Species composition, Plant Community structure and Natural regeneration status of Belete Moist Evergreen Montane Forest, Oromia Regional state, Southwestern Ethiopia

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ABSTRACT

Belete forest is one of the very few remnant moist evergreen montane forests in Ethiopia. The objective of this work was to study the vegetation structure, composition and Natural regeneration status of Belete moist evergreen montane forest. To investigate the plant community structure, composition and regeneration status of Belete forest, line transects were laid down on the longest transect starting from the bottom valley to the top ridge. Sample quadrats 20m x20 m, 5m x 5m, 1m x 1m were laid for trees, shrubs, sapling and seedling, and herbaceous layer respectively in a nested form. The sample quadrats were laid down along transects at a distance of 50m from each other. A total of 69 quadrats were sampled. Vegetation classification was performed using PC - ORD for windows version 5.0. Five communities were recognized. Results showed that a total of 157 plant species representing 69 families and 135 genera were recorded. These were composed of 31.2% Herbs, 28.7% Trees, 26.1% Shrubs, 5.7% Climbers, 5.1% Liana, 1.9% Epiphytic herbs, and 1.3% herbaceous Ferns. The major families were Fabaceae and Asteraceae each represented by 10 species (6.4%), followed by Lamiaceae 9 (5.7%) and Rubiaceae 6 (3.8%). Other thirty three families consisting 19.8% were represented by one species only. Regeneration status of the forest was analyzed by comparing saplings and seedlings with the matured trees. Results revealed that Belete moist evergreen montane forest is at good regeneration status. Planning and management of the forest should be assisted by research findings, such as detailed ecological studies in relation to various environmental factors.

Keywords: Belete forest, Community structure, Moist Evergreen Montane Forest, Regeneration.

1. INTRODUCTION

Ethiopia has the fifth largest floral diversity in tropical Africa (Motuma Didita et al., 2010). Due to its diverse topography that has given rise to the development of wide diversities of flora and fauna rich with endemic elements. Between; 6,000-7,000 species of higher plants are estimated to exist in the country of which about 780-840 (12-13%) plant species are estimated to be endemic (Demel Teketay, 2001; Girma Balcha et al., 2004; Nune et al., 2007).

However, these biologically rich resources of Ethiopia are vanishing at an alarming rate due to extensive deforestation. Although several factors drive natural forest destruction in Ethiopia, agricultural land expansion triggered by increasing human population is probably the dominant force (Mulugeta Lemenih and Demel Teketay, 2006; Motuma Didita et al., 2010).

Afromontane forests are among the most species-rich ecosystems on earth (Schmitt et al., 2010). They are under severe land-use pressure, because the same environmental conditions that foster high species diversity also render tropical montane forest areas suitable for agricultural uses (Schmitt et al., 2010). Deforestation in Afromontane areas has been generally associated with increased run-off and soil erosion leading to a decline in soil fertility. The Afromontane areas of eastern Africa, including the Ethiopian highlands, constitute vivid examples of tropical forest ecosystems that have exceptional species richness, high concentrations of endemic species, and which are under great human land-use pressure. These are, therefore, internationally recognized as the Eastern montane Biodiversity Hotspot (Schmitt et al., 2010). Much of the Ethiopian highlands would bear montane forests if untouched; hence remnants of these forests still occur in the central part of the country (Tamrat Bekele, 1993).

Therefore, the objective of this paper is to present the results of the study of the vegetation structure, composition and natural regeneration status of Belete moist evergreen montane forest and provide reliable information for the development of appropriate management plan.

2. MATERIALS AND METHODS

2.1. Study area description

Belete forest is situated in Shabe-Sombo District, Jimma zone, Oromia National Regional State, 375 km Southwest of Addis Ababa (Fig 1) and is part of the Belete Gera National forest priority area. The forest is located at longitudes between $36^0$15' E and $36^0$45' E and latitude $7^0$30' N and $7^0$45'N (Kitessa Hundera and Tsegaye Gadissa, 2008) and Altitude between 1,300 and 3,000 masl (Cheng et al., 1998). In Belete Forest, soils are generally fine-textured. Nitisols and Cambisols, often more than 100cm deep, occur in areas with gentle slopes and forest cover. Leptosols are found on mountain peaks, steep slopes and stream banks where soil is shallow (less than 30cm deep). Luvisols dominate in depressions such as marshes and lowlands along rivers (Cheng et al., 1998). The mean annual rainfall of the area is between 1800 and 2300 mm with maximum rainfall between the months of June and September. The mean annual temperature of the area is between 15^0C and 22^0C (Kitessa Hundera and Tsegaye Gadissa, 2008).

2.2. Sampling design

To investigate the plant community structure, species composition, and regeneration status of Belete moist evergreen montane forest (BMEMF), seven line transects were laid down starting

from the bottom valley to the top of the ridge. Sample quadrats 20m x 20 m (Trees), 5m x 5m (Seedlings, Saplings and Shrubs; and Lianas), and 1m x 1m (Herbaceous layer) were laid down (smaller quadrats within the larger quadrats). The sample quadrats were laid down along transects at a distance of 50m from each other using measuring tape meter. A total of 69 quadrats (2.76 hectare) were sampled. Individuals were classified in a series of girth classes at specific intervals (≥10 cm Diameter at Breast Height (DBH) (considered as trees) 3.5 to 10 cm DBH) (saplings) and DBH less than 3.5 cm (seedlings) according to Dhaulkhandi et al. (2008); and Tiwari et al. (2010).

Figure 1. Map of the study area.

