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Research Article

Woody Species Composition Analysis of Shawo Sacred Forest, Ethiopia

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Abstract

In sacred forests of indigenous communities, landscapes are deemed sacred and are protected through social norms and spiritual values. The main objective of this study was to analyze the woody species composition of Shawo forest and explore the traditional governing systems that safeguard the sacred forest up to the present. Systematic sampling method was used to collect data. Accordingly, 42 quadrats each with 400 m^2 (20 m X 20 m) was laid along the 14 transect lines. All woody plant species were collected and identified in each of these quadrats. Vegetation parameters such as DBH and Height of Plant species in each quadrat were recorded. Interview and group discussion were held with local community to gather socio-cultural information. From the result, 16 plant species were found. The average plant density was 499 individual ha^{-1}. The average DBH and H value of plant species was 9.21 cm and 10.43 m respectively. The maximum mean plant height was 39.43 m (Syzygium guineense). The total basal area of all plant species was found to be 56.1 m^2 ha^{-1}. From the total plant species of Shawo forest, Syzygium guineense has the largest basal area 35.77 m^2ha^{-1} (63.77%) occurring in all 42 plots. The most important plant species of Shawo forest was Syzygium guineense with important value index (IVI) of 151.7 contributing to 50.57% of total IVI. For future sustainability of Shawo forest, community traditional conservation practices should be appreciated and supported.

Keywords: Sacred Forest**;** Woody species; Indigenous Knowledge; Shawo Forest

Introduction

Sustained forest management requires the balancing of the economic, environmental andsocial functions and values of forest (FAO, 2010). Sacred natural areas are good examples of age-old approaches of conserving both biological and cultural diversity (Robson, 2007). This is usually in a religious or spiritual sense Individuals may experience a sacred place in different ways as a site of fascination, attraction, connectedness, danger, healing, ritual, identity, exposure, and transformation (Jamir and Pandey, 2002). Since many sacred places in nature are associated with indigenous cultures, such societies commonly use natural resources from these sites for their survival, economy, medicines, rituals, and other purposes. Historical, cultural, and spiritual aspects of indigenous societies are grounded in the biodiversity, ecosystems, and landforms in their habitat. According to IUCN (2009), 11% of the world's forests are currently under community ownership and located mainly in sacred sites. They protect an enormous range of natural environments; species and pastoral landscapes. Thus sacred places are most important in biodiversity conservation.

In Ethiopia, religious believes have been playing a crucial role in biodiversity conservation (Bengali *et al.*, 2003). Churches and Monasteries forests are conserved in similar

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term sacred grove (Bongers *et al*., 2002). They have been protected for centuries as a focus of unity for people of various religions and cultures (Desissa *et al*., 2002). The level of protection given to these sacred areas varies among various religions, ranging from complete preservation to the utilization of resources for religious purposes (Bongers *et al*., 2002). As a result, in many parts of Ethiopia native trees may only be found in these sacred areas, since ruthless deforestation over the past centuries has resulted in the destruction of most forests in the country (Bishaw, 2009). Despite the role sacred forests are contributing, little information is available on Ethiopia's sacred forests and conservation status. Sporadic researches done in the country and oral traditions indicated the presence of many sacred natural sites like indigenous ritual areas, sacred forest patches, sacred trees, sacred mountains, sacred monastic groves, and sacred springs (Bengali *et al*., 2003). Unfortunately, most of these sacred sites are not well studied. Besides, conservation benefits are not recognized and remain neglected in national conservation policies (Bongers *et al*., 2002).

The Shawo sacred forest is found in Southern Ethiopia Dita Woreda. The forest is on a landscape where important indigenous species of plants are found. However, no woody species composition analysis has been done on the sacred forest so far. Therefore, the purpose of this study was to bridge the knowledge gap floristic composition and assess the significance of the plant-human interaction that maintained the sacred forest for many years.

Objective of the Study

The main objective of this study was to analyze the woody species composition of Shawo forest and explore the traditional governing systems of the forest resource.

Specifically, the study was designed to:

- Assess the woody species composition of Shawo sacred forest
- Explore the indigenous community conservation practices in Shawo forest

Materials and Methods

Description of the Study Area

Location: The study was conducted in Shawo forest, located in Dita Woreda, Southern Nation Nationalities and Peoples Regional State (SNNPRS). Astronomically, it is found between 37º 24′ 43″ East to 6º 16″ 38º.91″ North. The altitude of the area ranges from 2185 m to 2278 masl (Fig. 1).

