A Study on Biodiversity Management In *Daaddegoyo* (Traditional Home Gardens) by Kaficho People of Bonga area (Southwestern Ethiopia) : An Ethnobotanic Approach

By
Feleke Woldeyes

A Thesis Submitted to the School of Graduate Studies in partial fulfillment of the requirement for the Degree of Master of Science in Biology, Addis Ababa University

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Abstract

The study was conducted in three villages around Bonga (Southwest Ethiopia) to investigate the role of the local people in managing biological diversity through agricultural activities. The Kafichos, the indigenous people of the study area, are settled farmers who practice traditional home gardening. Their *enset* based home garden, which consists of a complex mixture of annual and perennial plants, is locally called *Daaddegoyo;* and provides them with almost every thing required for subsistence. Data on vegetation (species record, cover-abundance, number of individuals, and plant specimens), and soil samples were collected from sample plots. Ethnobatanic information was gathered by conducting open ended discussions with key informants, owners of home gardens and other family members. The collected plant specimens were identified in the Niational Herbaruim (ETH). The vegetation data was analysed using the computer program SYNTAX and five clusters were recognixed: *Ensete-Xanthosoma* community, *Ensete-Coffea* community, *Ensete-Brassica* community, *E*nsete-Xanthosoma-*Saccharum* community and *Ensete-Xanthosoma-Nicotiana* community. The clusters were compared for the mean values of the soil chemical factors using the ANOVA test. A total of 170 plant species were recorded from the 21 *Daaddegoyo* (home gardens) of which 47% were found to be protected or tolerated. Although a decrease in total number of plant species per village with an increase in altitude was observed, the ANOVA (Analysis of Variance) test result indicated no sighificance difference among the three villages in the number of species per garden. The Daaddegoyo whose framework is made by *Ensete ventricosum* is strongly linked to the other two land-use systems: *Kubbo* ('managed forest") and *Guudo* (Intact forest). It is a stable agroecosystem that harbours a significant biodiversity, and this has resulted from innovative processes by local farmers over generations. Therefore, the *Daaddegoyo* is an *in-situ* repository of crop germplasm and deserves protection.

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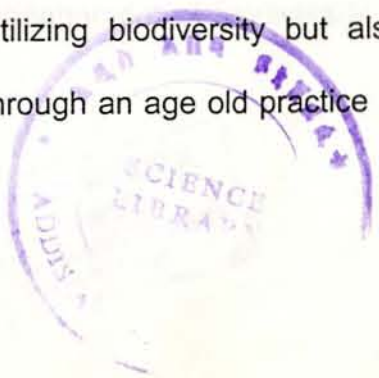
1. INTRODUCTION

Biodiversity is defined by the Convention on Biological Diversity as 'the variability among living organisms from all sources including terrestrial, marine and other ecosystems and ecological complexes of which they are part (Stork, 1996). Biodiversity encompasses all species of plants, animals, micro-organisms, the genetic variability within these species, and the ecosystems and ecological processes that they form and which sustain them (Pagiola *et al.* 1977). The term "Biodiversity" signifies the integration of ecology and genetics in conservation theory; and it represents diversity at all levels of biological organization: the community, the species, the organism and the gene (Frankel *et al.*, 1995).

Biodiversity is important for the fact that it is this variety and variation occurring in nature which has sustained the harmonious existence of life on earth (Reddy, 1994). Biodiversity forms the basis of a global life-support within which human beings have fulfilled many of their needs (Blaikie and Jeanrenalud, 1996). Biodiversity is of extreme significance, particularly for traditional peoples, who greatly depend on it for their subsistence. For them, it is a matter of survival since their livelihoods depend on free and open access to a great variety of biological resources for food, fuel, medicine, housing materials and economic security (WWF/TNC/WRT, 1993).

Therefore, indigenous people have not only been utilizing biodiversity but also developed a system of managing it. This is achieved through an age old practice of



traditional agriculture and a consequent accumulation of knowledge through a series of observations and innovative processes (Miller *et al.*, 1995).

As Altieri (1992) puts it, many lessons on how to manage and preserve biodiversity (specifically agrobiodiversity) are intrinsic to traditional forms of agriculture. However, this reality is barely understood by outsiders; and this gap in knowledge can only be filled by conducting an ethnobotanic research. Ethonobotanical studies aid in documenting and disseminating of knowledge on the interaction between biodiversity and human society, and how biodiversity is valued in different societies and how it is influenced by human activities and actions (Martin, 1995).

Since ethnobotany has developed greatly only during the last two decades (Prance, 1996), it can be said that ethnobotanic studies are today merely at the start; and only a very few studies generally oriented to ethnobatany have been made in Ethiopia (e.g. Indigenous food crops, their preparation and home gardens in Ethiopia, by Zemede Asfaw (1997); A study on the ecology and ethnobotany of non-cultivated food plants and wild relatives of cultivated crops in Gambella region, by Tesfaye Awas, (1997); An ethnobotanical study of medicinal plants used by the Zay people in Ethiopia, by Mirutse Giday, (1999).

Therefore, one could easily perceive how the gap in knowledge is enormous, and it is this very fact that initiated the present study on the management of biodiversity in

home gardens (*Daadegoyo*) by Kaficho people of Bonga area. This study site was selected because:

- Home gardening is a long standing agricultural practice of the people of the area;

- The region is one of the wettest part of the country that receives year round rainfall; and has a good natural vegetation cover;

- From some preliminary observations it is known that the forest is rich in its floristic composition; some plants that are cultivated in home gardens also grow in the forest; a wild relatives of the cultivated *enset* occurs close to the farms; and the local people use plant resources from the wild for various purposes.

The objectives of this study were:

- to gather information on the diversity of useful plants in the homegarden and nearby natural vegetation;

- to study how the agrobiodiversity varies with distance from the house;
- to compile an authentic checklist of the plant taxa maintained in the home gardens around Bonga;

- to document the indigenous knowledge, practices, and the associated oral tradition of the indigenous people living in the area, focusing on those that helped to maintain the existing diversity of plants both in cultivated and in the wild habitats;

- to assess the influence of indigenous practices on plant biodiversity, the role they play in the conservation and preservation of local ecosystems, and how biodiversity is valued by the local people.

2.0 DESCRIPTION OF THE STUDY SITE

2.1 Geographical location

The study was conducted in three farmers' villages (Kayakella, Gidid and Mera) around Bonga town of Kafa-Shakka Zone, in the Southern Nations, Nationalities and Peoples Region. Bonga town (7° 16' N, 36° 14'E) is located at 415 km southwest of Addis Ababa at an altitude of 1760m a.s.l. Kayakella (7 ° 18' N, 36° 14'E, 1760m a.s.l.) is situated 6 km north of Bonga. Gidi (7°14'N, 36°16'E, 1870m a.s.l.) is 5 km southeast of Bonga, and Mera (7° 16'N, 36° 19E, 2210m a.s.l.) is 15 km east. (Fig.1)

2.2 Physiography and Geology

The topography in the region is characterized by undulating surfaces. The Precambrian basement complex rocks (granite, gneiss, metasediments, and dolomites) underlie all other rocks in Ethiopia (Mohr, 1971, Sutcliffe, 1992). The Kafa highlands, West of the Omo valley, comprise a great thickness of Tertiary basalt's which overlie the basement complex (Sutcliffe, 1992). In this region, crystalline basement rocks are exposed in some places (Davidson, 1983).

2.3 Soil

In Kafa and other parts of southwest Ethiopia, soils are predominantly developed on Trap series volcanic and felsic and metamorphic Precambrian material (FAO, 1984). The range of parent materials on the highland plateau is not strongly reflected in soil development because of high rainfall, greater than 2220 m.m during some years(FAO, 1984). This situation, therefore, has resulted in very similar soils irrespective of parent materials, and the predominant soil is one of Dystric Nitisols and Orthic Acrisols, with inclusion of Dystric Cambisols (FAO, 1984). According to Murphy (1959), the soils around Bonga are brown to reddish-brown clay loams to clay.

2.4 Climate

Seasonal variations in pressure systems and air circulation seem to determine the seasonal distribution of rainfall in Ethiopia (Daniel Gamachu, 1977). According to Daniel Gameachu (1977), there exist 14 rainfall regimes in Ethiopia, which he categorizes into two main types, and the Kafa highlands come under Type I that is characterized by contiguously distributed rainy months and evenly distributed rain. According to unpublished data obtained from National Meteorological Service Agency, the mean annual rainfall at Bonga is 1736 mm. The average yearly minimum temperature at Bonga ranges from 10-12.9°C and the mean annual maximum ranges from 24.2-27.7°C.

2.5 *Vegetation*

The Kafa-Shakka Zone is one of the places in the country with a good vegetation cover. The forest in this area is one of the few remaining extensive tracts of primordial forests left in Ethiopia (Davidson, 1983). Friis *et al.* (1982) recognize four forest formations in Ethiopia (low land rainforest, upland rainforest, upland dry evergreen forest and riverine forest); and according to them the forests of Kafa highlands belong to the upland rainforest. On the other hand, Chaffey (1979) and Ensermu Kelbessa *et al.* (1992) describe this forest as the humid broad-leaved forest composed of broad-leaved species. The forest of Kafa is the richest in its species composition, with frequent vascular epiphytes, and also have a well developed stratification (Friis *et al.*, 1982).

Kumelachew Yeshitila (1997) describes the plant community of Bonga forest as *Olea welwitschii-Chionanthes mildbraedii* type in which *Olea welwitschii* dominates the upper layer; *Schefflera abyssinica, Polyscias fulva* and *Vepris dainellii* are the associated trees, *Chionanthes mildbraedii* is the characteristic shrub; *Oplismenus compositus, Sanicula elata*, and *Aframomum corrorima* are characteristic herbs; and the lianas are represented by *Landolphia buchananii, Hippocratea africana, H.goetzei,* and *Combretum paniculatum.*

2.6 *Population and land use*

According to CSA (1998), the total human population of Kafa-Shakka Zone is 848,630, and the population density is 66.6 persons per square kilometer. The two major nationalities are the Kaficho and the Shakkecho. The 'Woredas' in which the study was carried (Gimbo and Manjiwo) are mainly inhabited by the Kaficho people.

