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Floristic Composition, Structure and Distribution On Closure Area in Dara woreda, Sidama Zone, Southern Ethiopia

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ABSTRACT

Floristic composition, vegetation structure and distribution on closure area were carried out in Dara woreda Sidama Zone, South Nation Nationalities People Regional state (SNNPR), with the objectives of to investigate floristic composition, structure and distribution and provide information on sustainable management of the vegetation. To determine and record floristic composition, structure and distribution, (20x20x42 quadrates: 1.68ha), from the closure area was used. For the collection of herbaceous species subplots of 2mx2m at the four corners and the centre of the large releve /sample plots/ was laid for each study site. Height and diameter at breast height of all woody species greater or equal to 2 m and 2 cm were measured respectively. We recorded a total of one hundred twenty nine species of plants, representing 106 genera and 55 families were recorded. Out of total plant species, 22% were trees, 39 % shrub, 29% herbs, 7.0 % lianas/climbers, 3 % were ferns. Of the total specie 3 (only 2.3%) species are endemic to Ethiopia. Three community types are described:- Terminalia schimperiana- Protea gaguadi -Dodonaea angustifolia, Syzygium guineense- Comboretum molle-Clutia abssinica, Eucalyptus saligna community type. The general arrangement of all species was found to show high density at lower height and DBH classes. Density of woody species varied considerably among species. The total densities of matured woody plant in the study area were 3287 stem hectare^{-1}, density of sapling 972 stem hectare^{-1} and density of seedling were 508 stem hectare^{-1} . The most species diverse families were Fabaceae represented by 17 species (13.2 %), Rubiaceae by 10 species (7.8%), Asteraceae by 9 species (7.00%), Acanthaceae by 6 species (4.7%), Lamiaceae by 5 species (3.9%), Celastraceae, Combretaceae, Moraceae and Myrtaceae represented by 4 species and the remaining families were represented by one to three species. High dependency of the people on firewood, construction, medicine for human and livestock from the closure area and the lack of fencing and conflict of wild animals and local people are the major problems that could pose series threat to the vegetation of the closure areas .Moreover, excavation of a part of the closed area for road construction and income generation activity by local people that could jeopardize future existence of closure area vegetation .Therefore, to address these problems and enhance the sustainable utilization of the closure area resource the collaboration of government, nongovernmental organizations as well as the local communities is a pillar to conserve vegetation of the study area .

Key Words/ Phrases *Closure area, Composition, Floristic, Structure,*

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INTRODUCTION

Evidences suggest that area closures are becoming promising alternatives to combat desertification and conserve biodiversity in completely degraded lands by facilitating vegetation, succession through modification of both physical and biological site conditions (Ediyo Mieso and Emiru Birhane, 2005). Efforts to control the problem of land degradation have been made at several levels. The main activities have been soil and water conservation works and the establishment of area exclosures (Betru Nedasa *et al*., 2005).

Area closure is one of the strategies of biodiversity conservation, in the Ethiopian context it can be defined as the degraded land that has-been excluded from human and livestock interference for the purpose of rehabilitation (Betru Nedessa *et al*, 2005). The practice of enclosing land in Ethiopia has been traditionally exercised for centuries around church boundaries by restricting the use of forests around only as prestige for the religious sites **(**Tefera Mengistu *et al*., 2005**).**

Since the 1980s, establishment of area closure and plantations on degraded lands that have been used for livestock grazing and or crop production in the past, have been widely practiced. In most part of Ethiopia, the method has been practiced with the general objective of land rehabilitation and replenishing the denuded vegetation as well as satisfying the need for livestock fodder and other tree products (Bendz, 1986; Emiru Birhane, 2002).

There are two major types of area closure practiced in Ethiopia. The most common type involves closing of an area from livestock and people so that natural regeneration of the vegetation can take place. The second option comprises closing off degraded land while simultaneously implementing additional measures such as establishing soil and water harvesting structures to enhance the regeneration process (Betru Nedessa, 2005; WACOT, 2007). In Sidama Zone, Dara Woreda is among the areas affected by profound land degradation and associated consequences (DWARDO, 2009). Therefore this require appropriate technologies such as establishing ecological based vegetation cover and appropriate SWC measures. In this study floristic composition, structure and distribution on closure area were investigated in the study site.

Material and methods

Study Site

Mechisho and Kumato/Kara kenbara/ closure areas are located in Dara woreda, Sidama Zone of South Nation Nationalities People Regional State. Dara woreda is among the 21 woredas in Sidama Zone. Dara woreda is bounded by Aleta Chuko woreda in the North, Aleta Wonedo woreda in the North East, Hulla woreda in the East, Gedeo Zone in the South and Guji zone of Oromiya region in the West and South East. Dara woreda lies approximately between $6^0$35' - $6^0$54' N and 38^0 25' - $38^0$51' E **(**BoFED, 2008**).** Dara woreda covers an area of 27,000 hectare.

