).Those includes Afro-alphine and Sub-Afroalphine vegetation, Dry evergreen montane forest and grassland, Moist evergreen montane forest, Evergreen scrub, Combretum Terminalia (broad-leaved) deciduous woodland, Acacia-Commiphora (small-leaved) deciduous woodland, Lowland semi-ever green forest, The desert and semi-desert scrubland, and Riparian and swamp vegetation (Friis and Sebsebe Demissew, 2001).

The vegetation resources, including forests are being destroyed at an alarming rate because of a number of factors. The major factors for the destruction of natural forests are agricultural (expansion conversion of natural vegetation to farmland) and overexploitation for various purposes such as fuel wood, cultivation purpose, charcoal production, construction material and timber, unsustainable utilization of natural resources (over-consumption), deforestation. Additionally forest fires, land degradation, habitat loss, drying of water bodies, soil erosion and fragmentation, invasive species, and wetland destruction (drying of water bodies) leads to the decline of forest and forest resource. All are spurred by rapid human population growth. Population is growing at a rate of about 3% yr- (Anonymous 1988). Poor management of stake holders such as Zone, Woreda and Kebele rural and agricultural organizations also leads to the decline of natural high forest.

Deforestation is one of the biggest challenges for the country. The natural high forest will be gone in a few decade time due to deforestation (accelerated the decline of vegetation). Deforestation and land degradation lead to ecological and socio-economic crises in Ethiopia (Nigatu, 1987). The current rate of deforestation is (i.e. 15000-20000) hectare per year (EFAP, 1994).

The vegetation of the western Ethiopian escarpment, named by White (1983), as 'undifferentiatedWoodlands (Ethiopian type)' has an interesting andpartially unique flora (Sebsebe Demissew et al. 2005).Much of this vegetation type is more or lessintact in Benishangul Gumuz Region and is characterised by broadleaved deciduous trees. The most commontree species are Anogeissus leiocarpa Guill. &Perr, Balanites aegypticus Wall, Boswellia papyrifera Hochst, Combretum collinum Fresen, Dalbergia melanoxylon Guill. &Perr, Lannea fruticosa Engl, L. welwitschii (Hiern) Engl, Lonchocarpus laxiflorus Guill. & Perr., Pterocarpus lucens Guill. & Perr, Piliostigma thonningii (Schumach.) Milne-Redh., Stereospermum kunthianum Cham, Terminalia laxiflora Engl. and T. macroptera Guill. & Perr. The solid-stemmed bamboo Oxytenantheraabyssinica Munro is common on escarpments and hilly areas. The ground cover is dominated by geophytes such as Chlorophytum Ker Gawl., Costus L., Crinum L., Dorstenia L., Drimiopsis Lindl. & Paxton, Eulophia R. Br.ex Lindl,Habenaria Willd., Hypoxis L., and Ledebouria Roth at the beginning of the rainy season (May andJune). Towards the end of the rainy season (Septemberand November), a tall stratum of perennial grasses, including species of Andropogon L., Cymbopogon Spreng., Hyparrhenia Andersson ex E. Fourn., Panicum L., Pennisetum Pers. and Rottboellia L. f. becomes dominant.This vegetation is adapted to annual fires,

which mostlyoccur in December and January. Benishangul Gumuz Region is little knownbotanically and several new records from the region have been published as additions to the Flora of Ethiopia and Eritrea (Edwards et al. 2000).

Ethiopian Biodiversity Institute (EBI) is the lead technical institution responsible for the conservation and sustainable utilization of the county's biodiversity resources, including Medicinal plants. (EBI) has the objective to ensure the proper conservation and sustainable utilization of the county's biodiversity resources. In line with this, (EBI) has the powers to, among other things, initiate policy and legislative proposals on the conservation of biodiversity; explore and survey the diversity and distribution of the country's biodiversity resources; ensure the conservation of the country's biodiversity using in situ and ex situ methods; develop a strategy for the conservation of species threatened by extinction; formulate policy ideas that promote processes that enhance the existence of biodiversity and control processes that threaten biodiversity; develop systems and technical standards for the conservation of the country's biodiversity; issue directives on the collection, dispatch, and export of genetic materials from the country; and give permits for those who need to access genetic materials from the country (Pro No 381/2004).

