Addis Ababa University
School of Graduate Studies

A Study on the Ecology and Management of the Dess'a Forest in the North Eastern Escarpment of Ethiopia.

Gebremedhin Hadera

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Abstract

This study aims to investigate the potentials and limitations of involving local communities in biodiversity conservation and to propose appropriate development strategies for harnessing such potentials in the Dess'a Forest, Eastern Tigray, North Eastern escarpment of Ethiopia.

The Dessa Forest has a high degree of species diversity and endemism that is threatened by increasing human pressure. Conceptually, the research was based on the appreciation of the existence of varying value systems of the local communities in relation to the forest resources.

The study further examine the regeneration, and forest structure to obtain information on forest status and to see factors governing the ecology of the forest. Data on the vegetation structure were collected from 59 randomly selected sample plots located at 50 meters altitudinal intervals, ranging from 1500 to 2850 meters above sea level.

In the sample plots of the study area 82 species belonging to 33 families were identified. Relative density, Relative frequency, Relative basal area and importance value Index were calculated for each species which showed the overall forest situation.

The Importance Value Index (IVI) was analyzed along altitudinal gradient of which five dominant species were identified. These dominant species were Olea *europaea, Juniperus procera, Rhus natalensis, Maytenus arbutifolia and Tarconanthus camphoratus.*

It was found that in most cases *Olea europaea* sub sp. *cuspidata* was the highest contributor to the relative basal area of the forest area.

The general configuration of all species was found to have high density at lower Diameter at Breast Height (Dbh) classes and low density at higher Dbh classes. Shrub and less quality woody species were dominant in the smaller Dbh classes. Horizontal distribution of the species revealed that the number of species increase with the increase in altitude.

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List of Acronyms

MOA : Ministry Of Agriculture.

FTP : Forest, Trees and People.

EFAP : Ethiopian Forestry Action Programme.

IUCN : International Union for the Conservation of Nature and Natural Resources.

EPA : Environmental Protection Authority.

FAO : Food and Agriculture Organization of the United Nations.

TFAP : Tigray Forestry Action Programme.

UNEP : United Nation Environmental Programme.

JICA : Japanese International Cooperation.

JCRAF: International Center for Research in Agroforestry.

SFCDD: State Forests Conservation and Development Department.

NCS : National Conservation Strategy.

IFS : International Foundation for Sciences.

IUFRO: International Union of Forestry Research Organization.

UNDP : United Nations Development Programme.

ECA : Economic Commission for Africa.

HTS : Hunting Technical Services.

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1. Introduction

1.1. Background and statement of the problem

Communities everywhere in the world have developed knowledge and found ways to derive livelihoods from the biological diversity, in wild and domesticated forms. Hunting and gathering communities use thousands of plants and animals for food, medicine and shelter. This deep and sophisticated ecological knowledge has given rise to cultural rules for conservation (Shiva, 1990).

However, the relationship between humans and the landscapes that surround them is often viewed as being antagonistic suggesting that habitats have to be protected against human mismanagement and overuse (Richard and Little, 1994). Today, the diversity of ecosystems, and ways of life of different communities is under threat of extinction. Habitats have been enclosed or degraded, diversity has been eroded and livelihoods derived from biodiversity are threatened (Shiva, 1990).

According to Melaku Worede (1990), the prime cause for the reduction of bio-diversity in areas under cultivation is the technological and economic push to replace diversity with homogeneity in forestry, agriculture and animal husbandry. For example forestry development schemes introduce monoculture of industrial species like eucalyptus and push into extinction the diversity of local species which fulfill local needs (IUFRO, 1995; ICRAF, 1988).

Kessler (1993), on the other hand ignores the above mentioned primary causes and instead focuses on causes such as conversion of forest areas for agricultural lands, demands for fuelwood, construction material and fodder. EFAP (1994), also supports the idea that destruction of biodiversity is driven by the demand for cropping and grazing land for subsistence of the growing population.

These demands, coupled with that for fuelwood, are responsible for the loss of forests, woodlands and bushlands. However, according to Shiva (1990) and FTP(1995), stable communities, in harmony with their ecosystem, always protect bio-diversity. It is only when populations are displaced by dams, mines, factories, and commercial agriculture that their relationship with bio-diversity becomes antagonistic rather than co-operative. The displacement of people and displacement of diversity goes hand in hand and displaces people further destroying bio-diversity (EFAP, 1994).

Historical sources in Ethiopia indicate that on the basis of potential climatic climax some 40% of Ethiopia's land area to have been originally covered by closed forest (EFAP,1994). If the Savannah woodlands are included, 66% of the country is believed to have been covered with woodland forest (Brietenbach, 1963). Especially during the last century, Ethiopia's forests and woodlands have been declining both in size and composition. By the early 1950, high forests were reduced to 16% of the total land area. It has been estimated that by the early 1980s the land area covered by forest had declined to 3.6% and by 1989 to about 2.7% (IUCN, 1990; EFAP 1994; EPA, 1997). This enormous reduction in forest cover of the country has led to a marked increase in degraded shrub vegetation

and overall bio-diversity erosion (FAO, 1985). The transformation is most advanced in the northern highlands of Ethiopia where the population has been concentrated for many centuries (EFAP, 1994; TFAP, 1997,). Recently, environmental degradation, particularly depletion of bio-diversity and degradation of natural forest cover has reached a serious stage (UNEP, 1995). Efforts to conserve the remaining natural forest and rehabilitate and combat environmental degradation have been in progress during the past few decades (EFAP, 1994). However, the problem is still far from being resolved due to the failure in realizing the importance of direct involvement of local people in planning, monitoring, evaluation and implementation process of the forest resource management (JICA, 1997). Lack of appropriate forest and land tenure policies and restriction of forest development responsibilities to the government alone have greatly hampered the forest conservation and expansion in the past three decades (IUCN, 1994).

Biodiversity Conservation by Government bodies has a shorter history in Ethiopia. But it is clear that a number of communities had traditional resource management practices including some elements of biodiversity conservation (EFAP, 1994). However, there seems to be little systematic documentation of such practices.

To conserve the remaining natural forests of Ethiopia and the environment for the genetic resources and raw material for the industries, 58 National Forest Priority Areas (NFPA'S) covering an area of 3.6 million hectares have been

selected (SFCDD, 1990). However, the study carried out by the Ministry of Water Resource for the Abbay River Basin Master Plan Project in 1966 indicated that

protection of these NFPAs was not to have been effective. The NFPA's failed to fully recognize the historical and customary rights and interests of local communities in forest products and forest lands. Past planning efforts have been hampered by the non-inclusion of local communities and their leaders (JICA,1997). Local communities frequently disregarded the boundaries established by the forestry sector on the grounds that these boundaries violated their traditional access to and dependence on the forest. Management plans of the government are perceived by local communities as the state's attempt to assert claims and rights which do not acknowledge the interest and rights of the local people.

On the other hand, on examining customary rules and practices related to forest conservation and management, a study carried out by UNDP/ ECA, (1997) in Dibate woreda in Metekel zone (Benishangul-Gumuz Region) indicated that local people set aside natural bamboo stands for particular purposes. Farmers developed rules and regulations governing the use of these bamboo resource, and local people agreed on societal norms in relation to the management and utilization of these bamboo resources. Despite the fact that the area has been deforested due to settlement during the past two decades, these bamboo patches have still survived. Similar indigenous forest management approaches have been observed elsewhere in some parts of Ethiopia (NCS, 1990).

One of the arguments is that although traditional management approaches could contribute substantially to designing current forest management approaches for the country, too little attention is given to indigenous knowledge management systems by existing forest departments, because policies are derived only from

formal forestry approaches (Kessy, 1998). Hence, confrontation and conflict is likely to be the worst in countries such as Ethiopia where environmental problems have been associated with population growth, adverse economic trends and subsistence agriculture. The failure of the forestry sector to review its forest policies and accommodate new conservation approaches, such as participatory forest management has contributed much to the problem of forest destruction.

The management of woody plants such as trees and shrubs has been based on experience and tradition since time immemorial. Limitations to further promote these practices and problems related to desertification, caused by inappropriate land use and escalating pressure on the carrying capacity of natural resources have only occurred in the second half of this century (Maydell, 1990).

Much of the eastern escarpment including Dess'a Forest was originally covered by fairly dense forest but the activities of man and his animals over the past few decades have affected the composition of the natural vegetation. Increased pressure on the land in recent years has resulted in continued degradation even of the secondary communities (TFAP, 1997). This will further cause the removal of original floristic components, destruction of natural regeneration of woody plant species and overgrazing which will in turn cause soil erosion.

Tree species composition and diversity depend on factors such as density and diversity of trees in the original vegetation, the attitude of people toward conservation of trees, agricultural practices and proper management of livestock (Pullan, 1974). Maydell (1990), suggested that heterogeneity and diversity are the preconditions for environmental stability and for sustainable multipurpose

management. A range of vegetation parameters are generally investigated to understand forest management issues. These parameters may include species diversity, density, size distribution of trees and dominance. Such information confers important implications and may indicate the availability of forest products and level of degradation or status of standing stock.

The problem of biodiversity conservation and forest vegetation management in the last remaining natural dry forest of the north eastern escarpment is a complex one. It is complex because of the diversity of interest of the stakeholders and the disturbances of ecological processes.

It was questionable whether the values and perceptions of the key local stakeholders are consistent with the government conservation efforts and management objectives. Antagonisms are growing nowdays between government conservation policies and the local people. Recommendations of the IFS/IUFRO workshop (1995), on strengthening community participation in planning and management of dryland forestry is thus, the basic consideration in this research would be to try and understand the local people-forest nexus.

To understand the people - forest interaction vegetational parameters such as species composition, diversity, regeneration potential, vegetation structure and conservation methods in use by the local community need to be recorded in order to have some base line data that may help to give some suggestions about the restoration, resilience level and rational utilization of the Dess'a Forest, which is the last remaining natural dry montane evergreen forest in the area.

1.2. Objectives of the study

1.2.1. General Objective

To Investigate the people-forest interaction and propose appropriate Management strategy.

1.2.2. Specific Objectives

- To document the indigenous forest management practices and investigate what the local people consider their future relationship with the forest ought to be.
- To investigate the perceptions of different groups of the community concerning biodiversity and its value to the local people.
- To identiify the most important tree/shrub species
- To assess the structure and regeneration pattern of the forest vegetation.
- To identify the species diversity at different elevations of the study area.
- To identify the major activities that contribute to the forest degradation

1.3. Description of the study area

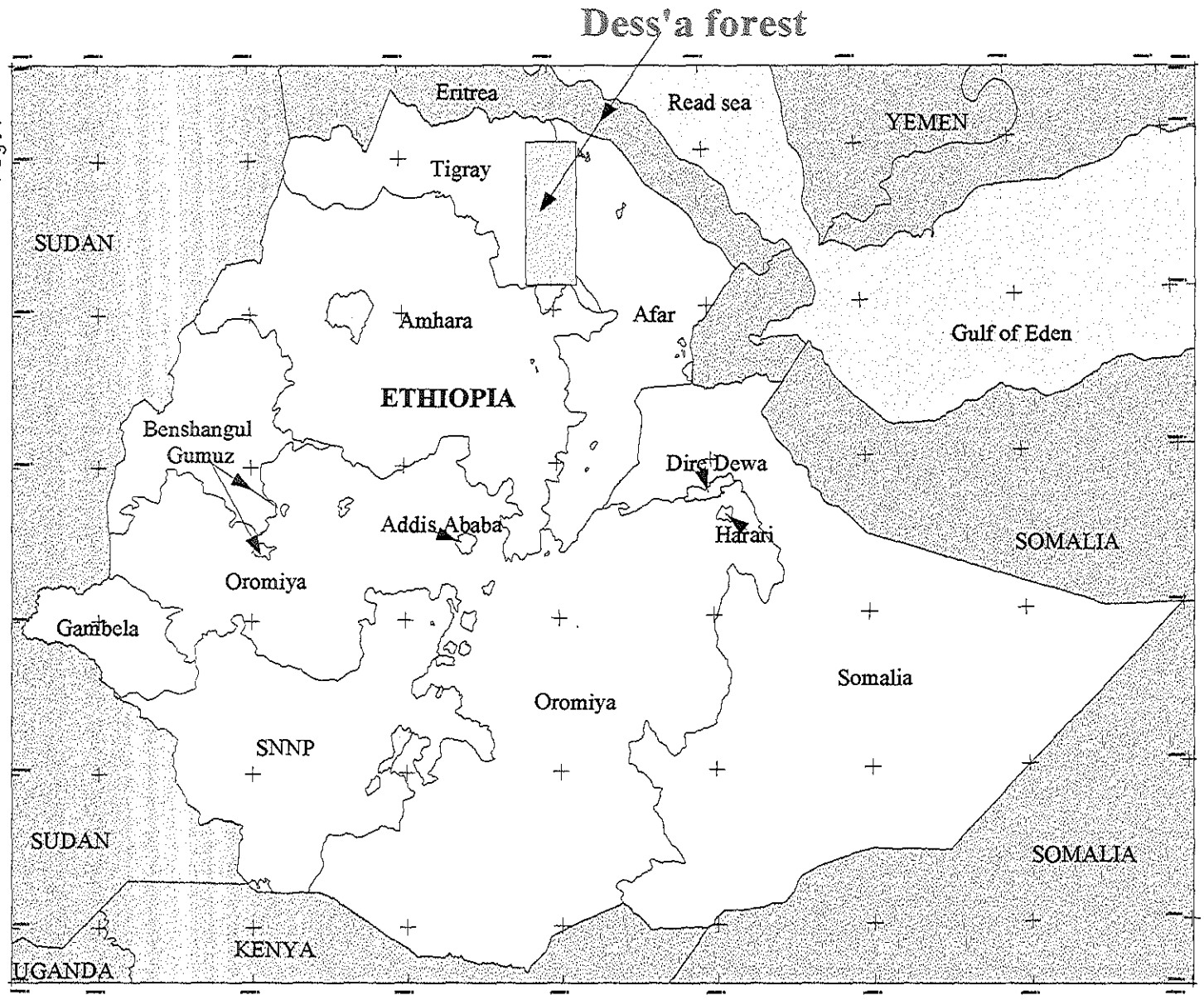
1.3.1. Location.

The Dess'a forest is located in Eastern Tigray zone, North Eastern Ethiopia. Dess'a forest is located lies between 13^0 20 'and 14^0 10' North latitude and 39^0 37' and 39^0 54" East longitude along the eastern escarpment of the North Ethiopian highlands where altitude abruptly falls from 3068 meters above sea level to 1500 m.a.s.l in the east. It covers an estimated area of 120, 000 hectares (SFCDD, 1994) bordering Shiket and Kunoba woredas in the East, Atsbi-Womberta in the West, Erob worda in the North and Enderta worda in the South. (Figure 1).

1.3.2. Climate

Most of the eastern plateau area has a montane climate. It forms part of the Ethiopian highland massif, which is bounded by a tropical continental zone to the South and West, and by a tropical desert zone to the North and East (HTS, 1976). The rainfall has a bimodal distribution pattern with an early long rainy season in July – September and short rain in March and April. Annual rainfall in the study area varies from 250 mm in the extreme Eastern lowland area to over 1000 mm in the West with mean annual rainfall of 615 mm around Atsbi, typical of the North Eastern plateau area (TFAP, 1997). The area does not suffer from extremes of temperature and seasonal variations are not great. Occasional frosts have been reported on the plateau, however, a temperature below 5^0C regularly occur in the month of December at altitudes above 2800 m.a.s.l (HTS, 1976).

Fig.1



Location of the study area

Scale : 1:9,000,000

Source: Ethiopian Mapping Agency and Statistical Authority

1.3.3 Physiography

The main drainage systems are oriented towards the Afar lowland to the east. The area consists of gently undulating to mountainous relief with an altitude range of 1500-3068 m.a.s.l. Air photo interpretation and field observation report of the soil study team identified four landscape units (Kebede Agize and Admasu Bizuneh 1997). The gently undulating landscape occupy part of the plateau and lower valley floor. The valley floods are reasonably flooded and filled by alluvial sediments and streams which discharge from higher elevations. The mountain and most of the valleys are located on the most central part of the forest area. They are moderately to highly dissected and degraded. The degree of degradation increases towards the east and northern part of the forest area.

The entire forest area comprises sedimentary rocks of Mesozoic age. The northern part of the study area is dominated by fine to medium grained cross bedded red white sand stone whereas the southern part is dominated by limestone (Kebede Agize and Admasu Bizuneh, 1997).

1.3.4. Soils

Soils of the area have been classified according to the FAO 1984. Accordingly, the most common soils of the area are the freely draining and variably textured cambisols found on flat to steep slope lands. Other soils which generaly have agricultural potential include the cracking clay vertisols found on valley floors and on upland plateau. Luvisols which are fairly heavy textured but adequately drained soils are found on the higher plateau while regosols are found on eroded slopes. Most of the soils at lower altitudes are calcareous, but at higher altitudes they contain low Calcium Carbonate (Kebede Agize and Admasu Bizuneh, 1997).

1.3.5. Vegetation

Much of the study area was originally covered by fairly dense forest (HTS, 1976) but human activities and domestic animals over centuries have affected the composition of the natural vegetation to such an extent that climax or near climax communities remain only in small protected and inaccessible locations. Increased pressure on the land in recent years has resulted in continued degradation of even the secondary communities.

The vegetation cover of the area was classified and mapped by HTS (1976) in to three major vegetation types. i.e. Shrub steppe found on the slopy area at the eastern edge of the forest area, Montane evergreen thicket at the southern part of the forest area and Montane dry evergreen forest found at the central and northern part of the forest area.

According to Wilson (1977), the upper tree layer of the forest was dominated by *Olea europea* sub species *cuspidata* with the following species in the canopy i.e. *Acokanthera schimperi, Ehretia cymosa, Juniperus procera, Syzygium guineense*. Tree species recorded by Wilson (1977) include *Canthium schimperianum, Carissa edulis, Euclea schimperi, Grewia ferruginea, Rhus natalensis*, while shrubs on the forest floor recorded were *Cadia purpurea* and *Calpurnia aurea*

Recent study by Aalbaeck (1993), classified and mapped the vegetation into four major vegetational types, semi-arid woodland, semi-arid open woodlands, shrubs, grassland and dry *Juniperus Olea* forest. Today, the good timber has already been removed from this area, but there are substantial reserves left with wood suitable for construction, fire wood and other non timber forest products. Most of

the North eastern escarpment slope is occupied by lower quality woodland of the montane evergreen thicket and scrub type, which has not been utilized to any great extent (HTS, 1976; SFCDD, 1997).

1.3. 6. Land-use.

As it was indicated by the socio-economic survey conducted in 1997 (MOA, 1997), there are about 20,025 families and 5217 households residing inside and outside of the forest area, respectively. The average population density is estimated to be about 440 persons/Km^2 . The highland part of the forest, mostly the western part of the forest is occupied by the Tigray people who practice sedentary farming system while the Afar people in the eastern part of the forest occupy the lowland area. The Afars are pastoralist people.

In the highland, however, animal husbandry was identified as the number two economic activity of households coming next to crop cultivation. Communities living in and around the forest area bring their cattle into the forest for grazing particularly during the dry season. On the other hand the Afar reside with their livestock inside the forest through out the year as long as there is grass for their cattle.

The average number of livestock including goats and sheep per family in the area is estimated to be around 59 (MOA, 1997) and if we simply relate the size of the grazing land to the number of cattle, there is a considerable overstocking. As the number of cattle increases, the limited grazing land will have less capacity to maintain the increasing stock. In the mean time, the land becomes overgrazed causing erosion and the livestock suffer from scarcity of grass.

2. Literature Review

2.1. Local Communities and their knowledge on Biodiversity conservation.

Biodiversity is defined as the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological systems of which they are part. On the other hand, the term indigenous people (Martin, 1995) refers to people who follow traditional or non industrial life styles in areas that they occupied for generations. Indigenous knowledge has been defined as knowledge that is unique to a given culture or society (shiva, 1990).

Indigenous knowledge is dynamic, it changes through indigenous creativity and innovations as well as through contacts with other knowledge systems. As it was indicated by Martin (1995), each society has a variety of types of knowledge systems which deal with the natural and physical environment as well as with social environment which passes from generation to generation through trial and error experiment. Koech (1996) indicated that people in diverse environmental settings, exhibiting a wide range of terrain, environmental factors and niches, have been interacting with the world around them and teaching through indigenous approaches their children the value of conserving, protecting and sustaining the resources in their respective communities. This ecological education was very effective as it emphasizes the value of living in harmony with the environment around them (FTP, 1995).

Indigenous knowledge focuses on human needs. Since a long time, this knowledge has been dealing with the uses, characteristics and other properties of trees, shrubs and herbs that lead to their use for human beings. Local people

often have great expertise in the identification of species with complex and realistic taxonomic systems (Wood, 1995). The utilization of forest products by the local people has considerably contributed their skill in identification of the various useful plant species which are being used in the modern world. Traditionally, local communities world wide are extremely knowledgeable about local plant and other natural resources on which they are so immediately and intimately dependent (FAO,1995). Thus, local people can identity useful species and source areas for higher quality plants and seeds, for any given species, they may know the plant habitat, growth rate, method of regeneration, compatibility with other plants and interaction with animal or insects (FTP, 1989). Local people can also observe the response of a species to change in site conditions, due to fire, drought, or floods and responses to different management practices such as lopping, pruning, reduction of shade, soil tillage of intercropping (Pandey, 1997).