2.3.Vegetation data collection

All trees, shrubs and herbs including vascular epiphytes were recorded from the systematically established quadrats along each transect. Species which were readily identifiable were recorded in the field. For species which were difficult to identify in the field, their local name were recorded, herbarium specimens were collected, pressed and dried properly using plant presses and were taken to the Jimma University Herbarium and National Herbarium of Addis Ababa University (ETH) for identification. Voucher specimens were deposited in the Herbarium of

Jimma University. The nomenclature of the Species followed the published volumes of the Flora of Ethiopia and Eritrea (FEE).

In each quadrat identity, number, and diameter at breast height (DBH) and diameter at stump height (DSH) were measured for trees and shrubs respectively. Diameter at Breast Height was measured at 1.3 m above the ground while Diameter at Stump height was measured at 0.5 m above the ground. DBH and DSH were measured using Diameter tape. Saplings and seedlings were also identified, numbered, and measured for their DBH (For the Sapling).

2.4. Data analysis

A hierarchical cluster analysis was performed using PC-ORD for windows version 5.0 to classify the vegetation into plant community types based on abundance data of the species in each quadrat. The data matrix contained 69 quadrats and 149 species. Even though 157 specimens were collected, eight species were collected outside the quadrats for floristic composition only and are not included in structural analysis.

The indicator species in each community type were determined using Indicator Species Analysis (ISA) (Dufre´ne and Legendre, 1997). A species is considered as an indicator of a group when its indicator value is significantly higher at $P < 0.05$ (Tadesse Woldemariam, 2003). The clusters were designated as plant community types and given names after two or three dominant or characteristic species.

2.5. Regeneration status of the forest

Regeneration status of the forest was analyzed by comparing saplings and seedlings with the matured trees according to Dhaulkhandi et al. (2008); and Tiwari et al. (2010), i.e., Good regeneration, if seedlings >saplings >adults; Fair regeneration, if seedlings> or ≤ saplings ≤ adults; Poor regeneration, if the species survives only in sapling stage, but no seedlings (saplings may be <, > or = adults); and if a species is present only in an adult form it is considered as not regenerating.

2.6. Structural analysis

Species structure (frequency, density, abundance, basal area, and importance value index (IVI) of tree species in the forest were analyzed. Importance value index (IVI) was calculated by summing up relative frequency (RF), relative density (RD) and relative dominance (RDO) values.

3. RESULTS

3.1. Floristic composition

A total of 157 species of vascular plants belonging to 135 genera and 69 families were identified in Belete moist evergreen montane forest (Appendix I). From the identified species Pteridophytes and gymnosperms were represented by two species each, and the remaining 153 species were Angiosperms. *Podocarpus falcatus* and *Juniperus procera* are the two gymnosperms found in the study area. The most species rich families were presented Fabaceae and Lamiaceae with ten and nine species respectively. Thirty three families were represented each by one species. The growth forms of the species recorded from Belete moist evergreen montane forest was dominated by herbs, followed by trees (Fig 2).

Belete moist evergreen montane forest consists of 17 (10.82%) endemic species to Ethiopia some of which are included in the IUCN Red Data List (Table 1).

3.2. Vegetation classification

A total of five clusters were clearly recognized from the cluster analysis. Each plant community type is listed and described below.

1. *Teclea noblis – Vernonia auriculifolia* Community

The community had two indicator species (*Teclea noblis and Vernonia auriculifolia*) with significant indicator values. The altitudinal range of this community was from 1864-2245 masl. Woody species associated with this community are *Coffea arabica, Ficus sycomorus, Teclea noblis, Vernonia auriculifera, Maesa lanceolata, Galineria saxifraga, Sapim ellipticum , Lippia adoensis, Leontis africana,* and *Millettia ferruginia*.. Herbs such as *Communila difusa* and *Oplismenus hirtellus* are the dominant in the herb layer of this community. *Rangaeris amaniensis* was the only epiphytic herb found in this community.

2. *Olea welwitschii – Rytigynia neglecta* Community

The altitudinal range of this community was from 1865-2210 masl. Woody species associated with this community are *Ekebergia capensis, Vepris dainellii, Olea welwitschii, Allophylus abyssinicus, Celtis africana, Domboya longebracteolata, Flacourtia indica, Ehretia cymosa* and *Prema schimperi.* Herbs such as *Canna indica* and *Basananthe haningthoniata* are the dominant in the herb layer of this community. *Habenaria petitiana* is the only epiphytic herb found in this community. Even though *Canna indica* is an exotic plant; it may be escaped from gardens.

3. *Apodytes dimidiata – Clausena anisata* Community

This community type was distributed and is situated at altitudinal ranges from 1966-2171 masl. The indicator species characterizing this community are *Apodytes dimidiata* and *Clausena anisata*. Woody species associated with this community include *Calpurnia aurea, Clausena anisata, Schefflera abyssinica, Prunus africana, Combretum paniculatum, Landolphia buchinanni, Polyscias fulva, Podocarpus falcatus, Toddalia asiatica,* and *Fagaropsis angolensis.* Herbs such as *Guizotia scarba, Rumex nepalensis* and *Bidens biternata are* also common in this community. *Peperomia tetraphylla* was the epiphytic herb found in this community.