Soil and landscape*:* The soils are primarily clay or clay loams which have evolved from volcanic rocks (basalt) and volcanic tuff in the higher altitudes of the study area. The dominant soil color is reddish brown to dark brown (FAO, 1990). The principal soil types are cambisols and nitosols. These soils are very shallow and agriculturally unproductive (MOA, 1991).

Climate: The study area experiences a bimodal rainfall pattern (Fig. 2). It has an average annual temperature of 16.7ºC and an average rainfall of 1246 mm.

***Vegetation*:** Shawo forest is one of the oldest natural forests in Ethiopia. It covers an area of 130 ha. The forest's establishment is not exactly known. The current elders suggested that, the forest's existence has equal history with the indigenous peoples living there. The forest dominated by an evergreen tree species, *Syzygium guineense*.

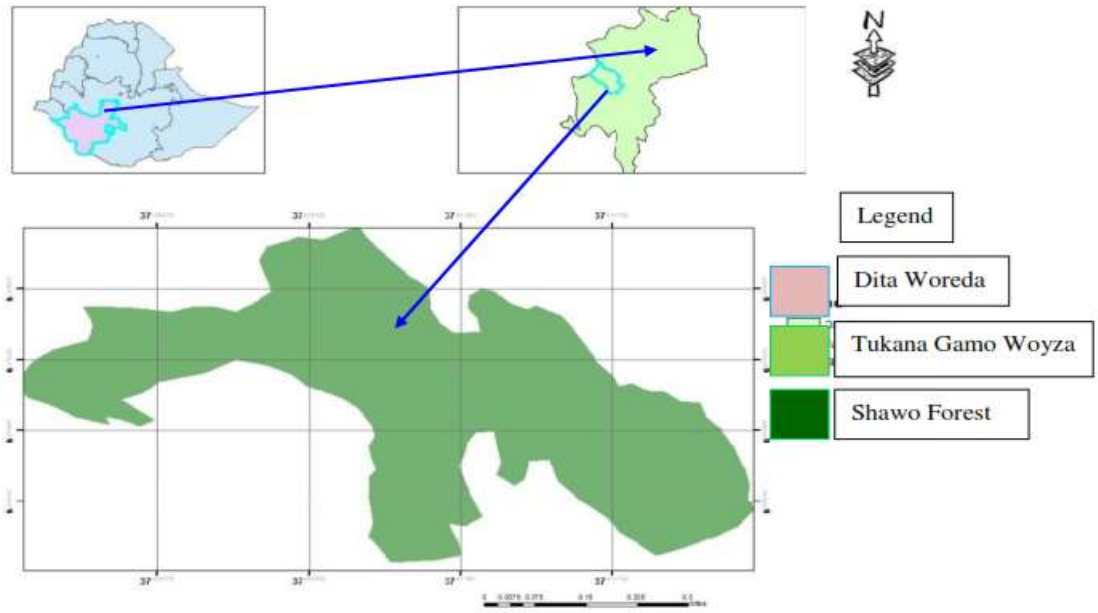

Fig. 1: Location of study area

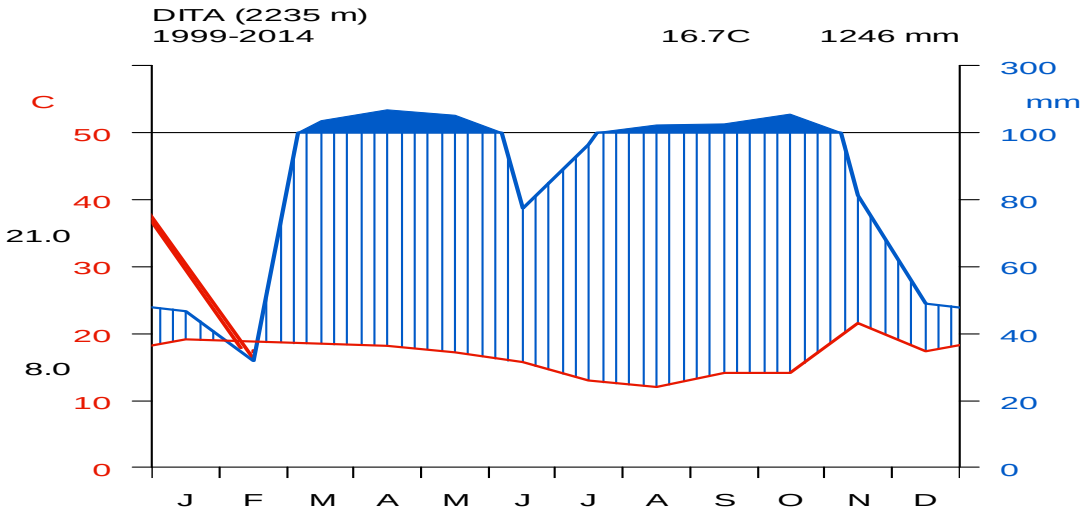

Fig. 2: Climadiagram of the study area

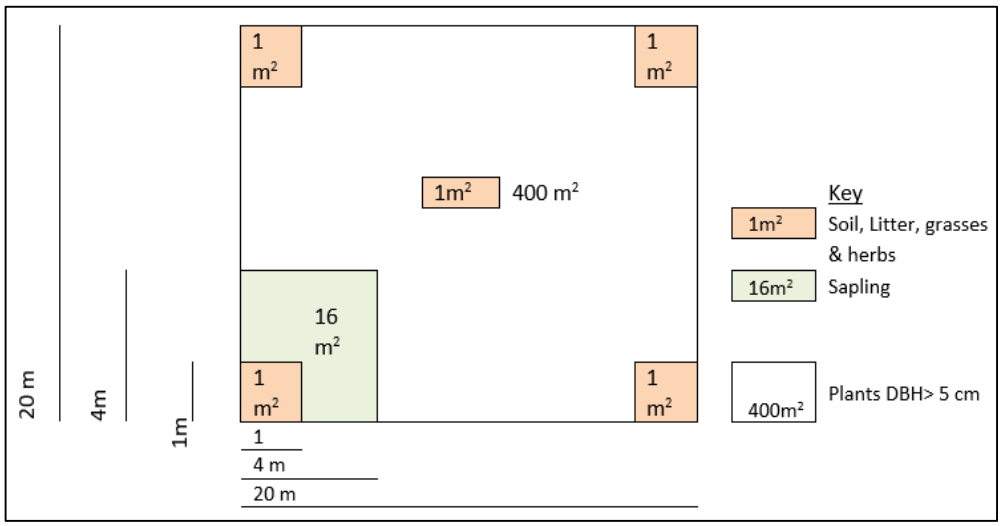

Fig. 3: Sampling quadrates design for filed data collection.

***Population*:** The study area has a total population of 4199, of whom 1973 are men and 2226 women. The majority of the inhabitants practiced Christianity, with 96.87% of the population and 2.43% practiced traditional beliefs. More than 90% of the peoples spoke Gamo as a first language).

Data Collection and Analysis

Site selection and sampling design: A systematic sampling method was used to take vegetation samples. 