Although most of the local people do not know how to read and write, their indigenous knowledge was passing from one generation to the next through oral, story telling and practical experience (Martin, 1995). Even though, it is less recognized aspect, indigenous knowledge has experimental nature (Chambers, 1984). Conclin (1979), recorded that a bush women in Kenya who was considered to have an average knowledge of plant lore in the community recognized, identified and named 206 out of 211 plant species. Some farmers in Nigeria use colour of soil to identify degree of soil fertility (Netting , 1968). Another information was that soil colour is used by Somali people in Northern Kenya to distinguish soil-vegetation associations (Chambers, 1969). A study carried out by Reed (1970) in Kenya discoved that farmers generally sowed according to the phase of the moon, believing that there were lunar phases in rainfall pattern. The

meteorological office, however, was not at first convinced , by the belief but a subsequent analysis of rainfall at 200 sites near Nairobi confirmed the association between rainfall and lunar phase (Chambers, 1969) which supported the belief.

Okafor (1996), in his study indicated that a large body of indigenous knowledge exists on the use and conservation of biodiverstiy among local people. In his observation, Okafor (1996) pointed out that people in countries of West Africa have long relied on biodiversity for their food, medicine, cultural practices, cash income and general well being. They also have well established traditional practices which have implications for conservation of ecosystems and individual species, Another observation by Koza (1996) in India showed that local people have various indigenous knowledge system related to use and conservation of biodiversity around them, which is reflected in their diet, day to day life, home gardens, local markets etc. The data analysis shows that more than 600 species of plants are in regular use for various purposes among the rural people in the area.

Conclusions drawn from the studies showed that biodiversity conservation using indigenous knowledge systems is being done through this effective system. But, nowadays erosion and modification of indigenous knowledge systems is fast due to development processes. However indigenous knowledge for biodiversity conservation and development could be possible with community participation. Humans have used forest lands and openings for agriculture and livestock production since the Neolithic age. They have been dependent on trees and shrubs to provide shade, shelter, medicines, food, and fodder for their animals. They have intentionally planted multipurpose trees on farmlands to provide

windbreaks, to prevent soil erosion, and to obtain food and fodder from the trees (Owino, 1992). This kind of continued practice of conservation, management and use of forest resources, through customary ways by local communities is today designated as ethnoforestry (Pandey 1997). Protection provided by customary rules to habitats are classified as protection ethnoforestry. Traditional methods of regeneration of livelihood species by people are known as plantation ethnoforestry and traditional methods of growing trees and crops in farmland are studied under the field of ethnoagroforestry (World Forestry Congress, 1997).

In Ethiopia local people have responded to the declining availability of forest resources by protecting trees or deliberately incorporating them into their farming system (EFAP, 1994). Similarlly, studies in Zimbabwe (FAO, 1989) showed that local people had selectively maintained their favorite wild fruit species by the local communities in most severely deforested areas.

In other cases farmers in many parts of Africa (Balic, 1996) have begun planting fruit trees, both as a source of income, and as a supply of food for the household Though, the availability of foods from the wild may be decreasing, in some cases, this is being compensated for by the increased cultivation and deliberate management of desired species by the local communities (FAO, 1995).

In Southern and South Western part of Ethiopia, tree species such as *Cordia africana, Croton macrostachyus Acacia albida, Erythrina abyssinica* are favored by indigenous farming communities (Kidane Mengistu, 1994; EFAP 1994). In coffee growing areas, particularly in the south eastern part of the country, farmers deliberately *leave Cordia africana, Croton macrstachyus, Milletia feruginea,*

Albizia gummifera and some *Acacia spp* within their farm land (EFAP, 1994). These trees are mainly used as a shade for the coffee plantation. In high potential cereal zone, *Acacia albida (Faidherbia albida*) and *Acacia* etbaica are usually left on the farmlands. During the dry period these trees are mainly used as a source of fodder for livestock and soil fertility.

The same study indicated that scattered trees of *Moringa olifera,* and *Terminalia browni* were observed in the sorghum and maize fields in North Omo zone. In case of crop failure Moringa trees serve as human food supplement while *Terminalia* trees provide wood material for traditional spear and farm implements.

According to Saxena (1993), nowadays, there is a clear and explicit recognition by the international community of the critical role of farmers and indigenous people in preserving biodiversity and providing knowledge of the value of plants and forest resources for various uses. As it was indicated by Netting (1968), the traditional knowledge innovations and practices are of importance to the conservation of biological diversity and the sustainable use of its components. The study further noted that indigenous and local communities have a close and traditional dependence on biological diversity. Their livelihood and life styles often depend and are shapped by this dependence.

FAO (1995), indicated that local communities are provided with the knowledge on how plants are distributed, managed, used and the relationships between plants, people and animals in their ecosystems. The information provided by local communities can give scientists leads on what useful traits the germplasm contains. Hence, local ethnobotanical knowledge should be conserved as part of

living cultural-ecological systems, helping to maintain a sense of pride in local culture knowledge and the environment so essential for biodiversity conservation (FAO, 1995).

Encouraging the incorporation of practical indigenous concepts of indigenous knowledge in resource planning and in the management of the dwindling resources, indigenous resources management method can contribute immensely to conventional approach in planning and using resources in a sustainable fashion (Koech, 1996). A synthesis of observations and studies carried out by Zemede Asfaw (1996) on traditional practices and ethos favoring preservation of biodiversity in Ethiopia showed that Ethiopia's traditional production systems lifestyles and social ethos have contributed to preservation of biological diversity.

This study indicated that modernization is generally associated with biodiversity erosion while traditional lifestyle is relatively in harmony with its integrity. Farmers, pastoralists, forest dewellers and others living close to nature have a store of knowledge and practices refined through long years of innovations and invention which need to be mobilized and enhanced by integrating with modern science (Zemede Asfaw, 1996).

2.2. Participatory community forest management.

Community and communal management of forests have two distinct meanings (Kessy, 1998). The term community refers to all the people living in one place (Village) but the term communal refers to different groups in a community with common interest to discret parts of the community (FAO, 1995). In systems of

communal forest management, access is more closed, reserved exclusively for members of the group and no others. In community forest management access is more open, more inclusive of the whole. In this case all members of the community have rights of access following mutually agreed upon rules and responsibilities. Community management of forest resources is, therefore, considered to involve collective action (Cernea, 1990) institutional development, enduring social structures and value systems that activate and organize individual actors (Kessy, 1998).

Hardins concept on "The tragedy of the commons", collective management of natural resources was viewed as being destructive and leading inevitably to over exploitation of the resources (Hardin, 1968). As time went by, it became clear that Hardin confused collective management of resources and open access situations. Subsequent works, however, showed that there is a role for collective action in resource management in both resource utilization and nature conservation (Wade, 1987). This affirms that community forest management should be considered as a complementary management strategy in managing tropical forests.

Community forest management consists, of a group of deliberate activities by a community for conservation and possible enhancement of useful forest resources and controlled utilization of those resources (Wiersum, 1993). In this case community forest management refers specifically to forest management activities in which the responsibility for planning and carrying out the management activities lie with local people acting individually, communally or as partners of the forest service (Wiersum, 1992).

As pointed out by Kessy (1998), the main feature of community forestry has to be participatory and directed towards rural needs. On the other hand state forest management systems have alienated the local forest users from the surrounding forests. This has been reported by Cernea (1990) and Kajembe (1994), as one of the reasons why government and donor funded interventions geared at conservation law enforcement and village afforestation have failed in some areas and deforestation continued. Attempts to reverse the trend, requires involving the local people in participatory community forest management. However,according to Kessy (1998), recommended approaches in participatory forest management vary from one locality to another, mainly because different interest groups have varying perspectives on what participation entails.

Inglis (1994) distinguishes between passive, interactive and dynamic participation. According to Inglis (1994) raising people's awareness in forestry development through extension is referred to as passive participation. Participation is said to be interactive when local entrepreneurs and companies are involved in tendering. Dynamic participation on the other hand goes deeper to address issues such as implementation of joint forest management agreements with local communities and other interested parties.

Involvement of communities in the protection of state forest is generally a recent experience. Depending on local situations community participation can have several forms. In India for example, the joint forest management approach is widely applicable (Singh, 1994). In Nepal the government is handing over the national forests to local user groups, while in the handling Philippines several

programmes have been implemented to improve access to forest for indigenous people (Lynch and Tabolt, 1995).

Singh (1994) pointed out that in India, the restrictions on the use of forests by local communities in the interest of forest conservancy resulted in conflicts between the state and the local people. As the ownership and management of forests rested with the state, the local people remained interested only in the exploitation of forest resources and took no interest in their regeneration and sustainable development. In view of steeply rising human and livestock, protection of forests progressively become a difficult task. It became evident that the forests can not be protected by the state alone and active involvement of the local people is necessary and deteminant for forest conservation. Joint forest management approach has thus, been adopted in the 1970's to protect and rehabilitate the degraded natural forests (Open and scrub vegetation) (Sarin, 1993).

According to Singh (1994), the success of joint forest management in many areas of India has been quite impressive. Degraded forests have been regenerated into good forests yielding a large number of products for meeting local peoples requirements. Unbelievable changes in the attitude of the state and of the local communities have been brought about as a result of joint forest management to jointly participate in the regeneration and production of forest. The partnership of the state and the local communities is of very far reaching importance for forestry sector in India.

In Kenya, it was indicated by Mungala (1994), the communities neighbouring the forests feel a strong sense of entitlement to forest products but have neither the right to ownership of gazetted forests nor responsibility for care and maintenance of the forest environment. But on the other hand, there has been widespread forest destruction through encroachment and illegal removal of forest produce. To reverse this situation, the Forestry Department sought to bring the government and user communities into joint cooperation by introducing the participatory community forest management strategy. Under this programme, the communities were charged with policing the forests and apprehending illegal users. In exchange they had exclusive rights to certain areas in the forests.

It is argued that local community interest in participatory management of the forests is influenced by the need for forest products, by cultural factors and in the option of using forests as a source of income or employment (Kessy, 1992). According to Sarin (1993), a number of factors need to be considered in stimulating joint forestry management strategies. Effective local institutions have to be created as viable units of organization. These have to be functional with clearly defined norms and ability to carry out management function (Kessy, 1998). Under joint forest management there is often a need to reconcile state forest management objectives and local community objectives because these are frequently diverse. The state might aim at large scale commercial utilization for national income and for establishing water sheds while local communities are mostly interested in small scale wood as well as non-wood exploitation for their subsistence (Wiersum, 1993). As it was pointed out by Kessy (1998), in many cases the state, aims at having centrally controlled forests with simulated rules and regulating on their management. However with poor infrastructure and

corruption enforcement of such rules and regulations becomes impossible, creating a kind of open access situation (FAO, 1986). Local communities would most prefer locally controlled management with communally accepted norms in forest utilization.

Because, community management of forest resources involves collective actions, observations of group norms and distribution of benefits. It requires well established institutions if it is to be effective. Kessy (1998), noted that collective actions have the highest occurrences and chance of being effective when people belong to organized groups, and when they are informed and consciously perceive that it is in their best interest to act properly in a coordinated manner (Cernea, 1990). Mobilization of social units to participate actively in forest management activities is one of the avenues through which forestry incentives can function as mechanisms for building up social capacity for rural development (Cernea, 1990)

2.3. Vegetation Structure

The Study of form and structure in natural communities is termed as physiognomy (Whittaker, 1970) whereas vegetation physiognomy is defined as the external appearance of vegetation. According to Kershaw (1964) physiognomy is used to characterize an assemblage of plants based on the external appearance of the vegetation changes in structural types along environmental gradients.

All earlier attempts in classifying vegetation were based in physiognomic criteria (Whittaker, 1970). As stated by Crawly (1986), the physiognomy of vegetation is composed of either functional or structural characteristics. Functional attributes are evergreen or deciduous habit, flowering season, pollination mechanism, seed dispersal and shade tolerance while the structural characteristics are the vertical and horizontal arrangements including life form, growth form and size class distribution components of the vegetation. Tamrat Bekele (1994) stressed the importance of using structural characteristics in analyzing vegetation structure on his study of vegetation ecology of remnant Afromontane forests.

According to Kershaw (1964), There are three components of vegetation structures:-

a) Vertical structure (stratification)

b) Horizontal structure (spatial distribution of species or populations),

c) Quantitative structure(Abundance of each species in the community)

Geographical variation in temperature and moisture are the main factors which have an impact on the change of vegetation structure (Denslow, 1987). Hence, It is possible to predict the structure of the vegetation once we know the important

environmental factors such as temperature and moisture in the area. As we move along the environmental gradient from favorable to unfavorable environment, there is a decrease in height of dominant species and the percentage of ground cover. According to Crawley (1986), the structure of the forest regulates the distribution of plants, growing under the canopy by controlling the availability of resources to them.

2.3.1. Vertical structure of plant communities.

Forests may show several vertical layers such as trees, shrubs herbs or multi – story layers of dominant, co-dominant layers among tree species as well s mixture of seedlings, saplings and pole size stem which occupy different vertical layers according to the development stages. Most competition show vertical structure, on stratification which is associated with decrease in light. Therefore , stratification is created as a result of competition for light , which occur whenever one plant casts a shadow on another or within a single plant when one leaf shades another leaf (Getachew Eshete, 1998). Competition among plant species of the forest results in the creation of vertical structure of the Vegetation (Spurr & Barnes, 1980).

Furthermore, much of the vertical structuring is the result of gap formation and the dynamics of gap recolonization and the higher the complexity of the vertical structure, the greater the species richness of the forest due to creation of different habitat conditions for the plants (Crawley, 1986).

Species have different positions along a vertical gradient of depth in the Community and decreasing light intensity. The species of each layer have Characteristics that make the best use of the available resources of light nutrients, and water of their vertical place (Denslow, 1987).

The forest trees, with their upper foliage in full sunlight, form the canopy or upper most level. The leaves and branch surfaces of the canopy trees may absorb and scatter more than half of the sunlight energy (Whittaker, 1970) , but beneath the canopy there is a lower layer of smaller trees utilizing some of the remaining light. This lower tree stratum usually contains both younger individuals of the canopy tree species, and mature trees of other and smaller species that do not normally reach canopy height (Denslow, 1987). However, since the forest canopy may not be totally closed, understorey species get light which penetrates through the over story and when the wind moves the foliage of the over storey.

According to Whittaker (1970), less than 10 percent of the sunlight reaching the upper canopy may penetrate through the tree foliage of both levels, and pectoral composition of the remaining internal light of the forest is changed from that of sunlight. Species of a third level of vegetation are adapted to utilizing this weaker light within the forest, further reducing the light that reaches herbs beneath the shrub layer. The remaining 1-5 percent of incident sunlight in many forests supports the growth of the herb layer (Hamilton, 1974). In any fully stocked forest, competition for light, moisture and nutrients between growing individuals in the overstay will result in the limitation of some tree species especially the species which are genetically less suited for survival under the particular environmental

conditions that may exist. Vertical differentiation is thus a common feature of many natural communities.

2.3.2. Horizontal distribution of plant communities

Vegetation may be defined as an assemblage of plants growing together in a particular location and may be characterized either by its component species or by the combination of structural and functional attributes that characterize the appearance of vegetation. Each species is distributed in its own way, according to its own genetic, physiological and life cycle characteristics and its way of relating to both physical environment and interactions with other species (Niering, 1987). Vegetation distribution at a given altitude is determined by physical environment such as temperature or biological environment and competition.

As it was stated by Hamilton (1974), temperature, moisture availability and human disturbance are the three most important environmental factors that can affect florstic composition whereas underneath plants are greatly influenced by competition. The elevation gradient includes decreasing mean temperature, increasing rainfall, increasing wind speed toward higher elevations. Temperature generally decreases with elevation which is a main factor in elevational distribution of the species (Barton, 1993).

Whitakker (1970) indicated that species diversity increases from high elevation to low, hence from moist forests to the lower mountain slopes. The amount of organic matter produced, on the other hand, decreases from high elevations to low in response to the moisture gradient. Soil organic matter content decreases, from high elevation to low. The assemblages of environmental factors that change

together through space along with a community gradient influence's its population. The slope can be occupied by many species of plants those which have evolved in relation to one another, and they influence another populations, some competing and will have evolved in such a way that competition is reduced by niche differentiation (Whittaker, 1975).

It is well known that many features of tropical forest change with increasing altitude. It is customary to describe and classify this latitudinal variation by means of vegetation zones (Hamilton, 1975 and Richards 1964). In east Africa as a whole, the lowland forest and mountain forest belts are said to be sharply differentiated floristically (Chapman and White 1970) to an approximate altitude. The boundary between these belts is variously considered to be 1300 m.a.s.l. (Greenway, 1943), 1370 m.a.s.l (Chapman and White, 1970), 1500 m.a.s.l (Moreou 1963) and 2000 m.a.s.l. (Richards, 1964).

According to the study made on Harena forest (Lisanework Nigatu and Mesfine Tadesse,1989), it was found that there were five vegetation zones which showed close relation ship with the change in elevation. Hamilton (1975) suggested that more forests occur between 1500 and 2000 m.a.s.l as compared with higher or lower altitudes.

2.4. Effects of topographic factors on vegetational structure

Topographic features such as altitude, slope and aspect are well marked in their effect in vegetational structure. In many mountain areas from lower to upper elevations, soil moisture increases (Barton, 1994) and as a result, plant standing cover and production increase's substantially in higher altitudinal elevation (Whittaker, 1972 and Niering, 1987).

In mountain regions, the climate changes with altitude, giving rise to altitudinal zonation of vegetation. The main climate change is a fall in temperature with an increase in altitude. Furthermore, mountain areas usually receive more rainfall, higher relative humidity and greater wind speeds. Mountain regions have mainly steep slopes and thin, rocky soils. This is the reason why vegetation on mountainous areas have shallow roots (Riley, 1966). Therefore, altitude is an important environmental factor in influencing the growth and development of plants and vegetation distribution and composition of species due to variation in temperature, moisture, radiation and atmospheric pressure (Toumy, 1947).

As the temperature falls with an increase in altitude, the vegetation of tropical mountains looks like the vegetation of temperate regions physiographically than that of the surrounding low lands (Mooney, 1974). This indicates that areas with similar climate but geographically isolated are characterized by similar plant species.

Additionally, moisture gradient, radiation, temperature, air pressure and other related climatic factors of the environment are influenced not only by altitude , but also by the direction and steepness of the slope. The slope facing the wind ward

side receive more rainfall while the leeward facing slope is dry (Misra , 1974). The steepness of the slope of an area may play an important part in altering the character of the vegetation due to the intensity of light, moisture difference, run – off and soil erosion.

Another important environmental factor which determines the structure of vegetation is the effect of aspect or exposure. Hence, areas in Northern hemisphere with a slope facing to the South recieves the strong mid-day radiation more or less perpendicular, while a steep slope facing North may receive weak morning and evening rays (Barbour, 1987). This difference in light intensity may have thus, an effect on temperature variation which in turn may cause the difference in vegtational distribution.

2.5. Factors affecting natural regeneration

The natural regeneration of forest in forest ecosystems is fundamental for evolution (Ackzell, 1994). The rate of establishment and the composition of the regeneration depend on many factors. The number of germinating seeds depends on seed availability and germination conditions. In forest ecosystem, the regeneration condition of tree species is described by forest structure, which in turn rely upon the availability of enough number of seedlings, saplings and poles in different diameter classes. The interaction of physical and biological factors of the environment affects the establishment and development of seedlings and coppices (Pande and Bischt,1988).

2.5.1. The forest environment

The dynamic nature of forest canopies provides many different regeneration niches to which different species have become specialized. Forest regeneration begins with the dispersal of seeds to sites suitable for germination. The dispersed seeds must be viable, escape predators, encounter light, moisture and temperature conditions required for germination. These factors, together with nutrient relations and herbivory, control growth and reproduction (Clark, 1986 and Bazzaz, 1991). Pathogens and predators are causing more mortality in seed or seedlings present at higher densities close to parent frees (Clark, 1986). Therefore, it can be assumed that seeds dispersed over greater distances would have a greater chance of escaping natural enemies and the maximum number of surviving seedlings should occure at some intermediate distance away from parent trees (Clark, 1986).

The germination of many pioneer and secondary species is triggered by disturbance. Disturbance is known to play an important role in ecosystem dynamics (Chapman, 1993). Disturbances such as gap formation, herbivore, competition from herbs, fire, drought, and harvesting can influence composition and structure of forest communities leading to the destruction of the entire seedling population (Clark, 1986).