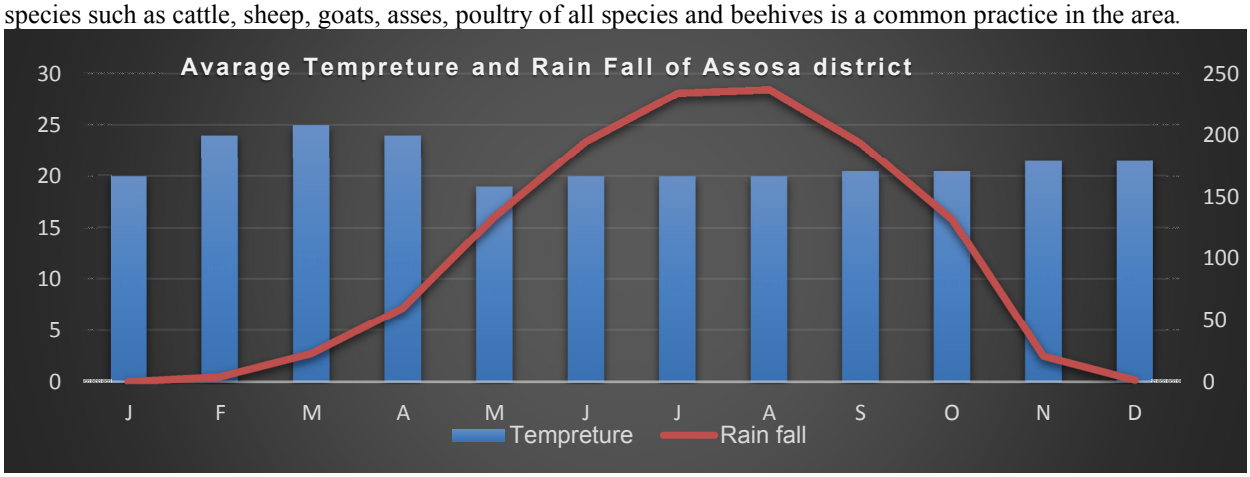
With this responsibility Ethiopian biodiversity institute was studied and selected biodiversity hotspot area found in the country and established seven biodiversity center across different parts of the country. Accordingly, Assosa Biodiversity Center was established in Benishangul Gumuz Region which studies biodiversity in Benishangul Gumuz Region, western and Kellem wollega zones. Before establishment of Assosa Biodiversity Center experts of Ethiopian Biodiversity Center was suggested areas suitable for forest field gene bank and called Assosa forest field gene bank found in Assosa district. Later on after Assosa biodiversity center established Ethiopian biodiversity institute provided full mandate of monitoring of Assosa forest field gene bank to Assosa biodiversity center. However, there was no recorded adequate data that explain Assosa forest field gene bank. Therefore, the aim of this study was to investigate abundance and diversity of woody plant species of Assosa forest field gene bank, Benishangul Gumuz Regional State, Western, Ethiopia.