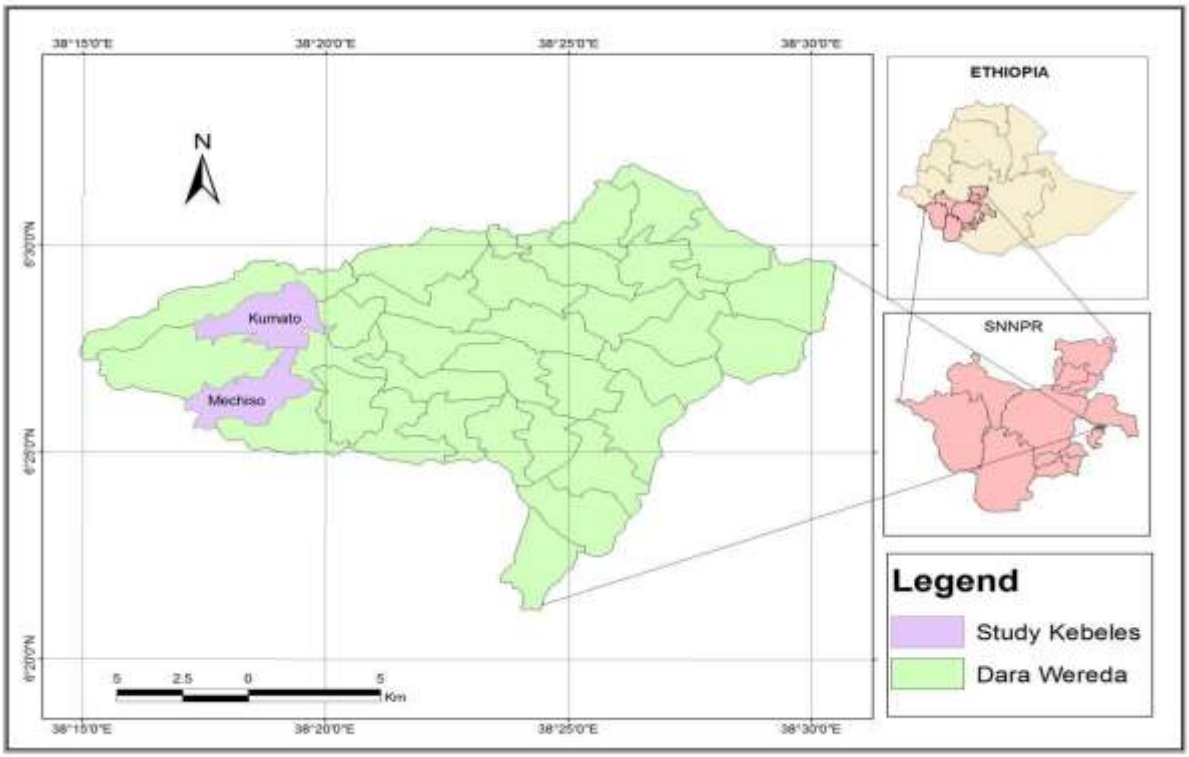

Figure 1: Map of the study area

Mechisho closure area is situated in Dara woreda, Sidama Zone, and South Nation Nationalities people regional state. It is about 87 km south from Hawassa which is the capital of the region and 3km north from Dilla town. The geographic location of the centre of the study area is at 60 26‘ 240‘‘ N latitude and 380 80‘ 952‘‘ E longitudes. Mechisho closure area covers 47.6 ha and was the (9yrs) area closure that is located some 5 kms from Kebado town. The sites have an altitude ranging between 1613 - 1773 m. The altitude of the land is lower towards the western and higher towards the eastern and south eastern parts of the district. The site has been established in 2002 by the district agricultural and rural development office in collaboration with the local population. The land was completely barren due to intensive deforestation prior to delineation as area closure site.

Kumato/kara kenbara/ closure area located at 06028.576‘‘ N latitude and 38019.023‘‘E longitude, with altitudinal range of 1633 to 1712 m.a,s.l .The closure area covers 11.8 ha and was the 5 years compared to the other sites of the age 9 year area closure. The site has been established in 2007 by the district agricultural and rural development office in collaboration with local community **(**DWARDO, 2009). The land was completely barren due to intensive grazing, deforestation and browsing prior to delineation as area closure site. Following soil and water conservation structures (SWC) have been constructed and the area was not completely protected from grazing and human interference.

Population

According to the national population and housing census of Ethiopia in the year 2007, the total number of the population was 155265 of which 76475 male and 78790 were female . The annual population growth rate of the Dara woreda is 2.9% **(**CSA, 2010). Hence, by using the annual growth rate of Dara woreda the projected number of the population in 2011 estimated at 179113, of which 88221 male and 90892 female (SZFEDS, 2011).

Climate

The mean annual rainfall in Dara woreda is about 1527 mm and the rainfall distribution is bimodal. The mean annual temperature is about 12.4 ^{o}c and the mean minimum temperature is 11.4^{o}c. The mean maximum temperature is 25.5 ^{o}c.

Topography

Physiographically, Dara woreda lies in the eastern escarpment of the Ethiopian rift valley system. The elevation is lower (1100m) towards the western and higher (2900m) towards the eastern and southeastern parts of the woreda. The Dara woreda is reach in permanent rivers. Among the various rivers, Lega Dara River in the vicinity of Dilla Town, Bonkoka and Jegesa are the most important rivers. The other streams like Bora, Goshe, Ameje, Mirgo, Darancho, Ula Ula and Loke are also found in the Dara woreda **(**DWARDO, 2009).

Data Collection

Floristic data

Cover/aboundance data was collected from a total area of 42 quadrats (20 m x 20 m) where 32 plots from Mechisho and 10 plots from Kara kenbara closure areas were included. Sample plots were laid using systematic sampling techniques in which three transect line and one transect line was laid in Mechisho and Kara kenbara closure area along East to West direction, respectively by using GPS. The distance between consecutive plots along the transect line was 200 m in and samples plots were placed at 50 m elevation intervals in transects from each other. For the collection of herbaceous species, subplots of 2m x2m at the four corners and the centre of the large sample plot were used. Each individual of the woody species in each plot was counted and recorded.

Voucher specimens were collected for each plant species encountered, numbered, pressed and taken to National Herbarium of Addis Ababa University and Herbarium Ethiopian Biodiversity Institute for identification and final deposit. The Nomenclature followed was that of Hedberg and Edwards (1989), Phillips (1995), Edwards *et al*. (1995, 1997 and 2000), Hedberg *et al*. (2003 and 2006) and Mesfin Tadesse (2004).

Data analysis.

Vegetation data.

In this study, a hierarchical cluster analysis was made by using PC-ORD for windows version 5.0 (McCune and Mefford, 1999; McCune and Grace, 2002) to classify the vegetation into plant community types and EtimateS program used to analyze species richness of the two area closures. The community types distinguished and further identified. The naming of the communities was given after one or three dominant characteristic species.

Structural data.

From all trees and shrubs recorded in the 42 quadrates only species with DBH greater or equal to 2cm and height of trees and shrubs greater or equal to 2m were used in the analysis of vegetation structure .Their density, height, and diameter at breast height and basal area were used for description of the vegetation structure. To analyze the population structure of wood plant species, all individuals of each species encountered in the quadrates were grouped in to arbitrary diameter and height class and histograms were developed using diameter, height class versus density per hectare in each of the classes using Microsoft Excel Computer Software (Mekuria Argaw *et al.*, 1999).

RESULTS AND DISCUSSION

Floristic composition

A total of 129 plant species (ferns, lianas /climber, shrubs, trees and herbs) were and presented in (Appendix 1) . Among these, 79 woody species were recorded in all of the 42 quadrats. The identified species belongs to 106 genera and 55 families. The major families were Fabaceae represented by 17 species (13.2 %), Rubiaceae by 10 species (7.8 %), Asteraceae by 9 species (7 %), and Acanthaceae by 6 species (4.7 %) and Lamiaceae by 5 species (3.9 %).

Shrubs occupied the highest vegetation composition followed by herbs and trees. Trees and shrubs together contributed to 61 % of the vegetation composition (Fig 2) . Three endemic plant species were recorded. The endemic plant account only 2.3% from the total vegetation composition. These endemic plants include Aloe pubescens, Millettia ferruginea and Thunbergia ruspolii.

Figure 2: Distribution of plant species by their habits.