42 Sample plots of 400m^2 were laid along 14 parallel transect lines from North West to East direction following reconnaissance (Fig. 3). The transect lines were laid at 150 m interval. The main sampling plots were laid on transect lines with 200 m interval each using the GPS navigation system and compass. The sample plots were laid 100 m away from border to avoid edge effect. The first transect line and the first plot on each transect line was laid randomly. A dimensions of 4 m × 4 m (16 m^2) for sapling data collection, was (Nega *et al*., 2015).

Woody Species Composition Data Collection: Plant species were identified by using published volumes of Flora of Ethiopia and Eritrea. In addition, plant specimens were collected, pressed and dried for further identification and checkup. The sapling layer of Plants with a DBH less than 5 cm and a height less than 1.3 m were measured by using Vernier Caliper in all nested quadrats (16 m^2) of the main plots (Fig. 3).

Socio-economic data collection and field Survey: Both primary and secondary data were used. Primary data was collected from filed survey (observation, interview and focus group discussion). Secondary information was collected from Dita *Woreda* Administration Offices and Agricultural and Rural Development Office. Random sampling technique was used in selecting the interviewees. The forest informants that participate in conservation practice were selected for the survey. A total of 60 households were interviewed using structured questionnaire. Accordingly, data concerning forest

conservation practices and indigenous knowledge was collected.

Focus group discussion was done with 6 peoples; two traditional leaders, farmers, administrators and forestry expert in the area. These discussions points were open-ended issues of indigenous forest conservation mechanisms that are intended to elicit views and opinions from the participants.