Land is used exclusively for agriculture, and the Kafichos categorize their surrounding into different systems: *Daaddegoyo* (home garden), *Buddigoyo* (Crop field), *Gaddo* (fallow land, grazing land), *Kubbo* ('managed forest'), and *Guudo* (intact forest).

The agricultural practice is *enset*-based mixed cultivation. The major subsistence crops cultivated include *enset,* taro, yam, maize, sorghum, beans and cabbage. Coffee is the main cash crop, except in areas at higher altitude where it does not grow naturally. Coffee is harvested and sold both from the managed forest (which is a privately used forest) and from the intact forest (which is government forest). Coffee obtained from home gardens is mainly used for house consumption. Crops that are cultivated to generate income include *teff,* wheat, barley, sorghum, some legumes and tuber crops.

Cattle and smallstock are common. Beekeeping is an important activity that contributes significantly to household's income.

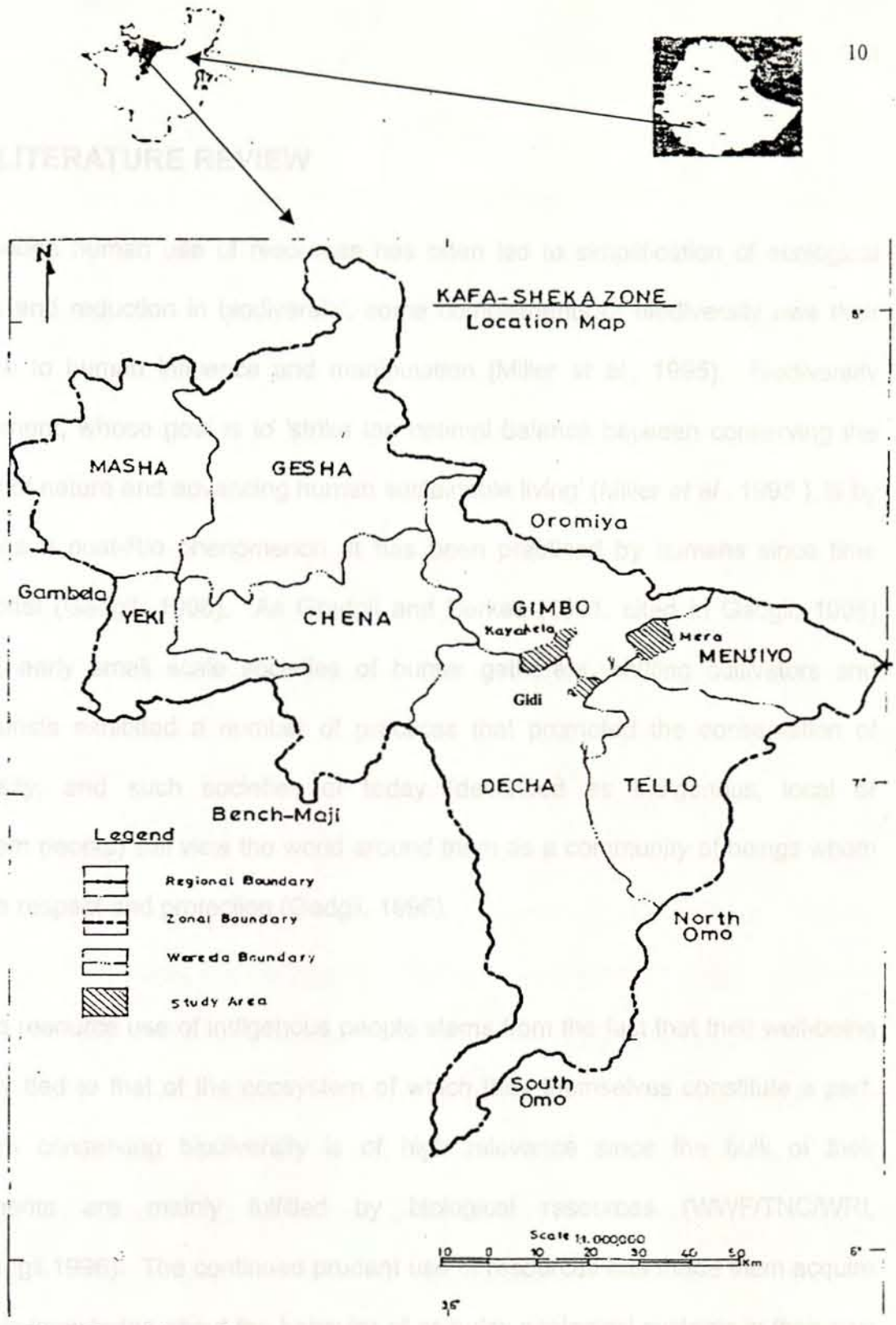


Fig.1 Map of the study area

3.0 LITERATURE REVIEW

Even though human use of resources has often led to simplification of ecological systems and reduction in biodiversity, some complements of biodiversity owe their existence to human influence and manipulation (Miller *et al.*, 1995). Biodiversity management, whose goal is to 'strike the optimal balance between conserving the diversity of nature and advancing human sustainable living' (Miller *et al.*, 1995), is by no means a post-Rio phenomenon. It has been practiced by humans since time immemorial (Gadgil, 1996). As Gradgil and Berkes (1991, cited in Gadgil, 1996) indicate, early small scale societies of hunter gatherers, shifting cultivators and horticulturists exhibited a number of practices that promoted the conservation of biodiversity; and such societies of today (described as indigenous, local or ecosystem people) still view the world around them as a community of beings whom they give respect and protection (Gadgil, 1996).

The wise resource use of indigenous people stems from the fact that their well-being is closely tied to that of the ecosystem of which they themselves constitute a part. For them conserving biodiversity is of high relevance since the bulk of their requirements are mainly fulfilled by biological resources (WWF/TNC/WRI, 1993;Gadgil,1996). The continued prudent use of resources has made them acquire a valuable knowledge about the behavior of complex ecological systems in their own localities (McNeely *et al.*, 1995; Miller *et al.*, 1995).

Altieri (1999) mentions that indigenous people possess a detailed knowledge about their environment and he attributes this to acute observation and experimental learning. This opinion is in agreement with that of Barsh (1999) who states that this traditional ecological knowledge of indigenous and tribal people is scientific in that it is empirical, experimental and systematic. However, he indicates that it differs from western science in two respects. First, the knowledge is highly localized (i.e. it focuses on the complex web of relationships between humans, animals, plants, natural forces, spirits and landforms within a particular locality or territory). The other point is that the knowledge has important social and legal dimensions (i.e. every ecosystem is conceptualized as a web of social relationships between a specific group of people and the other species with which they share a particular place.

In most traditional societies, the earth is understood to be " the soup of all that is good" (Alcorn, 1999). Local people, who often have a rich and detailed knowledge of local plants, animals and ecological relationships, have derived resources management systems appropriate to their local, ecological and social situation (Alcorn, 1999). Their traditional economic systems have a minimum impact on biodiversity since they tend to utilize a great diversity of species, harvesting small numbers of each of them (Barsh, 1999). Moreover they try to increase the biological diversity of the territories in which they live as a strategy for increasing the variety of resources at their disposal (Barsh, 1999).

Humans have been practising agriculture since time immemorial to satisfy their basic needs. Traditional farming systems suited to the ecological conditions of particular

localities, have evolved wherever man settled (Beets, 1990). The evolution of these systems is related to a wide range of factors; and many traditional agricultural practices would not have been possible without specific local practices to support them (Goering *et al.*, 1993). Many of the traditional agricultural management systems provide opportunities for the conservation and sustainable use of biodiversity (Miller *et. al.,* 1995). For example, African cultivators stress food diversity and security over high productivity in their resource management (WWF/TNC/WRT, 1993). The techniques employed here include careful management of crop species and cultivar diversity, staggered planting and harvesting dates, mixed cropping, relay cropping, utilizing a variety of micro environments appropriately).

Currently, traditional agroecosystems, particularly those in developing countries, are portrayed as the world's largest repositories of crop and livestock genetic diversity (Miller *et al,* 1995; Altieri, 1999). This is because they contain today's great diversity of plant and animal germplasm that arose from traditional management processes over thousands of years (Beets, 1990; Miller *et al.*, 1995). Miller *et al.* (1995) described the small-scale farmers of traditional agriculture as effective creators of varietal diversity and stewards of genetic diversity.

There exist today various types of complex agricultural systems such as raised fields, terraces, polycultures, agroforestry systems that met the environmental requirements for food production by the local people (Altieri, 1999). According to Shaxon and Tauer (1992), such systems exhibit two characteristics that could immediately be noticed by

even the most casual observer: high diversity of crops grown and high degree of inter cropping. Altieri (1999) described this phenomenon as the farmer's strategy towards complexity that demonstrates his deep ecological rationale since the kinds of agriculture with the best chance of enduring are those that deviate least from the diversity of the natural plant communities within which they exist. One of such traditional farming practices is home gardening.

Home gardening is an integrated land use and agricultural production system which has been practiced for centuries throughout the tropical world (Sommers, 1982; Brownrigg, 1985; Christanty, 1990; Landauer and Brazil, 1990). Traditional home gardens (also known by different names: compound farms, homestead gardens, mixed garden, dooryard gardens, etc.) are usually the small plots of land surrounding the house, and consist of a mixture of trees and shrubs, other perennials, annual crops and animals (Christanty, 1990; Fernandes and Nair 1990; Power and Flecker, 1996; Godbole, 1997). They are fairly stable agroecosystems, one of the most intensively cultivated parts of an overall farm, and managed by the household members who are the primary consumers of the products (Fernandes and Nair, 1990; Landauer and Brazil, 1990; Power and Flecker, 1996).

