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Floristic Composition and Structure of Zerat Forest, Central Ethiopia

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Abstract

This study was conducted in Zerat Afromontane Forest in North Showa Zone of Amhara Regional State of Ethiopia. The objective of the study was to investigate floristic composition and structure of the forest as well as to explore factors accounting for loss of forest in the study area. Systematic sampling was used to collect vegetation data from 66 sample plots of size 20 x 20 m (400m^2). In-depth interviews were conducted with farmers living in close vicinity to the forest to identify challenges and threats on the forest. R-statistical package, Estimate-S and Microsoft Excel were used to analyze the data. Vegetation classification was performed using R-statistical package. Rarefaction was applied to compare the species richness of the plant communities in the study area. Sorensen's similarity coefficient was used to detect similarities among the plant communities. A total of 156 plants belonging to 133 genera and 67 families were identified. Asteraceae is the most dominant family followed by Fabaceae and Lamiaceae. It was noted that 17 of the plants encountered in the study area are endemic to Ethiopia. Three plant communities were identified in the study area: Juniperus procera Community Type, Senecio gigas-Scorpiurus muricatus Community Type, and Maytenus obscura-Chenopodium album Community Type. Anthropogenic distrubances such as grazing by domestic animals, fuel wood and timber extraction are the main threats to the forest in the study area. Conservation measures such as awareness creation, provision of alternative energy sources and minimizing illegal timber production need to be practiced for sustainable use of the forest.

Keywords: Afromontane forest; Zerat Forest; Rarefaction; Sorensen's similarity coefficient; Endemic species; anthropogenic disturbance.

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1. Introduction

As a result of its wide range of altitude and great geographical diversity with rugged mountains, flat-topped plateaus and deep gorges, Ethiopia is an important regional center for biological diversity [1,2]. There are about 6500-7000 vascular plants in Ethiopia, nearly 12 % of which are endemic [3]. Nearly 40 percent of the Eastern Afromontane Biodiversity hotspot occurs in Ethiopia [4].Thus, the Ethiopian highlands include part of the world's biodiversity hotspots but one of the most degraded ones [5]. This is partly because of the fact that the majority of subsistence agriculture practicing population in Ethiopia resides in the highlands. The vegetation resources of Ethiopia are disappearing at alarming rate due to agricultural expansion, fuel wood scavenging, weak institutional capacity and population growth [6,7].

Hence, investigations on the vegetation resources of the country are inevitably needed in order to ensure sustainable management of the remnant vegetation and to abate the actual and potential consequences of loss of vegetation.

Previous attempts to describe and classify the vegetations of Ethiopia include those by [8- 12]. However, the floristic composition and structure of Zerat Forest was not studied thus far. The present study was, therefore, conceived to investigate the plant composition and the structure of Zerat Forest.

2. Materials and Methods

2.1 Location of the Study Area

Zerat forest is found in Menz Mamma district in North Shoa Zone of Amhara Regional State of Ethiopia. The forest occurs within coordinates of 10º11′247″-10º12′707″N and 39º46′154″-39º46′992″E. The topography of the area is steep and dissected by ravines and gorges through which rivers and streams tumble down the eastern escarpment of the Great Rift Valley. The forest is found on very steep slopes in narrow valleys mostly facing to the East. The area is bounded by a steep escarpment of the Rift Valley in the East and low-lying agricultural areas of Menz in the West (Figure 1).

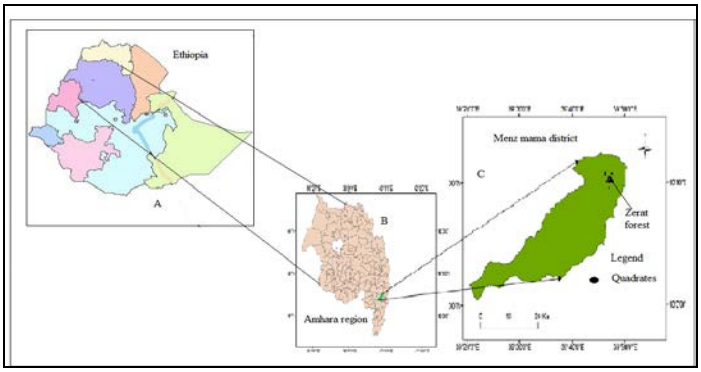

Figure 1: Map of the study area. 'A' shows location of Amhara regional state in Ethiopia. 'B' shows the location of Menz Mamma district in Amhara Regional State. 'C' shows the location of the study area in Menz Mamma district.

2.2 Climate

The study area is characterized by bimodal rainfall distribution. The main (long) rainy season is from June to September and the short rainy season is from February to April. The average annual rainfall and mean annual average temperature of the area is 1050 mm and 12.5^0C, respectively.

2.3 Floristic data sampling

Systematic sampling was used to collect floristic and structural data. The first plot was located randomly at lowest altitude, and then the remaining plots were established at 50m intervals along altitudinal transect. Transects were spaced 1km apart. A total of 66 sample plots were established along transect lines.

