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International Journal of Plant Biology & Research

Research Article

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

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Submitted: 05 July 2018

Accepted: 28 August 2018

Published: 31 August 2018

ISSN: 2333-6668

Keywords

- Woody species
- Diversity
- Field gene bank
- Richness
- Evenness

Abstract

This study was aimed to investigate the diversity and abundance of woody plant species of Assosa forest gene bank. An inventory was made to collect the required data and sample plot of size 20mx20m quadrant was used for this particular study. Sixteen quadrates 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. A total of 44 woody plant species representing 34 genera and 26 families of were identified. From 44 identified woody plant species 948 number of individual plants were counted and recorded. Most of woody plant species counted and recorded from the Assosa forest field gene bank were belongs to Combretaceae family. The current study reveal that Assosa forest field gene bank has more diverse (H=3.17), unevenly distributed (E=0.46) and abundance of all individuals of plant species.

INTRODUCTION

Vegetation types in Ethiopia also highly diverse, varying from Afro alpine and Sub Afro alphine to Riparian and swamp vegetation [1]. 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. 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 [1]. These diversified vegetations are found in different parts of the region and they are used to meet the basic needs of the forest dependent communities. They play an indispensable role in the protection of environment, regulating climate, controlling water runoff, maintaining ecological balance and producing valuable materials such as timber for construction and furniture, extraction of chemicals, paper and pulp. Furthermore, they have paramount role in purifying the air, serving as a habitat for wild animals and have aesthetic value [2]. Apart from ecological values, forests are also significantly important for the economy of many tropical and sub-tropical countries. 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 [3]. The vegetation of the western Ethiopian escarpment, named by White as 'undifferentiated Woodlands (Ethiopian type)' has an interesting and partially unique flora [4]. Much of this vegetation type is more or less intact in Benishanigul Gumuz Region and is characterized by broadleaved deciduous trees. The most common tree species are Anogeissus leiocarpa Guill. & Perr, Balanites aegypticus Wall, Boswellia papyrifera Hochst, Combretum collinum Fresen, Dalbergia melanoxylon Guill. & Perr, Lannea fruticosa Engl, L. wel witschii (Hiern) Engl, Loncho carpus 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 Oxytenanthera abyssinica Munro is common on escarpments and hilly areas. The ground cover is dominated by geophytes such as Chlorophytum Ker Gawl., CostusL., Crinum L., DorsteniaL., Drimiopsis Lindl. & Paxton, Eulophia R. Br. exLindl, Habenaria Willd., Hypoxis L., and Ledebouria Roth at the beginning of the rainy season (May and June). Towards the end of the rainy season (September and November), a tall stratum of perennial grasses, including species of Andropogon L., Cymbopogon Spreng., Hyparrhenia Andersson

ex E. Fourn., PanicumL., Pennisetum Pers. and Rottboellia L. f. becomes dominant. This vegetation is adapted to annual fires, which mostly occur in December and January. Benishanigul Gumuz Region is little known botanically and several new records from the region have been published as additions to the Flora of Ethiopia and Eritrea [2].

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; ideas that develop a strategy for the conservation of species threatened by extinction; formulate policy 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 [5]. With this responsibility, Ethiopian biodiversity institute was studied and selected biodiversity hotspot area found in the country and established seven biodiversity centers across different parts of the country. Accordingly, Assosa Biodiversity Center was established in Benishanigul Gumuz Region which studies biodiversity in Benishanigul Gumuz Region, western and Kellem wollega zones. Before establishment of Assosa Biodiversity Center experts of Ethiopian Biodiversity Center were 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, Benishanigul Gumuz Regional State, Western Ethiopia.

MATERIALS AND METHODS

Description of the study area

The study was conducted in Benishanigul Gumuz Regional state, Assosa Zone particularly in Assosa districts. Assosa is located in Benishanigul-Gumuz regional state in western Ethiopia at a latitude and longitude of 10°04′N 34°31′E and 661km far from 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 was 22°C and the precipitation recorded at the meteorological station at Assosa is 237mm. The geology of the study area is characterized mainly by the occurrence of intrusive rock [6-8]. Dominantly occurred soils in the study area include among others dystricnitosols and calcaric and eutricfluvisols [9,10]. The area has warm temperature at March and the lowest at July [6]. 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*, *Tamarindusindica*, *Dalbergia melanoxylon*, *Ficus* sp., and *Boswellia papyrifera* [7,8]. 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.