Vegetation Classification

Three community types were obtained from the classification output. Their description based on the dominant and characteristic species and their altitudinal distribution is as follows

***I- Terminalia schimperiana- Protea gaguadi -Dodonaea angustifolia* community type.**

This community type is distributed between the altitudinal ranges of 1666-1776 m.a.s.l. Large numbers of species and releves were associated to the community. It was represented by 91 species and 22 sample plot (0.88 hectare). In the group, there are many species with high indicator value , Moreover with the dominant species used to name the community, *Syzygium guineense, Clutia abssinica, Comboretum molle, Ochna schweinfurthiana, Schrebera alata and Vangueria madagascariensis* among the dominant trees /shrubs in the community. The herb layer is dominated by *Satureja abyssinica, Leucas argentea* and *Hyparrhenia spp*. The common climbers/lianas of this community are *Ampelocissus bombycina* . Also ferns like, *Cheilanthes viridis* and *Pteridium aquilinum* is common to this community *(Fig. 6).* .

II- *Syzygium guineense- Comboretum molle- Clutia abssinica* community type

This community is found between 1732-1778 m a.s.l. It embraces 29 species and 16 sample plot (0.64 ha) .The dominant tree/ shrubs in the community are *Syzygium guineense, Comboretum molle, Clutia abssinica, Apodytes dimidiate, Ochna schweinfurthiana, Celtisafricana, Tagites minuta,`Justica schimperiana, Croton macrostachyus and Psydrax schimperiana* .The herb layer of this community dominated by *Hypoxis villosa, Satureja punctata, Satureja abyssinica, Leucas argentea* and *Hyparrhenia spp*. The common fern of this community are *Pteridium aquilinum and Pleopeltis excavate (Fig. 6).*

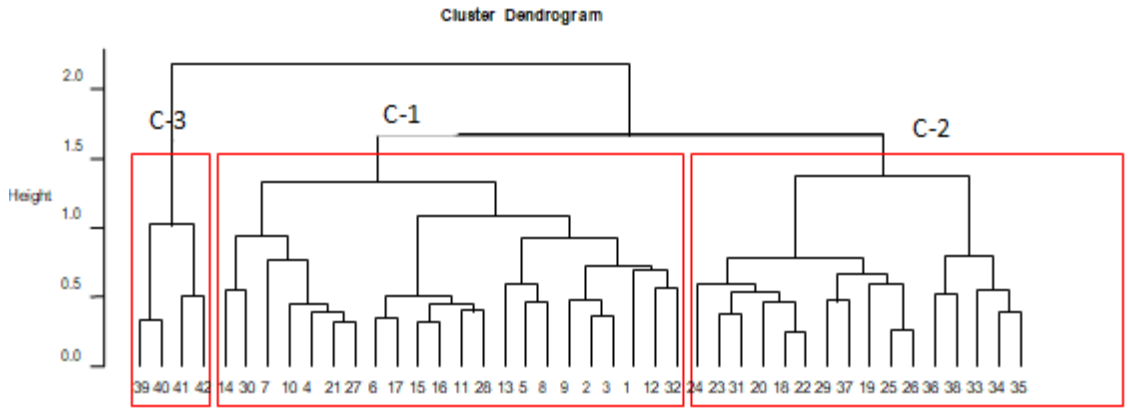

Figure 6: Dendrogram output of the vegetation data obtained from hierarchical cluster analysis

The plot code and arrangement of plot along the dendrogram.

Community 1.(Plot 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,21,27,28,30,32)

Community 2.(Plot 18,19,20,22,23,24,25,26,29,31,33,34,35,36,37,38)

Community 3. (Plot 39 , 40, 41 , 42)

III- *Eucalyptus saligna* community type.

This community is found between 1717 and 1728 m a.s.l. It encompasses relatively the smallest number of sample plot (4 sample plot) and 9 species than the rest community type. This community found at the border of the closure areas. The woody species dominating this community are *Eucalyptus saligna, Eucalyptus camaldulensis*, *Osyris quadripartite*, *Calpurnia aurea*, *Syzygium guineense* and *Clutia abssinica.* The herb layer of the community consisted of *Leucas argentea*, *Hyparrhenia spp*.and *Berkhega spekeana (Fig. 6).*

Comparison of species richness between Mechisho and Kara kenbara Closure Areas

Species accumulation curve plot showing the cumulative number of species recorded as a function of sampling unit, and illustrate the increase in the total number of species encountered during the process of data collection. Species–area curves can be considered as one form of species accumulation curve, in which species richness is related to an increase in the area sampled (Newton, 2007). Due to difference in size of the closure area survey method and objective of the study direct comparison of the species, diversity between closure area of the study area and among other closure area is not rational. However the

overall species richness of the two area closure compared by using species accumulation curve.

Species accumulation curve gives us a way to judge how well the various species richness estimators work. The ideal estimator would be a straight horizontal line (green) in the graph at the level where the species accumulation curve (red) were level off. But to settle down to a steady value as we get more samples: the blue line Sobs (number of species observed in the graph would be fine. When we see separately, in Mechisho closure site the number of species observed in ten sampling unit (quadrates) in the upper green dotted-line with 95% confidence intervals have 77.73 species .Comparatively, in Kara kenbara study site in the same number of sampling unit the number of species in the upper bound with 95% confidence intervals have 41 .44 . Moreover in Mechisho closure area in the lower bound the number of species observed is 56.67 whereas in Kara kenbara 30.56. However, the actual recorded number of species in Mechisho closure area is 65.23 while in Kara kenbara 36 species (fig 2). Therefore, in Mechisho closure area relatively more species found. May this is probably due to disturbances system, microclimatic condition and due to difference in age of closure area the number of species in Kara kenbara closure area reduced.