Materials and Methods

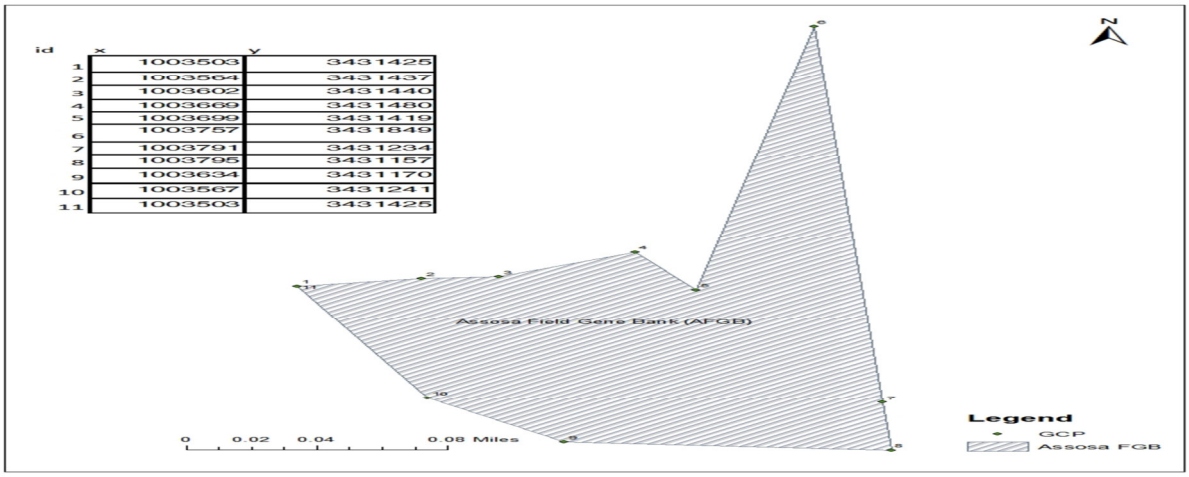
Description of the study area

The study was conducted in Benishangul Gumuz Regional state, Assosa Zone particularly in Assosa districts. Assosa is located in Benishangul-Gumuz regional state in western Ethiopia at a latitude and longitude of 10°04′N 34°31′Eand 661 far form Addis Ababa which was the capital city of Ethiopia. Assosa forest field gene bank was far about 0.5km from Assosa town to North West on the way to Abrahamo Kebele near Ahmed Nasir Metasebia Stadium. The annual temperature of the areas varies and the daily mean temperature 22°C and the precipitation recorded at the meteorological station at Assosa is 237 mm. The area has warm temperature at March and the lowest at July (NMAE, 2017).

The District is covered with relatively tall trees; at least with 20% canopy coverage including integral open space and felled areas that are awaiting restocking, the predominant species found in the area are *Combretum* sp., *Terminalia* sp., *Cordia africana*, *Adansonia digitata*, *Tamarindus indica*, *Dalbergia melanoxylon*, *Ficus* sp. and *Boswellia papyrifera*(WBISPP, 2004) and (Awas T,2007).The area is also covered by small trees, bushes, and shrubs, that are special and restricted to the region and in some cases mixed with grasses; Small grasses are the predominant natural vegetation of the area which are important for grazing and browsing of animals. The area is also allotted to extended rain fed crop production, mostly oil seed, cereals and pulses. Animal production of the species such as cattle, sheep, goats, asses, poultry of all species and beehives is a common practice in the area.



The map of Assosa forest Field Gene Bank



Vegetation data collection

Data analysis

An intensive inventory was made to collect the required data. Sample plot of size 20 × 20 m quadrant was used for this particular study. sixteen quadrats of sample plot were systematically laid down with an interval of 100 m along four transect lines and all woody plant species were recorded from the site on the data collecting sheet.

Vegetation data analysis

The collected data were analyzed using SPSS version 20 and other software packages. Descriptive statistics was applied to determine the relative frequency and abundance of species. The species diversity, richness, and evenness indices were calculated according to Shannon wiener (1949). After properly encoding the parameter in to the proper indices formula. Locally recognizable or native plants were identified while in the field and their names were verified using technical handbook; useful trees and shrubs for Ethiopia. (Azene Bekele. 1993).

Diversity Indices

Diversity indices measure the degree of the uncertainty. If the diversity is high in given habitat, the certainty of observing particular species is low. Diversity indices include; density index, Shannon's equitability (E) and similarity co-efficient. In this diversity, index and Shannon's equitability was used. Diversity index was calculated according to Shannon wiener (1949).

Shannon equation formula as follows;

$$H' = -\sum_{I=1}^{S} [(pi)(\ln pi)]$$

Where H ′=Shannon Diversity indices

S=the number of species

Pi =Proportion of individuals

ln= natural logarism

Evenness (equitability): Shannon-Wiener evenness index was calculated as (Holm, 1997-2005):

$$J = \frac{H'}{\ln S}$$

Where, lnS is the natural logarithm of the total number of species evenness (a measure of species abundance). A value of evenness approaching zero reflects larger difference in abundance of species, whereas the higher evenness value means all species are equally abundant or even their distribution within the sample quadrant.

Result and Discussion

The diversity of woody plant species of Assosa forest field gene bank

A total of 44 woody plant species representing 26 families of were identified from Assosa forest field gene bank. Besides, from 44 identified woody plant species 938 number of individual plant were counted and recorded. Most of the woody plant species identified from Assosa forest field gene bank were belongs to Combretaceae family. Fabaceae, Anacardiaceae, Rhamnaceae, Poaceae, Moraceae, Boraginaceae, and Bombaceae were the second most abundant families where various identified woody plant species belongs, respectively (table.1). *Terminalia laxiflor* species was the dominate plant species with accounting 13.64% of the Assosa forest field gene bank.*Gardenia volkensii,Combretum mole,Albizia malacophylla and Oxytenanthera abyssinica* species

were also abundantly existing woody plant species in Assosa field gene bank, respectively (table.1). From the total woody species, 33 (79.75%) were trees, 5(5.87%) trees/shrubs, and 6(14.38%) shrubs.