Plots of size 20 x 20 m ($400m^2$) were used for collection of floristic and structural data. From each 20 x 20 m plot, local name (or voucher specimen code if the local name was not known), diameter at breast height (at 1.30 m above ground), height, number of individuals and cover abundance of all trees having DBH > 2 cm were recorded

The height, number of individuals and cover abundance of shrubs, younger trees and woody climbers with DBH 1.5-2 cm were collected from subplots of size 5 x 5 m which were laid at five different locations of the main plots. Within 5 x 5 m subplots, 2 x 2 m plots were laid to collect cover-abundance data of herbaceous plants. Tree height was measured using Suunto clinometers and diameter at breast height using meter tape. Meter tape was used to measure heights of relatively shorter woody plants.

Cover-abundance values were estimated using the modified Braun Blanquet scales following [13-15]. Voucher specimens were collected for all plant species and were identified at National Herbarium (ETH). The nomenclature of the plants was based on the published volumes of the Flora of Ethiopia and Eritrea [16-22].

2.4 Data Analysis

The percentages of various plant families as well as DBH and height classes of woody plants in the study area were summarized in bar graphs. Dominance curve was used to rank the relative abundance of the species identified. Classification and ordination methods were used to describe vegetation types and to examine the relationship between vegetation types and environmental variables. R statistical package [23] was used for cluster and ordination analysis.

Indicator species analysis was performed to find indicator species characterizing the communities. Indicator species analysis was performed in R using package labdsv [24]. Interpolated species accumulation curves were used to display the expected number of species in each community type as a function of accumulated number of plots. EstimateS 8.2 software [25] was used to compute the expected species richness and species richness estimators. Sorenson's index was computed to assess the floristic similarity between the plant communities of the study area

3. Results and Discussion

3.1 Floristic Composition

A total of 156 plant species belonging to 133 genera and 67 families were recorded (Annex 1). Asteraceae is the most dominant family in the study area. The dominance of Asteraceae in dry afromontane vegetation of Ethiopia was also reported by [26]. Fabaceae, Lamiaceae and Euphorbiaceae were represented by equal number of species in the study area. Families such as Poaceae, Rosaceae, Cyperaceae, Polygalaceae. Rutaceae, Boraginaceae, Oleaceae, Apocynaceae, Rubiaceae, Scrophulariaceae, Solanaceae and Myrsinaceae were also represented in the flora of the study area.

3.2 Growth Forms

Most of the plants encountered in the study site were herbs as shown in Figure 2.

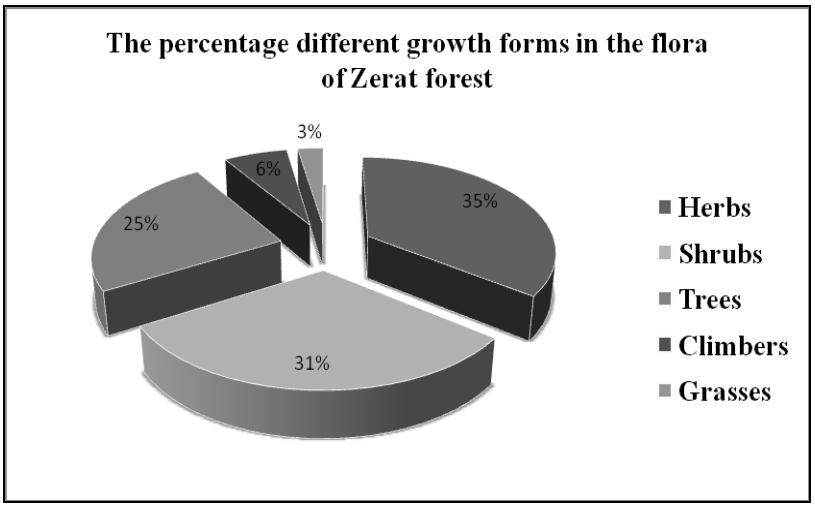

Figure 2: The contribution of different plant growth forms in the flora of Zerat forest.

Herbs account for most of the flora recorded followed by shrubs. Other researchers who studied Afromontane forests of Ethiopia such as [26] in his study in Gurage Mountains reported that herbs account for a large proportion of plants encountered in such forests.

3.3 Plant Endemism in Zerat Natural Forest

Seventeen plant species (Table 1), which are endemic to Ethiopia, were encountered in Zerat forest (based on the Published volumes of Flora of Ethiopia [16-22]). They account for 11% of the total floristic composition of the forest. This finding is almost consistent with [3] that nearly 12 % of the flora of Ethiopia are endemic to the country.

The number of endemic plants recorded in Zerat Forest is almost similar with the number of endemic plants recorded in other dry Afromontane forests of Ethiopia as shown in Table 2.

Table 1: Endemic Plants in Zerat Forest. (IUCN categories: CR=Critically Endangered, LC=Least Concern; NT= Not Threatened and VU = Vulnerable).