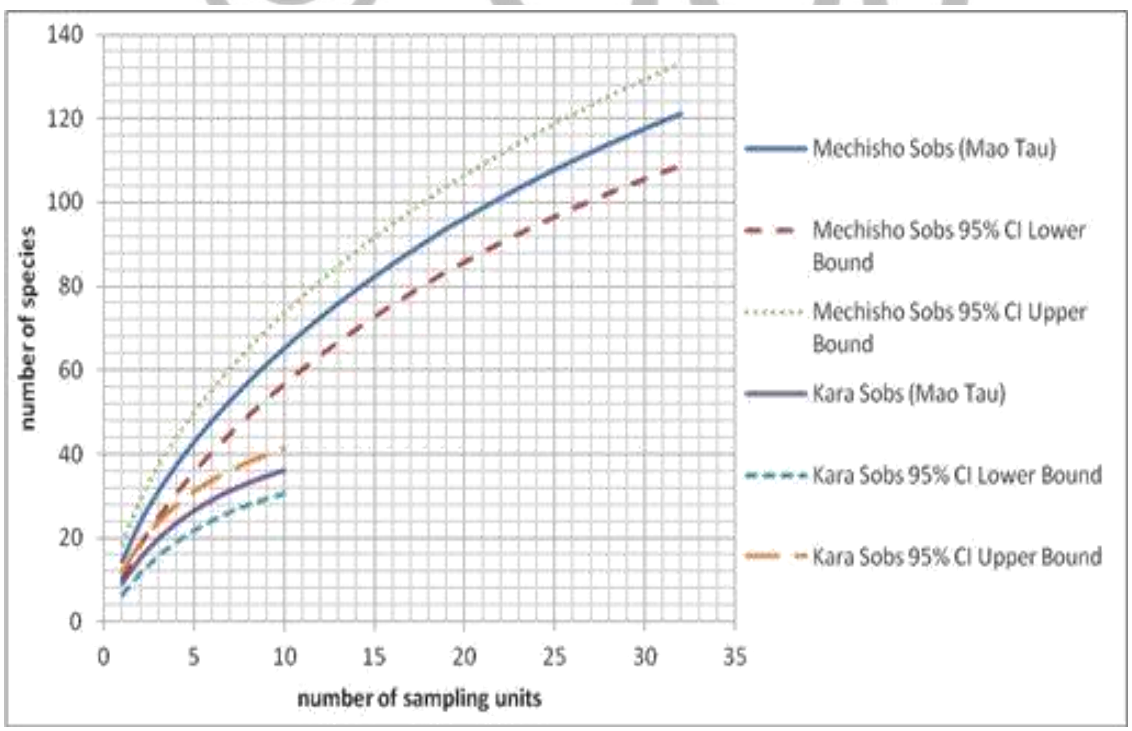

Figure 3. Comparison of species accumulation curves for two area

Density of woody species

For all matured woody species with DBH > 2.0 cm, the mean density of the area closures was 3287 individuals per hectare, mean density of saplings was 972 ha^{-1} and that of the seedling is 508 ha^{-1}. The total overall density of woody plants in the area closures was 4757 ha^{-1} of which the proportion of adult, sapling, and seedling, was 68.9%, 20.4%, and 10.6% respectively. .

Table 1:- Density ha^{-1} for seedling, sapling, and matured/adult/ in the area closure.

Closure area	Matured/Adult	Sapling	Seedling	Total
Mechisho	3211	936	488	4625
Kara kenbara	76	36	20	132
Total	3287	972	508	4767

From the result, it is likely to recommend that the effects of disturbances system, the microclimatic condition difference and age of closure area, in density of seedlings, sapling and adult between the two areas (Mechisho and Kara kenbara closure area) might have resulted. From the pre requisite of favorable environment and low disturbance may in nine year area closures to sustain new regeneration species and the existed ones. Conversely, May in 5 years area closure disturbances system and the microclimatic condition decreased regeneration of woody species and may as age and status of protection increased the chance of regeneration of woody species probably increased.

Height of woody plant

The woody plants in the area closures could be easily divided into four height classes. So, the pattern in the height class in area closures showed in each decreased with an increasing in height classes from height class 1 up to class 4 (Figure 4). The highest number of individual wood plants was found in the height 1, 2 , 3 and 4 average values of 49.2%, 39.1%, 9.3 % and 2.2 % respectively. Woody plants height classes 1 and 2, together make up 88.3 %, while woody plants in the height class 3 &4 contributed 11.2 % in area closures which is the lowest density per ha in study site . More number of individuals per hectare was found in lowest height classes, which contributed to larger proportion 88.3. %. This could suggest that lowest height individuals dominate the closures site. Such patterns commonly referred to as

reverse J-shape distribution showing stable population . Height class distribution of wood plant species (height ≥2m in area closures of the study site. 1= 2-3.99 m, 2=4-5.99m, 3=6.0-7.99 m, 4= ≥8m

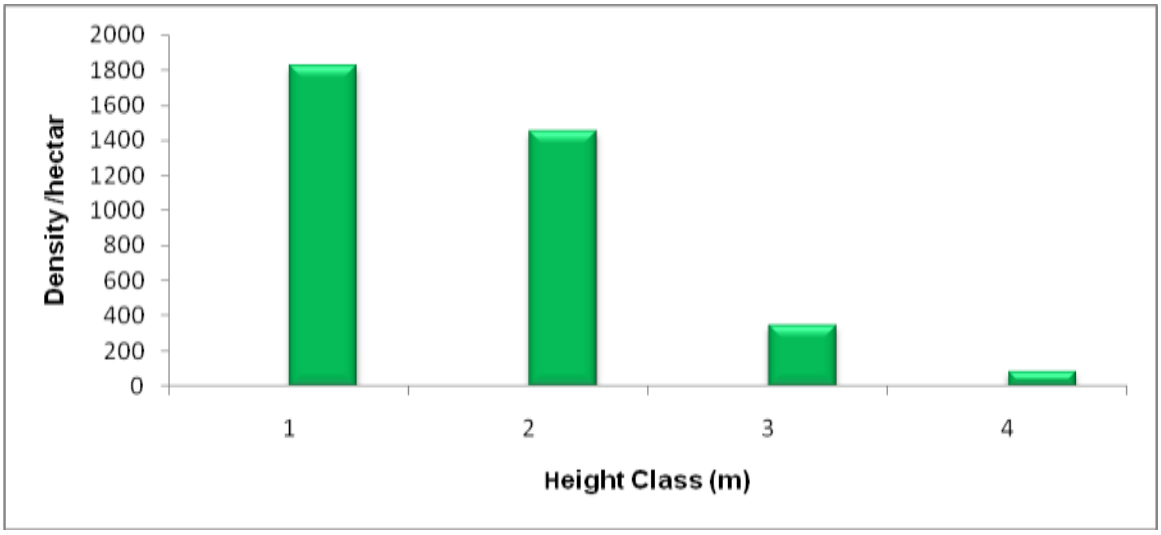

Figure 4: Height class distribution of wood plant species (height ≥2m in area closures . 1= 2-3.99 m, 2=4-5.99m, 3=6.0-7.99 m, 4= ≥8m

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Diameter at Breast Height (DBH)

DBH class distribution of all individuals in different size classes showed a reversed J shape distribution (Figure 5). This is a general pattern of regular population structure where the majority of the species had the highest number of individuals at lower DBH classes with gradual reduction toward high DBH classes. This suggests good reproduction and recruitment potential of woody species. Similar result was reported by Senbeta (2006) and Bekele (1993). However, the number of individual in the higher diameter classes declined considerably suggesting that the closure area vegetation profoundly exploited before the delineation the area as closure area. Of these mature plant species *Syzygium guineense* had 1818 individuals ha^{-1} 55.3% , *Protea gaguadi* 540 ha^{-1} (16.4%), *Dodonaea angustifolia* had 278 individuals ha^{-1}(8.4%), *Terminalia schimperiana* 207 individual ha^{-1} (6.3 %) contributed to the largest proportion of individuals per hectare.