Table.1. List and description of woody plant species found in Assosa forest field gene bank

No	Local name	Scientific name	Family	Language	Number of individual plants	Percentage
1	Baguri	*Terminalia laxiflora*	Combretaceae	Amharic	128	13.64
2	Gambelo	*Gardenia volkensii*	Rubiaceae	Amharic	87	9.27
3	Abalo	*Combretum mole*	Combretaceae	Amharic	72	7.67
4	Chigoro, Hamaseran	*Albizia malacophylla*	Fabaceae	Amharic/ Oromifa	71	7.56
5	KerKeha	*Oxytenanthera abyssinica*	Poaceae	Amharic	62	6.6
6	Grawa	*Vernonia amygdalina*	Asteraceae	Amharic	56	5.97
7	Ye zinjero temenja	*Lannea welwitschii*	Anacardiaceae	Amharic	44	4.69
8	Washint,Zana	*Stereospermum kunthianum*	Bignoniaceae	Amharic	42	4.47
9	Kota/Baddan	*Balantites egyptica*	Balanitaceae	Amharic	31	3.3
10	Agam	*Carissa spinarum*	Apocynaceae	Amharic	31	3.3
11	Yekolla wanza	*Piliostigma thonningii*	Fabaceae	Amharic	28	2.98
12	Ameraro	*Discopodium penninervum*	Solanaceae	Amharic	27	2.88
13	Sefa/Soyoma	*Grewia bicolor*	Poaceae	Amharic/ Oromifa	22	2.35
14	Kega	*Rosa abyssinica*	Roseaceae	Amharic	21	2.23
15	Ye-tit zaf	*Ceiba pentandra*	Bombaceae	Amharic	21	2.23
16	Ambalta	*Entada abyssinica*	Fabaceae	Amharic	19	2.0
17	Wulkeffa	*Dombeya torrida*	Sterculiaceae	Amharic	18	1.9
18	Wanza	*Cordia Africana*	Boraginaceae	Amharic	18	1.9
19	Etse Menabele	*Securidaca longipedunculata*	Polygalaceae	Amharic	17	1.8
20	Ado qurqura	*Ziziphus mucronata*	Rhamnaceae	Amharic	16	1.7
21	Qurqura	*Ziziphus spina-christi*	Rhamnaceae	Amharic	15	1.6
22	Zenfok	*Combretum aculeatum*	Combretaceae	Amharic	11	1.17
23	Koshele	*Acantus sennii*	Acanthaceae	Amharic	11	1.17
24	Merenz	*Strychnos spinosa*	Loganiaceae	Amharic	9	0.95
25	Embus	*Rhus glutinosa*	Anacardiaceae	Amharic	7	0.74
26	Inkoy	*Ximenia Americana*	Olacaceae	Amharic	6	0.63
27	Korch	*Erythrina abyssinica*	Fabaceae	Amharic	6	0.63
28	Ergofit	*Erythrina brucei*	Boraginaceae	Amharic	6	0.63
29	Lenquata	*Grewia villosa*	Tiliaceae	Amharic	5	0.53
30	Wachu dima, Adii	*Acacia seyal*	Fabaceae	Afan Oromo	5	0.53
31	Giishta	*Annona senegalensis*	Annonaceae	Amharic	5	0.53
32	Dokma	*Sizigium gunensis*	Myrtaceae	Amharic	4	0.42
33	Selen	*PPhoenix reclinata*	Arecaceae	Amharic	4	0.42
34	Ader	*Dichrostachys cinerea*	Fabaceae	Amharic	3	0.32
35	Plem	*Vitex doniana*	Verbenaceae	Amharic	2	0.21
36	Kitkita	*Dodonaea viscose*	Sapindaceae	Amharic	2	0.21
37	Shola	*Ficus vasta*	Moraceae	Amharic	2	0.21
38	Shola	*Ficus sycomorus*	Moraceae	Amharic	2	0.21
39	Sabansa Girar	*Acacia senegal*	Fabaceae	Amharic	2	0.21
40	Sesa	*Albizia gummifera*	Fabaceae	Amharic	2	0.2
41	Bazra girar	*Acacia abyssinica*	Fabaceae	Amharic	2	0.21
42	Roka, Humer	*Tamarindus indica*	Fabaceae	Amharic	2	0.21
43	Agangulesh	*Adansonia digitata*	Bombaceae	Bertenga	2	0.21
44	Mango	*Mangifera indica*	Anacardiaceae	Amharic	2	0.21
Total	**44**	**44**	**26**	**44**	**938**	**100%**

Species diversity, Richness, and equitability

Shannon – wiener diversity index (1949) was computed for the sampled area vegetation data of Assosa forest field gene bank as follows.

Table.2 Shannon – wiener diversity index of Assosa forest field gene bank.