The evolution of home gardens is widely believed to be manly related to resources constraints by the majority of authors who made studies in the area. According to many authers (e.g. Fernandes and Nair, 1990; Thaman, 1990; Hoogerbrugge and Fresco, 1993; Rugalema *et al.*, 1994) the multi-story home garden agroforestry plots might have evolved from shifting cultivation under the influence of resource

constraints such as population pressure and the consequent reduction in available land, labour and capital, and physical limitations such as remoteness of the area which forces the inhabitants to produce most of their basic needs by themselves. However, this is not an implicit explanation for the evolution of home gardens and a different possibility was mentioned by Rocheleau *et al.*, (1988). According to them, farmers may be motivated to adapt and develop home gardening even in situations where they have access to extra land. For example, they cite, farmers from Northeast Zambia practice home gardening, even though there exists extensive woodland where they could expand their holdings. These farmers have concentrated their efforts on intensifying production on the limited land they already possess and by doing so they are trying to define and secure their land rights.

Though the home garden (which is simultaneously an orchard, a vegetable garden, a medicinal garden, a bee yard, a garbage disposal unit and a compost heap) may appear as a disordered unit, it is intelligent in its basic pattern (Anderson 1950, cited in Budowski, 1990). Contrary to the apparent appearance of random arrangement of plant species, the home garden is carefully structured and acquires a complex architecture (Fernandes and Nair, 1990; Gillespie *et al.*, 1993).

The structure and function of the home garden are interrelated and therefore the structure can vary from place to place and change from time to time by being influenced by factors such as soil type, the climate, the site's altitude, the owners need and social status and cultural background (Abdoellah, 1990; Karyono, 1990).

The structure and composition of home gardens is a result of gardeners effort to maximize yield from their land based on the understanding of the various requirements of the plant species (Abdoellah, 1990). The system begins with annual crop plants and progresses through different stages of complexity towards a relatively stable ecosystem consisting of trees and highly diverse under story crops (Jose and Shanmugaratnam, 1993). According to Jose and Shanmugaratnam (1993) mature home gardens share characteristics of a climax ecosystem to varying degrees; and for this reason they are regarded by different authors (Fordham, 1983; Brownrigg, 1985; Okigbo, 1990; Jose and Shanmugaratnam, 1993) as human ecosystems which mimic the natural tropical forest.

Even though the herbaceous and woody plants are grown in home gardens forming a multi-storeyed canopy favorably placed to exploit both above and below ground environmental conditions (Adegbehin and Igboanugo 1990), a clear cut stratification does not exist in the vertical dimension (Caballero, 1992). However, different authors (Sommers, 1982; Fernandes and Nair, 1990; Caballero, 1992; Jensen, 1993) recognize three to four canopy strata. In general terms, home gardens consist of three layers: the upper layer (that consists of fully grown timber and fruit trees over 25m in height and medium-sized trees of 10-20m in height), the intermediate layer (that consists of various fruit trees of 5-10 m in height), and the lower layer (that consists of different vegetables, medicinal and other food plants such as cassava, banana, papaya, plantain, yam etc. which range from less than 1 m to 3 m in height).

There is also a ground layer of prostrate species such as sweet potato, melon, pumpkin and several others.

In the multilayered canopy configuration of home gardens, the plant density and the species richness is less in the upper strata creating a gradient of light intensity and quality throughout the lower strata (Fordham, 1983), and different species flourish within these strata when the light region suits them better than their associates(Millat-e-Mustafa *et al.*, 1997). The percentage canopy cover in home gardens is inversely related to holding size, i.e. the intensity of vertical space use is lower in larger holdings and greater in smaller holdings; and this is a result of farmers' attempt to maximize productivity from their small gardens by exploiting space as best as they can (Jose and Shanmugaratnam, 1993).

Though it may appear at a first sight that the horizontal arrangement of crops in home gardens is haphazard, each ensemble occupies a characteristic location (Okigbo, 1990; Jose and Shanmugaratnam, 1993) which is determined by factors such as light, water and fertility requirements, micro-environmental adaptation, habit of the crop, use of the crop, security and crop protection, aesthetics, and incidental or accidental factors (Christanty, 1990, and Okigbo, 1990).

For example, leafy vegetables and spices which are constantly harvested for daily cooking are usually planted close to the kitchen; some ornamentals and vegetables are grown along pathways, or front or side ways where there is sufficient light, and

also for security and aesthetic purposes, plants with high-water requirements are planted in the part of the garden with high soil moisture, those with high nutrient requirements are grown near livestock pens and garbage dumps, large canopied trees are often placed near the margin and spaced far enough apart, trailing and climbing crops are planted close to trees or to the fence so that they can get support and at the same time ensure exposure to sun light, and some other crops may occupy characteristic positions such as mounds, ridges, beds and so on (Budowski, 1990; Christanty, 1990; Okigbo, 1990; Gillespie *et al.*, 1993; Jensen 1993; Jose and Shanmugaratnam, 1993; Zemede Asfaw and Ayele Nigatu, 1995).

As far as the structure below ground is concerned, very little is known about the rooting pattern and configuration in multi species home garden (Fernandes and Nair, 1990). However, from limited studies done in gardens of multi-storey crop combination, it was found out that the horizontal and vertical distribution of the root system involved little or no overlapping (Nair,1979 cited in Fernandes and Nair, 1990). According to Fordham (1983), it is unlikely for the compound rooting profile of an inter-planted stand to be as well organized as the crop canopy, but it is possible to envisage combinations of crops where deep rooting species exploit water reserves beneath those in which more shallow-rooted plants are growing

Although home gardens are generally reported as being less than one hectare, their most general characteristic is the plant diversity. Different authors expressed this situation as follows: diversity is a cardinal trait of traditional home gardens

(Brownrigg, 1985); a prominent structural characteristics of home gardens is the great diversity of species with many life forms (Soemarwoto, 1987); home Gardens in many ecological zones constitute agricultural systems and land use with the highest biodiversity (Okigbo, 1992). The diversity in home gardens is not restricted to the species level only, it also occurs at the intraspecific level.

According to Sathees-Babu *et al.*, (1992), the high biological diversity in home gardens is a deliberate strategy aimed at producing harvest throughout the year, controlling pests and diseases, using natural resources such as light, water and soil nutrients efficiently and risk aversion. Plant diversity in home gardens may vary from one home garden to the other and among different geographical regions, and it is influenced by ecological, socio-cultural, socio-economic, individual and political factors (Christanty, 1990; Caballero, 1992; Esquvel and Hammer, 1992; Gessler *et al.*, 1997).

In addition to diverse plant species, the home gardens also contain an animal component consisting livestock production, poultry, bees and some wildlife such as birds, bats, insects, and civet cats which play an essential role in biological processes such as pollination, natural hybridization and seed dispersal (Michon and Mary, 1994). Some home gardens are also known to contain ponds, and Nguyen (1995) describes the structure and species composition of Vietnamese home gardens. According to him, about 20 species of fish, frog, shrimp and crab are found deep in

the water; water ferns and water lilies grow at the surface of the pond water, and herbaceous vegetables are planted near the edge and at the bank of the pond.

Home gardens are highly developed traditional agroforestry systems (Karyono, 1990), and they are perhaps the most environmentally appropriate farming systems operating in the tropics (Sommers, 1982). The home garden agroecosystem is a low to medium input subsistence farming system in socio-economic and ecological terms (Jose and Shanmugaratnam, 1993). The ecological "philosophy" behind home gardens is directing succession rather than fighting it (Jose and Shanmugaratnam, 1993), and management practices remain simple, occasional, and hardly interfere with natural processes (Michon and Mary, 1994). According to Millat-e-Mustafa (1997a), sustainable land use is that which maintains an acceptable level of production and simultaneously conserves the basic resources on which production depends (enabling production to be maintained), and traditional home gardening is one of the agricultural practices that best fits this definition. Factors that contribute to the sustainability of home gardens include efficient use of resources, reduced soil erosion due to the multi-layered structure, maintenance of soil fertility, and minimum loss of products that could be caused by pests, diseases and weeds (Sommers, 1982; Abdoellah, 1990; Adegbehin and Igboanugo, 1990; Immink, 1990; Mettrick, 1993; Rugalema *et al.*, 1994).

The primary function of home gardens is production of food for the household almost continuously throughout the year (Fernandes and Nair, 1990), and this is ensured by

the high diversity of plant species with different flowering, fruiting and cropping seasons (Christanty, 1990; Karyono, 1990). The species diversity makes also possible the production of various food products that provide a substantial proportion of the nutritive and calorific requirements of the local diet. In addition to their role in food production, home gardens serve several other functions: they are source of products other than food such as medicinals, construction materials, fish poison, beauty aids, fibre, they are source of income (excess produce is sold), they are sites for testing and domestication (Soleri and Cleveland, 1989; Esquivel and Hammer, 1992), they are places for conservation - by harbouring hundreds of trees and other plant species, some animal species; and they are useful also in reducing the destructive use of the few small

nature reserves that are left (Nguyen, 1995), and they also have socio-cultural and aesthetic functions.

Different management practices are performed in home gardens which are based on knowledge accumulated over generations. Soil fertility is usually maintained with farmyard manure, pen manure, household refuse, kichen waste, compost and crop residues. Pruning is another important operation practiced by the gardener based on such objectives as facilitated harvesting of fruits, increased fruit and timber production, and providing light to the more valuable understorey plants (Millat-e-Mustafa, 1997a). Farmers also practice companion planting of crops that complement each other to make maximum use of available land through intensive cropping of the garden both vertically as well as horizontally and consequently to

secure sustained yield (Sommers, 1982). Crop selection is another practice performed by farmers (who are experts in the task), and as Hailu Mekbib (1995) mentions, generally farmers select their land races based on gastronomic criteria (that include taste, storage, cooking time, and other processing opportunities) and agronomic criteria (that include length of maturity period, drought tolerance, resistance to disease and bird damage, and ability to compete with weeds). Although diseases, pests and weeds do not pose a serious problem due to the high diversity of crop plants and the closed canopy character of home gardens, some crop protection activities are performed. These include weeding, use of scarecrows and scaring sounds against large animal pests (Zemede Asfaw and Ayele Nigatu, 1995), and cultivation of some plants that may repel insects (Sommers, 1982).

