ORIGINAL ARTICLE

Floristic Composition of Traditional Sacred Landscapes in Bedelle Woreda, Illubabor Zone, Oromia Regional State, Ethiopia

Dereje Denu*, Tamene Belude*

Abstract

This study was conducted on the Floristic Composition of Sacred Landscapes in Bedelle Woreda, Illubabor Zone, Oromia Regional State. The aim of the study was to assess the plant species diversity in the sacred sites of Bedelle Woreda. Three sacred sites (Boqa in Banshure Kebele, Boqa in Socho Kebele and Mute in Mirga Mute Kebele) were selected for plot study based on their size (≥0.5 ha) and a general plant species inventory was conducted on the remaining 13 sacred sites. Systematic sampling was the technique used for collecting data from the three sacred sites selected for plot study. From the study conducted on the entire (16) sacred sites, 143 plant species belonging to 122 genera and 62 families were encountered. Of the total collection of plant species, ~7% were found to be endemic to Ethiopia. The total species collected from Boqa sacred forest patch in Socho Kebele was 76, from Boqa in Banshure was 62 and from Mute sacred forest was 58 belonging to 40,37and 33 families respectively. The study indicated that the sacred landscapes are important sites for plant biodiversity conservation. Thus, attention should be given to the sacred site conservations as they are used as means of in-situ conservation of plant biodiversity.

* *Jimma University Biology Department, Jimma, Ethiopia.*

INTRODUCTION

Sacred natural sites are valuable areas for the biodiversity conservation in many cultures around the world. The respect of traditional communities for nature and the restriction of access to sacred sites have often led to well-conserved areas with high biological diversity, rare and threatened species (Schaaf, 2003). Several tribal communities around the world preserved small virgin forest patches since time immemorial (Desalegn, 2009) which serve as refugia for large numbers of endemic and rare plants (Khan *et al.*, 1997; Tiwari *et al.*, 1998). Sacred sites are thus areas which possess biological importance and play a pivotal role in environmental conservation (Salick *et al.*, 2007). Sacred sites have local deities and spirits (Martin, 2000) and store rare and extraordinary flora and fauna (Baker, 2004). Salick *et al*.(2007) also indicated that the sacred sites are useful in conserving old growth trees and forests.

The decline in forest cover and the resulting biodiversity loss is nowadays a global problem seeking a global solution. The loss of natural vegetation due to human induced impacts is going on and yet not checked. According to FAO (2006) report, from 1990-2000, the net global loss of forest was 8.9 million hectares per year. The worldwide forest loss from 1990 to 2005 as estimated by FAO was 3% and at present the global forest loss is about 200 km^2 each day (FAO, 2006).

The sacred landscapes such as mountains, water bodies, grave yards and others are home for various species of plants ranging from herbs to shrubs and trees and became areas to save the biodiversity and maintain the local as well as global gene pool of the indigenous species of plants. Sacred sites are used as tool, for *in situ* conservation of flora and fauna, and are also reservoirs for local biodiversity and threatened species. The Three Sisters Caves in Kenya (Marshall, 2010) and the small forest patches of Gamo highland (Desalegn, 2009), for example played a vital role in protecting (even preserving) biodiversity against the threats of agricultural encroachment and illegal logging.

Sacred sites also serve as wildlife sanctuaries where the wild animals are rescued. They serve as refuges for threatened species (Marshall, 2010). The respect for sacred sites from the local community protected the ecosystems and the biodiversity in them. Despite their contribution to biodiversity conservation, these sacred forests have not been given due attention so far. Of the studies carried out on Ethiopian vegetation (e.g., Pichi-Sermolli, 1957; Hailu, 1982; Lisanework, 1987; White, 1970 cited in Friis, 1992; Tamrat, 1993; Teshome, 1997; Kumelachew, 1997; Sebsebe, 1998; Ermias, 2005; Dereje, 2007) so far, none of them addressed the floristic composition and/or ecology of the traditional sacred landscapes and their role in maintaining species diversity and richness.

The recognition and protection of sacred places in nature may be needed more than ever before for the survival of biodiversity and accordingly that of mankind in our days. The spiritual, historical and cultural aspects of the ecology of indigenous societies are grounded in the biodiversity, ecosystem, and landforms in their habitat. It is crucial to consider the indigenous people in exploring the relationships between sacred places, biodiversity, and conservation (Sponsel, 2008).