Vegetation data collection

The vegetation of the region can be classified in to eight-vegetation type. Those are dense forest, riverine forest; broad leaved deciduous wood lands, acacia wood land, bush land, shrub lands, boswellia wood land and bamboo thickets. An inventory was made to collect the required data. Sample plot of size 20m × 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 Assosa field gene bank 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 abundance and diversityof woody plant species. The species diversity, richness, and evenness indices were calculated according to Shannon wiener [9]. 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 [10].

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 [9].

Shannon equation formula as follows;

$$H' = \sum_{i=1}^{s} (p_i)(Inp_i)$$

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 [11].

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

Where, lnS are 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.

RESULTS AND DISCUSSION

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

A total of 44 woody plant species representing 34 genera and 26 families was identified from Assosa forest field gene bank. Besides, from 44 identified woody plant species 948 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 (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, Albiziamalacophylla* 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.

Species diversity, richness, and equitability

Depending up on Shannon-Wiener diversity index the calculated value of species diversity and evenness of Assosa forest field gene bank were (H= 3.17) and (E=0.46) respectively (Table 2). According to Kent and Coker, Shannon-Wiener index value varies between 1.5 and 3.5 and rarely exceeds 4 [12]. Accordingly, Shannon-Wiener indices for woody plant species of Assosa forest field gene bank were high. These 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=3.17) compared with that of Chilimo dry Afro montane forest (H=2.72) [13]. and less species diversity and evenness than peninsula of Zegie with Shannon-Wiener Diversity Index of (H=3.72) and (E = 0.84) [14], and agreement with the studies of Sorecha and Deriba [15]. Accordance with Kent and Coker ratings the result of the present study showed that Assosa forest field gene bank has uneven species distribution [12]. 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 disturbance on parts that were not fenced (Table 2).

The current trend and threat to Assosa forest field gene bank

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 Benishanigul 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 cultivated seedling was distributed to local community to be plant on encroached areas; bare land and the rest were planted in Assosa forest field gene bank by accession for conservation, research, and educational purpose. Now a day, Assosa forest field gene bank 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 regenerations seedling and less awareness of surrounding community about the field gene bank, their hunting behavior and inaccessibility of car to the area for tour purpose were the most threat to Assosa forest gene bank.

The vegetation of the western Ethiopian escarpment, named by White, as 'undifferentiated woodlands (Ethiopian type)' has an interesting and partially unique flora Sebsebe Demissew et al., [4]. Much of this vegetation type is more or less intact in the Benishanigul 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 confirmed that Assosa forest field gene bank harbors adversity of woody plant species. *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. Moreover, ecologically it serves as habitat for many fauna and flora has also great role in water,

