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Research article

Floristic composition and plant community analysis of vegetation in Ilu Gelan district, West Shewa Zone of Oromia region, Central Ethiopia

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Abstract: This study was conducted on Dirki and Jato sites vegetation in Ilu Gelan district, west Shewa zone of Oromia region, 195 km west of Addis Ababa, to identify floristic composition and plant community types the vegetation. Systematic sampling method was used to collect vegetation data from 54 (20 m × 20 m) plots. To collect data for herbaceous plants, five 1 m × 1 m subplots were laid in each of the main plot, where four were at the corners and one at the center. Cover/abundance values were visually estimated to use for cluster analysis. Shannon - Wiener Diversity Index was used to calculate species diversity, richness and evenness whereas Soresen's Similarity ratio was used to compare the vegetation with other related vegetation. Two hundred and thirteen species were recorded from the sample plots, where Fabaceae, Asteraceae and Poaceae were the most dominant families with 23, 22 and 12 species respectively. Eleven endemic and two near endemic species were recorded from the study area. Based on IUCN Red Data List, nine species were least concern; three were near threatened while one was vulnerable. Three plant community types were recognized from the study area.

Keywords: Plant community - Diversity - Endemic species - Near endemic species - Abundance.

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INTRODUCTION

Ethiopia is a country found in the horn of Africa between the geographical coordinates of 3° 24′ and 14°53′ North and 32° 42′ and 48° 12′ East. According to MOA (2000), the total area of the land of the country is 1.12 million km^2. The country has different topographic land features such as mountains, deep gorges, low lands, valleys and flattened plateaus. These different topographic features assisted different types of flora and fauna that have been well adapted to their own geographical features and climatic conditions. According to Fayera Senbeta *et al.* (2007), the climate and topography of Ethiopia vary considerably and appear to have effects on the distribution of biological diversities. Thus, Ethiopia has been considered a country having high biodiversity in Horn of Africa (NBSAP 2005).

A large part of Ethiopia was believed to have been covered by forests and woodland vegetations in the past (Friis 1992). However, due to continuous massive deforestation made on it, the vegetation cover has been reduced through time to what it looks like at the present (Moges *et al*. 2010). Different researchers have studied the vegetation of Ethiopia at different times (White 1983, Friis 1992, Teketay 1992, Bekele 1994, Ayalew 2003, Awas *et al*. 2001, Senbeta 2006, Senbeta *et. al*. 2007, Didita 2007, Adamu *et al*. 2012, Dibaba *et al*. 2014). The results of these studies could broadly categorize the vegetations of Ethiopia into nine major types. These include: Afroalpine and Subafroalpine Vegetation, Dry Evergreen Montane Vegetation, Moist Evergreen Montane Forest, Evergreen Scrub, *Combretum-Terminalia* (broad-leaved deciduous) woodland, *Acacia-Commmiphora* (Small-leaved deciduous) woodland, Wetlands, Lowland Dry forest, and Desert and semi-Desert

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scrub. Out of the nine vegetation types, four of them occur in the dryland regions. These include,

1) *Combretum-Terminalia* (Broud-leaved deciduous woodland),
2) *Acacia-Commiphora* (Small-leaved deciduous woodland),
3) Desert and semi-desert scrub land, and
4) Dry Evergreen Montane Vegetation.

The coverage of each of the vegetation category has been declining rapidly due to the anthropogenic impacts such as demand of land use for expansion of agriculture by local farmers, overgrazing, illegal exploitation of forests and forest products (Friis 1992, Senbeta & Tefera 2001). Extensive agricultural investment and expansion of road construction through vegetation are also becoming other causes of deforestation. Currently, increasing rate of drought, desertification and shortage of food for both humans and animals are becoming serious problems that need attentions (Moges *et al.* 2010). These problems are directly related to the pressures exerted on vegetation by human beings, and thus need immediate solutions. Therefore, it is very important to study the current status of our vegetation to identify the problems and threats associated with them and make a useful recommendation that is helpful for planning their future conservation and sustainable management.

The aim of this study was to generate basic scientific information by identifying and documenting the floristic composition and plant community structures of the vegetation in the study area. In addition to this, it aimed to assess and point out the environmental factors influencing the structures of the plant communities.

MATERIALS AND METHODS

Description of the study area

Ilu Gelan District is found in West Shewa Zone of Oromia Regional State, central Ethiopia (Fig. 1). The District is located on the Addis Ababa-Nekemte main road about 200 km from Addis Ababa to the west. IJaji is the central town of the District and is located on geographical coordinates of 08° 59′51" N and 37° 19′49" E with the altitude of 1812 m a.s.l.

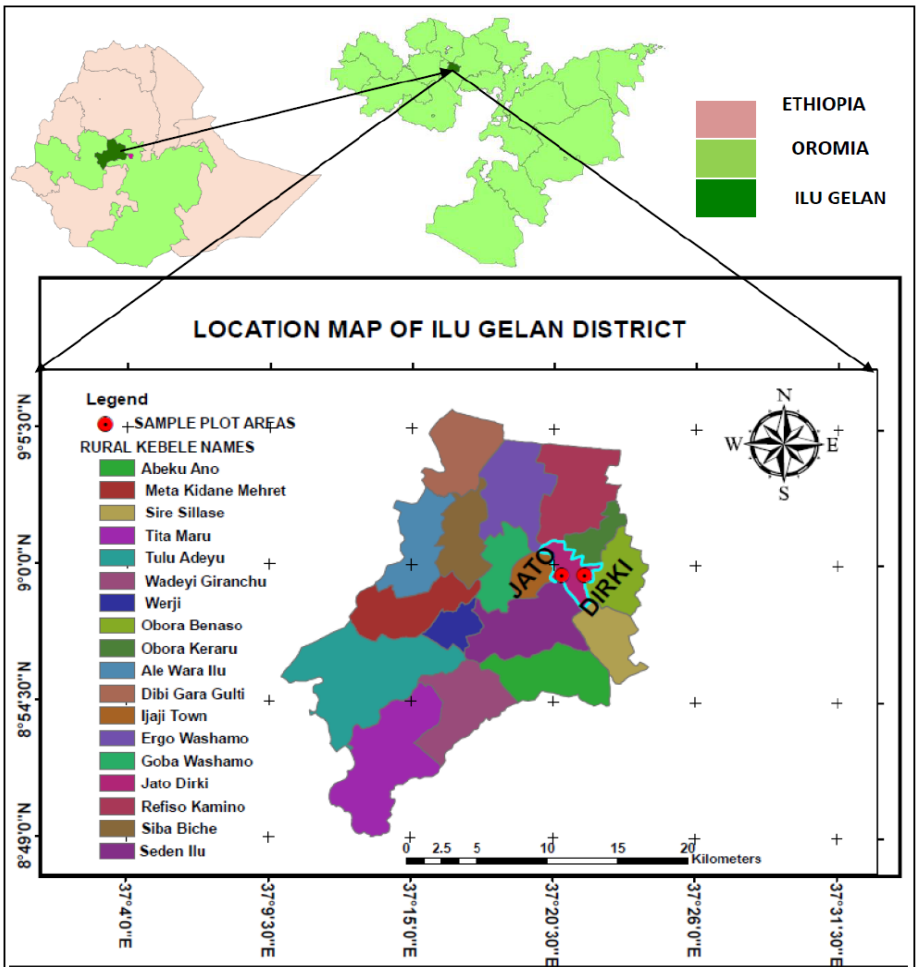

Figure 1. Map of Ethiopia showing the Regional States and the study area.