The presence of many sacred sites in Bedelle Woreda, the role of sacred sites for *in situ* conservation of plant species, the absence of any previous document regarding the sacred sites of the Woreda and their contribution in biodiversity conservation motivated us to conduct this research work.

MATERIALS AND METHODS

This study was conducted on the sacred sites in Bedelle Woreda (Fig 1), Illubabor zone, Oromia Regional State. The Woreda is located at about 145 km from Jimma (Northwest) and 480 km from Addis Ababa in southwest direction.

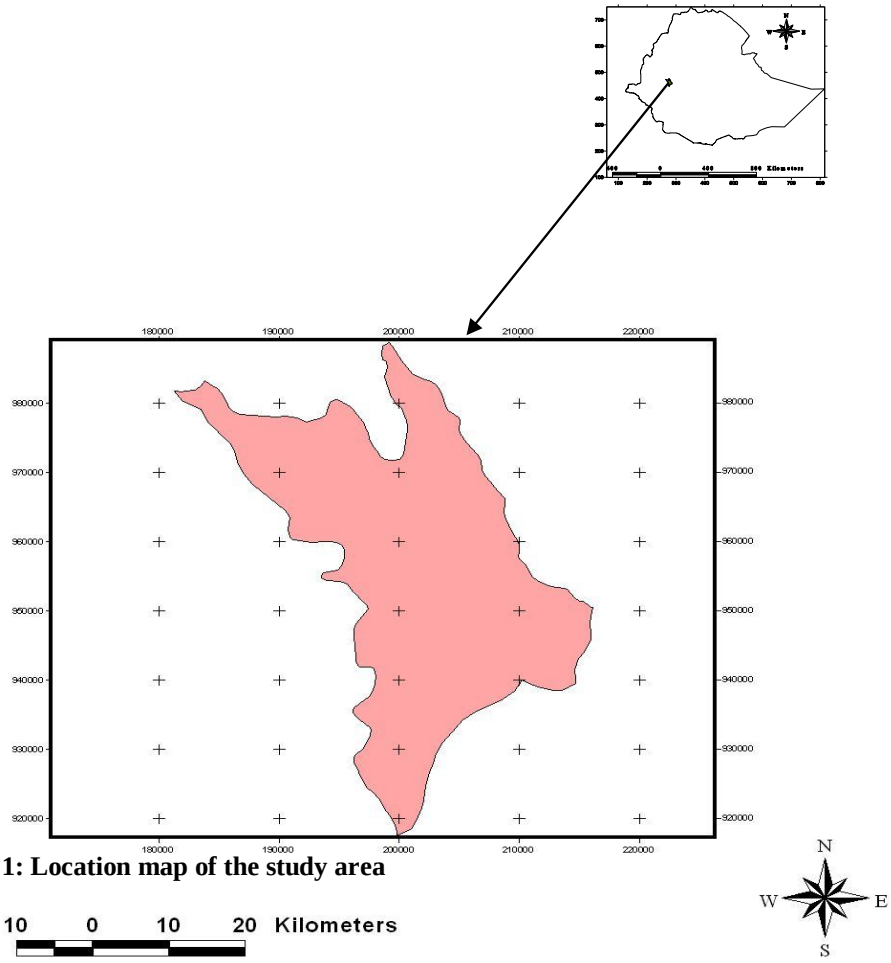

Fig 1: Location map of the study area

The human population of the Woreda is 98481 (male 49.85% and female 50.15%) (CSA, 2008). The total land area of the Woreda is estimated to 1,678.44 km^2 with population density of 83.1 people per km^2. Different crops are cultivated in the Woreda, but the major ones are Maize, teff, sorghum and coffee. Wheat, barley, millet, hot pepper etc are also cultivated. Coffee is the most important cash crop of the Woreda and its cultivation covers over 50% of the land in the Woreda.

Study Design

Assessment of plant species was carried out in all the sacred sites identified. Three sacred forest patches were selected based on their size (≥ 0.5 ha) for plot study. A stratified systematic sampling technique was used in the selected three sacred forest patches. Two plots of different sizes (20 m x 20 m and 1 m x 1 m) were used for the three selected sacred sites. Five 1m x 1m subplots were nested within the 20m x 20m plot (one at each corner and one at the center) (see Fig. 2).