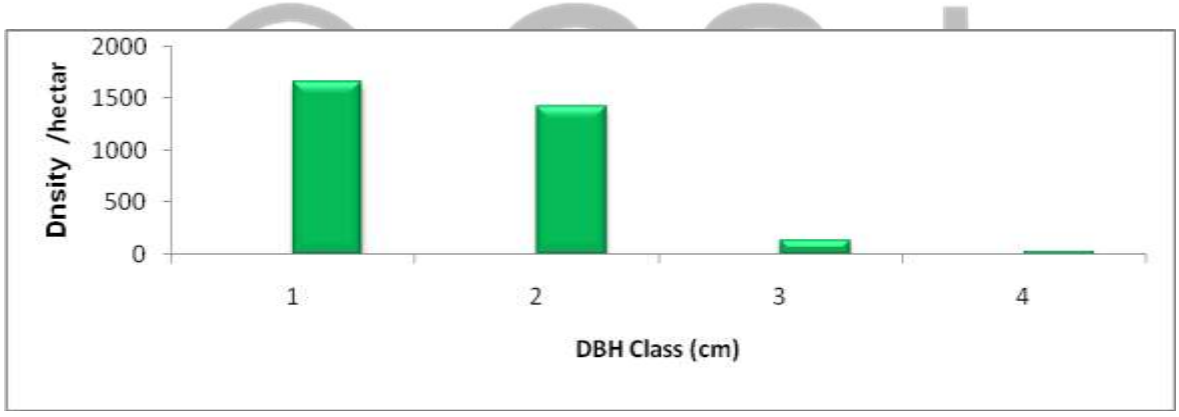

Figure 5: DBH class distribution of woody plant species in the study areas

1=2- 4.99, 2=5 - 7.99, 3= 8- 10.99, 4= $\geq$ 11

Diameter class distribution of selected woody species demonstrated various patterns of population structure, implying different population dynamics among species (Figure 6a-d). The first pattern was an inverted J-shaped distribution exhibited by species with high number of individuals in the first and second DBH classes and with gradual decreases towards higher DBH classes (Figure 6a), which suggested good reproduction and healthy regeneration potential of the species in the forest (Bekele, 1993; Senbeta, 2006). This group is represented by *Syzygium guineense, Dodonaea angustifolia , Terminalia schimperiana*

In the second pattern lowest DBH classes have lower densities followed by an increase in the number of individuals towards the middle classes and then a progressive decrease towards the higher DBH classes which depicted a bell-shaped distribution pattern (Fig. 6b) that indicate a poor reproduction and recruitment potential. The third pattern shows a J-shaped pattern of distribution (Fig.6c). In this pattern, DBH classes were missed from one or more lower DBH classes. Some species under this pattern have big individuals that are less competent to reproduce and hence reveal poor reproduction and weak position of regeneration. The forth pattern is characterized by having large number of individuals in the first lower DBH class and disappearing in the next two or three middle classes and finally increasing with an increase in DBH forming a U-shaped pattern (Fig. 6d) which is due to human intervention.

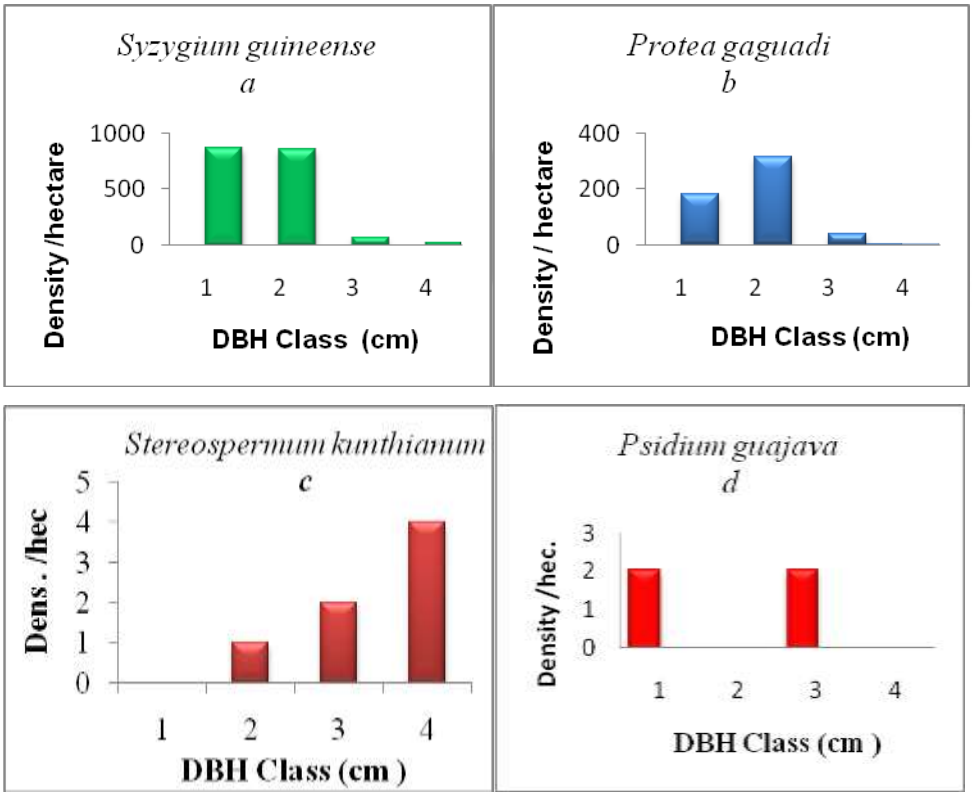

Figure 6 a-d: Four representative's patterns of population structure in the closure site vegetation

Socio-economic importance.

Vegetation restoration incorporates both biophysical and socioeconomic values; that is, ecosystem restoration as well as the changes in human well-being associated with it. It is important to consider the social and economic impacts of forest restoration initiatives, particularly the effects on people living in or near the restored vegetation area. In many developing countries large populations of rural people live near forests and depend on them for subsistence and, sometimes, for commercial purposes. Many of these communities have had a close and long-standing association with the forests; until relatively recently; resource management in more remote regions was left largely in their hands (David L. and Don G., 2003).

Ecological Benefit

According to the information from group discussion and individual's interview, the major ecological benefit that people of the study area obtained from the closure area were rejuvenation of different vegetation, re-occurrence of different wild animals, gully stabilization and wind break against the strong wind and amount of rain, river and spring water increase and not dry up season to season. About 76% (46) of the informants pointed out that the temperature, the amount of moisture (rain fall) patterns, soil rejuvenation of the vegetation in the area closure. It is also interesting to see that the informants were aware of the relationship between vegetation and climatic change.