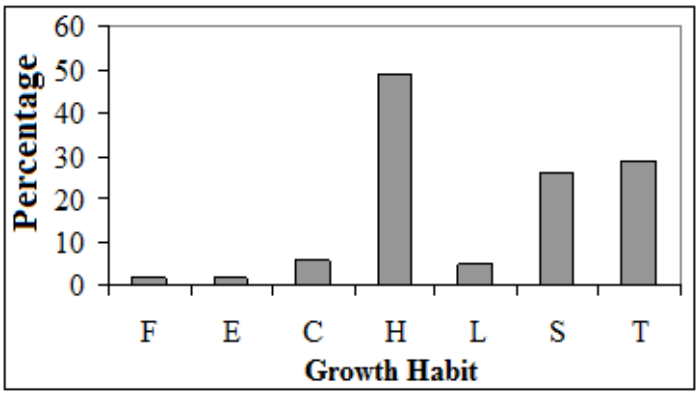

Figure 2. Growth habit of plants in BMEMF; F = Fern, E = Epiphyte, C= Herbaceous climber, H = Herb, L = Woody climber, S = Shrub and T =Tree.

Table 1. Plant species in BMEMF and their status (EN= Endangered, NE= Not Evaluated, NT=near threatened, VU= Vulnerable, CR= critically endangered), LC= Least Concern.

S.No	***Species***	***Family***	***Growth Habit***	***Conservation Status***
1	*Aframomum corrorima* (Braun) Jansen	Zingiberaceae	Herb	NE
2	*Amophophallus galaensis* (Engl.) N.E.Br.	Araceae	Herb	NE
3	*Carum piovani* Chiov	Apiaceae	Herb	NE
4	*Cirsium dender* Friis	Asteraceae	Herb	NE
5	*Clemattis longicauda* steud.ex A.Rich	Ranunculaceae	Climber	NE
6	*Crotolaria rosenii* (Pax) Milne-Redh. Ex Polhill	Fabaceae	Shrub	NT
7	*Domboya longebracteolata* Seyani	Sterculiaceae	Shrub	VU
8	*Erythrina brucei* Schweinf	Fabaceae	Tree	LC
9	*Lippia adoensis Hochst.ex Walp.*	Verbenaceae	Shrub	LC
10	*Millettia ferruginea* (Hochst.) Bak	Fabaceae	Tree	LC
11	*Plecranthus garckeanus* (Vatke) J.K.Morton	Lamiaceae	Herb	NE
12	*Satureja paradoxa* (Vatke) Engl. ex Seybold	Lamiaceae	Herb	NE
13	*Thalictrum scimperianum* Hochst.ex Schweinf.	Ranunculaceae	Herb	NE
14	*Tiliacora troupinii* Cufod.	Menispermaceae	Liana	VU
15	*Urtica simensis* Steudel	Urticaceae	Herb	NE
16	*Vepris dainellii* (Pichi-Serm.) Kokwaro	Rutaceae	Tree	LC
17	*Vernonia yabellona* Mesfin	Asteraceae	Shrub	NE

4. *Pouteria adolf-friedricii – Dracaena afromontana* Community

This community type was distributed at altitudinal ranges from 1842-2232 masl. The indicator species of this community are *Pouteria adolfi-friederici, Dracaena afromontana, Cynoglossum amplifolium* and *Plecranthus garckeanus*. Woody species associated with this community include *Dracaena steudneri, Domboya torrida, Hippocrata africana,* and *Jasmium abyssinicum.* Herbs such as *Piper capens, Afromomum corrorima, Setaria megaphylla,* and *Gomphocarpus abyssinica* are also common in this community. *Peperomia tetraphylla* and *Diaphananthe adoxa* was the epiphytic herb found in this community.

5. *Olea capensis – Croton macrostachyus – Diosporyus abyssinica* Community

This community type was distributed at altitudinal ranges from 1871-2208 masl. The indicator species of this community are *Olea capensis, Diosporyus abysssinica,* and *Croton macrostachyus*. Woody species associated with this community include *Cordia africana, Rothmania urcelliformis, Brucea antidysenterica, Myrsine africana, Tiliacora troupinii, Crotolaria rosenii,* and *Ocmium grattissum.* Herbs e.g., Cayratia *ibuensis,* and *Amophophallus galaensis* are also common in this community.

3.3. Vegetation structure analysis

3.3.1. Shrub and tree density

Tree and shrub density, expressed as the number of individuals with DBH greater than 3.5 cm was 760.95/ha and those individuals with DBH between 10 and 20 cm and with DBH greater than 20 cm were 305.07ha^{-1} and 149ha^{-1}, respectively. In this case individuals less than 3.5cm were considered as seedlings. The ratio described as a/b, is taken as the measure of size class distribution (Grubb *et al*., 1963). Accordingly, the ratio of individuals with DBH between 10 & 20 cm (a) to DBH > 20 cm (b) was 2.04 for BMEMF.

3.3.2. Frequency

Syzygium guineense was found to be the most frequent species occurring in 50% of the total quadrats sampled followed by *Olea capensis* (40%), *Olea welwitschii* (39%), *Schefflera abyssinica* (39%) and *Diosporyus abysssinica* (30%).

3.3.3. Diameter at Breast Height (DBH)

Diameter at Breast Height distribution of Belete moist evergreen montane forest was classified into eleven classes conventionally (Fig 3). As presented in figure 3 about 60.4% of the individuals are found in the first two classes (<20 cm). The remaining nine Classes together

account for about 39.6%. The number of stems in DBH class less than 10 cm is 306.88ha^{-1} (40.33%), 305.07ha^{-1} (40.09%) for DBH 10-20 cm and for DBH > 20 cm 149ha^{-1}(19.58%).

