ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

A Survey of Nontimber Forest Products and their Conservation Status in the Gimbo District, SNNPR, Southwest Ethiopia

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Addis Ababa

July 2008

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A thesis submitted to the School of Graduate studies of the Addis Ababa University in partial fulfillment of the requirements for the Degree of Master of Science in Biology (Botanical Sciences)

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Dedication

To my mother **Romanework Asres** and to my late great grand mother **Kuribachew Woldehanna**

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LIST OF ABBREVIATIONS

Abbreviations	Acronyms
CIP	Community Improvement Programm
EARO	Ethiopian Agricultural Research Organization
EFAP	Ethiopian forestry action plan
EWNHS	Ethiopian Wild Life Natural History Society
GDP	Gross domestic product
GOs	Governmental Organizations
GTZ	Gesellschaft fuer technische Zusammenabeit
IVI	Importance value index
m.a.s.l.	Meters above sea level
MFPs	Minor forest products
NGOs	Nongovernmental authorities
NMA	National meterological anegncy
NTFP	Nontimber forest product
NTFPs	Nontimber forest products
OXFAM	Oxford and family
PFM	Participatory forest management
PRA	Participatory rural appraisal
SPSS	Statistical package for social sciences
SUPAK	Sustainable poverty alleviation in Kaffa
THPs	Traditional health practices
WBISP	Woody biomass inventory and strategic planning project
WCED	World Commission on Environment and Development

Abstract

The study was carried out to document the NTFPs and assess their conservation status within the Bonga Forest of Gimbo District. Also in the study, by comparing two forest patches one managed by PFM and another freely accessed by the local people, the role of PFM in forest conservation is evaluated. To do all these, ethnobotanical studies, market surveys and vegetation studies were carried out. Ethnobotanical and market data collection were done in accordance with PRA techniques. And vegetation data were collected within 60 sample plots that have a dimension of 30 m X 30 m wherein data for all trees and lianas were recorded. Data for all the shrubs and herbs were also collected within subplots of 5 m X 5 m and 2 m X 2 m respectively. Random walking technique was used to lay the main plots. Vegetation study determined stem density, forest structure, population structures of important tree species, IVI and biodiversity patterns. The study documented 26 NTFPs categories. Out of these, house construction materials, honey and coffee are the most preferred NTFPs. NTFPs; coffee, honey and beeswax, korrorima, wild pepper, carpets made of *phoenix reclinata* leaves, fruits of *Fagaropsis angolensis*, *Ramnus prinioides* leaves and branchs, firewood, charcoal, ropes of different kinds are the NTFPs widely found in the local markets. The status of NTFPs in the study area has reduced over the years and the stutus of *Fagaropsis angolensis* was known to have reduced highly. Student's t-test revealed that neither total stem density nor trees and shrubs density separately in the forests under PFM and free access differ significantly. This shows that although higher rate of selective logging is evident in the free access forest, there is also high rate of reproduction or regeneration or succession within this forest. The biodiversity pattern of the forests in the study area was found to be high (H'= 4.37 & 4.27) and (E =0.94 & 0.91) in the PFM and free access forests respectively. Preference ranking results shows that *Olea welwitschii, Elaeodendron buchananii, Syzygium guineense, Allophylous abyssinicus, Millettia ferruginea, Cordia Africana, Ehretia cymosa , Euphorbia ampliphylla, Ficus sur, Poutera adolfi-friedericii, Shefflera abyssinica* and *vernonia amygdalina* are the most preferred tree species that are source of NTFPs and the IVI result indivcated *Cordia africana, Ficus thonningii, Dombeya torrida, Ekebergia capensis, Vernonia auriculifera, Fagaropsis angolensis, Galinieria saxifrage, Pitosporum virdiflourm* and *Psychotria orophilia* to be the least important tree species. Therefore, the above-mentioned tree species should be a center of foret conservation scheme in the area either due to their high preferredness or due to their low abundance.

Key words: Nontimber forest products, participatory forest management, forest structure, population structure, importance value index, preference ranking

1. Introduction

1.1. Background and justification

There is no exact data with regards to the past and present amount of forest area coverage in Ethiopia (Abate Ayalew *et al*., 2006). However, it is believed that the natural forests of Ethiopia once covered about 42 million ha (about 40%) of the country's land area of the 110 million ha. This forest cover now accounts to only about 4.07 million ha which is about 3.56 % of the country's land area (WBISP, 2004; cited in Getachew Desalegn and Wubalem Tadesse, 2004). And according to Million Bekele (2001), the high forests which used to cover 16% of the land area in the early 1950s were reduced to 3.6% in the early 1980s and further declined to 2.7% in the early 1990s. Both cases show the rapid decline of forestry resource in the country unequivocally.

Of the remaining natural forests, most are located in less accessible and/or less populated areas of the southern and southwestern parts of the country (Kumelachew Yeshitela 1997; Kidane Mengistu, 2002). With the current annual loss of the high forest area estimated to be at the range of 100,000-200,000 ha per year, the country will lose all its natural high forests within the coming few years if the current trend of forest destruction is allowed to continue (Kidane Mengistu, 2002). Therefore, appropriate management systems must be introduced in order to save, protect and develop these resources.

Among the underlying factors for the high rate of forest destruction in the country are; subsistent economy of the rural poor, lack of awareness and inappropriate or less attention given by policy makers, GOs and even NGOs towards the forestry sector. Therefore, to combat this high rate of deforestation and degradation as a whole, due attention should be given to the forestry sector and Ethiopian forests have to be valuated for all the nontimber forest products (NTFPs) and services they are known to provide. Since NTFPs are not considered and developed in Ethiopia, forestry's contribution to GDP of the country in 1991/92 was estimated to be less than 3% (EFAP, 1994). But with exact inventory and evaluation of Ethiopian forests including its NTFPs and services it offers, the figure is for sure way above the 3%. EARO (1998; cited in Million Bekele, 2001), suggested, if direct consumption of commodities such as fuelwood and the indirect

contributions of forests to watershed management and soil conservation as well as that of forest products utilized in other manufacturing and construction activities are considered in the calculation, the contribution of forestry to the total GDP and agricultural GDP will be much higher amounting to about 10%. Yet if the NTFPs are developed and industries that consume NTFPs are expanded, the share of forest to the country's GDP can be even higher.

Nontimber forest products (NTFPs), described in the past as minor Forest products (MFPs) because of their small revenue value, were generally only used by the forest dwellers. Their economic value started increasing after 1960 as new uses for NTFPs were found in several industries (Saxena, 2003). In the present world NTFPs are known to generate huge amount of revenue. Forexample today in India, NTFPs provide approximately 40% of the total official forest revenues, 55% of forest-based employment and 70% of the total exports from forest products (Tewari and Campbell, 1997).

While NTFPs are traditionally used and appreciated by peoples of many cultures world wide, the significance of these products for sustainable economic growth, cultural endurance and environmental health is receiving increasing recognition by governments, researchers and other official agencies (Wilkinson and Elevitch, 2006). Meanwhile in the past decade it has been witnessed a rapid growth of interest in NTFPs among conservation and development organizations (Wallenberg and Ingles, 1998; Neumann and Hirsch, 2000). This can be attributed to increasing recognition of the contribution that NTFPs makes to the livelihoods of large numbers of people in developing countries (Arnold and Perez, 1998), and the suggestion that NTFPs can be harvested with relatively little impact on the forest environment (Neumann and Hirsch, 2000).

Research has focused on exploring the contributions that NTFPs can make to sustainable development by increasing financial income to rural communities and by increasing the value of forest resources thereby providing an incentive for conservation (Richards 1993, Wollenburg and Ingles, 1998). As a result commercialization of NTFPs is widely considered to offer a mechanism by which conservation and development goals can be

achieved concurrently (Christina and Ulrik, 2002). Because of the above facts and others, Ethiopian researchers, NGOs and the government are also considering NTFPs to be an important component for sustainable forest management and biodiversity conservation.

The most important NTFPs in Ethiopia according to Getachw Desalegn and Wubalem Tadesse (2004), include; Gum Arabic (from *Acacia senegal* and other species); Frankincense (from *Boswellia* spp); Myrrh (from *Commiphora* spp); Wild coffee, spices and condiments; traditional medicine; wild honey and bees wax; bamboo (*Arundinaria alpina* and *Oxytenanthera abyssinica*); reeds (*Arundo donax*); wild palm(*Phoenix reclinata*); food from wild edible plants and their products(fruits, seeds and edible oil); essential oil from aromatic plants; fats; fodder; fibers; tannins and dyes; ropes; resins; latex; ornament; panel products produced from giant or long grasses; roof thatch for local house construction; byproducts after liquidating lumber; Wild edible and non-edible animal products; and other extractives; flavoring, sweeteners, balsams and pesticides.

Although, the NTFPs of Ethiopia are diverse, the majority of them are still less known, less managed and understood (Getachew Desalegn and Wubalem Tadesse, 2004; Million Bekele, 2001). There is no inventory information with regards to the NTFPs to estimate the potential and plan its development. The biological, silvicultural and technical methods applicable to their management and utilization have not been developed and need urgent attention. Every management program for these resources must address these constraints effectively. Information on the management of natural stands of these crops is not readily available particularly information on the growth and factors influencing natural regeneration (Million, 2001).

Therefore, according to Million Bekele (2001), in Ethiopia, future program in NTFPs need to focus on:

- Inventory of resources
- Investments in research and development to improve the management of these resources

- Avoid the unsustainable and wasteful harvesting of these resources and estimate their monitory value to the national economy.
- Improve the marketing conditions of these products.
- Commercialization of some of the selected NTFPs through private sector involvement.
- Large-scale development of industries that use these resources as raw material.

The above recommendation is well taken and by this study inventory of NTFPs within the Bonga forest has been carried out.

Bonga forest, which makes 70% of the land mass of the Kaffa zone ($AGRIBUSINESS_a$, 2004), is an important place with center for *Coffea arabica* genetic diversity (Taye Bekele, 2003). Therefore, conservation of Bonga forest is very important in that it helps maintain the genetic resource of the important *Coffea arabica* and other genetic resources *in-situ* ($AGRIBUSINESS_a$, 2004). According to Taye Bekele (2003), Bonga forest is important ecologically, socioculturaly and economically in that it is a good source of organic coffee, cardamon, wild pepper, medicinal plants and other NTFPs. It is also of particular interest to tourists because of cultural wealth of different tribes particularly the Keficho and the Menja tribes. The breath-taking waterfall close to Bonga town is another site of interest. The forest is also suitable for bird watching as it inhabits more than 100 bird species.

Despite the immense importance of the Bonga forest as mentioned above, estimated rate of deforestation of Bonga forest is about 25,000 ha per year, which is about 1/4-1/8 of the total country's forest land lost every year (SUPAK, 2004). This indicates that sufficient attention towards conserving this forest is not given. Feyera Senbeta (2006) reported that the conservation efforts made in Bonga forest so far are not encouraging. The adjacent communities appear to have unrestricted access to the forest. As a result, the forest is subjected to agricultural expansion and selective cutting. Only very recently, FARM-Africa initiated the participatory forest management approach and the implementation process has been on going since 1996.

NTFPs are very important in managing forests sustainably and participatory forest management interventions should make use of these resources. According to AGRIBUSINESS$_a$ (2004), the more lucrative NTFPs gained from Bonga forest the more it will be possible for the forest genetic biodiversity to be maintained. In order to use NTFPs for sustainable forest management, accurate information is needed on the status and regenerative capacity of the resource and on the harvesting techniques used to provide the product, in addition to information on the socio-economic and cultural aspects affecting the use of the NTFPs (Lorbach, 2002).

Therefore, this study focuses on generation comprehensive data regarding the NTFPs resource of the Bonga Forest as studied in the Gimbo District. To carry out a comprehensive study on the NTFPs resource of the Bonga forest, ethnobotanical, market and ecological data collection is very vital. Meanwhile, by this study the inventory of the NTFPs of the Bonga forest as studied in Gimbo district was carried out, market survey to evaluate market price of the different NTFPs and compare price variation over time was carried out , ecological data: like forest structure and population structure of the forest and forest trees coupled with biodiversity estimation was carried out 1) to compare the PFM and non-PFM forest patches found in the Gimbo District 2) to evaluate the conservation status of the most important forest trees used as a NTFP. The comparison of the PFM and the non-PFM forests was important in that it helps in evaluating the role of PFM and NTFPs in forest conservation.

All these findings of the study will be helpful in providing base line data so as sound management activities can be carried out in one of the remnant forests of Ethiopia, the Bonga Forest, which is among the national forest priority areas of Ethiopia.

2. OBJECTIVES

2.1. General objective

- To asses the NTFPs found in Gimbo District and to study the amount, value and conservation status of the NTFPs.

2.2. Specific objective

- To document the NTFPs found in the Gimbo District.
- To document the plant and animal species used as NTFP and carry out analysis on the preference of the local community.
- To compare population structures of two forest patches (management units) one managed by PFM (participatory forest management) and the other not managed by PFM.
- To evaluate population structure of the most important NTFPs trees.
- To make market surveys so as to asses the status of NTFPs in the local economy.
- To analyze the role of NTFPs in the sustainable forest management scheme in the area. This is done by comparing the two forest management units.
- To evaluate the conservation status of the NTFPs by analyzing their availability over the past few years.
- To make biodiversity measure and compare the biodiversity between the two forest management units.

3. LITRATURE REVIEW

3.1. Defining Nontimber Forest Products

Various terms (e.g., Nontraditional, Secondary, Minor, Nonwood and Special or Specialty) forest products have been used to describe products that come from the forests that are not timber-based. Recent legislation in the USA uses the term "Forest Botanical Products" to describe these products (H.R. 2466, 1999). The USDA forest service defines them as special forest products (USDA forest service, 2001). But, a more common and widespread term is "Nontimber Forest Products". Nontimber Forest Products (NTFPs) are plants, part of plants, fungi, mosses, lichens, herbs, vines, shrubs, or trees and other biological materials harvested from within and on the edges of natural, manipulated or disturbed forests (chamberlain, *et al.,* 2004). Plant parts harvested include the roots, tubers, leaves, bark, twigs and branches, fruits, sap and resin, as well as the wood (Chamberlain, *et al.*, 1998). Animal products such as honey and wild games are also recognized as NTFPs (Wilkinson and Elevitch, 2006). Products from plants such as tannins, rubber, gums, gum resins, resins, essential oils, honey, medicines, fodder, wild fruits and several other materials were classified as minor forest products. These are presently grouped as Nontimber Forest Products and have immense application in the industry, and also provide livelihood to millions of rural poor (Coppen, 1995).

According to Stellmacher (2005), NTFPs are currently classified into four major product categories: culinary, wood based, floral and decorative, medicinal and dietary supplements. And NTFPs are often gathered from natural forests. Others maybe produced with varying degrees of cultivation and domestication, either within a forest ecosystem or as part of planted forest system such as an agroforestry project.

3.2. Coffee

Coffee plays an important role in the world economy. It is the second most valuable exported commodity on earth after oil. More than 80 countries in the developing world depend on coffee as a major source of their foreign currency earnings. For instance, coffee generated about US$13 billion in 1983 and US$18 billion in 1994 for the exporting countries (Tadesse Woldemariam, 2003). Until 2000, coffee contributed to

80% of Burundi's, 67% of Ethiopia's, 55% of Uganda's and 30% of Nicaragua's earnings from export (Oxfam, 2002).

Coffea arabica is a species of coffee indigenous to Ethiopia. It is also known as the "coffee shrub of Arabia", "mountain coffee" or "arabica coffee". *Coffea arabica* is believed to be the first species of coffee to be cultivated, being grown in southwest Arabia for well over 1,000 years. It is considered to produce better coffee than the other major commercially grown coffee species, *Coffea canephora* (C.*robusta*). Arabica coffee contains less caffeine than any other commercially cultivated species of coffee. Wild plants grow to between 7-12 m tall, and have an open branching system; the leaves are opposite, simple, elliptic-ovate to oblong, 6-12 cm long and 4-8 cm broad, glossy dark green. The flowers are produced in axillary clusters, each flower white, and 1-1.5 cm diameter. The fruit is a berry 10-15 mm long, maturing bright red to purple, containing two seeds (the coffee 'bean'). The trees are difficult to cultivate and each tree can produce anywhere from 0.5-5 kg of dried beans, depending on the tree's individual character and the climate that season (http://en.wikipedia.org/wiki/Coffea_arabica, cited on 3, 1, 2007).

About 25% of Ethiopia's 77.6 million population depend on coffee for their livelihood. The Ethiopian coffee is also important source of coffee genetic resources for the world coffee industry. Because, Ethiopia is the only center of origin and diversification of Arabica coffee (*Coffea arabica*), which is cultivated in most parts of the tropics, accounting for 90% of the world coffee market, and about 70% of the production (Tadesse Woldemariam, 2003). *Coffea arabica* is also a very important medicinal plant. Chapman & Hall, 1997; cited in Dawit Abebe *et al* (2003), *Coffea arabica* contains caffeine and caffeic acid which posses virucidal and anti HIV-properties respectively. Caffeic acid also shows antibacterial and antifungal properties (Harbone & Baxter, 1993; cited in Dawit Abebe *et al*, 2003).

However, deforestation and change in land use are threatening its forest gene pools *of Coffea arabica* in Ethiopia. This has been aggravated with the recent coffee price crisis on the world market as a result of market liberalization. Coffee crisis affected the livelihood of about 15 million Ethiopians, out of which 5 million are severely affected

and facing famine (Tadesse Woldemariam, 2003). Coffee is found in 81% of the total 30,440 ha forest of Gimbo District (SUPAK, 2004).

3.3. Honey and Wax

3.3.1. Honey

Nectar is a solution of sugars and other minor constituents that bees collect and concentrate into honey. Honeys contain a wide range of sugars, varying according to the nectar source, and small amounts of other substances such as minerals, vitamins, proteins and amino acids. Honey has value as a food, as a medicine, as a cash crop for both domestic and export markets and as an important part of some cultural traditions (Bradbear, 2004**)**.

3.3.2. Beeswax

Beeswax is the material that bees use to build their nests. It is produced by young honeybees that secrete it as a liquid from special wax glands. Beeswax is valued according to its purity and colour. Light-coloured wax is more highly valued than dark-coloured wax, because dark wax is likely to have been contaminated or overheated. The finest beeswax is from wax cappings, which are the wax seals with which bees cover ripe honeycombs. This new wax is pure and white. The presence of pollen turns it yellow (Bradbear, 2004**)**.

Beeswax has many traditional uses. In some countries in Asia and Africa, it is used in creating batik fabrics and in the lost-wax method of casting small metal objects. Beeswax is widely used as a waterproofing agent for wood and leather, and for strengthening threads; it is used in village industries such as candle-making and as an ingredient in ointments, medicines, soaps and polishes. Beeswax is in great demand on the world market. There are more than 300 industrial uses for beeswax. Cosmetics and pharmaceutical industries are the major users, accounting for 70 percent of the world trade, and require first-class beeswax that has not been overheated. The price ranges from US$4 to US$8 per kg. Other significant users are the beekeeping industries in

industrialized countries that need beeswax for cosmetic foundations and for candle-making. Beeswax is used in the manufacture of electronic components and CDs, in modeling and casting for industry and art, in polishes for shoes, furniture and floors, in grafting waxes and in specialized industrial lubricants **(**Bradbear, 2004**).**

3.3.3. Honey and beeswax in Ethiopia

There are an estimated 10 million bee colonies in Ethiopia. This figure at present is the highest in Africa. Out of the 10 million, 2.5 million is estimated to be found inside forests and crevices while the remaining 7.5 million is confined to hives. Ethiopia is also a country endowed with surplus honey source flora. These two facts therefore, make the country the leading producer of honey and beeswax in Africa. On world level, also, Ethiopia is fourth in beeswax and tenth in honey production (Girma Defar, 1998**).**

However, there are major constraints that affect apiculture in Ethiopia. And these are lack of beekeeping knowledge, shortage of trained manpower, shortage of beekeeping equipment, pests and predators and inadequate research works to support development programmes **(**Girma Defar, 1998**)**.

3.4. Fuelwood and Construction

In Ethiopia, wood is the main energy source for urban and rural people. Wood is also widely used for construction, fencing and making farm implements. The estimate for annual wood production in 1990 was about 4 million m^3, out of which 90 per cent was utilized as fuelwood. The wood required for fuel and construction purpose mainly comes from the secondary high forests, woodlands and bush lands. Wood for fuel and construction comes also from trees planted on farms, and plantations (Kidane Mengistu, 2002).

3.5. Medicinal Plants

Medicinal plants can be defined as plants / herbs grown for medicinal purposes, as opposed to growing them for culinary or ornamental purposes. They can also be defined as any plant which provides health-promoting characteristics, temporary relief on symptomatic problems or has curative properties. (http://davesgarden.com/terms/go/573/, cited on 3/1/2007)

Medicinal plants comprise one of the important components of the Ethiopian vegetation. On record there are 1000 species of medicinal plants constituting a little over 6% of Ethiopia's vascular flora. They are distributed all over the country, with greater concentration in the south and south-western parts of the country. The woodlands of Ethiopia are the source of most of the medicinal plants, followed by the montane grassland/dry montane forest complex of the plateau. Other important vegetation types for medicinal plants are the evergreen bushland and rocky areas (Girma Defar, 1998).

It is reported that 60-85% of every developing country's population relay on traditional medicine (Sofowora, 1982; cited in Abiyot Berhan *et al*., 2006). And Some 25% of the medication prescribed world-wide contains ingredients extracted directly from medicinal plants; the total economic value of medication extracted from plants is estimated at USD 43 billion a year (Rijsoort, 2000). In Ethiopia, it is estimated that about 85% of the Ethiopian population has no access to modern health care and medicine (Amare Getahun, 1976; Dawit Abebe, 1986; cited in Abiyot Berhan *et al*, 2006). Even if they have access the drugs are expensive (Abiyot Berhan *et al*., 2006). Therefore, over 85 percent of the rural population, plus an increasing number of the poor in urban centers, and animal husbandry employ many of the available plants, as well as products from wild animals and minerals as their primary source of healthcare in the fight against various physical and mental health problems (Girma Defar, 1998).

Ethiopia has a long history of traditional healthcare based largely on rich, though unstandardized, pharmacopoeia drawn mostly from plants used both by women in the home in self-administration and traditional health practitioners (THPs). The efficacy of a

few of these plants (*Hagenia abyssinica*) and *Glinus lotoides* from the treatment of tapeworm infection, and *Phytolacca dodecandra* as a molluscicide in the control of schistosomiasis) has been scientifically determined, but the safety and efficacy of many others in the treatment of various diseases remains underdeveloped (Girma Defar, 1998).

However, man made factors like Rapid increase in population, the need for fuel, urbanization, timber production, overharvesting, destructive harvesting, invasive species, commercialization, honey cut, degradation, agricultural expansion and habitat destruction coupled with natural causes like recurrent drought, bush fire, disease and pest out breaks are making many of the plant species used in THPs rare and limited in distribution (Ensermu Kelbessa *et al*., 1992).

Besides that, organized and documented information on use and marketing of medicinal plants in Ethiopia is fragmentary. Even though there is some literature in traditional medicine, it does not include any economic value of plant medicine that generates income for people who practice it for their livelihood (Girma Defar, 1998). Therfore, loss of indigenous knowledge about THPs is becoming a major challenge.

In the Bonga forest, medicinal plants are known to be present in abundance. About 23 trees/shrubs have been named (by the local population) that have medicinal properties and being used independently or mixed with other products. Out of these, six (*Hagenia abyssinica, Myrsine melanophloeos, Myrsine africana, Croton macrostachyus, Phytolacca dodecandra* and *Embelia schimpri*) are used in one form or another to treat tapeworm infection. *Ekbergia capensis* and *Olea capensis* subsp *macrocarpa* are used to treat abdominal cramps. The list goes on that roots, leaves, stems and barks of a number of tree species are used to treat skin disease, wounds, malaria, venereal disease, common cold and coughs, lung troubles and asthma (AGRIBUSINESS$_b$, 2004).

3.5.1. Status of the medicinal plants

An estimate of the threat to medicinal plants can be made from the type of plant and the parts used. Harvesting the roots of a tree poses more of a threat than collecting the fruits and seeds, and this can be more threatening than using the leaves. The plants used, as

recorded in Jensen's list, have often been confirmed from notes on specimen labels. The proportion of the plants in the list is as follows:

Table 1: Plant parts used as medicine in Ethiopia

Part Used	Percentage
Ash	1
Bark	6
Bulb/tuber	1.7
Flower	2.5
Fruit	13
Gum/resin	2
Herb/stem	26
Leaf	43
Root	25
Sap	10
Seed	13
Smoke	2.5
Wood	0.5

Source: Girma Defar, 1998

It is interesting to note that a high proportion of plants are used for their leaves. This indicates that many of the medicinal plants are being used in a sustainable way. However, it has also shown that about a quarter of the plants used are harvested for their roots, tubers or bulbs. These species need special attention to determine their status and what measures should or could be taken to have them conserved (Girma Defar, 1998).

3.6. Spices and Condiments

Although spices and condiments can be defined in many ways, in this study the definition stated by Jansen (1981) is adopted. Mean while, spices and condiments are plants or plant products including culinary herbs that are used to flavour foods or beverages before, during or after their preparation. According to Jansen (1981), among the spices and condiments found in Ethiopia are: cardamon (*Elettaria cardamomum*), Indian long pepper (*Piper longum*), *Aframomun corrorima* (commonly known as Korrorima) and *Rhamnus prinoides* (commonly called Gesho).

3.6.1. *Aframomum corrorima (Braun) Jansen*

Aframomum corrorima is a monocotyledonous flowering plant belonging to the family Zingiberaceae. *A. corrorima*, commonly known as false cardamom or Ethiopian cardamom, is one of the most widely used spices in Ethiopia to flavour food and beverages.This herb is endemic to Ethiopia. It grows naturally at an altitude of 1700–2000 m on slightly shaded, more or less open places in forests. Although this plant grows in the wild, cultivation has recently been reported from some parts of the country. Morphological characteristics are scaly underground rhizomes and leafy stems, growing up to a height of 1–2 m. The plant flowers from January to September and the fruits mature about 2–3 months later. They are brownish in colour, have a flask-likeshape, are 3–6 cm long and 1.5–3 cm in diameter. Dried fruits are commonly sold in markets (Araya Hymete *et al.*, 2006).