Endemic species	**Family**	**IUCN category**
Mikaniopsis clematoides	Asteraceae	LC
Satureja paradoxa	Lamiaceae	NT
Solanecio gigas	Asteraceae	LC
Rhus glutinosa	Anacardiaceae	VU
Urtica simensis	Urticaceae	LC
Kalanchoe petitiana	Crassulaceae	LC
Inula confertiflora	Asteraceae	NT
Kniphofia foliosa	Asphodelaceae	CR
Cynoglossum coeruleum	Boraginaceae	*
Lippia adoensis	Verbenaceae	LC
Thymus schimperi	Lamiaceae	LC
Laggera tomentosa	Asteraceae	NT
Gladiolus balensis	Iridaceae	*
Plectocephalus varians	Asteraceae	LC
Cineraria abyssinica	Asteraceae	LC
Crotalaria rosenii	Fabaceae	NT
Becium grandiflorum	Lamiaceae	NT

Table 2: Plant endemism in Zerat forest compared with other forests in Ethiopia

Forest	No of endemic species	No of endemic species common in Zerat & other forests	% similarity
Zerat (this study)	17		
Gedo [32]	15	6	35
Denkoro [31]	12	7	41
Komto [33]	18	7	41
Chilmo[35]	18	7	41
Biteyu[34]	16	6	35

3.4 Height Class Distribution

Most of the woody plants in the study area have height class less than 5 m. Trees with height class greater than

30 m comprised a small proportion of the woody plants investigated as shown in Figure 3.

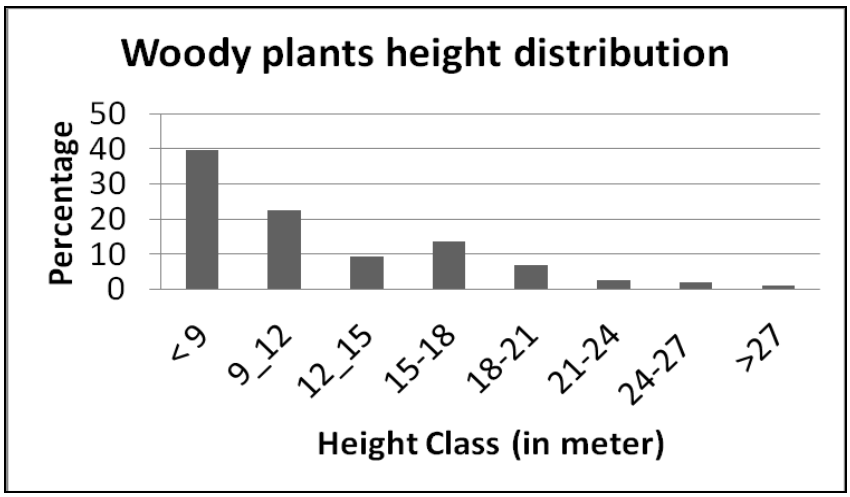

Figure 3: Height class distribution of woody plants in Zerat Forest

The least representation of trees with higher height classes may be due to selective logging of relatively large trees for various purposes. Zerat forest has considerable similarity with other afromotane forests of Ethiopia in terms of the height class distribution of woody plants as shown in Table 3. Data with regard to the height class distribution of the other afromontane forests of Ethiopia are from [27] and [26].

Table 3 : Height Class Distribution of Woody Plants in Zerat and other Afromontane Forests of Ethiopia

Height class (in cm)	The Ethiopian Afromontane Forests and Percentage Contribution of Height Classes of woody plants					
	Gurage mountains	Jibat	Chilimo	Menagesha	Wofwasha	Zerat
< 9	40.6	25.5	42.1	38.5	23.3	39.7
9-12	19.3	24	30.8	32	21.3	22.64
12-15	14.75	15.2	15.3	10.8	13.7	9.43
15-18	12.6	14	7.5	11	13.1	13.74
18-21	5.8	7.2	3.4	2.2	6.1	6.89
21-24	3.04	3.7	<1	2.2	1.6	2.6
24-27	1.9	3.5	0	1	8	1.9
>27	2.86	6.8	0	<3	12.8	1.1

In all of the Afromontane forests listed in table 3, mature seed bearing trees are less represented. Hence, appropriate conservation measures are needed to ensure the sustainability of the forests.

3.5 DBH Class Distribution

The DBH class distribution of woody plants also shows (Figure 4) that there is selective logging of larger trees.

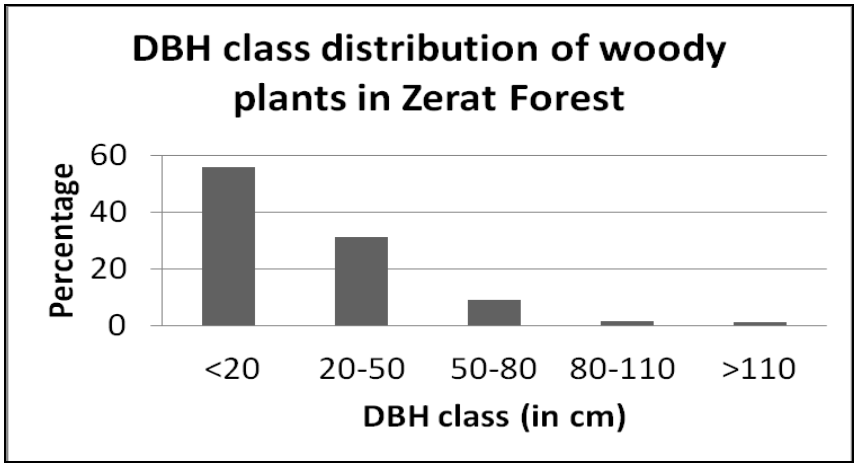

Figure 4: DBH class distribution of woody plants in Zerat Forest

The selective logging of larger trees will jeopardize the sustainability of the forest as it involves removal the reproductively mature seed bearing woody plants. As it is the case for height class distribution, Zerat forest has considerable resemblance with other afromontane forests of Ethiopia in terms of DBH class distribution of woody plants as shown in Table 4.