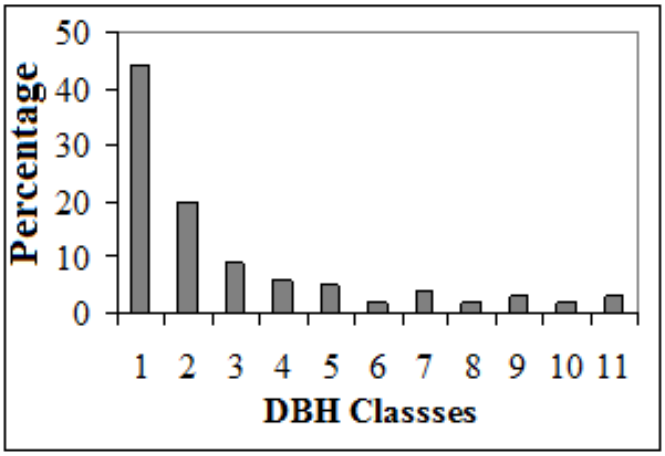

Figure 3. DBH class distribution of Belete Moist Evergreen Montane Forest **1**. 3.5-9.5, **2**. 9.6-20, **3**. 21-30, **4**. 31-40, **5**. 41-50, **6**. 51-60, **7**. 61-70, **8**. 71-80, **9**. 81-90 , **10**. 91-100 and **11**. >100.

3.3.4. Basal area (BA)

Total basal area for Belete moist evergreen montane forest was found to be 103.5 m^2/ha.

3.3.5. Important Value Index (IVI)

The importance value index (IVI) of the most common and frequent trees of BMEMF was calculated and *Olea welwitschii* was found to have the highest IVI (34.6) followed by *Schefflera abyssinica* (34.4), *Syzygium guineense* (29.5), *Diosporyus abyssinica* (17), *Olea capensis* (16.7), *Pouteria adolfi-friederici* (16.2), *Prunus Africana* (15.5), *Millettia ferruginea* (14), *Croton macrostachyus* (12.3) and *Ficus sycomorus* (11.3). The highest basal area of these important species made the species to have large value of relative dominance and hence got the highest IVI (4).

3.3.6. Tree species population structure

The evaluation of selected tree species reveals six main patterns of population structure. These include:

1) Inverted J-shape; which shows a pattern where species frequency distribution has the highest frequency in the lower diameter classes and a gradual decrease towards the higher classes (*Pouteria adolfi-friederici*) which shows good reproduction and recruitment.

2) Broken inverted J-shape (*Olea capensis*); the density of individuals in the lower DBH class (especially 1 and 2) is very high but becoming lower in the highest DBH classes even nothing in some DBH classes like (6,7 and 8). This showed that there is selective cutting of the species for different purposes like for construction and fuel wood.

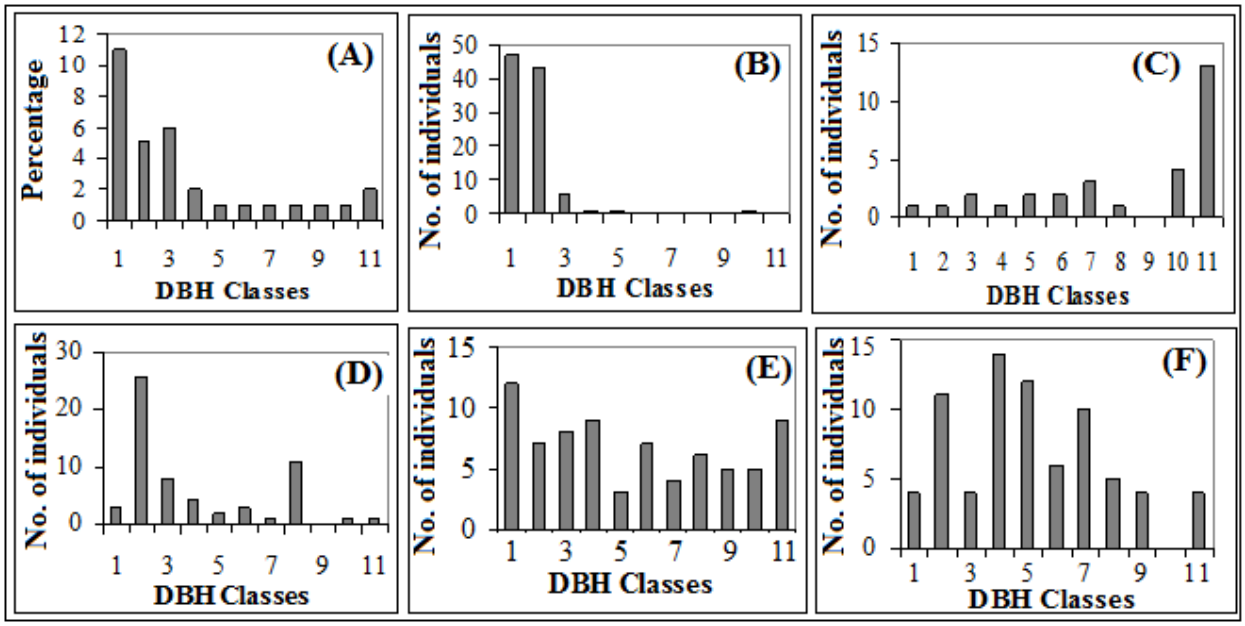

Figure 4. Population structure of selected tree species, (**A)** *Pouteria adolfi-friederici*, (**B)** *Olea capensis*, (**C)** *Schefflera abyssinica*, (**D)** *Prunus Africana* and *Diosporyus abysssinica*, (**E)** *Olea welwitschii*, and (**F)** *Syzygium guineense.* [**Note**: DBH classes are: **1)** 3.5-9.5 cm, **2)** 9.6-20 cm, **3)** 21-30 cm, **4)** 31-40 cm, **5)** 41-50 cm **6)** 51-60 cm, **7)** 61-70 cm, **8)** 71-80 cm, **9)** 81-90 cm, **10)** 91-100 cm and **11)** > 100 cm].