This study was conducted in the District on two nearby sites known as Dirki and Jato which are found on the south of the main road when driving from Gedo, the central town of Cheliya District, to Ijaji at about 1o km from Gedo to the west. The vegetation of Dirki lies on a steep mountain between 08° 59′16.1″–08° 59′50.8″ N and 37° 22′45.50″–37°23′15.8″ E while that of Jato is found between the latitudes 08° 58′41.5″–08° 59′10.8″ N and longitudes 37° 21′59.7″–37° 22′50.6″ E.

Climate

The climate of Ilu Gelan District is considered to belong to the Weina Dega and Kolla agro-ecological zones of Ethiopia. As most parts of the District are found in the low land, the mean annual temperature of the area is relatively high (Amenu 2007). Meteorological data obtained from National Meteorology Service Agency (NMSA 2015), indicates that Ilu Gelan area obtains high rainfall between May and September and low rainfall from December to February (Fig. 2). The climadiagram figure shows that the study area is typical of forest vegetation rainfall distribution. This indicates that the woodland vegetation was resulted from cutting effects exerted on the original forest in the past. According to the data, the highest mean annual rainfall of the study area recorded for twenty years (1995–2014) was 1351 mm and recorded in July whereas the lowest mean annual rainfall was 11.2 mm and recorded in February. The mean maximum temperature over the twenty years was 28.1ºC while the mean minimum temperature was 13.8ºC. The highest temperature, 31.7ºC, was recorded in February whereas the lowest temperature, 11.2ºC, was recorded in November.

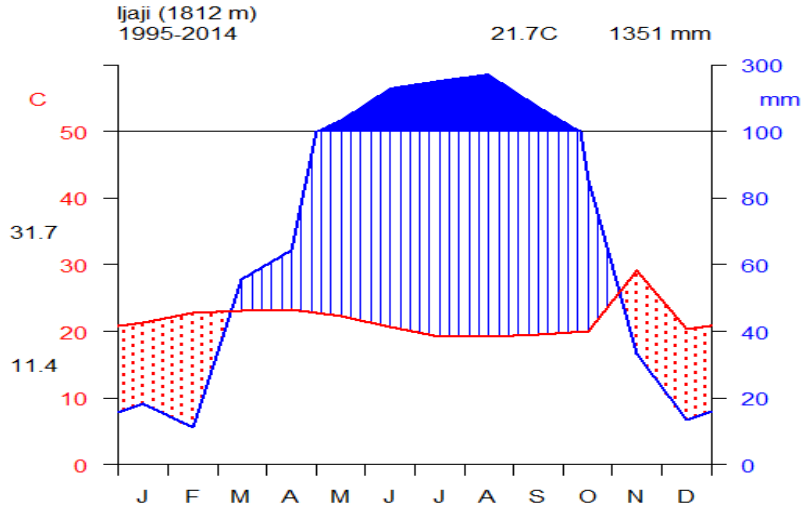

Figure 2. Climadiagram showing rainfall distribution and temperature variation from 1995–2014 around Ijaji Town. [Source: National Meteorological Service Agency (NMSA 2015)]

Sampling design

Systematic transect sampling following Kent & Coker (1992) was used for the study. After the highest altitude was recorded, one 20 m × 20 m quadrat was first taken at the peak of Dirki and radiating transects were laid down from the top to the base of the mountain in four (N, W, S and E) directions. However, in the case of Jato, vegetation cover is found only in the north and north-west facing aspects of extending escarpment. Thus, three transect lines were laid down from the top to the base of the escarpment on the north and north-west facing aspects, where the distance between the three consecutive transects was measured to be 300 m.

Along the transect lines of each study site, 20 m × 20 m (400 m^2) quadrats were laid down at every 25 m altitudinal drop to analyze species turnover. Each transect contains different numbers of plots depending on the length of each transect. In addition, five 1 m × 1 m subplots, one at each of the four corners and one at the center of the 20 m × 20 m main plot were also laid to sample herbaceous plants. A total of fifty four 20 m × 20 m quadrats were laid for vegetation data collection, where 32 were from Dirki and the rest 22 from Jato site.

Data collection

a. Environmental data collection:

In each of the quadrat, altitude and geographical coordinates were measured using Garmin 72 GPS (Geographical Position System) and aspect was determined using Suunnto Compass. Codes were given to aspects following Woldu *et al*. (1989) as:

North= 0; East= 2; South= 4; West= 2.5 and NW= 1.3

Ecological disturbances such as grazing and impacts of human beings (cutting, collecting firewood, producing charcoal and trampling in the vegetation) were noticed and recorded as present or absent in the sampled plots. Grazing intensity was estimated following Woldu & Backeus (1991) and Tekle *et al.* (1997) as:

0= nil; 1= slight; 2= moderate and 3= heavy

The state of human interference was estimated following Hadera (2000), Yeshitela & Bekele (2002), Kidane *et al*. (2010) and codified using a 0–3 subjective scale to record the degree of the impacts (from cutting, fuel wood collection, charcoal production and sign of trampling) as:

0= nil; 1= low; 2= moderate and 3= heavy

b. Vegetation data collection:

Data collection was conducted from November 06 to 20, 2014. A complete list of trees, shrubs, lianas, and herbs was made from the systematically selected plots laid down along each transect. Plant species that occur outside the sample plots, but inside the study area were recorded as present in the floristic composition to produce a complete list of the plants in the vegetation area. Estimation of cover/abundance values for woody species was made and recorded in the field.

The local name of each species, if present, was recorded during the field work. Specimens of all encountered woody and herbaceous plants were collected, pressed, dried and brought to the National Herbarium (ETH), Addis Ababa University, for taxonomic identification. The specimens were identified by comparing with authenticated specimens housed at ETH and by referring to the Flora of Ethiopia and Eritrea. Voucher specimens were kept at ETH.

Cover abundance data defined here as the proportion of area in a quadrat covered by every species recorded and gathered from each quadrat were converted to the 1–9 Braun-Blanquet scale, which was later modified by van der Maarel (1979).

Data analysis

a. Vegetation classification:

The computer program R software for windows 3.0.2 version was used to analyze the vegetation data through Agglomerative Hierarchical Classification technique. Euclidean distance and Ward's method were used for clustering the vegetation data using R software for windows 3.0.2 version. Three plant community types were obtained from the hierarchical clustering analysis and named using two characteristic species having the highest mean cover abundance values in their community.

b. Diversity analysis:

Shannon-Wiener Diversity Index was used to analyze the species diversity, species richness and evenness of the vegetation as:

$$\boldsymbol{H} = -\sum \boldsymbol{Pi} \ln \boldsymbol{Pi}$$

Where, H: Shannon-Wiener Index; Pi: proportion of individual species; ln: log base$_n$.