Though any member of the household can be found at work in the home garden, women are usually responsible for the management; and men help in more labour demanding activities like digging and pruning and may devote special attention to particularly useful trees that they are cultivating or encouraging (Brownrigg, 1985; Ninez 1990; Zemede Asfaw, 1997). Women grow medicinals, spices, condiments and dyes (which are known as "women's plants") and also vegetables in the home garden so as to ensure the continuous availability of fresh material close to the kitchen (Brownrigg, 1985; Soleri and Cleveland 1989; Okigbo, 1990). Due to their intimate association with the garden, women are aware of the utility of plant diversity and means for maintaining it (Godbole, 1997).

It is speculated that home gardening in Ethiopia is as old as agriculture (Zemede Asfaw and Ayele Nigatu, 1995), and this might particularly be true in the South and Southwest of the country where vegeculture is the common practice and traditional home gardening is a long standing tradition. The home garden system of this region, which is described as the *enset*-complex by Westphal (1975), is an *enset (Ensete ventricosum)* based cropping system comprising the concurrent cultivation of various tubers, legumes, cereals, oil-crops, vegetables, spices and condiments, and stimulants (Taye Bezuneh, 1996). The system is praised to be sustainable, and supports the lives of about 10 million people of South and Southwestern Ethiopia (Judith, 1974; Brandt, 1996). The Kafichos of Kafa-Shakka Zone in the Southern Nations Nationalities and Peoples Region are one of the indigenous peoples who practice this traditional home gardening whose framework is made by the *enset* plant.

4.0 MATERIALS AND METHODS

4.1 Field data collection

4.1.1 Vegetation data

A reconnaissance survey was made in November,1999 to select farmers' villages around Bonga town. Three villages: Kayakella (6 km north of the town), Gidi (5 km southeast of the town) and Mera (15 km further east of the town) were selected. The field study was conducted from November to end of December 1999, and an additional field trip was made in April, 2000.

21 home gardens were selected from the villages employing preferential sampling first, and then systematic sampling method. It was discovered from the reconnaissance survey that the home garden system is strongly linked to the forests and this made it necessary to sample this vegetation. Therefore, 50m x 25m nine sample plots from the 'managed forest' (*Kubbo*) and six samples from the less disturbed forest-'intact forest '(*Guudo*) were taken.

The entire home garden was taken as a releve and plants, which were described as useful by the community, were listed according to the folk taxonomy. A 5m x 30m transect was made from the house site to the margins of the garden. Within this transect, the type of plant found, number of

individuals of each type, habit of the plant were recorded, and cover abundance values were estimated according to the modified Bran-Blanquet 1-9 scale (Van der Maarel, 1979). In the sample plots of the natural vegetation, each plant that was mentioned as useful by informants was listed.

Voucher specimens were collected for each type of plant encountered unless it was possible to identify it without any doubt. The specimens were dried, fumigated and identified in the National Herbrium (ETH). The identification work was performed by using the Flora book volumes of Ethiopia and Eritrea, and also by comparing with the authentic specimens of the herbarium. Some books on the vegetation of Ethiopia (Useful Trees and Shrubs for Ethiopia by Azene Bekele, 1993; A Glossary of Ethiopian Plant Names by Woldemichael Kelecha, 1987) were used.

4.1.2 Environmental data

The altitude and geographic location of each village was specified by using GPS. Soil samples were collected using soil auger from two depths: 0-30 cm, and 30-60 cm. in the home garden. The samples were taken from spots where different types of crops were cultivated. It was tried to do this at different distance from the house to the edge of the garden.

4.1.3 Ethnobotanic information

Indigenous people were made to involve in the study. Local informants, owners of home gardens and other household members were motivated to release any information they have. Open-ended interviews were made on plant names, planting practices, source of planting materials, plant use, land use systems and other traditional and socio-cultural practices. Information delivered was jotted down, and traditional songs and stories that pertain to the study were recorded. Some practices and objects of ethnobotanic interest were photographed and a few are collected.

4.2 Soil analysis

Soil samples were analysed in the National Soil Research Laboratory. Laboratoty tests were conducted after the soil samples were air dried and ground to pass through 2mm sieve. Soil p^H was determined in 1: 2.5 soil-water solution with standard glass electrode. Electrical conductivity was measured in 1:2.5 soil-water suspension at 25 °C. Calcium and magnesium were determined by Atomic Absorption Spectrometry technique, and sodium by flame photometry. Cation exchange capacity was determined by the ammonium acetate method; and Olsen's method was employed to determine available phosphorous. The Kgeldahl procedure was used to test for percentage total nitrogen, and percentage organic carbon was determined following the procedure of Walkley and Black.

4.3 Data analysis

Vegetation data (cover-abundance values) were analysed using the computer software program SYNTAX (Podoni, 1988) that employs the average linkage clustering procedure. The resulting clusters were then recognized as community types. Community-environment relationships were tested by the statistical test ANOVA (Analysis Of Variance). Species richness was calculated using Mergalef's richness index (Millat-e-Mustafa, 1997b); and a species importance was estimated using Use Value Index (Philips, 1996).

5.0 RESULTS

5.1 Folk taxonomy of Kaficho People

The Kaficho people have their own system of classifying their environment and its components. This includes the classification of the landscape climatic zones, vegetation, agricultural practices and the biotic components.

The landscape is classified based on two main criteria: elevation and the purpose for which the land is used. The part of the landscape with maximum elevation in an area is called *Guudoggeppo;* a leveled (flat) land is called *Yimaanoo;* a land with a gentle slope is called *Shareboo* and a gorge is referred to as *Bamboo* or *Dugulloo.*

Based on the purpose a land category serves and its vegetation cover, the local people classify their surroundings as *Daaddegoyo* (home garden), *Buddigoyo* (crop field), *Gaddo* (fallow-land, grazing-land), *K*ubbo ('managed'-forest), and Guudo ('intact'-forest",i.e. less-disturbed forest). These systems fit into the different categories recognized based on elevation; i.e. *Daaddegoyo* occupies some portion of the leveled (flat) land *(Yimaano), Buddigoyo* occupies some portion of the leveled land *(Yimaano)* and the slightly tilted land (*Shareboo*), the managed-forest is located in the gorges (*Bamboo* or *Dugulloo*), and the intact forest occupies lands with maximum elevation in the surrounding (Fig. 2). These systems (except the *daaddegoyo*) can be changed from one type to the other though the degree of

conversion may vary. The *daaddegoyo* occupies a central postion to which all the other systems can be converted into but not vice versa (Fig. 3).