Data Analysis

Vegetation data analysis: The collected data was organized and recorded on the excel data sheet and analyzed using Statistical Package for Social Science (SPSS) software version 20. The height and diameter data was arranged in classes for applying appropriate model of biomass estimation equation. Analysis of variance (one-way ANOVA) was used to determine statistically significant differences of carbon stocks along different DBH, height and soil depth. Differences at the 0.05 level were reported as significant.

***Socio-economic data analysis*:** descriptive statistics interpretation, summarization and description of views and perceptions of the community were analyzed by using Statistical Package for Social Science (SPSS) software version 20.

Results

Floristic Composition of Shawo Forest

In the present study area, 16 plant species were recorded. According to species distribution, out of the sixteen plant species *Rubus* sp. has the highest density with 2039 individual ha^{-1} (Table 1); while *Ocotea kenyensis* has the lowest density with 29 individual ha^{-1} (Table 1). Regarding exotic plant species, only two exotic plant species were recorded, *Eucalyptus globules* (Myrtaceae) and *Juniperus procera* (Cupressaceae) that has density of 226 and 128 individual ha^{-1}, respectively (Table 1).

Woody Species Composition and Structure

In the current study, average plant density of 499 individual $ha^{-1}$was recorded (Table 1). The average DBH and H value for Shawo forest plants was 9.21 cm and 10.43 m respectively. The minimum and maximum mean DBH of plants was 2cm and 50.86 cm which were recorded in *Rubus* sp. and *Vernonia* sp., respectively (Table 2). Similarly, the minimum and maximum mean plant height was 1.57 m (*Ocotea kenyensis*) and 39.43 m (*Syzygium guineense)* (Table 2).

The total basal area of all plant species was 56.1 $m^2.ha^{-1}$. From the total plant species of Shawo forest *Syzygium guineense* has the largest basal area 35.77 m^2ha^{-1}(63.77%) and *Ocotea kenyensis* contributes the minimum basal area 0.01 $m^2.ha^{-1}$(0.02%) (Table 2).

Table 1: Species distribution of Shawo Forest

SN	Scientific name	Family	Vernacular name	No. of plant ha^{-1}
1	*Echinopse giganteus*	Asteraceae	Angusa	89
2	*Vernonia* sp.	Asteraceae	Othesa	32
3	*Eucalyptus globulus*	Myrtaceae	Bahirzaf	226
4	*Croton macrostachyus*	Euphorbiaceae	Ayika	878
5	*Ilex mitis*	Aquifoliaceae	Botte	30
6	*Vernonia myriantha*	Asteraceae	Buzo	342
7	*Ocotea kenyensis*	Lauraceae	Dongo	29
8	*Rubus* sp.	Rubiaceae	Argi	2039
9	*Embelia schimperi*	Primulaceae	Enkoko	134
10	*Maesa lanceolata*	Primulaceae	Gergecho	804
11	*Euphorbia abyssinica*	Euphorbiaceae	Akirsa	496
12	*Dombeya torrid*	Malvaceae	Lolashe	30
13	*Brucea antidysenterica*	Simaroubaceae	Merko	938
14	*Syzygium guineense*	Myrtaceae	Ocha	600
15	*Juniperus procera*	Cupressaceae	Tside	128
16	*Maytenus gracilipes*	Celasteraeae	Tsutso	1190