The equitability or evenness of the species in each quadrat was computed using the formula:

$$\text{Equitability } \boldsymbol{J} = \frac{\boldsymbol{H'}}{\boldsymbol{Hmax}} = \sum_{\boldsymbol{i=1}}^{\boldsymbol{S}} \frac{\boldsymbol{Pi} \ln \boldsymbol{Pi}}{\ln \boldsymbol{S}}$$

Where, S: the number of species; Pi: the proportion of individuals of the ith species or the abundance of the ith species expressed as a proportion of total cover; ln: log base.

c. Phytogeographical similarity:

Sorenson's Similarity ratio was used to evaluate the similarity between the three plant community types of the vegetation in the study area and as well as the similarity between the Vegetation and four other previously studied vegetationon the basis of their species composition.

$$\boldsymbol{Ss} = \frac{\boldsymbol{2a}}{\boldsymbol{2a + b + c}}$$

Where, Ss: Sorensen's similarity coefficient; a: number of species common to both samples /communities/ study areas; b:number of species in sample 1; c: number of species in sample 2.

RESULTS

Floristic composition

The study showed that Dirki and Jato vegetation (Fig. 3 & Fig. 4) had high species richness in plants of different growth forms. Plant species of different growth forms (trees, shrubs, lianas and herbs) were recorded

from the study area (Fig. 5). Out of the total plant species recorded from the study area, trees and herbs each comprised 32.71% while shrubs and lianas constituted 27.57% and 7.01% respectively.

Figure 3. Vegetation of Dirki site.

Figure 4. Vegetation of Jato site.

A total of 69 families with 167 genera and 214 species were recorded from the study area (Appendix 1). Of all the families, Fabaceae, Asteraceae and Poaceae were the three most dominant families represented by 18, 15 and 11 genera, and 23, 22 and 12 species respectively. These three dominant families together constituted 57 (26.64%) of the total species richness in Dirki and Jato Vegetation. The next dominant families, Euphorbiaceae, Acanthaceae, Rubiaceae, Lamiaceae and Combretaceae were represented by 11, 9, 9, 9 and 7 species respectively and constituted 45 (21.03%) of the total species. Other four families which accounted 23 (10.75%) of the total species were Malvaceae, Moraceae and Rhamnaceae and constituted six species each, while Solanaceae was represented by five 5 species.

Figure 5. Some of the collected plants from the study area: **A,** *Mimusops kummel* A. DC.; **B,** *Combretum paniculatum* Vent.; **C,** *Rothmannia urcelliformis* (Hiem) Robyns; **D,** *Acanthus polystachius* Delile.

Each of the families Oleaceae, Ranunculaceae and Rosaceae were represented by four species while Boraginaceae, Celastraceae, Loganiaceae, Sapindaceae and Verbenaceae were represented by three species each. These eight families constituted 27 (12.62%) species while other 13 families represented by 2 species each constituted 26 (12.15%) of the total species. The rest 36 families that contributed 16.82% of the total species were represented by one species each. Out of the total 214 species identified from the study area, one hundred and six, which were collected from the 54 quadrats were used in the floristic analysis. The rest 108 plant species were collected from outside of the quadrats but inside the woodland vegetation, and included in the floristic list to make the description of the vegetation more reliable.

Endemic plant species

Table 1. List of endemic species with their IUCN threat categories.

Species	Family	Habit	IUCN category
Acanthus sennii Chiov.	Acanthaceae	S	NT
Bidens ghedoensis Mesfin	Asteraceae	H	LC
Bidens pachyloma (Oliv. & Hiern) Cufod.	Asteraceae	H	LC
Cirsium schimperi (Valke) C. Jeffrey ex Cufod.	Asteraceae	H	LC
Clematis longicauda Steud.ex A. Rich.	Ranunculaceae	L	LC
Crotalaria rosenii (Pax) Milne-Redh.ex Polhill	Fabaceae	H	NT
Echinops longisetus A. Rich.	Asteraceae	H	LC
Lippia adoensis Hochst. ex Walp	Verbenaceae	S	LC
Millettia ferruginea (Hochst.) Bak.	Fabaceae	T	NT
Phyllanthus mooneyi M. Gilbert	Euphorbiaceae	S	VU
Pycnostachys abyssinica Fresen.	Lamiaceae	H	LC
Solanum marginatum L.f.	Solanaceae	S	LC
Vernonia leopoldi (Sch. Bip. ex Walp.) Vatke	Asteraceae	S	LC

Note: T= Tree, S= Shrub, L= Liana, H= Herb; NT= Near Threatened, LC= Least Concern, VU= Vulnerable.

Out of the total plant species identified from the study area, eleven species were identified as endemic to Ethiopia while two were near endemic *i.e.*, confined to Ethiopia and Eritrea (Table 1). Based on the IUCN

Criteria of level of threat, nine species were least concern (LC), three species were assessed as near threatened (NT) while one species was vulnerable (VU).

Vegetation classification

a. Plant community types:

Three plant community types were identified from the hierarchical cluster analysis using the computer software program R for windows version 3.0.2. The computer program for determining the optimal number of clusters was used to decide the number of plant community types. Ward's method and Euclidean distance were used to draw the dendrogram showing dissimilarity among the three clusters (Fig. 6). The vegetation classification was done by using the cover abundance value estimate of each species included in the analysis. Distribution of the three plant community types (C_1= Community Type 1, C_2= Community Type 2, and C_3= Community Type 3) along with their altitudinal range was given in table 2. The plant community types were named by two characteristic species confied to only one of the three plant community types (Table 3).