Table 4 : DBH class distribution of woody plants in Zerat and other Afromontane Forests of Ethiopia

Forest						
DBH class (in cm)	Wofwasha [27]	Menagesha [27]	Chilmo [27]	Jibat [27]	Gurage mountain [26]	Zerat (this study)
<20	32.6	56.9	60.8	48.9	55	55.67
20-50	31.7	32.8	36.5	39.5	28.8	31.23
50-80	14.6	6.5	2.6	9.8	13	9.11
80-110	11.7	2.5	0	1.4	2.2	1.65
>110	9.5	1.1	0	<2	0.9	0.27

3.6 Plant Communities in the Study Area

Cluster analysis revealed that there are three main plant communities in the study as shown in Figure 5.

Community 1 includes plots : 1,16,17,18,19,20,32,33,34,36,48,49,50,65,&66.

Community2 includes plots:15,30,31,35,47,51,52,53,54,56,59,60,61,62,63& 64.

Community 3 includes plots: 2,3,4,5,6,7,8,9,10,11,12,13,14,21,22,23,24,25,26,27,28,29,37,38,39,40,41,42,43, 44, 45,46,55,57 & 58.

Each community was named after the species which with higher indicator values (Table 5). The indicator values were determined by combining the relative abundance and relative frequencies of each species.

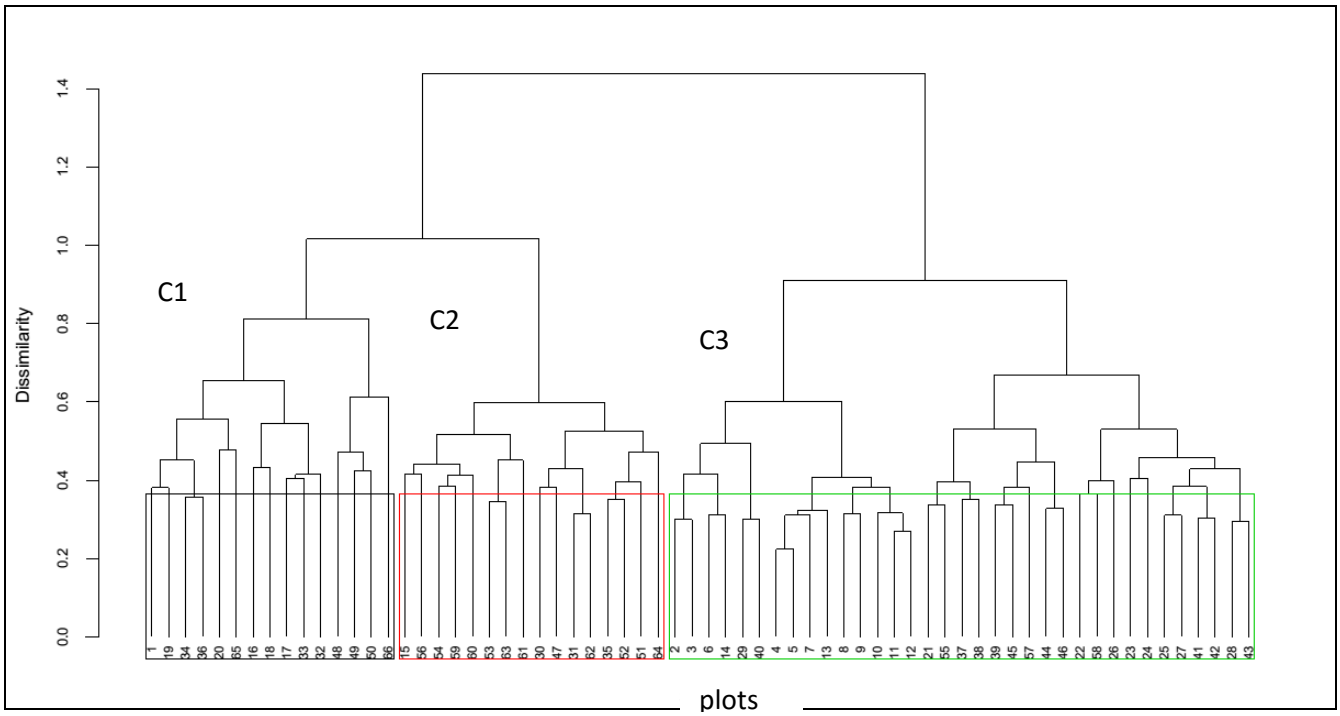

Figure 5: Denrogram showing plant communities in Zerat Forest. C1-C3 represent the three plant communities of the study area.