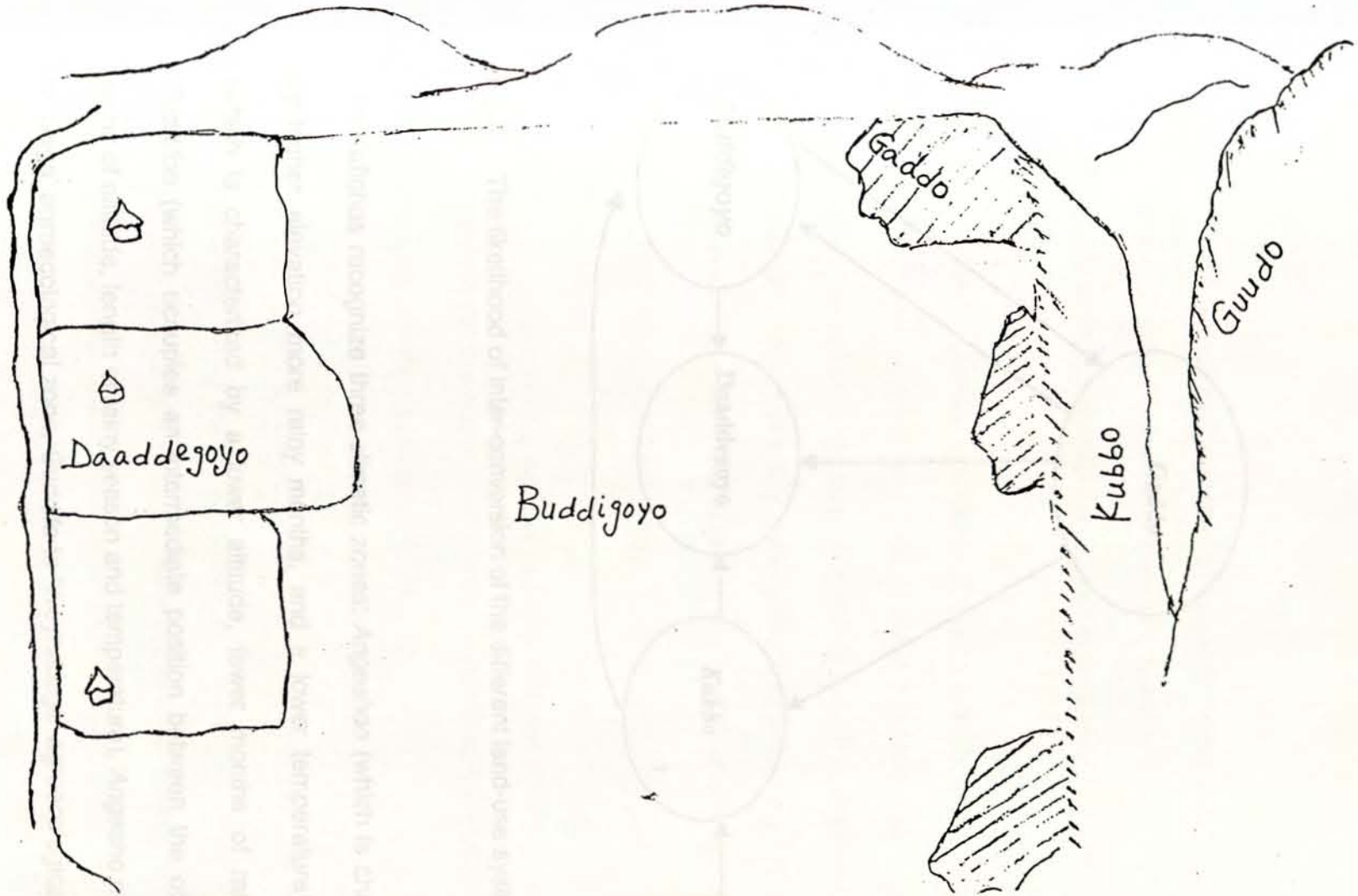


Fig. 2- The *Daaddegoyo* (the home garden) and its surroundings in Bonga area

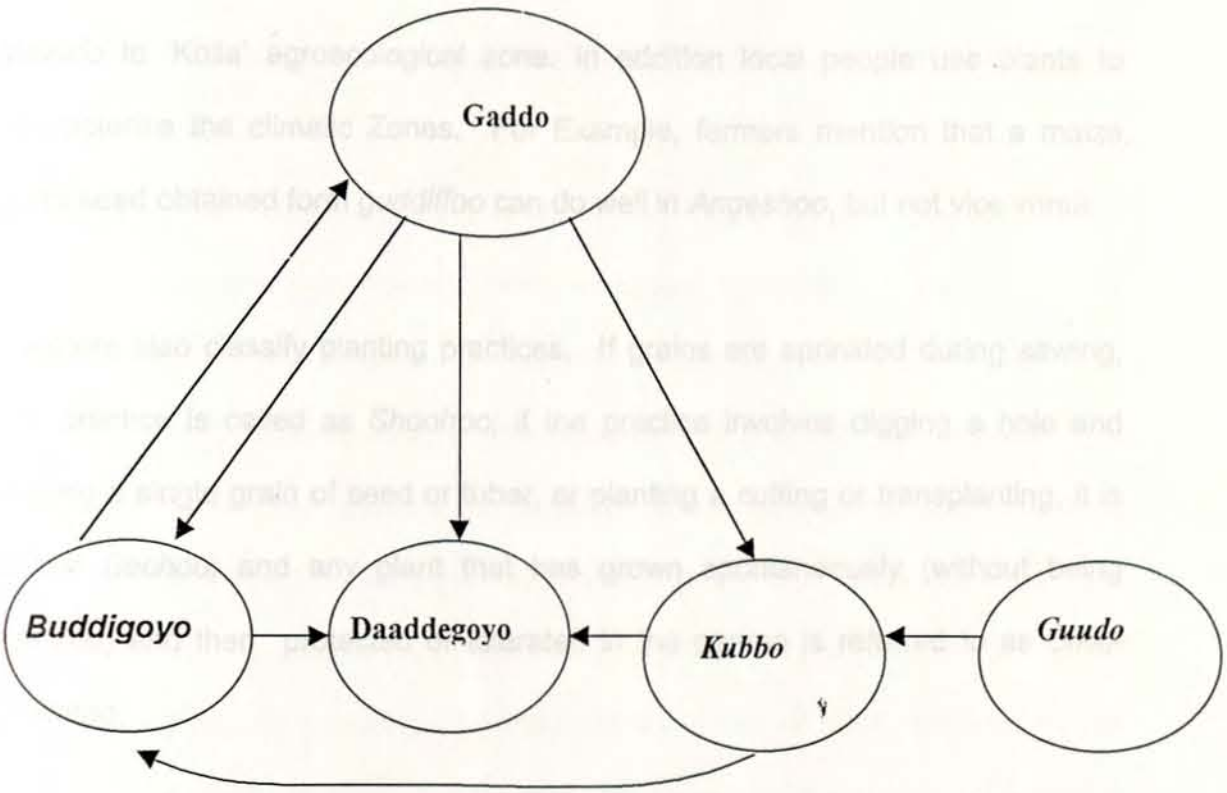


Fig.3 The likelihood of inter-conversion of the different land-use systems

The Kafichos recognize three climatic zones: *Angeshoo* (which is characterized by higher elevation more rainy months, and a lower temperature), *Worefoo* (which is characterized by a lower altitude, fewer months of rainfall), and *Guddifoo* (which occupies an intermediate position between the other two in terms of altitude, length of rainy season and temperature). *Angesho* corresponds to 'Dega' agroecological zone, *Guddifo* to 'Woynadega' agroecological zone and

Worefo to 'Kolla' agroecological zone. In addition local people use plants to characterize the climatic Zones. For Example, farmers mention that a maize plant seed obtained form *guddiffoo* can do well in *Angeshoo*, but not vice versa.

Farmers also classify planting practices. If grains are sprinkled during sawing, the practice is called as *Shoohoo;* if the practice involves digging a hole and putting a single grain of seed or tuber, or planting a cutting or transplanting, it is called *Bechoo;* and any plant that has grown spontaneously (without being planted) and then protected or tolerated in the garden is referred to as *Cikki-Colletoo.*

Plants of the home garden are categorized into different groups based on their use as *Daaddemayo* (the major food crops), *Gishiishimayo* (vegetables), *Cinno* (spices), *Attoo* (medicinals) and *Uunoo* (odorants) .

The Kaficho people have a detailed knowledge of plants in their gardens and the natural vegetation. They recognize plants at the species level, at the local (farmers') variety level, and also at the level below local variety. For example, they recognize the species *Ensete ventricosum*, *Enset* plant, more than 40 clones (local varieties), and a few of these local varieties are further classified.

5.2 *Plant diversity in home gardens (*daaddegoyo*) and associated land use systems.*

Farmers cultivate diverse plant species in their home garden (*daaddegoyo*) to satisfy their subsistence needs. Simultaneously, those plants, which grow by themselves, are either protected or tolerated for their known or perceived use. In the managed forests (*Kubbo*), where management practices are occasional, a number of useful plant species are protected and encouraged through selective clearing. The 'intact' forest (*Guudo*) is very rarely visited by people, perhaps once or twice by a person during specific periods of the year such as the coffee or honey harvesting period, and it contains a number of plant species that are useful to the local people. Tables 1, 2 and 3 show useful plants encountered in the home gardens,'managed'and 'intact'forests.

*Table 1 Plants encountered in the Daddegoyo (*home garden*), their use and state of conserevation. Symbols represent plant use (Af, Animal feed; Bv, Bevarage; Cn, Construction; Fd, Food; Fn Fence; Hd, Hot-drink; In Income; Md,Medicinal; Ir,Insect repellant; Od, Oderant; Or,Ornamental;; SP, Spice; Tc, Technological and crafts; Ot, Others) and State of cultivation (C,Cultivated; P/T, Protected or Tolerated).* * Sterile specimens that could not be identified.

VERNACULAR NAME (In Kafinoono)	SCIENTIFIC NAME	Plant use	State of cultivation	Remark
Aa'imacoo	*Artemisia afra* Jack. ex Wild.	Md,Sp	C	
Ababoo (1)	*Tagetes minuta* L.	Or,Ir	C	
Ababoo (2)	*Syadenium compactum* N.E.Br.	Fn	C	Recent
Achoo	*Solanum americanum* Miller	Fd,Md	P/T	
Aggiyoo	*Clerodendron myricoides* (Hochst.) R.Br ex Vatke	Fn,Cn,Md	P/T	
Ajjoo	*Coccinia abyssinica* (Lam.) Cogn.	Fd	C	
Ambaaxxoo	*Rumex abyssinicus* Jacq.	Sp,Tc	P/T	
Amblaachoo (Addeche-attoo)	*Verbena officinalis* L.	Md	C,P/T	
Amichi - attoo	*Persicaria senegalensis* (Meisn.) Sojak.	Md,Ir	C	
Ammitiballoo*		Fn,Ot	P/T	
Anaanasoo	*Ananas comosus* L. Merr.	Fd	C	Recent
Ataaroo (Kappaaroo)	*Buddleja polystachya* Fresen.	Fn,Cn	P/T	
Ataroo	*Pisum sativum* L.	Fd	C	
Avokaadoo	*Persea americana* Mill.	Fd,In	C	Recent
Baaqeeloo	*Vicia faba* L.	Fd	C	
Baaroo	*Zea mays* L.	Fd	C	
Bare-guccoo	*Capsicum annum* L.	Fd	C	
Bare-Kolosoo	*Capsicum annum* L.	Fd	C	
Barzaafoo	*Eucalyptus sp.*	Cn	C	
Bayiroo	*Paullinia pinnata* L.	Cn,Ot	C	
Beroo	*Erythrina abyssinica* Lam. ex DC.	Fn	C,P/T	
Beeshoo	*Cyperus fischerianus* A. Rich.	Od	C	
Bibberoo	*Millettia ferruginea* (Hochst.) Bak.	Cn,Fn,Ot	P/T	
Booqqoo	*Bersama abyssinica* Fresen.	Fn	P/T	
Botoo	*Lagenaria siceraria* (Molina) Standl.	Ot	C	

Table 1 Contd...