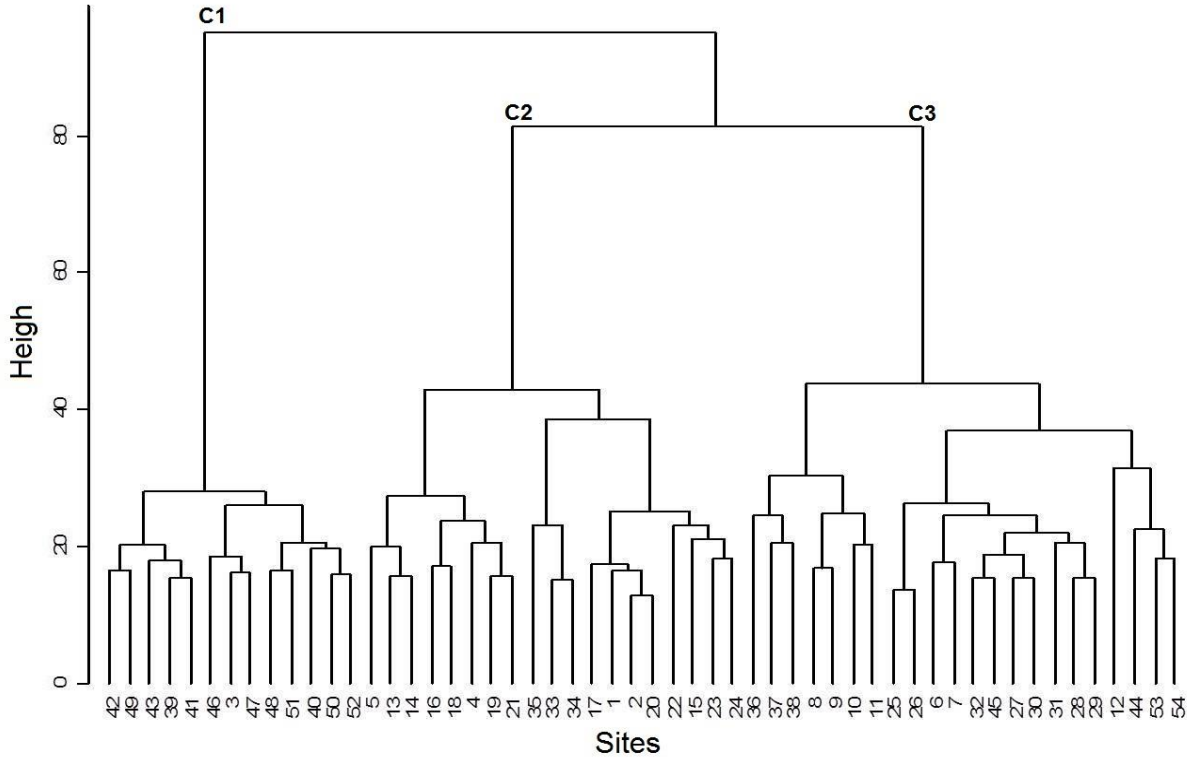

Figure 6. Dendrogram showing the plant community types of the study area. [Agglomerativ Hierarchical Clustering Using Euclidean Distance equation: $\sqrt{\sum(X\,i\,j - Xik)^2}$]

Table 2. Distribution of plots of the three plant communities with their altitudinal ranges.

Community	Altitude (m a.s.l.)	Total plots	List of plots
C1	1920–2136	13	3, 39, 40, 41, 42, 43, 46, 47, 48, 49, 50, 51 and 52
C2	1950–2078	19	1, 2, 4, 5, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 33, 34 and 35
C3	1803–1953	22	6, 7, 8, 9, 10, 11, 12, 25, 26, 27, 28, 29, 30, 31, 32, 36, 37, 38, 44, 45, 53 and 54

Descriptions of the three plant community types

a. *Acacia etbaica - Lantana trifolia* community type

This community type is distributed between the altitudinal range of 1920–2136 m a.s.l. It is represented by 13 plots comprising 62 plant species; out of which 50 are commonly shared with community two and 51 with community three. *Acacia etbaica* and *Lantana trifolia* are the characteristic species of this community. *Acacia abyssinica is a* dominant tree species in this community type while other common tree and shrub species associated with the community include: *Maesa lanceolata*, *Syzygium guineense*, *Combretum molle*, *Premna schimperi*, *Hypericum quartinianum*, *Rosa abyssinica*, *Stereospermum kunthianum* and *Nuxia congesta*. In this

community, common herbaceous species covering the ground surface are *Bidens biternata*, *Bidens ghedoensis*, *Cynodon dactylon* and *Oplismenus hirtellus*.

b. *Buddleja polystachya* - *Teclea nobilis* community type

This community is distributed between the altitudinal range of 1950–2078 m a.s.l. It is represented by 19 plots consisting of 73 species; out of which 50 are shared with community one while 66 species are shared with community three. *Buddleja polystachya* and *Teclea nobilis* are the characteristic species in the community. *Calpurnia aurea* is a dominant species whereas common tree and shrub plant species found in this community include *Osyris quadripartita, Albizia schimperiana, Rhus natalensis, Euclea divinorum, Olinia rochetiana and Schrebera alata*. Whereas, *Helinus mystacinun* and *Dioscorea shimperiana* are common lianas recorded in this community type. On the other hand, *Hypoestes aristata*, *Panicum monticola*, *Justicia ladanoides* and *Cyperus sesquiflorus* are the dominant species at herbaceous level.

c. *Combretum paniculatum* - *Rothmannia urcelliformis* community type

This community type is distributed between the altitudinal range of 1803–2080 m a.s.l. It is represented by 22 plots consisting of 95 species. *Combretum paniculatum* and *Rothmannia urcelliformis* are characteristic species of the community. Other dominant woody species of this community include: *Clausena anisata*, *Maytenus arbutifolia*, *Grewia ferruginea*, *Calpurnia aurea*, *Carissa spinarum*, *Croton macrostachyus*, *Millettia ferruginea*, *Acacia abyssinica*, *Bersama abyssinica*, *Vangueria apiculata* and *Rytigynia neglecta*. On the Other hand, *Clematis longicauda* is a characteristic liana of this community whereas the characteristic herbaceous species covering the ground surface are *Achyranthes aspera*, *Cynodon nlemfuensis*, *Pycnostachys abyssinica* and *Setaria megaphylla.*

Table 3. Mean cover abundance estimates of species of the three communities.

	Community type		
Species	**One**	**Two**	**Three**
Acacia abyssinica	4.15	2.21	3.59
Acacia etbaica	**0.08**	0.00	0.00
Albizia schimperiana	2.69	6.00	2.55
Bersama abyssinica	1.08	5.26	3.55
Buddleja polystachya	0.00	**0.11**	0.00
Calpurnia aurea	4.46	7.37	5.27
Carissa spinarum	2.92	6.00	4.5
Clausena anisata	2.08	7.05	6.59
Combretum molle	3.62	2.26	1.91
Combretum paniculatum	0.00	0.00	**1.09**
Croton macrostachyus	4.23	5.00	4.41
Euclea divinorum	0.08	5.16	0.36
Ficus sycomorus	0.00	0.00	0.23
Ficus vasta	0.00	0.00	0.09
Grewia ferruginea	3.92	4.47	5.59
Lantana trifolia	**0.08**	0.00	0.00
Mimusops kummel	0.00	0.00	0.23
Olea capensis	0.00	0.00	0.31
Olinia rochetiana	1.85	5.26	0.05
Osyris quadripartita	6.23	3.53	0.55
Premna schimperi	6.62	6.79	5.27
Rothmannia urcelliformis	0.00	0.00	**0.32**
Schrebera alata	0.38	3.94	0.05
Syzygium guineense	7.38	3.16	1.68
Teclea nobilis	0.00	**0.26**	0.00

Species richness, evenness and diversity of the three communities

Shannon-Wiener diversity index was computed for the three plant community types of the woodland vegetation of Ilu Gelan District (Table 4). Community three had the highest diversity followed by community two while community one showed the least diversity. Community type three had the highest species richness whereas the least species rich community is community type one. However, equitability (evenness) which measures the relative abundance of different species present in each community showed relatively the highest value for community two followed by community three and the lowest for community one.

Table 4. Shannon-Wiener diversity index for woodland vegetation of Ilu Gelan District.

Community type	Diversity index (H')	Species richness (S)	H_{max}	Equitability (J)	Average altitude (m a.s.l.)
One	3.847	62	4.128	0.932	2045.50
Two	4.068	73	4.291	0.948	2014.00
Three	4.316	95	4.553	0.947	1941.50

Similarity between the three plant community types

Sorensen's Coefficient Index was used to calculate the degree of similarity among the three plant community types. The highest similarity was observed between communities one and three while the least similarity was observed between communities two and three. The result from the analysis showed communities one and two, community one and three, and communities two and three shared about 74.63%, 64.97% and 78.57% similarity in species composition respectively.