Table 2: Mean DBH, H, BA and IVI of Shawo forest plant species

Scientific Name	Mean		BA (m^2. ha^{-1})	RD	RDom ($x10^{-6}$)	F (%)	Dom	Total area covered by a species in 42 plots	RF	IVI	IVI Rank
	DBH	H									
Echinopse giganteus	2.70	2.40	0.05	0.96	6.30	7.14	34.34	0.00	1.47	2.43	13.00
Vernonia sp.	50.86	23.60	6.50	0.26	2856.03	11.90	10152.95	1.63	2.45	2.71	12.00
Eucalyptus globulus	11.37	21.22	2.29	1.24	923.74	19.05	2942.99	0.53	3.92	5.17	10.00
Croton macrostachyus	3.05	3.50	0.64	9.41	82.20	47.62	430.85	0.05	9.80	19.21	4.00
Ilex mitis	4.12	2.85	0.04	0.32	4.71	7.14	26.65	0.00	1.47	1.79	14.00
Vernonia myriantha	2.35	3.06	0.15	3.83	19.40	26.19	104.04	0.01	5.39	9.22	8.00
Ocotea kenyensis	2.20	1.57	0.01	0.32	1.35	4.76	7.60	0.00	0.98	1.30	15.00
Rubus sp.	2.00	3.70	0.64	22.48	74.20	57.14	442.74	0.04	11.76	34.25	2.00
Embelia schimperi	2.48	2.38	0.06	1.28	7.20	7.14	38.62	0.00	1.47	2.75	11.00
Maesa lanceolata	2.80	3.50	0.49	8.29	60.60	35.71	320.03	0.03	7.35	15.64	6.00
Euphorbia abyssinica	11.37	21.22	5.03	3.67	1535.39	33.33	6596.35	0.87	6.86	10.53	7.00
Dombeya torrid	2.30	1.60	0.01	0.32	1.50	4.76	8.31	0.00	0.98	1.30	15.00
Brucea antidysenterica	2.36	2.60	0.41	10.04	51.80	47.62	275.44	0.03	9.80	19.85	3.00
Syzygium guineense	27.56	39.14	35.78	31.12	99989532.37	100.00	581939.59	56943.58	20.59	151.70	1.00
Juniperus procera	18.53	30.70	3.45	3.83	4771.64	64.29	375.29	0.04	2.45	6.28	9.00
Maytenus gracilipes	2.40	2.38	0.54	2.65	71.50	64.29	375.29	0.04	13.24	15.88	5.00
Total			56.10	100.00	100.00	3161.00	561017.16	485.71	100.00	300.00	

BA-basal area: RD-relative density: RDom- relative dominance:F%= frequency percentage: RF- relative frequency: IVI-importance value index