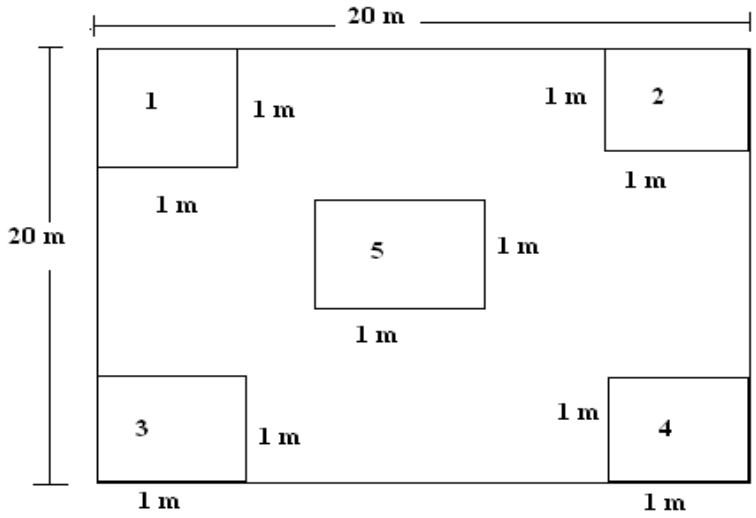

Fig. 2: Study Design for collecting data from the sacred sites in Bedelle Woreda

Data collection

Data on tree species were collected from 20 m x 20 m sample plot. Herbaceous species were collated from the five 1 m x 1 m subplots. The collected sample specimens were brought to Jimma University Regional Herbarium for identification referring to Flora of Ethiopia and Eritrea. For the determination of the status of endemic taxa, Vivero *et al.* (2005) was used. The spatial distributions of sacred landscapes and the plots in the study area were recorded using Global Positioning System (GPS). Measuring tapes, GPS, altimeter and camera were employed for collecting data.

Data analysis

In the data analysis, excel spread sheet and Biodiversity Professional Version 2 were used. Species diversity, richness and evenness in the sacred sites, and the association of the sacred sites in species composition were analyzed.

Species diversity, richness and evenness

Diversity of plant species was evaluated using Shannon-Wiener Diversity index.

$$H = -\sum PiLnPi$$

Where, Pi = the ratio of a species average to the total species average

Ln = the natural logarithm to base e ($\log_e$)

The species evenness or equitability was calculated applying the following formula.

$$J = \frac{H}{Hmax}$$

Where J is the species evenness and H is Shannon-Wiener diversity index, H_{max} equals to lnS, where S is the number of species.

Floristic association of the sacred forests

The association of the three traditional sacred forest patches was calculated using Sorensen's coefficient of similarity (SC). This index is used to measure the similarity between two habitats. The three forests were compared taking two of them at a time. $SC = \frac{2a}{2a+b+c}$

Where a = number of species common to both habitats

b = number of species present in the first and absent from the second habitat

c = number of species present in the second and absent from the first habitat

RESULTS

The Spatial distribution of Sacred Sites

The sacred sites of the woreda and their geographical locations are indicated in Table 1 while their spatial distribution which was produced by Arc View version 3.3 GIS software is indicated in Fig 3.

Table 1: The sacred sites in Bedelle woreda

S. No	*Name of sacred site*	*Category of the sacred sites*	*Location (UTM)* *Northing*	*Easting*	*Altitude in meter*	*Species recorded*
1	Boqa (banshure)	Qollo	0210731	0942635	1969	62
2	Qollo Sonbo	Qollo	0210682	0942616	1934	22
3	Bakka irressa1	Marjeja	0210527	0944203	1863	11
4	Sida Abbalemu	Sida	0210061	0944160	1880	1
5	Sida Abachafe	Sida	0210115	0944004	1895	1
6	Sida Shibe	Sida	0210668	0944603	1871	5
7	Qollo Bashana	Qollo	0207931	0945105	1938	1
8	Sida Abba Jamaa	Sida	0208346	0944317	1980	20
9	Shorro tessoo	Owwala (Burial)	0208007	0944718	1928	21
10	Sida Digeja	Sida	0209468	0939128	1926	12
11	Mute	Qollo	0206937	0937579	2167	58
12	Boqa (Socho)	Qollo	0202358	0937607	1986	76
13	Sida ?	Sida	0206076	09373351	2031	8
14	Sida Abbabor	Sida	0206188	0936351	2115	13
15	Sida Hadhagissa	Sida	0204248	0936926	1943	15
16	Bakka irressa 2	Marjeja	0204236	0936984	2000	5