DISCUSSION

Dominance of Fabaceae and Asteraceae has been reported from different floristic studies done by different researchers at different times (Yineger *et al*. 2008, Tadesse *et al*. 2008, Abdena 2010, Kebede 2010, Didita *et al*. 2010, Alemu 2011, Adamu *et al*. 2012, Dibaba *et al*. 2014). Similarly, the results from analyzed data showed that Fabaceae and Asteraceae are the most dominant species in Dirki and Jato Woodland Vegetation. Fabaceae and Asteraceae are represented by 23 and 22 species respectively, while Poaceae followed by 12 species. The dominance of these families is also in line with the assessment results that show their dominance positions in the Flora of Ethiopia and Eritrea. Fabaceae and Asteraceae might have got the top dominant position probably due to having efficient pollination and successful seed dispersal mechanisms that might have adapted them to a wide range of ecological conditions in the past (Kelbessa & Soromessa 2008). However, the variation in topography and environmental conditions like the amount of rainfall and temperature could be the causes of variation in dominance positions of plants taxa. Ethiopia is considered one of the countries of east Africa known by plant endemism (Vivero *et al*. 2005). The diverse topographic land features having various climatic conditions assisted Ethiopia to be a country of high biodiversity (Gebrehiwot & Hundera 2014).

Results from data analysis showed that the woodland vegetation of Dirki and Jato consists of 13 endemic species of the flora of Ethiopia and Eritrea. From these, 11 species are endemic to Ethiopia while two are near endemic (*Lippia adoensis* and *Solanum marginatum* are confined to Ethiopia and Eritrea). Based on the IUCN Criteria of the level of threat, nine species are least concern (LC); three species are near threatened (NT) while one species has been categorized under vulnerable (VU).

Plant community types

The results from cluster analysis showed that there are differences among the three plant communities in species composition. The differences could be attributed to variations in environmental gradients that can limit the ecological distributions of plant species (Lulekal 2014). As described in Bekele (1993), this variation in species composition could also be related to the effects of environmental factors such as altitude, aspect, soil contents and moisture, human impacts and grazing intensity. Lower altitudinal ranges, aspects more exposed to sun light directions, soils with sufficient moisture contents and part of vegetation less exposed to disturbance accesses can support relatively more biodiversity than the reverse of each component.

CONCLUSION

The results from this study showed that plant species of different life forms (trees, shrubs, lianas and herbs) were identified from the vegetation of Dirki and Jato in Ilu Gelan District. Out of the total plant species recorded from the vegetation, most proportions (65.42%) were trees and herbs while the rest 27.57% and 7.01% were shrubs and lianas respectively.

Plants recorded from the study area belong to 69 families, 167 genera and 214 species; whereas Fabaceae, Asteraceae and Poaceae were the most dominant families with 23, 22 and 12 species respectively. These three dominant families constituted 26.64% of the total species richness of the study area. Euphorbiaceae and Acanthaceae were the fourth and fifth dominating families while Rubiaceae, Lamiaceae and Combretaceae were the next three consecutive dominant families in the vegetation. These five species are represented by 11, 9, 9, 9 and 7 species respectively, and constitute 45 (21.03%) of the total species recorded from the study area. Families Malvaceae, Moraceae, Rhamnaceae and Solanaceae constitute 23 (10.75%) of the total species and the

first three families were represented by six species each while Solanaceae contributed five species. Families Oleaceae, Ranunculaceae and Rosaceae were represented by four species each while families represented by three species each in the vegetation were Boraginaceae, Celastraceae, Loganiaceae, Sapindaceae and Verbenaceae. These eight families together contribute 27 (12.62%) of the total species while other 13 families represented by two species each constituted 26 (12.15%) of the total species. The rest 36 (16.82%) families were represented by only one species each.

Of the total 214 species identified from the study area, 11 are endemic to Ethiopia while two species are near endemic (*Lippia adoensis* and *Solanum marginatum* are found in Ethiopia and Eritrea only). According to the IUCN Red Data List, nine of these species were included in least concern (LC), two were considered near threatened (NT) whereas one species has been put under vulnerable (VU) category.

Based on the cover abundance values of the identified species, three plant community types were recognized from the study area and named by two characteristic species having highest mean cover abundance estimate in each community. The three communities are *Acacia etbaica* - *Lantana trifolia* Community Type, *Buddleja polystachya* - *Teclea nobilis* Community Type and *Combretum paniculatum* - *Rothmannia urcelliformis* Community Type. Community three had the highest diversity and species richness than the two communities. Communities one and two were more similar in species composition than communities one and three or two and three.

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Appendix 1. List of plant species collected from Dirki and Jato sites in Ilu Gelan District.

S.N.	Species name	Family	Local name	Ha	C. code	Housed at
1	*Abutilon longicuspe* Hoehst. ex A. Rich.	Malvaceae	Hincinnii	S	Z192	ETH
2	*Acacia abyssinica* Hochst. ex Benth.	Fabaceae	Laaftoo	T	Z023	ETH
3	*Acacia etbaica* Schweinf.	Fabaceae	Doddota	T	Z197	ETH
4	*Acacia persiciflora* Pax	Fabaceae	Laaftoo	T	Z204	ETH
5	*Acanthus polystachius* Delile	Acanthaceae	Sokorruu adii	S	Z176	ETH
6	*Acanthus sennii* Chiov.	Acanthaceae	Sokorruu	S	Z013	ETH
7	*Achyranthes aspera* L.	Amaranthaceae	Maxxannee	H	Z118	ETH
8	*Acmella caulirhiza* Del.	Asteraceae		H	Z182	ETH
9	*Adiantum poiretii* Wikstr.	Adiantaceae		H	Z027	ETH
10	*Albizia schimperiana* Oliv.	Fabaceae	Imalaa	T	Z005	ETH
11	*Allophylus macrobotrys* Gilg	Sapindaceae	Sarara	T	Z125	ETH
12	*Allophylus africanus* P. Beauv.	Sapindaceae	Qarxammee	T	Z162	ETH
13	*Aloe macrocarpa* Tod.	Aloaceae	Hargisa	S	Z178	ETH
14	*Andropogon abyssinicus* Fresen.	Poaceae	Baallammii	H	Z179	ETH
15	*Apodytes dimidiata* E. Mey. ex Am.	Icacinaceae	Qumbaala	T	Z157	ETH
16	*Argyrolobium fischeri* Taub.	Fabaceae		H	Z016	ETH
17	*Aspilia mossambicensis* (Oliv.) Wild	Asteraceae	Keelloo	S	Z165	ETH
18	*Asystasia mysorensis* (Roth) T. Anders.	Acanthaceae		H	Z166	ETH
19	*Bersama abyssinica* Fresen.	Melianthaceae	Lolchiisaa	T	Z008	ETH
20	*Bidens biternata* (Lour.) Merr. & Sherfft.	Asteraceae	Keelloo	H	Z183	ETH
21	*Bidens ghedoensis* Mesfin	Asteraceae	Keelloo	H	Z120	ETH
22	*Bidens pachyloma* (Oliv. & Hiern) Cufod.	Asteraceae	Keelloo	H	Z153	ETH
23	*Bridelia micrantha* (Hochst.) Baill.	Euphorbiaceae	Agiraabaa	T	Z094	ETH
24	*Brucea antidysenterica* J.F.Mill.	Simaroubaceae	Qomonyoo	S	Z185	ETH
25	*Buddelja davidii* Franch.	Loganiaceae	Qawwwisa	S	Z151	ETH
26	*Buddleja polystachya* Fresen.	Loganiaceae	Qawwisa	T	Z075	ETH
27	*Caesalpinia decapetala* (Roth) Alston	Fabaceae	Arangamaa	L	Z149	ETH
28	*Calpurnia aurea* (Ait.) Benth.	Fabaceae	Ceekaa	S	Z001	ETH
29	*Capparis tomentosa* Lam.	Capparidaceae	Arangamaa	S	Z142	ETH
30	*Carissa spinarum* L.	Apocynaceae	Agamsa	S	Z051	ETH
31	*Celtis africana* Burm.f.	Ulmaceae	Cayii	T	Z108	ETH
32	*Chionanthus mildbraedii* (Gilg & Schellenb.) Stearn	Oleaceae	Karra waayyuu	T	Z199	ETH
33	*Cirsium schimper* (Valke) C. Jeffrey ex Cufod.	Asteraceae		H	Z152	ETH
34	*Cissampelos pareira* L.	Menispermaceae	Hidda kalaalaa	L	Z018	ETH
35	*Clausena anisata* (Willd). Benth.	Rutaceae	Ulmaayii	S	Z003	ETH
36	*Clematis hirsuta* Perr. & Guill.	Ranunculaceae		L	Z144	ETH
37	*Clematis longicauda* Steud.ex A. Rich.	Ranunculaceae	Hidda fiitii	L	Z063	ETH
38	*Clematis simensis* Fresen.	Ranunuclaceae	Hidda fiitii	L	Z020	ETH
39	*Clerodendrum myricoides* (Hochst.) Vatke	Lamiaceae		S	Z131	ETH
40	*Clutia abyssinica* Jaub. &- Spach.	Euphorbiaceae		S	Z085	ETH
41	*Combretum adenogonium* Steud. ex A. Rich.	Combretaceae	Rukeessa	T	Z212	ETH
42	*Combretum collinum* Fresen.	Combretaceae		T	Z080	ETH
43	*Combretum molle* R. Br. ex G.Don	Combertaceae	Rukeessa	T	Z041	ETH