Seeds of *A. corrorima* are used medicinally in Ethiopia as a carminative, purgative and tonic agent (Wannakrairoj and Wondyifraw Tefera, 2004; Araya Hymete *et al.*, 2006). They contain 1–2% essential oil, with 1, 8-cineole as the main constituent (35–42%); the presence of other monoterpene structures has been reported. Essential oils from other members of the genus *Aframomum* are reported to contain several mono-, sesqui- and diterpenes (Araya Hymete *et al.*, 2006). According to Sebsebe Demissew (1993; cited in Wannakrairoj and Wondyifraw Tefera, 2004) korarima oil has similar chemical composition with that of its famous relative, the Indian cardamom (*Elettaria cardamomum* (Zingiberaceae*)*, except for its reduced content of terpinyl acetate, which is the major component in the latter.

Traditionally extracts of cardamom (*Elettaria cardamomum)* seeds and fruits have been used to treat skin conditions and to aid digestion in South Asia. It was also used to treat cases of food poisoning and has been widely used in Ayurvedic medicine to treat disorders of the stomach and urinary system, asthma, bronchitis and heart problems (http//www.plantcultures.org.uk cited on October11, 2006).

Cardamom (*Elettaria cardamomum)* has also the following uses (http//www.plantcultures.org.uk cited on October11, 2006);

- When mixed with neem and camphor, cardamom is used as a nasal preparation to treat colds. An infusion of cardamom can be used as a gargle to relieve sore throats, which has led to its use in cough sweets.

- Roasted seeds were boiled with betelnuts to make a drink that would be used to treat indigestion and nausea. They are also added to tea to make a tonic to relieve the symptoms of stress due to overwork or depression.

- Cardamom seeds are given to patients with bad breath and a capsule of cardamom taken with honey is reputed to improve eyesight.

- It has been used traditionally to treat areas of the body that have red-pigmentation. It is often incorporated into soaps and hand creams. The traditional uses of cardamom to treat skin conditions have attracted the attention of those developing plant-based cosmetics,

- Its use as an aromatic stimulant is recognized in Britain and Europe and it is well known for its stomach calming properties.
- Cardamom oil is aromatic with antibacterial properties and is used in cosmetics and chewing gums. Cardamom oil is also used in cosmetics because of its cooling properties and it is a pale to colourless liquid that can be easily incorporated into different solutions. The taste is warm and spicy and can be used as a flavour to chewing gum
- Researchers have shown that extracts of cardamom have anti-inflammatory activity but the compounds in the extracts were not identified

Although quite many traditional uses of cardamom has been identifyed, to date there are very few scientific studies on cardamom seeds that provide scientific evidence for its traditional uses (http//www.plantcultures.org.uk cited on October11, 2006).

Previously Ethiopia was well known for its considerable exports of korarima capsules to the world market, mainly as a substitute for the Indian cardamom. However, the supply has greatly fluctuated during the past few decades that the total annual korarima export has decreased to less than 60 tones in the years 1994- 1998, fetching only some 2.1 million USD (Chanyalew 1999; cited in Wondyifraw Tefera and Wannakrairoj, 2004). This situation could mainly be ascribed to the reduction of production as a result of the ever increasing destruction of the natural habitat, which is even threatening the mere existence of the crop in the country. Compared to cardamom, korarima has a relatively wider adaptation and higher productivity (ca 5.5-fold), a factor that could have attracted producers' interest to expand its production. However, there are no visible activities regarding establishment of new plantations due to the varied problems associated with the sector. Among others, these include lack of a sustainable market outlet, absence of processing industries and high yielding cultivars of superior quality, and a shortage of planting materials (Wannakrairoj and Wondyifraw Tefera, 2004**).**

3.7. Palms

Palms are monocots, included in the section of angiosperms characterized by bearing a single seed leaf. Scientifically palms are classified as belonging to the family palmae (the alternative name is Arecaceae), are perennials and distinguished by having woody stems (Dennis, 1998**)**.

3.7.1. *Phoenix reclinata* Anthirity

The Senegal date palm (*Phoenix reclinata)* is one of the palms commonly known in Ethiopia. This plant is known to be used as ornamental (avenue tree) plant. It is also important for soil improvement, for making roble, for making tannins (dyes), for making roof thatch (Azene Bekele, 1996). The use of palms as beverages is also common in some parts of the world. Palm wine or toddy is an ancient beverage derived from the sap of a number of different palm species, and serves as an appropriate example of beverage. The sap is obtained by tapping and collecting the liquid in a receptacle from an inflorescence of the tree employing sophisticated techniques that must have required considerable trial

and error experimentation. Tapping the stem or felling the tree is also a means of obtaining sap that are much simpler. There is no difference in the quality of the sap obtained from the different methods. Because of the presence of naturally occurring yeasts, the sweet palm sap ferments within hours in to mild alcoholic beverage. *Phoenix reclinata* is one of the maney palm species from which tapping palm wine is common (Dennis, 1998).

Table 2: Nutritional composition of palm wine from *Phoenix reclinata* (per 100g)

Moisture (%)	98.3	Potassium(mg)	157
Ash(g)	0.4	Copper(mg)	0.05
Protein(g)	0.2	Zinc(mg)	0.02
Fat(g)	-	Manganese(mg)	Trace
Fiber(g)	-	Phosphorous(mg)	1.74
Carbohydrate(g)	1.1	Thiamin(mg)	0.01
Energy value	22+109	Riboflavin(mg)	0.01
Calcium(mg)	0.45	Niacin(mg)	0.5
Magnesium(mg)	5.12	Vitamin C(mg)	6.5
Iron(mg)	0.07	Alcohol(%v/v)	3.6
Sodium(mg)	5.85	-	-

***Source*:** Dennis, 1998

3.7.2. Bamboo

More than 1,500 bamboo species are found world wide (Ohrnberger, 1999; cited in Kassahun Embaye, 2004). Of these Africa has about 43 species of bamboo; fourty of these 43 species are mainly distributed in Madagascar while the remaining three species are found in main land Africa (Ensermu Kelbessa *et al.*, 2000). Of the three species of bamboo found in main land Africa, Ethiopia has two of the species referred as the high land and the lowland bamboo whose basic difference is their culm. The culm of the high land bamboo being hollow while that of the low land bamboo being solid (Kassahun Embaye, 2004).

Around 86% of the African bamboo resource is found in Ethiopia spread in the major Bamboo growing areas of the SNNP, Oromiya, Benishangul, Amhara, and Tigray regions. And among the major Bamboo Areas in Ethiopia the two sites are in Bonga forest (Ensermu Kelbessa *et al.*, 2000). According to SUPAK (2004), the total bamboo forest area in Bonga forest is estimated to be about 20,000 ha which is 2% of the total Kaffa zone land area. Gimbo is a district that is known to posses no bamboo forest (LUPof Gimbo District).

Bamboo provides a wide range of goods and services more than any other plant (Weldemichael Kelecha, 1980; Amare Getahun, 1992; Ayre-smith, 1963; Liese, 1995; cited in Kassahun Embaye, 2004). In Asia bamboo is used in many ways. For example in Nepal, bamboo is used in more than 180 ways (Poudyal, 1991; cited in Kassahun, 2004). But in Ethiopia despite the fact that bamboo is the most freely and readily available resource for the communities living near by the natural bamboo forests, its uses have been backward and limited in making huts, beehives, furniture and the like. Bamboo shoots are also known to be consumed by some rural people (Woldemichael Kelecha, 1980; Amare Getahun, 1992; cited in Kassahun Embaye, 2004).

Bamboo is the fastest growing perennial plant (Liese, 1995;cited in Kassahun Embaye, 2004). Because of its fast growth, since it produces many vegetative shoots every year and because of the fact that its rhizomes and roots are very good in holding soils, bamboo is the most preferable plant for rehabilitating soils (Kassahun Embaye, 2004).

3.8. Wild foods

The term ‘wild-food’ is used to describe all plant resources outside of agricultural areas that are harvested or collected for the purpose of human consumption in forests, savannah and other bushland areas (Bell, 1995**).** But in this thesis, wild food besides plants, includes mushrooms and animals. Wild foods are important in that they are usually used to pass drought seasons of the year and help prevent starvation (Zemede Asfaw, 1997).

According to Zemede Asfaw (1997), 8% of Ethiopian higher plant species are edible and out of this only 25% are cultivated. Wild animals are also eaten in different parts of

Ethiopia. According to many studies conducted elsewhere wild animals have been known to have a considerable proportion of the meal and do also support the household economy (eg. Cowlishaw *et al.*, 2003)

3.9. Gum, gum resins and resin

Natural gums (gums obtained from plants) are hydrophilic carbohydrate polymers of high molecular weights, generally composed of monosaccharide units joined by glucocidic bonds (Davison, 1980). They are generally insoluble in oils or organic solvents such as hydrocarbons, ether, or alcohols. Gums are either water soluble or absorb water and swell up or disperse in cold water to give a viscous solution or jelly and upon hydrolysis they yield arabinose, galactose, mannose and glucuronic acid (Mantel, 1949; cited in Balakrishnan, 2000).

Based on their solubility in water gums are classified as (1) soluble, (2) insoluble and partially soluble gums. Certain gums dissolve in water to form a transparent colloidal solution (e.g. Gum Arabic). Gums such as gum tragacanth, gum karaya do not dissolve in water but swell up into a jelly-like mass. However, if sufficient amount of water is added they yield a thick transparent solution. Partially soluble gums first form a swollen jelly by dispersing in water and become solution on addition of more water. Mogador or Morocco gum (from *Acacia gummifera*) is an example of partially soluble gum (Balakrishnan, 2000).

Resins are polyterpenes and their acid derivatives. They are oxidation products of terpenes in all manners of incomplete stages. Resins are very complex chemical compounds and are soluble in organic solvents. They do not have affinity for water. The less soluble resins can be made to dissolve by a process known as ‘running’ or sweating (Mantel, 1950; cited in Balakrishnan, 2000). When the resins contain essential oils, they are called oleoresins or soft resins. Gumresins are a combination of resins and true gums with a mixture of characteristics of both. Certain gumresins contain small amount of essential oil. They are called oleo-gumresins. Small quantities of resins exude on the surface of the trunk due to injury by wind, fire, lightening or wound caused by animals.

However, for commercial purpose tapping is necessary. Sometimes the natural exudation is so copious that the resin becomes buried and fossilized in the soil around the trunk. Vast deposits of resin may be found where the original forest has disappeared. Amber is an example of fossil resins (Balakrishnan, 2000).

Gum, gum resins and resin have numerous uses. Use of gums and resins by human goes back to remote times. Gum Arabic has been used at least 4500 years before (Davison, 1980). The industrial applications of gums and resins have expanded tremendously in recent years. They have been used in many unrelated industries. Gums and resins form an important and widely used group of nontimber forest products, and are principal components in food and pharmaceutical industries. The world market for gum only as food additives is over US $ 10 billion in 1993 (Coppen, 1995). Some important uses of natural gums and resins also (Balakrishnan, 2000) are paper industry, textile industry, petroleum and gas industry, pharmaceuticals, cosmetics, beverages, diary products like for cream stabilization, for low calorie milk shake and in cheese products. Gums and resins have also numerous applications in the food industry like for flavour fixation, for bulking dietic foods, for confectionery uses, for bakery products and so on.

Gums are also used for making inks, paints, metal cutting fluids, toys, air fresher gels, hydro-mulching to promote seed germination, boiler compounds, ceramics, welding rods, cleaners crayon and in mining, polymerization aide, lithography, stabilizing insecticides, surface coating of wood and plastics, polish, leather industry, adhesives and explosives. Gum resins have been used in industry such as perfumery, and other cosmetics, medicine, spices and incense. Resins are now mainly employed in paints, varnishes, lacquers, sizing paper, manufacture of soap, linoleum, sealing wax, adhesives, medicines, ink, etc

3.10. Other NTFPs

Other NTFPs include; ferns, lianas, furniture and fixtures made from NTFPs as a row material, other products from bees, etc.

3.10.1. Other products from bees

In addition to honey and wax, bees will produce a number of other products all of which enjoy commercial markets. These include pollen, propolis and royal jelly (Bradbear, 2004)

3.10.2. Lianas

Lianas, defined here as climbers that cannot support themselves in an upright position but which grow over other plants and/or nonliving structures, are characteristic features and dominant growth forms in tropical forests (Gentry & Dodson, 1987; Gentry, 1991; Nabe-Nielsen, 2001; Schnitzer & Bongers, 2002; in Feyera senbeta 2005) .According to Feyera Senbeta (2005), 56 species of lianas have been recorded from Bonga forest

3.11. Challenge in NTFPs Inventory

In this research, NTFPs are inventoried using conventional forest inventory techniques. Jenny Wong, however after reviewing 126 studies, concluded that conventional forest inventory techniques have limitations while applied for NTFPs inventory. This is because of the inherent nature of NTFP described below (http://cms1. gre.ac.uk/ conferences/ iufro/proceedings /Wong% 20paper c%202. pdf cited on 15/4/2006);

- ***Rarity***: many NTFPs are rare which means that only a few plots of a conventional inventory designs will contain the species of interest. This results in very inefficient and costly inventories which often do not produce the quality of data required.
- ***Clumped distributions***: NTFPs often occur in relatively dense patches within the landscape.
- ***Imperfect detectability***: people dealing with trees have rarely come across the problem of searching for an elusive or moving target because trees are generally large and static. Unfortunately, many NTFPs are not so obvious (e.g. truffles and epiphytes) and these require that detectability is considered.
- ***Seasonality***: many NTFPs are seasonal but timber accrues slowly over time consequently forest inventory methods do not cope well with seasonality.

- ***Mobility***: animals run away, fruit falls off a tree and rolls down a hill but trees are static.
- ***Quantification of yield for non-destructive harvesting***: most of the methods for determining timber yield from a forest are concerned with the harvesting of entire individuals. For NTFPs often only a small part of the individual is harvested. There is little theoretical background for determining harvesting levels for parts of a plant. It seems that the simple adoption of forest inventory practice is not going to meet the needs of NTFP inventory.

Therefore, in this study, NTFPs inventory is coupled with socio-cultural and economic surveys to minimize the limitation of the conventional forestry inventory techniques used to inventory NTFPs found in Gimbo District. In doing this it is believed more realistic result is delivered.

Lund (1997, 1998; cited in Wong, 2000); Green wood, (1996) and Gronow and Safo, (1996), have identified four types of study that are needed for a successful and sustainable development of NTFPs. And these are:

a) Biodiversity inventory (list of species)
b) Resource inventory
c) Cultural studies
d) User market and product surveys

a) <u>Biodiversity inventories</u>: deal with producing a check list of the taxa identified at the sample, locality or plot. And it is presented by species and family. Species list are a useful sources of information on the distribution and ecology of NTFPs, but provide little or no information on the abundance. Therefore, resource inventory is vital in NTFPs inventory/studies.

b) <u>Resource inventories</u>: deal with determination of abundance, distribution and management potential of NTFPs. There are three possible types of resource inventories for NTFPs study.

1) Single resource inventories: an inventory aimed at the quantification of the abundance and distribution of a single product. This method is very important when the NTFP under study is very valuable. E.g. high value medicinal plants, bamboo, rattan or palm products, etc.

2) Single purpose multi resource inventories: an inventory aimed at gathering management information on several NTFPs in a given area. This method can be a sound and pragmatic means of studying the distribution, abundance and NTFPs management potential of the area to be logged.

3) Multi purpose resource inventories(MRI): is a type of data collection effort designed to meet all or part of the information requirements for two or more products, functions (such as timber management and watershed protection) or sectors (such as forestry and agriculture).
   Many of the NTFPs assessment take place in MRI. NTFPs are often a small component of resource inventory.

   In this research, single purpose multi resource inventories method of resource inventory is carried out.

c) Cultural studies: this is gathering of anthropological data. Anthropological data are gathered using participatory approaches like (PRA) techniques. Ethnobotany in particular is the relevant anthropological data that should be gathered in NTFPs study and ethnobotany deals with the inventory of traditional use of plants by peoples.

d) User, market and products surveys: is an economic assessment of the actual and potential contribution of NTFPs to the local and macroeconomics. And is also an economic assessment of the marketing and value addition of NTFPs.

3.12. The role of NTFPs for Sustainable Development.

Sustainable development is development which meets the needs of the present with out compromising the ability of future generations to meet their won needs (WCED, 1987; cited in Jhonatan, 2000). A development is sustainable if it is economically, environmentally and sociallysustainable (Jhonatan, 2000).

NTFPs are important for sustainable development because of the following reasons;

- They are diverse. They have greater monetary value per unit weight. Therefore, harvesting of NTFPs generally requires more labour and less capital, causing less pressure on the ecology. NTFPs also supplement and supplant timber cutting from the forests (Arnold and Townson, 1998). NTFPs are also environmentally sustainable.
- They provide job opportunity for the poor and women. This has been proved by many studies carried out (eg. Singh, 1997; Millik, 2001). Therefore, NTFPs guarantee equitable (fair) distribution of resources resulting in a socially sustainable system.
- They generate income which is of an imidiet type. And since they are diverse they can be harvested throught out the year. Therefore,making them economically sustainable.
-

3.13. The role of NTFPs in Sustainable Participatory Forest Management (PFM).

Participatory forest management (PFM) or sometimes called joint forest management (JFM), is a forest management system in which, communities (forest users and managers) and government services (forest department) work together to define rights of forest resource use, identify and develop forest management responsibilities, and agree on how forest benefits will be shared. PFM involves the legal transfer of forest resources (use rights) from the government forest services to a community management group. PFM will enable communities to sustainably manage forest areas, under legal use rights agreements. (FARM-Africa / SOS Sahel Ethiopia, 2007).

Under PFM /JFM arrangements, local communities are permitted to collect NTFPs and enjoy the benefits from them. Besides NTFPs, the communities are given a share in the harvest of timber (Rao, 1998). Therefore, since the benefit farmers get from NTFPs is of an immediate nature and with less damage to the forest, NTFPs are the key resource in PFM.

1.14. Species Richness and Eveness

Altough biodiversity has genetic, species, ecosystem and cultural diversity attributes; species diversity is still a commnest measure of biodiversity (Kent and Coker, 1994). Species diversity comprises two components i.e. species richness and evenness.

Species richness is a simplest measure of species diversity whereby it referes to the total number of species in a community. Evenness on the other hand is the measure of equitabiliy. The two well known indices to measure species richness are Shannon weiner index and sympsons index. Shannon weiner function is the most popular measure of species richness and is not affected by sample size (Kent and Coker, 1994). Shannon weiner (H') is known to never exeed 5.0 (Washngton, 1984; cited in Salanga, 2004)

$H' = -\sum (Pi \ln Pi)$ where; Pi denotes the proportion of a particular species in a sample.
Evenness (E) is also computed as E=H/Hmax; where Hmax = Ln (Number of species)

4. STUDY AREA AND METHODS

4.1. Study Area

4.1.1. Geographic location

The study was carried out in Gimbo District, southwest Ethiopia. Gimbo District is one of the ten districts of the Kaffa Zone, southwest Ethiopia. The District is found within the geographical location of 6^0N - 13^0N and 34^0E - 46^0E (Figure, 1) and has a total land area of 87,187 ha. Gimbo District is the district in Kaffa that contains the major towns of the Zone namely; Bonga, Uffa and WushWush. Bonga is the administrative center of the Kaffa Zone and is found 440 km southwest of Addis Ababa.

4.1.2. Topography

Gimbo District has 85% of its area as highland and 15% low land. From the highland 10% has an altitudinal range of 2000-2500 m a.s.l and 75% is within altitudinal range of 1500-2000 m a.s.l. And the lowland is found within altitudinal range of 1000-1500 m a.s.l. (SUPACK, 2004). The area has rugged and mountainous topography (Abayneh Derero *et al.*, 2003) and also has gentle and flat landscape towards the Gojeb River.

4.1.3. Geology and soil

The geology of Gimbo District comprises (Eocene-oligocene) Jima volcanics (MoWR, 1996a; cited in Abayneh Derero *et al.*, 2003). And the dominant soil unit comprises chromic luvisol, very deep dark reddish over dark reddish brown clay loam over clays (MoWR, 1996b; cited in Abayneh Derero *et al.*, 2003). Nitosols, regosols and cambisols are among the different soil taxonomic groups of the study area (Feyera Senbeta, 2006).

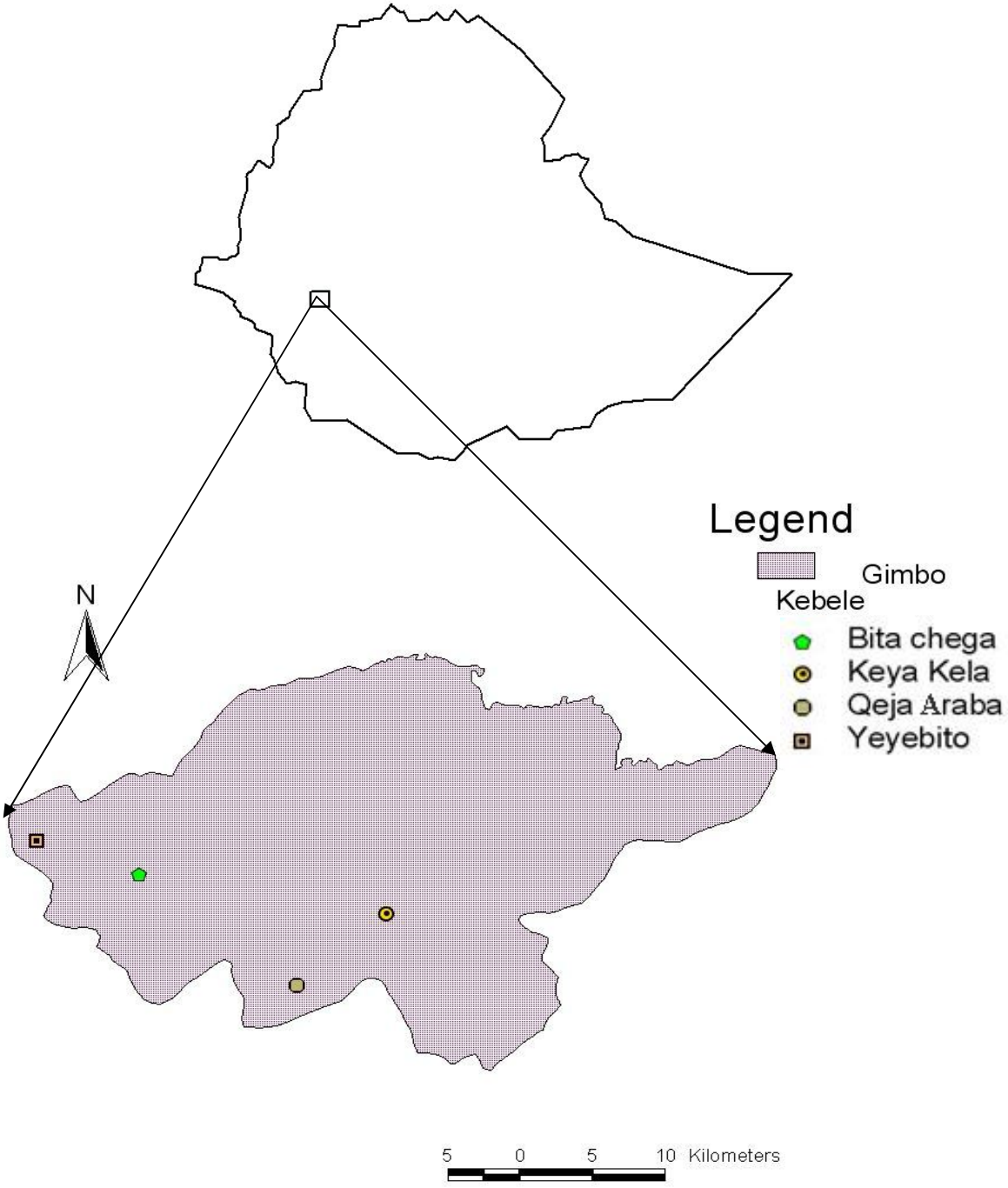


Figure 1: Map of the study area

4.1.4. Climate

Gimbo District has long rainy season from March to November, the wettest season being May and June. The mean annual temperature of the district measured at Bonga town is 19.5 ^{o}C (EWNHS, 1997; cited in Abayneh Deraro *et al.*, 2003).

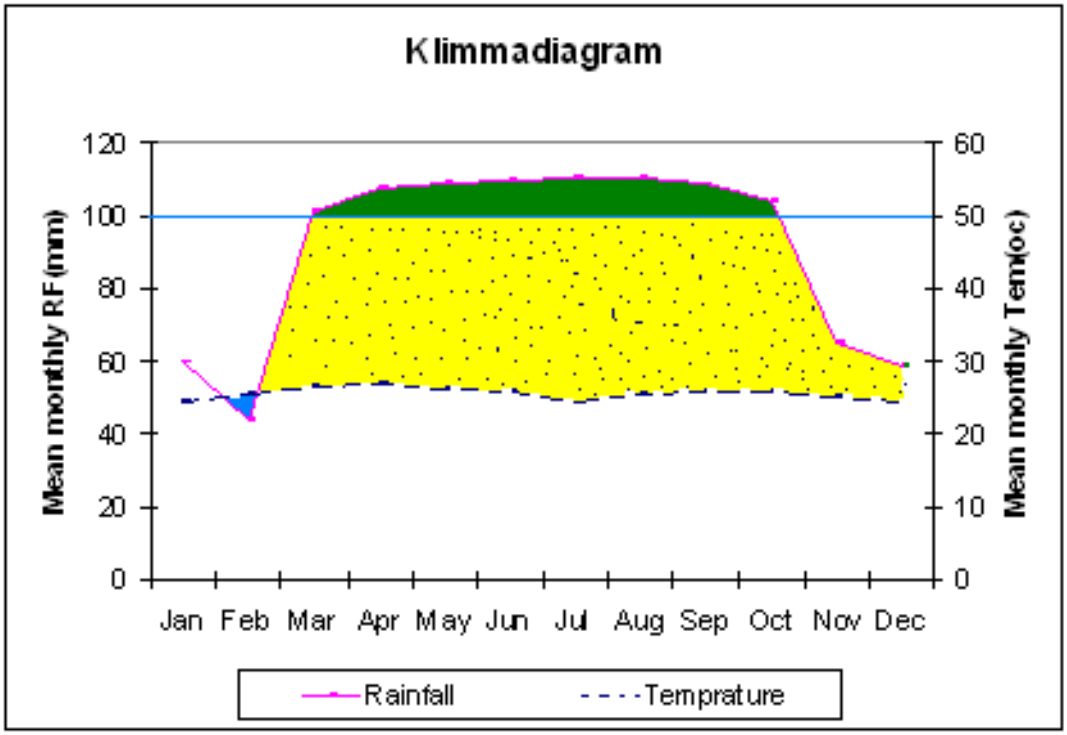


Figure 2: Climate diagram of the study area (Bonga metrological station).Source: Ethiopian Metrological Service Agency, data for 20 years (1998-2007).