Bunoo	*Coffea arabica* L.	BV,In	C	
Buqqoo	*Cucurbita pepo* L.	Fd,Md	C	
Burttukoanoo (1)	*Citrus sinensis* (L.) Osbeck	Fd	C	
Burttukaanoo (2)	*Citrus aurantium* L.	Fd	C	
Butoo	*Schefflera abyssinica* (Hochst. ex A. Rich.) Harms.	Fn,Cn,Ot	P/T	
Caaroo	*Ficus sur* Forsk.	Fn,Cn,Tc	C,P/T	
Caatoo	*Catha edulis* (Vahl.) Forssk. ex Endl.	Md,Bv,In	C	
Caatto	*Albizia schimperiana* Oliv.	Cn,Tc,Ot	P/T	
Caddiraamoo	*Ruta chalepensis* L.	Sp,Md	C	
Caggoo	*Maesa lanceolata* Forssk.	Cn,Ot	P/T	
Caphoroo (Ooppo)	*Ficus sp.*	Fn, Tc,Ot	P/T	
Ceelle-ababoo (1)	*Euphorbia cottonifolia* L.	Fn	C	Recent
Ceelle-ababoo (2)	*Iresine herbstii* Hook. f.	Or	C	Recent
Celle-duuqqisho	*Allium cepa* L.	Fd	C	
Cido	*Cupressus lucitanica* Mill.	Tc	C	
Comexxoo	*Amaranthus dubius* Mart	Fd	P/T	
Coori-ababoo	*Canna indica L.*	Or	C	Recent
Daamakasho	*Ocimum lamiifolium* Hochst . ex Benth.	Md,Fn	P/T	
Daammo	*Ocimum gratissimum* L.	Md,Fn	P/T	
Daggichoo	*Celosia trigyna* L.	Md	P/T	
Dangirettoo	*Vernonia auriculifera* Hiern	Fn,Md	P/T	
Dawri-shaanoo	*Brassica sp.*	Fd	C	
Deebboo	*Coriandrum sativum* L.	Sp,Md	C	
Dichoo	*Aeollanthus sp.*	Sp,Md	C	
Digiccoo	*Calpurinia aurea* (Art.) Benth.	Fn,Cn,Tc	P/T	
Diiqqoo(stem with sugar y juice)	*Sorghum bicolor* (L.) Moench	Fd	C	
Diiroo	*Ocimum basilicum* L. var. *thyrsi-florum*	Sp	C	
Dinnichoo	*Ipomoea batatas* (L.) Lam.	Fd	C	
Di'oo	*Cordia africana* Lam.	Cn,Tc	C,P/T	
Doo'iroo	*Solanecio gigas* (Vatke) C. Jeffrey	Fn,Md	P/T	

Table 1contd.....

Emoo	*Dracaena fragrans* (L.) Ker-Gawl.	Fn	C	
Faranjji-ataro	*Cajanus cajan* (L.) Mil.	Fd	C	
Faranjji-buqqoo	*Sechium edule* Sw.	Fd	C	Recent
Faanjji-kookoo	*Passiflora edulis* Sims.	Fd	C	
Gaatoo	*Cucurbita sp.*	Af	P/T	
Gachoo	Euphorbia ampliphylla Pax.	Fn,Cn,Tc	C	
Gamadaaro	Cardamine trichocarpa A.Rich.	Fd	P/T	
Gare-ababoo	*Rosa sp.*	Fn,Or	C	
Garoo (1)	*Caesalpina decapetala* (Roth.)Alston	Fn	C	
Gawushoo	*Solanum americanum*	Fd	C	
Geeshoo	*Rhamnus prinoides* L'Herit.	Bv,In	C	
Giixoo	*Cyathea manniana* Hook.	Fn	P/T	
Gimiyoo	*Grewia ferruginea* Hochst.ex A.Rich.	Fn,Cn		
Girawoo	*Vernonia amygdalina* Del.	Cn,Af	P/T	
Gobelloo	*Phaseolus lunatus* L.	Fd	C	
Goddoo	*Artemisia absinthium* L.	Sp	C	
Goojjam-doqqoo	*Solanum tuberosum* L.	Fd	C	
Gorechoo	*Rumex nepalensis* Spreng.	Md	P/T	
Guccinoo	*Carduus leptacanthus* Fresen.	Md	P/T	
Hinnimaacho*		Cn	P/T	
Hupphichoo (1)	*Laggera crispata* (Vahl) Hepper & Wood	Sp	P/T	
Hupphichoo (2)	*Physalis micrantha* Linle	Fd	P/T	
licingaaccoo(1)	*Vigna membranacea* A.Rich.	Af	P/T	
licingaaccoo(2)	*Convolvulus kilimandschrii* Engl.	Af	P/T	
Imaamoo	*Urera hypselodendron* (A.Rich.)Wedd.	Md	P/T	
Inbriccoo	*Clausena anisata* (Willd.) Hook.f. ex Benth.	Cn,Ot	P/T	
Kafi-qiiddoo	*Colocasia esculenta* (L.) Schott	Fd	C	
kareshoo	*Polyscias fulva* (Hiern) Harms.	Tc, Ot	P/T	
kefo	*Ocimum basilicum* L. var. hawli	Sp	C	
Keelloo	*Bidens prestinaria* (Sch. Bip.)Cuf.	Sp	P/T	

Table 1 Contd....

Kollaachoo	*Erythrina brucei* Schweinf.	Fn, Tc	C, P/T	
Kookoo	*Cyphomandra betaceae* (Cav.)Se.	Fd	C	
Kooshoo	*Hagenia abyssinica* (Bruce) J.F.Gmel.	Md, Tc	P/T	
Kosheretoo	*Lippia adoensis* Hochst. ex.Walp.	Sp, Od	P/T	
Koyoo	*Brassica oleracea* L.	Fd,	C	
Kotegobboo	*Phaseolus vulgaris* L.	Fd	C	
Maangoo	*Mangifera indica* L.	Fd	C	Recent
Maccllaago	*Foeniculum vulgare Mill.*	Sp,Md	C	
Meelloo	*Ficus vasta* Forsk	Ot	P/T	
Michigiigoo	*Englerina woodfordioides* (Scheweinf) Balle	Fn	P/t	
Michigobboo	*Lablab purpureus* (L.) Sweet	Fd	C	
Michi-oocino	*Manihot esculenta* Granz	Fd	C	Recent
Mixmixxee	*Capsicum frutescens* L.	Fd	C	
Moggoccoo	*Triumfetta brachyceras* K. Schum	Fn,Af	P/T	
Moonye-ababoo	*Datura innoxia* Mill.	Fn,Or	C	Recent
Muuttoo	*Linum usitatissimum* L.	Fd	C	
Muuzoo	*Musa paradisiaca* L.	Fd,Af,In,Ot	C	
Naanayoo	Mentha spicata L.	Sp	P/T	
Nacce-duuqishoo	*Allium sativum* L.	Fd	C	
Nacce-shaanoo	*Brassica carinata* A. Br.	Fd,Ot	C	
Naddoo	*Satureja parodoxa* (Vatke) Engler	Od	P/T	
Naxxaachoo	*Rytigyna negelecta* (Hiern) Robyns	Fn,Cn	P/T	
Nopphoo (1)	*Sesbania melanocaulis* Bidgood & Friis	Ot	C	
Nopphoo (2)	*Cineraria abyssinica* Sch. Bip. ex A.Rich.	Md	P/T	
Nuuqqishoo	*Brucea antidysenterica* J.F.Mill.	Md,Fn	P/T	
Oocinoo	*Dioscorea cayenensis-rotundata* complex	**Fd**	**C**	
Oofiyoo (Oogiyoo)	*Aframomum corrorima* (Braun) Jansen	Sp,Md	C	
Oomoo	*Prunus africana* (Hook.f.) Kalkm.	Cn,Tc,Ot	P/T	

Table1 contd...

Orooroo	*Ekebergia capensis* Sparm.	Tc,Cn.Ot	P/T	
Paappayoo	*Carica papaya* L.	Fd,Md	C	
Qadoo	*Poa sp.*	Or	C	
Qammoo	*Rhus ruspolii* Engl.	Cn	P/T	
Qaysiro	*Beta vulgaris* L.	Fd	C	Recent
Saarenge gobboo	*Phaseollus coccineus* L.	Fd	C	
Shaatishaatoo	*Pavonia urens* Cavan.	Md	P/T	
Shawukkoo*		Cn,Ot	P/T	
Sheddoo	*Sapium ellipticum* (Krauss) Pax.	Fn,Cn,.Ot	P/T	
Shee'oo	*Allophylus abyssinicus* (Hochst.) Radlk.	Cn,Fn,Tc	P/T	
Sheetoo	*Indigofera arrecta* Hochst.ex A.Rich.	Tc	P/T	
Shenaafoo	*Brassica nigra* (L.) Koch.	Fd	C	
Shigiyoo	*Chionanthus mildbraedii (Gilg & Shel.) Stern*	Cn	P/T	
Shiippoo	*Lepidium sativum* L.	Md	C	
Shikko	*Maytenus gracilipes* (Welw.ex Oliv.) Exell	Fn	P/T	
Shinaatoo	*Arundinaria alpina* K. Schum.	Cn<tc,Ot	C	
Shonkooroo	*Sacccharum officinarum* L.	Ot	C	
Shoobbenoo	*Mentha aquatica* L.	Sp	C	
Shoobboo	*Lantana trifolia* L.	Fn,Cn	P/T	
Shuukindoo	*Artemisia abyssinica* Sch. Bip ex A.Rich.	Md	C	
Suufoo	*Amaranthus hybridus* L.	Fd	C	
Sudaan-qiiddoo	*Xanthosoma sagittifolium* (l.) Schott	Fd	C	Recent
Timaatimoo	*Lycopersicon esculenta* L.	Fd	C	
Togoo	*Dicliptera laxata* C.B.Cl.	Md	P/T	
Tojjoo	*Peponium vogelii* (Hook-f.) Engl.	Md	P/t	
Toochoo	*Cymbopogon citratus* (DC.) Stapf.	Sp,Md	C	
Tugoo	*Tacazzia apiculata* Oliv.	Cn,Fn	P/T	
Tombaa'oo	*Nicotiana tabacum* L.	Md,Ot	C	
Turungii	*Saturega punctata* (Benth.)Briq.	Md	C	
Ufoo (1)	*Celtsi gomphophyila* Bak.	Cn,Ot	P/T	

Table 1contd....