3) J-shape; which shows a type of frequency distribution in which there is a low number of individuals in the lower diameter classes but increases towards the higher classes (*Schefflera abyssinica*).

4) Irregular, in which they are distributed differently in almost all classes (*Prunus africana*) and the first pattern was formed by the species having high number of individuals in the second class and relatively lower in first and third class then decrease with increasing DBH towards the higher classes except for the 8th class which was increased (*Diosporyus abysssinica*).

5) U-shape, which shows a type of frequency distribution in which there is a high number of lowest and highest diameter classes but a relatively low number in the intermediate classes (*Olea welwitschii*) in which the intermediate diameter classes are less represented may be due to selective removal of medium sized individuals

6) Bell-shape, it is a type of frequency distribution in which number of individuals in the middle diameter classes is high and low in lower and higher diameter classes (*Syzygium guineense*). According to Feyera Senbeta et al. (2007) Bell shape pattern indicates a poor reproduction and recruitment of species which may be associated with intense competition from the surrounding trees.

3.3.7. Natural regeneration of Tree species in Belete moist evergreen montane forest

The present study showed that regeneration status of BMEMF is at good regeneration status (Fig 5) *i.e.* seedlings >saplings >adults.

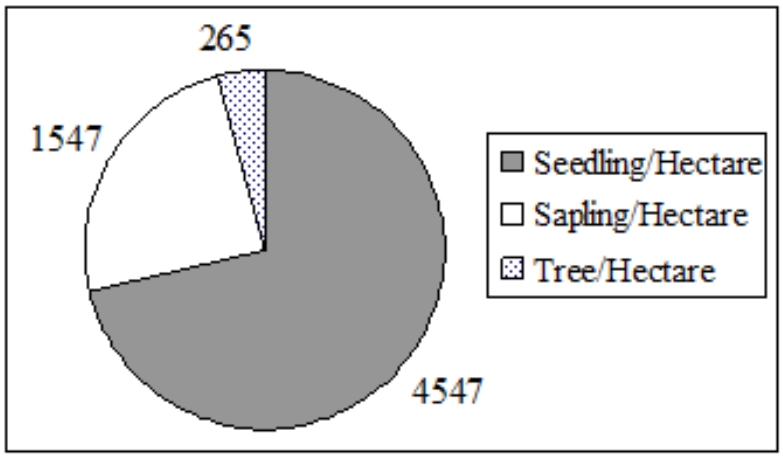

Figure 5. Regeneration status of Belete Moist Evergreen Montane Forest.

3.3. Phyto-geographical comparisons with other moist evergreen montane forests of Ethiopia

Belete Moist Evergreen Montane Forest was compared with other montane forests in Ethiopia (Table 2).

Table 2. Phyto-geographical Comparison of BMEMF with other forests in Ethiopia; N= Number of species included in comparison, a= common to both forests, b= found only in BMEMF, c= found only in the forest in comparison with BMEMF, and S = Sorensen`s similarity coefficient.

Forest	***Altitudinal Range (masl)***	***N***	***a***	***B***	***c***	***S***
Yayu[5]	1200-2000	102	51	104	51	0.65
Gura Ferda[6]	800-1900	66	46	59	20	0.53
Sheko forest[7]	900-1,810	155	80	75	294	0.43
Mana Angetu[8]	1533-2431	155	61	94	150	0.5

Source: [5](Tadesse Woldemariam et al., 2008), [6](Kitessa Hundera and Bishaw Deboch 2008), [7](Feyera Senbeta et al., 2007), and [8](Ermias Lulekal et al., 2008).

3. DISCUSSION

The proportion of endemic plant species in montane forests of Ethiopia is high, Ranging between 11-15% of the total number of species (Friis and Sebsebe Demissew, 2001).This showed that BMEMF comprises high endemicity (10.82%).

It is observed in the *Teclea nobilis – Vernonia auriculifolia* community, most of the associated woody species occupy a shrub layer (e.g. *Teclea nobilis, Coffea arabica, Galineria saxifraga*) which have been found as characteristic shade tree of semi-forest coffee systems and plantations (Schmitt, 2006). Belete forest in Jimma zone was cleared to establish coffee plantations during the past decades (Cheng et al., 1998). On the other hand, communities like *Apodytes dimidiata – Clausema anisata*, where *Apodytes dimidiata* has been reported to occur in forest clearings/edges and described by other authors as having characteristics typical of early successional species (Schmitt, 2006) this may be because of the highway road to Bonga which divided the forest in to two and clearing of the forest for the electric power extension. While *Pouteria adolf-friedicii* is an emergent climax tree species within the *Pouteria adolf-friedicii – Dracaena afromontana* community, which is characteristic tree of moist evergreen montane forest.

The proportion of medium-sized individuals is larger than the large sized individuals (DBH > 20 cm) but the ratio is relatively lower than the results obtained for other forests Menagesha Suba and Chilimo forests (Tamrat Bekele, 1993), Masha Anderacha forest (Kumlachew Yeshitela and Tamrat Bekele, 2003) and Menna angetu forest (Ermias Lulekal et al., 2008). The proportion of small-sized individual was much larger (40.33%) although the above ratio is lower, indicating that BMEMF is at good regeneration.