4.1.5. The people

The people in the study area are largely speakers of the language Keficho. These Keficho speaking people have social groupings sometimes considered as tribes. Also in the area, there are Oromo, Amhara, Tigre, Kembata and Hadiya ethnic populations. The resource use pattern observed today has multicultural dimentions because this mix of people of different culture and knowledge backgrounds brings different pattrnes in to play.

4.1.6. Population

Table 3: Population and Household Estimates of Gimbo Woreda (a) and of the study area (b) in numbers, Year July 1, 2006

a)

Number of kebeles	**Number of people**			**Number of households**
40	Male	Female	Total	25340
	59016	60942	119958	

b)

Name of the kebele	**Number of people**			**Number of households**
	Male	**Female**	**Total**	
Yeyebitto	1203	1270	2473	490
Bita chega	1048	1092	2140	419
Kaya kela	720	735	1455	293
Qeja araba	1344	1233	2577	494

(***Source***: Kaffa zone Finance and economy office)

4.1.7. Land use and economy

Table 4: Gimbo district land use/cover (ha)-(a) and the status of Montane forest (ha) in the study site-(b)

a)

Land use types		**Land area(ha)**
Built up area		674
Cultivated land	Intensively	35,034
	Moderately	1,348
	Tea plantation	2,617
Montane forest	Undisturbed	23,009
	Disturbed	8,357
	Highly disturbed	3,162
Wood land	Dense shrub/bush	902
	Savanna	0
plantation	eucalypt	1,259
	juniper	912

	Coffee investment area	406
Grassland	Open	1,893
	Wooded	327
Wetland	Perennial	4,511
	Seasonal	2,776

b)

Study site	**Montane forest**		
	Undisturbed	**Disturbed**	**Highly disturbed**
Yeyebito	1,388	278	10
Bita Chega	2,320	10	0
Qeja Araba	0	2,349	10
kayakela	793	992	198

(***Source***: SUPAKS, 2004)

4.1.8. Vegetation

Bonga forest and Kafa forest are classified in the vegetation of Ethiopia refered to as moist evergreen montane forests. The forests are located within altitudinal range of 1100-2700 m a.s.l. The forests in this area are normally the richest in species (Friis *et al*., 1982).According to the recent inventory carried out by the Institute of Biodiversity Conservation and Research through the GTZ-supported Forest Genetic Resources Conservation Project, Bonga forest is characterized by three distinct vegetation types (Taye Bekele, 2003). These vegetation types are:

Upland Rainforest Vegetation- This vegetation occurs at altitudes between 1500-2200 m a.s.l and characterized by big tree species such as *Olea welwitschii, Schefflera abyssinica, Euphorbia ampliphylla, Croton macrostachyus, Albizia schimperiana, Prunus africana, Syzygium guineense* and Polyscias *fulva*. It also contains common smaller trees and shrubs such as *Millettia ferruginea, Teclia nobillis, Dracaena steudneri, D. afromontana, Galiniera saxifraga* and *Coffea arabica*. Ground herbs include false cardamom (*Afromomum corrorima*).

Upland Humid Forest Vegetation- This vegetation occurs at altitudes between 2450 - 2800 m a.s.l and characterized by tree and shrub species such as *Hagenia abyssinica*, *Ilex mitis*, *Myrsine melanophloeos* (*Rapania melanophloeos*), *Maesa lanceolata* and *Bersama abyssinica.*

Arundinaria /Bamboo Thicket- This vegetation occurs at altitudes between 2400-3050 m a.s.l and characterized by bamboo thicket either in pure stands or may exist in mixture with trees, including *H. abyssinica*, *M. melanophloeos*, and *Hypericum revolutum*.

4.2. Methodology

4.2.1. Site selection

The Gimbo District has 40 Kebeles and for 10% sampling size, four Kebeles were chosen based on the land use map of the woreda. Based on the land use map, among the four kebeles chosen for the study, two Kebeles (Yeyebito and Bita Chega) were chosen from the undisturbed montane forest site and the other two Kebeles namely Keya Kela and Qeja Araba were chosen from the disturbed montane forest sites. The other rational for choosing the four Kebeles was forest management practices, proximity to the big towns and NTFPs potential. Out of the forest found within the four Kebeles, the forest found within the two Kebeles of Yeyebito and Bita Chega is managed by participatory forest management intervention while the forest found within the other two Kebeles is not managed by participatory forest management intervention.

4.2.2. Informants selection

From each kebele, due to the limited time and budget available during the data collection phase of this study, 5% of the households were interviewed in similar manner with that of Makenya (2005). Hence Cotton (1996) reported when using semi structured interviews, small number of respondants can be enough for ethnobotanical surveys. Therfore, the number of respondents/informants summed up to 86(25, 21, 15, and 25). Again 40 (10 from each of the four kebeles) resource people were chosen to be key informants. The key informants were selected in such a way that they represent different age groups and sex.

It was learned from Cotton (1996) that by selecting the respondants randomly the probability of gaining general information will be higher and selecting respondants systematically and by the help of local administrators ensures the gathering of detailed facts about the subject matter of particular interest. Accordingly, since most of the resource persons with good knowledge about NTFPs in the study area are believed to be elderly men and women, most of the key informants were chosen to be with ages greater than 40. And the rest of the key informants were selected in such a way that they represent different sex and age groups and were picked randomly. Finally, the informants stratification in terms of age and sex appears to be as it is provided in Appendix 3. Therefore, seven (17.5%) out of the forty key informants were female, from the total forty key informants, three (7.5%) were with the age range of 14-19, seven (17.5%) with ages ranging from 20 up to 29, four (10%) were with ages ranging from 30 up to 39, 15 (37.5) with ages ranging from 40 up to 49 and the rest eleven (27.5%) of the key informants were 50 and above.

4.2.3. Reconnaissance survey

Reconnaissance survey was carried out from February 1- February 15, 2006. During the reconnaissance survey the researcher got familiarized with the plant species present in the area and a check list of species observed was prepared, key informants were selected, the questionnaire was pre-tested, the actual situation of the site was evaluated and accordingly the suitable sampling design and lay out for the vegetation data collection was determined and a GPS reading of the four kebeles (study sites) of the study area was taken which enabled the researcher to plot the map of the study area.

4.2.4. Data collection

Data collection was carried out from March 1 - April 1, 2006 and from May 22 - June 30, 2006. The total time spent during the reconnaissance survey and data collection was ample enough in that the researcher was able to get familiarized with the geography and the people of the area. This intern, helped to win the trust of the people during interviews and ethnobotanical data collection.

a) Ethnobotanical data collection

A Participatory Rural Appraisal technique (PRA), as explained by Grenier (1998) and Martin (1995), was employed. The PRA techniques include; semi-structured interviewing, free listing, preference ranking and direct observation.

Semi-structured interview – some predetermined questions and topics were prepared (Annex 1), but also leaving some room for similar topics of interest to be persused as the interview develops. The questions were both open ended and closed. According to Newell (1993), open-ended questions will allow individuals to interact in any way they wish. The questions were translated into Amharic. The interview was conducted in an informal and conversational way but carefully controlled. The survey was done in Yeyobito (490 households), Bita Chega (419 households), Keyakela (293 households) and Queja Araba (494 households). The sample size in each kebele was made to be 5% of the total number of households. Therefore, in total 86 households were randomly surveyed. Meaning for each kebele 25 house holds in Yeyebito, 21 in Bita chega, 15 in Keyakela and 25 in Queja Araba were surveyed.

In this study semi structure interviews were carried out in order to determine the NTFPs known to be found in the study area and evaluate their conservation status. Household dependency on NTFPs as compared to agriculture (dairy and crops) was also evaluated using the interview results.

Free listing – volunteer informants were used to free list the NTFPs. This list includes local names, uses and part of the plants or the NTFPs used and was accompanied by the display of the NTFPs which were able to be located.

To do the free listing, 10 key informants were chosen from each of the 4 kebeles (the study site). And according to the free listing exercise, for each of the NTFPs and NTFPs categories identified, plant and animal species and their parts used as NTFP were also identified.

Preference ranking – NTFPs and species were ranked based on a 1-5 scale mark given by the key informants preference. Wherein a very highly preferred NTFP or species gets the highest mark (5) and the least prefferd NTFP or species gets the least mark (1).This can help know which NTFPs or species are highly or least preferred or which have few or more alternatives.

Guided field walk and direct observation – according to Cunningham (2001), observation is an appropriate method to gather data on more sensitive issues. Therefore, field observation was used in the PRA exercise. This was aided by prepared questions (Annex 4).

b) Vegetation data collection

Vegetation data was important for this study in that it helped in determining the status of some of the most important NTFPs. Due to the rugged terrain of most of the forest parts and due to the limited time and budget available during this study, transect laying was not favored but rather more simpler technique was used to lay the plots for vegetation data collection. Therefore, random walking technique (Kent and Coker, 1994) was used. Mean while, begining from a certain point within the forest, based on randomly drawn numbers from 0-360 to determine direction and from 20,50,100,200,500 to determine distance, the the sample plots were laid. Suunto compass was used to guide the direction while walking to the next plot and pacing was used to measure the distance to the next plot.

Due to the homoginiety of the forest physiognomy in the study area, stratification of the forest was not fovoured. However, it was made certain that the reverine forest patches within the forest were not left out. So 4 sample plots were laid within the reverine forest patches of the forest under study. And the rest 56 plots were ramdomly selected. By so doing, 30 sample plots within the PFM forest and 30 plots within the free access forest were laid making the total number of sample plots 60, and making the total area sampled 5.4 ha where each plot is with an area of 0.9ha.

Square sample plots with the dimension 30 m X 30 m were used in this study as used by Tamrat Bekele (1994). Inside the 30 m X 30 m, a 5 m X 5 m and a 2 m X 2 m sub plots (Kent and Coker, 1994) were laid to measure the shrubs and herbs respectively.

- Within the 30 m X 30 m plot every tree and lianas were counted and recorded. For all the trees, with circumference of ≥4 cm, at the breast height, circumferance at the breast height (CBH) and height measurements were taken. To measure the CBH diameter tape was used and to measure the height, hypsometer was used. The CBH was converted to the Diameter at breast height (DBH) by dividing the CBH with 3.14. The DBH was therefore, used in data analysis and interpretation.
- Within the 5 m X 5 m plots all shrubs were counted per individual species and recorded.
- Within the 2 m X 2 m plots, all herbs were counted per individual species and recorded.

Plant specimens were collected for most species and brought back from the field so that by comparing to authenticated specimens housed at the National Herbarium (ETH) they can be identified. For most tree species whose names were obviously known they were identified on the field. The use of local names and all the published volumes of Flora of Ethiopia and Eritrea was also important for this study.

In this study vegetation data were mainly collected so that the status of some of the most important NTFPs and plant species population structure can be determined and evaluated. And also to determine the status of the vegetation structure in the study area as a whole and even compare the vegetation structure and biodiversity patterns between the two forest patches one managed by PFM and the other not so but is freely accessed.

c) Market data collection

Market data was collected mainly in Bonga town yet some information was gathered in Wushwush and Ufa markets aswell. Data was collected by interviewing different section

of the society during market days. The checklist of questiones possed to respondants was as indicated on Annex 5.

d) Team composition

The research team included; the researcher (with the background in Forestry and Botany), forty key informants selected from the four kebeles of the study area, one house hold member from the 5% of the households found in the four kebeles of the study area, any one of the community member who was contacted by chance and provided valuable information, 12 field assistants (3 from each of the four kebeles) who have good knowledge about the vegetation of the study site.

4.3. Data Analysis

4.3.1. Vegetation data analysis

The status of NTFPs was examined by estimating stem density, importance value index (IVI), forest structure, population structure and biodiversity pattern.

4.3.1.1. Stem density

Stem density of the trees and shrubs was used to compare the two types of forests (the PFM and free access forests) for total biomass. Number of individual trees in the total sample plots were counted and converted to per hectare basis. And similarly the number of shrub individuals was counted in all the sample plots and was converted to per hectare basis. Statistical packages for social sciences (SPSS/13) was used in determining standard error of the mean. Then the density of trees and shrubs was ploted for both types of forets using Microsoft exel. A two tailed student t- test was carried out using SPSS/13.

4.3.1.2. Importance value index

Importance Value Index (IVI) allows a comparison of ecological significance of species in a given forest type and depicts the sociological structure of a population in its totality in the community (Lamprechet, 1989). Importance value index is a good index for summarizing vegetation characteristics and ranking of species (Kendeya Gebrehiwot, 2003).

The IVI was calculated as the sum of relative frequency, relative density and relative basal area (Colinvaux, 1986; Abayneh Derero *et al.*, 2003).

- Relative frequency was calculated by multiplying the ratio of absolute frequency of a species to the sum of absolute frequencies of all the species by 100 (Colinvaux, 1986; Abayneh Derero *et al*, 2003). Absolute frequency of a species was obtained by counting the number of plots in which the given species was recorded (Colinvaux, 1986; Kent and Coker, 1994; Tadesse Woldemariam, 2003).
- Relative density was calculated by multiplying the ratio of species density/ha of a single species to the sum of species density/ha of all species by 100 (Colinvaux, 1986; Abayneh Derero *et al*, 2003). Density was calculated by the number of individuals of a species per unit area (Abeje *et al.*, 2005).
- Relative basal area was calculated by multiplying the ratio of basal area/ha of a single species to the sum of basal area/ha of all species with 100 (Colinvaux, 1986; Abayneh Derero *et al,* 2003). Basal area of a species was calculated by the formula;

$$\mathbf{BA} = \frac{\mathbf{\Pi\,(DBH)^2}}{\mathbf{4}}$$ where **BA** = Basal area

DBH = Diameter at breast height(1.3 m above the ground)

Π = 3.14

Then for comparison the IVI values were ploted on a bar graph of seven IVI classes namely; IVI class 1(0-5), IVI class 2 (5-10), IVI class 3 (10-15), IVI class 4 (15-20), IVI class 5 (20-25), IVI class 6 (25-30) and IVI class 7 (>30).

4.3.1.3. Forest structure

The population structure was determined by analyzing the height and diameter distribution patterns. This was helpful to determine the age of the foret, level of disturbance.

Tree height distribution: to develop the tree height distribution of the forest in the study area,10 height classes; height class1 (with trees <5 m), height class 2 (5-10 m), height class 3 (10-15), height class 4 (15-20), height class 5 (20-25), height class 6 (25-30),

height class 7 (30-35), height class 8 (35-40), height class 9 (40-45) and height class10 (≥45 m) was formed based on the data obtained. Then the number of individuals corresponding to each height class was recorded. Then, the number of individuals versus the height classes was plotted on a bar graph using Windows Microsoft excel (Fig. 10).

Tree diameter distribution: The pattern of diameter distribution is usually used to represent the population structure of a forest (Khan *et al.*, 1987). To develop the tree diameter distribution of the forest in the study area, 11 diameter classes; diameter class 1 (1.2-5 cm), diameter class 2 (5-10 cm), diameter class 3 (10-25 cm), diameter class 4 (25-40 cm), diameter class 5 (40-55 cm), diameter class 6 (55-70 cm), diameter class 7 (70-85 cm), diameter class 8 (85-100cm), diameter class 9 (100-115 cm), diameter class 10 (115-130 cm) and diameter class 11 (≥130 cm) was formed based on the data obtained. Then, the number of individuals corresponding to each diameter class was recorded. Then the number of individuals versus the diameter classes was plotted on a bar graph using Windows Microsoft excel (Fig. 11).

4.3.1.4. Population structure

In addition to the forest structure, the population structure of the nine tree species, identified to be most important NTFPs source based on the preference ranking exercise and the interview result, was carried out. The nine tree species are; *Olea welwitschii*, *Scheffleria abyssinica*, *Syzygium guineense*, *Fagaropsis angolensis*, *Phoenix reclinata*, *Euphorbia ampliphylla*, *Elaeodendron buchananii*, *Ehretia cymosa* and *Millettia ferruginea.*

Although *Vernonia amygdalina* was an important tree species in that it is known to be the source of pollen and nectar for the bees to make honey, there was not any big individual encountered in the study area. Therefore, despite the importance, it was not possible to develop the population distribution of this species.

Population structure is the numerical description of individuals of different size or age within a population at a given moment of time (Peters, 1996). To determine the

population structure of the forests under study, the tree height distribution and tree diameter distribution was used.

To develop the population structure of the trees of interest, based on the data obtained, diameter classes were formed where diameter class 1 was (1.2-4 cm), diameter class 2 (4-10 cm), dimeter class 3 (10-20 cm), dimeter class 4 (20-60 cm), diameter class 5 (60-100 cm) and diameter class 6 (≥100 cm). The number of individuals corresponding to each diameter class was recorded. Then the number of individuals versus the diameter classes was plotted on a bar graph using Windows Microsoft excel (Fig.12 & 13).

4.3.1.5. Biodiversity

Biodiversity was determined using Shannon Weaver diversity index (Flower and Cohen, 1992) as follows;

H' **= -∑** ***(Pi ln Pi)*** *where* ***Pi*** denotes the proportion of a particular species in a sample.

The Shannon weaver index takes into account species richness and proportional abundance to calculate a single diversity measure. Therefore, in effect it is a measure of evenness of species abundance in a sample, with more even samples gaining higher value (Makenya, 2005).

4.3.2. Ethnobotanical data analysis

Data obtained from semi-structured interviews was coded in such a way that the objectives of the questions can be addressed and then processed by using SPSS13. Then the result was described mainly in percentages. Also preference ranking was carried out whereby the results are displayed in the form of tables.

5. RESULTS

5.1. NTFPs Resource Base of Gimbo District

After interviewing 86 households and after discussions with the key informants and personal observation, 26 NTFPs and NTFPs categories were identified (Table 5). Out of the 86 respondents 13.8% recognized all the 26 NTFPs and NTFPs categories 53% recognized 19 of the NTFPs and NTFPs categories and all of the respondents recognized 7 of NTFPs and NTFPs categories namely house construction materials, wood for farm impliments, firewood, coffee, honey, kororima and wild pepper.

From personal investigation, it was also noted that the area has a potential for civet musk, pollen, propolis and royal jelly cultivation and production. However, these NTFPs are not developed in the study area.

Table 5: List of NTFPs in the Gimbo District

No	NTFPs	Important Plant/animal Forest species giving the products	Important Plant/animal parts used
1	House construction material	*Elaeodendron buchananii*	Stem/trunks, branches, leaves
		Olea welwitschii	
		Oxyanthus speciosus	
		Syzygium guineense	
		Eucalyptus globulus and *Eucalyptus comaldulensis*	
		Phoenix reclinata	
		Dracaena fragrans	
		Euphorbia ampliphylla	
		Rhytigyna neglecta	
		Dalbergia lactea	
		Cyathea manniana	
		Pouteria adolfi- friedericii	
		Sapium ellipticum	
		Protea gaguedi	

		Arundinaria alpina *Cyperus dichroostachyus*	
2	Honey and beeswax	*Schefflera abyssinica* *Vernonia amygdalina* *Polyscias fulva* *Maesa lanceolata* *Coffea arabica* *Bidens prestinaria* *Olea welwitschii* *Sapium ellipticum*	Flowers(nectar&pollen)
3	Wood for farm impliments	*Chionanthus mildbraedii* *Ole a welwitschii,* *Cordia Africana,* *Rothmannia urcelliformis* *Galiniera saxifraga* *Vepris dainelli*	Stem, root
4	Beehive making	*Euphorbia ampliphylla* *Polyscias fulva* *Croton mycrostachyus* *Pouteria adolfi- friedericii*	Stem/trunk
5	Firewood	All woody species exept *Euphorbia ampliphylla* and *Cyathea manniana*	Stem,Branch,leaves
6	Lianas		Stem
7	coffee	*Coffea arabica*	Fruit,leaves,stem
8	Medicinal plants	See Table 7	Leaves, Roots, barks
9	*Rhamnus prinioides*	*Rhamnus prinioides*	Leaves, branchs, stem
10	Palms and Dracaenas	*Phoenix reclinata* *Dracaena steudneri* *Dracaena fragnans* *Dracaena afromontana*	Trunk,leaves,fruits
11	Korroroma	*Aframomum corrorima*	Capsule(seeds)
12	*Fagaropsis angolensis*	*Fagaropsis angolensis*	Fruit,bark
		Syzygium guineense	Fruits,leaves

13	Edible plants	*Phoenix reclinata* *Peponium vogelii*	
14	Mushrooms/Bracket fungi	Polyporus spp, Macrolepiota spp, Agaricus spp.	The cape(pileus)
15	Edible wild animals	*Tragelaphus scriptus*(miniliki), *Sylvicapra grimmia, Cyncerus caffer, Potomachores porkes*	
16	Charcoal	*Millettia ferruginea, Syzygium guineense*.	Stem
17	Wild pepper	*Piper capense*	Fruit
18	Cattle forage	*Oplismenus hirtellus* *Vernonia amygdalina* *Melletia fruginea* *Dracaena fragnans* *Phaulopsis imbricata* *Isoglossa punctata*	The leaves
19	*Catha edulis*	*Catha edulis*	Leaf
20	*Euphorbia ampliphylla*	*Euphorbia ampliphylla*	Trunk/stem
21	Dies	*Rothmannia urcelliformis*	Fruit
22	Fern Tree	*Cyathea manniana*	Trunk/stem
23	Latex	*Tiliachora fungifera*	The milky exudates
24	Ropes	*Dombeya torrida, Syzygium guineense, Hibiscus berberidifolius* *Phoenix reclinata*	Bark leaf
25	Ground honey (locally called Tazma maar)	-	-
26	Household tools like plates, vessels, horn, drum, barrel, axe handle, grinders (mukecha & zenezena), cart	*Schefflera abyssinica* *Pouteria adolfi- friedericii* *Cordia africana* *Ficus sur*	stem

Also from the interviewed households, 30 households were to be Kafas and the rest 22, 12, 8, 8, 6 households were Menjas, Oromos, Hadiyas, Amaharas and Tigrays respectively. From the households survey, it was understood that all of the respondents are dependent on the NTFPs to meet their construction, firewood & charcoal, medicinal and other needs. However, it was also understood that the degree of dependency vary with the respondents ethnic origin (Annex 6).

5.1.1. Wood for house construction

In Gimbo District, as in most parts of Ethiopia, there are two types of houses that are built. The two common types of houses are referred to as traditional (mud hut) and modern (mud house). The basic difference between the two types of houses is the shape of the houses and their roof. The traditional (mud hut) is circular in shape while the modern one is square or rectangular in shape. The roof of the traditional house is thatched while the modern one is covered by galvanized iron sheets.The traditional house is built using lianas instead of nail for forming the frame work of the wall and the roof. The modern house on the other hand is built using nails while forming the frame of the roof and the wall.

Table 6: List of Plant species in and around Gimbo District used to construct houses

Traditional house(mud hut)		**Modern house(mud house)**	
Purpose	**Species used**	**Purpose**	**Species used**
Mager*	*Dracaena fragrans, Cordia africana, Dalbergia lactea, Rytigynia neglecta*	Mager*	*Elaeodendron buchananii, Oxyanthus speciosus., Olea welwitschii, Syzygium guineense*
Meseso*	*Syzygium guineense*	Kuami*	*Elaeodendron buchananii, Olea welwitschii, Oxyanthus speciosus., Eucalyptus globulus* and *Eucalyptus comaldulensis*
Balla*	*Olea welwitschii*	Wall weraj*	*E.globulose* and *E.comaldulensis, Olea welwitschii, Elaeodendron buchananii*
Wall	*Phoenix reclinata, Pouteria adolfi-friedericii, Syzygium guineese, Elaeodendron buchananii, Sapium ellipticum, Cyathea manniana*	Demdimat*	Eucalyptus, *Olea welwitschii, Elaeodendron buchananii*
Roof	*Euphorbia ampliphylla, Syzygium*	Wall	*Phoenix reclinata,*

	guineense, Oxyanthus speciosus.,bamboo		*Elaeodendron buchananii, Eucalyptus globulose* and *Eucalyptus comaldulensis*
Roof weraj*	*Olea welwitschii, Elaeodendron buchananii*	-	-
Roof thatching	*Phoenix reclinata, Cyperus dichroostachyus*, straws from cereal crops	-	-

N.B;* *refers to the local naming in Amharic*

Figure 3: *Cyathea manniana*, an important tree fern used for house construction

5.1.2. Honey

In and around Gimbo District there are two types of honey. One is white and cruder while the other one is brown and less crude. The white one is made from the flowers of *Schefflera abyssinica* while the brown one is made from the flowers of *Vernonia amygdalina.*

In Gimbo District, the white honey is common. Although the bee makes the honey from both *Schefflera abyssinica* and *Vernonia amygdalina* resources, the honey from *Vernonia amygdalina* (brown honey) is not harvested. This is done because, if the brown honey is harvested the bee will be short of food and will not produce more white honey.

Therefore, although it is possible to harvest the brown honey, the farmers leave it to be fed by the bees and the bee will make more white honey. which is the honey harvested for use at home or for sale.

Apart from *Schefflera abyssinica* and *Vernonia amygdalina,* there are many other plants that are important in honey production in Gimbo District. Their importance is in two ways; one is for hanging the traditional beehives and the other is as a source of nectar. The plant species that are important for hanging the traditional beehives are; *Polyscias fulva, Croton macrostachyus, Albizia gummiferia, Syzygium guineense, Sapium ellipticum, Millettia ferruginea, Elaeodendron buchananii, Ficus sur, Pouteria adolfi-friedericii, Cordia africana***,** *Ficus sur*. And the plant species that are source of nectar next to *Schefflera absyssinica* and *Vernonia amygdalina* are; *Polyscias fulva, Maesa lanceolata, Bidens prestinaria, Coffea arabica, Olea welwitschii* and *Sapium ellipticum*. The flower of *Clematis hirusta* (a liana), according to informants information, flowers every six years and it is very fatal for bees if they happen to suck the nectar.

Honey is locally used to make local beverages like"Tej" and "Tella", it is also a good source of income for the people of Gimbo; it is source of food and it is also used to treat some illnesses like cold, stomach discomforts and wounds.

5.1.3. Wood for farm impliments

People in and around Gimbo District use different kinds of wood for construction of farm impliments. The most important types of wood used to make the farm impliments are woods from *Chionanthus mildbraedii* and *Olea welwitschii* to make MOFER(a woden structure of the traditional Ethiopian ploughing tool that extends from the kember to the ground), *Galiniera saxifraga, Olea welwitschii* and *Cordia africana* to make KEMBER(a woden structure of the traditional Ethiopian ploughing tool that restes on the oxen), *Olea welwitschii, Chionathus mildbraedii, Vepris dainelli* and *Rothnannia urcelliformis* to make ERF (a woden structure of the traditional Ethiopian ploughing tool that the farmer holds while manipulating the poughing process), the root of *Olea welwitschi* is used to

make the DEGER (a small woden structure of the traditional Ethiopian ploughing tool that s useful in tieing the *Erf* and *Mofer* on the plough ground) .