These factors are responsible for mortality of the seedlings in a forest ecosystem. Both fire and browsing have beneficial and adverse influences. Fire is essential for germination of some seeds but kills many young seedling (Menaut, 1995), while browsing is an important agent of seed dispersal and increases the germination rate of several seeds, but also removes seedlings (Kessler and

Breman, 1993). Both the increase in livestock numbers and the reduced rainfall may be responsible for the inability of seedlings to survive the dry season. Thus, stress by drought and intensive herbivory influences much, the survival of woody plants. Herbivores play an important role in the forest regeneration through the removal of photosynthetic and supporting tissue. This may result in changes, in plant architecture and in extreme cases in the death of individuals.

Selective logging on forest succession results the removal of one species and the leaving of another by changing the composition of the forest. Repeated logging can remove progressively more of primary forest trees, so reduce the number of seed sources for eventual succession and increase the damage to the forest floor and its populations of juvenile trees. In selective logging activities in many cases most, if not all, individuals of a species above a certain size are felled.

This practice can seriously diminish the future stock of commercially important species. Also, related species can become seriously threatened when a tree species is excerssively logged. In Ethiopia, indigenous tree species such as *Cordia africana, Podocarpus falcatus, Hagenia abyssinica, Juniperus procera* and *Pygeum africanum* are in danger due to heavy exploitation for their valuable timber (EFAP, 1994).

2.5.2 . The Light environment

The immediate effect of canopy opening is an increase in duration and intensity of direct sunlight to lower strata of the forest (Denslow, 1987). The amount of sun radiation received by the gap depends on gap size, shape and orientation, local topography and the height of the surrounding forest (Denslow, 1987). Gap size is critical in determining the recruitment and establishment of different tree

seedlings. One of the mechanism by which gap size regulates regeneration dynamics is by increasing light levels, temperature, nutrient availability and other properties of enviornmnt.

The radial energy available near the forest floor and the shift in spectral quality as the light passes through the canopy are important for regeneration. Different parts of individuals may simultaneously experience vastly different light environment. Because of sunflecks, a shoot or a single leaf may experience rapid shifts from very low to very high light level. This shift affects carbon-gain capabilities and the growth and resource allocation of seedlings (Bazzaz, 1991). The dense shade cast by some tree species may affect the abundance and distribution of tree seedlings. The consequences of such hetrogeneity in light availability will be greater for seedlings than for sapling size classes (Denslow, 1987).

According to Whitemore (1990), there are two classes of tree species, pioneer and climax. The essential differences are that pioneer species germinate only in full light in a canopy gap while climax species by contrast usually germinate below a canopy and their seedlings are shade tolerant. Pioneer species colononize big canopy gaps and below them climax species establish. As the pioneers die, creating small gaps, the climax species grow-up to succeed them (Whitemore, 1990). Pioneer tree species have orthodox seeds, capable of dormancy while many climax species have recalcitrant seeds which can not be stored and which germinate immediately. They form seedling banks on the forest floor and await a canopy gap to start upward growth. Therefore, a forest rich in

species diversity is at an intermediate frequency, because intemediate state contains both pioneer and climax species (Whittaker, 1970).

3. Material and Methods

3.1 Procedure for sampling Localities

Kushets (smallest administrative unit) and Tabias (the 2nd higher administrative unit) within and adjoining the forest area were identified and selected for collecting information on ethnoforestry and traditional forest management practice. The study has attempted to cover all the three Woredas (the 3rd highest administrative unit) and 12 Tabias adjoining the Dessa natural forest. Within the 12 Tabias there are 47 Kushets out of which 35 Kushets fall within and very close to the forest area while 13 kushets are located far away from the forest area (Table 1).

Table 1:Number of household heads interviewed

No	Total number of Kushets in the study area	Total number Of forest Kushets in the study area	Forest kushet covered by the study	Total number of families in each forest Kushet	Total umber of ousehold heads in each forest Kushet	Total number of household heads interviewed from each forest kushet
1	4	4	1	1401	365	11
2	3	2	1	1486	495	15
3	4	2	1	2214	554	17
4	4	3	1	1832	458	14
5	4	3	1	2000	500	15
6	4	3	1	1673	418	13
7	4	1	1	2091	523	16
8	4	4	1	1072	268	8
9	5	5	1	1370	274	8
10	4	1	1	1666	417	13
11	4	4	1	1540	385	12
12	3	3	1	1680	560	17
Total	**47**	**35**	**12**	**20,025**	**5217**	**159**

Therefore, taking into account the time constraint as well as the similarity because in the situation of the different Kushets within each of the Tabias, it was decided to select and study only one Kushet per Tabia which was found to be within and

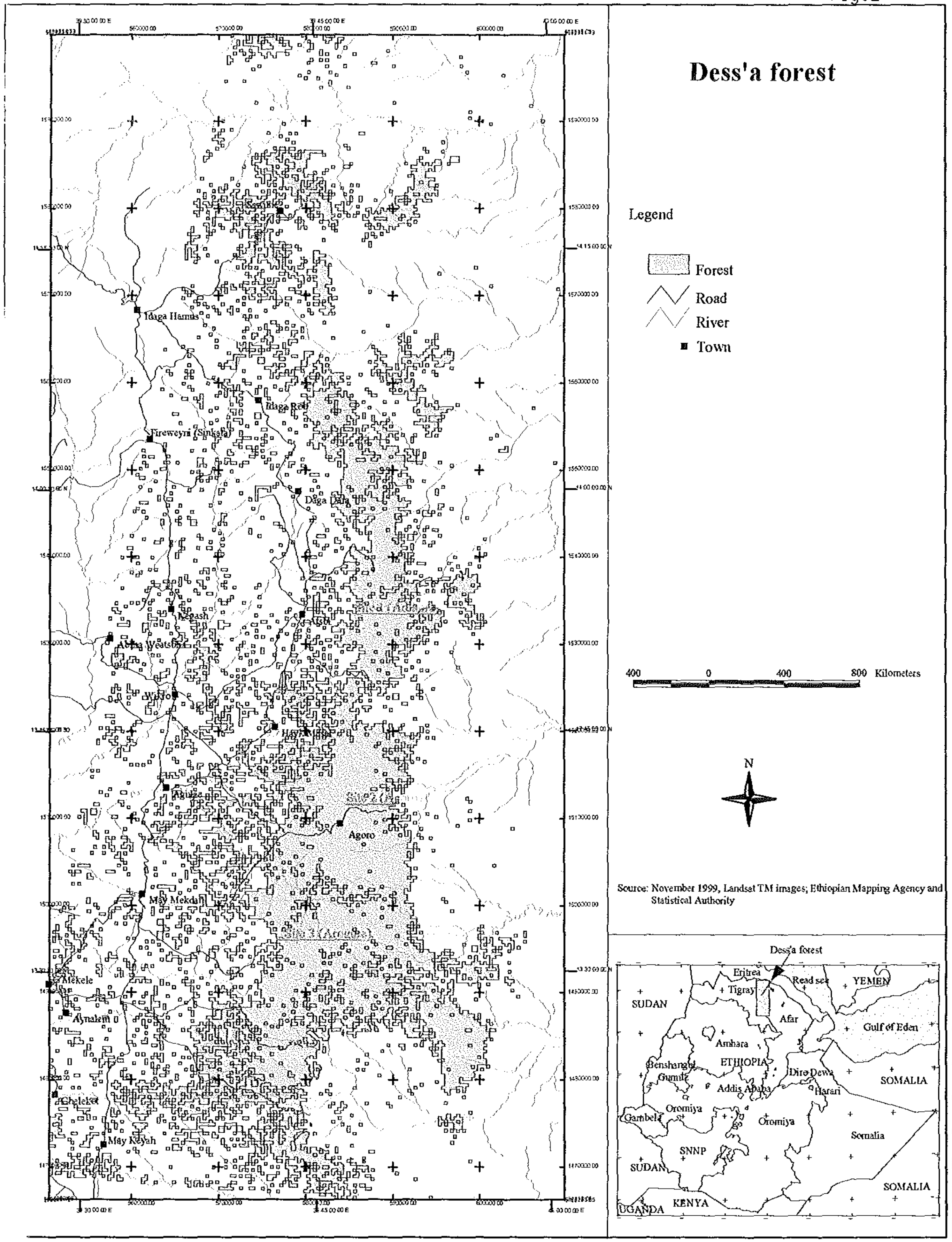
very close to the natural forest. Thus, whenever a forest Tabia was found to contain more than one Kushet that encompass part of the forest area, it was deemed sufficient to select the one Kushet with the most significant forest area to be included in the study. The Woredas, Tabias and Kushets included in the study are listed in Table 2 below.

Table 2: Forest Kushets covered in the study area

No	Woreda	Tabia	Forest Kushet
1	Tsaeda-Amba	Edaga-Robue	Hawile
2	Atsbi-Womberta	Haresaw	Haresaw
		Gebrekidan	Astgebet
		Ruba-Feleg	Agowo
		Felege-Weini	Usot
		Kal-Amin	Bohole
		Hayelom	Dege-Abur
		Kelisha-Emni	Lugda
		Era	Enguleyta
		Michael-Emba	Adi-Areomo
3	Didba-Dergagen	Dergagen	Hilisha
		Lemlem	Akeza

For the vegetation sampling on the other hand, inorder to identify the various forest characteristics and describe the existing vegetation structure three transect lines perpendicular to the topography were randomly laid at three different sites, namely, Adikore – Wahdis, Agoro – Adi arwa and Aragure – Gedel-hawlo in the North, Central and Southern part of the forest area, respectively (Figure 2).

Fig.2


Dess'a forest
Legend
Forest
Road
River
Town
400 0 400 800 Kilometers
N
Source: November 1999, Landsat TM images; Ethiopian Mapping Agency and Statistical Authority
Idaga Hamus
Agoro
Mekele
Dess'a forest
Eritrea
Tigray
Read sea
YEMEN
SUDAN
Afar
Gulf of Eden
Amhara
ETHIOPIA
Dire Dewa
SOMALIA
Addis Ababa
Harari
Oromiya
Gambela
Somalia
SNNP
SUDAN
KENYA
SOMALIA
UGANDA

3.2. Methods

3.2.1. Traditional forest management practice

3.2.1.1. Focus group interview

A focus group interview was employed to address qualitative issues concerning community attitudes torwards forest management, felt needs and to design appropriate solutions. This method involves 8-10 number of people. Participants are asked questions and make up their responses, in a social context. They hear each other's responses stimulate one another and consider each others presence when responding. Wheraeas they do not necessarily have to reach consensus and give a like – minded responses but there is nothing to stop them from doing so, neither to discourage them from giving divergent responses. Developed by Robert K. Merton and his associates in the 1950s, the focus group interview has become a widely used standard form of interview (Yeraswork Admiassie, 1997).

The focus group interview method was found appropriate for this study for three reasons. Firstly, it is proper to study the setting where the time and other resources available for the study are limited. Focus group interview is a highly efficient qualitative data collection technique. Secondly, focus group interviews provides quality controls on data collection in that participant tend to provide checks and balances on each other that weed out false or extreme views. Also, the group's dynamics typically contribute to focussing on the most important topics and issue. Thirdly, information can be obtained from different people with the task of finding out about the potential willingness and capacity of communities to participate in future management activities.

In this way, The leaders and residents of each Kushet were interviewed as a group with the help of detailed listing of relevant issues. The groups were asked to respond to questions relating to factual data on past occurrences and present conditions of the forest as well as their future aspirations. It was made to keep the size of the group to 12 for the group discussions. The groups were made to include previous as well as current leaders, members of the clergs and elders inorder to get benefit from the knowledge of those in leading positions at different times and with different social functions. The group was made to include one participant each from pervious and current leaders and religions personages while the rest nine were respnesentative of the household heads. With this technique, information on traditional forest management practices were collected.

3.2.2. Ethnoforestry /Indigenous knowledge on trees and shrub species.

3.2.2.1. Semi – Structured interview

In order to gather in depth information in ethnoforestry, it is better to hold interview with people who are knowledgeable about the topic at hand. Such respondents are those referred to as key informants. During semi structured interviewing respondents are asked to respond to predetermined questions or topics and some questions which arise as the process continues (Grenier 1998).

Most Semi Structured interviews are conducted with a single person at a time. This allows people to express personal viewpoint, discuss disagreements in the community and speak freely without being interrupted or contradicted by others as it is normally the case in group interactions (Martin, 1995). Semi structured interviews provide results of inventories, rankings and assessment of similarities.

Therefore, The survey has tried to encompass independent household interview. Accordingly, a questionnaire was prepared for interviewing mainly the male/female household heads 3% of the total household heads from each Kushet were selected randomly from 12 Kushets in 12 Tabias in the study area and copies of these questionnaires are provided in Appendix I and 2.

3.2.2.2. Direct Matrix Ranking and scoring

Within male and female household heads interview, a direct matrix ranking exercise, was conducted to discover local attitudes on various topics related to tree/shrub species preferences. The procedure of this technique requires respondents to compare, score and rank individual tree/shrub species using their own criteria (Martin, 1995) . During The survey 82 most important tree/shrub species were identified to determine the range of uses obtained from each tree and shrub species. In order to be consistent through out the survey and for the purposes of comparison, use categories were adopted for all species in the 12 Kushets in the study area.

Each respondent was asked to score each species based on the benefit that it gives to the local community as high or low as he/she wished. This free scoring was explained to the respondents so that they could indicate the relative importance of each species compared to the others (FTP, 1995). Respondents were told to give the highest score (4) for the species they thought was most important and (1) for the one they felt was least important. Scoring is a comparative measure which provides an indication of their magnitude of importance in relation to each other while ranking indicates, the degree of importance given to each item.

Accordingly, nine most important use categories were adopted to determine the most important tree /shrub species in the study area and identify the use diversity that can be obtained from each tree and shrub species. The use categories were summarized as follows:-

1. Construction Material
2. Fuel wood
3. Animal fodder
4. Bee forage
5. Human food (fruits, tubers and vegetables)
6. Human medicine
7. Vetrinary medicine
8. Farm Implement
9. Tush (Traditional smoke-bath)

3.2.2.3. Direct Pair Wise ranking and scoring

Direct pair wise ranking and scoring technique was the best method to determine priority management problems and options perceived by the local communities (FTP 1995.) Hence, activities supposed to be the major threat to the degradation of the forest in the study area as perceived by the local people, literature and general observation of the researcher were adopted for all the study Kushets. Accordingly, Categories of activities were established. The activities were:-

1. Fire hazard
2. Fuelwood collection for household consumption
3. Fuelwood collection for sale
4. Logging

5. Grazing

6. Bee hive making

7. Construction materials

8. Charcoal making

The number of pairs of activities were established as described by Martin (1995) from the relation (N-1)N/2, where N is the number of activities. In this case, 28 pairs of activities were established based on matrix algebra. Each respondent was then requested to select an activity that he/she considered being a major threat to the degradation of the natural forest from each of the 28 established pairs of activities. To obtain the general trend of the degradation of the natural forest an overall number of times each activity was chosen by all respondents was added . This was recorded in a pair wise matrix and based on the mean score of the respondents a rank was assigned to each of the eight activities. A total of 159 household heads (3%) from all the 12 Kushets were involved in this exercise.

3.2.3. Plant specimen collection and identification

Sample specimens were collected from dthe study area in duplicate, numbered, pressed and dried for identification. Accordingly, a total of 83 species from 33 plant families were collected from the study area. Voucher specimens of the identified species are deposited in the National Herbarium, Addis Ababa university. The list of speies and collection numbers are given in Appendix 3.

3.2.4. Environmental Data

Environmental data on topographic and soil depth were gathered from each sample plot. Everest altimeter, Suunto clinometer and Suunto compass were

used to measure altitude, slope, and aspect respectively. Position of each sample plot was located using GARMIN GPS so that one can easily locate them on the map.

Soil depth was also determined based on the effective rooting depth adopted by FAO (1984) as follows:-

1. Very shallow 0-25 cm
2. Shallow 26-50cm
3. Moderate deep 51-100 cm
4. Deep 101 – 150 cm.
5. Very Deep > 150 cm

Biotic variables such as grazing and browsing intensity were also estimated according to FAO (1984) following subjuctive scale, 0=nil, 1 = slight, 2= moderate 3 heavy, 4= destructive while human impact was coded as 1 = none , 2 = low 3 = moderate and 4 = high. In addition to the above variables ground cover of each sample plot was estimated following the FAO (1984) scale as 1 = bare, 2 = sparse , 3= moderate , 4 = dense.

3.2.5. Vegetation Sampling

A line transect inventory design (Hamilton, 1975) was choosen for this study. Transects are of considerable importance in the description of vegetation structure along an environmental gradient or in relation to some marked feature of topography (Chapman, 1986). Transects are a form of systematic sampling in which samples are arranged linearly and usually contiguously. They are very commonly used in studies and are appropriate to the investigation of gradients of change when they should be positioned at right angles to the zonation ((Hamilton, 1975).

In the present study transect lines perpendicular to the topography were laid randomly at 3 different sites located at the North, Central and Southern part of the forest area. The purpose of this alignment is to identify any variation due to elevation variation, soil depth, slope %, biological impact and physiography.

A series of sample plots with the size of 20 m x 20 m (n = 59), Zerihun Woldu et al (1989) for the stand data and a 5m x 5 m size sub–plot for regeneration study were established at every 50 meters drop in altitude. Accordingly, in all the three transects at every 50 meters drop in altitude. Accordingly, in all the three transects i.e. Adikoro – wahdis, Agoro – adi-arwa and Aragure – Gedel hawlo, 29, 18 and 12 sample plots, respectively, were established and the data collected includes the following characteristics: Species density, Species diversity, Basal area, Size distribution and Regeneration pattern.

All tree and shrub species taller than 2m and > 2 cm in diameter were measured for height and diameter at breast height, (Dbh) i.e. 1.3 m above ground level. The heights were measured using a Suunto Clinometer and the Dbh with Dbh caliper within each sub – plot, all woody stems, < 2 cm in Dbh were classified as seedling/ sapling and counted by species.

The following indices and parameters were calculated to determine the vegetation structure and species diversity :

1. Species diversity was calculated using the Shannon diversity index for the comparison of species diversity at different altitudes using the formula, H^1 = N log N - $\sum$ n log n (Shannon and wiener, 1963), where N = Total

number of individuals of all species in a plot, n = No. of individuals of a species in a plot.

2. For all individuals having > 2cm Dbh and 2 meters height, Relative density, Relative frequency, Relative basal area and Importance Value Index (IVI) (Curtis and McIntosh, 1950) were calculated for each species using the following formulas.

2.1 Relative density = Number of individuals of species A/Total number of individuals of all species * 100.

Density is defined as the number of individuals of particular species peer unit area.

2.2 Relative frequency = Number of plots occurrence/Total number of plots * 100.

Frequency is the chance of finding a species in a particular area in a particular trial sample. The frequency value obtained reflects the pattern of distribution as well as diversity.

2.3 Relative Basal Area = Total basal area of all individuals of a species/Total basal area of all species *100.

Basal area is the cross-sectional area of the tree at point 1.3 meters above the ground.

2.4 Importance value Index (IVI) = Relative density + Relative frequency + Relative basal area.

4. Results and Discussion

4.1. Traditional forest management.

The findings of this study provide constructive suggestions concerning the sustainable indigenous management system that has at least partially came down to the present. The indigenous management practice was anchored on the social rule systems such as the exclusive group use-right in the "rist system"
(A system in which land is supposed to be owned by exclusive group of people) and the traditional rules and regulations governing the rational utilization of the forest resources.

4.1.1. Exclusive group use-right in the rist system.

The survey has produced information to the effect that the discrete ristegna groups occupying the land along the forest held and retained well established rist right to clearly delineated sections of the forest area. This situation was operating until the rist tenure was discontinued by the land reform of 1975 which replaced it with a kind of state sanctioned use-right system based on the peasant association on the Kushet and Tabia. Most of the ristegna groups were taken as the basis of the new Kushets and Tabias and the traditional right of the group continued to operate as before under the new structures, although with certain modifications.

The respondents who participated in the focus group discussions held in all the 12 Kushets related the story of their forefathers who established the rist right on the cultivated land as well as on a section of the forest area.

According to the respondents, only those persons who are able to prove their lineage to the pioneer-ancestors were recognized as full members of the ristegna group and permitted to obtain a share of land or participate in
the utilization of the common forest resources of the group on equal footing with the rest of the group. All outsiders whatever their social position, were excluded from access to the land and the forest resources. If and when outsiders were permitted to make use of the group resources, this had to be on the permission of the group.

Due to the rist system, the forest resources came to be controlled access resources with definite groups acting as collective owners and exercising exclusive control over their utilization. Respondent groups in all the kushets were all explaining about the vigilance of their fathers and forefathers in guarding the exclusive right of the common forest resources.

As a rule, outsiders attempting to encroach on the right of the group by felling timber or by clearing land for cultivation were repulsed even when the intruders were office holders and other powerful personalities. Only in Dege-Abur Kushet of Hayelom Tabia respondents said that the ristegna group were so confident of the potential of the forest resources that they allowed outsiders to come and cut down trees at will. But, the only resources whose utilization was controlled was the grazing area within the forest area that was reserved exclusively for plowing oxen. During the focus group discussions, respondent in almost all the kushets expressed their experience on how the communities had repeatedly defeated the attempts of powerful external groups attempting to encroach on their right over the forest and the utilization of the resources.