44	*Combretum nigrican* Lepr. ex Guill. & Perr.	Combretaceae		T	Z055	ETH
45	*Combretum paniculatum* Vent.	Combretaceae	Hidda baggii	L	Z137	ETH
46	*Commelina benghalensis* L.	Commelinaceae	Gororaa	H	Z168	ETH
47	*Cordia africana* L.	Boraginaceae	Waddeessa	T	Z114	ETH
48	*Crassocephalum macropappum* (Sch.Bip.ex A. Rich) S. Moore	Asteraceae		H	Z170	ETH
49	*Crassocephalum x picridifolium* (DC) S. Moore	Asteraceae		H	Z169	ETH
50	*Crassula alata* (Viv.) Berger	Crassulaceae		H	Z145	ETH
51	*Crepis rueppelli* Sch. Bip.	Asteraceae		H	Z136	ETH
52	*Crotalaria pallida* Ait.	Fabaceae		H	Z200	ETH
53	*Crotalaria quartiniana* A. Rich.	Fabaceae		H	Z132	ETH
54	*Crotalaria rosenii* (Pax) Milne-Redh.ex Polhill	Fabaceae		S	Z123	ETH
55	*Croton macrostachyus* Del.	Euphorbiaceae	Bakkanniissa	T	Z030	ETH
56	*Cucumis dipsaceus* Ehrenb. ex Spach	Cucurbitaceae		H	Z113	ETH
57	*Cyathula polycephala* Bale.	Amaranthaceae		H	Z135	ETH
58	*Cymbopogon commutatus* (Steud.) Stapf	Poaceae	Jajjaba	H	Z101	ETH
59	*Cynodon dactylon* (L.) Pers.	Poaceae	Coqorsa	H	Z103	ETH
60	*Cynodon nlemfuensis* Vanderyst	Poaceae	Waratii	H	Z207	ETH
61	*Cyperus sesquiflorus* (Torr.) Mattf. & KUk.	Cyperaceae	Qeexamaa	H	Z052	ETH
62	*Dalbergia lactea* Vatke	Fabaceae	Sarxee	T	Z107	ETH
63	*Desmodium repandum* (Vahl) DC.	Fabaceae		H	Z213	ETH
64	*Diaphananthe candida* Cribb	Orchidaceae	Digaluu	H	Z062	ETH
65	*Dicranopteris linearis* (Burm.f.) Underw.	Gleicheniaceae	Fern	H	Z034	ETH
66	*Dioscorea schimperiana* Hochst. ex Kunth	Dioscoreaceae		H	Z047	ETH
67	*Diospyros abyssinica* (Hiern) F. White	Ebenaceae	Ilkee	T	Z089	ETH
68	*Dodonaea angustifolia* L. f.	Sapindaceae	Ittacha	S	Z088	ETH
69	*Dombeya torrida* (G.F. Gmel.) P. Bamps	Sterculiaceae	Daannisa	T	Z116	ETH
70	*Dovyalis abyssinica* (A. Rich.) Warb.	Flacourtiaceae	Koshommii	T	Z045	ETH
71	*Dracaena steudneri* Engl.	Dracaenaceae	Meerqoo	S	Z150	ETH
72	*Drimia altissima* (L.f.) Ker-Gawl.	Hycinthaceae	Qullubbii waraabessaa	H	Z209	ETH
73	*Echinops longisetus* A. Rich.	Asteraceae	Qoraattii harree	S	Z058	ETH
74	*Ehretia cymosa* Thonn.	Boraginaceae	Ulaagaa	T	Z021	ETH
75	*Ekebergia capensis* Sparrm.	Meliaceae	Somboo	T	Z095	ETH
76	*Englerina woodfordioides* (Schweinf.)M. Gilbert	Loranthaceae	Digaluu	S	Z119	ETH
77	*Entada abyssinica* Steud. ex A. Rich.	Fabaceae	Ambaltaa	T	Z196	ETH
78	*Erythrococca abyssinica* Pax	Euphorbiaceae	Geelloo	S	Z067	ETH
79	*Eucalyptus camaldulensis* Dehnh.	Myrtaceae	Baargamoo diimaa	T	Z068	ETH
80	*Euclea divinorum* Hiern	Ebenaceae	Mi'eessaa	T	Z038	ETH
81	*Euphorbia schimperiana* Scheele	Euphorbiaceae		S	Z011	ETH
82	*Ficus mucuso* Ficalho.	Moraceae	Qilinxoo	T	Z141	ETH
83	*Ficus salicifolia* A. Rich.	Moraceae	Qilinxoo	T	Z167	ETH
84	*Ficus sur* Forssk.	Moraceae	Harbuu	T	Z164	ETH
85	*Ficus sycomorus* L.	Moraceae	Odaa	T	Z130	ETH
86	*Ficus thonningii* Blume	Moraceae	Dambii	T	Z128	ETH