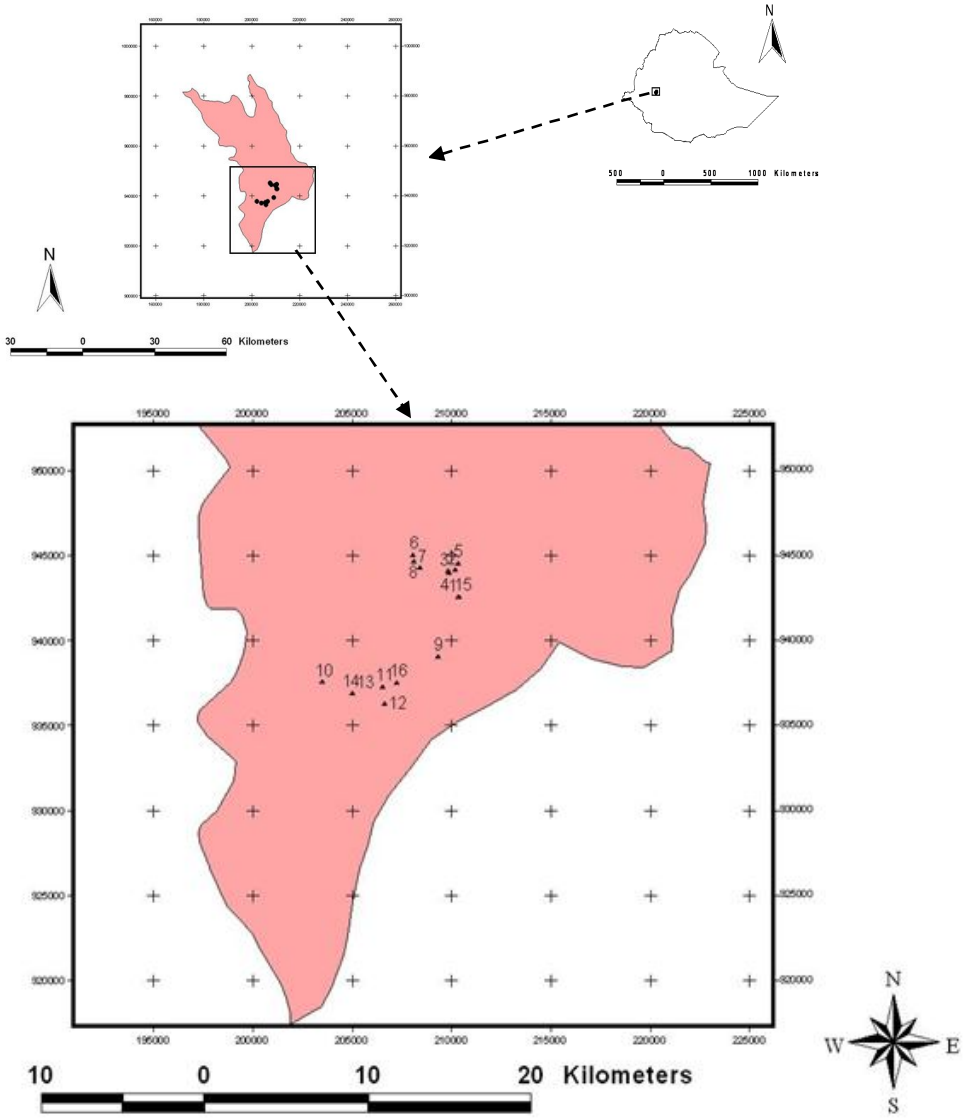

Fig 3: The spatial distribution of sacred sites in Bedelle woreda (1=Boqa (Bansure), 2=Qollo Sonbo, 3=Bakka irressa 1, 4= Sida Abbalemu, 5=Sida AbbaChafe, 6=Sida Shibe, 7= Qollo Bashana, 8=Sida Abba Jama, 9= bakka Owwala, 10= Sida Digeja, 11=Mute, 12= Boqa (Socho), 13= Sida?, 14= Sida Abbabor, 15=Sida Hadhagissa, 16=Bakka irressa 2).