Diversity index(H ′)	3.49
Species richness	44
Evenness (equitability)	0.0037

Depending up on Shannon-Wiener diversity index the calculated value of species diversity and evenness of Assosa forest field gene bank were 3.49 and 0.0037 respectively (Table 2). According to Kent and Coker (1992), Shannon-Wiener index value varies between 1.5 and 3.5 and rarely exceeds 4. Accordingly, Shannon-Wiener indices for woody plant species of Assosa forest field gene bank were high. This higher diversity indices of Shannon indicated that there was better species diversity in Assosa forest field gene bank due to protection from human and animal disturbance helps individual plant species to have better regeneration and abundance than the open site where there is repeated human and livestock interference.

This result was relatively high value of Shannon-Wiener Diversity Index (H=3.49) compared with that of Chilimo dry Afromontane forest (H = 2.72) (Tadesse Woldemariam al. et, 2000) and less species diversity and evennessthan peninsula of Zegie with Shannon-Wiener Diversity Index of (H=3.72) and (E = 0.84)(Alelign, et, al, 2007) and agreement with the studies of (Sorecha and Deriba, 2017).Accordance with Kent and Coker (1992) ratings the result of the present study showed that Assosa forest field gene bank has un even species distribution.Therefore, Assosa forest field gene bank has more diverse, unevenly distributed with unrelated abundance of all individuals of plant species. Low value of evenness indicates that the one or a few species were highly dominant, while others were present with few individuals.

The species identified in Assosa forest field gene bank were high in abundance and distribution. In addition to this, out of the 44 woody plant species almost the entire site is dominated by only six species namely *Terminalia laxiflora, Gardenia volkensii, Combretum mole, Albizia malacophylla, Oxytenanthera abyssinica*and *Vernonia amygdalina* accounted more than 50% of the species identified. This shows extreme difference in species abundance among each other due to the nature of ecosystem and absence of fence over the entire area of Assosa field gene bank and high-level of disturbance on parts that were not fenced.

The current trend and threat to Assosa forest field gene bank

Currently Assosa biodiversity center was attempt to make the forest gene bank enrich through collection of germplasm of indigenous plants species from different localities of Oromia and Benishangul with emphasize to endemic, economically important and endangered plant species. Those collected plant germplasm phenology and treatment method were identified by the relative expert and germplasm plantation was held in nursery site found in near to Assosa town, which exist in Bambasi medicinal plant field gene bank. Half amount of seedling was distributed to local community to be planted on area where forest cleared; bear land and the rest were planted in Assosa forest field gene bank with accession for conservation, research, and educational purpose.

Now a day, Assosa forest field genebank has well protected and on good management conditions. However, there were various factors, which affects fauna and flora exist in Assosa forest field gene bank. Due to the absence of fence over the entire area of the forest field gene bank there was illegal entrance of local community and urban dwellers to use the forest and its product for different purposes. The other lead factor that deteriorate the sucessessful protection of Assosa field gene bank were outbreak of annual fire which hinders germination and regeneration seedling and less awareness of surrounding community about the field gene bank, their hunting behavior and inaccessibility of car to the area for tour were the most threat to Assosa forest gene bank.

The vegetation of the western Ethiopian escarpment, named by White (1983), as ‘undifferentiated woodlands (Ethiopian type)’ has an interesting and partially unique flora (Sebsebe Demissew *et al.* 2005). Much of this vegetation type is more or less intact in the Benishangul Gumuz Region and is characterized by broadleaved deciduous trees and vegetation is adapted to annual fires, which mostly occur in December and January. Even though this idea was true occurrence of annual fires in Assosa field gene bank was exposed wildlife to migration, hunters and protection of the forest field gene bank from human interference was necessary for entrance and residence of wildlife.

Conclusion and Recommendation

The current study result show that total of 44 woody plant species representing 26 families of were identified from Assosa forest field gene bank. Besides, from 44 identified woody plant species 938 number of individual plant were counted and recorded. *Terminalia laxiflora*and Combretaceae were the dominant woody plant species and family found in Assosa field gene bank.From the total woody species, 33 (79.75%) were trees, 5(5.87%) trees/shrubs, and 6(14.38%) shrubs. The species identified in Assosa forest field gene bank were high in abundance and distribution with (H= 3.49) and (E=0.0037) respectively. Outbreak of annual fire, less awareness

of surrounding community and inaccessibility of car to the area for tour purpose were the most threat to Assosa forest gene bank. The concerned body must work to alleviate all listed threats encountering Assosa forest gene bank.

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