5.1.4. Beehive

A beehive is mainly made from *Euphorbia ampliphylla* and *Polyscias fulva* stems. It can also be made from the stem of *Croton macrostachyus* and *potuera adolfi-friedericii*. To construct a beehive what the farmers do is first they fell the desired tree. Then, the tree is cut into one meter logs. Each one meter log is split into two along its length. Then each half log is hollowed so that when the two half logs are brought together they will form a beehive.

The two hollowed half logs are tied together using lianas. To protect the bee from rain and heat, the beehive is finally covered with grasses, leaves of *Phoenix reclinata* or bamboo sheathes.

Figure 4: A common traditional beehive (covered with bamboo sheath)

5.1.5. Firewood

Firewood is the most important if not the only source of energy in most kebeles of the Gimbo District. Firewood is obtained from the natural forest. Most of the people of the Gimbo District collect firewood themselves. However, in some places (like in Bonga, Wushwush and Uffa towns), the people buy the firewood from the ambulatory vendors for household uses.

The plant species that are used as firewood are all woody species. From trees there are only two species that are not used as firewood. These are; *Cyathea manniana* and *Euphorbia ampliphylla.*

Figure 5: An ambulatory vendor in Bonga town carrying fuelwood for sell.

5.1.6. Climbers/runners/ vines stem

Climbers and vines are very important NTFPs in Kaffa zone. Among the many lianas that are found within the Gimbo district forests, the uses of *Tiliacora troupinii*, *Cisscus quadriangulata*, *Landolphia buchananii*, *Clematis longicauda, Jasmenium abyssinica*, *Comperatum paniculatum*, *Clematis hirsuta* and *Guania longispicata* is recognized by the local people.

Lianas are considered as a nail in house construction specially while constructing traditional huts. The stems of vines are used to hold the different parts of the house in similar manner that a nail does. *Tiliacora troupinii* is the most preferred vine for the purpose of house construction since it is very strong. If *Tiliacora troupinii* is not available, then *Cisscus quadriangulata* and *Landolphia buchananii* can be alternatives. But they are not as strong as the *Tiliacora troupinii*. *Landolpia buchananii* climber, apart from its use in house construction, is well known by the milky exudation that is apparent

when its stem is cut or wounded. This milky exudate is used by kids to make a ball that has rebounding ability.

Clematis hirsuta is one of the climbers found within the Bonga forest and is very important in that it provides clean drinking water when the stem is cut. The water coming out of this stem is also used as an eye ointment. But the best climber with regards to providing drinking water is the climber called *Guania longispicata*. This climber provides drinking water better than *Clematis hirsuta* both in quantity and quality.

5.1.7. Coffee

The coffee species found in the forests of Gimbo District is *Coffea arabica. Coffea arabica* has several uses in Gimbo District. The main use is for drinking. The beans of *C. arabica* are used to make coffee drink. The leaves are also used to make a drinking coffee. The dried branches and leaves are also used as firewood. The sterile *C. arabica* trunks are also used to make arrow handle and are also used as walking stick. Apart from the above uses *Coffea arabica* beans are good source of income to local farmers. The use of *C. arabica* as medicine is also known by the local people. Coffee is again important socio-culturally. People in the study area are seen to discuss many ideas sitting around coffee ceremony and it is often coffee that they invite their guests.

5.1.8. Medicinal plants

About 45 plant species were dealt by this study for their assumed medicinal properties. Out of the 45 plant species described by the local people as the major medicinal plants, 51.11% were herbs, 22.22% trees, 20 % shrubs and 6.66% climbers. The local people also described verbally that some paracitic plants that grows on *Coffea arabica, Euphorbia ampliphylla, Croton macrostachyus, Syzygium guineense, catha edulis, and Foniculum vulgare* are used to treat some ailments (Table 7). And most of the medicinal plants are needed for their leaves (Figure 6).

Table 7: List of plant species in Gimbo District with their medicinal values, ailments, parts used, recipe, prescription and mode of action.

No	Plant species name	Habit	Family	Used to treat the disease	Plant part(s) used	Recipe	Prescription	Mode of action
1	*Ajuga alba*	H	Lamiaceae	Antrax,kurtmat	Leaf + petiole, Leaf + petiole	Squashed +Areki, Squashed +Areki	Drinking, Drinking	Cure, cure
2	*Anethum foeniculum*	H	Apiaceae	STD(name not verified),mech and many others(multipurpose)	Root+leaf	squashed	drinking	cure
3	*Colocasia esculenata*	H	Araceae	Gonorria(chebt)	Root	Squash +boiled	drinking	cure
4	*Cordia africana*	T	Boraginaceae	Tonsillitis,constipication of man and cattle	Bark,bark	Placemet,powered	Chewing, drinking	Cure, cure
5	*Dalbergia lactea*	Sh	Fabaceae/ Papelinoidae	Snake bite,scorpion bite,spider poisioning, Cattele skin parasite	Leaf, leaf	Squashing, squeezing	Drinking, rubbing	Cure, cure
6	*Embelia schimperi*	Cl	Myrsinaceae	Tape worm	Fruit	powdering	drinking	cure
7	*Impatiens ethiopica*	H	Baslsaminaceae	cholera	Leaf	squashed	drinking	cure
8	*Lannea schimperi*	H	Anacardiaceae	Stomach problem	Leaf	squashed	drinking	cure

9	*Lantana camara*	H	Verbenaceae	Troat infections	Leaf+salted	Squashed	drinking	cure
10	*Nicotiana tabacum*	Sh	Solanaceae	cholera	Leaf + petiole	squashed	drinking	cure
11	*Persicaria senegalensis*	H	Polygonaceae	tonsillitis	Root	Placemet	Chewing	cure
12	*Psychotria orophila*	T	Rubiaceae	Danrouff of human and cattele,boldness in human	Leaf	squashed	rubbing	Cure, prevention
13	*Senna septemtrionalis*	H	Fabaceae/ Cesalpinoidae	Snake bite,scorpion bite,spider poisioning	Leaf	Squashing	Drinking	cure
14	*Solanecio gigas*	T/Sh/ H	Asteraceae	Anthrax	Leaf	-	-	cure
15	*Teclea nobilis*	T	Rutaceae	Stomach problem	Leaf	squashed	drinking	cure
16	*Thalictrum schimperianum*	H	Ranunculaceae	Bad spirit	Leaf	squashed	rubbing	prevention
X	Parasitic plants of							
	1)*Coffea arabica*		-	Kurtmat	-	-	-	-
	2)*Euphorbia ampliphylla*		-	Tuberculosis	-	-	-	-
	3)*Croton macrostachyus*		-	Kurtamat	-	-	-	-
	4)*Syzygium guineense*		-	Majic	-	-	-	-
	5)*catha edulis*		-	Kurtmat	-	-	-	-
	6)*Foniculum vulgare*		-	Boils	-	-	-	-
17	*Aframomum corrorima*	H	Zingebelaceae	Stomachache	Capsule	placement	Bite+chew	cure
18	*Amorphophallus gallaensis*	H	Araceae	Dermal infection	Tuber	placement	rubbing	cure
19	*Asparagus asparagoides*	H	Asparagaceae	Gohonoria	Root	squashed	Drinking	Cure
20	*Catha edulis*	Sh	Celastraceae	STD(name not verified)	Leaf	Boiled with aditives	Drinking	cure

21	*Celtis africana*	T	Ulmaceae	Cattle tuberculosis	Bark(middle layer)	placemet	Nose application	Cure
22	*Clausena anisata*	Sh	Rutaceae	Hens,chicken disease(commonly known as kinkin)	Leaf,bark	squashes	Washing	cure
23	*Clematis longicauda*	Cl	Ranunculaceae	Teeth disease	Leaf	squeezed	Placement	Cure
24	*Coffea arabica*	Sh	Rubiaceae	Stomachache, amoebae	Beans	Rosted+powdered	Eating, drinking	Prevention + cure
25	*Croton macrostacyus*	T	Euphorbiaceae	stomachache	Leaf	squashed	drink	Cure
26	*Dodonaea angustifolia*	Sh	Sapindaceae	Stomachache	Leaf	-	-	-
27	*Ehretia cymosa*	T	Boraginaceae	Rebis, bad sperit	Root	squashed	Drinking	Cure
28	*Gutenbergia rueppellii*	Cl	Asteraceae	stomachache	Leaf tip	squashed	drink	Cure
29	*Isoglosa somalensis*	H	Acanthaceae	Teeth infection	Leaf	squashed	placement	cure
30	*Justicia schimperiana*	Sh	Acanthaceae	Gum infection	Fruit	burned	smoking	cure
31	*Lannea fruticosa*	T	Anacardiaceae	Leg and hand breakage	Leaf	toasted	tying	cure
32	*Leonotis neptifolia*	H	Lamiaceae	Eye disease, fever(mich)	Leaf	Squashed,squashed	Ointment, drinking	cure
33	*Nelsonia canescens*	H	Acanthaceae	Feet infection(fungus)	Leaf	toasted	rubbing	cure
34	*Pentas cafensis*	H	Rubiaceae	Eye disease	Leaf	squashed	Ointment	Cure
35	*Phaulopsis imbricata*	H	Acanthaceae	Influenza	Leaf	Squashed +boiled	drinking	cure
36	*Ranunculus*	H	Ranunculaceae	Teeth disease,eye disease	Leaf	-	-	cure

	multifidus							
37	*Rhamnus prinoides*	Sh	Rhamnaceae	Syphilis(chebt)	Leaf,Root,most importantly stem	Squashed + boiled	drinking	cure
38	*Sida tenuicarpa*	Sh/T	Malvaceae	Child diseases	Root	squashed	Drinking	Cure
39	*Solancio manni*	H	Asteraceae	Fever (mich)	Leaf	Squashed + coffee	drink	cure
40	*Triumfetta brachyceras*	H	Rubiaceae	Child, cattle constipation	Whole plant	Squashing plants to get the mucus like exudate	Feeding the exudate	cure
41	*Urera hypselodendron*	H	Urticaceae	Increase immunity, additional food for babies	Leaf	Boiled	drinking	Cure
42	*Utrica simensis*	H	Urticaceae	Fever (mich)	Leaf	Squashed+ coffee	drink	cure
43	*Vepris dainelli*	T	Rutaceae	Breast disease	Fruit	-	-	-
44	*Verbena officinalis*	H	Verbinaceae	Maleria	Whole plant	-	-	cure
45	*Vernonia auriculiferaa*	T	Asteraceae	wounds	Leaf	Toasted	Placement	Cure

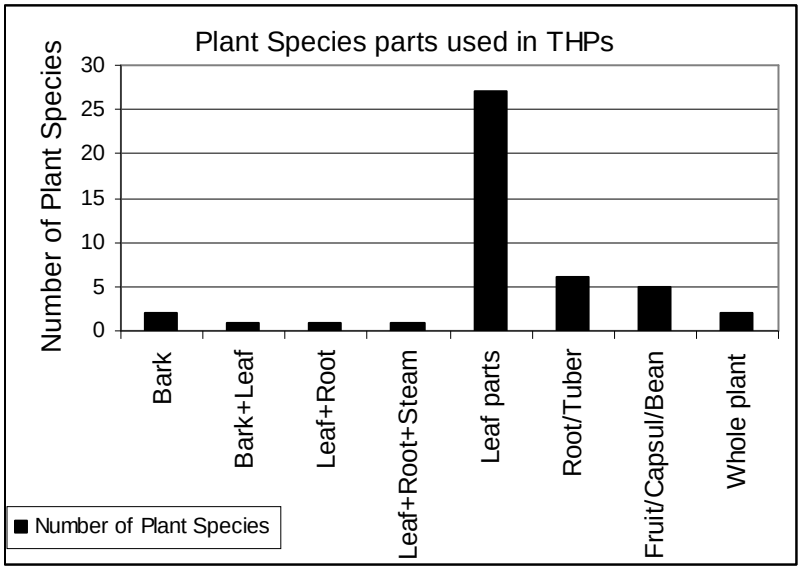


Figure 6: Plant parts of the major medicinal plants used in THPs in Gimbo District

5.1.9. *Rhamnus prinioides* L'Herit

Rhamnus prinioides is an important spice in "Gimbo" used to make local beverages namely "Tella", "Tej" and "Areki".The leaves of *R. prinioides* is used to make "Tella" and the stem and the branches are used for making "Tej" and "Areki".

5.1.10. Palms and dracaenas

There are four species of palms and dracaenas in Gimbo District. These are *phoenix reclinata*, *Dracaena steudneri*, *D. afromontana* and *D. fragrans. Phoenix reclinata* has several uses; its leaves are used to make carpets, bags, ropes, and are also used to cover the roof of a hut. Its trunk is used widely for making culverts and even bridges, for house contruction and gate making. The fruit of *Phoenix reclinata* is also edible.

The carpets made from *Phoenix reclinata* leaves are very important in and around Gimbo District in that they are used as carpet, as mattresses and most importantly as coffins. Elderly key informant described *Phoenix reclinata* as being every thing to the people of Kaffa.

The other three important species of this category in Gimbo forests; namely *Dracaena steudneri*, *D.afromontana* and *D. fragrans* are usually used as cattle feed during the dry season. The leaf of *Dracaena steudneri* is also used as a replacement for *Ensete ventricosum* leaves for foiling the paste of bread and "Kocho" while baking. And *D. fragrans* is used as live fence. This species easily propagates vegetatively, what the local people do is go to the forest cut the plant, and plant cuttings around their house boundary that will latter become a live fence.

a) The trunks of *Phoenix reclinata* used to make culverts

b) The trunks of *Phoenix reclinata* used to make a fence/gate

c) *Dracaena steudneri* at the edge of the Forest in "Keya kella" kebele

d) *Dracaena fragnans* a common live fence

Figure 7: Palms and dracaenas of the Gimbo District and their uses

5.1.11. *Aframomum corrorima* (Braun) Jansen

Aframomum corrorima, in Gimbo District, is mainly used as a source of income. It is also used to spice coffee (most importantly tea made from coffee leaves). The capsule of *Aframomum corrorima* is also used to relieve stomach discomforts and most people chew the ripen capsule of *Aframomum corrorima* when they suffer from stomach discomforts.

5.1.12. *Fagaropsis angolensis*

The fruit of *Fagaropsis angolensis* is an important spice in Gimbo District. The fruit is put in milk and coffee to flavor them. One of the informants reported that, if a person starts to drink milk and coffee spiced with this fruit, then he/she would never prefer to drink coffee or milk without being spiced with this fruit.

The bark of *Fagaropsis angolensis* is mixed with salt and fed to cows so that the milk production improves and tastes better. It is also believed that when the bark of *Fagaropsis angolensis* is mixed with salt and given to cattle, the cattle's resistance to diseases will be boosted and the cattle will be very healthy and productive.

5.1.13. Edible wild plants and fruits

It was learnt that the wild plants and fruits that are edible in and around Gimbo District are, the fruits of *Phoneix reclinata*, *Syzygium guineense*, *Rubus steudneri* and *Peponium vogelii*. The fruit of *Peponium vogelii* is very important to the local people in that it is known to treat Gastric illnesses.

5.1.14. Mushrooms/Bracket fungus

There are edible and non-edible mushrooms recognized in Gimbo District. According to respondents, those non-edible mushrooms do not have good appearance and it is believed that when some body passes by these mushrooms the teeth will be dislocated. Therefore, when some body passes by these mushrooms, he/she will hold his/her mouth with the hand very tightly. Those non-edible mushrooms are known as "Gash Gaecho" Gash in Kafa means teeth.

Similarly, there are edible and non-edible bracket fungi recognized by the local people in the study area. The edible bracket fungus is the one that grows on the living trees while the non-edible one is the one that grows on the dead trees.

The edible mushrooms are locally known as "Tachi Koyo","Koto","Yachae" and the bracket fungus "Earo". According to the taste, the local people prefer (Table 8).

Table 8: Mushrooms and Bracket fungus preference in Gimbo district

Rank	Scientific name	Local name	Description
1st	Polyporus sp.	Earo	Grows on trees.
2nd	Macrolepiota sp.	Koto	Looks like an umbrella and is big in size. Two of the Koto mushroom can feed a family for one meal
3rd	*Agaricus bisporous*	Tachi Koyo	They are very small and grow in cluster.
4th	*Agaricus campestris*	Yachae	They are very small and grow in cluster; they are as white as a paper.

5.1.15. Edible wild animals

Tragelaphus scriptus (miniliki)/ known as "Dikula", *Sylvicapra grimmia* known as "Midako", *Cyncerus caffer* knowen as "Goshe" and Potomachores *porkes* known as "Yechaka Assama" are the wild animals that the local people use as source of bushmeat. However according to the respondents, the number of these animals has reduced very much and it is very hard to find them.

5.1.16. Charcoal

Charcoal is the next most important fuel next to firewood. Charcoal is mostly produced around the towns of Bonga, Wush wush and Ufa. Other wise, charcoal is not widely used

in the rural areas. The most important trees which charcoal is made are *Millettia ferruginea* and *Syzygium guineense*.

5.1.17. Wild pepper

The fruit *of Piper capense* (wild pepper), is a very important spice that is found in Gimbo District. The fruit of this plant is a source of income to the local people. The ripen fruit is sometimes eaten by some people. However, people don't usually prefer to collect this fruit for sale because its price is not paying. People said that a ripen *Piper capense* fruit of 50 kg sac will only weigh 5 kg in dry state which is needed on the market.

5.1.18. Cattle forage

The most important plants used as cattle forages are: the grass species called *Oplismenus hirtellus,* the herbs *Hypoestes forskaolii* and *Achyranthes aspera*. The leaves of *Vernonia amygdalina* and *Millettia ferruginea* are also important cattle forages. *Dracaena fragrans* is very important cattle forage in that it is drought resistant and during the dry seasons the leaves of this plant are important cattle forage.

5.1.19. *Catha edulis* (Vahl) Frossk.ex Endl

Chata edulis grows wild in side the natural forests and is grown around the farmyards. *Chata edulis* is sold to the market generating income to the farmers and is chewed by people as a stimulant. The plant is also used for THP in the study area.

5.1.20. Dyes

The fruit of *Rothmannia urcelliformis* is used to dye carpets made of *Phoenix reclinata*. The fruits of *Rothmannia urcelliformis* and *Phoenix reclinata* are boild together so that the leaves of *Phoenix reclinata* get coloured. The fruits of *Rothmannia urcelliformis* are also important to blacken traditional clothes at times of griffing ("hazen").

5.1.21. Ropes

Ropes are important in the day-to-day life of the people living in Gimbo District. Ropes are used to tie cattle and are also used to climb trees while hanging beehives. In Gimbo District and the surroundings, there are robes made from fibers of *Ensete ventricosum*, bark of *Dombeya torrida*, bark of *Hibiscus berberidifolius* and *Syzygium guineese*. Ropes are also made from a mixture of *Ensete ventricosum* fibers and *Hibiscus berberidifolius* barks. The rope made from the bark of *Dombeya torrida* is the one used to climb trees while hanging bee hives. Therefore it is this rope that is preferred by the local people for the strength. The ropes made from the fibers of *Ensete ventricosum* and from the bark of *Hibiscus berberidifolius* are comparable in strength but during the rainy season, the *Hibiscus berberidifolius* ropes are preferred as they are not damaged by the rain but rather get stronger as they get wet. The ropes made from *Syzygium guineense* bark are less preferred and are not widely used but can serve some purpose.

5.1.22. Fern tree

Cyathea manniana is a fern tree found in the study area. This plant is very much desired by the local people for house construction and fencing. The reason why this species is favoured is that it cannot be damaged by nematodes and insects, thus making it a very durable construction material.

5.1.23. Latex

Most of the Euphorbiaceae species are known to bear latex. From some of the Euphorbiaceae species in Gimbo District, the latex of *Landolphia buchananii* and *Euphorbia ampliphylla* are recognized by the local people for their use as sticker (paper and money) .The latex of *Landolphia buchananii* is white in colour and it is widely known by the local people for its use by children for making balls.

5.2. NTFPs Preference

Among the 19 NTFPs and NTFPs categories dealt during the preference ranking exercise, the most preferred NTFPs are the house construction materials (Table 9). House

construction materials are the most preferred NTFPs in all the four kebeles. And as can be seen in Table 9, according to the local people's preference honey, wood for farm impliments and firewood are amongst the highly preferred NTFPs in all of the four kebeles, But coffee seems to be preferred in different degrees among the four kebeles in that in the PFM kebeles it is ranked in the fourth and sixth position while in the free access forest it ranked second in both the kebeles.

Table 9: NTFPs preference in Gimbo District

No	NTFPs	Study sites (kebeles)								District rank	
		Yeyebito		Bita chega		Queja araba		Kayakela		Gimbo	
		Tot. score	rank	Tot. score	rank	Tot. score	rank	Tot. score	rank	Tot. score	rank
1	House construction material	48	1st	48	1st	48	1st	48	1st	192	1st
2	Honey	47	2nd	46	3rd	40	3rd	40	4th	173	2nd
3	Wood for farm impliment	42	3rd	47	2nd	40	3rd	42	3rd	171	4th
4	Beehive	40	4th	36	6th	33	5th	33	7th	142	7th
5	Firewood	39	5th	44	5th	34	4th	37	5th	154	5th
6	Climbers/runners/ vines stem	34	6th	44	5th	33	5th	37	5th	148	6th
7	coffee	34	6th	45	4th	47	2nd	46	2nd	172	3rd
8	Medicinal plants	31	7th	34	7th	33	5th	30	9th	128	8th
9	*Rhamnus prinioides*	19	8th	33	8th	30	6th	31	8th	113	11th
10	*Phoenix reclinata*(palm)	18	9th	30	10th	33	5th	36	6th	117	10th
11	Cardamom	18	9th	29	12th	20	9th	14	13th	81	15th
12	*Fagaropsis angolensis* fruit	17	10th	25	14th	25	8th	25	11th	92	13th
13	Edible plants &	16	11th	29	11th	14	11th	13	14th	72	14th

	fruits										
14	Mushrooms	14	12th	18	15th	14	11th	14	13th	60	18th
15	Edible wild animals	13	13th	32	9th	17	10th	11	15th	73	16th
16	Charcoal	11	14th	26	13th	30	6th	33	7th	100	12th
17	Wild pepper	10	15th	29	11th	14	11th	13	14th	66	17th
18	Cattle forage	-	-	34	7th	29	7th	28	10th	91	9th
19	*Catha edulis*	-	-	29	11th	20	9th	20	12th	69	14th

5.3. Species preference for plants of specific NTFPs catagory

Plants are the source of most NTFPs. Therefore the plant species preference was carried out. As can be seen in tables 11-13, *Olea welwitschii* is the most important plant species in that it is used in many ways and is the most preffered species for house construction, farm implements making or firewood. And *Euphorbia ampliphylla*, Ficus sp, *Pouteria adolfi- friedericii*, *Polyscias fulva*, *Croton macrostachyus*, *Brucea antidysenterica* are plant species used by the local people for making beehives (Table10).

Table 10: Preference ranking for plants suitable for beehive making

No	Plant species	Study sites (kebeles)								District rank	
		Yeyebito		Bita chega		Queja araba		Kayakela		Gimbo	
		Tot. score	rank	Tot. score	rank	Tot. score	rank	Tot. score	rank	Tot. score	rank
1	*Euphorbia ampliphylla*	45	1st	40	1st	49	1st	45	1st	179	1st
2	Ficus sp	30	2nd	30	2nd	45	2nd	30	2nd	135	2nd
3	*Pouteria adolfi-friedericii*	28	3rd	29	3rd	30	3rd	25	3rd	112	3rd
4	*Polyscias fulva*	28	3rd	29	3rd	25	4th	24	4th	106	4th
5	*Croton macrostachyus*	24	4th	24	4th	23	5th	20	5th	91	5th
6	*Brucea antidysenterica*	24	4th	24	4th	20	6th	20	5th	88	6th

Table 11: Preference ranking for plants suitable for house construction

No	Plant species	Study sites (kebeles)								District rank	
		Yeyebito		Bita chega		Queja araba		Kayakela		Gimbo	
		Tot. score	rank	Tot. score	rank	Tot. score	rank	Tot. score	rank	Tot. score	rank
1	*Olea welwitschii*	48	1st	42	1st	48	1st	48	1st	186	1st
2	*Elaeodendron buchananii*	35	3rd	40	2nd	40	2nd	45	2nd	160	2nd
3	*Syzygium guineense*	36	2nd	37	3rd	40	2nd	40	4th	153	3rd
4	*Cyathea manniana*	-	-	37	3rd	36	3rd	35	6th	108	9th
5	*Chionanthus mildbraedii*	33	5th	33	4th	35	4th	33	7th	134	4th
6	*Rhytigyna neglecta*	34	4th	33	4th	33	5th	30	8th	130	5th
7	*Fagaropsis angolensis*	-	-	30	5th	30	5th	28	9th	88	12th
8	*Psychoteria orophila*	30	7th	29	6th	28	6th	25	10th	112	7th
9	Oxyanthus sp.	-	-	28	7th	28	7th	22	12th	78	13th
10	*Allophylous abyssinicus*	22	10th	27	8th	22	7th	22	12th	93	11th
11	*Apodytes dimidiate*	-	-	25	9th	20	8th	21	13th	66	15th
12	*Galiniera saxifraga*	27	9th	23	10th	40	9th	20	14th	110	8th
13	*Pouteria adolfi-friedericii*	36	2nd	-	-	36	2nd	42	3rd	114	6th
14	*Protea gaguedi*	36	2nd	-	-	30	3rd	38	5th	104	10th
15	*Jastica shemperiana*	32	6th	-	-	22	6th	23	11th	77	14th
16	*Prunus africana*	28	8th	-	-	-	8th	22	12th	50	16th

Table 12: Preference ranking for plants suitable for firewood

No	Plant species	Study sites (kebeles)								District rank	
		yeyebito		Bita chega		Queja araba		kayakela		Gimbo	
		Tot. score	rank	Tot. score	rank	Tot. score	rank	Tot. score	rank	Tot. score	rank
1	*Olea welwitschii*	49	1st	24	1st	50	1st	48	1st	171	1st
2	*Macaranga capensis*	34	2nd	-	-	48	2nd	45	2nd	127	4th
3	*Allophylus abyssinicus*	30	3rd	30	3rd	40	3rd	40	3rd	140	2nd
4	*Polyscias fulva*	24	5th	24	7th	36	5th	38	4th	122	6th
5	*Albizia gumiferia*	23	6th	28	5th	35	6th	35	6th	121	7th
6	*Sapium ellipticum*	21	8th	19	10th	33	7th	33	7th	106	10th
7	*Millettia ferruginea*	27	4th	30	3rd	38	4th	38	4th	133	3rd
8	*Oxyanthus speciosus*	27	4th	-	-	38	4th	38	4th	103	11th
9	*Vernonia amygdalina*	22	7th	24	7th	33	7th	30	8th	109	9th
10	*Maesa lanceolata*	23	6th	29	4th	30	8th	28	9th	110	8th
11	*Croton macrostachyus*	23	6th	-	-	30	8th	28	9th	81	13th
12	*Ficus ovata*	21	8th	-	-	28	9th	26	10th	75	14th
13	*Schefflera abyssinica*	21	8th	19	10th	28	9th	26	10th	94	12th
14	*Bersama abyssinica*	24	5th	-	-	25	10th	22	11th	71	16th
15	*Phoenix reclinata*	-	-	25	6th	25	10th	22	11th	72	15th
16	*Syzygium guineense*	-	-	33	2nd	48	2nd	45	2nd	126	5th
17	*Prunus africana*	-	-	29	4th	38	4th	36	5th	103	11th

Table 13: Preference ranking for plants suitable for farm impliments

No	Plant species	Study sites (kebeles)								District rank	
		yeyebito		Bita chega		Queja araba		Kayakela		Gimbo	
		Tot. score	rank	Tot. score	rank	Tot. score	rank	Tot. score	rank	Tot. score	rank
1	*Olea welwitschii*	46	1st	45	1st	48	1st	46	1st	185	1st
2	*Chionathus mildbraedii*	32	4th	35	2nd	45	2nd	35	3rd	147	2nd
3	*Cordia africana*	-	-	33	4th	45	2nd	42	2nd	120	4th
4	*Prunus africana*	25	6th	24	7th	30	5th	28	5th	107	6th
5	*Ehretia cymosa*	34	2nd	34	3rd	35	4th	35	3rd	138	3rd
6	*Galiniera saxifraga*	24	7th	25	6th	25	7th	24	6th	98	7th
7	*Vangueria apicualata*	28	5th	30	5th	28	6th	30	4th	116	5th
8	*Vepris dainelli*	20	8th	22	8th	20	8th	28	5th	90	8th

Figure 8
While carrying out an informal discussion with two of the key informants in "Queja Araba" Kebele

5.4. Status of NTFPs over the past 5-10 years

According to most of the key informants judgment, most of the NTFPs have reduced in abundance over the past 5-10 years. Only *Phoenix reclinata* and medicinal plants have increased in abundance.