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

Local name	Scientific name	Genera	Family	Language	Number of individual plants	Percentage
Baguri	*Terminalia laxiflora*	Terminalia	Combretaceae	Amharic	128	13.5
Gambelo	*Gardenia volkensii*	Gardenia	Rubiaceae	Amharic	87	9.17
Abalo	*Combretum mole*	Combretum	Combretaceae	Amharic	72	7.59
Chigoro, Hamaseran	*Albizia malacophylla*	Albizia	Fabaceae	Amharic/ Oromifa	71	7.48
KerKeha	*Oxytenanthera abyssinica*	Oxytenanthera	Poaceae	Amharic	62	6.54
Grawa	*Vernonia amygdalina*	Vernonia	Asteraceae	Amharic	56	5.9
Yezinjerotemenja	*Lannea welwitschii*	Lannea	Anacardiaceae	Amharic	44	4.64
Washint,Zana	*Stereospermum kunthianum*	Stereospermum	Bignoniaceae	Amharic	42	4.43
Kota/Baddan	*Balantites aegyptica*	Balantites	Balanitaceae	Amharic	31	3.27
Agam	*Carissa spinarum*	Carissa	Apocynaceae	Amharic	31	3.27
Yekollawanza	*Piliostigma thonningii*	Piliostigma	Fabaceae	Amharic	28	2.95
Ameraro	*Discopodiumpenninervum*	Discopodium	Solanaceae	Amharic	27	2.84
Sefa/Soyoma	*Grewia bicolor*	Grewia	Poaceae	Amharic/ Oromifa	22	2.32
Kega	*Rosa abyssinica*	Rosa	Roseaceae	Amharic	21	2.21
Ye-tit zaf	*Ceibapentandra*	Ceiba	Bombaceae	Amharic	21	2.21
Ambalta	*Entada abyssinica*	Entada	Fabaceae	Amharic	19	2.0
Wulkeffa	*Dombeya torrida*	Dombeya	Sterculiaceae	Amharic	18	1.89
Wanza	*Cordia Africana*	Cordia	Boraginaceae	Amharic	18	1.89
Etse Menabele	*Securidaca longipedunculata*	Securidaca	Polygalaceae	Amharic	17	1.79
Ado qurqura	*Ziziphus mucronata*	Ziziphus	Rhamnaceae	Amharic	16	1.68
Qurqura	*Ziziphusspina-christi*	Ziziphus	Rhamnaceae	Amharic	15	1.58
Zenfok	*Combretum aculeatum*	Combretum	Combretaceae	Amharic	11	1.16
Koshele	*Acantus sennii*	Acantus	Acanthaceae	Amharic	11	1.16
Merenz	*Strychnos spinosa*	Strychnos	Loganiaceae	Amharic	9	0.95
Embus	*Rhus glutinosa*	Rhus	Anacardiaceae	Amharic	7	0.73
Inkoy	*Ximenia Americana*	Ximenia	Olacaceae	Amharic	6	0.63
Korch	*Erythrina abyssinica*	Erythrina	Fabaceae	Amharic	6	0.63
Ergofit	*Erythrina brucei*	Erythrina	Boraginaceae	Amharic	6	0.63
Lenquata	*Grewia villosa*	Grewia	Tiliaceae	Amharic	5	0.52
Wachudima, Adii	*Acacia seyal*	Acacia	Fabaceae	Afan Oromo	5	0.52
Giishta	*Annona senegalensis*	Annona	Annonaceae	Amharic	5	0.52
Dokma	*Sizigium gunensis*	Sizigium	Myrtaceae	Amharic	4	0.42
Selen	*Phoenix reclinata*	Phoenix	Arecaceae	Amharic	4	0.42
Ader	*Dichrostachys cinerea*	Dichrostachys	Fabaceae	Amharic	3	0.31
Plem	*Vitex doniana*	Vitex	Verbenaceae	Amharic	2	0.21
Kitkita	*Dodonaea viscose*	Dodonaea	Sapindaceae	Amharic	2	0.21
Shola	*Ficus vasta*	Ficus	Moraceae	Amharic	2	0.21
Shola	*Ficus sycomorus*	Ficus	Moraceae	Amharic	2	0.21
SabansaGirar	*Acacia senegal*	Acacia	Fabaceae	Amharic	2	0.21
Sesa	*Albizia gummifera*	Albizia	Fabaceae	Amharic	2	0.2
Bazragirar	*Acacia abyssinica*	Acacia	Fabaceae	Amharic	2	0.21
Roka, Humer	*Tamarindus indica*	Tamarindus	Fabaceae	Amharic	2	0.21
Agangulesh	*Adansonia digitata*	Adansonia	Bombaceae	Bertenga	2	0.21
Mango	*Mangifera indica*	Mangifera	Anacardiaceae	Amharic	2	0.21
44	44	34	26	44	948	100%

Table 2: Shannon – wiener diversity index of Assosa forest field gene bank.	
Diversity index (H')	3.17
Species richness	44
Evenness (equitability)	0.46

soil conservation and great contribution for education and research. 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.

ACKNOWLEDGEMENT

Authors are grateful to Ethiopian Biodiversity Institute Assosa Biodiversity Center for material and financial support.

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Cite this article

Abera Y, Yasin A (2018) Diversity and Abundance of Woody Plant Species of Assosa Forest Field Gene Bank, Benishanigul Gumuz Regional State, Western Ethiopia. Int J Plant Biol Res 6(5): 1100.