87	*Ficus vasta* Forssk.	Moraceae	Qilxuu	T	Z122	ETH
88	*Flacourtia indica* (Burm.f.) Merr	Flacourtaceae	Akuukkuu	T	Z066	ETH
89	*Galiniera saxifraga* (Hochst.) Bridson	Rubiaceae		T	Z040	ETH
90	*Gardenia ternifolia* Schumach. &Thonn.	Rubiaceae	Gambeela	T	Z033	ETH
91	*Geranium arabicum* Forssk.	Geraniaceae		H	Z070	ETH
92	*Girardinia diversifolia* (Link) Friis	Urticaceae	Doobbii	H	Z124	ETH
93	*Glycine wightii* (Wight& Am.) Verdc.	Fabaceae		H	Z115	ETH
94	*Gnidia glauca* (Fresen.) Gilg	Thymelaeaceae	Qaqaroo	S	Z175	ETH
95	*Gouania longispicata* Engl.	Rhamnaceae		L	Z195	ETH
96	*Grewia ferruginea* Hochst.ex A. Rich.	Tiliaceae	Dhoqonuu	T	Z056	ETH
97	*Guizotia schimperi* Sch. Bip. ex Walp.	Asteraceae	Tuufoo	H	Z069	ETH
98	*Helinus mystacinus* (Ait.) E. Mey. ex Steud.	Rhamnaceae	Hidda hoomachoo	L	Z050	ETH
99	*Heliotropium zeylanicum* (Burm f.) Lam.	Boraginaceae	Maxxannee	H	Z029	ETH
100	*Hygrophila schulli* (Hamilt.) M.R. & S.M Almeida	Acanthaceae	Qoraatii saree	H	Z096	ETH
101	*Hymenodictyon floribundum* (Hochst. & Steud.) Robinson	Rubiaceae	Gaarrii	T	Z154	ETH
102	*Hyparrhenia anthistirioides* (Hochst. ex A. Rich) Stapf	Poaceae	Sanbaleeta	H	Z090	ETH
103	*Hypericum quartinianum* A. Rich.	Guttiferae	Hinnee	T	Z181	ETH
104	*Hypoestes aristata* (Vahl) Nees	Acanthaceae	Darguu	H	Z092	ETH
105	*Ilex mitis* (L.) Radlk.	Aquifoliaceae		T	Z206	ETH
106	*Ipomoea plebeia* Meeuse	Convolvulaceae		H	Z081	ETH
107	*Justicia ladanoides* Lam.	Acanthaceae		H	Z083	ETH
108	*Justicia schimperiana* (Hochst. ex Nees) T. Anders.	Acanthaceae	Dhummuugaa	S	Z171	ETH
109	*Kalanchoe marmorata* Bak.	Crassulaceae	Bosoqqee	H	Z048	ETH
110	*Laggera crispata* (Vahl) Hepper & Wood	Asteraceae		H	Z189	ETH
111	*Landolphia buchananii* (Hall.f.) Stapf	Apocynaceae	Hidda geeboo	L	Z208	ETH
112	*Lantana trifolia* L.	Verbenaceae		S	Z198	ETH
113	*Leonotis ocymifolia* (Burm. f.) Iwarsson	Lamiaceae		S	Z211	ETH
114	*Lippia abyssinica* (Otto & Dietr.)	Verbenaceae		S	Z078	ETH
115	*Lippia adoensis* Hochst. ex Walp	Verbenaceae	Kusaayee	S	Z006	ETH
116	*Loudetia flavida* (Stapf) C. E. Hubb.	Poaceae		H	Z043	ETH
117	*Maesa lanceolata* Forssk.	Myrsinaceae	Abbayyii	T	Z059	ETH
118	*Malva verticillata* L.	Malvaceae	Hincinnii	H	Z044	ETH
119	*Maytenus arbutifolia* (A.Rich.) Wilczek	Celastraceae	Kombolcha	S	Z007	ETH
120	*Maytenus gracilipes* (Welw. ex Oliv.) Exell	Celastraceae	Acaacii	S	Z100	ETH
121	*Maytenus obscura* (A. Rich.) Cuf.	Celastraceae	Kombolcha	S	Z073	ETH
122	*Medicago polymorpha* L.	Fabaceae	Siddisa	H	Z074	ETH
123	*Microglossa pyrifolia* (Lam.) 0. Kuntze	Asteraceae		S	Z110	ETH
124	*Mikaniopsis clematoides* (Sch. Bip. ex A. Rich.) Milne-Redh.	Asteraceae		H	Z091	ETH
125	*Millettia ferruginea* (Hochst.) Bak.	Fabaceae	Sootalloo	T	Z117	ETH
126	*Mimosa pigra* L.	Fabaceae	Arangamaa	S	Z214	ETH
127	*Mimusops kummel* A. DC.	Sapotaceae	Qolaatii	T	Z140	ETH
128	*Monechma debile* (Forssk.) Nees	Acanthaceae		H	Z028	ETH
129	*Myrsine africana* L.	Myrsinaceae	Qacama	S	Z065	ETH
130	*Nuxia congesta* R.Br. ex Fresen.	Loganiaceae	Qawwisa	T	Z194	ETH

131	*Ocimum lamiifolium* Hochst. ex. Benth.	Lamiaceae	Ancabbii diimaa	S	Z014	ETH
132	*Ocimum urticifolium* Roth.	Lamiaceae	Ancabbii adii	S	Z084	ETH
133	*Olea capensis* L. subsp. *macrocarpa* (C.H. Wright) Verdc.	Oleaceae	Gagamaa	T	Z147	ETH
134	*Olea europaea* L. subsp. *cuspidata* (Wall.ex G.Don) Cif.	Oleaceae	Ejersa	T	Z097	ETH
135	*Olinia rochetiana* A.Juss.	Oliniaceae	Daalachoo	T	Z025	ETH
136	*Ophrestia radicosa (A. Rich.) Verde.*	Fabaceae	Hidda bofaa	H	Z017	ETH
137	*Oplismenus hirtellus* (L.) P. Beauv.	Poaceae	Ashuffee	H	Z053	ETH
138	*Oreosyce africana* Hook.f.	Cucurbitaceae		H	Z186	ETH
139	*Osyris quadripartita* Decne	Santalaceae	Waatoo	T	Z026	ETH
140	*Panicum monticola* Hook.f.	Poaceae	Marga gogorrii	H	Z105	ETH
141	*Pavetta abyssicica* Fresen.	Rubiaceae		S	Z024	ETH
142	*Pellaea calomelanos* (Sw.) Link	Sinopteridaceae		H	Z071	ETH
143	*Pennisetum thunbergii* Kunth	Poaceae	Migira saree	H	Z102	ETH
144	*Periploca llnearlfolia* Quart.-Dill. & A. Rich.	Asclepiadaceae	Hidda aannannoo	L	Z160	ETH
145	*Phaulopsis imbricata* (Forssk.) Sweet	Acanthaceae		H	Z049	ETH
146	*Phoenix reclinata* Jacq.	Arecaceae	Meexxii	T	Z129	ETH
147	*Phyllanthus mooneyi* M. Gilbert	Euphorbiaceae		S	Z187	ETH
148	*Phyllanthus ovalifolius* Forssk.	Euphorbiaceae	Qacamoo	T	Z104	ETH
149	*Phymatosorus scolopendria* (Burn.f.) Pic. Serm	Polypodiaceae		H	Z184	ETH
150	*Phytolacca dodecandra* L'Herit.	Phytolaccaceae	Andoodee	S	Z148	ETH
151	*Pittosporum viridiflorum* Sims	Pittosporaceae	Soolee adii	T	Z210	ETH
152	*Plectranthus punctatus* (L.f.) L'H'er.	Lamiaceae		H	Z205	ETH
153	*Pliostigma thonningii* (Schumach.) Milne-Redh	Fabaceae		T	Z127	ETH
154	*Podocarpus falcatus* (Thunb.) R.B. ex. Mirb.	Podocarpaceae	Birbirsa	T	Z098	ETH
155	*Polypogon schimperianus* (Hochst. ex Steud.) Cope	Poaceae	Daggala	H	Z042	ETH
156	*Premna schimperi* Engl.	Lamiaceae	Urgeessaa	S	Z009	ETH
157	*Prunus africana* (Hook.f.) Kalkm.	Rosaceae	Hoomii	T	Z203	ETH
158	*Pseudognaphalium luteo-album* (L.) Hilliard & Burtt	Asteraceae		H	Z022	ETH
159	*Psychotria orophila* Petit	Rubiaceae		S	Z099	ETH
160	*Pterolobium stellantum* (Forssk.) Brenan	Fabaceae	Arangamaa	L	Z138	ETH
161	*Pycnostachys abyssinica* Fresen.	Lamiaceae	Bokkolluu	H	Z121	ETH
162	*Rhamnus prinoides* L'Herit.	Rhamnaceae	Geeshoo	S	Z087	ETH
163	*Rhamnus staddo* A.Rich.	Rhamnaceae	Qadiidaa	T	Z093	ETH
164	*Rhoicissus revoilii* Planch.	Rhamnaceae	Indirifaa	L	Z061	ETH
165	*Rhus natalensis* Krauss	Anacardiaceae	Xaaxessaa	T	Z019	ETH
166	*Rhus vulgaris* Meikle	Anacardiaceae	Xaaxessaa	T	Z002	ETH
167	*Ricinus communis* L.	Euphorbiaceae	Qobboo	S	Z202	ETH
168	*Rosa abyssinica* Lindley	Rosaceae	Qaqawwii	S	Z060	ETH
169	*Rothmannia urcelliformis* (Hiem) Robyns	Rubiaceae	Qola-gurraa	T	Z146	ETH
170	*Rubia cordifolia* L.	Rubiaceae	Maxxannee	H	Z036	ETH
171	*Rubus apetalus* Poir.	Rosaceae	Goraa	L	Z201	ETH
172	*Rubus steudneri* Schweinf.	Rosaceae	Goraa	L	Z188	ETH
173	*Rumex nepalensis* Spreng.	Polygonaceae	Timijjii	H	Z191	ETH