Table 14: NTFPs status in Gimbo District where; A=increased, B=Remained same, C=Reduced, D=highly reduced

No	NTFPs	Yeyebito				Bita chega				Queja araba				Kayakela				Forest				Gimbo
																		PFM/status		Free/status		
		A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D		**score**		**score**	
1	House construction wood	0	**7**	3	0	0	**5**	5	0	0	2	**8**	0	0	0	**10**	0	B	12/20	C	18/20	C
2	Honey(source)	0	0	10	0	0	0	10	0	0	0	2	8	0	0	0	10	C	20/20	**D**	18/20	C
3	Wood for farm impliments	0	5	5	0	0	4	6	0	0	0	6	4	0	0	9	1	C	11/20	C	15/20	C
4	Beehive material	0	3	7	0	0	0	10	0	0	4	6	0	0	0	10	0	C	17/20	C	16/20	C
5	Firewood	0	5	5	0	0	7	3	0	0	5	5	0	0	4	6	0	B	12/20	C	11/20	C
6	Lianas	0	0	10	0	0	1	9	0	0	0	7	3	0	0	5	5	C	19/20	C	12/20	C
7	Coffee	0	0	10	0	0	0	10	0	0	3	7	0	0	5	5	0	C	20/20	C	12/20	C
8	Medicinal plants	8	2	0	0	7	0	3	0	5	0	5	0	5	7	0	0	**A**	15/20	B	7/20	**A**
9	*Rhamnus prinioides*	0	10	0	0	2	8	0	0	0	7	3	0	0	5	5	0	B	18/20	B	12/20	B
10	*Phoenix reclinata*	7	3	0	0	5	4	1	0	5	3	2	0	4	4	2	0	**A**	12/20	**A**	9/20	**A**
11	Cardamom	0	0	10	0	0	2	8	0	0	3	7	0	0	5	5	0	C	18/20	C	12/20	C
12	*Fagaropsis angolensis*	0	0	0	10	0	0	0	10	0	0	0	10	0	0	0	10	**D**	20/20	**D**	20/20	**D**
13	Edible plants & fruits	0	10	0	0	0	10	0	0	0	8	2	0	0	1	9	0	B	20/20	C	11/20	C
14	Mushrooms/Bracket fungi	0	0	10	0	0	0	10	0	0	0	9	1	0	1	9	0	C	20/20	C	18/20	C
15	Edible wild animals	0	0	0	10	0	0	5	5	0	0	9	1	0	3	7	0	**D**	15/20	C	18/20	C
16	Charcoal	0	10	0	0	0	10	0	0	0	5	5	0	0	4	6	0	B	20/20	C	11/20	B
17	Wild pepper	0	5	5	0	0	4	6	0	0	0	10	0	0	0	10	0	C	11/20	C	20/20	C
18	Cattle forage	7	3	0	0	6	2	2	0	0	5	5	0	0	4	6	0	**A**	13/20	C	11/20	C
19	*Catha edulis*	0	0	10	0	0	0	10	0	0	0	10	0	0	0	10	0	C	20/20	C	20/20	C

5.5. Result of Market Survey

There were three types of NTFPs vendors identified by the market survey. And these are ambulatory, temporary and permanent vendors. The ambulatory vendors sell firewood, charcoal, *Rhamnus prinoides* and sometimes rope and carpets. The temporary vendors sell coffee, *Fagaropsis angolensis* fruit, carpets and rope. And the permanent vendors sell honey, honey wax, cardamom, wild pepper, coffee and tazma mar.

The temporary vendors living in the two kebeles of the study site (Queja araba and Keya kella) take their products to the market twice to Bonga and once to Uffa. And the other temporary vendors living in the other two kebeles of the study site (Yeyebito and Bitachega) take their products to the nearby markets of Wushwush and Woshi once a week.

Among the ambulatory vendors contacted for interview, 25% of them came from the two kebeles, Qeja araba and Keyakela (which are among the four kebeles of the study site). And none of them lived in Bonga town. And among the temporary vendors only 5% came from Queja araba and Keya kela. And 15% of the temporary vendors lived in Bonga town (showing the presence of retail). And all the permanent vendors are residents of Bonga town.

Figure 9: Carpets and containers made of *Phoenix reclinata* leaves for sell at Bonga market
Table 15: current price of NTFPs with in the Bonga town

No.	Type of product		Unit	Bonga open market	Bonga shops	Bonga from ambulatory merchants
1	Coffee	Unpeeled/Dry berrey	1kg	4.5 birr	-	-
		Peeled/beans	1kg	15 birr	16 birr	-
2	Honey		1kg	-	16 birr	-
3	Beeswax		1kg	-	24 birr	-
4	Korrorima		1kg	-	15 birr	-
5	Wild pepper		1kg	-	9 birr	-
6	Carpet(made of *Phoenix reclinata*)	Low quality	1m*2m	3 birr	-	3 birr
		Good quality	1m*2m	10 birr	-	-
		Good quality and decorated with colours	1m*2m	15 birr		-
7	*Fagaropsis angolensis* fruit		Local coffee cupful	0.25 birr	-	-
8	*Rhamnus prinoides*		Woman load	-	-	5 birr
9	Firewood		Woman load	-	-	7-10 birr
10	charcoal		50kg sack	-	-	
11	Rope	made of *Phoenix reclinata*)	6 m	1 birr	-	1 birr
		made of *Hibiscus berberidifolius*	6 m	1.5 birr	-	1.5 birr
		Made of *Dombeya torrida*	30 m	40 birr	-	40 birr

NB: * stands for multiplication sign (showing dimention i.e. length * width).

5.6. Availability of NTFPs

In the study area (Table 16), the months of September, October, November and December are the most important months for the harvest of coffee and cardamom. In April of the year, honey is harvested. Several other NTFPs like *Phoenix reclinata*, *Rhamnus prinoides*, *Cyathea manniana*, *Piper capense*, medicinal plants, wild foods, mushrooms and firewood are harvested during the whole year. The major crops that are grown in the study area are harvested during the months of September, October and November.

Table 16: NTFPs availability in the months of the year versus availability of major crops

NTFPs	Months of collection/ months of availability											
	J	F	M	A	M	J	J	A	S	O	N	D
Coffee									■	■	■	■
Honey				■								
Honey wax				■								
Cardamom									■	■	■	■
Fagaropsis angolensis fruit	(Once in 6- 7 years) rare											
Rhamnus prinoides	■	■	■	■	■	■	■	■	■	■	■	■
mushrooms	(Every 3 months) not specific											
Wild fruits	■	■	■	■	■	■	■	■	■	■	■	■
Wild pepper	■	■	■	■	■	■	■	■	■	■	■	■
Medicinal plants	■	■	■	■	■	■	■	■	■	■	■	■
Firewood	■	■	■	■	■	■	■	■	■	■	■	■
Phoenix reclinata	■	■	■	■	■	■	■	■	■	■	■	■
Cyathea manniana	■	■	■	■	■	■	■	■	■	■	■	■
Maize									■			
Barley										■	■	
Teff									■	■	■	

5.7. Threats to the biodiversity and NTFPs of the Gimbo District

During this study, as it has been witnessed by other concerned individuals, it was learnt that large amount of natural forest has been converted to a private coffee investment holdings. This trend is also continuing and the researcher came across large areas demarketed as an investment land. And according to the researcher's observation and informal discussion carried out with the local people, the investors are involved in massive production of coffee and honey by clearing the forest and destroying the biodiversity. This is one treat to the biodiversity of the area.

Another treat is the resettlement of people whereby the government follows as a policy and the other one is a volunteer resettlement whereby farmers from another corner of the country do by their own. In both cases the pressure has been exerted on the biodiversity of the natural forest. Although there needs to be further study, it was believed that the resettlement programme carried out by the government was less damaging than that by the volunteer resettlers. This could be due to the inherent different nature of the people that are resettled by the government and that of the volunteer resettlers.

Household tools like plates, vessels, horn, drum, barrel, axe handle, grinders (mukecha & zenezena), cart, beehive are made in a very distructive manner. However, since the quality of these items is poor, there is no market for sell to other markets therefore, these products exept the beehives, are produced once per household which make the threat less despite the massive chunk of stem that is needed in making them.

During the study, it was observed that farmers deliberately kill trees so that they can be allowed to cut it and use it. It was learned that in the PFM scheme for most of the tree species, it is when the trees die and get old that farmers are allowed to cut them for use. So in the PFM sites and especially in the Bitacheka Kebele, there were quite many trees that were made to die deliberately.

5.8. Result of the vegetation Data

5.8.1. Floristics

A total of 130 plant species belonging to 57 families were delt by this study. Out of the 130 plant species encountered, 105 of the plant species were found within the sample plots and the rest 25 of the plant species were not found within the sample plots. The families Rubiaceae, Acanthaceae, Asteraceae and Euphorbiaceae comprise about 25.76 % of the plants species documented by this study. And the most abundant family is Rubiaceae represented by 12 species (9.23%) of the plants species (Table 17).

Table 17: List of plant sopecies in the study area

No	Scientific names	Habit	Family	In	Out
1	*Acanthus eminens*	Sh.	Acanthaceae	X	
2	*Achyranthes aspera*	H	Amaranthaceae	X	
3	*Aframomum zambesiacum*	H	Zingiberaceae	X	
4	*Aframonum corrorima*	H	Zingiberaceae	X	
5	*Ajuga alba*	H	Lamiaceae	X	
6	*Albizia grandibacteata*	T	Mimosaceae	X	
7	*Albizia gummifera*	T	Fabaceae	X	
8	*Allophylus abyssinicus*	T	Sapindaceae	X	
9	*Amorphophallus gallaensis*	H	Araceae	X	
10	*Antheum foeniculum*	H	Apiaceae		X
11	*Apodytes dimidiata*	T	Icacinaceae	X	
12	*Arundinaria alpina*	T	Poaceae		X
13	*Asparagus asparagoides*	H	Asparagaceae	X	
14	*Bersama abyssinica*	T	Melianthaceae	X	
15	*Bidens prestinaria*	H	Asteraceae	X	
16	*Brucea antidysenterica*	Sh.	Simaroubaceae	X	
17	*Canthium oligocarpum*	T	Rubiaceae	X	
18	*Catha edulis*	Sh	Celastraceae	X	
19	*Celtis africana* Brum	T	Ulmaceae	X	
20	*Chionathes mildbraedii*	T	Oleaceae	X	

21	*Cissus quadriangularis*	Cl.	Vitaceae	X	
22	*Clausena anisata*	Sh.	Rutaceae	X	
23	*Clematis hirusta*	Cl.	Ranunculaceae	X	
24	*Clematis longicauda*	Cl.	Ranunculaceae	X	
25	*Coffea arabica*	Sh.	Rubiaceae	X	
26	*Colocasia esculenta*	H	Araceae		X
27	*Comelina difusa*	H	Commelinaceae	X	
28	*Comperatum paniculatum*	Cl.	Combrataceae	X	
29	*Crdia Africana*	T	Boraginaceae	X	
30	*Croton macrostacyus*	T	Euphorbiaceae	X	
31	*Cyathea manniana*	T	Cyatheaceae	X	
32	*Cyperus dichroostachyus*	H	Cyperaceae		X
33	*Cyprus rigdifolius*	H	Cyperaceae	X	
34	*Dalbergia lactea*	Sh.	Fabaceae	X	
35	*Dichrocephala integrifolia*	H	Asteraceae	X	
36	*Dinbollia kilimandscharica*	T	Sapindaceae	X	
37	*Dodonea angustifolia*	sh	Sapindaceae		X
38	*Dombeya torrida*	T	Sterculaceae	X	
39	*Dracaena afromontana*	T	Dracaenaceae	X	
40	*Dracaena fragrans*	Sh.	Dracaenaceae	X	
41	*Dracaena steudneri*	T	Dracaenaceae	X	
42	*Ehretia cymosa*	T	Boraginaceae	X	
43	*Ekebergia capensis*	T	Meliaceae	X	
44	*Elaeodendron buchananni*	T	Celatraceae	X	
45	*Embelia schimperi*	Cl.	Myrsinaceae	X	
46	*Erythrococca trichogyne*	Sh.	Euphorbiaceae	X	
47	*Euphorbia ampliphylla*	T	Euphorbiaceae	X	
48	*Fagaropsis angolensis*	T	Rutaceae	X	
49	*Ficus ovata*	T	Moraceae	X	
50	*Ficus sur*	T	Moraceae	X	
51	*Ficus thonningii*	T	Moraceae	X	
52	*Galiniera saxifrga*	T	Rubiaceae	X	
53	*Gouania longispicata*	Cl.	Rhamnaceae	X	
54	*Gutembergia ruepelli*	H	Asteraceae		X

55	*Hibiscus berberidifolius*	Sh.	Acanthaceae	X	
56	*Hippocratea goetzei*	Cl.	Celastraceae	X	
57	*Hypoestes forskaolii*	H	Acanthaceae	X	
58	*Ilex mitis*	T	Aquifoliaceae	X	
59	*Impatiens ethiopica*	H	Balsaminaceae		X
60	*Impatiens hochstetteri*	H	Balsaminaceae	X	
61	*Isoglosa somalensis*	H	Balsaminaceae	X	
62	*Isoglossa punctata*	H	Acanthaceae		X
63	*Jasminum abyssinicum*	H	Acanthaceae	X	
64	*Justica shimperiana*	Cl.	Oleaceae	X	
65	*Landolphia buchananii*	Sh.	Acanthaceae	X	
66	*Lannea fruticosa*	Cl.	Apocyanaceae	X	
67	*Lannea shimperi*	T	Anacardiaceae		X
68	*Lantana camara*	H	Anacardiaceae		X
69	*Leonotis nepitifolia*	H	Verbenaceae		X
70	*Lepidotrichilia volkensii*	H	Zingiberaceae	X	
71	*Macaranga capensis*	T	Meliaceae	X	
72	*Maesa lanceolata*	T	Euphorbiaceae	X	
73	*Margaritaria discoidea*	T	Myrsinaceae	X	
74	*Millettia ferruginea*		Euphorbiaceae	X	
75	*Myrsine africana*	T	Fabaceae	X	
76	*Mythenus gracilipus*	Sh.	Myrsinaceae	X	
77	*Nelsonia canescens*	Sh.	Celastraceae	X	
78	*Nelsonia Thomsonii*		Acanthaceae		X
79	*Nicotiana tabacum*	H	Ranunculaceae		X
80	*Ocimum lamiifolium*	Sh	Solanaceae		X
81	*Ocotea kenyensis*	H	Lamiaceae	X	
82	*Olea welwitschii*	T	Lauraceae	X	
83	*Olyra latifolia*	T	Oleaceae	X	
84	*Oncoba spinosa*	H	Poaceae	X	
85	*Oplismenus hirtellus*	T	Flacourtiaceae	X	
86	*Oxyanthus speciosus*	H	Poaceae	X	
87	*Paullinia pinnata*	T	Rubiaceae	X	
88	*Pavetta abysinica*	Cl.	Sapindaceae	X	
89	*Pentas cafensis*	T	Rubiaceae	X	
90	*Pentas lenceolata*	H	Rubiaceae		X
91	*Persicaria senegalensis*	H	Rubiaceae	X	
92	*Phaulopsis imbricata*	H	Polygonaceae		X

93	*Phoenix reclinata*	H	Acanthaceae	X	
94	*Piper capense*	T	Palmaceae	X	
95	*Pittosporum virdiflorum*	H	Piperaceae	X	
96	*Podocarpus falcatus*	T	Pittosporaceae	X	
97	*Polyscias fulva*	T	Podocarpaceae	X	
98	*Pouteria adolfi-friedericii*	T	Apocynaceae	X	
99	*Protea gaguedi*	T	Sapotaceae	X	
100	*Prunus Africana*	T	Proteaceae		X
101	*Psychotria orophila*	T	Rosaceae	X	
102	*Ranunculus multifidus*	Sh.	Rubiaceae	X	
103	*Rhamnus prinoides*	H	Ranunculaceae	X	
104	*Rothmannia urcelliformis*	Sh	Rhamnaceae	X	
105	*Rubus studneri*	Sh.	Rubiaceae	X	
106	*Rungia grandis*	Sh.	Rosaceae	X	
107	*Rytigynia neglecta*	Sh.	Acanthaceae	X	
108	*Sapium ellipticum*	T	Rubiaceae	X	
109	*Satruja paradoxa*	T	Euphorbiaceae	X	
110	*Schefflera abyssinica*	H	Lamiaceae	X	
111	*Senna septemtrionalis*	T	Araliaceae	X	
112	*Sida rhombifolia*	H	Fabaceae/ Cesalpinoidae		X
113	*Sida tenuicarpa*	H	Malvaceae	X	
114	*Solanecio* gigas	Sh/H	Malvaceae		X
115	*Solanecio mannii*	T/Sh/H	Asteraceae		X
116	*Stephania abyssinica*	H	Asteraceae		X
117	*Syzygium guineense*	Cl.	Meinispermaceae	X	
118	*Teclea nobilis*	T	Myrtaceae	X	
119	*Thalictrum schimperiannum*	T	Rutaceae	X	
120	*Thelypteris confluens*	H	Ranunculaceae	X	
121	*Tliacora troupinii*	H	Aspleniaceae	X	
122	*Trema orientalis*	Cl.	Meinispermaceae	X	
123	*Triumfetta brachyceras*	T	Ulmaceae	X	
124	*Urera hypselodendron*	H	Rubiaceae		X
125	*Utrica simensis*	H	Urticaceae		X
126	*Vangueria apiculata*	H	Urticaceae		X

127	*Vepris dainellii*	T	Rubiaceae	X	
128	*Verbena officinalis*	T	Rutaceae	X	
129	*Vernonia amygdalina*	H	Verbenaceae		X
130	*Vernonia auriculifera*	T	Asteraceae	X	

5.8.2. Stem density

A total density of stem (trees and shrubs) in the PFM forest was 9933 stems/ha while in the free access forest it was 7596 stems/ha. The density of trees in the PFM forest was 973 stems/ha and in the free access it was 1156 stems/ha, while the density of shrubs in the PFM forest is 8960 stems/ha and in the free access it was 6440 stems/ha (Fig. 8).

Student t-test showed that total density of stems in the PFM forest was not significantly different from that of the total density of stems in the free access forest (2-tailed P value of 0.181, t =1.372 with 29 d.f, 95% CI). The test also showed that neither the tree density nor the shrub density inside the PFM forest and free access forest patches have significant difference (2-tailed P value of 0.058, t = -1.972 with 29 d.f, 95% CI for the trees) and (2-tailed P value of 0.154, t = 1.465 with 29 d.f, 95% CI for the shrubs).

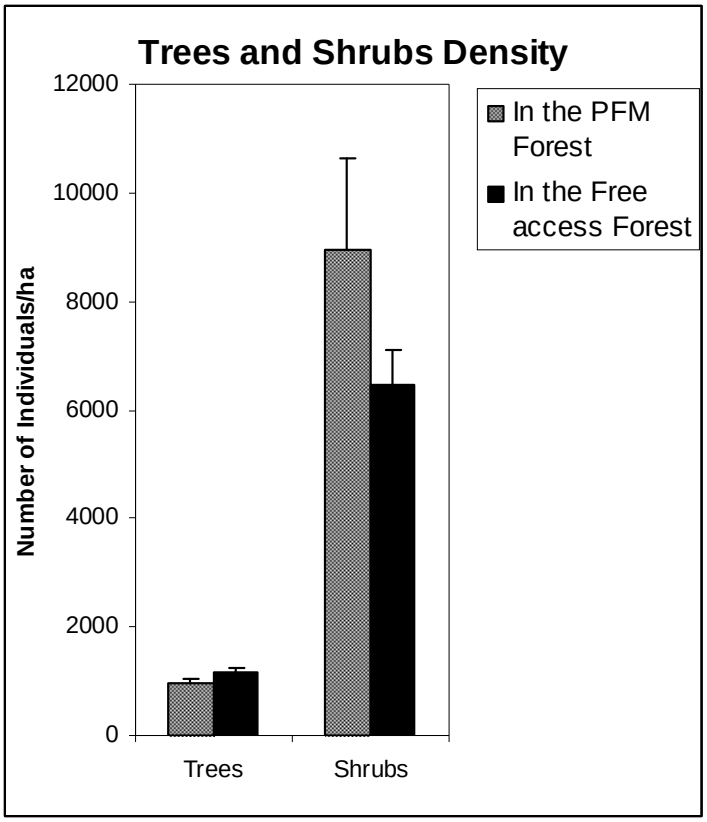


Figure 10: Tree and shrub density in the study area

5.8.3. Abundance, basal area, frequency and importance value index (IVI)

The importance value index showed that; in the PFM forest 31 of the individuals have IVI between 0-5, ten individuals have IVI between 5-10, six individuals have IVI between 10-15, three individusals have IVI between 15-20, and one individual has IVI >30. There are no individuals that have IVI between 20-25 and 25-30. Again in the Free access forest, twenty five of the individuals have IVI between 0-5, eighteen individuals have IVI between 5-10, three individuals have IVI between 10-15 and another 3 individuals have IVI between 15-20. There are no individuals that have IVI between 20-25 and >30 but there is one individual that has IVI between 25-35.

The five most important tree species in the PFM forest are; *Olea welwitschii, Podocarpus falcatus, Schefflera abyssinica, Elaeodendron buchananii* and *Chionanthus mildbraedii* while in the free access forest *Olea welwitschii, Vepris dainelli, Chionanthus mildbraedii,*

Schefflera abyssinica and *Elaeodendron buchanannii* are the five most important tree species. And to the contrary the five least important tree species in the PFM forest are; *Cordial africana*, *Ficus thonningii*, *Dombeya torrida*, *Ekebergia capensis* and *Vernonia auriculifera* while in the free access forest *Fagaropsis angolensis*, *Vernonia auriculifera*, *Ekbergia capensis*, *Pittosporum virdiflorum* and *Bersama abyssinica*. The total density/ hectare of all the woody pant species was 973 and 1156 in the PFM and the free access forest patches respectively. And the total basal area of all the woody plant species in the PFM forest was 48,4653m^2/ha while it was 384297.805m^2/ha in the free access forest.