Floristic Composition

From the study of 16 sacred sites in Bedelle Woreda, a total of 143 plant species belonging to 122 genera and 62 families was encountered. Of the total plant collections in the study area 140 were identified to the species and three of them to the genus level.

The number of species per family in the studied sacred sites ranges from 1 to 12. *Asteraceae* is the most species rich family represented by 12 species followed by *Fabaceae and Rubiaceae* 11 species each, *Euphorbiacea* (9 species) (Fig 4). *Lamiaceae* and *Oleaceae* represented by 6 and 5 species respectively, *Celastraceae*, *Combretaceae, Urticaceae* and *Amaranthaceae* are composed of 4 species each; and *Rutaceae*, *Moracceae, Myrsinaceae*, *Poaceae*, *Polygonaceae* and *Rhamnaceae* contain 3 species each. *Verbenaceae, Rosaceae, Ranunculaceae, Protiaceae, Myrtaceae, Hypericaceae, Cucurbitaceae, Anacardiaceae* and *Acanthaceae* all have 2 species each while the of other families are represented by one species each. The species rich families such as *Asteraceae, Fabaceae* and *Rubiacea* together contributed to 23.78% of the total species collected. Of the 122 genera, *Vernonia* is composed of 4 species, *Albizia, Combretum, Ficus* each composed of 3 species. The genera represented by 2 species are *Acanthus, Bidens, Hippocratea, Clematis, Hypericum, Maytenus, Ocimum, Olea, Oplismenus, Oxyanthus* and *Syzygium* (Fig 5).