Economic Benefit

Significant information from the group discussion mainly emphasized that due to the closure of the area and rehabilitation of the vegetation, they could able to get food from wild edible fruits (Syzygium guineense, Carissa spinarum and Psidium guajava), and grasses (Hyparrhenia spp.)for construction of house roofing and feeding of livestock in dry season. Also some plant used as medicine for different disease for instance Satureja abyssinica medicine for head ache, Ajuga remota medicine for abdominal disease of human being etc.

Even from the neibouring woreda (Yirgalem and Aleta Chuko) People buy these medicinal plant from the local people illegally, that means without the permission of the woreda agricultural office. These 51.7% of the informants pointed out that due to delineation of the closure area acquired economical benefit.

Social Benefit

The results of interview made with local community showed that 25 % (15 respondents) were agreed on the benefit from the closure area, which includes ritual and cultural value and around the closure area celebrate different holiday.

The use categories obtained from the response include, construction, food, forage, firewood, medicinal, shade, and gully stabilization. The highest proportions of closure area plants were used for firewood (71.70%), medicine for human (68.3%), construction (60%), and forage (55%) shade (50%), food for human (45%), gully stabilization (38.3%) and medicine for domestic animals (26.7%) . According to the response of the respondents closure area vegetation like, *Terminalia schimperiana ,Protea gaguadi and Comboretum molle* used for construction and fire wood, *Stereospermum kunthianum and Dodonaea angustifolia* commonly used for tooth brush, *Satureja punctata, Satureja abyssinica, Ajuga remota* used as medicine for human being, *Asparagus africanus and Dodonaea angustifolia* used as medicine for domestic animals , fruit of *Syzygium guineense, Carissa spinarum and Psidium guajava* used commonly for food during fruiting season and even a means of income by put up for sale the fruit.

Key problems and recommended solutions

In spite of the fact that enclosure of the area has many importance's there are also some problems coupled with it . According to the participants, the current system is too weak to effectively prevent illegal harvesters, as result, there is no equal benefit sharing among the community members. Beside this, low incentive packages for guards, weak rules, lack of fencing , conflict of wild animals and local people, ineffective monitoring are mentioned as major challenges that have been barrier to fully benefit from the enclosures in the area. As the villagers in Mechisho village are incurring losses due to attacks by wildlife on their crops. According to the informants wild edible tubers or Boina (*Dioscoria sp*.), Wase (*Ensete ventricosum*) and Badala (*Zea mays*) extremely damaged by wild animals, due to the cost of damages caused by wildlife to their crops and property local community has negative attitude to the a rea closure .

Lack of fencing of the closure area

According to the group discussion held with informants, fencing of the closure area has been a means of protection of their crops damage from the wild animals, however still no one give solution for the problem even the Woreda Agricultural and Rural Development Offices not take solution for the problem. As it is pointed by 95% of the informants, both the death of wild animals by local community, and damages being caused by wild animals on crop reduce if the fencing is built .Moreover, fencing can protect the farmer's livestock from entering to the closure area.

Plate 1 a, b**.** Threat to Mechisho closure area through excavation.

Conflicts of wild animals of the closure area and the local community.

Yet the majority of the respondents agreed on the positive benefit of the closure area, in the aspects of ecological, economical, social and as well as aesthetic and cultural value. But they worried that their crops are repeatedly damaged and eaten by wild animals particularly by porcupines and Pigs. On the other hand, Hyenas are also smashed their crops. According to informants group discussion, defending their cattle and crops from wild animals become difficult. As it is indicated in 100% all the informants recommended that, the construction of the fence would radically reduce these negative impacts and mitigating their damage on crops

Conclusion and recommendations

In this study, the closure areas had a floristic richness of 129 plant species (ferns, lianas /climber, shrubs, trees and herbs) with 106 genera and 55 families. The collected species were composed of 22 % trees, 39% shrub, 29 % herbs, 7.0 % lianas/climbers, and 3 % ferns. This implies that the closure areas comprise a diversified plant species. From this one can conclude that if the closure area is sustainable used, it could be a good source of vegetation resources. Result from the study indicate that the closure area had species diversity belonging to Fabaceae with the dominant families and followed by Rubiaceae ,Asteraceae, and Acanthaceae ,Lamiaceae ,Celastraceae, Combretaceae, Moraceae and Myrtaceae .

Based on structural description height and DBH class distribution the closure area vegetation dominated by small sized tree and shrub species in secondary stage of development, this indicating that the closure area vegetation was heavily exploited and affected in the previous periods, but good regeneration is in process at the present time. The density of woody plant species in the closure area decreases with increasing DBH and Height class which implied the dominance of small sized in the lower class. As compared to Kara kenbara closure area, Mechisho closure area reveal high species richness this is probably due to, microclimate, degree of interference and disparity in age of closure area. On the other hand, woody species were substantially richer in Mechisho enclosures than in Kara kenbara areas, indicating the importance of enclosures for the conservation of biological diversity and increment of woody species as age of enclosure increase.

Due to the delineation of the area closure the local people gain highest ecological, followed by economical and social benefit. However, lack of fencing and conflict of wild animals and local people is the main problem that results negative attitude toward the closure area in local people.

Therefore, to improve the natural diversity and structure of the vegetation, minimize the influence of the surrounding communities and utilize the closure area vegetation resources sustainably for present and future generation. The much-needed positive attitudes towards

vegetation protection and development can only be obtained from the rural communities through the development of a legitimate benefit sharing mechanism. Thus community participation is quite important .In order to increase productivity of the closures, practices such as introduction of adequate forage plantations and beekeeping is necessary, total exclusion of the exclosures may not be advantageous.

Recommendations

Our result of this study can contribute towards our understanding of the pattern of floristic composition, structure and distribution which is considerably importance in its conservation. Based on the results of the study, the following recommendations were drawn. To conserve the biodiversity of the area detailed ecological and botanical studies are vital concerning the species composition, diversity and distribution of plant species.

Some areas of the vegetation that are relatively undisturbed can be designated for strict conservation so that they may act as repositories of biodiversity and possibly as a source of forest genetic resources. Other exploited parts by local communities can sustainably be used by developing appropriate vegetation management plan. Enhanced conservation education, public awareness by establishing school, eco-clubs and build their capacities, and organize experience sharing.

One of the serious threats to the vegetation of closure area (Dara woreda) is the excavation of a part of closure area for road construction, lack of fencing and conflict of wild animals and local people being carried out in the area. There is an urgent need for an open discussion between the communities, political and administrative bodies to come up with concrete alternative plan that would help the people without demolished all the closure area again.

The present study is limited to species composition, structure and distribution then further studies on, environmental parameters, vegetation management and conservation system, and regeneration of the woody species is recommended. Detailed ethno botanical studies are also required to explore the wealth of indigenous knowledge on the diverse uses of plant and their implication in conservation.

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APPENDIX 1:-List of species recorded in study areas.