Table 18: IVI result in both the PFM and free access forest

A) Inside the PFM forest

Trees	Frq.	Rl. Frq.	D/ha	Rl. D/ha.	BA/ha	Rl BA/ha	IVI
Olea welwitschii	22	4.84581	29	2.98047276	136916.6	28.2504	36.0766828
Podocarpus falcatus	1	0.22026	1	0.10277492	94556.25	19.5101	19.8331349
Schefflera abyssinica	7	1.54185	15	1.54162384	72698.1	15	18.0834738
Elaeodendron buchanannii	19	4.18502	114	11.716341	8533.852	1.76082	17.662181
Chionathes mildbraedii	26	5.72687	85	8.73586845	1200.585	0.24772	14.7104584
Verpis dainelli	26	5.72687	80	8.22199383	3238.625	0.66824	14.6171038
Syzygium guineense	18	3.96476	47	4.83042138	25468.15	5.25492	14.0501014
Milletttia ferruginea	23	5.06608	44	4.52209661	11240.9	2.31937	11.9075466
Phoenix reclinata	16	3.52423	63	6.47482014	3147.47	0.64943	10.6484801
Galiniera saxifarga	19	4.18502	57	5.85817061	437.2715	0.09022	10.1334106
Dracaena steudneri	12	2.64317	16	1.64439877	23910.75	4.93358	9.22114877
Albizia grandibacteata	19	4.18502	43	4.41932169	2692.049	0.55546	9.15980169
Bersama abyssinica	24	5.28634	29	2.98047276	458.1564	0.09453	8.36134276
Ficus vasta	14	3.0837	49	5.03597122	7.696391	0.00159	8.12126122
Dracaena afromontana	12	2.64317	43	4.41932169	2355.39	0.486	7.54849169
Polyscias fulva	14	3.0837	8	0.82219938	15533.88	3.20516	7.11105938
Oxyanthus speciosus	18	3.96476	29	2.98047276	109.1911	0.02253	6.96776276
Ficus sur	9	1.98238	6	0.61664954	21017	4.3365	6.93552954
Croton macrostachyus	7	1.54185	8	0.82219938	20936.07	4.31981	6.68385938
Macaranga	11	2.42291	14	1.43884892	6413.541	1.32333	5.18508892

capensis							
Rytigynia neglecta	12	2.64317	20	2.05549846	536.6684	0.11073	4.80939846
Albizia gummifera	5	1.10132	28	2.87769784	2454.176	0.50638	4.48539784
Allophylus abyssinicus	13	2.86344	10	1.02774923	634.849	0.13099	4.02217923
Cyathea maninana	1	0.22026	35	3.5971223	**50**	0.01032	3.8277023
Prunus africana	5	1.10132	8	0.82219938	9103.621	1.87838	3.80189938
Canthium oligocarpum	10	2.20264	12	1.23329908	1357.13	0.28002	3.71595908
Dinbollia kiligmandscharica	11	2.42291	9	0.92497431	184.1826	0.038	3.38588431
Eupohrbia ampliphylla	5	1.10132	8	0.82219938	3670.205	0.75729	2.68080938
Pouteria adolfi-friedericii	7	1.54185	3	0.30832477	2253.598	0.46499	2.31516477
Pittosporum viridiflorum	6	1.32159	6	0.61664954	160.6806	0.03315	1.97138954
Maesa lanceolata	5	1.10132	6	0.61664954	1047.564	0.21615	1.93411954
Ocotea kenyensis	6	1.32159	4	0.41109969	923.7438	0.1906	1.92328969
Ehretia cymosa	5	1.10132	6	0.61664954	891.4544	0.18394	1.90190954
Ilex mitis	3	0.66079	3	0.30832477	4547.063	0.93821	1.90732477
Fagaropsis angolensis	5	1.10132	5	0.51387461	1100.313	0.22703	1.84222461
Apodytes dimidiata	5	1.10132	3	0.30832477	683.0326	0.14093	1.55057477
Sapium ellipticum	3	0.66079	2	0.20554985	2596.868	0.53582	1.40215985
Psychotria orophila	4	0.88106	5	0.51387461	25	0.00516	1.40009461
Trema orientalis	4	0.88106	2	0.20554985	712.4617	0.147	1.23360985
Celtic africana	4	0.88106	2	0.20554985	95.01062	0.0196	1.10620985
Oncoba spinosa	3	0.66079	2	0.20554985	96.75041	0.01996	0.88629985
Vangueria apiculata	3	0.66079	2	0.20554985	50	0.01032	0.87665985
Teclea nobilis	2	0.44053	2	0.20554985	187.5442	0.0387	0.68477985
Vernonia amygdalina	2	0.44053	2	0.20554985	51.30927	0.01059	0.65666985
Pavetta abyssinica	2	0.44053	2	0.20554985	4.607514	0.00095	0.64702985
Sapium ellipticum	1	0.22026	1	0.10277492	124.5872	0.02571	0.34874492
Cordia africana	1	0.22026	1	0.10277492	111.8483	0.02308	0.34611492
Ficus thonningii	1	0.22026	1	0.10277492	101.6454	0.02097	0.34400492
Dombeya torrida	1	0.22026	1	0.10277492	19.93395	0.00411	0.32714492
Ekebergia capensis	1	0.22026	1	0.10277492	5.779665	0.00119	0.32422492
Vernonia auriculifera	1	0.22026	1	0.10277492	0	0	0.32303492
Sum	454	100	973	100	484653	100	300

B) In the free access forest

Trees	Frq.	Rl. Frq.	D/ha	Rl. D/ha.	BA/ha	Rl BA/ha	IVI
Olea welwitschii	24	4.5801527	68	5.8823529	64178.5	16.7001997	27.16271
Vepris dainellii	21	4.0076336	150	12.975779	8522.745	2.21774494	19.20116

Chionathes mildbraedii	19	3.6259542	129	11.15917	9450.645	2.45919831	17.24432
Schffeleia abyssinica	13	2.480916	16	1.384083	46133.645	12.0046602	15.86966
Elaeodendron buchananii	12	2.2900763	49	4.2387543	26232.545	6.82609815	13.35493
Milletttia ferruginea	23	4.389313	55	4.7577855	11491.445	2.9902448	12.13734
Syzygium guineense	11	2.0992366	47	4.0657439	15515.545	4.03737544	10.20236
Croton macrostachyus	8	1.5267176	33	2.8546713	16738.045	4.35548811	8.736877
Dracaena steudneri	15	2.8625954	10	0.8650519	16752.495	4.35924822	8.086896
Phoenix reclinata	18	3.4351145	40	3.4602076	4124.045	1.07313781	7.96846
Ficus sur	15	2.8625954	48	4.1522491	2628.895	0.68407756	7.698922
Polyscias fulva	10	1.9083969	53	4.5847751	3165.245	0.8236438	7.316816
Teclia nobilis	17	3.2442748	41	3.5467128	1586.795	0.41290765	7.203895
Euphorbia ampliphylla	8	1.5267176	16	1.384083	15781.795	4.10665765	7.017458
Podocarpus falcatus	11	2.0992366	6	0.5190311	16202.545	4.21614305	6.834411
Allophylus abyssinicus	18	3.4351145	36	3.1141869	808.195	0.21030435	6.759606
Oxyanthus speciosus	14	2.6717557	6	0.5190311	13649.995	3.5519316	6.742718
Dinbollia kilimandscharia	20	3.8167939	26	2.2491349	1931.045	0.50248661	6.568415
Rytigynia neglecta	20	3.8167939	26	2.2491349	1438.045	0.37420068	6.44013
Pouteria adolfi-friedericii	19	3.6259542	25	2.1626298	1914.045	0.49806296	6.286647
Albizia gummifera	8	1.5267176	5	0.432526	16557.845	4.3085974	6.267841
Macaranga capensis	8	1.5267176	5	0.432526	16528.945	4.30107719	6.260321
Dracaena afromontana	16	3.0534351	28	2.4221453	1902.995	0.49518759	5.970768
Prunus africana	13	2.480916	16	1.384083	7921.845	2.06138182	5.926381
Lepidotrichilia volkensii	18	3.4351145	23	1.9896194	1344.545	0.3498706	5.774604
Cyathea manniana	9	1.7175573	25	2.1626298	3285.095	0.85483055	4.735018
Margaritaria discoidea	6	1.1450382	5	0.432526	10980.995	2.85741813	4.434982
Sapium ellipticum	13	2.480916	14	1.2110727	2299.095	0.59825869	4.290247
Canthium oligocarpum	13	2.480916	13	1.1245675	2626.345	0.68341401	4.288898
Ficua vasta	10	1.9083969	9	0.7785467	5178.895	1.34762546	4.034569
Maesa lanceolata	7	1.3358779	13	1.1245675	5743.295	1.49449073	3.954936
Ehretia abyssinica	4	0.7633588	34	2.9411765	570.195	0.14837321	3.852908
Vernonia amygdalina	8	1.5267176	7	0.6055363	5352.295	1.39274672	3.525001
Ficus thonningii	8	1.5267176	12	1.0380623	1975.245	0.51398811	3.078768
Ilex mitis	8	1.5267176	7	0.6055363	3326.745	0.8656685	2.997922
Galineria saxifraga	7	1.3358779	7	0.6055363	1863.895	0.48501319	2.426427
Ocotea kenyensis	7	1.3358779	6	0.5190311	2150.345	0.55955173	2.414461
Albizia grandibacteata	4	0.7633588	3	0.2595156	4859.295	1.26446079	2.287335
Cordia africana	5	0.9541985	7	0.6055363	1697.295	0.44166139	2.001396
Oncoba spinosa	6	1.1450382	6	0.5190311	542.145	0.14107419	1.805143

Trema orientalis	5	0.9541985	5	0.432526	864.295	0.22490241	1.611627
Psychotria orophyla	4	0.7633588	3	0.2595156	2138.445	0.55645518	1.57933
Pavetta abysinica	5	0.9541985	4	0.3460208	756.345	0.19681221	1.497031
Celtis sp.	4	0.7633588	5	0.432526	1155.845	0.30076805	1.496653
Apodytes dimidiata	4	0.7633588	3	0.2595156	728.295	0.18951318	1.212388
Fagaropsis angolensis	2	0.3816794	5	0.432526	1330.095	0.34611049	1.160316
Vernonia auriculifera	2	0.3816794	2	0.1730104	888.095	0.23109552	0.785785
Ekebergia capensis	2	0.3816794	2	0.1730104	515.795	0.13421753	0.688907
Pittosporum viridiflorum	1	0.1908397	1	0.0865052	492.845	0.12824559	0.40559
Bersama abyssinica	1	0.1908397	1	0.0865052	474.145	0.12337958	0.400724
Sum	524	100	1156	100	384297.805	100	300

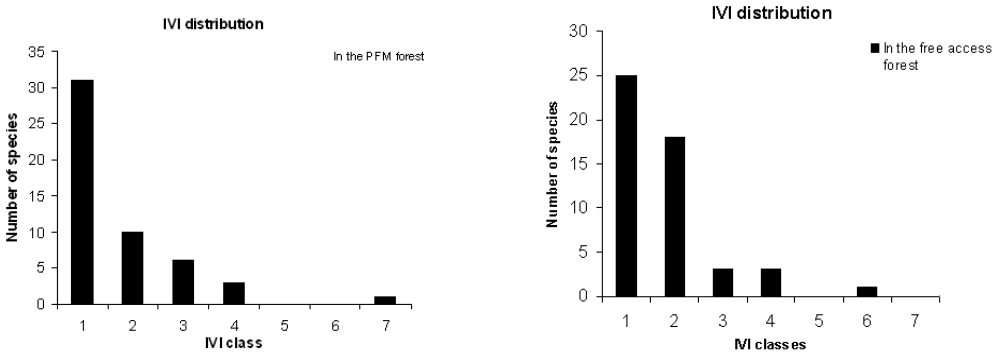


Figure 11: IVI distribution

5.8.4. Forest structure

The forest structure in both the PFM and the free access forests showed an inverted "J" shape for both the tree height distribution and tree diameter distribution. In both forest patches small-sized individuals are present in large amount. Individuals with height measuring less than 10 m comprise 88.3% and 89% of the total individuals in the PFM forest and free access forests respectively. Furthermore, individuals with height less than 5 m comprise 78% of the total individuals in the PFM forest while in the free access forest it was 85% of the individuals that are less than 5 m in height.

Again the diameter distribution showed that small-sized individuals comprise the major proportion of the forest in the study area. Similarly in the PFM forest, individuals with

DBH less than 25 cm comprise 85.3% of the total individuals and in the freee access 88%. And individuals with smaller diameter size, less than 5 cm, comprise 78% of the total individuals in the PFM forest while it was 85% in the free access forest.

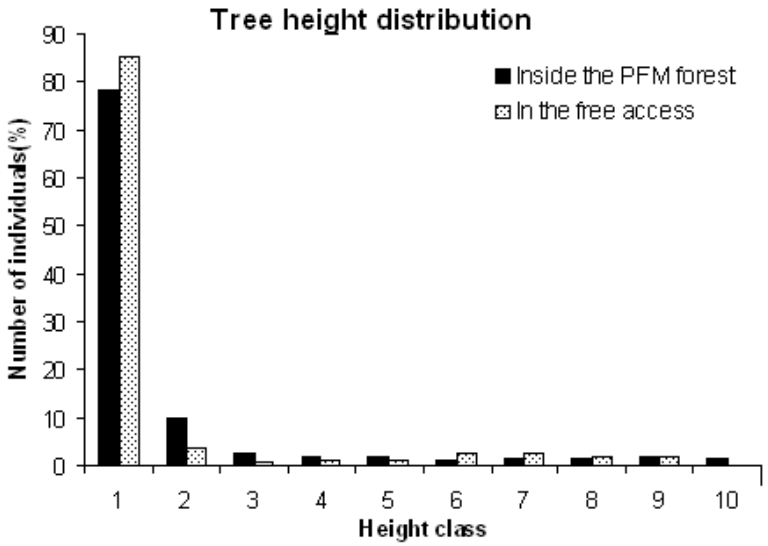


Figure 12: Tree height distribution

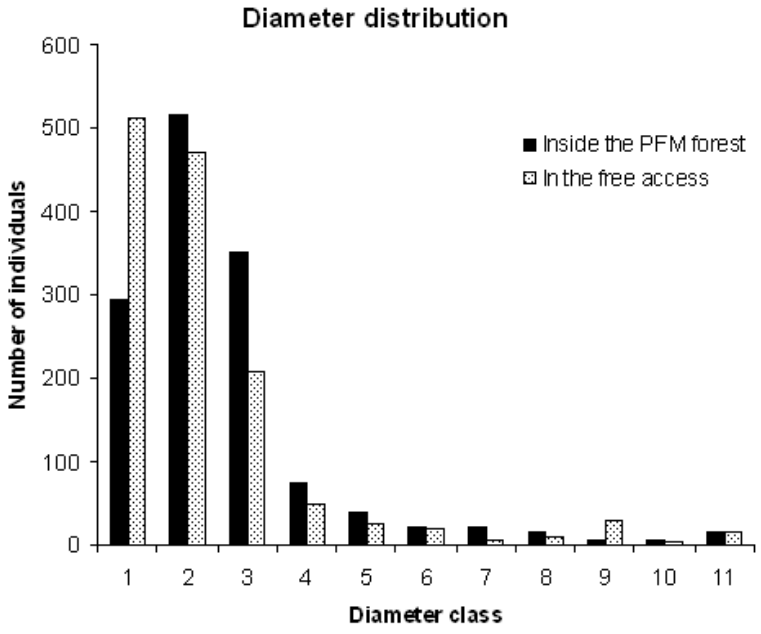


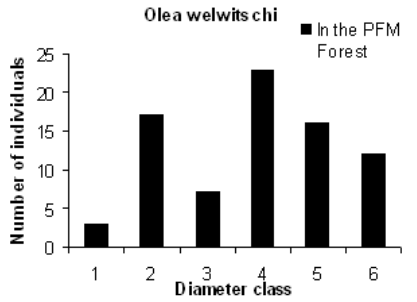
Figure 13: Tree diameter distribution

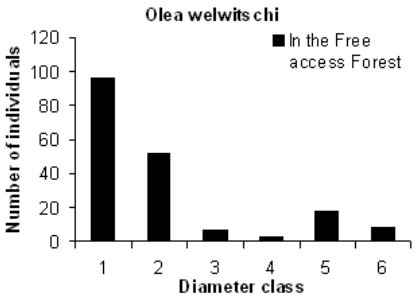
5.8.5. Selected trees population structure

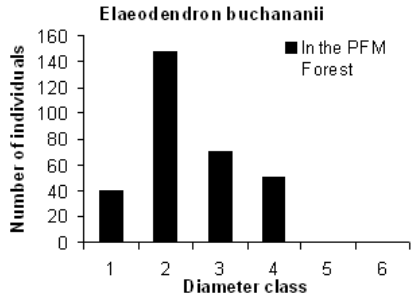
The population structure of the selected 9 tree species revealed the following general patterns: 1) abnormal or irregularly interrupted shape, 2) Gaussian curve, 3) “J” shape, 4) inverted “J” and 5) “U” shape

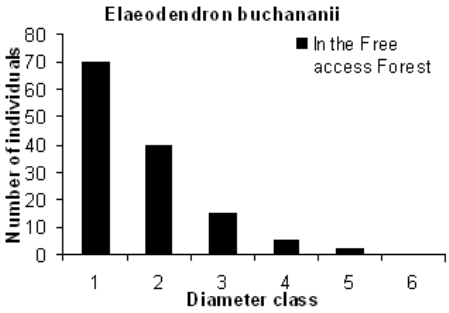
The species that depicted an abnormal population structure are; *Olea welwitschii* (free access), *Phoenix reclinata* (PFM), *Ehretia cymosa* (PFM) and *Millettia ferruginea* (PFM and Free access). And those species with a gaussian curve population structure are; *Syzygium guineense* (PFM) but lack representation at diameter class 1, *Olea welwitschii* (PFM) with disturbance at diameter class 1 and 3. “U” shape was depicted by the population structure of *Syzygium guineense* in the free access forest.

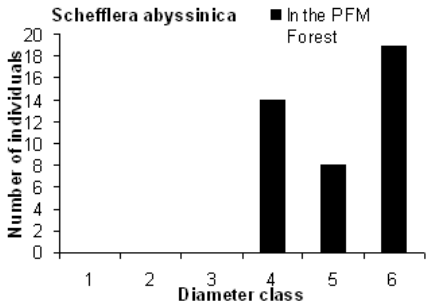
Schefflera abyssinica (PFM and free access) and *Fagaropsis angolensis* (free access) depicted a population structure that is “J” shaped. But *Schefflera abyssinica* (PFM) lacks representation at diameter calss 1, 2 and 3 while *Schefflera abyssinica* (free access) lacked representation at diameter classes 2 and 3. Similarly *Fagaropsis angolensis* (free access) also lacked representation at diametr classes 2, 3 and 4. The rest species depicted a population structure that resembles an inverted “J” shape. These spesies are; *Elaeodendron buchananii* (PFM) with disturbance at diametr class 1 and lacking representatioan at diameter class 6, *Elaeodendron buchananii* (free access) lacking representatioan at diameter class 6, *Phoenix reclinata* (free access) lacking representation at diameter class 1 and 6, *Fagaropsis angolensis* (PFM) lacking representation at diameter class 4,5 and 6, *Euphorbia ampliphylla* (PFM and free access) / *Fagaropsis angolensis* (PFM) lacking representation at diameter class 3, 4 and 5 while *Fagaropsis* angolensis(free access) lacked representation at diameter class 4.

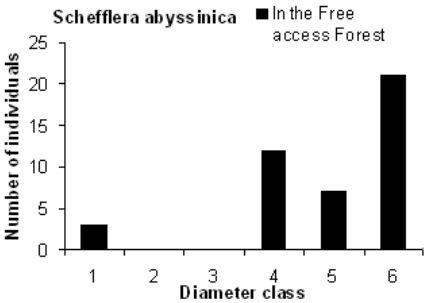


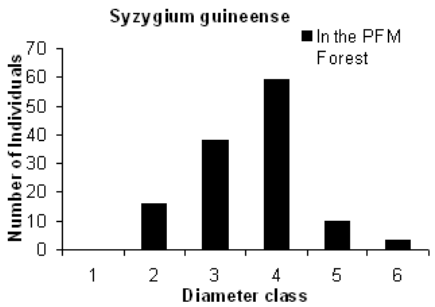


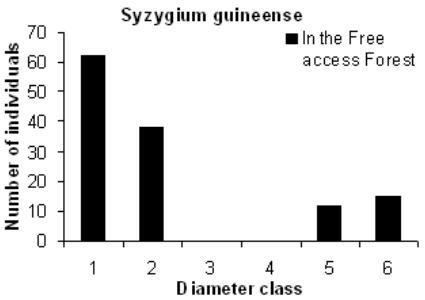


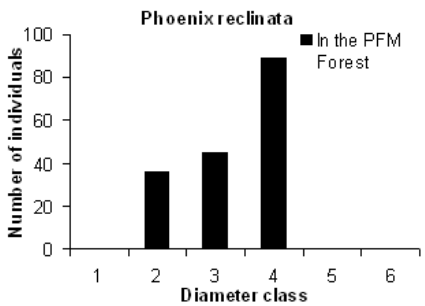


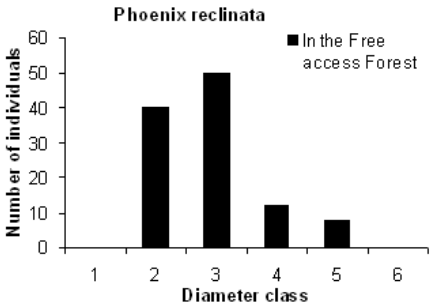












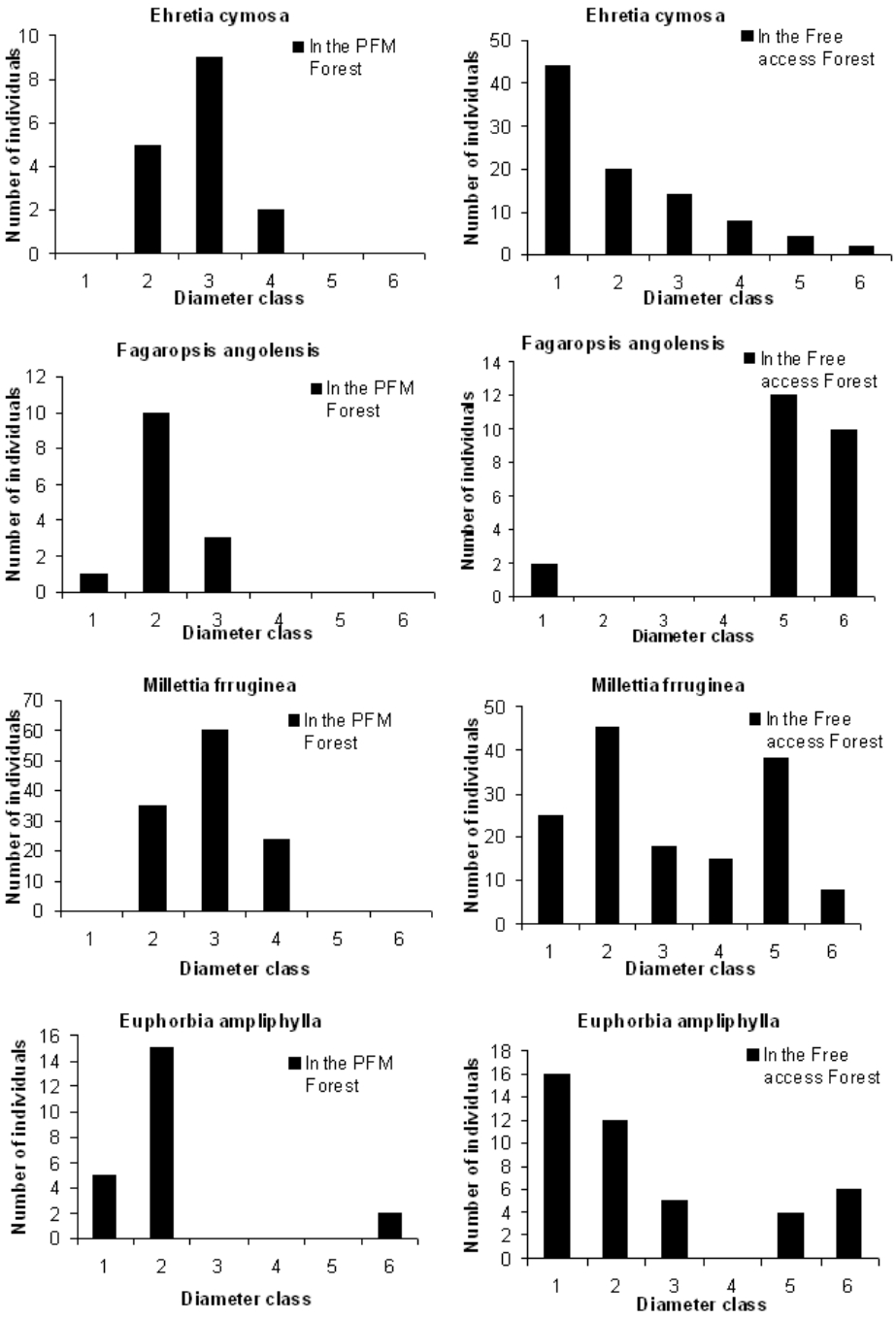


Figure 14: Population structure of the most important tree species

5.8.6. Biodiversity pattern

The over all diversity (H) in both the PFM forest and the free access forest was found to be very high depicting 4.37 for the PFM forest and 4.27 for the free access forest. Although there is not much diversity difference in both forest patches of the study area, individual plots show clear difference in diversity pattern indicating the plots in the PFM forest are high in diversity (Fig. 13). Plots 1-30 are those plots in the PFM forest while 31-60 are in the free access forest whose "H" value is sorted asendingly.

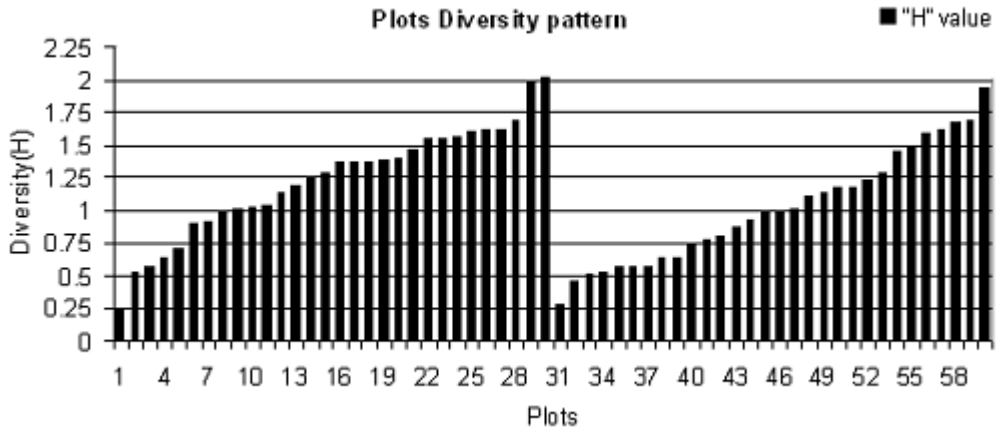


Figure 15: Plots diversity pattern

The evenness computed, for the total number of species recorded 105 in the freee access and 104 in the PFM forest, in the two forest patches revealed that in the PFM forest E = 0.94 and in the free access E = 0.91.

6. DISCUSSION

6.1. NTFPs Resource Base of Gimbo District

By this study, a total of 26 NTFPs or NTFP categories were identified to be found in Gimbo District. This result parallels another report by Beijinene *et al.* (2004). According to Beijinene *et al.* (2004), 11 types of NTFPs were reported to be present in the forests of Kafa and Shaka.

The 45 medicinal plant species reported by this study, were also reported by others studies to have medicinal uses (eg. Ermias Lulekal et al., 2008).

Out of the 26 NTFPs or NTFP categories identified by this study, the mushrooms are the less talked of and less recognized ones. But if these mushrooms and bracket fungus are domesticated, they can be good source of income and food for the local people of the study area. According to Dawit Abate (1998), identification of edible mushrooms is the first step in the domestication process. Therefore, the documentation of the above edible three mushrooms and one bracket fungus species delt in this study is a vital source of information for the domestication and future development of the mushroom/ bracket fungus sector.

6.2. NTFP and Species Preference

In the study area, among the 19 NTFPs and NTFPs categories evaluated, the five most important NTFPs and NTFPs categories are; house construction wood, honey, coffee, wood for farm impliments and firewood. The least three preferred NTFPs and NTFPs categories are; edible wild animals, wild pepper and muhrooms/bracket fungi.