The general trend of population structure showed an inverted J-shape for DBH classes. The majority of the species had a large number in smaller-diameter size classes with decreasing frequency as the size class increased. If a particular tree species displays such a size distribution, then continuous recruitment can generally be inferred, suggesting that the population is viable as sufficient regeneration it taking place for the population to be maintained (Newton, 2007). Even though the overall DBH distribution revealed inverse-J shape, different population dynamics for different species were revealed. According to Midgleya and Niklas (2004) the mean total basal area of tropical forests is $35m^2ha^{-1}$. Therefore, the total basal area of BMEMF when compared to tropical forest was found to be very high. Even though about 44.85% of all the individuals had DBH less than 9.5 cm (DBH class 1), the percentage contribution of these classes to the total

basal area was only 6.2%. Conversely, individuals in the DBH classes greater than 40 cm had a density of about 19.56% of the total, but they contributed to about 71% of the total basal area computed for the Forest.

The high IVI value of the species is mainly due to their high dominance and density which may be due to their low demand by the local people for timber (Example *Syzygium guineense, Ficus sycomorus* and *Schefflera abyssinica)* and other construction material; and their high value for honey production (*Schefflera abyssinica, Pouteria adolfi-friederici and Croton macrostachyus).* Distribution of species among different IVI classes indicated that most of the species were in the lower IVI classes. The most important ten species contributed about 67.29 % of the total importance values.

Forest regeneration requires the establishment of seedlings and saplings within the same (similar) environment where the parent trees grow. However, in rain forests, environmental conditions determining performance of adult trees contrast with those under which their seeds germinate and develop. Adult trees occupy a volume of the forest canopy, with levels of light availability at least one order of magnitude higher than those prevalent in the forest understory (Pugnaire and Valladares, 2007). Regeneration status of the forest was analyzed by comparing saplings and seedlings with the matured trees according to Dhaulkhandi et al. (2008) and Tiwari et al. (2010). The present study showed that regeneration of BMEMF is at good status (Fig 5).

Even though the regeneration status of the forest is good, it has been observed that there were few tree species which are either regenerating poorly (example; *Hagenia abyssinica* and *Fagaropsis angolensis*) or not regenerating at all (example; *Spathoda campanulata*). Moreover, regeneration status of *Podocarpus falcatus* is restricted only to two quadrats only which were nearest to the mature *Podocarpus falcatus* trees. This may be due to habitat restricted preferences and seed predators (Mwavu and Witkowski, 2009). Belete Moist Evergreen Montane Forest shared significant number of species with Yayu, Gura ferda, Mana angetu, and Sheko forests in decreasing order. The high similarity observed among these forests could be due to similar climatic conditions.

4. CONCLUSION AND RECOMMENDATION

Belete moist evergreen montane forest is one of the National Forest Priority Areas (NFPAs) Ethiopia which comprises economically and ecologically important plants. The edge of the

forest, which is easily accessible by the people of the community, is planted by coffee. This is disturbing and reducing the size of the forest. The major threats observed in Belete forest were encroachment, coffee production and agricultural expansion. Thus proper management and monitoring practices is required. Hence the following recommendations are forwarded.

- Species with low Important Value Index should be given appropriate attention and should be conserved *in-situ* through the collaboration of local communities and the District Agriculture and Rural Development Office, NGOs and other stakeholders.
- Continuous forest inventory should be conducted.
- Planning and management of the forest should be assisted by research findings, such as detailed ecological studies in relation to various environmental factors such as soil type and properties to promote the sustainable use of the forest and its products
- Comprehensive studies should be initiated to document the plant resource utilization pattern.

5. ACKNOWLEDGMENTS

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APPENDIX 1. List of plant species recorded from Belete moist evergreen montane forest.

Key: T = Tree; S = Shrub; H = Herbs; L = woody climber; EH = Epiphytic herb; and F = Fern.

Species name	***Local name (Afaan Oromoo)***	***Family***	***Habit***
Acacia abyssinica Hochst ex Benth.	Laaftoo **	Fabaceae	T
Adenia sp.	Hoolaa malkaa	Passifloraceae	C
Adiantum thalictroides Schlechtend.	Baala Handdaqqoo	Adiantaceae	F
Aframomum corrorima (Braun) Jansen	Koroorima	Zingiberaceae	H
Albizia gummifera (J.F.Gumel.) C.A.Sm	Hambabbeessa	Fabaceae	T
Allophylus abyssinicus (Hochst.) Radlkofer	Se'o	Sapindaceae	T
Amophophallus galaensis (Engl.) N.E.Br.	Qicuu	Araceae	H
Apodytes dimidiata E.Mey.ex Am.	Wandabiyoo	Icacinaceae	T
Asparagus africanus Lam.	Sariitii	Asparagaceae	S
Basananthe hanningtoniata (Mast.) W.J.de Wilde	Laaleessa	Passifloraceae	C
Basilicum polystachyon (L.) Moench.	***	Lamiaceae	H
Bersema abyssinica Fresen.	Lolchiisaa	Melianthaceae	T
Bidens biternata (Lour.) Merr. & Sherff	Maxxannee	Asteraceae	H
Brassica sp.	Raafuu simbiraa	Brassicaceae	H
Brucea antidysenterica J.F. Mill.	Qomonyoo	Simaroubiaceae	T
Byttneria catalpitiolata Jacq.	Haleele	Sterculiaceae	T
Calpurina aurea (Ait.) Benth	Ceekaa	Fabaceae	S
Canna indica L.	Qoccoo seyixanaa	Cannaceae	H
Carum piovani Chiov	Baala maraqii	Apiaceae	H
Cayratia ibuensis (Hook.f.) Suesseng	Hidda simbiraa	Vitaceae	H
Celtis africana Burm.f.	Qahee	Ulmaceae	T
Ceropegia sankurensis Schltr.	***	Asclepiadaceae	C
Cirsium dender Friis	Baalawaraantii	Asteraceae	H
Cissus quadragularis L.	Dambaree	Vitaceae	C
Clausenia anisata (Wild.) Hook. F.ex. Benth	Ulumaayii	Rutaceae	S
Clematis hirsuta Perr. & Guill.	Hidda huxoo	Ranunculaceae	C
Clemattis longicauda steud.ex A.Rich	Hidaa nama gubu	Ranunculaceae	C
Clerodendron myricoides (Hochst.) Vatke	Marasissaa	Lamiaceae	C
Coffea arabica L.	Buuna	Rubiaceae	S