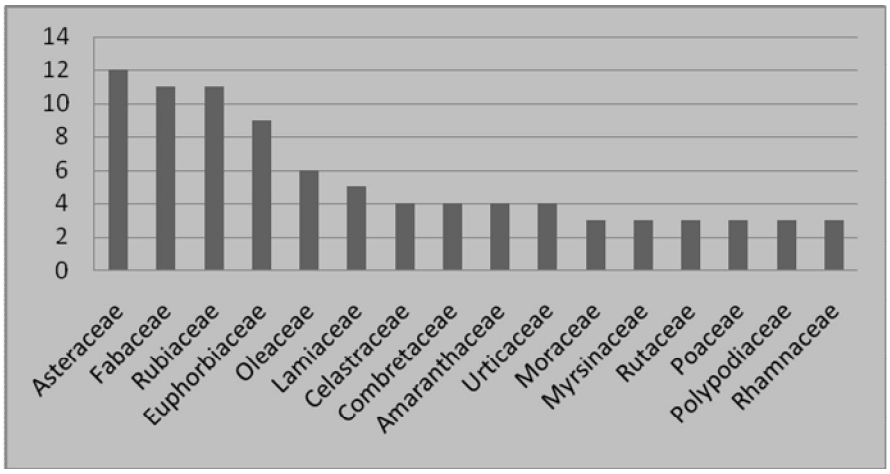

Fig. 4: The species rich families in the sacred sites

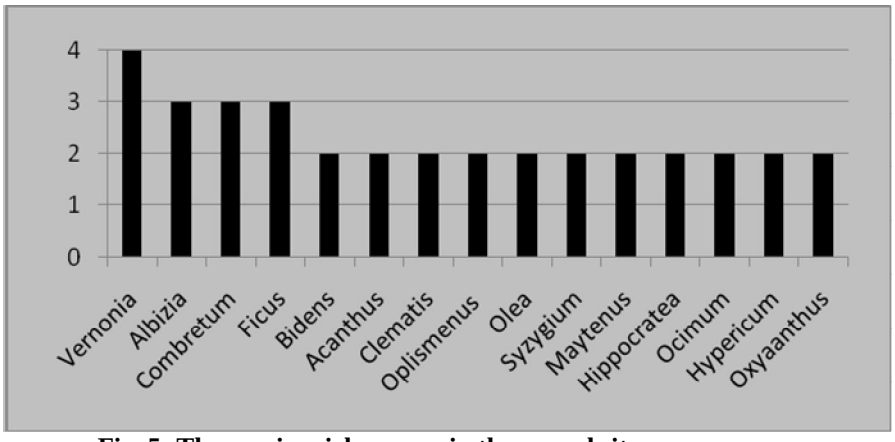

Fig. 5: The species rich genera in the sacred sites

The total number of species collected from Boqa sacred forest patch in Socho Kebele was 76. They belong to 70 genera and 40 families. The most species rich families are *Euphorbiaceae* represented by 7, *Fabaceae* represented by 7, *Rubiaceae* by 6 followed by *Asteraceae* by 5 species, *Lamiaceae* by 5 species and *Oleaceae* by 4 species. *Amaranthaceae, Moraceae, Myrsinaceae, Polypodiaceae, Rhamnaceae, Solanaceae, Urticaceae and Rutaceae* each are composed of 2 species while all the rest are represented by one species.

Of the total collection of the plant species in the sacred forest of Socho, herbs and shrubs are the richest habit groups comprising 27.63% and 26.32% respectively, and followed by trees representing 25% of the total collection. Trees/Shrubs are represented by 8%, climbers and epiphytes are composed of 6.58% each. Trees, shrubs and trees/shrubs together contributed to 59.21% of the total species collected from the forest. The number of plant species collected from Boqa (Banshure) sacred site was 62. They are distributed among 57 genera and 37 families. *Asteraceae, Fabaceae* and *Lamiaceae* are composed of 5 species each, *Rubiaceae, Euphorbiaceae* and *Combretaceae* are composed of 3 species each, *Ranunculaceae, Protiaceae, Poaceae, Hypericaceae* and *Anacardiaceae* consists 2 species each and the rest are composed of one species each.

Herbs and shrubs are the top species rich habit groups each of them having 28.57% of the total species composition followed by the second rich habit group, tree with 26.98%. Trees/shrubs and climbers are composed of 6.35% each and the least species number is recorded for epiphyte group (3.17%).

Of the three sacred sites where the plot studies were conducted, the least number of species was encountered from Mute sacred forest with 58 species belonging to 55 genera and 33 families. The record of trees and shrubs with 20.69% and 18.97% respectively is less than that of Boqa in Socho and Boqa (Banshure). Mute is the richest of the three sacred sites in herbaceous species composition (34.48%). Trees/shrubs are (8.62%), climbers (10.34%) and epiphytes (6.9%) in composition (Table 2).

Table 2:-Habit distribution of plants in the three traditional sacred sites

Sacred site	Trees	Shrub	Tree/Shrub	Herb	Epiphyte	Climber	Total
Boqa (Banshure)	16 (25.8%)	18(29.03%)	4(0.06%)	18(29.03%	2(0.03%)	4(0.06%)	62
Boqa (Socho)	19(25%)	20(26.32%)	6(7.9%)	21(27.63%)	5(6.58%)	5(6.58%)	76
Mute	12(20.69%)	11(18.97%)	5(8.62%)	20(34.48%)	4(6.9%)	6(10.34%)	58

Endemic species

The Ethiopian endemic plant species encountered in the sacred sites are shown in table 3. They are distributed among six families. *Asteraceae* and *Fabaceae* constitute 30% and 20% of the endemic taxa respectively in the area and the rest five families each are composed of 10% of the endemic species. The endemic species represent about 7% of the total collection in the study area. Herbs represent 50%, trees 30% and shrubs 20% of the total number of the endemic species encountered in the area.

Vepris dainellii, Solanecio gigas, Milletia ferruginea, Erythrina brucei, Lippia adoensis and *Phyllanthus mooney* are already in the Red List of endemic species. All of these species are under the species of least concern (LC) category of IUCN except *Phyllanthus mooney*, which is under the vulnerable category (Vivero *et al.*, 2005). There is no data (ND) regarding the threat category for the remaining endemic species.

The endemic species are distributed among different Floristic Regions of Ethiopia. *S. gigas* is the widely distributed (in 10 Floristic Regions) endemic species in Ethiopian floristic regions. For the distribution of all species see Table 3.