The unperiodical availability and small abundance of mushrooms and bracket fungi in addition to the fact that mushrooms and bracket fungi are not sold in the markets in good price, made them to be less preferred NTFPs in Gimbo District. Also the rapid decrease in the number of edible wild animals found in the forests and the low selling price of wild pepper may have made the two NTFPs categories to be less preferred by the local people in the Gimbo District.

6.3. Status of NTFPs

In the study area most of the NTFPs are being reduced in abundance over the years (Table 14). The only NTFPs that have increased in abundance, according to the interview result, are medicinal plants. *Rhamnus prinoides* and charcoal have their abundance unchanged over the years. And another NTFP whose abundance decreased highly is the *Fagaropsis angolensis* fruit.

With the fact that the forests in the study area are secondary and are recovering, there may have been an increase in the abundance of herbs and invasive species which may be used as medicine.infact from the 45 major medicinal plants delt in this study, 53.33% were herbs. Therefore, the increased abundance in medicinal plants may be attributed to the fact that the forest is recovering. On the other hand, the unchanged abundance of the *Rhamnus prinoides* and charcoal may be due to the fact that *Rhamnus prinoides* can easily propagate vegetatively and is not sold in the central market but is rather consumed by the house holds and sold to the local markets only. And for the charcoal, the reason for unchanged abundance may be due to the fact that most farmers don't relay on charcoal as source of energy but they rather depend on firewood.

The high reduction of abundance of *Fagaropsis angolensis* is because the species is important for its fruit and bark. Specially the fruit is collected from the forest and is taken to the village making the reproduction of the species imposible. Therefore, it is obvious that the species abundance will reduce much even in the future.

6.4. Marketability of NTFPs

The price of the major NTFPs coming to the local markets in the study area have increased since 2003. When the market price surveyed by this study is compared to the price surveyed by Taye Bekele (2003), the price of coffee has increased from 7-8 birr per killo to 15-16 Birr, the price of honey from 8 birr per killo to 16 birr, the price of cardamom from 6-9 birr per killo to 15 birr, the price of wild pepper from 4 -5 birr per killlo to 9 Birr, the price of fuel wood from 5-6 birr per women load to 7-10 birr and The

price of charcoal from 14 birr per 50 kg to 20-25 birr (Table15 & Annex 8). This result supports the finding that the status of most NTFPs in the study area has been reducing (Table 14). And it is obvious when status of goods is getting scarce prices will increase. Meanwhile, less supply will result in high price. Other wise the increase in price was not as a result of value addition.

6.5. NTFPs Availability

In the Gimbo District, the months of September-December are the most prosperous because the crops growing in the area are harvested during these months (Table 16). These months are prosperous also because cardamom and coffee are harvested during these months. Especially in the 2 kebeles of the study area (Keyakelo and Qeja araba), these months are important because plenty of coffee is harvested. The income generated during these months (September-December) is utilized and for most of the farmers, at around April, another source of income is needed. It is therefore why most farmers especially from the two kebeles (Yeyebito and Bitachega) depend on honey. Which is largely harvested in April.

Nowadays, farmers with good saving from the harvest of coffee and crop of the early months, have started to store honey and sell it when the price for honey rises. This way honey is gaining importance in providing seasonal trade off.

Phoenix reclinata, Rhamnus prinoides, Cyathea manniana, Piper capense, medicinal plants, wild foods and fuelwood are important in that, they are harvested all over the year. Mushrooms are also important in that they are harvested in three months time. Therefore, the above NTFPs are good source of income for the poor farmers and women at times of empty pocket or stomach.

6.6. Tree and Shrubs Density

The Density of Trees: Density of trees in the PFM forest is lower than the density of trees in the free access forest. This could be due to the fact that the PFM forest is

recovering from past disturbances and the canopy is closing letting less sunlight to reach the floor of the forest hindering the regeneration of trees. On the other hand in the free access forest since the forest is likely to be more disturbed than the PFM forest, more light will reach the forest floor enabling the regeneration of trees whereby more small sized tree individuals number increases. Similar finding was reported by Hitimana *et al.* (2004) whereby among sites in disturbed and undisturbed Moist Lower Montane Forest, western Kenya, the density of the trees was found to be higher in the disturbed site than in the undisturbed. The justification Hitimana *et al.* (2004) forwarded for this difference in density is regeneration diffrence, site quality or both. However, the difference in tree density observed in this study, can be more explained by the level of regeneration than the site quality because the shrubs density result depicted the reverse scenario.

The Density of Shrubs: Although the density of trees was high in the free access forest than the PFM forest, the density of shrubs for the two forest sites revealed the reverse. The density of shrubs in the free access forest was much lower than the density of shrubs in the PFM forest. This can probably be explained by the fact that coffee management practices resulted in the clearance of most shrubs that compete with the coffee. This assertion can be valid by the fact that coffee is more important in the free access forest than the PFM forest (result of preference ranking and SUPPAK, 2004) and the high frequency and density of coffee observed on the site. Schmitt *et al.* (2005), reported the existence of small number of mature shrubs in the coffee managed forests of Bonga.

6.7. Importance value index

Generally speaking, since the total density/ hectare of all the tree species was 973 and 1156 in the PFM and the free access forest patches respectively and the total basal area of all the tree species in the PFM forest was 48,4653m^2/ha while it was 384297.805m^2/ha in the free access forest, it it shows that the PFM forest is made up of few but big diameter tree species while the free access forest is made of many but small diameter trees. However, there was not major difference in vegetation composition. Meanwhile, both forest patches have *Olea welwitschii*, *Elaeodendron buchananni*, *Chionanthus mildbraedii* and *shefflera abyssinica* among the five most important tree species. Again

these four species were reported as among the most tree species in the forests of Bonga(Abayneh Derero *et al.*,2003).

6.8. Forest Structure

Tree Height Distribution: In the study area (the PFM forest and the free access), trees with height less than 10 m comprised 88% and 89% of the total individuals respectively. And showing an inverted "J"-shaped distribution. This is a good indicator for good regeneration and recruitment process of the forest. A similar result was reported in the different afromontane forests of Ethiopia (Tamrat Bekele, 1993; Abayneh Derero *et al*. 2003; Feyera Senbeta, 2006). Feyera Senbeta (2006), in particular, reported afromontane forests in Ethiopia generally have a considerable number of the forest individuals in the lower diameter and height classes.

In the study area, it was learned that, trees of height classes 1, 6 and 7 were proportionally more in number in the free access forest than the PFM forest. This can be due to high regeneration percentage in the free access forest resulting more of the height class 1 individuals. And for height classes 6 and 7 it can be due to the deliberately left tall trees for coffee shade resulting more proportion of individuals in the free access forest. For the rest of tree height classes, the PFM forest has higher number of individuals or both the PFM forest and the free access forest had equal proportion of tree individuals. This can be due to the difference in level of disturbance.

Diameter Distribution: In the diameter distribution also, both forest patches depicted an inverted "J" shaped structure. This is a good sign for recruitment process of the forest patch. However, the PFM forest is some how moving to the climax forest stage in that number of individuals in the diameter class 1 are smaller than the number of individuals in the diameter class 2 of the same forest patch. As forests move to the climax they suppress small-sized individuals and ultimately depict some form of Gaussian curve shape. According to Raven and Johnson (1991) also, in succession the earlier succssional stages are more productive than the later ones.

In the free access forest however, despite the low number of individuals at the higher diameter class, which could be the result of logging, the diameter distribution depicts good inverted "J" shape structure indicating good recruitment. And also indicating that the forest is disturbed and is secondary.

6.9. Population Structure of the Important Tree Species

Although the totality of forest structure of the forest patches in the study area depicts an inverted "J" shape, individual trees population structure did not match with the structure of the whole forest. Good overall forest regeneration do not necessarily mirror the regeneration status of constituent tree species (Hitimana *et al*, 2004).

***Olea welwitschii*:** *Olea welwitschii* depicted a Gausina structure with disturbance and an abnormal distribution in the PFM forest and the free access forests respectively. In the PFM forest there are less small individuals showing poor regeneration. And there is also poor recruitment in the PFM forest due to the fact that big individuals are more in proportion than the small individuals. However, it was found that, there is more *Olea welwitschii* logging in the free access forest than the PFM forest. In the free access forest diameter classes 2, 3 and 4 are smaller in number. This may indicate that *Olea welwitschii* is cut without regulation in the free access forest. The pressure on these diameter classes (2 and 3) in the free access forest can also be due to the suitability of individuals at diameter classes 2, 3 and 4 for house construction and farm impliment.

***Schefflera abyssinica*:** In both forest patches the population structure of this species shows "J" shape. This indicates that in both forest patches there is poor regeneration and recruitment of *Schefflera abyssinica*. However, the representation of diameter class 1 in the free acces forest and the lack of reperesentation in the PFM forest indicates that regeneration of this species in the PFM forest is poor due to the canopy closure. The PFM forest and the free access forests seem to have almost equal number of big individuals of *Schefflera abyssinica*. This could be due to the site preference of the species. The lack of representation at diameter classes 2 and 3 indicates that there is very poor recruitment of the species in both forest patches.

Syzygium guineense: *Syzygium guineense* in the PFM forest depicted a Gaussin structure. This indicates that there is poor regeneration and recruitment. Since there is no individual representation at diameter class 1, it is an indication for poor regeneration. In the free access forest, the species depicted a "U" shape structure which indicates that there is selective logging of the species. Furthermore, the "U" shape depicted indicates that the species is having poor recruitment. Since diameter classes 3 and 4 are perfect sizes for pole and are desired for construction and since Syzygium *guineense* is highly desired for construction (Table 11), the selective logging can be associated with construction. So it indicates that with no PFM scheme in the free access forest, farmers were able to selectively log the specific pole size individuals while in the PFM forest the pole sized individuals were not being cut.

Elaeodendron buchananii: In both the PFM and free access forests the population structure of this species depicted an inverted "J" shpe. This is an indication for good regeneration and recruitment of the species. In both the forests there is no representation at diameter class 6. This could be due to the inherent nature of the species not being able to rich this size or this could be due to selective logging.

Phoenix reclinata: *Phoenix reclinata* has an irregular population structure in both PFM and free access forest patches. In the PFM forest, diameter classes 1, 5 and 6 are lacking representation. And in the free access forest, diameter classes 1 and 6 are missing. Both forests seem to have poor regeneration but this may not be true. The lack of representation at diameter class 1 is due to the lack of *Phoenix reclinata* individuals with DBH (1.2 - 4 cm) and at the same time with height >2 m. Due to the nature of *Phoenix reclinata*, the seedlings have big diameter but cannot rich the height of 2 m. Therefore, seedlings counted were not measured for diameter because they were smaller than 2 m. Having this fact, it can be said that in the PFM forest there is a better recruitment of the species than in the free access forest. The missing representation of diameter class 5 in the free acces forest indicate that selective cutting was carried out. And the lack of representation of diameter class 6 in both forest patches may be due to the inherent nature of the species not being able to rich the size.

Ehretia cymosa: In the PFM forest, an abnormal distribution and in the free access forest an inverted "J" shape distribution is depicted. In the PFM forest there is poor regeneration and recruitment. The diameter classes 5 and 6 lack representation indicating that there may be selective logging. In the free accces however, there is good reproduction and recruitment. This maybe attributed to the fact that there is ample light reaching the ground making regeneration possible. It is also possible to say that this species have been havily exploted in the past in the free access forest and is now recovering.

Fagaropsis angolensis: *Fagaropsis angolensis* depicted an inverted "J" shape structure in the PFM forest with no diameter representation at diameter classes 4, 5 and 6. This shows that there is poor recruitment but the reproduction seems just good. In the free access forest, the species depictes a structure resembling "J" shape with no representation at diameter classes 2, 3 and 4. This indicated that the species is having poor reproduction. The absence of diameter classes at diameter classes 4, 5 and 6 in the PFM forest indicates that the species is having less presence in the area due to may be ecological requirements. During an interview with the farmers, it was indicated that the species is having fewer representation in the PFM forest over the years. And the lack of representation at diameter classes 2, 3 and 4 in the free acces could be due to little regeneration of the species leading to few recruitees at those diameter classes. The species is mostly desired for its fruit; therefore, this can be one of the reasons for poor regeneration that can be more understood if the soil seed bank is studied.

Euphorbia ampliphylla: In both the PFM and free access forests *Euphorbia ampliphylla* depicted an inverted "J" shape. In the PFM forest there is no representation at diameter classes 3, 4 and 5. This shows that the species have been selectively logged. This is also an indication that NTFPs like that of *Euphorbia ampliphylla* are used as alternative wood sources in PFM. The other reason why this species is logged in large amount than in the free access is that it is highly desired for beehive making and the people living around the PFM forest are known to produce much more honey than the farmers living around the free access. In the free access forest, since farmers are able to cut any other tree species

they least prefer *Euphorbia ampliphylla* for other purposes and do not cut it as extensively as that of the PFM forest farmers. The other reason is that they produce honey in small amount and they only cut few and specifically individuals with desirable diameter size. This may be why the diameter class 4 is lacking representation in the free access. Other than that, the species is having good reproduction and recruitment in the free access.

Millettia ferruginea: In both the PFM and free access forests *Millettia ferruginea* is depicting an abnormal distribution. In the PFM forest, there are no individuals represented at diameter classes 1 and 6. This shows that there is poor regeneration and poor recruitment. But in the free access forest all the diameter classes are represented. And the much representation at the diameter classes 5 and 6 shows that there may be deliberately left individuals so that they can be used as shades for the coffee. *Millettia ferruginea* is the most important coffee shade tree (Diriba Muleta *et al*. 2007). It was also learnt that the free access forest area is found in a coffee production area where forest coffee was found in abundance.

6.10. Species Diversity

It was found out that the species richness (H') in the PFM forest was higher than in the free access forest. This could be due to the impact of farmers selective logging in the free access. The lower value of the Shannon diversity index in the free access forest is congruent with the hypothesis saying: as there is more selective logging there is the dominance of few early successesional species and lower Shannon index value (Bone *et al*.1797; cited in Feyera Senbeta, 2006). This is also congruent with the result of forest structure (Fig. 10) showing more small-sized individuals in the free access than the PFM forest. And much further explained by the existence of more selective logging in the free access forest than in the PFM forest (Fig. 12). Also the lower evenness value found in the free access forest shows that there is a dominance of fewer species. N.B. low evenness indicates dominance of few species (Feyera Senbeta, 2006).

However, the species diversity in the two forest patches is not that much different may be due to similarity in the site potential, topography, climate, ecology and forest history. N.B. PFM forest has started since in the past few years. And the two forests have intermediate disturbance so that they have high H' value. According to intermediate disturbance hypothesis, diversity is high at sites that had an intermediate frequency of disturbance and will be lower at sites that have very high or very low disturbance frequency (Hanenton et al, 1991: cited in Makenya, 2005).

7. CONCLUSION

In Gimbo District, there are about 26 NTFPs and NTFPs categories documented by this study. However, the most important NTFPs that are typical to the study area are: honey and honey wax, coffee, spices and condiments, ground honey (tazma), lianas, *Fagaropsis angolensis* fruit and fern tree. In the study area there is also a big accumulation of herbal medicinal knowledge and medicinal plants are also potentially present. In the study area one bracket fungus species and three mushroom species were identified as edible. It was also noticed that the local people have good demand for these edible mushrooms and bracket fungus. However, the resource is scarse and the scarsity has increased over the years. It is therefore important for the mushrooms and bracket fungus to be domesticated.

Medicinal plants of the study area were known to have their abundance increased over the past few years. But most of the 26 NTFPs have their abundance declined over the past few years while one important NTFP (*Fagaropsis angolensis*) has its abundance highly reduced. Therefore the conservation status of most, if not all, the NTFPs and NTFPs category of the Gimbo District is not good.

In the study area NTFPs with their diversity are present all around the year making them important in the daily life of the farmers. NTFPs are important in that they are source of income through most of the months of the year. It is also to be observed that, NTFPs are major commodities marketed in the local market or produced in the area to be sold in the central market of the country.

The prices of NTFPs have increased in the local markets as well central market. Therefore, farmers are getting better price now than the earlier years. Farmers have also learnt to store some of the NTFPs (honey) so as to sell it at times of better price. However, the rise in price for NTFPs is not due to value addition or production quality but due to, maybe, high demand for the products in the central market.

The density of trees and shrubs in the study area showed that there are more individuals in the PFM forest than in the free access forest. The high number of individuals in the

PFM forest is attributed to the presence of more shrubs in the PFM forest than the free access forest. This may be due to the fact that free access forest is a good source of forest coffee and farmers deliberately cut shrubs in persuit of coffee management. But in the PFM forest, since coffee is not a major product and as a result of PFM , shrubs are left to grow.

With regards to the forest structure, both the PFM and free access forests depicted healthy inverted "J" shape showing good reproduction and recruitment. But in the free access forest there are more small-size individuals than the PFM forest, indicating the forest is more depleted and is in the natural process of recovering. The population structure of the important tree species also showed that in the free access most species are on the process of recovery having many small size individuals. *Olea welwitschii* and *Syzygium guineense* depicted a population structure indicating the depletion of these individuals in the free access forest.

The IVI also showed that in the study area, *Cordia africana*, *Ficus thonningii*, *Dombeya torrida*, *Ekebergia capensis*, *Vernonia auriculifera*, *Fagaropsis angolensis*, *Galinieria saxifrage*, *Pitosporum virdiflourm* and *Psychotria orophilia* are the least important tree species calling for attention for conservation.

The species diversity in the two forest patches seem to be very high and also indicate a small difference between the two forest patches. However the species diversity result i.e. Shannon index and evenness show that there is more selective logging and as a result there is more dominance of fewer species in the free access forest indicating trend of lose of biodiversity in the free access forest if the selective logging practice should continue in the future. The high species diversity recorded by this study also indicates that Gimbo forests and Bonga forest in general are still good source of NTFPs be it herbs for medicine or other NTFPs.

This study did not generate ecological (vegetation) data that supports the PFM through the use of NTFPs is better managing the forest in the study area. However, population

structure of the major NTFPs trees indicated that they do better off in the PFM forest. And The most important plant species used as source of NTFPs are identified by the preference ranking exercice and are; *Olea welwitschii, Elaeodendron buchananii, Syzygium guineense, Allophylous abyssinicus, Millettia ferruginea , Cordia Africana, Ehretia cymosa , Euphorbia ampliphylla, Ficus sur, Poutera adolfi-friedericii Shefflera abyssinica* and *vernonia amygdalina*

Genarally, NTFPs are important in the socio economic, socio cultural and ecological well being of the Gimbo surrounding and the country as a whole. Moreover, Gimbo although having diverse NTFPs, the conservation status of these NTFPs is dwendelling therefore, calling for better attention for better management of the resource.

8. RECOMMENDATIONS

- Since NTFPs have peculiar characters like clumpy, rare or ununiform distribution pattern, mobility character and they are many times harvested not as a total plant/animal but part of animal or plant namely root, fruit, gall bladder, feather, etc, it is very hard to get statistically valid inventory of nontimber forest products collectively. Therefore, in the future, it is highly recommended to carry out surveys of NTFPs treating one at a time. This way biometrically sound inventory can be carried out using the conventional forestry measurements. As an example the most important tree species *Fagaropsis angolensis* has to be studied treated alone so that the future management of this endangoured species is possible.

- Investment in and around Gimbo District should not be allowed to be of a direct production and harvesting type. However, it should be restricted to enabling farmers and cooperatives build their capacity to add value to the NTFPs and should only be restricted to commercialization of certain NTFPs like coffee, honey, mushrooms, bamboo, etc. Factories and industries that process NTFPs that the farmers harvest could be established by investors rather than taking up so much of land. To this effect, the scheme for market expansion and commercialization of NTFPs (honey) that is being carried out by SOS-sahel/UK is an exemplary procedure in which other NGOs, GOs and investors should capitalize.

- For certain species whose fruits are desired as a NTFP, e.g. *Fagaropsis angolensis*, the PFM scheme in the study area should be able to design certain management intervention otherwise the populations of such kind of species will be extinct in the future. This is because the reproduction (regeneration) of the species will be hampered because the fruits collected are not returning to the forest soil.

- Although the forest structure in both the PFM forest and the free access forest depicted an inverted "J" shape which is a good indication for health, in the PFM

forest, the seedlings are being suppressed and individuals at diamer class 1 are small in number than individuals in the diameter class 2. Therefore, it is important to carry out some silvicultural intervention (selective logging) in the PFM forest so as to increase light energy reaching the forest floor.

- Although the population structure of the selected tree species did not clearly depict the extent of depletion of the forest in the free access than the PFM forest, it was observed on the site that PFM is recommended to be a good intervention in the free access forest also. As can be seen from the population structure of the important tree species, the most important tree species; *Syzygium guineense* and *Olea welwitschii* are being depleted in the free access forest.
- *Olea welwitschii, Elaeodendron buchananii, Syzygium guineense, Allophylous abyssinicus, Millettia ferruginea , Cordia Africana, Ehretia cymosa , Euphorbia ampliphylla, Ficus sur, Poutera adolfi-friedericii Shefflera abyssinica* and *vernonia amygdalina* should be center of NTFPs conservation plan due to the fact that they are highly desired by the local people as a source of NTFP

- Considering the immense contribution that NTFPs can make to the sustainable development of the nation, NTFPs should be given due attention whereby NTFPs research, development, conservation activities are coordinated at department level at the MoARD. During this study, it was learnt that there is an NGO operating in the Kaffa- Sheka that deals with the development, conservation and research of the NTFPs of the Kaffa -Sheka. This is a good start considering the NTFPs potential of the Kaffa- Sheka. However, the project should expand to all the districts of the southwest including Gimbo.

- The high species diversity recorded in the study area indicates that in the study sites there is more potential of NTFPs and future studies in the area of NTFPs documentation and development should be carried out.

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10. ANNEXES

Annex 1. Data Collection tools

A) Checklist of questions for the semi structured interview of the household survey.

Date: _____ Questioner No: _____ Name of interviewer: Fisseha Asmelash

Particulars of the area: _____

_____

Name of the village: _____

Sociodemographic data

Name of the respondent (optional): _____

Sex (mark bi tick): Male____ Female____

Ethnic: _____

Age (Ask or estimate): 15-24 25-34 35-44 above 44

Questions on cultural knowledge and ethnobotany

1. Do you know any NTFPs that are found in your area? Yes/No
2. If yes, what are those NTFPs that you get in your area?
3. Which plant parts are preferred for the specific NTFPs you get in your area?
4. What are the habit and habitat of the plant species that you mentioned above?
5. Which plant pars are preferred for the specific NTFPs?
6. How do you harvest NTFPs? (Cutting parts, felling plants, up rooting……)
7. Prioritize the NTFPs in order of importance and value.
8. Is honey one of the NTFPs in your area? If yes,

a) Do you use traditional, modern or both traditional and modern bee hives?

b) How many beehives do you have?

Traditional _____

Modern _____

c) How many of the bees hives do usually bare honey? (as a ratio or percentage)

Traditional _____

Modern _____

d) Frequency of harvesting per bee hive per year

Traditional _____

Modern _____

e) Quantity of honey harvested per bee hive

Traditional _____

Modern _____

f) How do you make traditional bee hives? And what plant species are used for making bee hives?

9. When did you start harvesting NTFPs(1: since time in memorial, 2: ten years before, 3: very recently)
10. Do you get all the NTFPs from the forests? If no, where else do you get it?(1: in the farm land, 2: in the home stead)
11. If you get the NTFPs from the farmland and homestead, who plants them?
12. If you are the one to plant them, when did you start this activity? (1: since time in memorial, 2: ten years before, 3: very recently)

13. Are you allowed to harvest NTFPs from the forests? Yes/No
14. How is the trend of abundance of the major NTFPs in the forest?
    a) Before five years?
    b) Within this five years?
15. Which of the NTFPs found in your area is used by children, men, and women?
16. What are your major activities during the months of the year?
17. What are the major crops that you grow? How much is sold to the market and how much is consumed?
18. What are the diary products that you produce? How much ids sold to the market and how much is consumed?
19. How much of the NTFPs harvested is utilized in the house, sold to the market, spoiled?
20. Which NTFPs is sold in good price, spoiled more? The NTFPs from the forest or the NTFPs from the home stead and farm land? What do you think is the reason?
21. What uses is known by the people for the specific NTFPs that are harvested?
22. How much is the price of the specific NTFPs in the local market and central market?
23. How much of the specific NTFPs do you usually harvest per year?
24. Which of the NTFPs require much labor and time during harvesting, processing and storing?
25. What are the major problems of the specific NTFPs either during harvesting, processing and storing?
26. To whom you sell your NTFPs? To the local dwellers, merchants or others/

27. How many times a year do you harvest the specific NTFPs?
28. Which NTFPs regenerate fast after harvesting? Which die and which regenerate slow after harvesting?
29. Is there any kind of management activity carried out by people in your area towards the NTFPs found in the forest?
30. What are some of the wild animals found in your area?
31. Are there any wild animals recently noticed? Which are those species?
32. Are there any wild animals recently disappeared? Population reduced?
33. Are any of the wild animals edible? If so name them.
34. Are any of the wild animals known to cause damage?
35. What do you use for fuel? Fuel wood, char coal…
36. Do you grow Enset? If yes,
    a) How much Enset do you have?
    b) How much Enset is harvested per year?
    c) What do you make out of Enset?
    d) Is Enset found in the forest?

B) Semi structured interview checklist for Market Survey

Name of the respondent (Optional) _____

Sex (mark by tick) Male_____ Female_____

Age (ask or estimate) 15-24 25-34 35-45 above 45

Type of Vender a) Ambulatory b) Temporary c) Permanent

Adress (Kebele) _____

1. Which NTFPs have a market value?
2. Are you engaged in any business that requires NTFPs? If yes, which ones?
3. Which NTFP is more prefferd for your business?
4. Which NTFP fetch you more cash income? Why?
5. Which NTFP fetch you less cash income? Why?
6. To whome do you sell NTFPs?
7. What is the price of the different NTFP sold in the area?
8. How many times do you sell NTFPs a week?

B) Items for guided field walk

Name of village: _____ Name of respondent (optional) _____

Sex (mark by tick): Male_____ Female_____

Ages (ask or estimate): 15-24 25-34 35-44 above 44

1. How do you call thins plant/Animal or mushroom?
2. Why do you call it so?
3. What are its uses?
4. When is these plant/animal or mushroom most important?
5. How is the availability of these plants/animals or mushrooms?
6. How is the trend of the availability of these plants/animals or mushrooms?
7. How is the availability of these plants/animals or mushrooms before and after the PFM scheme?
8. How many trees do you think a single farmer needs for energy?