Combretum paniculatum A.Rich.	Baggee	Menispermaceae	L
Commelina kotschyi Hassk.	Kalaalaa	Commelinaceae	H
Commlina diffusa Burm.f.	Haalaala Jaabbii	Commelinaceae	H
Cordia africana Lam.	Waddeessa	Boraginaceae	T
Crassocephalum rubens (Juss. Ex Jacq.) S.Moore.	Tiroobuto	Asteraceae	H
Crotolaria rosenii (Pax) Milne-Redh. Ex Polhill	Sufaafen	Fabaceae	S
Croton macrostachyus A.Rich	Mekkannisa/Bakanisa	Euphorbiaceae	T
Cyathea manniana Hook.	Sisinhoo	Cyatheaceae	F
Cynanchum altiscandens K.Schum.	Soogoo	Asclepiadaceae	H
Cynoglossum amplifolium Hochst. Ex A.DC.	Guriyoo	Boraginaceae	H
Cyperus bulbosus Vahl	Qunnii	Cyperaceae	H
Cyperus rigidifolius Stued.	Qunnii	Cyperaceae	H
Desmodium repandum (Vahl) DC.	Hidda Bookee	Fabaceae	H
Diaphananthe adoxa Rasm.	Harmee	Orchidaceae	EH
Diosporyus abysssinica (Hiern.) F.White	Lookoo	Ebenaceae	T
Discorea bulbifera L.	Kotte harree	Dioscoreaceae	H
Domboya longebracteolata Seyani	Dhoqonuu	Sterculiaceae	S
Domboya torrida (J.F.Gumel.) P.Bamps	Daannisa	Sterculiaceae	T
Dracaena afromontana Mildbr.	Emoo	Dracaenaceae	S
Dracaena steudneri Engl.	Yuddoo	Dracaenaceae	T
Echinops steudneri O.Hoffm	Duchoo	Asteraceae	S
Ehretia cymosa Thonn.	Ulaagaa	Boraginaceae	T
Ekebegia capensis Sparm.	Somboo	Meliaceae	T
Embellia schimperio Vatke Count	hidaaHaanquu	Myrsinaceae	L
Erythrina brucei Schweinf	Waleensuu**	Fabaceae	T
Euphorbia abyssinica Gmel.	Adaamii**	Euphorbiaceae	T
Fadogia cienkowski Schweinf.	Qoorricha ilkaani	Rubiaceae	S
Fagaropsis angolensis (Engl.) Dale	Siglu	Rutaceae	T
Ficus brachypoda Hutch.	Carobillaacha	Moraceae	T
Ficus sycomorus L	Harbuu	Moraceae	T
Ficus thoningi Blume	Dembii	Moraceae	T
Ficus vasta Forssk.	Qilxuu **	Moraceae	T

Flacourtia indica (Brm.f.) Merr	Akuukkuu	Flacourtiaceae	T
Floscopa glomerata (Wild. Ex J.A. Schult. & J.H.Schult)	Kaalaala	Commelinaceae	H
Galineria saxifraga (Hochst.) Bridson	Simararuu	Rubiaceae	T
Girardina diversifolia (Link) Friis	Gubdu Qelemee	Urticaceae	H
Gloriosa superba L.	Aramandawa	Colchicaceae	S
Gomphocarpus abyssinicus Decne.	Yereso	Asclepiadaceae	H
Gouania longispicta Engl.	Homochiisa	Rhamnaceae	L
Grewia bicolor Juss.	Rapse	Tiliaceae	S
Grewia ferruginea Hochst. ex A.Rich.	***	Tiliaceae	S
Grewia sp.	***	Moraceae	T
Guizotia scabra (Vis) Chiov.	Haadaa	Asteraceae	H
Habenaria petitiana (A.Rich)	Bercoqqee	Orchidaceae	H
Hagenia abyssinica (Bruce) J.F.Gmel	Heexoo	Rosaceae	T
Harpachne schimperi Hochst. ex A.Rich	Biila	Poaceae	H
Hibscus berberidifolius A.Rich	Gejo	Malvaceae	S
Hibscus micrantus L.f.	Nacaa	Malvaceae	H
Hippocrata africana (Willd) Loes	Xiyoo	Celasteraceae	L
Jasminum abyssinicum Hochst ex DC.	Misrich	Oleaceae	L
Juniperus procera Hochst.	Gaattiraa	Cupressaceae	T
Justicia caerulea Forssk.	Xelenji	Acanthaceae	H
Justicia exigua S.Moore	Dinniicho	Acanthaceae	H
Justicia flava (Vahl) Vahl	Togoo Jalddesa	Acanthaceae	H
Justicia schimperiana (Hochst. Ex Nees) T. Anders	Dhummuugaa	Acanthaceae	S
Kalonche quartiniana A.Rich	Bosoqqee	Crassulaceae	H
Kotschya africana Endl.	Heennaa**	Fabaceae	S
Landolphia buchananni (Hall.f.) Stapf	Yebo	Apocynaceae	L
Lantana trifolia L.	Munandurba	Verbenaceae	S
Leontis africana (P.Beauv) Briq	Raskimmiiri	Lamiaceae	H
Lepidotrichilia volkensis (Gurke) Leroy	Gursadi	Meliaceae	S
Lippia adoensis Hochst.ex Walp.	Kusaayee	Verbenaceae	S
Maesa lanceolata Forssk.	Abbayyii	Myrsinaceae	S
Maytenus arbutiolia (A.Rich.) Wilczek	Kombolcha	Celasteraceae	S