Table 5: Species with significant indicator values (in percentage) in each community. Species with highest indicator values are bolded. The indicator values of the species were considered as significant if the respective probability values were less than 0.05 [28].

Name of species	Community	Indicator value	Probability
Juniperus procera	1	30.72	0.040
Senecio gigas	2	58.97	0.001
Scorpiurus muricatus	2	58.51	0.001
Verbascum sinaiticum	2	57.01	0.001
Ricinus communis	2	53.51	0.001
Citrus aurantifolia	2	49.72	0.002
Buddleja polystachya	2	48.65	0.001
Euphorbia prostrata	2	48.52	0.001
Lippia adoensis	2	47.44	0.002
Maytenus obscura	3	45.2	0.004
Chenopodium album	3	40.61	0.027
Maesa lanceolata	3	25.95	0.020

The three plant communities which were identified in the study site are described as follows:

Community 1: *Juniperus procera* Community Type

The plots belonging to this community have altitude range of 2437 to 2616 m a.s.l. *Juniperus procera* , *Dombeya torrida*, *Polyscias fulva*, *Olinia rochetiana,* and *Olea capensis* were dominant species in the tree layer of this community. *Indigofera arrecta, Rumex nervosus, Clutia lanceolata,* and *Inula confrtiflora* were important species in the shrub layer of this community.

Community 2: *Senecio gigas* - *Scorpiurus muricatus* Community Type

This community occurred at altitude range of 2500 to 2568 m a.s.l. *Allophylus abyssinicus, Ekebergia capensis and Olea europaea subsp.cuspidata* were the common species in the tree layer of this community. *Senecio gigas, Scorpiurusmuricatus, Rosa abyssinica, Sisymbrium erysimoides, Carissa spinarum, Ricinus communis, Asparagus africanus, Pycnostachys meyeri, Alchemila pedata, Artemisia abyssinica, Cyperus cyperus, Stephania abyssinica and Jasminum abyssinicum* were the most common species in this community.

Community 3*: Maytenus obscura- Chenopodium album* Community Type

This community is mainly composed of species such as *Maytenus obscura, Chenopodium album, Croton macrostachyus, Grewia ferruginea, Rhus glutinosa , Teclea nobilis, Dichrostachyus cinerea, Hypericum revolutum, Bersama abyssinica, Brucea antidysentrica, Clerodendrum myricoides, Dodonaea anguistifolia* and *Rumex nervosus.* The similarity between the three plant communities of the study area is presented in Table 6.

Table 6: Sorenson's Similarity between the Plant Communities of Zerat Forest

Community	I	II	III
I	1		
II	0.67	1	
III	0.41	0.56	1

Table 6 shows that highest similarity was observed between community one and two i..e 67% similarity. Lowest similarity (41%) were observed between community one and three.

3.7 Comparison of Species Richness of the Plant Communities

Sample-based rarefaction was used to compute the expected species richness of each of the communities in the study area. Figure 6 shows the expected species richness of each community i.e. the rate at which new species were included vis-à-vis the number of samples. The expected species richness values were used for plotting the species accumulation curve of each community. Such species accumulation curves have been used

for quantitative comparison among species assemblages [29,30].

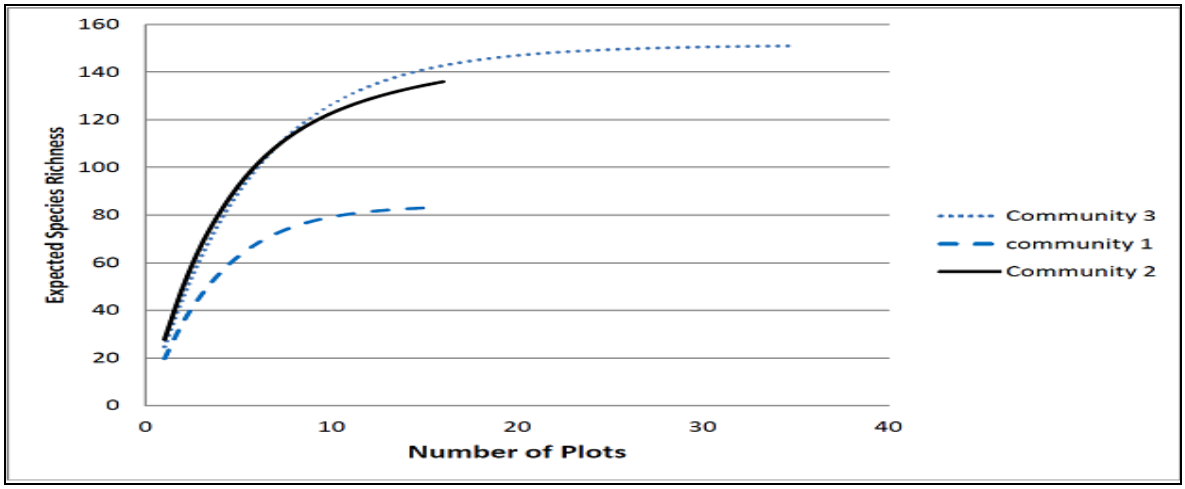

Figure 6: A joint plot of sample-based rarefaction curves of the communities (1-3) showing expected richness as a function of sampling effort. Y-axis represents species richness whereas x-axis represents number of plots studied.