Annex 2: Names of plant species identified in the area

Coll No	Scientific names	Habit	Local names	language
FA1	*Apodytes dimidiata E.mey ex. Ern.*	T	Wundifo	kaffa
FA 2	*Syzygium guineense* (Wild.)DC	T	Yinoo	kaffa
FA 3	*Oxyanthus speciosus* DC.	T	Ophero	kaffa
FA 4	*Vepris dainellii*(Pich-Serm)Kokowaro	T	Mengirexxoo	kaffa
FA 5	*Chionathes mildbraedii* (Gilg & schellenb.) Stearn	T	Shigiyo	kaffa
FA 6	*Galiniera saxifrga*(Hochst.) Bridson	T	Diidoo	kaffa
FA 7	*Olea welwitschii* (Knobl.)Glig & Schellenb.	T	Yahoo	kaffa
FA 8	*Allophylus abyssinicus* (Hochst.) Radlkofer.	T	Shee'oo	kaffa
FA 9	*Rytigynia neglecta*(Heirn)Robyns	T	Naxxaachoo	kaffa
FA 10	*Ocotea kenyensis* (Chiov.) Robyns &wilezek	T	Najjoo	kaffa
FA 11	*Millettia ferruginea* (Hochst.)Bak.	T	Bibero	kaffa
FA 12	*Canthium oligocarpum* Hiern.	T	Xxixxidiboo	kaffa
FA 13	*Phoenix reclinata* Jacq.	T	Zembaba	kaffa
FA 14	*Lepidotrichilia volkensii* (Gurke) Leory	T	Yebboo	kaffa
FA 15	*Schefflera abyssinica* (Hochst. ex A.Rich.) Harms	T	Butto	kaffa
FA 16	*Macaranga capensis* (Baill.)Sim	T	Shaakeroo	kaffa
FA 17	*Croton macrostacyus* Del.	T	Wagoo	kaffa
FA 18	*Ficus thonningii* Blume.	T	Xigaagoo	kaffa
FA 19	*Bersama abyssinica* Fresen.	T	Booqqoo	kaffa
FA 20	*Dracaena steudneri* Engler	T	Yuddo	kaffa
FA 21	*Elaeodendron buchananni* (Loes.)Loes.	T	Waasho	kaffa
FA 22	*Fagaropsis angolensis*(Engl.)Dale	T	Yaayo	kaffa
FA 23	*Prunus Africana* (Hook.f.)Kalkm.	T	Oomo	kaffa
FA 24	*Podocarpus falcatus*	T	Xiidoo	kaffa
FA 25	*Dombeya torrida*(J.F.Gmel.)P.Bamps	T	Shawkoo	kaffa
FA 26	*Dracaena afromontana*	T	Chookmatoo	kaffa

	Mildber.			
FA 27	*Margaritaria discoidea* (Baill.)Webster		Gaaboo	Kaffa
FA 28	*Euphorbia ampliphylla* Pax	T	Kulkual	Amharic
FA 29	*Trema orientalis* (L.) Bl.	T	Shoottoo	kaffa
FA 30	*Teclea nobilis Del.*	T	Shengaaro	kaffa
FA 31	*Ficus ovata* Vahl	T	Caaroo	kaffa
FA 32	*Pouteria adolfi-friedericii*(Engl.)Baehni	T	kerero	Amharic
FA 33	*Pittosporum virdiflorum* Sims	T	Sholloo	kaffa
FA 34	*Albizia gummifera* (J.F.Gmel.) C.A. Sm.	T	Caatto	kaffa
FA 35	*Ilex mitis* (L.) Radlk.	T	Qetoo	kaffa
FA 36	*Polyscias fulva* (Hiern.)Herms	T	Qaaresho	kaffa
FA 37	*Albizia grandibacteata* Taub.	T	Qoyo	kaffa
FA 38	*Cyathea manniana* Hook.	T	Sheeshino	kaffa
FA 39	*Oncoba spinosa* Forssk.	T	Shooratoo	kaffa
FA 40	*Crdia Africana* Lam.	T	D'io	kaffa
FA 41	*Vangueria apiculata* K.Schum.	T	Qerallo	Kaffa
FA 42	*Ehretia cymosa* Thonn.	T	Wegamoo	kaffa
FA 43	*Celtis africana* Brum.f.	T	Ufoo	kaffa
FA 44	*Pavetta abysinica* Fresen.	T	Tushimoo	kaffa
FA 45	*Ficus sur* Forssk.	T	Caberroo	kaffa
FA 46	*Vernonia amygdalina Del.*	T	Giraawo	kaffa
FA 47	*Maesa lanceolata* Frossk.	T	Ceegoo	kaffa
FA 48	*Vernonia auriculifera* Hiern.	T	Dangeraxoo	kaffa
FA 49	*Protea gaguedi* J.F. Gmel.	T	Xumoo	Kaffa
FA 50	*Lannea fruticosa* (A.Rich.) Engl.	T	-	-
FA 51	*Arundinaria alpina* L.	T	Shiinaato	kafa
FA 52	*Sapium ellipticum* (Krauss) Pax.	T	Shedoo	kaffa
FA 53	*Ekebergia capensis* Sparrm.	T	Orooroo	kaffa
FA 54	*Dinbollia kilimandscharica* Taub	T	Qaqerechoo	kaffa
FA 55	*Landolphia buchananii* (Hall.f)Stapf	Cl.	Yemoo komboo	kaffa
FA 56	*Jasminum abyssinicum* Hochst.ex.Dc.	Cl.	Haawetoo komboo	kaffa
FA 57	*Comperatum paniculatum* Vent.	Cl.	Begoo komboo	kaffa
FA 58	*Paullinia pinnata* L.	Cl.	Beyroo komboo	kaffa
FA 59	*Cissus quadriangularis* L.	Cl.	Caomoo komboo	kaffa
FA 60	*Embelia schimperi* Vatke.	Cl.	Dupoo komboo	kaffa

FA 61	*Hippocratea goetzei* Loes.	Cl.	Qaawo komboo	kaffa
FA 62	*Stephania abyssinica* (Dillon et A.Rich.) Walp.	Cl.	E'koo komboo	kaffa
FA 63	*Tliacora troupinii* Cuf.	Cl.	P'eo komboo	kaffa
FA 64	*Clematis longicauda* Steud.ex.A.Rich	Cl.	Shaago komboo	kaffa
FA 65	*Clematis hirusta* Perr. & Guill.	Cl.	Shudoo komboo	kaffa
FA 66	*Gouania longispicata* Engl.	Cl.	Aceebenoo komboo	kaffa
FA 67	*Solanecio* gigas (Vatke) C.Jeffrey	T/Sh/ H	-	-
FA 68	*Coffea arabica* L.	Sh.	Bunnoo	kaffa
FA 69	*Rungia grandis* T.Anders.	Sh.	Huxxoo	kaffa
FA 70	*Clausena anisata* (Willd.)Benth.	Sh.	Emmbriicoo	kaffa
FA 71	*Catha edulis*(Vahl) Frossk.ex Endl	Sh	Chat	Amharic
FA 72	*Mythenus gracilipus*(Welw.ex. Oliv.)Exell	Sh.	Shiikoo	kaffa
FA 73	*Dracaena fragrans* (L.) ker-Gawl.	Sh.	Emmo	kaffa
FA 74	*Rothmannia urcelliformis*(Hiern)Robyns	Sh.	Dibboo	kaffa
FA 75	*Psychotria orophila* Petit	Sh.	Aaemmatoo	kaffa
FA 76	*Erythrococca trichogyne* (Muell.Arg.)Prain	Sh.	Biicerkuucho	kaffa
FA 77	*Dalbergia lactea* Vatke	Sh.	Bitbitoo	kaffa
FA 78	*Rubus studneri* Schweinf.	Sh.	Geroo	kaffa
FA 79	*Myrsine africana* L.	Sh.	Shuratoo	kaffa
FA 80	*Brucea antidysenterica* J.F. Mill.	Sh.	Nuuqishoo	kaffa
FA 81	*Acanthus eminens* C.B.Clarke	Sh.	Pecho	kaffa
FA 82	*Justica shimperiana* (Hochst. Ex. Nees) T.Anders.	Sh.	Shesheroo	kaffa
FA 83	*Hibiscus berberidifolius* A.Rich	Sh.	Sheroo	kaffa
FA 84	*Rhamnus prinoides* L'Herit	Sh	Gesho	Amharic
FA 85	*Dodonea angustifolia* L.f	Sh	-	-
FA 86	*Nicotiana tabacum* L.	Sh	-	-
FA 87	*Sida tenuicarpa* Vollesen	Sh/H	-	-
FA 88	*Thelypteris confluens* Schott	H	Giixoo	kaffa
FA 89	*Oplismenus hirtellus* (L.)P.Beaur	H	Yawello	kaffa
FA 90	*Achyranthes aspera* L.	H	Gecoo	kaffa
FA 91	*Hypoestes forskaolii* Roem. &	H	Qoorro	kaffa

	Schult			
FA 92	*Impatiens hochstetteri* Warb.	H	E'qeeqo	kaffa
FA 93	*Aframonum corrorima*(Braun) Jansen	H	Qoroorima	kaffa
FA 94	*Cyprus rigdifolius* Steud.	H	Micoo	kaffa
FA 95	*Dichrocephala integrifolia*(L.f) kuntze	H	Shutti	kaffa
FA 96	*Ocimum lamiifolium* Hochst ex.Bent	H	Yemich medhanit	Amharic
FA 97	*Piper capense* L.f	H	Turffoo	kaffa
FA 98	*Satruja paradoxa*(Vatke) Engl.	H	Tebbelesh	kaffa
FA 99	*Amorphophallus gallaensis* (Engl.)N.E.Br.	H	Shiimbiishiixxo	kaffa
FA 100	*Aframomum zambesiacum*(Baker)K.Schum	H	Yezenjero korerima	Amharic
FA 101	*Isoglossa punctata* (Vahl)Brumitt & Wood	H	Yulii gecoo	kaffa
FA 102	*Phaulopsis imbricata* sub sp Imbricata (Forssk.)Sweet	H	Sheetii qeffo	kaffa
FA 103	*Sida rhombifolia* L.	H	Shetto	kaffa
FA 104	*Ranunculus multifidus* Forssk.	H	Hogioo	kaffa
FA 105	*Ajuga alba*(Gurke) Robyns	H	Herb14	-
FA 106	*Leonotis nepitifolia*(L)R.Br	H	Herb10	-
FA 107	*Thalictrum schimperiannum* Hochst.ex.Schweinf	H	Nerine	kaffa
FA 108	*Asparagus asparagoides* (L.)Weight	H	Ufoo	kaffa
FA 109	*Pentas lenceolata* (Forssk.) Deflers	H	Herb7	-
FA 110	*Olyra latifolia* L.	H	Hotto	kaffa
FA 111	*Bidens prestinaria* (Sch.Bip.) Cufod	H	Kello	kaffa
FA 112	*Comelina difusa* Burm.f	H	Nallexxo	kaffa
FA 113	*Nelsonia Thomsonii*	H	Haagio	Kaffa
FA 114	*Impatiens ethiopica* Gery-Wilson	H	-	-
FA 115	*Lannea shimperi* (A.Rich.) Engl.	H	-	-
FA 116	*Lantana camara* L.	H	-	-
FA 117	*Senna septemtrionalis*	H	-	-
FA 118	*Colocasia esculenta* (L.) Schott.	H	-	-
FA 119	*Nelsonia canescens*(Lam.) Spreng.		-	-
FA 120	*Isoglosa somalensis* Lindau	H	-	-

FA 121	*Urera hypselodendron* (A.Rich.)Wedd.	H	-	-
FA 122	*Solanecio mannii* (Hook.f.) C.Jeffrey	H	-	-
FA 123	*Utrica simensis* Setudel	H	-	-
FA 124	*Gutembergia ruepelli* Sch.Bip.	H	-	-
FA 125	*Pentas cafensis* Chiov.	H	-	-
FA 126	*Triumfetta brachyceras* K.Schum.	H	-	-
FA 127	*Cyperus dichroostachyus* A.Rich	H	-	-
FA 128	*Antheum foeniculum* L.	H	-	-
FA 129	*Verbena officinalis* L.	H	-	-
FA 130	*Persicaria senegalensis*(Meisn.) Sojak.	H	-	-

Annex 3: List of the Key Informants in the study

No	Name of key Informant	Kebele	Sex	Age
1	Admasu H/mariam	yeyobito	M	21
2	Alemayehu Keyto	yeyobito	M	40
3	Admasu Abamecha	yeyobito	M	18
4	Gezahegn Gebere	yeyobito	M	23
5	Abebech Haile	yeyobito	F	40
6	Abebech W/youhannes	yeyobito	F	46
7	Timotios Manchalew	yeyobito	M	45
8	Abebe Abafogae	yeyobito	M	40
9	Hailemariom	yeyobito	M	38
10	Hagerae Alemu	yeyobito	F	40
11	Wudinesh W/michael	Bitachega	F	28
12	G/yesus G/michael	Bitachega	M	50
13	Haile Desta	Bitachega	M	50
14	G/Giorgis Keno	Bitachega	M	80
15	Zeryihun Bahiru	Bitachega	M	14
16	Abate W/selasse	Bitachega	M	25
17	Azage Habte	Bitachega	M	28
18	Aklilu H/Yesus	Bitachega	M	18
19	W/senbet Habte	Bitachega	M	42
20	Ayele G/Meskel	Bitachega	M	28
21	Getachew Berhanu	Qeja Araba	M	38
22	Wondimu G/Giorgis	Qeja Araba	M	40

23	Workinesh G/Michael	Qeja Araba	F	45
24	Wodajo W/Yesus	Qeja Araba	M	35
25	Abeto Haile	Qeja Araba	M	42
26	Bezabih W/Yesus	Qeja Araba	M	46
27	Assefa Beyene	Qeja Araba	M	50
28	Beyene Abadiga	Qeja Araba	M	65
29	Kichirasha W/Senbet	Qeja Araba	M	70
30	Berhanu G/Mariam	Qeja Araba	M	65
31	Tadesse Tegegn	keyakello	M	55
32	Bekele Zewde	keyakello	M	35
33	G/Mariam W/Gebreal	keyakello	M	56
34	Aselefech Ambo	keyakello	F	50
35	Gezahegn W/Mariam	keyakello	M	45
36	Melaku Mammo	keyakello	M	50
37	Gebabo G/Michael	keyakello	M	45
38	Weynitu Bekele	keyakello	F	28
39	Abeto Motto	keyakello	M	48
40	Ashebir G/Medhin	keyakello	M	45

Annex 4: Meteorological data at Bonga/Kaffa station (*source: NMA*)

a) Monthly total rain fall in mm

year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1988	**87.9**	**89.9**	**35.8**	**119.7**	**135.4**	**223.1**	**NA**	**286.8**	**213.1**	**219.7**	**23.7**	**42.2**
1989	**42.2**	**38.5**	**128.6**	**201.8**	**97.9**	**109.3**	**179.7**	**205**	**169.6**	**146.3**	**34.3**	**118**
1990	**60.6**	**134.6**	**138.3**	**143**	**254.4**	**173.4**	**189.6**	**233.5**	**216**	**74.4**	**85.5**	**65.2**
1991	**73.2**	**50.2**	**126.7**	**226.1**	**202.3**	**220**	**194.2**	**264.1**	**201.5**	**53.4**	**52**	**51.8**
1992	**88.3**	**NA**	**102.2**	**103.6**	**155.6**	**257.8**	**191.5**	**194.9**	**159.3**	**285**	**99.9**	**59.1**
1993	**138.7**	**89.8**	**99.3**	**250**	**276.8**	**244.9**	**178**	**121.2**	**202.8**	**183.1**	**11.4**	**2.7**
1994	**10.2**	**9.1**	**71.6**	**179.4**	**245.7**	**NA**	**236**	**139.9**	**126.3**	**46.2**	**111.6**	**19.1**
1995	**0**	**42**	**52.3**	**158.9**	**153.4**	**160.8**	**172.6**	**214.4**	**223.3**	**56.8**	**31.6**	**151.8**
1996	**45.5**	**36.6**	**155.4**	**202**	**188.9**	**159.6**	**158**	**178.3**	**214**	**93.6**	**94.8**	**21.7**
1997	**86.2**	**12**	**133.5**	**231.7**	**205.9**	**212.7**	**181.8**	**146**	**138.4**	**239.9**	**248.2**	**135.9**
1998	**128.2**	**47.6**	**64.7**	**173.4**	**223.1**	**217**	**207.5**	**260.4**	**192.3**	**154.2**	**14.5**	**0**
1999	**NA**	**6**	**108.1**	**174.6**	**181.9**	**138.2**	**165.1**	**121.9**	**138**	**162.7**	**23**	**22.2**
2000	**6.3**	**4.6**	**101.4**	**194.3**	**214.1**	**161.6**	**232.1**	**135.1**	**147.5**	**260.4**	**38.7**	**28.9**
2001	**NA**	**67.5**	**119.4**	**NA**	**NA**	**192.5**	**178.3**	**197.3**	**195.7**	**118.1**	**69.7**	**6.4**
2002	**36.1**	**22**	**172.5**	**131.1**	**102.2**	**253.2**	**142.1**	**159**	**166.4**	**158.8**	**33.1**	**115.7**
2003	**47.2**	**23.3**	**51.5**	**213.3**	**47.7**	**352.1**	**462.9**	**433.4**	**314.3**	**26.8**	**46.4**	**48.7**
2004	**95.4**	**16.1**	**95**	**NA**	**NA**	**82.8**	**142.2**	**NA**	**NA**	**85.6**	**63.7**	**109.2**
2005	**33.7**	**39.5**	**158**	**163.5**	**319.4**	**202.1**	**172.5**	**178.9**	**184.7**	**140**	**89.7**	**0**
2006	**31.2**	**68.5**	**155.8**	**88.6**	**NA**	**185.7**	**287.9**	**206.4**	**183.7**	**148.1**	**NN**	**108.7**
2007	**NA**	**30.2**	**NA**	**198.9**	**295.1**	**276.5**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

b) Mean maximum temperature in degree Celsius

year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1988	**13**	**12.7**	**14**	**14.3**	**13.1**	**12.1**	**NA**	**14.3**	**12.6**	**12.4**	**13.3**	**9.1**
1989	**9.1**	**10.2**	**11.7**	**13.7**	**13.9**	**13.5**	**13.9**	**13.1**	**13.5**	**12.3**	**12.1**	**12.7**
1990	**10.4**	**12.9**	**13**	**14**	**14.4**	**14.2**	**13.4**	**13.5**	**13.3**	**12.2**	**11.6**	**10.2**
1991	**12.1**	**11**	**12.7**	**11.2**	**10.8**	**10.2**	**10.3**	**13**	**12.9**	**12.2**	**11.9**	**9.8**
1992	**8.7**	**10.8**	**12.2**	**11.1**	**12.5**	**11**	**11**	**10.3**	**10.9**	**11**	**12.2**	**12**
1993	**11.3**	**10.6**	**12**	**12.5**	**12.6**	**12.7**	**11.3**	**11.7**	**12.2**	**12.6**	**10.5**	**8.2**
1994	**9**	**10.8**	**13**	**13**	**13.9**	**NA**	**13.7**	**13.7**	**12.6**	**8.3**	**10.1**	**9.2**
1995	**8.8**	**10.8**	**10.4**	**12.5**	**13.1**	**12.3**	**11.4**	**11.6**	**12.6**	**9.7**	**9.4**	**11**
1996	**11.5**	**11.1**	**11.1**	**9.6**	**10.7**	**10.1**	**10.5**	**11**	**11.5**	**11.9**	**10.8**	**10.2**
1997	**10.8**	**10**	**12.2**	**12.8**	**13**	**13.1**	**12.7**	**NA**	**NA**	**NA**	**NA**	**NA**
1998	**NA**	**12.2**	**12.3**	**11.4**	**11.3**	**12.1**	**11.8**	**11.9**	**11.4**	**12.1**	**9.6**	**8.2**
1999	**8.8**	**10.2**	**11.9**	**11.9**	**11.5**	**11.9**	**11.3**	**11.6**	**12.3**	**12.7**	**9.8**	**9.2**
2000	**9.5**	**7.8**	**12**	**12.3**	**12.5**	**12.9**	**12.9**	**13.6**	**12.9**	**13.3**	**12**	**8.9**
2001	**NA**	**11.9**	**12.2**	**NA**	**NA**	**13.2**	**12.6**	**13.4**	**13.1**	**13.3**	**12.3**	**11.5**
2002	**11.8**	**10.1**	**12**	**13.9**	**13.4**	**13**	**13.2**	**12.9**	**13.2**	**12.8**	**12.7**	**14.1**
2003	**10.8**	**11.7**	**12.2**	**13.5**	**14.2**	**12**	**10.9**	**10.8**	**11.5**	**10.2**	**10.1**	**10.5**
2004	**10.5**	**10.6**	**12.5**	**15**	**NA**	**14.4**	**13**	**14**	**13.7**	**11.8**	**11.1**	**13.9**
2005	**11.4**	**11.4**	**13.3**	**NA**	**13**	**14.5**	**14**	**13.3**	**14.1**	**13.2**	**10.8**	**8**
2006	**11.8**	**12.3**	**13.1**	**14.1**	**13.2**	**14.1**	**14.1**	**15**	**13.9**	**14.3**	**13**	**13**
2007	**NA**	**13.3**	**NA**	**14.8**	**14.7**	**14.5**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

c) Mean minimum temperature in degree Celsius

year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1988	**27.2**	**27**	**28.6**	**28.1**	**27**	**25.7**	**NA**	**25.8**	**25.6**	**26.6**	**28.3**	**28.3**
1989	**28.3**	**27.8**	**28**	**26.5**	**27.2**	**26.2**	**24**	**24**	**24.7**	**26.7**	**27.9**	**26.8**
1990	**28.2**	**26.8**	**27.6**	**28.1**	**27.9**	**26.2**	**26**	**26.7**	**25.9**	**28.7**	**28.6**	**29.3**
1991	**28.6**	**29.6**	**28.4**	**27.8**	**27.7**	**27.3**	**25.6**	**25.8**	**26.7**	**27.7**	**28**	**27.8**
1992	**27.9**	**27.9**	**29.2**	**28.2**	**28.3**	**26.2**	**25.8**	**25.2**	**25.8**	**26.5**	**28**	**27.9**
1993	**26.8**	**27**	**28.5**	**27.1**	**27.7**	**27.4**	**26.3**	**27.2**	**27.1**	**26.8**	**29.4**	**30.1**
1994	**31.2**	**32**	**29.3**	**28.5**	**26.8**	**NA**	**25.4**	**25.5**	**26.8**	**29.1**	**27**	**27.9**
1995	**30**	**29.5**	**29.8**	**28.1**	**27.2**	**27.1**	**25.1**	**25.7**	**26.7**	**27.7**	**29.5**	**27.7**
1996	**26.5**	**29.2**	**28.2**	**26.7**	**26.4**	**25.5**	**24.3**	**24.1**	**25.6**	**27.4**	**27.7**	**27.1**
1997	**27.4**	**29.7**	**29**	**26.7**	**25.9**	**25.6**	**25.2**	**25.6**	**27.1**	**26.5**	**26.4**	**27.9**
1998	**28**	**28.4**	**27.4**	**29.1**	**26.6**	**27.2**	**25**	**24.6**	**25.8**	**26.4**	**28.5**	**29.3**
1999	**29**	**28.5**	**28.6**	**27.6**	**26.1**	**26.4**	**24.6**	**25.1**	**26.4**	**26.4**	**28.3**	**28.9**
2000	**28.8**	**28.9**	**28.6**	**27.7**	**26.6**	**26.6**	**25.2**	**24.8**	**25.6**	**26.4**	**26.5**	**27.4**
2001	**NA**	**26.8**	**26**	**NA**	**NA**	**24.5**	**24.6**	**24.9**	**25.9**	**26.8**	**26.4**	**26.2**
2002	**27.1**	**28.5**	**26.6**	**26.7**	**26.3**	**25.9**	**26**	**25.3**	**25.9**	**26.8**	**26.7**	**25.8**
2003	**26.5**	**27.8**	**27.3**	**27.3**	**26.6**	**25**	**24.7**	**24.4**	**25.5**	**26.8**	**26.8**	**27.7**
2004	**27.3**	**23.9**	**30.3**	**28.8**	**21.5**	**25.3**	**25.9**	**25.6**	**25.7**	**26.6**	**27.7**	**27.6**
2005	**28.3**	**30.9**	**30.3**	**NA**	**26.3**	**26.1**	**25.1**	**26.3**	**26.5**	**26.9**	**27.5**	**28.2**
2006	**29**	**29.7**	**28.4**	**27.5**	**26.5**	**26.6**	**25.4**	**24.6**	**25.4**	**27.2**	**27.4**	**27.3**
2007	**NA**	**27.8**	**NA**	**28.2**	**27.1**	**26.3**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Annex 5: Summery of the partial socio economics of the 86 households surveyed

	Kaf	Mnj	Orm	Had	Amh	Tig
MzR	**3**	**1**	**15**	**7**	**18.75**	**7.5**
Est	**32.77**	**31.81**	**2**	**25**	**2**	**2**
Ox	**1**	**0.7**	**2**	**1**	**2**	**2**
Cw	**1.5**	**0.7**	**4.17**	**0.6**	**1.5**	**0.7**
Shp	**3.3**	**1.5**	**4**	**1.5**	**3**	**3**
Hn	**1.5**	**1.5**	**2.9**	**1.5**	**2**	**2**
HoR	**108**	**273.6**	**14.17**	**10.6**	**17**	**28**
CoR	**170**	**240**	**17**	**17**	**17**	**28**
CaR	**50**	**75**	**2**	**2**	**2**	**10**
WpR	**25**	**90.9**	**0**	**0**	**0**	**0**
FlD	**1**	**1.5**	**1**	**1**	**1.08**	**1**

Where: **MzR** is average maize production /year/quintals, **Est** is average Enset stands owned, **Ox** is average number of Oxen owned, **Cw** is average number of cows owned, **Hn** is average number of Hens owned, **Shp** is average number of sheep owned, **HoR** is average honey production/year/kilogram, **CoR** is average coffee production/year/ kilogram, **CaR** is average cardamom collected/year/kilogram, **WpR** is average wild pepper collected /year/kilogramme and **FlD** is average fuel wood consumed/day/woman load

Annex 6: Market survey result by Taye Bekele (2003), price of NTFPs in Birr

No.	Type of product	Unit	Bonga shops	Bonga open market	Oufa	Wushwush
1	Charcoal	50 kg sack	14			
2	Firewood	Woman load	6 (splitted)	4 (unsplitted)	5	
3	Wild Coffee	K.g.	7	7-8	8	7
4	Forest Honey	K.g.	8	8	8	
5	Cardamom	K.g.	6-7	9	8	
6	Wild pepper	K.g.	4-5			