Maytenus undata (Thunb.) Blakelok	Kombolcha	Celasteraceae	S
Millettia ferruginea (Hochst.) Bak	Askira	Fabaceae	T
Myrica salicifolia A.Rich.	***	Myricaceae	T
Myrsine africana L.	Qacaamaa	Myrsinaceae	S
Nicotiana glauca Graham	Timbatimbo	Solanaceae	S
Nuxia congesta R.Br. Ex Fresen.	Dhamaye	Loganiaceae	S
Ocimum lamifolium Hochst. Ex Benth.	Damakaase	Lamiaceae	S
Ocimum grattissimum L.	Hancabbii	Lamiaceae	S
Olea capensis L.	Gajjaa / Gagamaa	Oleaceae	T
Olea welwitschii (Knobl.)Gilg. & Schellenb	Baya	Oleaceae	T
Oplismenus hirtellus (L.) P.Beauv.	Salmayee/Kaloboye	Poacaeae	H
Orthosiphon schimperi Benth.	Daleecho	Lamiaceae	H
Oryla latifolia L.	Guha/Bambule	Poacaeae	H
Osyra wightiana Wallich ex Wight	Wontefulasa	Santalaceae	S
Oxyanthus speciosus DC	Briyango jalddessa	Rubiaceae	T
Parochaetus communis D.Don	Hidda boso	Fabaceae	C
Paullinia pinnate L.	Hidda Gafaarsa	Sapindaceae	L
Pavonia schimperiana Hochst .ex A.Rich.	Toogo	Malvaceae	H
Peneromia molleri C.DC.	***	Orchidaceae	EH
Peponium vogelli (Hook.f.) Engl.	Tuujo	Cucurbitaceae	C
Phoenix reclinata Jacq.	Meexii	Arecaceae	T
Physalis peruviana L.	Atoqurpe	Solanaceae	H
Phytolacca dodecandra L.Herit.	Handoodee	Phytolaccaceae	S
Piper capense L.F.	Tunjo	Piperaceae	H
Pittosporum viridiflorum Sims	Soole	Pittosporaceae	T
Plecranthus garckeanus (Vatke) J.K.Morton	Yeriyo	Lamiaceae	H
Podocarpus falcatus (Thunb.) C.N.Page	Birbiirsa	Podocarpaceae	T
Polyscias fulva (Hiern) Harms	Kariyo	Araliaceae	T
Pouteria adolfi-friederici (Eng.) Baehni	Qararoo	Sapotaceae	T
Prema schimperi Engl.	Cocoo/Qorasuma	Lamiaceae	S
Prunus africana (Hook.*f*) Kalkm	Omoo	Rosaceae	T
Psidium guajava L.	Shefaffee	Myrtaceae	S

Pupalia lappaceae (L.) A.Juss	Amomoo	Aaranthaceae	H
Rangaeris amaniensis (Kraenzl.) Summerh	Harme akukuu	Orchidaceae	EH
Rhamnus prinoides L.Herit.	Geshee/ Geeshoo	Rhamnaceae	S
Rothmania urcelliformis (Hiern) Robyns	Dibo	Rubiaceae	T
Rubus apetalus Poir.	Guraa ferda	Rosaceae	S
Rumex nepalensis Spreng	Baaruudaa	Polygonaceae	H
Rytigynia neglecta (Hiern) Robyns	Mixoo	Rubiaceae	S
Sanicula elata Buch.Ham. ex D.Don	Kefosimbiraa	Apiaceae	H
Sapim ellipticum (Krauss) Pax	Bosoqqaa	Euphorbiaceae	T
Satureja paradoxa (Vatke) Engl.ex Seybold.	Naddo	Lamiaceae	H
Scadoxus nutans (Friis & Bjornstad) Friis & Nordal	Qicuu	Amarylldaceae	H
*Schefflera abyssinica (*Hochst.ex.A.Ric*)* Harms.	Boto/ Gatamaa	Araliaceae	T
Senna septemtrionali (Viv) Irwin&Barneby	Sennameki	Fabaceae	S
Setaria megaphylla (Steud)Th.Dur.&Schinz	Jajjaba	Poaceae	H
Sida rhombifolia L.	Karaba	Malvaceae	H
Snowdenia polystachya (Fresen.) Pilg.	Muujja	Poaceae	H
Solanium incanum L	Hiddii	Solanaceae	S
Solanum tarderemotum Bitter	Aacoo	Solanaceae	H
Spathoda campanulata P.Beauv	Annuunnu	Bignoniaceae	T
Syzygium guineense (Wild.) DC.	Baddeessaa	Myrtaceae	T
Teclea noblis Del.	Mixiriti	Rutaceae	T
Thalictrum scimperianum Hochst.ex Schweinf.	Qooricha shaararriti	Ranunculaceae	H
Tiliacora troupinii Cufod.	Liqixii	Menispermaceae	L
Toddalia asiatica (L.)	***	Rutaceae	S
Urera hypselodendron (A.Rich.) Wedd	Dhuffiyyee	Urticaceae	H
Urtica simensis Steudel	Doobii	Urticaceae	H

Note : *** Local name is unknown; ** Found outside the quadrat.