174	*Rytigynia neglecta* (Hiern) Robyns	Rubiaceae	Mixoo	S	Z079	ETH
175	*Salix mucronata* Thunb. (S. subserrata Willd)	Salicaceae	Alaltuu	T	Z193	ETH
176	*Sapium ellipticum* (Krauss) Pax.	Euphorbiaceae	Bosoqa	T	Z139	ETH
177	*Satureja abyssinica* (Benth.) Briq.	Lamiaceae		H	Z174	ETH
178	*Satureja punctata* (Benth.) Briq.	Lamiaceae		S	Z106	ETH
179	*Schefflera abyssinica* (Hochst. ex A. Rich.) Harms	Araliaceae	Gatamaa	T	Z086	ETH
180	*Schrebera alata* (Hochst.) Welw.	Oleaceae	Qana'ee	T	Z004	ETH
181	*Scutia myrtina* (Burm. f.) Kurz	Rhamnaceae	Kombolcha adii	S	Z111	ETH
182	*Senna petersiana* (Bolle) Lock	Fabaceae	Gaafatoo	T	Z072	ETH
183	*Senna septemtrionalis* (Viv.) Irwin & Bameby	Fabaceae		S	Z190	ETH
184	*Setaria megapbylla* (Steud.) Th. Dur. & Schinz	Poaceae	Jajjaba	H	Z054	ETH
185	*Sida ternata* L.f.	Malvaceae	Hincinnii	H	Z082	ETH
186	*Sida rhombifolia* L.	Malvaceae	Karabaa	S	Z156	ETH
187	*Sida schimperiana* Hochst. ex A. Rich.	Malvaceae	Cirfiggii	S	Z012	ETH
188	*Sida urens* L.	Malvaceae	Hincinnii	S	Z035	ETH
189	*Solanum aculeatissimum* Jacq.	Solanaceae	Hiddii waraabessaa	S	Z037	ETH
190	*Solanum anguivi* Lam.	Solanaceae	Hiddii saree	S	Z133	ETH
191	*Solanum giganteum* Jacq.	Solanaceae		S	Z046	ETH
192	*Solanum macracanthum* A. Rich.	Solanaceae	Hiddii	S	Z015	ETH
193	*Solanum marginatum* L.f.	Solanaceae	Hiddii hongorcaa	S	Z155	ETH
194	*Sphaerantuhs suaveolens* (Forssk) DC.	Asteraceae	Bokkolluu	H	Z112	ETH
195	*Sporobolus africanus* (Poir.) Robyns & Tourny	Poaceae	Murii	H	Z010	ETH
196	*Stereospermum kunthianum* Cham.	Bignoniaceae	Botoroo	T	Z077	ETH
197	*Syzygium guineense* (Willd.) DC.	Myrtaceae	Baddeessaa	T	Z076	ETH
198	*Tagetes minuta* L.	Asteraceae		H	Z032	ETH
199	*Tapinanthus heteromorphus* (A. Rich.] Danser	Loranthaceae	Digaluu	S	Z057	ETH
200	*Teclea nobilis* Del.	Rutaceae	Hadheessa	T	Z159	ETH
201	*Teramnus labialis* (L. f.) Spreng.	Fabaceae		H	Z158	ETH
202	*Terminalia macroptera* Guill & Perr.	Combretaceae	Dabaqqaa	T	Z161	ETH
203	*Terminalia schimperiana* Hochst.	Combretaceae	Gaarrii	T	Z126	ETH
204	*Thalictrum rhynchocarpum* Dill. & A.Rich.	Ranunculaceae	Sire bizuu	H	Z163	ETH
205	*Thunbergia alata* Boj. ex Sims	Convolvulaceae		H	Z143	ETH
206	*Tragia ashiae* M.Gilbert	Euphorbiaceae	Gurgubbee	H	Z039	ETH
207	*Tragia brevipes* Pax	Euphorbiaceae	Gurgubbee	H	Z031	ETH
208	*Urera hypselodendron* (A.Rich,) Wedd.	Urticaceae	Laanqisaa	L	Z172	ETH
209	*Vangueria apiculata* K. Schum.	Rubiaceae	Buruurii	S	Z064	ETH
210	*Vernonia amygdalina* Del.	Asteraceae	Eebicha	T	Z177	ETH
211	*Vernonia hochstetteri* Sch.Bip. ex Walp.	Asteraceae	Sooyyoma	S	Z173	ETH
212	*Vernonia hymenolepis* A. Rich.	Asteraceae	Sooyyoma	S	Z180	ETH
213	*Vernonia leopoldi* (Sch. Bip. ex Walp.) Vatke	Asteraceae		S	Z109	ETH
214	*Vernonia myriantha* Hook.f.	Asteraceae	Reejjii	T	Z134	ETH

Note: T= Tree; S= Shrub; L= Liana; H= Herb; C. code= Collection code; Ha= Habit; ETH= National Herbarium of Ethiopia.