Respondents in Usot described various incidents of encroachment by external forces that promoted the ristegna group to rise up in resistance, i.e., Firstly, during the Italian occupation, the Italians prohibited the community from using the trees and even from bringing animals into the forest. However, the community sent its elders with a petition to the higher Italian authorities during that time and the decision got reversed.

Secondly, under the reign of Emperor Hailesilassie, around 1960, a certain governor of the area claiming to have received permission from the government to obtain timber for the church he was building, led his people and started felling trees. However, the people in the community reacted by sounding alarm and the community confiscated all the felled timber.

Thirdly, during the reign of Emperor Hailesilassie a certain person was appointed as forest officer by the then provincial administration. But, reaffirming the fact that they themselves are the managers of their own forest, the local people destroyed his house in a single night; and after that incident he never returned to the community.

This was strengthened by respondents from Bohole Kushet saying that another administrator in the area came with his men and oxen with the intention of clearing it and putting the cleared land under cultivation. The people of the community assembled and went to him with two containers containing milk and blood. He then understood the message and decided to give up. Furthermore, two other strong men, in the community cleared an area inside the forest and brought

an oxen to plough it. But, according to the respondents their fathers destroyed all their farm implements and sent them away.

Respondents in the Kushets of Enguleyta and Lugda had similar stories of resistance to relate. They said that, after liberation, an Italian entrepreneur who had obtained concession from the then provincial governor came to the forest and started to operate a saw-mill and to produce charcoal at the site called Golgol in Lugala Kushet, Kelisha-emni Tabia. Respondents described that their fathers sent a committee to Addis Ababa and successfully petitioned to the Emperor and the provincial governor was defeated. Later on, the governor attempted to turn a section of the forest into his private property by claiming it to be his hereditary estate (riste-gult). But, respondents, said that they went back to Addis Ababa and won their case once again.

Hence, according to the respondents in all the kushets where focus group discussions were held, outsiders were effectively excluded and the members of the community were able to manage the forest on a sustainable basis up to the existing generation.

4.1.2. Traditional rules and regulations on the rational utilization of the forest land resources.

According to the respondents during the group discussions, utilization of the major forest land resources, namely, grazing and forest products were on a sustainable basis by the members of the community based on the rules and regulations set by themselves for many thousand years until the delineation of the forest area as National Forest Priority Area (NFPA.) by the government.

4.1.2.1. Grazing inside the forest under traditional forest management

According to the respondents, the area was said to have been densely covered with forests. Most of the forest area was originally been used for grazing cattle. As a rule, the forest holding of each ristegna group was divided into two distinct areas for the purpose of grazing. A smaller grazing area closer to the farm land on the higher altitudes was set aside for the groups plough oxen. The rest of the forest area, on the other hand, was put at the disposal of all other animals. In some cases, even the people of neighbouring communities without any forest land of their own were tolerated when they brought their animals to graze, particularly during the dry season on the second type of the grazing land.

But according to the respondents, an exceptional type of grazing was practiced in Usot Kushet of Felege-Weini Tabia, that the community had two sections of grazing land for animals other than plough-oxen on which it practiced grazing by closing one of them during the big rains and the other during the small-rains.

The grazing area that was set aside for plough-oxen, in addition to being put at the exclusive disposal of group members, was subject to a number of regulatory rules making it a real institution. The rules on its utilization common to almost all the communities covered by this study were the following:-

- To bring in any other animal other than plough-oxen to the grazing area was strictly forbidden.
- The plough-oxen grazing area was closed for grazing during big rainy season.

- An officer was elected each year from the group members to serve as a "Keeper of the grazing land" for that particular year.
- In some of the communities, if some members were not able to use their right to use the plough oxen grazing area for lack of oxen, those who own more than the normal number of oxen compensate them by lending a hand with a pair of oxen in preparing their agricultural land.

4.1.2.2. Beekeeping inside the forest under the traditional forest management

According to respondents in the study area, almost all members of the original Kushets had their own beehive stations inside the forest known as ganda (stations of beehives) (Plate 2). For security reasons, the local people were establishing their ganda at the same site with other members of the community deep inside the forest which looks like a colony village. Neighbours mutually respect and protect each others ganda folowing their age old tradition.

4.1.2.3. Utilization of trees under the traditional forest management

The right to use trees from the forest was determined by the members of the risetgna group. Traditionally, all those who could trace lineage from the founding fathers had free access to the land recognized as the rist of his forefathers, and they could cut live trees or collect dead wood for construction purposes, for the manufacture of farm implements or for fuel.

According to the respondents, the members of the community did not need to obtain permission from any one to collect the timber / log or wood from the forest. However, respondents in all the study Kushets recalled that this did not lead to

abuse of trees. The members neither cut trees for sale, nor did they engage in the production of charcoal, nor did they clear the forest for cultivation. But, the respondents, in the southern part of the forest area in Hilisha and Akeza Kushets indicated that with the growth of small towns that the residents of both Kushets engaged in the sale of fuelwood and hence the whole forest area had been cleared.

4.2. Current forest management practice.

The major development that took place after the delineation of the forest area was to set aside the forest area as National forest priority area and put it under the official responsibility and management of the Regional Bureau of Agriculture and National resource. Since then, the Bureau posted paid forest guards which are normally chosen by the people of their respective communities.

According to the information gathered from the respondents in the study area, following the taking over, the responsibility of safeguarding the forest by the Bureau, the latter instituted rules and regulations governing the utilization of the forest land as a whole.

4.2.1. Grazing inside the forest under the existing forest management

According to the respondents in the focus group discussions under the newly established rule and regulations on the utilization of the forest land resources, the

communities continue to retain control over the forest when it comes to grazing. In all of the Kushets covered by the study, the communities themselves continued to manage their plough-oxen grazing area. The practice of gare (Temporaly stations for cattle) inside the forest also continued un-affected by the Bureau stewardship. But in recent years, the Bureau has started closing sections of the forest area in order to plant the open space with seedlings which finally created conflicts in Usot, Agowo, Engulyta and Lugda Kushets. The respondents in these Kushets consider the planting and closure of the forest land as if it is violating their right to graze their animals in the forest area. According to the respondents, the members of the Kushets who are being affected by the plantation and closure, as a sign of protest boycoated the planting of trees, although it was paid for by the forestry department. Hence, people had to be brought from other Kushets for planting.

Furthermore, merging of new Kushets to the old ristegna group members (old Kushet) for the convenience of administration work has made its contribution to the weakening of the traditional management of the forest area. In the newly constituted Kushets of Hawile in which two Kushets, Hawile and Asseraw were merged together, the former has no forest land of its own, and respondents reported that the members of the community of Hawile have set out to over-exploit and further degrade the forest area to which they had no access before and to whose traditional management practices they are strangers. The forest land of Asseraw Kushet has, thus become an object of heated confrontation and conflict among the members of the Kushets.

4.2.2. Bee keeping inside the forest under the existing management

As regards to the beekeeping, farmers continued to hold ganda or bee hive stations inside the forest as before. Respondents in all the Kushets of the study area, reported that nothing has changed regarding the bee keeping inside the forest. But on the other hand the researcher had observed debarked of standing *Juniperus procera* trees for the basic reasons that bee hive owners inside the forest, use the bark for covering the bee hives during cold season. Hence, many of the standing J*uniperus procera* trees were dead due to the debarking activities for the above mentioned purposes. (Plate 1).

4.2.3. Utilization of tree resources under the existing forest management

The rules and regulations regarding the utilization of the tree resources in the study area are enforced by the forest guards representing the forestry department and sanctioned by the Kushet and Tabia administration. The rules governing utilization of the tree resources are:-

- Cutting live trees from the natural forest is strictly forbidden.
- The extraction of dry timber is also forbidden, unless a special permission is granted.
- Collection of dry wood for fuel is permitted as long as this is for home consumption and not for sale.

However, according to the respondents in Hilisha and Akeza Kushets in the Southern part of the forest area and in Hawile Kushets in the Northern part of the forest area, since the Kushets are located near to the towns of Quiha, Makelle and Edagahmus respectively, the illegal extraction of fuelwood for sale has increased ever since contributing much to the forest degradation.

On the other hand, respondents from all the study Kushets indicated that they strongly object to the prohibition of fetching dry timber for building purposes, and above all the ban on cutting of live trees for the purpose of manufacturing farm implements that are so crucial to agricultural production.

4.3. Lessons and prospects.

A number of lessons can be learnt from the study in relation to sustainable management of the forest resources in the study area. As it has been observed from the focus group discussions, the local people living along the Dess'a forest were imperative in contributing much to the management of the forest resources and biodiversity conservation through the traditional management practice.

The findings of the study indicated that there were social rule systems for emphatically recommending of involving local people in the management of the forest land resources.

4.3.1. Human and ethical factors

As it has been seen from the findings of the study, there are already communities who are traditional users and managers of the forest. What we have here are not groups of seasonal encroachers. According to the respondents, they believe that they are permanent residents of the forest area whose livelihoods and life styles are inseparably interwoven with the forest.

Furthermore, these communities have a well established claim of possession to distinct sections of the forest area. The communities have kept alive their respective claims up to today through their indisputable proof of exclusive utilization and possession as well as stories of community struggle to keep out outsiders.

Moreover, it is the members of these communities who have protected and preserved the forest up to now. They have achieved this, because of a basic realization of the fact that their livelihood is to a large extent dependent on the continued presence of the forest. Hence, they have through the ages, persisted on a practice of optimal utilization and rational management.

4.3.2. Perceptions of the local communities.

Based on the findings of the study, local people have vested interest to participate in the management of the forest. This is a matter that issues out of the tangible economic benefits they get from it. Their animal husbandry and beekeeping economy is so crucial to their well being and are based on the forest and the forest land.

According to the respondents in Usot, Bohole, and Lugda kushets, without the forest all would be gone. Thus, they do not wish to lose total control over the forest, in order not to be deprived of their grazing areas or be forced to abandon the practice of gare and bee keeping through ganda. Hence, in their quest to minimize their losses and maximize their gains, local people are motivated towards the participation in the forest land resources management. They were unanimously indicating that they wish to continue to benefit from the forest and minimize possible disruptions to their way of life by becoming a part of the processes directing the future of the forest.

The respondents of all the Kushets have all affirmed their willingness to be involved in the sustainable development of the forest. But, they have indicated two conditions that must be considered by the forestry department in order to secure the genuinely voluntary participation of their communities.

The first of these conditions is that the original Kushets which are very near to the forest wants to be the sole partners in any future ventures concerning the forest resource over which they have always be a claim recognized by all.

The second condition refers to the security of access to benefits. The respondent groups were of the view that the local communities as represented by the kushet must be given guarantee so that the interest of its members will continue to be served and safeguarded.

4.3.3. Relevant local institutions for participatory forest management

The main local level institutions that are relevant for participatory forest management systems are the Kushet, Tabia and the Woreda. However, of these units, the most important one for this purpose is the kushet. The kushet is the unit well suited to anchor the co-management by coming directly into cooperative relation with the forestry department.

The Tabia and the Worda, on the other hand, could be supportive agents to facilitate the flow of communication and to give whatever administrative support that the forestry department and the kushet may need.

The reason for favoring the Kushet as the corner stone of a co-management for the forest was that the current Tabia is too large in term of both size of area and population, whereas the Kushet which has normally about 250-300 residents is not too small to provide a viable working unit. Secondly, the original Kushet is the unit whose resident are tied together by a common possession, ancestry and common symbols. Hence, there is a strong sense of solidarity and belongings in the Kushet, which are important factors for any endeavor requiring collective action in any forest development.

4.4. Local knowledge on the value of tree/shrub species

The relative importance of different tree/shrub species were assessed using direct matrix ranking and scoring technique. Relative importance of 82 tree/shrubs species was determined by providing respondents with a fixed number of beans.

They were asked to place the number of beans next to the sample of a tree/shrub species collected earlier by the researcher to reflect its importance in relation to other tree/shrub species on the displayed sample.

The forest provides a range of forest products for the surrounding communities and nearby markets. However, the contribution of these products to the daily running of household life vary from product to product. Fuelwood, building materials, Human medicine, vetrinary medicine, edible materials, animal fodder, bee fodder, farm impliments and Tush (Traditional smoke bath) were among the consumption products identified during the study.

4.4.1 Diversity in use values of trees/shrub Species

4.4.1.1. Medicinal tree/shrub species

A total of 33 tree/shrub species were recorded as a medicinal woody species used by the local people in the study area. The part, the way it is used and the type of disease for which it is used varies from one community to the other. Among the most important woody species frequently used as human medicines includes *Myrisine africana, Olea europaea, Juniperus procera, Pimpinella hirtella, clutia lanceolata, Solanium schimperianum, Ostegia integrifolia, Tarconanthus camphoratus, Rhus natalensis, Lavandula dentata, Asparagus africanus, Hagenia abyssinica, Heliotropium cinerascens, Grewia kakothatmus*, and *Terminalia browni.* (Table 3).

4.4.1.2 Veterinary medicines

Out of the 82 tree/shrubs species collected in the study area, 21 species were identified as veterinary medicines used by the local people. Among the most important tree/shrub species used as veterinary medicines by the local people are

Pimpinella hirtella, Otostegia integritolia, phytolacca dodecandra, Psiadia punctulata, Calpurinia aurae, Olea europeae, Juniperus procera, Inula confertiflora, Leucas abyssinica, Tarconanthus camphoratus and *Ackokanthera schimperi*. (Table 3).

4.4.1.3. Tush (Traditional smoke bath)

"Tush" (Traditional smoke bath) is something like smoke bath traditionally used by the women in the study area. According to the respondents, Tush, is said to be very important for delivered mothers. But nowadays all married women whether coupled, divorced or widowed are used to practice" Tush " every evening for one week. Tush is meant to give strength to delivered mother, to keep cleanliness and good aroma of their body and as protection against malaria for those who are living in the lowland areas.

Accordingly, respondents identified 19 most important tree/shrub species used for Tush preparation by the women in the study area. Among the woody species used by the women for Tush preparation includes species such as *Clutia lanceolata, Dodonea angustifolia, Tarconanthus camphoratus, Psiadia punctulata, Hypericum revolutum, Erica abrborea, Leucas abyssinica, Olea europaea, Olea welwitschii, Euclea schimperi* and *Spinuluma oxycantha*. (Table 3).

4.4.1.4. Farm implements

Out of the total tree/shurb species collected in the study area, 55 of them were found to be used for manufacturing farm implements by the local people in the study area. According to the respondents in the interview, even farmers coming from far distance were obtaining their wood for farm implements from the Dess'a natural forest for the past many years. Species such as *Nuxia congesta, Rhus*

glutinosa, Olea europaea, Juniperus procera, Dodonea angustifolia, Erica arborea, Stereculia africana, Maerua angolensis were found to be the most important sources of farm implements in the study area. (Table 3).

4.4.1.5. Building materials

The local people living around Dess'a forest, obtains the timber they need for construction of their houses from the forest. The stone houses (Hidmo) of the local people of the study area are well built from durable material and in a way that is environmentally sound. It is due to the generous supply of wood required for pillars, beams and above all for the construction of the ceiling that needs to be strong enough to support the stone and earth with which the roof is finally overlaid.

As it has been observed by the researcher during the study, to construct a single traditional house(Hidmo), a lot of Juniperus procera poles are cut for beams and ceiling and *Olea europeae* poles for pillar. Among the most important tree/shrub species identified for construction purposes are *Juniperus procera, Olea europeae, Rhus glutinosa, Abutilon longicuspe, Erica arborea, Hagenia abyssinica, Sterculia africana, Ehretia cymosa, Anogeissus leiocarpus, Boscia salcifolia and Celtis africana.*(Table 3)

4.4.1.6. Fuelwood

As it is true throughout the Region and in fact throughout the country at large, fuelwood was another importans aspect of the demand for forest products of the household in the study area. Additionally, quite significant number of households are also using woody biomass for lightening.

Accordingly, out of the 82 tree/shrub species collected from the study area, 66 of them were identified as the best source of energy by the respondents. The most important tree/shrub species used as a source of fuel wood energy includes *Olea europeae, Nuxia congesta, Erica arborea, Tarconanthus camphoratus, Juniperus procera, Maytenus senegalensis, Celtis africana, Rhus natalensis, Bersema abyssinica, Accacia sieberiana, Stereculia africana, Acacia mellifera* and *Acacia etbaica.* (Table 3)

4.4.1.7. Animal fodder

In all the 12 Kushets where semi structured interview was held, animal husbandry was identified as the number two source of income next to crop cultivation. As it was indicated by MOA (1997) the average number of cattle, sheep, goats and camels per family in the study area is around 59 indicating that the dependency on the forest for grazing and browsing is so great. (Plate 7 and 8).

The concentration of the high figures for the various types of animal holding around the forest area suggest's that the forest is a good source of many valuable tree shrub species used for grazing and browsing. Accordingly, during the interview 76 tree/shrub species were identified and used as an animal fodder by the local communities in the study area.(Table 3). Among the most important tree shrub species identified by the local people as a fodder includes *Olea welwitschii* (Plate 11).*Dovyalis abyssinica, Ximenia americana, Maytenus arbutifolia, Sydrax schimperiana, Tarconanthus camphoratus, Dovyalis Verrucosa, Maytenus senegalensis, Rhus natelensis, Canthium setiflorium, Cadia purpurea, Carisa edulis, Myrsine africana, Myrica salicifolia, Grewia kakothamnos*, and *Berchemia discolor* (Table 3).

4.4.1.8. Bee Forage

It has been indicated by the respondents that Dess'a forest is very rich in its floral diversity favourable for honey production. According to the respondents, bee keeping is the third most important economic activity in the forest Kushets following crop production and animal husbandry.

Bee keeping is practiced in all the Kushets but with varying degree. Not surprisingly, the home of bee and honey is the central part of the forest area with the best forest and also most of the bee hives. The tree poor Northern and Southern sectors produce little honey as compared to the central part of the forest area. According to the respondents in the central part of the forest area the maximum number of bee hives per household is 70 and the minimum is 12. On the contrary, the maximum number of beehives in the southern and northern sectors of the forest area is eight and the minimum is one. This indicates that there is no household in the study area with out bee hive.

According to the respondents, they harvest honey 3 to 4 times per annum and obtain 7 to 12 kg per hive per harvest. However, despite of the suitability of the area for honey production, bee keeping practice is totally traditional and the production is very much less compared to the production from modern bee keeping.

Accordingly, during the interview respondents identified 74 bee forage tree/shrub species in the study area. Species such as *Nuxia Congesta, Ximenia americana, Maytenus arbutifolia, Rhus glutinosa, Clutia lanceolata, Leucas abyssinica, Maytenus senegalensis, Rhus natalensis, Carisa edulis, Myrsine africana, Pavetta abyssinica, Terminalia browni, Rhamnus staddo* were identified as the most

important bee forage tree/shrub species by the local people in the study area during the semi structured interview.

4.4.1.9. Food materials

As it was indicated by the respondents in the study area, the forest and the wild plants and animals they contained are the main source of food for many people. Some of the tree and shrub species encountered in the study area were described to have edible berry of food value by the local people.

Accordingly, most of the interviewed individuals reported that the local people are dependent on the fruits of the wild trees and shrubs for their food. For instance, the fruit of optunia ficus indica locally known as " Beles" is used as a food for about three months during the rainy season when other food are in short supply. (Plate 3).

The local people in the study area were found to be familiar with a wide range of different wild fruits such as:- *Dovyalis verrucossa, Carissa edulis, Dovyalis abyssinica, Ximenia americana, Rosa abyssinica, Cordia ovalis, Ziziphus spina-christi, Manilkara butugi, Grewia trichocarpa, Dobera glabora, Grewia bicolor, Spinuluma oxycantha, Balanities aegyptiaca* and *Rhus natalensis* (Table 3).

Table 3: - Use Diversity of the trees/shrubs identified by the local People.