Table 3: The Ethiopian endemic plant species encountered in the study area and their distribution in Ethiopia (TU=Tigray, D=Gonder, GJ=Gojam, SU=Shewa, WG=Welega, HA=Harerge, IL=Illubabor, WU=Welo, AR=Arsi, SD=Sidamo, KF=Kefa, BA=Bale, GG=Gamo Gofa)

No	*Botanical Name*	*Family*	*Threat category*	*Distribution in the flora area*
1	*Milletia ferruginea*	Fabaceae	LC	TU,GD,GJ,SU,WG,HA,IL
2	*Solanecio gigas*	Asteraceae	LC	GD,GJ,WU,SU,AR,SD,IL,KF,BA,HA
3	*Vepris dainellii*	Rutaceae	LC	GJ,SU,WG,IL,KF,SD,BA
4	*Phyllantus mooney*	Euphorbiaceae	VU	SU,AR,IL,KF,GG,SD
5	*Amorphophallus gallaensis*	Araceae	ND	GJ,SU,IL,KF
6	*Bidens ghedoensis*	Asteraceae	ND	SU,WG,IL,KF,GG,SD
7	*Cirsium dender*	Asteraceae	ND	SU,IL,KF,GG
8	*Urtica simensis*	Urticaceae	ND	TU, GD,, GJ, SU,, AR, BA, SD
9	*Erythrina brucei*	Fabaceae	LC	WU,WG,GJ,SU,BA,HA,IL,KF,GD,GG, SD
10	*Lippia adoensis*	Verbenaceae	LC	TU, GJ, SU, AR, HA, KF, GG

Table 4: Diversity of species in the study forests

Sacred site	*H'*	*Richness*	H_{max}	*J*
Boqa (Banshure)(Banshure)	3.06	38	3.64	0.84
Mute	2.65	28	3.33	0.80
Boqa (Socho)	2.85	45	3.81	0.75

Association of the sacred sites

Sorenson's similarity index exhibited the degree of similarity of the three sacred sites in the type of species they are composed of (Table 5). Boqa (Banshure) sacred site has 18.80% and 23.70% similarity with Mute and Boqa in Sochu respectively. The highest similarity (61%) was observed between Mute and Boqa (in Socho) sacred forest patches.

Table 5: The similarity of the three sacred sites

Pair of sacred sites	a	b	c	SC	%
Boqa /(Banshure) v Mute	11	52	43	0.1880342	18.80
Boqa (banshure) v Socho	16	47	56	0.237037	23.70
Mute v Socho	39	15	33	0.6190476	61.90

DISCUSSION

Sacred sites are areas protected from human exploitation for their spiritual and cultural values. They could be forest patches, single trees, streams, lakes, ponds, rivers, mountains, roads etc. The 16 sacred sites of Bedelle Woreda are traditionally recognized as Qollo, Sida, Marjeja and Bakka Owwala (sacred grooves). Most of the sacred sites assessed were Sida (50%) followed by Qollo (31.25%) and the rest were Marjeja (12.5%) and sacred groove (6.25%). Among the 16 sacred sites we identified in Bedelle Woreda, Qollo Bashana, Sida Abalemu and Sida Abachafe were represented by single trees. In Oromo culture Qolo is represented by single tree and is believed to be inhabited by some powerful spirits (Workineh, 2005). In former times, in our study area, the single Qollo trees were surrounded by other tree species and form patches of forests. The three Qollos (Boqa in Banshure, Mute and Boqa in Socho) are still occupied by patches of forests. It might be because of the change in human spirituality that the forests around the sacred trees have gone in the rest of the sacred sites. Sida is represented by single tree and is equivalent to the Korma korbesa trees in Borena-Oromo culture. In most cases the non-sacred trees around the sacred ones are also valued and that is why we have several species of plants associated with the single sacred trees. The sacred trees are holy trees where blessings, peace-making and celebrations take place (Workineh, 2005). From my own experience of the study area, the trees on sida are sacred and the other trees around it are also respected for the sake of the spirit associated with the sacred tree.

The sacred groove is represented by 6.25% of the sacred sites encountered in the area and is composed of 21 plant species.

Sacred groves are distributed throughout the world (Africa, Europe, America, Asia, Australia) (Hughes and Chandra, 1997) and contributed to the conservation of biodiversity (Malhotra *et al.*, 2001; Bhagwat *et al*., 2005).