No	***Species***	***Family***	***Local name (Sidama)***	*Habit*
1	*Acacia pentagona (Schumach) Hook,f.*	*Fabaceae*	*Harangama*	*Climber*
2	*Acokanthera schimperi (A.DC.) Schweinf*	*Apocynaceae*	*Kararecho*	*Tree*
3	*Ajuga remota Benth*	*Lamiaceae*	*Alamura*	*Herb*
4	*Albizia schimperiana Oliv.*	*Fabaceae*	*Matecho*	*Tree*
5	*Albizia grandebracteata Taub*	*Fabaceae*		*Tree*
6	*Aloe pubescens Reynolods*	*Aloaceae*	*Arigessa/Eret*	*Herb*
7	*Ampelocissus bombycina (Bak.) Planch*	*Vitaceae*	*Choa*	*Climber*
8	*Apodytes dimidiate E.Mey.ex.Arn.*	*Icacinaceae*	*Garbicho*	*Shrub*
9	*Asparagus africanus Lam*	*Asparagaceae*	*Lalu xagicho*	*Shrub*
10	*Asystasia decipiens Heine*	*Acanthaceae*		*Herb*
11	*Asystasia gangetica (L.) T. Anders*	*Acanthaceae*		*Herb*
12	*Asystasia riparia Lindau*	*Acanthaceae*		*Herb*
13	*Berkhega spekeana Oliv*	*Asteraceae*	*Kosoricho*	*Herb*
14	*Bersama abyssinica Fresen.*	*Melianthaceae*	*Teberako*	*Shrub*
15	*Calpurnia aurea (Ait) Benth*	*Fabaceae*	*Chenkata*	*Tree*
16	*Capparis tomentosa Lam.*	*Capparidiaceae*		*Shrub*
17	*Carissa spinarum (Forsk)*	*Apocynaceae*	*Otilicho*	*Shrub*
18	*Celtis africana Burm.f.*	*Ulmaceae*	*Shisho*	*Tree*
19	*Cheilanthes viridis*	*Sinopteridaceae*	*Kokosso*	*Fern*
20	*Clutia abssinica Jaub*	*Euphorbiaceae*	*Mundimosha*	*Shrub*
21	*Coffea arabica L.*	*Rubiaceae*	*Buna*	*Shrub*
22	*Comboretum molle C.Dom*	*Combertaceae*	*Rukessa*	*Tree*
23	*Combretum collinum Fresen.*	*Combertaceae*	*Dhadale*	*Tree*
24	*Combretum sp.*	*Combretaceae*		*Shrub*
25	*Conyza hochhstetter Sch.Bip.ex.A.Rich*	*Asteraceae*	*Haiso*	*Herb*
26	*Crotalaria embarginella Vatke*	*Fabaceae*		*Herb*

27	*Croton macrostachyus Del.*	*Euphorbiaceae*	*Masina*	*Tree*
28	*Deschhampsia flexuosa (l.)Trin*	*Poaceae*	*Shakote*	*Herb*
29	*Desmodium repandum (Vahl.) Dc*	*Fabaceae*		*Shrub*
30	*Dichrostachys cinerea (L.) Wight. And Arn.*	*Fabaceae*		*Shrub*
31	*Diospyros abysinica (Hiern) White.*	*Ebenaceae*	*Loko*	*Tree*
32	*Dodonaea angustifolia L.f*	*Sapindaceae*	*Itancha*	*Shrub*
33	*Dovyalis abyssinica (A.Rich)Warb*	*Flacourtiaceae*		*Shrub*
34	*Ehretia cymosa Thonn.*	*Boraginaceae*	*Gidincho*	*Shrub*
35	*Eriosema jurionianum (Staner & De Craene)*	*Fabaceae*	*	*Herb*
36	*Eucalyptus camaldulensis Dehnn.*	*Myrtaceae*	*Mirte zere*	*Tree*
37	*Eucalyptus saligna Sm.*	*Myrtaceae*	*Yabesha zafe*	*Tree*
38	*Euclea racemosa Murr*	*Ebenaceae*	*Miessa*	*Shrub*
39	*Eulophia streptopetal Linal*	*Orchidaceae*		*Herb*
40	*Faurea rochetiana (A. Rich.)*	*Proteaceae*	*Danshicho*	*Tree*
41	*Ficus ovataVahl*	*Moraceae*	*Bula Odako*	*Tree*
42	*Ficus sycomorous L.*	*Moraceae*	*Odako*	*Tree*
43	*Ficus thonningii Blume*	*Moraceae*	*Takaressa*	*Tree*
44	*Ficus vasta Forssk*	*Moraceae*	*Kilito*	*Tree*
45	*Garcinia livingstonei T. Anders*	*Rhizophoraceae*	*Shilo*	*Tree*
46	*Gardenia ternifolia Schumach.and Thonn*	*Rubiaceae*	*Gambella*	*Shrub*
47	*Gnidia glauca Fresen.*	*Thymeliaceae*	*Mirida*	*Shrub*
48	*Heteromorpha trifoliata (Wendel.) Eckl. and Zeyh*	*Apiaceae*		*Shrub*
49	*Hyparrhenia sp.*	*Poaceae*	*Buyo*	*Herb*
50	*Hypericum quartinianum A.Rich.*	*Hypericaceae*		*Shrub*
51	*Nj Hypoxis villosa L.F.Cou.*	*Hypoxidaceae*	*Haiso*	*Herb*
52	*Indigofera atriceps (Hook.f)*	*Fabaceae*	*Balisha*	*Herb*
53	*Ipomea sp.*	*Convolvulaceae*	*Gereramo*	*Climber*
54	*Jacaranda mimosifolia D. Do*	*Bignoniaceae*	*Yetemengazafe*	*Tree*