NO	SPECIES NAME	USE DIVERSITY								
		Construction Material	Fuelwood	Animal Fodder	Bee Forage	Human Food	Human Medicine	Veterinary Medicine	Farm Implement	Tush (Traditional smoke) bath
1	Nuxia congesta	3	4	-	4	-	4	-	4	-
2	Dovyalis abyssinica	1	1	4	4	4	-	-	-	-
3	Ximenia americana	-	-	4	4	4	-	-	-	-
4	Maytenus arbutifolia	-	2	4	4	-	-	-	-	-
5	Rhus glutinosa	4	4	3	4	-	-	-	4	-
6	Abutilon longicuspe	4	3	-	4	-	-	-	-	-
7	Clutia lanceolata	-	-	-	3	-	4	-	-	4
8	Dodonaea angustifolia	1	3	3	4	-	1	4	4	4
9	Solanum shimperianum	-	-	-	4	-	4	4	-	-
10	Osyris quadripartita	1	1	1	4	-	4	4	4	-
11	Juniperus procera	4	4	4	3	-	4	4	4	-
12	Phytolacca dodecandra	-	-	-	0	-	4	4	-	-
13	Psydrax schimperiana	4	2	4	2	-	1	1	2	-
14	Pimpinella hirtella	-	-	1	1	-	4	4	-	-
15	Leucas abyssinica	-	-	3	4	-	-	-	-	-
16	Otostegia integrifolia	-	-	1	1	-	4	4	-	-
17	Dovyalis verrucosa	1	1	4	1	-	-	-	3	-
18	Tarconanthus camphoratus	3	4	4	3	-	4	4	3	4
19	Maytenus senegalensis	3	4	4	4	-	4	-	2	1
20	Celits africana	4	4	4	1	-	-	-	1	-
21	Rhus natalensis	3	4	4	4	4	4	-	2	-
22	Canthium setiflorium	1	1	4	2	-	1	1	1	1

4= Highest priority use 3= Secondary use 2= Sometimes used 1= Rarely used

Table 3 Coninued

NO	SPECIES NAME	USE DiIVERSITY								
		Construction Material	Fuelwood	Animal Fodder	Bee Forage	Human Food	Human Medicine	Veterinary Medicine	Farm Implement	Tush (Traditional smoke) bath
23	Psiadia punctulata	-	3	-	4	-	-	4	-	4
24	Bersama abyssinica	2	4	1	-	-	1	1	-	-
25	Acokanthera schimperi	2	3	1	1	-	4	4	3	-
26	Ficus palmata	1	1	1	1	-	4	4	1	-
27	Cadia purpurea	-	1	4	-	-	-	-	1	4
28	Carissa edulis	2	2	4	4	4	2	2	3	1
29	Myrsine africana	3	3	4	4	-	4	-	3	-
30	Lavandula dentata	-	-	4	4	-	4	-	-	-
31	Pavetta abyssinica	1	3	4	4	-	-	-	3	-
32	Hypericum revolutum	3	3	4	4	-	-	-	4	4
33	Erica arborea	4	4	4	4	-	-	-	4	4
34	Calpurnia aurea	3	4	2	4	-	-	4	3	3
35	Pavetta oliveriana	1	1	1	1	-	-	-	-	-
36	Myrica salicifolia	4	3	4	4	-	-	-	4	-
37	Asparagus africanus	-	-	3	-	-	4	-	-	-
38	Inula confertiflora	1	1	4	1	-	4	4	1	1

Table 3 Coninued

NO	SPECIES NAME	USE DIVERSITY								
		Construction Material	Fuelwood	Animal Fodder	Bee Forage	Human Food	Human Medicine	Veterinary Medicine	Farm Implement	Tush (Traditional Smoke bath
39	Salix subserrata	1	4	3	4	-	-	-	3	-
40	Acacia sieberiana	3	4	4	4	-	-	-	4	-
41	Pittosporium virdiflorum	3	4	4	4	-	-	-	-	-
42	Olea welwitschii	4	4	4	3	-	4	-	4	4
43	Becium grandiflorum	-	1	3	4	4	-	-	-	-
44	Clerodendrum myricoides	-	-	1	3	-	-	-	-	4
45	Heliotropium cinerascens	-	-	1	1	-	4	-	-	-
46	Teclea nobilis	3	3	4	3	-	-	-	3	-
47	Sterculia africana	4	4	4	3	-	-	-	4	-
48	Ficus populifolia	3	1	1	4	-	-	-	3	-
49	Cordia ovalis	4	3	3	4	4	-	-	3	-
50	Hagenia, abyssinica	4	3	1	4	-	4	-	4	-
51	Discopodium penninervum	-	-	1	1	-	4	-	-	-0
52	Jasminium grandiflorum	-	1	4	3	-	-	-	-	-
53	Ziziphus spina-christi	2	4	4	3	4	-	-	4	-
54	Grewia trichocarpa	1	1	4	1	4	-	-	-	-
55	Maerua angolensis	3	3	4	3	-	-	-	4	-
56	Ziziphus mucronata	2	4	4	3	4	-	-	4	-
57	Ehretia cymosa	4	4	4	3	-	4	-	4	-
58	Anogeissus leiocarpus	4	4	4	1	-	-	-	4	-
59	Grewia kakothamnos	1	3	4	3	4	-	-	4	-
60	Terminalia brownii	4	4	4	4	-	4	-	4	-
61	Ficus glumosa	4	1	3	4	-	1	1	3	-
62	Olea europaea	4	4	4	4	-	4	4	4	4

Table 3 Coninued

NO	SPECIES NAME	USE DIVERSITY								
		Construction Material	Fuelwood	Animal Fodder	Bee Forage	Human Food	Human Medicine	Veterinary Medicine	Farm Implement	Tush(Traditional Smoke bath)
63	Salvadora persica	1	1	4	1	-	-	-	-	-
64	Manilkara butugi	3	3	4	3	4	-	-	4	-
65	Barbeya oleoides	3	4	4	3	-	-	-	4	-
66	Boscia salicifolia	4	4	4	3	-	-	-	4	-
67	Grewia bicolor	3	4	4	3	4	-	-	4	-
68	Acacia mellifera	1	4	4	4	-	-	-	3	-
69	Balanites aegyptiaca	4	4	4	4	4	4	-	4	-
70	Clutia abyssynica	3	3	1	1	-	-	-	-	-
71	Dobera glabra	4	4	4	2	4	-	-	4	-
72	Berchemia discolor	2	4	4	2	4	-	-	2	-
73	Pyrostria phyllantheoidea	2	3	4	2	4	-	-	2	-
74	Acacia etabaica	4	4	4	4	-	-	-	4	-
75	Euclea schimperi	1	2	3	2	-	-	-	-	4
76	Rhamnus prinoides	-	-	4	3	-	4	-	-	-
77	Dracaena ellenbeckiana	4	-	1	-	-	-	-	4	-
78	Spinuluma oxycantha	2	2	4	3	4	-	-	4	4
79	Sansevieria abyssinica	1	-	1	-	-	-	-	4	-
80	Rhamnus staddo	-	-	4	-	-	4	-	-	-
81	Rosa abyssinica	1	1	4	4	4	1	1	1	1
82	Opuntia ficus indica	-	4	4	4	4	-	-	1	-

4.4.2. Summary of preference ranking for different uses

From the prefence ranking exercises, a summary of the overall preferences for each use has been complied and presented in Table 4. The overall total score was obtained by adding the scores of 1-9 uses given by each respondent from the survey. Based of the result it can be concluded that almost all species have at least one use, though most of the species are used for multiple purposes (Table 3)

According to the survey carried out, ten out of all the species collected were found to be having the highest scores indicating that these species are the most important tree/shrubs species used by the local communities for multiple purposes in the study area (Table 4).

Table 4:- Overall scores and ranks obtained by preference ranking of Tree/Shrub species

NO	LOCAL NAME	SPECIES NAME	TOTALSCORE	RANK
1	Awlie	Olea europaea	5088	1
2	Mekie	Balanites aegyptiaca	4452	2
3	May-Awlie	Olea welwitschii	4293	3
4	Ebuk	Tarconanthus camphoratus	4293	3
5	Tshdi	Juniperus procera	4243	3
6	Atami	Rhus natalensis	3975	4
7	Garsa	Dobera glabra	3816	5
8	Weiba	Terminalia brownii	3816	5
9	Hasti	Erica arborea	3816	5
10	Agam	Carissa edulis	3816	5
11	Dabia	Spinuluma oxycantha	3657	6
12	Wulaga	Ehretia cymosa	3657	6
13	Hitsawits	Calpurnia aurea	3657	6
14	Rewey	Grewia bicolor	3498	7
15	Abedia	Hypericum revolutum	3498	7
16	Tselimo	Maytenus senegalensis	3498	7
17	Tahses	Dodonaea angustifolia	3498	7
18	Awo	Boscia salicifolia	3339	8
19	Kusra bini	Ziziphus mucronata	3339	8
20	Madera	Cordia ovalis	3339	8
21	Tse-Tse	Myrsine africana	3339	8
22	Seraw	Acacia etbaica	3180	9
23	Yalu'e	Manilkara butugi	3180	9
24	Habi	Hagenia abyssinica	3108	9
25	Keretatmo	Grewia kakothamnos	3021	10
26	Alahdi	Sterculia africana	3021	10
27	Chi'a	Acacia sieberiana	3021	10
28	Niebi	Myrica salicifolia	3021	10

Table 4 Continued

NO	LOCAL NAME	SPECIES NAME	TOTALSCORE	RANK
29	Kerets	Osyris quadripartita	3021	10
30	Mishela-eff	Rhus glutinosa	3025	10
31	Melesha'e	Nuxia congesta	3021	10
32	Kaga	Rosa abyssinica	2862	11
33	Gatu	Berchemia discolor	2862	11
34	Leysham	Barbeya oleoides	2862	11
35	Mebttii	Acokanthera schimperi	2836	11
36	Sola	Pyrostria phyllantheoidea	2703	12
37	Chiquente	Ficus glumosa	2703	12
38	Sesem	Anogeissus leiocarpus	2703	12
39	Tetem Agajen	Maerua angolensis	2703	12
40	Tsameo	Inula confertiflora	2703	12
41	Beles	Optunia ficus indica	2544	16
42	Mekiar	Acacia mellifera	2544	13
43	Salha	Teclea nobilis	2544	13
44	Tsehag	Psydrax schimperiana	2544	13
45	Amdug	Pittosporium virdiflorum	2385	14
46	Quiha	Salix subserrata	2385	14
47	Me'ar-Atal	Pavetta abyssinica	2385	14
48	Alakit	Psiadia punctulata	2385	14
49	Kawa	Celits africana	2226	15
50	Mengolhats	Dovyalis abyssinica	2226	15
51	Beles-Adgi	Ficus palmata	2067	16
52	Kliaw	Euclea chimperi	1908	17
53	Gerento	Ficus populifolia	1908	17
54	Tebeb	Becium grandiflorum	1908	17
55	Akehe	Lavandula dentata	1908	17
56	Kalalinko	Canthium setiflorium	1908	17
57	Korenet	Solanum schimperianum	1908	17
58	M'lo	Ximenia americana	1908	17

Table 4 Continued

NO	LOCAL NAME	SPECIES NAME	TOTALSCORE	RANK
59	Gesho	Rhamnus prinoides	1749	18
60	Dintu	Grewia trichocarpa	1749	18
61	Tush Be'alalito	Clutia lanceolata	1749	18
62	Buwak	Abutilon longicuspe	1749	18
63	Siniel	Cadia purpurea	1590	19
64	Me-agaba	Dovyalis verrucosa	1590	19
65	Chi-endog	Otostegia integrifolia	1590	19
66	Meseguh	Pimpinella hirtella	1590	19
67	Atat	Maytenus arbutifolia	1590	19
68	Ajiera	Dracaena ellenbeckiana	1431	20
69	Asha-om	Bersama abyssinica	1431	20
70	Tsedo	Rhamnus staddo	1272	21
71	Balado	Clutia abyssinica	1272	21
72	Shewha	Clerodendrum myricoides	1272	21
73	Shibti	Phytolacca dodecandra	1272	21
74	Gaba	Ziziphus spina-christi	1239	8
75	Adayto	Salvadora persica	1113	22
76	Habi-tselim	Jasminium grandiflorum	1113	22
77	Kastanito	Asparagus africanus	1113	22
78	Siwa-Kerni	Leucas abyssinica	1113	22
79	Eja	Sansevieria abyssinica	954	23
80	Agol	Discopodium penninervium	954	23
81	Hanat	Heliotropium cinerascens	954	23
82	Guata	Pavetta oliveriana	636	24

4.5 Local People's Perception on the causes for forest destruction in the study area

Paired comparison as described by Martin (1995) was used to establish the activities perceived by the local people in the study area to be the major causes for the degradation of the natural forest.

Eight activities from the litrature and general observation by the researcher were used to form the pair for comparison. The activities were fire hazard, fuelwood collection for household consumption, fuelwood collection for sale on the market, logging, grazing, bee hive making, construction materials and charcoal making Each respondent was requested to select an activity from each of the 28 established pairs that he/she considered being a major cause for the degradation of the natural forest. At the end of the exercise each respondent was asked why he/she selected a certain activity first and another one last. Then the activities were ranked according to the number of times they were considered as destructive activity by the respondents from each pair.

A total of 159 houshold heads from the whole 12 Kushets of the study area were involved in this exercise. Accordingly, based on the results from the paired comparison it was found that fire hazard was the most destructive activity considered by most of the local people. The mean score was 118 (18.65 % of the total scores). Beehive making was considered the least destructive with a mean score of 182 (4.1% of the total mean scores). Construction materials was ranked 2nd while fuelwood collection for household consumption, fuelwood collection for sale, charcoal making, grazing and logging were ranked 3rd, 4th, 5th, and 6th, repectively (Table 5)

Table 5:- Total mean scores and ranking of the eight activities

Activities	Fire hazard	Fuelwood coleiction for household Consumption	Fuelwood collection for sale	Logging	Grazing	Bee hive making	Construction material	Charcoal making
Total score	827	741	721	378	371	182	809	405
Total mean score	118	106	103	103	53	26	116	51
Percentage	18.65	16.71	16.26	16.26	8.83	4.1	18.25	9.13
Rank	1	3	4	6	7	8	2	5

The explanation given by the respondents regarding the activities being considered as major causes for the degradation of the forest are given below:-

4.5.1. Fire hazard

According to the respondents in Usto, Bohole, Lugda, Agowo and Haresaw, fire broke out many times in the past at different times distructing a large area of the forest at a time killing herbs, seedlings, saplings and mature trees leaving many dead stumps of J*uniperus procera and Olea europaea* on the ground. Respondents believe that the causes for the fire are those people

who are always travelling to Berahle, in the lowland for collecting salt. (Plate 4). Those people usually rest and feed their camels inside the forest and cause the incidence of fire while preparing their food. On the other hand some of the respondents believe that local people are also contributing to the forest fire when they go out with their cattle for grazing in the forest during the dry season.

4.5.2 Construction materials

According to the respondents in most of the Kushets, a large volume of wood is being cut for churches, and new house construction and maintenance. When constructing the traditional stone houses (Hidmo), the local people, selectively cut and use *Olea europaea* for pillars and *Juniperus procera* for beams and ceiling. Hence, based on the results from the paired comparison, construction material was found to be with high score next to fire hazard in the study area.(Plate 5).

4.5.3 Fuelwood collection for household consumption

Other activity with high score is fuelwood collection for household consumption. Respondents pointed out that fuelwood collection for household consumption is another destructive activity, because 100% of the local people depend on the natural forest for fire wood as well as for lightening. They also mentioned that in Kushets where firewood availability was a problem, living

trees were cut and kept to dry at home.

4.5.4 Fuelwood collection for sale

According to the respondents from Hawile, Hilisha and Akeza, fuelwood collection for sale was the most destructive activity. The reason given by the respondents was that these Kushets are very close to towns such as Edagahamus, Quiha and Makalle.

However, the respondents from the rest of the Kushets considered fuelwood collection for sale was less destructive compared to the other activities. Furthermore, respondents from Usot, Bohole and Lugda Kushets pointed out that the local people in those Kushets do not experience the culture of selling fuelwood on the market.

4.5.6 Least scored activities

It was found that charcoal making, logging, grazing and bee hive making were considered as the least destructive activities to the natural forest in the study area.

For the case of charcoal making, most respondents considered it to be less destructive except those respondents from Hilisha and Akeza Kushets where they pointed out that charcoal making is considered as destructive activity next to fuelwood collection for sale. Logging was less destructive by the respondents as it was selectvive to a specific tree species i.e Juniperus procera that could

produce attractive log. According to the respondents logging is usually carried out when the local people failed to get a good harvest due to drought. However, most of the respondents pointed out that logging is nowadays discontinued by rules and regulations sanctioned by the communities.

Grazing was also considered less destructive for the reason that the grazing area within the forest was divided in to two distinct areas in which a smaller grazing area closer to the farm land is set aside for the plough oxen only and the rest of the forest area is put at the disposal of all other animals which is being practiced by closing one area during the big rains and the other during the small rains.

Another less destructive activity considered by the respondents was bee hive making. This activity was considered less destructive by respondents as it was selective to specific tree species i.e *Juniperus procera*. But, respondents in Usot and Bohole Kushets on the other hand considered hive making as the most destructive activity particularly to specific species i.e *Juniperus procera* which could produce log and bark suitable for making hives. They pointed out that debarking of live trees for such purpose kills the tree, especially when the tree is being debarked during dry season (Plate 1).

4.6. Forest Structure and Species Composition

A total of 82 tree and shrub species belonging to 33 families were identified in the present study. Average density for the whole forest area was 981 mature stems/ha. The density of seedlings and saplings was found to be 1025 stems/ha. A total of 2315 mature stems and 2419 individual of seedlings/saplings were recorded from the study area suggesting low stocking level for the individuals greater than 2 cm in dbh. The total number of trees in each Dbh class decreased with an increasing tree diameter classes. This relationship was also reported by Pande and Bishet (1958). Accordingly,

only *Olea europaea, Juniperus procera, Rhus natalensis* and *Tarconanthus Camphoratus*, and *Maytenus arbutifolia* are among the most dominant tree species, which will remain dominant with the existing pressure on the forest. The average density of these trees is 83,60,40, 38 and 34 stems/ha respectively

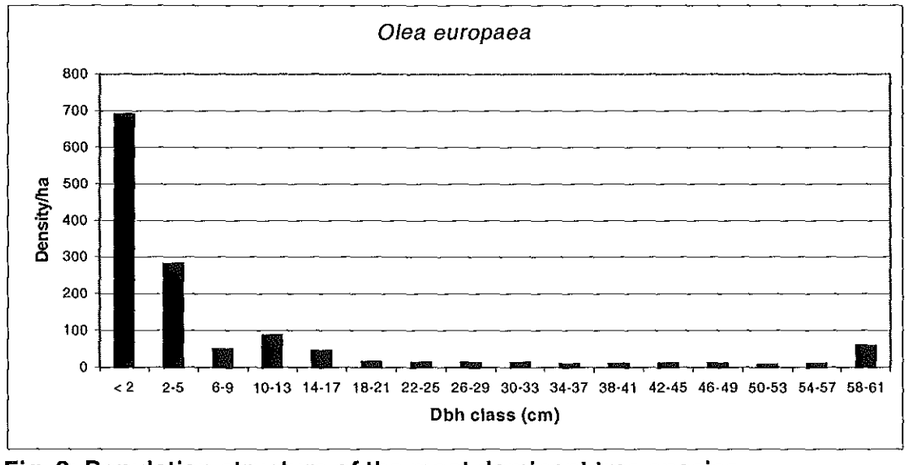
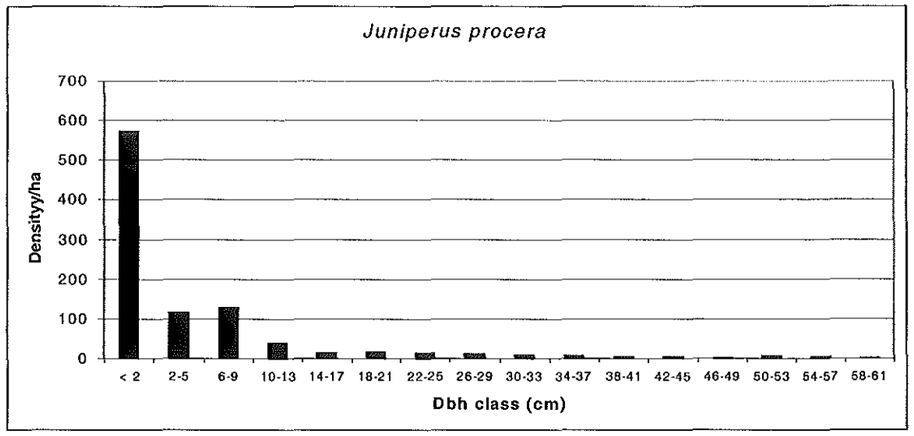
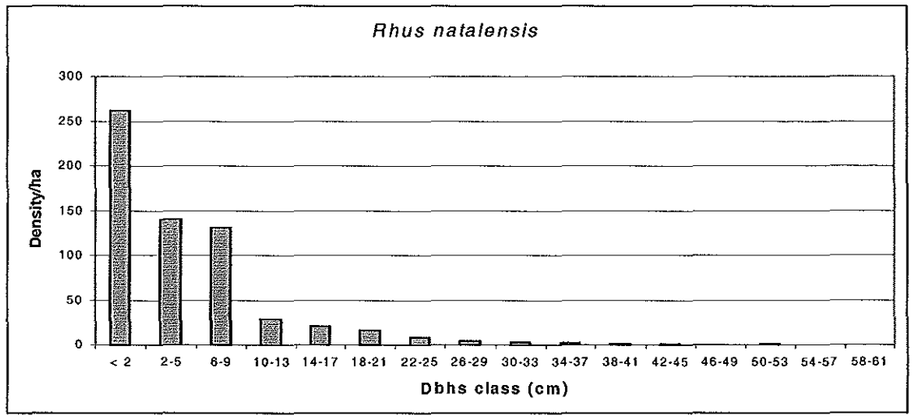