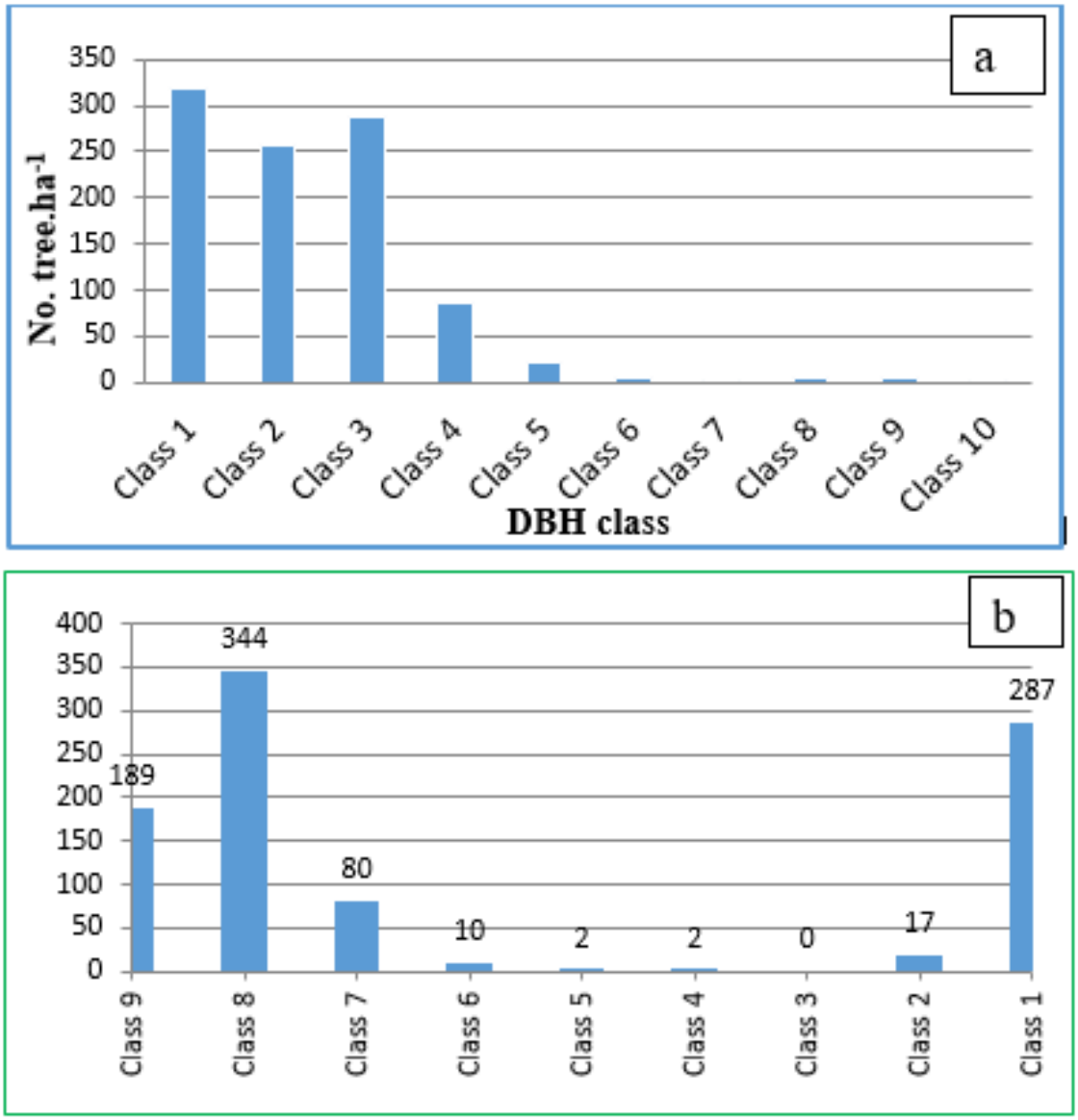

Fig.:4. Distribution of Plants in Shawo forest a) DBH class (inverted "J" shape) b) Height Class "U" shape

The most important plant species of Shawo forest was *Syzygium guineense* with important value index (IVI) of 151.7. It contributes 50.57% of the total importance value index. The least important plant species was *Ocotea kenyensis* with important value index (IVI) of 1.29 and *Dombeya torrid* (1.29), contributes 0.43% of the total importance value index each (Table 2). The order of Shawo forest plant species from the most important to the least based on Important Value Index were: *Syzygium guineense, Rubus* sp., *Bruceae antidysenterica, Croton macrostachyus, Maytenus gracilipes, Maesa lanceolata, Euphorbia abyssinica, Vernonia myriantha, Juniperus procera, Eucalyptus globules, Embelia schimperi, Vernonia* sp., *Echinopse giganteus, Ilex mitis, Ocotea kenyensis and Dombeya torrid* (Table 2).Within the Shawo forest, *Syzygium guineense* was occurred in all 42 plots, (100%) frequent. *Maytenus gracilipes* (64.28%) and *Rubus* sp (57.15%) were the 2nd and 3rd frequent species. Similar to IVI rank, *Ocotea kenyensis* (4.76%) and *Dombeya torrid* (4.76%) was the least frequent plant species in the area.

Community Forest Conservation Practices

Traditional forest conservation rules and regulations: Communities in the study area have their own understanding about the Shawo forest. They have traditional rules and regulations issued by the traditional leaders which come from their ancestors. According to the view of focus group discussion and interviews, the traditional leader was responsible to socio-cultural aspects of the community. They lead, order and punish the peoples in different situations. All peoples regardless of their economic status, religion, and age were penalized when they cut or use Shawo forest without the permission of the traditional leader.

Table 2: DBH and H class distribution of Shawo Forest

Height class	Class size in m	No. of plant (plant.ha^{-1})	**DBH class**	Class Size in cm	No. of plants (t.ha^{-1})
Class 1	(2-5]	287	Class 1	2-10	318
Class 2	(5-10]	17	Class 2	11-20	256
Class 3	(10-15]	0	Class 3	21-30	288
Class 4	(15-20]	2	Class 4	31-50	87
Class 5	(20-25]	2	Class 5	51-70	22
Class 6	(25-30]	10	Class 6	71-90	4
Class 7	(30-35]	80	Class 7	91-110	3
Class 8	(35-40]	344	Class 8	111-130	5
Class 9	(40-45]	189	Class 9	131-150	4
Class 10	>45	33	Class 1010	>150	1

Table 4: Shawo forest community leadership name from 10th generation up to the present

Generation	10th	9th	8th	7th	6th	5th	4th	3rd	2nd	1st (Current ethnic leader)
Leaders Name	**Gayza**	**Gayzaziba**	**Sando**	**Tsada**	**Guche**	**Buete**	**Gezatsi**	**UcheHankito**	**Hankito**	**Mucnchhankito**

Attitudes of the community about Shawo forest: As the focus group discussion and interviewees, Shawo forest is part of their life and identity. They are happy being having the forest and has positive attitude towards Shawo forest. As the traditional leaders' idea, they speak to the forest when something wrong happens to them. They feel the pains of the Shawo forest; they prey for the long live of the forest and they respect.