55	*Jasminium abyssinicum Hochst. ex DC.*	*Oleaceae*	*Torishcho*	*Climber*
56	*Justicaschimperiana(Hochst.exNees) T. Anders*	*Acanthaceae*	*Mekicho/Meke*	*Shrub*
57	*Kalanchoe spp.*	*Crassulaceae*	*Chologa*	*Herb*
58	*Kotschya rvifolia (Taub) F. White*	*Fabaceae*		*Herb*
59	*Laggeracrisputa(Vahl.)Hepper.and Wood*	*Asteraceae*	*Haiso*	*Herb*
60	*Laggera pterodonta (DC.)*	*Astraceae*	*Worancha*	*Herb*
61	*Lanneaschimperi(Hochst. ex A. Rich.)Engl*	*Anacardaceae*	*Handarako*	*Tree*
62	*Lantana camara L.*	*Verbenaceae*	*Woshahanasho*	*Herb*
63	*Leucas argentea Gurke*	*Lamiaceae*	*Bulancho*	*Herb*
64	*Macaranga capensis(Baill.) Sim*	*Euphorbiaaceae*		*Shrub*
65	*Maesa lanceolata Forsk*	*Myrsinaceae*	*Gobacho*	*Tree*
66	*Maytenus sp.*	*Celastraceae*		*Shrub*
67	*Maytenus arbutifolia (Hochst .ex. A.Rich) Wilczex.*	*Celastraceae*		*Shrub*
68	*Maytenus undata(Thunb.) Blakelock*	*Celastraceae*	*Chcho*	*Shrub*
70	*Miletia ferruginea (Hochst) Baker*	*Fabaceae*		*Shrub*
71	*Mussaenda arcuata Poir*	*Rubiaceae*		*Climber*
72	*Myrsine africana L.*	*Myrsinaceae*		*Shrub*
73	*Ochna schweinfurthiana F.Hoyprn*	*Ochnaceae*	*Bula chucho*	*Shrub*
74	*Olea africana Mill.*	*Oleaceae*	*Ijersa*	*Shrub*
75	*Osyris quadripartite Dech*	*Santalaceae*	*Karicho*	*Shrub*
76	*Passiflora edulis Sims*	*Pasiforiaceae*	*Hopa*	*Shrub*
77	*Paullinia pinnata L.*	*Sapindaceae*		*Climber*
78	*Pavetta gardeniifolia A. Rich*	*Rubiaceae*		*Shrub*
79	*Maytenus?senegalensis Sebsebe*	*Celastaceae*		*Shrub*
79	*Pavetta abyssinica Fresen*	*Rubiaceae*		*Shrub*
80	*Pavetta crassipes K.Schum*	*Rubiaceae*		*Shrub*
81	*Pavetta oliveriana Hiern*	*Rubiaceae*		*Shrub*

82	*Pavoniaprocumbens(Wight. And Arn) Walp*	*Malvaceae*	*Gancho*	*Tree*
83	*Pellaea calomelanos (SW.)*	*Sinopteridacea*	*Kokosso*	*Fern*
84	*Phyllanthus ovalifolius Forssk*	*Euphorbiaceae*	*Garambicho*	*Shrub*
85	*Pleopeltis excavate (Willd.) Sledge*	*Polypodiaceae*		*Fern*
86	*Podocarpusfalcutus(Thunb.) R.B.ex Mirb.*	*Podocarpaceae*	*Dagucho*	*Tree*
87	*Polyscias fulva (Hiern) Harms*	*Araliaceae*	*Kobircho*	*Tree*
88	*Premna schimperi Engl.*	*Lamiaceae*	*Udo*	*Herb*
89	*Protea gaguadi J.F Gmel*	*Proteaceae*	*Danshicho*	*Tree*
90	*Pseudarthiaconfertiflora(A.Rich) Balk*	*Fabaceae*	*Hanga besha*	*Shrub*
91	*Pseudognaphalium Oligandrum (DC)*	*Asteraceae*		*Herb*
92	*Psidium guajava L.*	*Myrtaceae*	*Zeitone*	*Shrub*
93	*Psydrax schimperiana A. Rich*	*Rubiaceae*	*Galicha/chikio*	*Shrub*
94	*Pteridium aquilinum L.*	*Dennstaedtiacee*	*Kokosso*	*Fern*
95	*Rhamnus staddo A. Rich*	*Fabaceae*	*Tado*	*Shrub*
96	*Rhus ruspollii Engl.*	*Anacardiaceae*	*Shisha*	*Shrub*
97	*Rhus vulgaris Meikle*	*Anacardiaceae*		*Herb*
98	*Rhynchosia schimperi Hochst.ex.Boiss*	*Fabaceae*		*Herb*
99	*Rubs apetalus Poir*	*Rosaceae*		*Climber*
100	*Ruellia patula Jacq*	*Acanthaceae*		*Herb*
101	*Sansevieria sp.*	*Agavaceae*	*Alga*	*Herb*
102	*Satureja punctata (Benth.) Briq.*	*Lamiaceae*	*Hamessa*	*Herb*
103	*Satureja abyssinica (Benth.) Briq*	*Lamiaceae*	*Umu xagicho*	*Herb*
104	*Scabiosa columbaria L.*	*Dipscacaceae*	*Inshikilo*	*Herb*
105	*Schizostephhanus alatus K.schum*	*Asclepiadaceae*	*Madhecho*	*Climber*
106	*Schrebera alata (Hochst.) Welw*	*Oleaceae*	*Dhamae*	*Tree*
107	*Senna occidentalis (L.) Link*	*Fabaceae*	*Woshecho/Sade*	*Shrub*
108	*Sida alba L.*	*Malvaceae*	*Ifaticho*	*Herb*
109	*Sida rhombifolia L.*	*Malvaceae*	*Kereketicho*	*Herb*
110	*Spermacoce sphaerostigma B244*	*Rubiaceae*	*Haiso*	*Herb*

111	*Stereospermum kunthianum Cham.*	*Bignoniaceae*	*Hare*	*Tree*
112	*Syzygium guineense (wild.) DC.*	*Myrtaceae*	*Goticho*	*Tree*
113	*Tagites minuta L.*	*Astraceae*	*Bowagnamo*	*Shrub*
114	*Teclea simplicifolia (Engl.) Verdoom*	*Rutaceae*		*Shrub*
115	*Tephrosia elata Deflers*	*Fabaceae*		*Herb*
116	*Tephrosia sp.*	*Fabaceae*		*Herb*
117	*Terminalia schimperiana Hochst*	*Combertaceae*	*Debeka*	*Tree*
118	*Thunbergia ruspol Lindau*	*Acanthaceae*		*Herb*
119	*Toddalia asiatic (L.) Lam.*	*Rutaceae*		*Shrub*
120	*Trema orientalis (L.) Bl.*	*Ulmaceae*	*Loloka*	*Shrub*
121	*Triumfetta tomentosa Boj*	*Tiliaceae*	*Fokoncho*	*Herb*
122	*Uvaria angolensis Oliv.*	*Annonaceae*	*Yaa*	*Shrub*
123	*Uvaria schweinfurthii Engl. and Diels*	*Annonaceae*	*Yawalo*	*Shrub*
124	*Vangueria madagascariensis Gmel*	*Rubiaceae*	*Burure*	*Shrub*
125	*Vernonia auriculifera Hiern.*	*Asteraceae*	*Rejecho*	*Shrub*
126	*Vernonia amygdalina Del*	*Asteraceae*	*Hecho*	*Shrub*
127	*Vernonia thomsoniana Oliva. and Hiern*	*Asteraceae*	*Sheshako*	*Shrub*
128	*Watheria indica L.*	*Sterculiaceae*		*Herb*
129	*Ximenia americanta L.*	*Olacaceae*	*	*Shrub*