Even though the primary purpose of protecting and maintaining the sacred sites was for their spiritual and cultural importance, they are also crucial in the conservation of biodiversity because of their cultural, biological and ecological integrities. The study on the sacred sites of Bedelle Woreda witnessed the role that the traditional sacred landscapes could play in conservation of plant biodiversity. From the plant species inventory of the sacred forest patches of the woreda, 143 plant species belonging to 122 genera and 62 families were identified and recorded. This shows the role of traditional sacred sites in the conservation of plant biodiversity. Our finding agrees with that of Alemayehu (2010) on monastery forests in north Ethiopia, and Desalegn (2009) on traditional sacred landscapes of Gamo in Southwest highlands of Ethiopia,

Of the total plant species identified and recorded from the sacred forest patches of Bedelle Woreda, 7% are endemic to Ethiopia and are distributed in different habit groups (herbs 50%, trees 30% and shrubs 20%) of the collection. Asteraceae is the richest family in endemic species composition (30%) followed by Fabaceae (20%). This agrees with Vivero *et al*. (2006) in which Asteraceae was reported to be the richest family in the number of endemic taxa. About 9.7% of the plant species known and recorded so far in the Flora of Ethiopia and Eritrea are endemic to the area (Vivero *et al*., 2006). Kumelachew and Simon (2002) showed that the moist montane forests of southwest Ethiopia are poor in tree and shrub species

endemicity compared to the dry afromontane forests of the country. This is in agreement with the findings of our study on the sacred sites of Bedelle Woreda in southwest Ethiopia. The sacred sites help in the conservation of rare and endemic species (Baker, 2004), are used as the last refuge for many threatened, endangered and endemic species of plants and animals (Malhotra *et al.,* 2001). Species like *Milletia ferruginea, Solanecio gigas, Vepris dainellii, Erythrina brucei* and *Lippia adoensis* in the IUCN least concern category and *Phyllantus mooney* in the vulnerable category were encountered from the sacred sites we studied witnessing that the sacred sites are of paramount importance in the conservation of threatened, endangered and rare species of plants and animals

The sacred sites harbor refugees, endemic and threatened plant species and their conservation is critical to avoid the risk of loss of these species. Most of the plant species in the study area have been lost due to land use change and the remaining (particularly the endemic ones) are confined only to the sacred sites. Desalegn (2009), and Schaaaf (2003) also showed the importance of sacred sites in the conservation of endemic and threatened species.

In this study, we also found out that the sacred sites are important in maintaining and safeguarding species diversity. In the diversity analysis,Boqa (Banshure) with species richness of 38 showed the diversity of 3.06 and Boqa (Socho) with species richness of 45 had a species diversity of 2.85. The tree and shrub species richness in Mute sacred site was the least compared to Boqa (Banshure) and Boqa in Socho and it was also the least in species diversity with diversity index of 2.65. Boqa (Banshure) with less species richness compared to Boqa in Socho is more diversified than the later, which is actually composed of more species. Boqa (Banshure) has relatively even distribution of species compared to Mute and Boqa in Socho. A site with high evenness value is composed of species with similar abundances. Boqa (Socho) with relatively least species evenness is more heterogeneous than the other two. The site with more evenness value (Table 4) has more even distribution of species and the one with low evenness value has relatively limited distribution.

The remnant trees on the farm lands between Mute and Boqa (Socho) sacred forest patches witness the continuity of the two patches in the past. The single continuous forest has been broken up into different patches due to agricultural activities and human settlements. That is why the two forest patches have the highest similarity index (61.90%) compared to their similarities with Boqa (Banshure) which is far away from them. This similarity analysis depends on the species presence/absence data and there is no consideration of density or abundance data.

CONCLUSION AND RECOMMENDATIONS

- From the study of Traditional Sacred landscapes in Bedelle Woreda, 143 plant species were identified and recorded. This witnesses the importance of sacred sites in the conservation of plant biodiversity.
- Of the total collection of the plant species (143) in the sacred sites of the woreda, ~7% were found to be endemic to Ethiopia.
- Some of the sacred sites such as Qolo Bashana, Sida Abbalemu and Sida Abbachafe lost their former status and the number of species in each of them has been reduced to single tree.

- Conservation of the Traditional Sacred landscapes in the woreda is of paramount importance in the conservation of plant biodiversity, because the loss of biodiversity has a multidimensional impact on the future of humanity.
- The target of this study was the importance of traditional sacred sites in the conservation of plant biodiversity and it excluded other values of the traditional sacred landscapes. Thus, we recommend further research to address the remaining aspects of the sacred sites as culture, peoples' spirituality and biodiversity are integral parts of each other.

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