Shawo forest is managed and protected by the community. Every person is responsible to the forest conservation. If the members of the community observe something on the forest, he/she directly inform to the traditional leaders and the leader 'Haleka" take measurement. In the community they have five representatives' main traditional leader ("Haleka"), vice traditional leader ("Mikitelhaleka") and other three members under the two decides every socio-economic issue of the peoples living in the district. Hence, Shawo forest is headed by them.

According to the focus group discussion, Shawo forest is old natural forest which is transferred to them from their ancestors. The traditional leader said that "I know the history back to 10th generations (approximately 1000 years back)". The community name is changed when the traditional leader changes. Accordingly, the oldest ethnic name was Gayiza (10th generation) and the current ethnic is Munche Hankito (Fig. 4).

According to the focus group discussion, the community has very high respect to the forest. The following remark was given by traditional leaders:

> *If somebody cut trees from Shawo forest or if he did wrong action thatperson will be not get elder and his/her families will not be blessed.*
>
> *(In Gamogna "Shawo wooraqa nxxedayewoykolanchisidaye cimenna anjetena").*

If the tree failed by different natural causes they undertake special ceremony to respect nature and express their sadness. They gathered and cried during the ceremony like what we did for human being funeral ceremony. They express their sorrow by beating their stomach with their right hand and prey for the dead tree. Finally, seedling will be planted as a substitution by the traditional leader. The dead tree will be given to the community for use.

***Utilization of forest by the local community*:** According to discussants, the community uses the dead wood and fallen branches fall for construction material. Some parts of the community use litter as fuel wood consumption. Beside the forest is used for curing differ diseases. Shawo forest is the

drug store to the community (source of traditional medicine) (Table 5).

Table 5: Some selected medicinal plants in Shawo forest

Plant species	Treatment
Embelia schimperi	Tap worm
Syzygium guineense	Tonsil
Maesa lanceolata	Mosquito Disease
Croton macrostachyus	scars
Eucalyptus globulus	Kintarote/hemorrhoids

Discussion

Floristic composition of Shawo Forest

In the study area, density of plants per hectare was (499 plant ha^{-1}) virtually greater than that of Munessa-Shashemene state forest, Birhanata Alem Petros Paulo's Church forest and Genete Tsige Kidus Giorgis Church forest 306, 136 and 340 individual ha^{-1}, respectively (Tolla, 2011; Tesfaye, 2007) (Table 2). Whereas the study area has almost similar result with Menebere Tsebaot Kidist Silase Cathedral Church forest 442 individuals ha^{-1} (Tolla, 2011).

Syzygium guineense and *Vernonia* sp. were mostly found in the DBH class of 20-40 cm, few in the lower and higher DBH class (Table 3). This indicates planting or regenerating of this species in the study site was very weak. So, even if the forest is under the community conservation it needs attention. *Echinopse giganteus, Vernonia* sp., *Croton macrostactachyes, Ilex mitis, Vernonia yabelloano, Ocotea kenyensis, Embelia schimperi, Maesa lanceolata, Dombeya torrid, Carrissa spinarim and Rubus* sp. almost found in DBH class of below 10 cm. Those species are completely absent in the middle and higher class. This might be due to late regeneration or late plantation. Also the survival level of plants might be another factor (Tolla, 2011; Shimelse, 2010).

Unlike DBH class with distribution of inverted "J" shape, H class showed "U" shape (Fig. 4a and b). This revealed the absence of intermediate class plants. These might be due to selective cutting and removal of medium size plant or it may be the regenerated plants are not grown due to high canopy of the higher class dominant species (Shimelse, 2010). Distribution of plant species (93.51%)was recorded only in 4 plants H classes (29.1%, 10.34%, 34.89% and 19.17% of the plant was grouped under H class 1, class 7, class 8 and class 9, respectively) (Table 3). The other plant H class covers only 6.49% of the total plant species (Table 3), even if it exhibited different trends from species to species. This might indicate a gap in regeneration of the plant in some earlier time. But there were good regeneration status of plants either planting or naturally regenerated in the near time.