Uffoo (2)	*Asparagus africanus* Lam.	Ot	P/T	
Uullulloo (Burbbushoo)	*Lucas martinicensis* (Jacq.) R.Br.	Od	P/T	
Uuxoo	*Ensete ventricosum* (Welw.) cheeseman	Fd,Cn,Af,Ot	C	
Waagoo	*Croton macrotachyus* Del.	Md,Tc	P/T	
Woccoo	*Thymus schimperi* Ronn.	Sp,Md	C	
Wogaammoo	*Ehretia cymosa* Thonn.	Fn,Cn	P/t	
Wokkoo	*Dioscorea bulbifera* L.	Fd	C	
Woshiroqqoo	*Plectranthus edulis* (Vatke) Agnew	Fd	C	
Wundifo	*Apodytes dimidiata* E.Mey. ex Arn.	Cn,Ot	P/T	
Xeho(Xesso)	Ricinus communis L.	Tc,Cn,Ot	P/T	
Xigaagoo	*Ficus thonningii* Blume	Fn,Cn	P/T	
Xiixidibboo	*Canthium oligocarpum* Hiern	Fn,Cn	P/T	
Xiqilggoomanoo	*Brassica oleracea* L. var. capitata L..	Fd	C	
Xumo	*Premna schimperi* Engl.	Fn,Cn	P/T	
Yahoo	Olea welwitschii (Knobl.) Gilg & Schell.	Cn,Tc,Ot	P/T	
Yajjino	*Apodytes dimidiata E.Mey. ex Arn.*	Cn,Fn	P/T	
Yammoo	*Caylusea abyssinica* (Fresen.) Fisch. &Mey.	Md	P/T	
Yangoo(grown for grains)	*Sorghum bicolor* (L.)Moench	Fd,Cn	C	
Yanjiballoo	*Zingiber officinale* Rescoe	Sp,md	C	
Yebboo	*Phoenix reclinata* Jacq.	Cn,Tc	P/T	
Ye'eroo	*Pycnostachys abyssinica* Fresen.	Fn,Md	C,P/T	
Yinoo	*Syzygium guineense* (Willd.) DC.	Cn,Ot	P/T	
Yumbroa'o	*Momordica foetida* Schumach.	Ot	P/T	
Yingaamoo	*Phytolacca dodecandra* L'Heirt	Fn,Ot	P/T	
Yuddo	*Dracaena steudneri* Engler	Af,Ot	P/T	
Zaytuunoo	*Psidium guajava* L.	Fd	C	Recent
'Anonymouus'	*Physalis peruviana* L.	Af	f	Recent

Table2 Useful plants encountered in the *Kubbo ('* managed forest ') and their use. Symbols represent plant use: Af,Animal feed; Cn,Construction; Fd, food; Fn, Fence; Hd,Hot-drink; In, Income; Md,Medicinal; Sp, Spice; Tc, Technological and crafts; Ot, Others. * Sterile specimens that could not be identified.

VERNACULAR NAME (In Kafinoono)	SCIENTIFIC NAME	Plant use
Aa'imato	*Psychotria orophila* Petit	Cn,Tc
Aggiyoo	*Clerodendron myricoides* (Hocht.) R. Br. ex Vatke	Cn, Md
Baggoo*		Ot
Bayiroo	*Paullinia pinnata* L.	Cn,Ot
Bibberoo	*Millettia ferruginea* (Hochst.) Bak.	Cn,Ot
Booqqoo	*Bersama abyssinica* Fresen.	Cn,Ot,Tc
Burtukaano	*Citrus sp.*	Fd
Bunoo	*Coffea arabica* L.	In,Hd
Butoo	*Schefflera abyssinica* (Hochst. ex A.Rich.) Harms.	Tc,Cn,Ot
Caattoo	*Albizia schimperiana* Oliv.	Cn,Tc,Ot
Caaroo	*Ficus sur* Forssk.	Cn,Tc
Caggoo	*Maesa lanceolata* Forssk.	Cn,Ot
Caphero(Ooppo)*		Tc,Fn Ot
Ciko	*Oncoba routledgei* Sprague	Cn,Ot
Coqimato	*Dracaena afromontana* Mildbr.	Cn,Fn,
Daamakasho	*Ocimum lamiifolium* Hochst. ex Benth.	Md
Daammo	*Ocimum gratissimum* L.	Md
Dangirettoo	*Vernonia auriculifera* Hiern	Cn,Md
Diibo	*Rothmannia urcelliformis* (Hiern) Robyns	Cn,Tc
Diidoo	*Galiniera saxifraga (Hochst.) Brids.*	Cn,Tc,Ot
Di'oo	*Cordia africana* Lam.	Cn,Tc,Ot
Danjiwuxaamoo	*Hypericum quartinianum* A. Rich.	Cn
Doo'iroo	*Solanecio gigas* (Vatke) C.Jeffrey	Fn,Md
Dupphoo	*Embelia schimperi* Vatke	Md
Eeppoo	*Ensete ventricosum* (Welw.) Sheeseman	Af,Ot
Emoo	*Dracaena fragrans* (L.) Ker-Gawl.	Cn,Fn
Gaattoo	*Cucurbita sp.*	Af

Table 2 contd...

Gabo*		Cn,Ot
Gachoo	*Euphorbia ampliphylla* Pax	Cn,Tc
Garoo (1)	*Caesalpina decapetala* (Roth.) Alston	Fn
Garoo (2)	*Rubus apetalus* Poir	Cn
Geeshoo	*Rhamnus prinoides* L'Herit	In
Girawoo	*Vernonia amygdalina* Del.	Cn,Af,Ot
Guccino	*Carduus leptacanthus* Fresen.	Md
Hawuttoo	*Jasminum abyssinicum* Hochst. ex DC.	Cn,Ot
Hinnimaacho*		Cn
Hupphichoo (1)	*Laggera crispata* (Vahl) Hepper & Wood	Sp
Imaamoo	*Urera hypselodendron* (A.Rich.) Wedd.	Md
Imbriccoo	Clausena anisata *(Willd.) Hook.f. ex Benth.*	*Cn,Ot*
Kareshoo	*Polyscias fulva* (Hiern) Harms	Cn,Tc,Ot
Koomoo	*Schefflera volkensii* (Eng.) Harms	Fn,Tc
Mengirexxoo	*Vepris dainellii* (Pichi-Serm.) Kokwaro	Cn,Md
Moggeccoo	*Triumfetta brachyceras* K. Schum.	Af,Ot
Naccee qomboo*		Cn,Ot
Naxxaachoo	*Rytigyna negelecta* (Hiern) Robyns	Cn,Ot
Nuuqqishoo	*Brucea antidysenterica* J.F. Mill.	Md
Ofiyoo (Ogiyoo)	*Aframomum corrorima* (Braun) Jansen	Sp,Md
Oomo	*Prunus africana* (Hook.f.) Kalkm	Cn,Tc,Ot
Orooroo	Ekbergia capensis Sparm.	Cn,Tc,Ot
Qammoo	*Rhus ruspolii* Engl.	Cn
Qareroo	*Pouteria adolfi-friedericii* (Engl.) Rob. & Gilb.	Cn,Tc,Ot
Qawoo	*Hippocratea goetzei* Loes.	Cn
Shakkeroo	*Macaranga capensis* (Baill.) Sim	Cn
Shauwkkoo*		Cn,Ot
Sheddo	*Sapium ellipticum* (Krauss) Pax	Cn,Ot
Shee'oo	*Allophylus abyssinicus* (Hochst.) Radlk.	Cn
Sheeshinoo	*Didymochlaena truncatula* (Sw.) J. Sm.	Cn,Ot

Table 2 contd...

Shengaaroo	*Teclea nobilis* Del.	Cn,Tc
Shero	*Hibiscus berberidifolius* A.Rich.	Ot
Shigiyoo	*Chionanthus mildbraedii*	*Cn*
Shikko	*Maytenus gracilipes* (Welw. ex Oliv.) Exell	Cn
Shinaatoo	*Arundinaria alpina* K.Schum.	Cn
sholloo	*Pittosporum viridiflorum* Sims	Cn,Md
Shoobbo	*Lantana trifolia* L.	Cn
Tugo	*Tacazzia apiculata* Oliv.	Cn,Ot
Turffoo	*Piper capense* L.f.	Sp
Ufoo(1)	*Celtis gomphophylla* Bak.	Cn,Ot
ufoo(2)	Asparagus africanus *Lam.*	*Ot*
Waagoo	*Croton macrostachyus* Del.	Cn,Md,Tc
Wogaammo	*Ehretia cymosa* Thon.	Cn,Tc
Wuhaabo	*Grewia ferruginea* Hochst ex A.Rich.	Cn,Tc
Xehoo (Eho)	*Ricinus communis* L.	Cn,Ot
Xigaagoo	*Ficus thonningii* Blume	Fn
Xiixidibboo	*Canthium oligocarpum* Hiern	Cn
Xumo	*Premna schimperi* Engl.	Cn,Md
Yahoo	*Olea welwitschii* (Knobl) Gilg & Schell.	Cn,Tc
Yajjno	*Apodytes dimidiata* E. Mey ex Arn.	Cn
Yebboo	*Phoenix reclinata* Jacq.	Cn,Tc,Ot
Yeemo	*Landolphia buchananii* (Hall. f.) Stapf	Cn,Ot
Yinoo	*Syzygium guineense* (Willd.) DC.	Cn,Ot
Yuddo	*Dracaena steudneri* Engler	Af,Ot
Yumbraa'o	*Momordica foetida* Schumach.	Ot
Zaytuunoo	*Psidium guajava* L.	Fd

Table 3 Useful plants encountered in the *Guudo* (' intact' forest) and their use. Symbols represent plant use: Af,Animal feed; Cn,Construction; Fn, Fence;Hd,Hot-drink; In, Income; Md,Medicinal; Sp, Spice; Tc, Technological and crafts; Ot, Others. * Sterile specimens that could not be identified.