Fig. 3: Population structure of the most dominant tree species





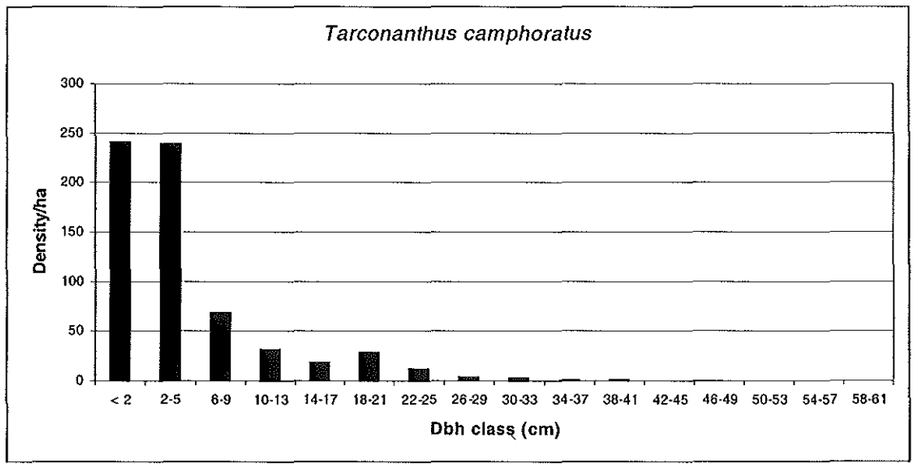


Fig. 3 continued

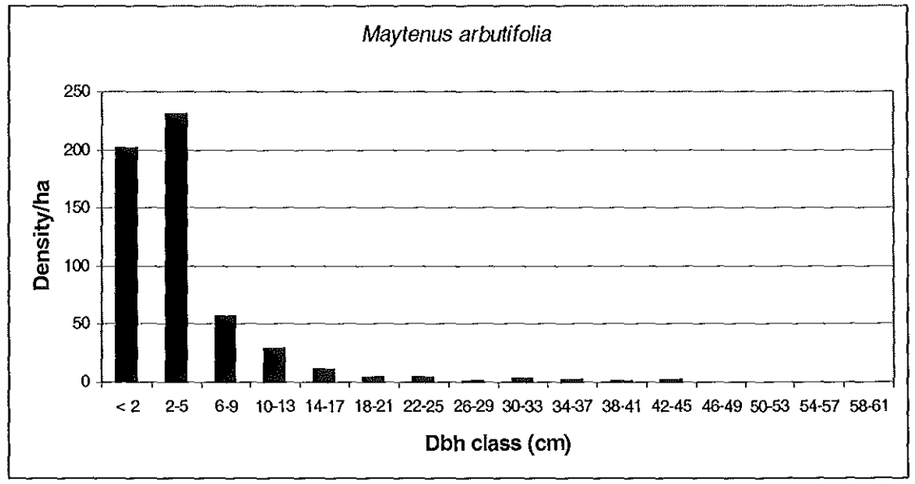


Fig. 3 continued

The remaining tree/shrub species recorded from the whole study area, have densities less than 30 stems/ha for all diameter classes. Density in size classes in the study area show that there is dominance of small sized individuals. The pattern of such density can be an indicator for community dynamics in the forest. The forest pattern is formed by the species structure with reversed J shape in Dbh class distribution. More than 50% of the individuals in the forest have Dbh in the range between 0-2 cm indicating the potentiality of the forest for future production, biodiversity and improvement capability of all the species if appropriate management practice is going to be applied.

On the other hand the low stocking level of mature trees confirmed that the forest was affect by forest fire, collection of fuelwood for household consumption and construction poles.(Table 5).

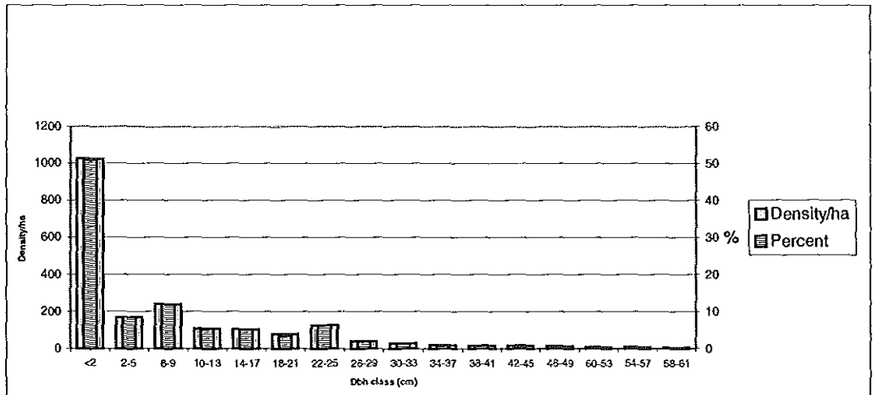


Fig. 4: Density distribution over Dbh classes

The horizontal structure by means of Dbh revealed that the feature of the forest is dominated by shrub vegetation. The height class distribution also follows the Dbh class distribution. More than 50% of the individuals have a height less than 2 meters. 25% of the individuals fall between 10-13 meters range in height. This gap was created by the deliberately left over of *Olea europaea* trees lopped every year for cattle feed by the local people. individuals > 30 meters in height are rare. The study confirmes that the number of individuals decreases as the height of the individuals increases .

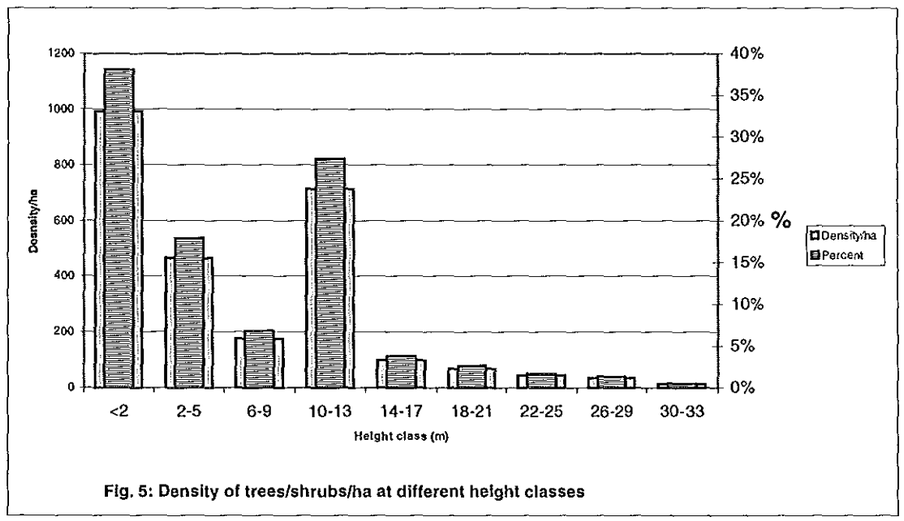


Fig. 5: Density of trees/shrubs/ha at different height classes

Relative density, Relative frequency, Relative Basal area and Importance value Index were computed for all tree and Shrub species having height > 2 meters and Dbh < 2 meters, over the whole study area. Accordingly, for tree/shrub species with Importance value Index (IVI) greater than 1 were presented in table 6. About 10% of the species recorded in the study area have a relative density of 5%. This includes species such as *Olea europaea, Acacia etbaica, Dovyalis abyssinica, Dodonea angustifolia, Maytenus arbutifilia* and O*syris quadripartita.* About 6% of the species have a relative density of 2% while 84% of the species have a relative density of less than 1%.

Analysis of the frequency distribution indicated that *Rhus natalensis, Maytenus arbutifolia, Rhus glutinosa, Euclea schimperi, Juniperus procera, Maytenus senegalensis, Olea europaea, Nuxia congesta, Maytenus africana, Psydrax schimperiana, Tarconanthus camphoratus, Ziziphus spina-christi* were found to be with the highest relative frequencies over the whole sltudy area. (Table 6).

Relative basal area of the species ranges from 0.05% to 24.89%. The contribution of each species to the basal area differ from one another. Species such as *Olea europaea, Juniperus procera, Tarconanthus camphoratus, Nuxia congesta, Maytenus arbutifolia, Acacia etbaica and Dodonea angustifolia* have the highest basal area percentage ranging from 10-16% being *Olea europaea,* and *Juniperus procera*, showing high Importance Value Index, (Table 6).

On the other hand, the density distribution over Dbh classes of the five most important species follow the same trend as that of the relative basal area. *Olea*

europaea attains the highest sizes and is by far the most dominant tree in the study area with a relative basal area of 24.89 followed by *Juniperus Procera*. As basal area provides a better measure of the relative importance of tree species than simple stem counts(Cain and Castro, 1959 in Tamrat Bekele, 1994), species with the largest contribution in basal area can be considered as the most important trees in the forest.

Table 6:- Relative Basal Area, Relative density, Relative frequency and importance value index of the dominant tree/shrub species recorded in the study area

Species Name	Relative Basal Area	Relative Frequency	Relative Density	Importance Value Index (IVI)	RANK
Acacia etbaica	11.20	6.50	3.60	21.30	20
Acacia sieberiana	5.60	4.94	0.12	10.66	23
Acokanthera schimperi	9.14	6.50	0.99	16.63	22
Anogeissus leicarpus	0.17	7.12	0.32	7.61	26
Calpurnea aurea	9.50	26.00	1.18	36.68	11
Carissa edulis	9.15	22.00	0.97	32.12	16
Cordia ovalis	0.18	6.40	0.67	7.25	27
Dodonea angustifolia	12.42	15.00	2.31	29.73	17
Dovyalis abyssinica	5.30	27.40	2.77	35.47	14
Dracaena ellenbeckiana	1.84	15.20	1.34	18.38	21
Erica arborea	0.21	6.56	0.26	7.03	28
Euclea shimperi	6.15	42.62	0.57	49.34	6
Hagenia abyssinica	0.32	1.63	0.55	10.50	24
Juniperus procera	16.88	40.88	6.90	64.66	2
Manilkara butugi	0.16	25.02	0.32	26.10	19
Myrsine africana	7.16	34.50	0.81	42.47	10
Maytenus arbutifolia	7.18	42.5	2.36	52.04	5
Maytenus senegalensis	7.9	38.52	1.64	48.06	7
Nuxia congesta	11.57	35.40	0.12	47.09	8
Olea europaea	24.89	37.70	8.55	71.14	1
Olea welwitschii	8.12	12.50	0.35	20.97	20
Osyris quadripartita	8.66	17.6	2.12	28.38	18
Rhus glutinosa	5.30	27.40	2.77	35.50	13
Rhus natalensis	9.20	41.54	6.20	56.94	3
Salix subseratta	0.14	1.60	0.58	2.32	30
Psydrax schimperiana	4.66	37.50	0.36	42.52	9
Tarconantuts camphoratus	13.92	33.55	5.22	52.69	4
Teclea nobilis	0.26	4.20	0.07	4.53	29
Terminalia browni	3.4	6.15	0.2	9.75	25
Ziziphus spina-christi	2.18	32.40	1.18	35.76	12

The distribution of mature tree/shrub over the three sites (Transects) at similar altitude showed a general tendency of increase in density/ha with an increase in altitude.

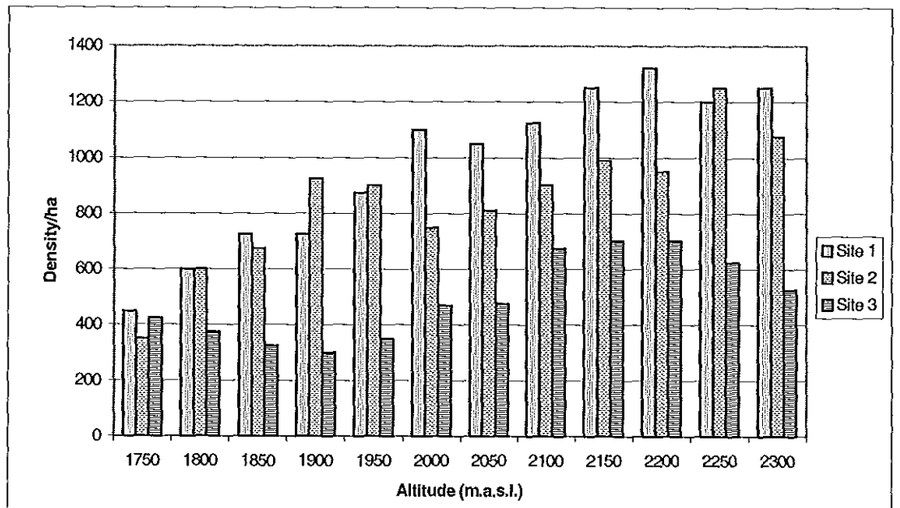


Fig. 6: Density of mature trees/shrubs/ha along the altitudinal gradient

In comparing the three sites, however, site 3 has the least density of indicating that the forest is more disturbed compared to sites 1 and 2.

The main contributors to the relative density especially to the mature trees were, however, *Juniperus procera, Olea europaea, Rhus natalensis, Tarconanthus camphoratus and Maytenus arbutifolia* (Plate 9 and 10).

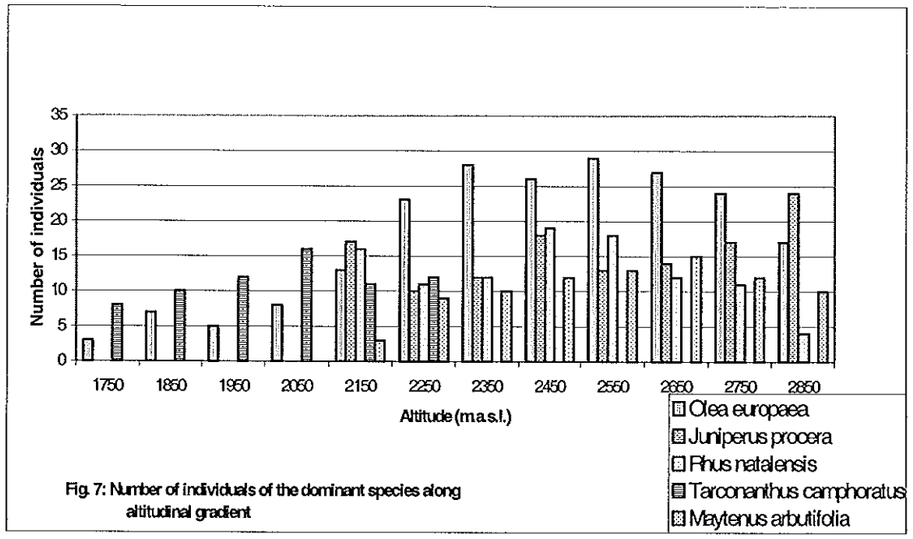


Fig. 7: Number of individuals of the dominant species along altitudinal gradient

The distrubution of the number of individuals of the dominant tree species along the altitudinal gradients is shown in figure 7. Accordingly, *Juniperus procera, Rhus natalensis and maytenus* arbutfolia were found on the altitude between 2550 – 2850 m.a.s.l., *Olea europaea* between 1750 – 2850, while *Tarconanthus comphoratus* was found between 1750 – 2250. *Olea europaea* was found along all the altitudinal ranges, while *Tarconanthus camphoratus* was absent above 2250 meters.

4.7. Species diversity along the altitudinal gradient

Species composition varies with the change in altitude. There is a tendency of increasing in the number of species as the altitude increases. More species were encountered at altitude 2150 m.a.s.l and 2200 m.a.s.l. The number of species increase as the altitude increases upto an altitude of 2150 m.a.s.l and start to decrease again as the altitude increases.

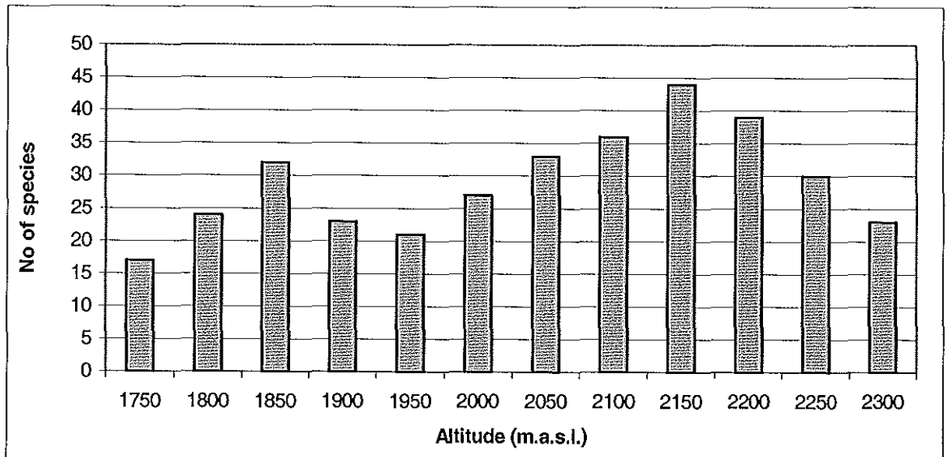


Figure 8: Species distrbution along elevation

Shannon – Wiener Index (1963) was used to calculate the species diversity along the altitudinal ranges of the study area. In this study the diversity Index for all Tree/shrub species showed an increase with an increase in altitude. The Diversity Index was greater in higher altitudes compared to the lower altitudes except at 2050 and 2000 m.a.s.l. where the number of species identified in the sample plot were low compared to the number of species found in the adjacent sample plots.

The result of the study further revealed that diversity Index was very high at 2150 and 2250 m.a.s.l while the lowest diversity was observed at altitudes 1750, 1800 and 1850 m.a.s.l.

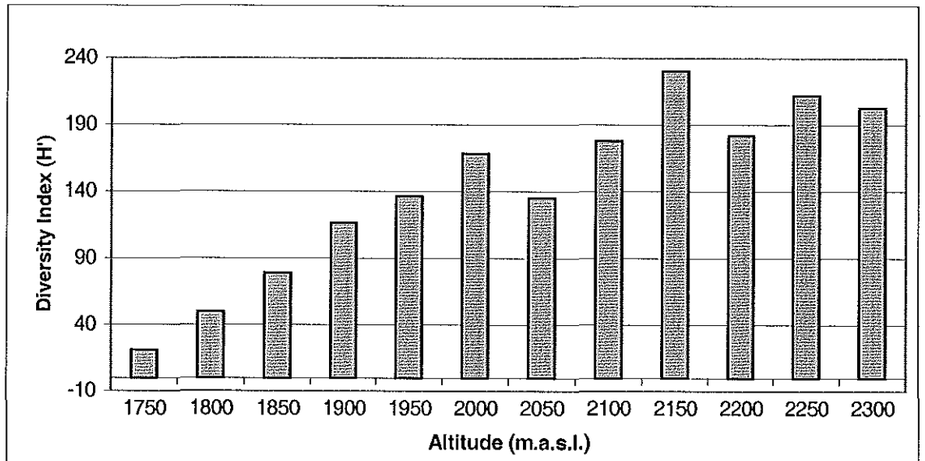


Fig. 9: Species diversity along the adjacent altitudinal intervals

This may be due to the sensitiveness of the Shannon- Wiener Index to rare species, since it assumes that individuals are randomly sampled from an infinite population and that all species are represented in the sample.

This means that if individuals of species are more or less equally distributed in the sample Plot, then the maximum possible species diversity would occur. But, if many individuals of a very few species are concentrated in the sample plot, compared to the number of the other species, then very few species will be abundant and the diversity Index would be low.

In this study comparison of species diversity between the three different sites of the study area on the same elevational ranges was carried out using ANOVA.

The result showed that the number of species at the adjacent altitudes within the three difference sites varies significantly. The result confirmed that there is significant different in species diversity between the three different sites of the study area on the same elevational ranges.

4.8. Regeneration status of the forest in the study area

The data on density of seedlings/saplings present at each altitude along the transects is presented in figure 10. Establishment of regenerating plants of tree and shrup species at all the transects indicated that the forest area is highly affected by biotic factors. The heighest average density of seedlings is recorded from site 1 (1423) as opposed to sites 2 (606) and 3 (438).

This study showed that the most disturbed (Site 3) has less young growth than the moderately disturbed (site 2) and least disturbed forest (site 1). This result of poor regeneration especially for commercially valuable species may be due to high pressure on both sites from cutting wood for fuel, construction material and uncontrolled grazing inside the forest (Table 5) and (Plate 4).

From the dominant tree species which represent the forest structure in all the three sites, *Olea europaea* has high number of seedlings and saplings. Most of the dominant tree species showed good forest structure having more number of small size classes and less bigger diameter class trees which may show healthy forest structure.

The renewal of the tree crop by natural means in the form of young crop is the indication of the healthy site. Regeneration assessment is an important part of

forest survey which serves in evaluating stocking and the composition of the forest to make a decision wether the area is well established with the desired species (Brand, Lekie and cloney, 1991).