If we compare the species richness of the communities at a point on the rarefaction curve (Figure 6) corresponding to the communities with the lowest number of plots i.e. 15 plots, community 3 had highest species richness (which is about 140 species); whereas community 1 had the lowest species richness (80 species). The low species richness of community 1 may be due to anthropogenic disturbance.

4.Conclusion and Recommendation

Zerat forest is characterized by high floristic diversity. Most of the plants encountered in the study were herbs. Epiphytes were not represented in the flora of Zerat forest. Anthropogenic disturbance might have contributed for absence of epiphytes. Zerat forest comprises considerable number of plants endemic to Ethiopia. As it is the case for the other Afromontane forests of Ethiopia, the woody plants of higher height and DBH classes are less represented in the population structure of Zerat forest. Selective exploitation of trees with higher height class may have contributed to the less representation those trees in the afromontane forests of Ethiopia. Hence, appropriate conservation measures such as stabilizing population growth to minimize the escalating demand for agricultural land and goods from forests, proving alternative livelihood and energy sources to farmers living in close proximity to forests, and promoting plantations in areas that have lost their original forest cover to minimize the pressure on the remnant forest patches of the study area and to restore the ecological services. The plantations could also serve as an alternative source of income for the rural poor in the study area who depend on selling timber, firewood and charcoal.

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recorded in the study area.

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Annex

Annex 1: List of plant species collected from Zerat forest (Ha=habit, T=tree, S=shrub, H=herb, G=grass T/S=tree/shrub, C=climber/Liana, F=fern and V.N=vernacularname)

No	Scientific Name	Family	V.N	Habit
1	Acacia albida	Fabaceae	Bazira girar	T
2	Acalypha ornata	Euphorbiaceae	Aleblabit	H
3	Acalypha psilostacha	Euphorbiaceae	Nacha	S
4	Acokanthra schimperi (DC.)Benth	Apocynaceae	Merenz	T
5	Adiantum thalictroides Schlechtend	Adiantaeae	Este anbesa	F
6	Alchemila pedata A.Rich	Rosaceae	yemidir kosso	H
7	Allophylus abyssinicus (Hochst.) Radlkofer	Sapindaceae	Embus	T
8	Aloe vera	Aloeaceae	Eret	H
9	ArtemisiaabyssinicaSch.Bip. ex A.Rich.	Asteraceae	Chkugn	H
10	Asparagus africanus Lam.	Asparagaceae	yesetkest (seriti)	S
11	Asplenium aethiopicum(Burm.f.)Bechereer	Aspleniaceae	Fern	F
12	Becium grandiflorum	Lamiaceae	yedega-mentese	S
13	Berberis holstii	Berberidaceae	Zinkila-	S

14	Bersama abyssinica Fresen.	Melianthaceae	Azamir	S
15	Biden mucranta	Asteraceae	adey abeba	H
16	Bidens pilosa L.	Asteraceae	yekura wosfie	H
17	Bidens prestinaria (Sch.-Bip.) Cuofd.	Asteraceae	Yemeskel-abeba	H
18	Bridelia micrantha (Hochst.) Baill.	Euphorbiaceae	Yenebir Tifer	C
19	Brucea antidysentrica J.F.Mill.	Simaroubaceae	abalo	S
20	Buddleja polystachya Fresen.	Loganiaceae	Anfar	S
21	Carissa spinarum L.	Apocynaceae	Agam	S
22	Chenopodium album	Chenopodiaceae	Amedmado	H
23	Cineraria abyssinica Sch. Bip. ex A. Rich.	Asteraceae	Etse yfat	H
24	Citrus aurantifolia (Christm.)	Rutaceae	lomi	T/S
25	Clausena anisata (Willd.)Benth.	Rutaceae	Limich	S
26	Clematis simensis Perr. and Guill	Ranunculaceae	AzoAreg	C
27	Clerodendrum myricoides (Hochst.)Vatke	Lamiaceae	Misirich	S
28	Clutia lanceolata Forssk.	Euphorbiaceae	Feyele feji	S
29	Commelina bengehalensis L.	Commelinaceae	Wof ankur	H
30	Convolvulus steudneri	Convolvulaceae	Felatsut	H
31	Cordia africana Lam.	Boraginaceae	wanza	T
32	Cotula abyssinica Sch.-Bip. ex A.Rich	Asteraceae	Arem	H
33	Crotalaria rosenii	Fabaceae	Abba-conanie-Enchet	T
34	Crotolaria abyssinica	Fabaceae	gerengere	T/S
35	Croton macrostachyus Del.	Euphorbiaceae	Bisanna	T
36	Cyanotis barbata D.Don.	Commelinaceae	Yejib dinch	H
37	Cyathia maniana	Cyathaceae	*	T
38	Cynodon dactylon (L.) Pers	Poaceae	Serdo sar	H
39	Cynoglossum coeruleum A. DC.	Boraginaceae	Chegogot	H
40	Cyperus cyperus	Cyperaceae	Engcha	G
41	Cyperus dichroostachyus A.Rich.	Cyperaceae	Giramta-	G
42	Cyperus longus	Cyperaceae	Filla sar	G
43	Cyprus papyrus	Cyperaceae	Ketema	G
44	Datura stramonium L.	Solanaceae	Atsefaris	H
45	Dichrostachys cinerea	Fabaceae	Ader	S
46	Digitaria abyssinica (Hochst ex.A.Rich.) Stapf.	Poaceae	*	H
47	Discopodium penninervum Hochst.	Solanaceae	Ameraro	S
48	Dodonaea anguistifolia L.f.	Sapindaceae	Kitkita	Sh
49	Dombeya torrida (J.F. Gmel.) P.Bamps	Sterculiaceae	Wulkeffa	T
50	Dovyalis abyssinica (A.Rich.) Warb	Flacourtiaceae	Koshim -	S
51	Ehretia cymosa Thonn.	Boraginaceae	Hulegeb	S