The height class distributions exhibited different trends from species to species. Most of the plants were found in plant H class 7, class 8 and class 9 (Figure 4(b)). This indicates the forest was dominated by mature plants and it was in a productive stage. Within individual plant species, *Syzygium guineense* was found in height class of above class 6 and completely absent in the lower H class (Table 2; Table 3). This could be because of the poor regeneration and plantations of those dominate species in the study sites relative to the other species. Whereas, *Echinopse giganteus, Carrissa spinarim, Ilex mitis, Vernonia yabelloano, Ocotea kenyensis, Embelia schimperi, Maesa lanceolata, Dombeya torrid, Bruceae antidysenterica* and *Croton macrostactachyus* found only in plant height class below class 6. This could be attributed to the late plantation or regenerated from deforested pre-existing Plants or dominated by dense *Syzygiumguineense* which may not be comfortable for the growth of Sapling (Table 2). But, *Eucalyptus globules, Euphorbia abyssinica, Juniperus procera* found in all plant height class (Table 2; Table 3). This could be due to the high survival rate of plants from regenerated or planted Plants, *Eucalyptus globules and Euphorbia abyssinica* survived better than other species on outskirts of the forest as a buffer. Accordingly, Shawo forest will be dominated by exotic species in the near future even if there was large number of regeneration or plantation of indigenous plants. *Syzygium guineense* were commonly recorded in all sampled plots (Table 2). All *Syzygium guineense* plant in the studied site was under height class greater than 25 m (Table 3). This dominancy could be attributed to the suitability of the agro-ecology making the plant dominant due to high canopy cover.

Basal area provides the measure of the relative importance of the species than simple stem count, species with largest contribution in dominance (Table 2). Unless considering only density in most case shrubs and saplings could be the dominant species (Gizaw, 2006). In the current study, the result revealed that *Syzygium guineense* contributes the largest basal area (63.77%) (Table 2). The other 15 plant species contributes little basal area (36.23%). This indicates that *Syzygium guineense* is the most ecologically important and dominant species in Shawo forest.

Frequency reflects the pattern of distribution, gives an approximate indication of the heterogeneity of the forest (Shimelse, 2010; Zegeye *et al.*, 2006). The current study showed that, the forest the less heterogeneity of the forest (Table 2). For instance, *Syzygium guineense* 100% frequent, *Croton macrostachyus* 64.28% frequent and the other plant species was less frequent which was below 50% (Table 2). In other studies, the average DBH value for individual plant was reported as (11.11cm (Shrestha, 2009), 16.22cm (Khanal *et al.*, 2010) and 25 cm (Yohannes *et al.*, 2015).

Community Forest Conservation Practices

Shawo forest has been conserved traditionally according to their traditional knowledge which comes from their ancestors. This could be due to absence of immigrant and/or other globalization effects like cultural colonization. Francesco *et al*. (1999) describes the effect of modern polices and globalization in indigenous peoples forest management. The study by Mergo (2014) on indigenous forest management among the Oromo of Horro Guduru studies also showed similar idea to the current study. Studies in other parts of Ethiopia also support the context that indigenous communities such as the Gumuz and Oromo of Horro Guduru has possessed sustainable strategies and systems ofnatural resources management through their cultural experiences (Mergo, 2014; Abbute, 2002). Also Saxena (2000) in India describes the sustainability of indigenous knowledge and experience in forest management.

Globally, the value of indigenous knowledge (IK) is becoming recognized by scientists, managers, and policy-makers. It is also becoming an evolving subject of national and international laws (Francesco *et al*., 1999). Indigenous peoples themselves have repeatedly claimed that they have fundamental rights to IK because it is necessary to their cultural survival, and this principle is increasingly being recognized in international law. However, in the Shawo forest community, no recognition and support from government agencies or other institutions was given to forest conservation practice so far. Though, they are managing the forest more than 1000 years (Table 4) effectively. Therefore, recognizing and valuing IK is essential as assessed.

Conclusion

The traditionally managed Shawo sacred forest is a reservoir diverse plant species. The vegetation composition structure of the forest has shown the presence of big trees dominated by *Syzygium guineense*. The practice of the community and the traditional governing structure has enabled the forest to sustainably benefit the nearby community. The traditional governance that lasted for ten generations has to be extended for the future. Hence, this traditional ecological knowledge of the indigenous people and its management practice should be recognized and valorized for maximum benefit.

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