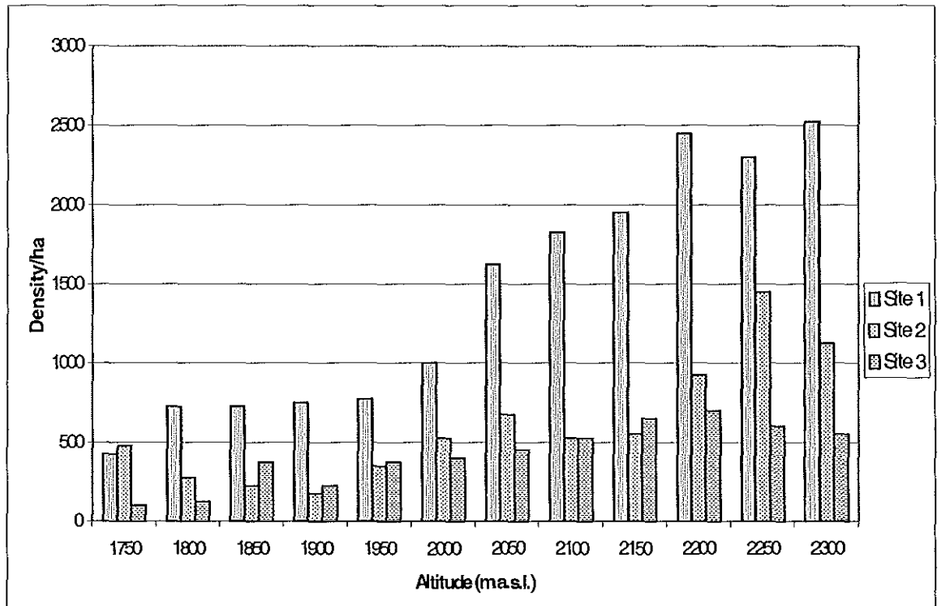


Fig. 10: Seedlings/saplings distribution (density/ha) along altitudinal gradient at the 3 sites.

The density/ha at each site increases as the Altitude increases. The highest density of was observed on 2050, 2100, 2150, 2200, 2250 and 2300 m.a.s.l compared to the lower altitudes.

Furthermore, the data on density of seedlings/saplings/ha confirms that as the density of mature trees/shrubs/ha increases the density of seedlings/saplings/ha increases relatively.

5. Conclusion and Recommendations

Understanding of the people-forest interaction is critical for sound vegetation management and maintenance of biodiversity. The assessment showed that the forest is mainly dominated by shrub and poor quality species. Besides to natural attributes of the forest, illegal collection of forest products has affected the compositions and structure of the forest adversely. However, the result confirms that the average density of tree/shrub species observed in the whole study area indicates that the stocking level of trees/shrub species is still high (981 stems/ha) compared to the normal tree density of 500 stems/ha to about 650 stems/ha (Kessy, 1992).

The result of this study has highlighted the current problems associated with the management of the forest. The number of bigger diameter class trees/shrub are being diminished particularly at the central and southern part of the forest where there is high human intervention. The diameter frequency distribution and the lack of big trees indicated that there is already lack of bigger diameter class, which may represent the true nature of the vegetation cover of the study area.

Therefore, to improve the natural diversity and structure of the forest , to minimize the external pressure on it from the surrounding population and to gain optimum production from the forest the following recommendations are made.

1. The importance of conserving biological resources and the need for managing this resources for present and future generation should be given much attention. Therefore, vegetation of the study area should be conserved based on the assumption that the rational use of the vegetation includes the requirements of

the local people and the production capacity of the environment. The forest resource should not be dominated by a conventional conservation approach that tends to alienate communities from conservation areas. The management and conservation of the natural resources is not possible without the active involvement of local people. Thus, participatory forest management approach must be introduced in the study area. This can provide the opportunity for the local communities to express their interests in relation to the forest conservation. It is only when such a framework for expressing, debating and resolving differences of interest is in place that each interest group will respect the interest of the other and develop cooperative norms. Sustainable management thus will largely depend on the level of interaction and cooperation amongst the stakeholders including the local people.

2. It is an urgent need to establish forestry research station in the forest for the understanding of the forest community dynamics, to know the factors which determine the florisitic composition and structure of the forest, ecology of each species and biophysical interaction.

3. Traditional practices on genetic conservation should be investigated so that local people can live in harmony and sustainably with nature in the future.

4. Carry out In - situ and ex-situ conservation systems to ensure sustainable management of biological diversity. This can help as an additional insurance against genetic losses from the exising forest area.
5. Investigate the impact of free grazing and closures on the natural regeneration of the most important tree species.

REFERENCES

Aalbaeck, A. (1993). Seed Zones of Ethiopia and Eritrea. Map prepared for national Tree Seed Project. The Ethiopian Mapping Authority, Addis Ababa.

Ackzel, L. (1994). Natural regeneration on planted clear-cuts in Boreal. Sweden Scand. J. For. 9: 245-250. Addis Ababa, Ethiopia.

Balick, M.I. (1992). Plants People and culture. The science of Ethnobotany, NewYork.

Barbour, N.G., Burk, J.H. and Pitts, W.D. (1987). Terrestrial plant ecology, (2nd ed.). The Benjamin / Cumming Publishing Company Inc. Tokyo.

Barton, A.M. (1994). Factors controlling plant distribution: Drought, Competition, and fire in montane pines in Arizona. Ecological Monographs, 63(4): 367-397.

Bazzaz, F.A. (1991). Regeneration of tropical forests: physiological responses of pioneer and secondary species. Rain forest regeneration and management vol.6, pp.91-118.

Breitenbach, F.V. (1993). The indigenous Trees of Ethiopia, Addis Ababa, Ethiopia.

Cernea, M.M. (1990). Beyond Community woodlots: Programs with participation Social Forestry Network paper No. 11, London.

Chambers, R. (1969). Report on Social and Administrative Aspects of Range Management Development in the North Eastern province of Kenya, Ministry of Agriculture, Nairobi, Kenya.

Chambers, R. (1983). Rural Development: putting the last first. John Wiley and sons, inc., New York, U.S.A.

Chapman, G.P. (1973). The Green Revolution. A Gaming Simulation, Institute of British Geographers, 5, 2, pp. 129 - 40.

Chapman, J.D. and White, F. (1970). The evergreen forests of Malawi. Common Wealth forestry Institute, University of Oxford 190 pp.

Clark, D.A. (1986) Regeneration of canopy trees in tropical wet forest. Tree, 1(6): 150-154

Concline, H.C. (1979). An Ethnoeclogical Approach to shifting Agriculture. The Natural History press, Garden City, New York.

Crawley, M.J. (1986). The structure of plant communities. Plant Ecology (ed. Michael and Crawley). Oxford Blackwell Sc. Pp. 1-50

Curtis, J. T. and McInosh, R.P. (1950). The interrelation of certain analytical and synthetic phytosociological characters. Ecology, 31:434-455.

Denslow, J.S. (1987). Tropical rainforest gaps and tree species diversity. Ann. Rev. Ecol. Syst. 18: 431-451.

EFAP (1994). Ethiopia Forest Action Program. Volume I, ii, iii and, IV. Final Report, MoNRDEP, EFAP Secretariat, Addis Ababa.

EPA (1997). Environmental policy, Environmental Protection Authority, Addis Ababa

FAO (1984 a). Geomorphology and soils. Assistance to landuse planning in Ethiopia, Addis Ababa.

FAO (1984 b). Forest resources and potential for Development. Assistance to landuse planning in Ethiopia, Addis Ababa.

FAO (1993). Common Forest Resource Management. Annoted Bibilography of Asia, Africa and Latin America, Community forestry Note No. 11, FAO, Rome.

FAO (1995 a). Forest resources in tropical forest management: principles and concepts. Forestry paper 107, 105 pp., Rome.

FAO, (1995 b). Tree growing by rural people. Food and Agriculture organizastion of the United Nations, Rome, Italy.,

FTP (1989). Rapid appraisal of tree and land tenure. Community forestry note No.5,

FTP (1995). The historical Matrix breaking away from static analysis. Newsletter No. 26/27.

Getachew Eshete (1998). The impact of different landuse systems on structure, regeneration, and some soil properties of Abernosa Acacia woodland (Eastern Shoa, Ethiopia). Thesis work submitted to Sewdish University of Agricultural Sciences, Faculty of Forestry.

Greenway, P.J. (1943). Second draft report on vegetation classification for the approval of the vegetation committee, Pasture Research Conference, Nariobi, Kenya.

Grenier, L. (1998). Working with Indigenous knowledge. A guide for researchers, International Development Research Center,115 pp.

Hamilton, A.C. (1974). Distribution patterns of forest trees in Uganda and their historical significance. Vegetation, 29:21-35.

Hamilton, A.C. (1975). Distribution patterns of forest trees in Uganda and their historical significance. Vegetatio, 29:21-35.

Hardin, G. (1968). The tragedy of the commons. Science 162:1243-1248.

HTS, (1976). Tigray Rural Development study, Appendix 6, Forestry, Borehamwood, England.

ICRAF (1988). Agroforestry in Dryland Africa, Nairobi, Kenya.

ICRAF (1991). A selection of useful trees and shrubs for Kenya. Nairobe, Kenya.

Inglis, A. (1994). The participatory approach. A background paper prepared for the Eighth large meeting of the UK Tropical Forest forum, Edinburgh.

IUCN. (1990). Biodiversity in Sub-Saharan Africa and its islands.

IUCN (1991). Caring for the Earth. A strategy for sustainable living, gland, Switzerland.

IUCN (1994). The IUCN Sahel studies 1991. The world Conservation union, gland, Switzerland.

IUFRO (1995). Dryland Forestry Research. Proceeding of an IFS/IUFRO Workshop, Stockolm, Sweden.

JICA (1997). Forest Resources management study in the South Western part of Ethiopia, Draft Final Report, Addis Ababa.

Kajembe, G.C. (1994). Indigenous Management systems as basis for community forestry in Tanzania. A case study of Dodoma urban and Lushoto Districts. Tropical Resources Management papers, Wageningen Agricultural University. The Netherlands, 194 pp.

Kebede Agize and Admasu Bizuneh (1997). Soil study of Dss'a Forest Ministry of Agriculture, Addis Ababa.

Kershaw, K.A. (1964). Quantitative and dynamic ecology. Edward Amold Publishing Co. Ltd, 183 p.

Kessler, J. J and Breman, H. (1993). The Role of Woody Plants in Agro - ecosystems in semi – arid Regions, Springler, Berlin.

Kessy, J.F. (1992). Socio-economic and policy aspects of extending environmentally sound land use techniques to the rural population. MSc-Dissertation, NORAGIC, Agricultural University of Norway:

Kessy, J.F (1998). Conservation and utilization of Natural Resources in the East Usambara Forest Reserves: Conventional views and local perspecives, Wageningen Agricultural University, the Netherlands.

Kidane Mengistu (1994). Forest Management stysems in Ethiopia: Overview and options for future development, FaWCDD, Addis Ababa.

Koech, M. K. (1996). Indigenous people and their knowledge in Development: National Environmental Action plan Contribution. 5th International Congress of Ethnobiology, Nairobi, Kenya.

Koza, p. (1996). Indigenous knowledge systems and Biodiversity conservation. 5th International congress of Ethnobiology, Nairobi, Kenya.

Lisanework Nigatu and Mesfin Tadesse (1989). An ecological study of the vegetation of the Harena forest Bale, Ethiopia. SINET: Ethiopia. J. Sci., 12(1): 63 - 93.

Lynch, O.J., and Talbott, K (1995).) Balancing acts of Community based forest management and national law in Asia and the pacific. World Resources Institute.

Martin, G. J. (1995). Ethnobotany: " People and Plants", Conservation manual . Champman and Hall, London, New York.

Maydell, H.J.Von. (1990). Appraisal of practices to manage woody plants in Semi-arid Environments. Wentorf, Germany.

Melaku Worede (1990). The importance of preserving Ethiopia's Biological diversity in the context of Natural Resources Management, Institute of Biological Diversity, Addis Ababa.

Menaut, J.C., lepage, M. and Abbadie L. (1995). Savannas, Woodlands and Dry forest in Africa. (Eds. Stephen H.B., Harold A.M. and Emesto Medina). Cambrdge University press. Pp. 64-89.

Misra, K.C. (1974). Manual of plant Ecology. Oxford and IBM pullishers company, New ,Delhi.

MOA (1997). Draft Forest Policy, Ministry of Agriculture, Addis Ababa.

MOA (1997). Socio Economic Survey of the Dessa forest, Ministry of Agriculture, Addis Ababa.

Mooney, H.A. (1974). Plant forms in relationship to Environment . Handbook of Vegetation Science, Vegetation and Environment, The Hague , Netherlands.

Moreau, R.E. (1963). Vicissitudes of the African biomes in the late pleistocene. Proc. zool. Soc. Lond. 141. 395 – 421.

Mungala, P.M. (1994). An overview of Forestry Management strategies in Kenya. A paper presented at the participatory forest Management workshop in Ethiopia on 17th - 18th March, 1994, Addis Ababa, Ethiopia.

NCS (1990). Ethiopian experience in conservation and development, National Conservation Strategy Vol. 3, Addis Ababa.

Netting R.M. and Stone M.P. (1996). Agro-diversity on a farming frontier: Kofyar smallholders on the Benue plains of central Nigeria. Africa 66 (1) 52-70.

Netting, R.(1968). Hill farmers of Nigeria, University of Washington Press, Seattle.

Niering, W.A. (1987) Vegetation dynamics (successions and climax) in relation to plant community management. Conservation Biology, 1(4).287-297.

Okafor, J.C. (1996). Contribution of Indigenous Knowledge and Local Initiatives to the Utilization and Conservation of Biodiversity and Forest Ecosystems in West Africa.

Owino, F. (1991). Balance between Agricultural lands and Forests. The case of developing countries, World Forestry Congress, France.

Pande, P.K. and Bischt, A.P.S. (1988). Regeneration behaviour of some tree species of some forested ecolsystems, Journal of Tropical Forests 4 (1) : 78-84.

Pandey, A, K. (1996). Wild Edible Plants of Shan Tribe of Assam: An Ethnobotanical study. 5th International Congress of Ethnobiology, Nairobi, Kenya.

Pandey, A.N. & singh, J.S (1985). Mechanism of ecosystem recovery: a case study from Kumaun Himlaya. Recreat & Reveget. Res. 3: 271-292.

Pullan, R.A. (1974). Farmed parklands in West Africa. Savannah, 3(2): 119-115.

Reed, W. (1970). The Ecology and Control of Earias. Ph. D. thesis, Reading University, Reading, UK.

Richard, P., and Little, P. (1994). Biodiversity in African Human Landscape: A concept paper prepared for the Biodiversity workshop. AAC and SSRC, Nairobi, Kenya.

Riley, D. and Young, A. (1966). World Vegetation: Cambridge University press, Cambridge.

Sarin, M. (1993). Joint Forest management, from conflicts to collaboration. Local institutions in join forest management, working paper No. 114, Ford foundation, New Delhi.

Saxena, N.C. (1993). Joint forest management: A new development band-wagon in India Rural development forestry network paper No. 14d:30-40.

SFCDD (1990). Ethiopian forest Resource base identification, conservation and Rational use in Ethiopia. State Forestry conservation and development department, Addis Ababa.

SFCDD (1994). Management plan for Wofwasha Forest. Ministry of Agriculture, Addis

Shannon, C,E., and Wiener, W., (1963). The Mathematical Theory of communication. University of Illinois Press, Urbana, 320 pp.

Shiva, V. (1990). Biodiversity, A Third World perspective, Third world Network, Pulau Pinang, Malaysia.

Singh, R.V. (1994). Participatory management for sustainable development of degraded forests in India, Indian council forestry research and education, Dehradun, India.

Spurr, S.H and Barnes, B.V. (1980). Forest Ecology third. Jhon Wiley & Sons.

Tamrat Bekele (1994). Studies on Remnant Afromontane Forests on the Central Plateau of Shewa, Ethiopia. Comprehensive Summaries of Uppsala Dissertations from the Faculty of Sciences and Techonology, 23:59 pp.

TFAP (1997). Tigray Forestry Action Program, main report, vol. I. Bureau of Agriculture and Natural Resources Development, Mekelle, Tigray, Ethiopia.

Toumy, J.W. (1947). Foundation of Siliviculture upon an Ecological Basis. John Wiley, New York.

UNDP/ECA (1997). Forestry Development program for Benshangul – Gumuz National Regional State. Vol. VII Addis Ababa.

UNEP (1995). Global biodiversity assessment, Nairobi.

Wade, R. (1987). The manaement of common property resources: Collective action as an alternative to privataization or state regulations. Cambridge Journal of Economics 11:95-106.

Whitmore, T.C. (1990.) Tropical rain forest. Clarendon Press Oxford. 226 pp.

Whittaker, R.H (1970). Communities and Ecosystems. The Macmillan Company, London. 158 pp.

Whittaker, R.H. (1972). Gradient Analysis of Vegetation. Bot. Rev. 42: 207

Whittaker. R. H. and Levin, S.A. (1975.) Niche theory and application ed. Benchmark papers in ecology, 3.

Wiersum, K.F. (1992). A decade of social and community forestry introduction. Forestry and rural development, Department of forestry, Wageningen Agricultural University. Wageningen.

Wiersum, K.F.(1993) Community management of natural forests in the tropics. Reader, forestry and rural development 2 course. Department of Forestry, Wageningen Agricultural University Wegeningen.

Wilson, E.O. (1988). Biodiversity. National Academy Press, Washington D.C.

Wilson, R.T. (1977). The vegetation of central Tigre, Ethiopia, in relation to its land use, Webbia 32 (1): 235 - 270.

Wood, P. J. (1995). Dry land Forestry Research, Hyytiala, Finland.

World Forestry Congress (1997), Forestry for Sustainable Development towards the 21st Century, Vol. 2,5 Ankara, Turkey.

Yeraswork Admassie (1997). Socio-economic study of the Dessa State forest, Report submitted to the Bureau of Agriculture and Natural Resources of the Tigray National Regional State, Addis Ababa.

Zemede Asfaw (1996). Traditional practices and Ethos Favouring Preservation of Biodiversity in Ethiopia. 5th International congress of Ethno biology, Nairobi, Kenya.

Zerihun Woldu, Feoli, E. and Lisanework Nigatu (1989). Partitioning an elevation gradient of vegetation from South Eastern Ethiopia by probablistic methods. Vegetatio, 81: 189-198.

Appendix 1:- Paired comparison field data collection form

Serial No	Pair/order	Activities
1	2,1	Fuelwood collection for household consumption, Fire hazard
2	3,1	Fuelwood collection for sale, fire hazard
3	3.2	Fuelwood collection for sale, fuelwood collection for household consumption
4	4,1	Logging, Fire hazard
5	4,2	Logging, Fuelwood collection for household consumption
6	4,3	Logging, Fuelwood collection for sale
7	5,1	Grazing, Fire hazard
8	5,2	Grazing, Fuelwood collection for household consumption
9	5,3	Grazing, Fuelwood collection for sale
10	5,4	Grazing, Logging
11	6,1	Hive making, Fire hazard
12	6,2	Hive making, Fuelwood collection
13	6,3	Hive making, Fuelwood collection for sale
14	6,4	Hive making, Logging
15	6,5	Hive making, Grazing
16	7,1	Construction material, Fire hazard
17	7,2	Construction material, Fuelwood collection for household consumption
18	7,3	Construction material, Fuelwood collection for sale
19	7,4	Construction material, Logging
20	7,5	Construction material, Grazing
21	7,6	Construction material, Hive making
22	8,1	Charcoal making, Fire hazard
23	8,2	Charcoal making, Fuelwood collection for household consumption
24	8,3	Charcoal making, Fuelwood collection for sale
25	8,4	Charcoal making, Logging
26	8,5	Charcoal making, Grazing
27	8,6	Charcoal making, Hive making
28	8,7	Charcoal making,Construction material

Appendix 2:- Sample of field checklist for Ethnobiological information.

I. List of preferred species for:-

1 Fire wood:_____
_____

2 Timber :_____

_____

3 Poles, Construction:
_____

_____

4 Bee forage:-
_____

_____

_____

5 Human medicine:-
_____

_____

6 Veterinary medicine:-
_____

_____

7 Human food:-
_____

_____

8 Animal fooder:-
_____

_____

9 Tush (Traditional smoke-bath)_____

II. **Perception on Biodiverstiy**.

1. Compare a natural and plantation forest and which one do you think is more important to your household and why?

_____
_____
_____
___.

2. Do you know the endemic tree/shrub species available in your community.

_____
_____
_____
___.

3. What do you think are the most destructive activities to Dess'a forest?

_____
_____
_____
___.

III. **Forest products utilization.**

1. What type of forest products are used in your household?

2. Can you please tell us if your household is involved in trading some of the forest products? If yes what type of products?

_____
_____
_____
___.

IV. **Perceptions or Forest management Issues**.

1. Before the demarcation of the Dess'a forest as National forest priority area how was it managed by the local communities.