52	Ekebergia capensis Sparrm.	Meliaceae	Lol	T
53	Embelia schimperi Vatke	Myrsinaceae	Enkoko	C
54	Erica arborea L.	Ericaceae	Asta	S
55	Euclea divinorum Heirn	Ebenaceae	Dedeho	T/S
56	Euphorbia longipetala	Euphobiaceae	Anterfa	T
57	Euphorbia prostrata Ait.	Euphorbaceae	Kulkual	T
58	Euphorbia tirucalli	Euphorbiaceae	Kinchib	S
59	Ficus sur Forssk.	Moraceae	Sholla	T
60	Ficus sycomorus L.	Moraceae	warka	T
61	Foenculum vulgare	Apiaceae	Ensilal	S
62	Galiniera saxifraga (Hochst)Bridson	Rubiaceae	Yetota-kolet	T
63	Galinsoga parviflora Cav. I	Asteraceae	Yeshewa-Arem	H
64	Geranium aculeolatum Oliv.	Geraniaceae	Etse mewit	H
65	Gerbera piloselloedes	Asteraceae	Yeamora kibe	H
66	Gladiolus balensis Goldblatt	Iridaceae	*	H
67	Grewia ferruginea Hochst.ex.A.Rich	Tiliaceae	Lenkoata	T
68	Hagenia abyssinica (Bruce) J. F. Gmel.	Rosaceae	Kosso	T
69	Halleria lucida L.	Scrophulariaceae	masinkero	S
70	Helichrysum fruticosum	Asteraceae	yedega nechilo	T/S
71	Hygrophila auriculata (Schum.)	Acanthaceae	Yesiet-mlas	H
72	Hyparrhenia hirta (L.) Stapf.	Poaceae	Senbeliet sar	H
73	Hypericum revolutum Vahl	Hypericaceae	Ameja	S
74	Hypoestes triflora	Acantaceae	*	H
75	Impatiens hochstetteri Warb.	Balsaminaceae	Girishit	H
76	Indigofera arrecta	Fabaceae	Digndig	S
77	Inula confrtiflora A. Rich.	Asteracea	woinagift	H
78	Jasminum abyssinicum Hochst.Ex DC.	Oleaceae	Tenbelel	C
79	Juniperus procera Hochst. ex. A. Rich.	Cupressaceae	Yeabesha Tsid	T
80	Kalanchoe petitiana A. Rich	Crassulaceae	Endahula	H
81	Kniphofia foliosa Steud. ex Hochst.	Asphodelaceae	Abelbila	H
82	Lablab purpureus (L.) Sweet	Fabaceae	Yeamora-Gwaya	H
83	Laggera tomentosa (Sch. Bip. ex A. Rich.) Oliv. & Hiern	Asteraceae	Keskeso	H
84	Launaea cornuta (Oliv. & Hiern.)C.Jeffrey	Asteraceae	Yeseytan-gomen	H
85	Leonotis raineriana	Asteraceae	Ras-kimmir	S
86	Lippia adoensis Hochst .ex Walp	Verbenaceae	Kessie	S
87	Lippia aedonsis	Verbenaceae	yewotet kessie	S
88	Lobelia rhynchopetalum Hemsl.	Lobeliaceae	Gibera	T
89	Maesa lanceolata Forssk	Myrsinaceae	Kelawa	T/S

90	Maytenus arbutifolia (A. Rich.) Wilczek	Celastraceae	Atat	T/S
91	Maytenus obscura (A.Rich.)Cuf.	Celastraceae	Kunbel	T
92	Medicago polymorpha L.	Fabaceae	maget	H
93	Mikaniopsis clematoides (Sch. Bip. ex A. Rich.) Milne-Redh.	Asteraceae	Hareg	C
94	Myrsine africana L.	Myrsinaceae	Kechemo	S
95	Myrtus communis	Myrtaceae	Ades	T
96	Nuxia congesta R. Br. ex Fresen.	Loganiaceae	Atquar	T
97	Ocimum urticifolium	Lamiaceae	Damakesie	H
98	Olea capensis subsp. Macrocarpa	Oleaceae	Damotie Woira	T
99	Olea europaea L.sub sp. cuspidata	Oleaceae	Woira	T
10	Olinia rochetiana A.Juss.	Oliniaceae	Tifie	T
101	Opuntia ficus indica (L.) Miller	Cactaceae	Beles	S
102	Orthosiphon pallidus	Lamiaceae	Aba-timara	H
103	Osyris quadripartita Decne.	Santalaceae	Keret	S
104	Otostegia integrifolia	Lamiaceae	Tinjut	S
105	Pavonia urens Cav	Malvaceae	Ablalat	H
106	Phoenix reclinata	Euphorbiaceae	Zembaba/Selen	T
107	Phytolacca dodecandra L'H'erit.	Phytolaccaceae	Endod	S
108	Pittosporum virdiflorum Sims	Pittosporaceae	weyil	T
109	Plantago major	Plantaginaceae	yemidir muata	H
110	Plectocephalus varians (A.Rich.) Jeffrey	Asteraceae	Etse-Yohannes	H
111	Podocarpus falcatus (Thunb.)Mirb.	Podocarpceae	Zigba	T
112	Polygala abyssinica	Polygalaceae	Etselebona	H
113	Polygala steudneri Chord.	Polygalaceae	Yabeba Fire	H
114	Polyscias fulva(Hiern) Harms	Araliaceae	yezinjero wonber	T
115	Prunus africanus (Hook.f.) Kalkam.	Rosaceae	Tikur Enchet	T
116	Prunus persica	Rosaceae	Kock	T
117	Psydrax schimperiana	Rubiaceae	Seged	T
118	Pterocephalus fruticossus	Asteraceae	Yedorokus	H
119	Pterocephalus fruticossus	Astraceae	Gime kitel	S
120	Pterollobium stellatum (Forssk.) Brenan	Fabaceae	Kentefa	C
121	Pycnostachys meyeri Hoof	Lamiaceae	Begged zemede	H
122	Rhamnus prinoides L' Herit.	Rhamnaceae	Gesho	S
123	Rhamnus staddo A.Rich.	Rhamnaceae	Tedo	S
124	Rhamphicarpa heuglinii	Scrophulariaceae	Yesetlib	S
125	Rhus glutinosa Hochst. ex. A. Rich.	Anacardiceae	Qmmo	S
126	Rhus retinorrhoea Oliv.	Anacardiaceae	Tilem -	T
127	Ricinus communis L.	Euphorbiaceae	Gulo-	S

128	Rosa abyssinica Lindley	Rosaceae	Kega	S
129	Rubus steudneri Schweinf.	Rosaceae	Enjory	C
130	Rumex nepalensis Spreng.	Polygonaceae	Tult	H
131	Rumex nervosus Vahl.	Polygonaceae	Emboacho	S
132	Salix subserrata	Salicaceae	*	T
133	Sarcostemma viminale (L.)R.Br	Asclepiadaceae	Moider Hareg	C
134	Saturejaparadoxa(Vatke)Engl.exSeybold	Lamiaceae.	*	h
135	Satureja punctata (Benth.) Briq.	Lamiaceae	Yeloskit	H
136	Satureja punctata(Benth.) Briq.	Lamiaceae	Lomishetsar	H
137	Scorpiurus muricatus L.	Fabaceae	yebeg-lat	H
138	Senecio gigas (Vatke) C. Teffrey	Asteraceae	shokolo	S
139	Sisymbrium erysimoides	Brassicaceae	yeznjero gomen	S
140	Snowdenia polystachya (Fresen.) Pilg.	Poaceae	Muja sar	H
141	Solanecio gigas (Hook.f) C. Jeffrey	Asteraceae	yeshikoko gomen	S
142	Solanum marginatum Jacq.	Solanaceae	Embuay	S
143	Sporobolous pyramidalis Beauv.	Poaceae	gaja	H
144	Sporobolus pectinellus Mez.	Poaceae	Akirma	H
145	Steganotaenia araliacea Hochst.	Apiaceae	yejib dula	T
146	Stephania abyssinica (Dill. Rich.) Walp.	Menispermaceae	yeayit hareg	C
147	Teclea nobilis Del.	Rutaceae	Worer	T
148	Thevetia peruviana K. Schum.	Apocynaceae	Abay nigus	H
149	Thymus schimperi Ronniger	Lamiaceae	Tosign	H
150	Trifolium polystachyum Fresen	Fabaceae	Shal	H
151	Urera hypselodendron (A.Rich.) Weed.	Urticaceae	Lanikuso	C
152	Urtica simensis steudel	Urticaceae	sama	H
153	Vangueria volkensi	Rubiaceae	Yezingero-enkoy	S
154	Verbascum sinaiticum Benth.	Scrophulariaceae	ketetina(ahiya joro)	H
155	Vernonia amygdalina Del.	Asteraceae	Girawa	S
156	Vernonia auriculifera Hiern.	Asteraceae	gujo	T