_____
_____
_____
___.

2. Were there any traditional laws preventing people from entering the forest for:

_____
_____
_____
__.

2.1 Bee Keeping _____
2.2 Grazing _____
2.3 Collecting of forest Products _____

3. How do you compare traditional forest management with the current rules used in managing the forests.

_____
_____
_____
__.

4. Are you satisfied with the current rules in managing the forest? Why?

_____
_____
_____
__.

5. Have you ever requested for permit to harvest forest products from the forest.

_____
_____
_____
__.

6. Have you ever been involved in making suggestions or decisions towards forest management.

_____
_____
_____
__.

7. How best do you think you could participate in forest management activities.

_____
_____
_____
___.

8. which local institution do you think can work with the Government in managing the forests for the benefits of the people.

_____
_____
_____
___.

9. Do you support the decision to gazette the Dessa forest.

_____
_____
_____
___.

10. What do you think will be the impact of this decision to your household.

_____
_____
_____
___.

Appendix 3: Tree and shrub species recorded in the study area

Coll no.	Species Name	Family Name
1	Nuxia congesta R.Br.ex.Fresen	LOGANIACEAE
2	Dovyalis abyssinica (A. Rich.), Warb.	COURTIACEAE
3	Ximenia americana L.	OLACACEAE
4	Rosa abyssinica R.Br.	ROSACEAEE
5	Maytenus arbutifolia (Hochst. ex A.Rich) Wilezek	CELASTRACEAE
6	Rhus glutinosa Hochst. ex.A.Rich.	ANACARDIACEAE
7	Abutilon longicuspe Hochst ex.A.Rich.	MALVACEAE
8	Clutia lanceolata Forssk	EUPHORBIACEAE
9	Dodonaea angustifolia L.f.	SAPINDACEAE
10	Solanum schimperianum Fracnch.	SOLANACEAE
11	Osyris quadripartita Hochst & Steud.	SANTALACEAE
12	Juniperus procera Hochst. Ex.Endl.	CUPRESSACEAE
13	Phytolacca dodecandra L.Her.	PHYTOLACCEAE
14	Psydrax schimperiana A.Rich	RUBIACEAE
15	Pimpinella hirtella A.Rich.	APIACEAE
16	Leucas abyssinica (Benth.) Briq.	LABIACEAE
17	Otostegia integrifolia (Forsk.) Briq	LAMIACACEAE
18	Dovyalis verrucosa (Hochst.) Warb.	FLACOURTIACEAE
19	Tarconanthus camphoratus Linn.	ASTERACEAE
20	Maytenus senegalensis (Lam.) Exell.	CELASTRACEAE
21	Celtis africana (A.Rich.) Warb.	ULMACEAE
22	Rhus natalensis Krausse Bridson	ANACARDIACEAE

Appendix 3 continued

Coll. no.	Species Name	Family Name
23	Canthium setiforium Hiern.	RUBIACEAE
24	Psiadia punctulata (Dc.) Vatke.	ASTERACEAE
25	Bersama abyssinica Fresen.	MELIANTHACEAE
26	Acokanthera schimperi (A.Dc.) Benth.	APOCYNACEAE
27	Ficus palmata Forsk.	MORACEAE
28	Cadia purpurea (Picc.) Ait.	PAPILIONACEAE
29	Carissa edulis Forssk. Vahl.	APOCYNACEAE
30	Myrsine africana L.	MYRSINACEAE
31	Lavandula dentata L.	LAMIACEAEE
32	Pavetta abyssinica Fresen.	RUBIACEAE
33	Hypericum revolutum Forsk	HYPERICAEAE
34	Erica arborea L.	ERICACEAE
35	Calpurpia aurea Lam. Benth.	PAPILIONA CEAE
36	Leucas stachydiformis (Hochst.ex Benth.) Briq.	LABIATEAE
37	Pavetta oliveriana Hiern.	RUBIACEAE
38	Myrica salicifolia Hochst. ex.A.Rich.	MYRICACEAE
39	Asparagus africanus Lam.	ASPARAGACEAE
40	Inula confertiflora A.Rich.	ASTERACEAE
41	Salix subserrata Willd.	SALICACEAE
42	**Acacia sieberiana Dc.**	**FABACEAE**
43	Pittosporium virdiflorum Sims.	PITTOSPORACEAE
44	Olea cf welwitschii (Knobl.) Gilg & Schellenb	OLEACEAE

Appendix 3 continued

Coll. no.	Species Name	Family Name
45	Becium grandiflorum Lam.	LAMIACEAE
46	Hagenia abyssinica J.F.Gmel.	ROSACEAEE
47	Discopodium penninervum Hochst	SOLANACEAE
48	Rhamnus staddo A.Rich	RHAMNACEAE
49	Jasminum grandiflorum L.	OLEACEAE
50	Clerodendrum myricodies (Hochst.) (R.Br.) ex Vatke	VERBENACEAE
51	Heliotropium cinerascens Dc.	BORAGINACEAE
52	Teclea nobilis Del.	RUTACEAE
53	Sterculia africana (Lour.) Fiori.	TERCULIACEAE
54	Ficus populifolia Vahl.	MORACEAE
55	Cordia ovalis R.Br.	BORAGINACEAE
56	Zizyphus spina-chrsti (L.) Desf.	RHAMNACEAE
57	Grewia trichocarpa	TILIACEAE
58	Maerua angolensis Dc.	CAPPRIDACEAE
59	Zizyphus mucronata Willd.	RHAMNACEAE
60	Ehretia cymosa Thonn	BORAGINACEAE
61	Anogeissus leiocarpus Dc. Guill. & Perr.	COMBRETACEAE
62	Grewia cf kakothamnos K.Schum.	TILIACEAE
63	Terminalia brownii Fresen.	COMBRETACEAE
64	Ficus glumosa Del.	MORACEAE
65	Olea europea sub sp. cuspidata	OLEACEAE
66	Salvadora persica L	SALVADORACEAE

Appendix 3 continued

Coll. no.	Species Name	Family Name
67	Manilkara cf butugi Chiov.	SAPOTACEAE
68	Barbeya oleoides Schweinf.	BARBEYACEAE
69	Boscia salicifolia Oliv.	CAPPARIDACEAE
70	Grewia bicolor, Juss.	TILIACEAE
71	Acacia mellifera (Vahl.) Benth.	FABACEAE
72	Balanites aegyptica Del.	BALANITACEAE
73	Clutia abyssinca Jaub. & Spach.	EUPHORBIACEAE
74	Dobera glabra (Forsk.)Juss.ex poir	SALVADORACEAE
75	Berchemia discolor (Klotzsch.) Hemsl.	RHAMNACEAE
76	Pyrostria cf phyllantheoidea (Baill.) Brids	RUBIACEAE
77	Acacia etbaica Schweinf.	FABACEAE
78	Euclea schimperi (A.Dc.) Dandy.	EBENACEAE
79	Rhamnus prinodides LHerit.	RHAMNACEAE
80	Dracaeana cf ellenbeckiana Engl.	RACEAENACEAE
81	Spinuluma oxycantha (Baill.) Aubrev.	SAPOTACEAE
82	Sansevieria abyssinica (Powellia) NE.Br. Wan.	AGAVACEAE
83.	Opuntia ficus Indica (L.)Mill	CACTACEAE

Appendix 4:- Tree/shrub field Data Collection form

I. Site description

1. Transect number _____
2. Plot number _____
3. Altitude _____
4. Slope % _____
5. Locality _____
6. Aspect _____
7. Position _____

II. Biological Impact.

1. Human Impact

1.1. None _____
1.2 Low _____
1.3 Moderate _____
1.4 High _____

2. Browsing and Grazing

2.1 None _____
2.2 Low _____
2.3 Moderate _____
2.4 High _____

III Soil Depth

1. Very Shallow
2. Shallow

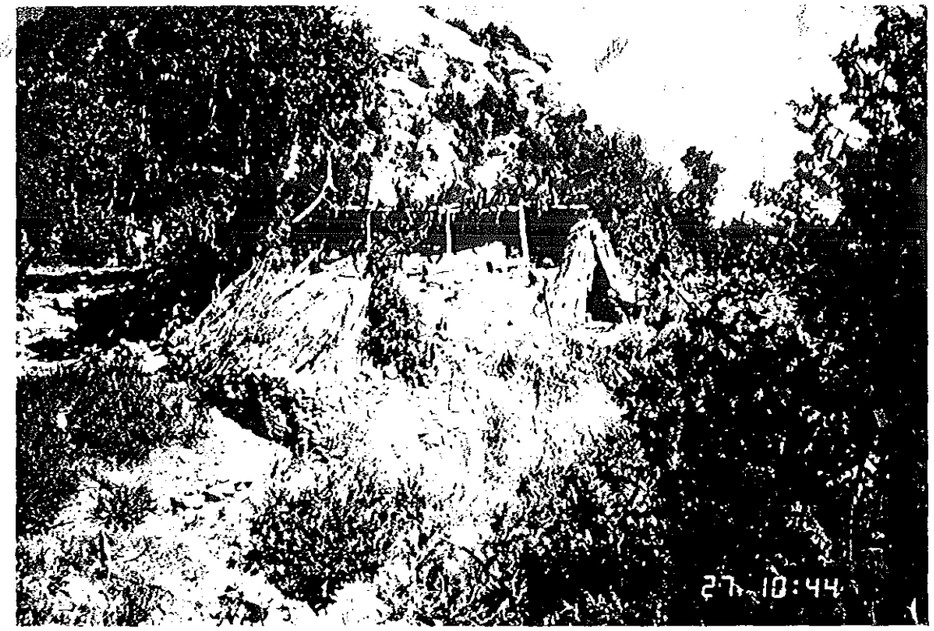
3. Deep
4. Very Deep

V. Stand Data

Tree No	Local name	Species Name	Dbh		Height		Repeneration	
			≤ 2 cm	> 2cm	> 2m	<2m	Apecies name	Frequence

V. Ground Cover

1. Bare _____
2. Sparse _____
3. Moderate _____
4. Dense _____



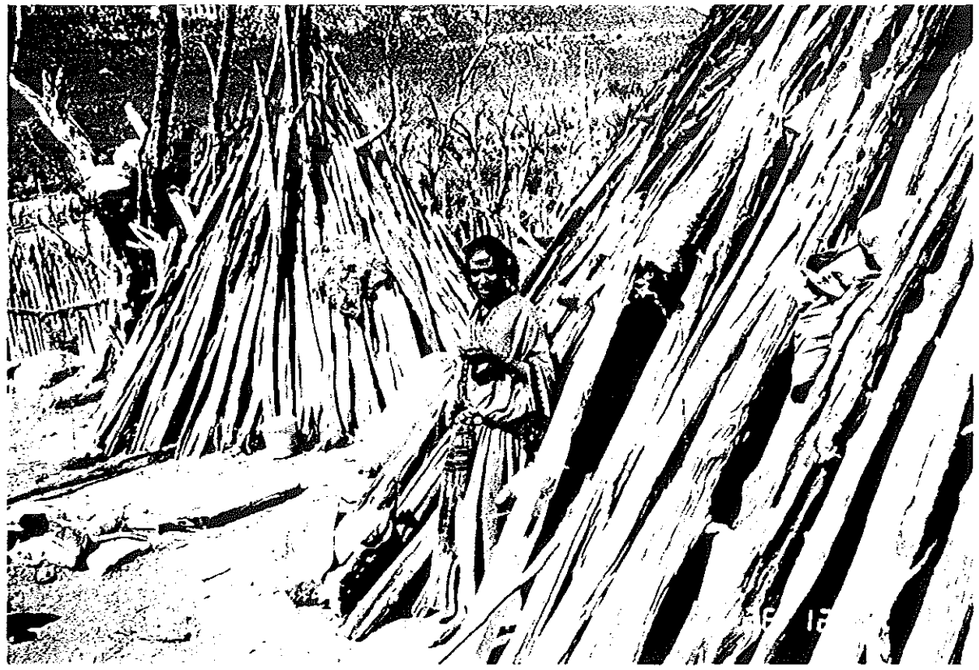
Ganda (stations of beehives)

2. Beehives inside the forest covered with the bark of Juniperus procera

1. **Dead standing debarked Juniperus procera tree.**

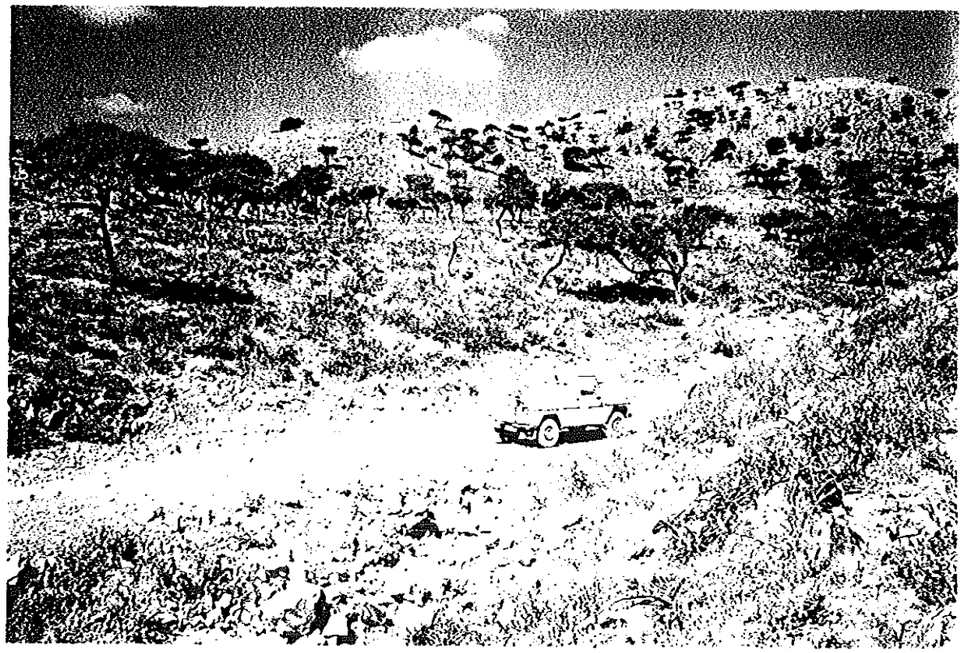
?. Local people collecting berries of Dovyalis abyssinica

4. **Camels inside the forest before and after they bring salt from Berahle in site 2 near Agoro.**



5- **Juniperus procera poles inside the forest near Lugda in site 2.**

Dracaena ellenbeckiana used for making bee hives, ropes, mats etc.by the local people.



6. **Acacia spp. In Adi-arwa in site 2**

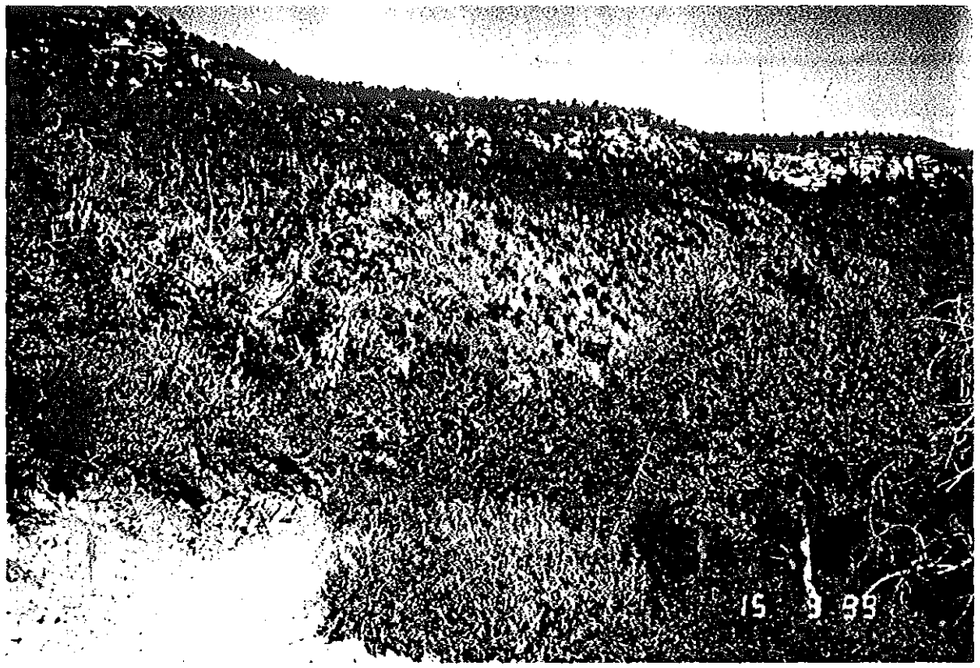
7. **Pure Juniperus forest near Mariam Dibo in site 1**

Sheep and goats inside the forest near Mariam Dibo in site 1.

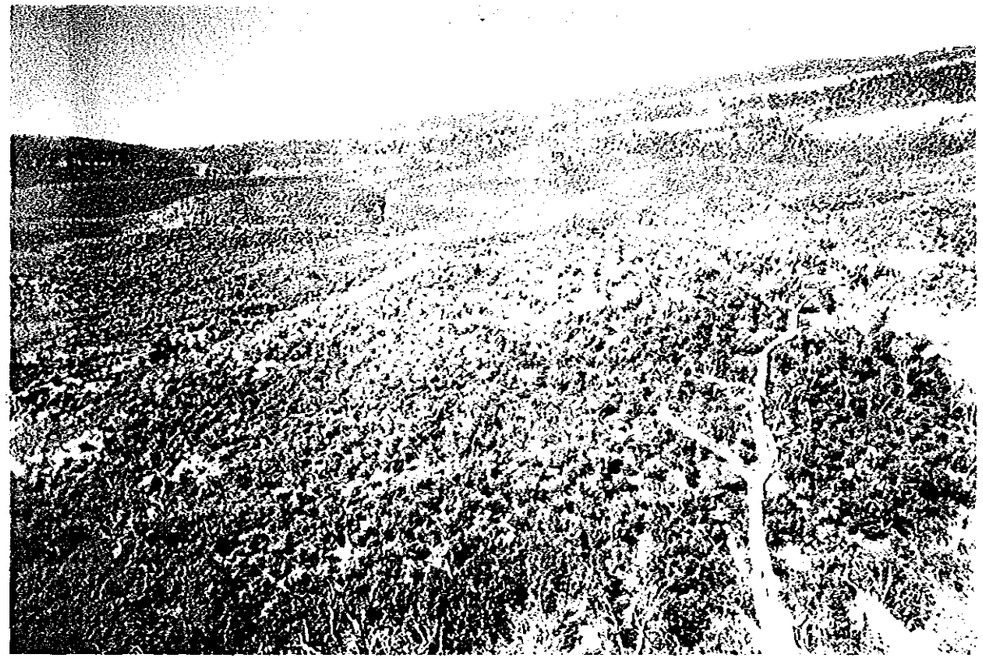
8. **Cattle inside the forest near Usot in site 1.**

Olea-Juniperus procera forest near Mariam Dibo in site 1.

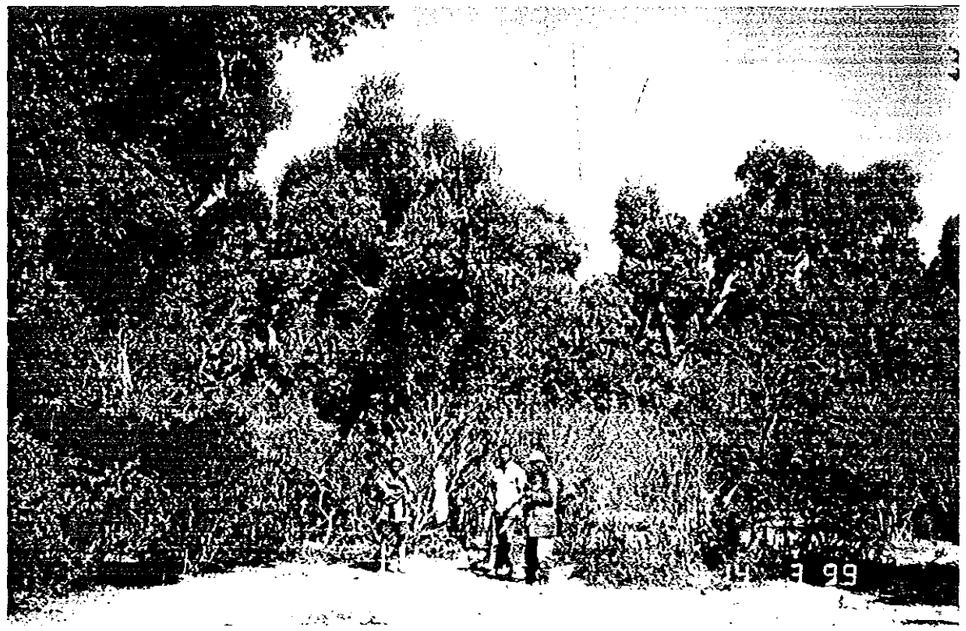
9. **Pure Olea europaea forest near Usot in site 1.**



Rhus spp. near Adi-arwa in site 3.



10. **Tarconanthus camphoratus forest near Agoro in site 2.**



(B)

Plate 11: (a) Lopping of Olea europaea branches for cattle feed near Wahdis in site 1.
(b) Lopping of Olea welwitschii branches for cattle feed near Mariam Dibo in site 1.