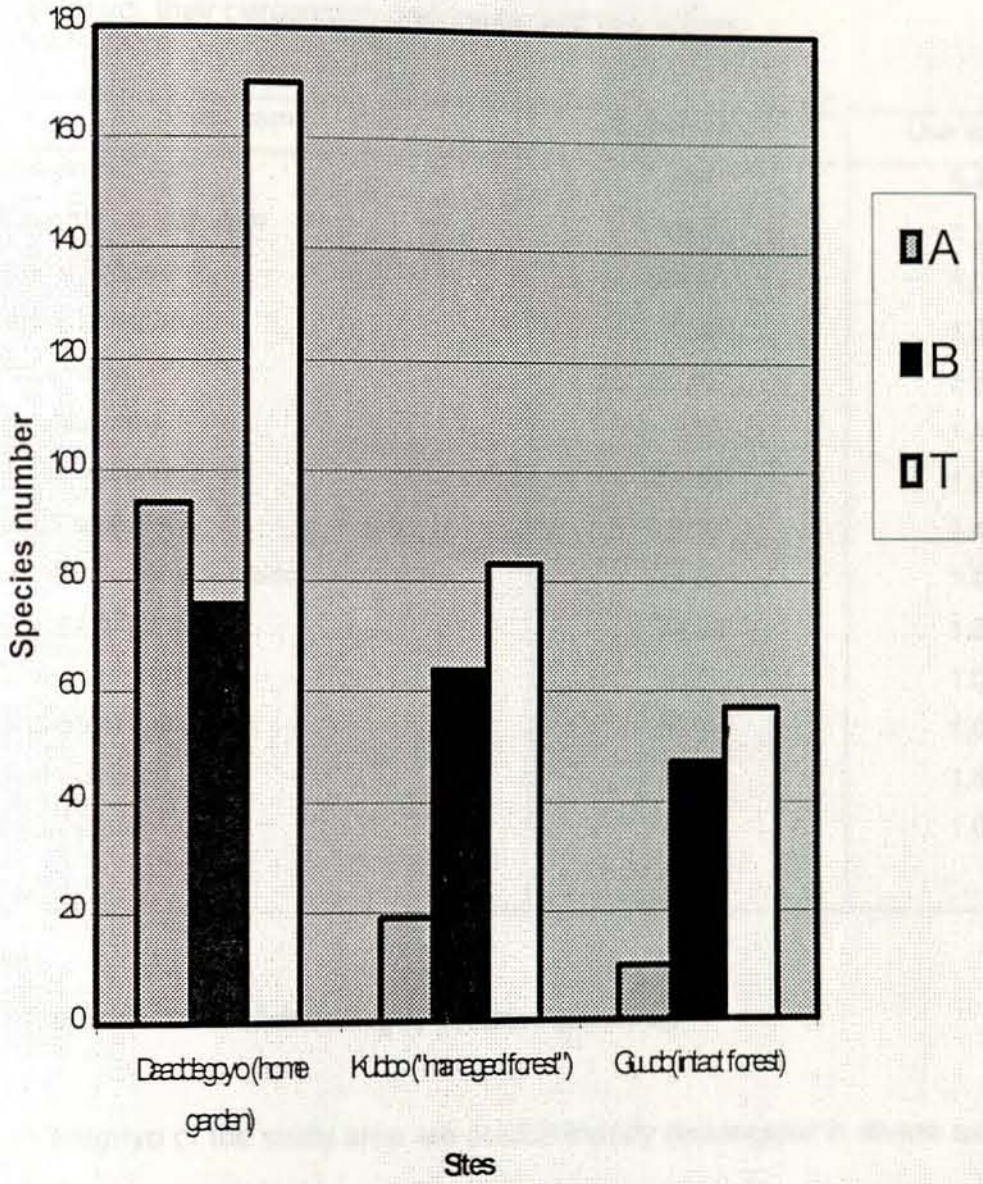
VERNACULAR NAME (In Kafinoono)	SCIENTIFIC NAME	Plant use
Aa'imato	*Psychotria orophilea* Petit	Cn,Tc
Baggoo*		Ot
Bibberoo	*Millettia ferruginea* (Hochst.)Bak.	Cn,Ot
Booqqoo	*Bersama abyssinica* Fresen.	Cn,Tc,Ot
Bnoo	*Coffea arabica* L.	In,Hd
Butoo	*Schefflera abyssinica* (Hochst. ex A. Rich.) Harms.	Tc,Cn,Ot
Caaroo	*Ficus sur* Forssk.	Cn,Tc
Caggoo	*Maesa lanceolata* Forssk.	Cn,Ot
Caphero(Ooppo)	*Ficus sp.*	Tc,Fn,Ot
Coqimato	*Dracaena afromontana* Mildbr.	Cn,Fn
Dangirettoo	*Vernonia auriculifera* Hiern	Cn,Md
Diibo	*Rothmannia urcelliformis* (Hiern) Robyns	Cn,Tc
Diidoo	*Galiniera saxiferaga (Hochst.)Brids.*	Cn,Tc,Ot
Di'oo	*Cordia africana* Lam.	Cn,Tc,Ot
Dupphoo	*Embelia schimperi* Vatke	Md
Emoo	*Dracaena fragrans* (L.) Ker-Gawl.	Cn,Fn
Gaattoo	*Cucurbita sp.*	Af
Gabo*		Cn,Ot
Gacho	*Euphorbia ampliphylla* Pax.	Cn,Tc
Garoo(2)	*Rubus apetalus* Poir.	Cn
Hawuttoo	*Jasminum abyssincum* Hochst ex Dc.	Cn,Ot
Imbriccoo	*Clausena anisata* (Willd.) Hook.f. ex Benth.	*Cn,Ot*
Koomoo	*Schefflera volkensii* (Engl.) Harms	Fn,Tc
Naache buuxo	*Pentas lanceolata* (Forssk.) Defl.	Md
Nacce qombo		Cn,Ot
Naxxaachoo	*Rytigyna neglecta (Hiern) Robyns*	*Cn,Ot*
Ofiyoo (Ogiyoo)	*Aframomum corrorima* (Braun) Jansen	Sp,Md

Table3 contd...

Oomo	*Prunus africana* (Hook.f.) Kallkm.	Cn,Tc,Ot
Orooroo	*Ekbergia capensis* sparm.	Cn,Tc,Ot
Qareroo	*Pouteria adolfi-friedericii* (Eng.) Rob.& Gilb.	Cn,Tc,Ot
Qato*		Cn
Qawoo	*Hippocratea goetzel* Loes.	Cn
Shaahiyo	*Lepidotrichilia volkensii* (Guerke) Leroy	Cn
Shakkeroo	*Macaranga capensis* (Baill.) Sim	Cn
Shawukkoo*		Cn,Ot
Sheddo	*Sapium ellipticum* (Krauss) Pax	Cn,Ot
Shee'oo	*Allophylus abyssinicus* (Hochst.)	Cn,Tc
shigyoo	*Chionanthus mildbraedii* (Gilg & Shell.) Stern	*Cn*
Shikko	*Maytenus gracilipes* (Welw. ex oliv) Exell	*Cn*
shinaatoo	*Arundinaria alpina* K.Schum.	Cn
Sholloo	*Pittosporum viridiflorum* Sims	Cn,Md
Tojjoo	*Peponium vogelii* (Hook.f.) Engl.	Md
tugo	*Tacazzia apiculata Oliv.*	*Cn,Ot*
Turffoo	*Piper capense* L.f.	Sp
Ufoo(2)	*Asparagus africanus* Lam.	Ot
Waagoo	*Croton macrostachyus* Del.	*Cn,Tc*
wogaammo	*Ehretia cymosa* Thonn.	Cn,Tc
Wundifo	*Apodytes dimidiata* E.Mey.ex Arn.	Cn
Xiidibboo	Canthium oligocarpum *Hiern*	Cn
Yahoo	Olea welwitschii *(Knobl.) Gilg &Schell.*	*Cn,Tc*
Yajjino	*Apodytes dimidiata* E.Mey ex Arn.	Cn
Yebboo	*Phoenix reclinata* Jacq.	Cn,Tc,Ot
Yeemo	*Landolphia buchananii* (Hall.f.) Stapf	Cn,Ot
Yinoo	*Syzygium guineense* (Willd.) DC.	Cn,Ot
Yuddo	*Dracaena steudneri* Engler	Af,Ot

Table 4 Ten plant species with the highest relative frequency of occurence in sample plots of the 3 systems

Plant Scientific Name	Relative % frequency		
	Daaddegoyo	*Kubbo*	*Guddo*
Coffea arabica	67	64	67
Millettia ferruginea	29	82	50
Bersama abyssinica	24	64	83
Maesa lanceolata	19	82	50
Prunus africana	33	27	57
Olea welwitschii	24	45	67
Phoenix reclinata	19	73	67
Vernonia auriculifera	48	45	17
Cordia africana	43	55	17
Dracaena fragrans	38	18	50



Fifg. 4 Proportion of plant species used for different purposes from the three land use systems. A: plant species used in the local diet and medicinal; B: plant species used for other purposes; T: total number of species.

Table 5 Plant species, which were mentioned by farmers as the most important crops in the daddegoyo, their percentage preference and use values.

Plant name	% preference	Use value
Ensete ventricosum	100	5.4
Xanthosoma sagittifolium	66.7	1.1
Brassica oleracea	57.14	1.0
Capsicum annuum	52.38	1.0
Coffea arabica	47.62	1.5
Brassica carinata	33.33	1.1
Colocasia esculenta	33.33	1.0
Cucurbita pepo	28.57	1.4
Dioscorea caynensis-rotundata complex	28.57	1.0
Saccharum officinarum	14.29	1.2
Phaseolus vulgaris	9.52	1.0
Coccinia abyssinica	4.76	1.0
Musa paradisiaca	4.76	1.5
Ipomoea batatas	4.76	1.0

5.3 *The structure of* daaddegoyo *(home gardens)*

The *daaddegoyo* of the study area are predominantly rectangular in shape except for a very few ones with a somewhat circular shape. There is a considerable variation in size among the *daaddegoyo*: the minimum size encountered during the study was 816m^2, the maximum 6000m^2 , while the average being 2774m^2(see Table 6).

Table 6 Shape and Size of *Daaddegoyo* (home gardens).

Village name	*Daaddegoyo* No.	Shape	Size(m^2)	Mean size (m^2)
Gidi	1	Rectangular	3025	1999.3
	2	"	2508	
	3	"	1400	
	4	"	816	
	5	"	2365	
	6	"	1680	
	7	"	2200	
Kayakella	8	Rectangular	4774	3283.3
	9	"	3128	
	10	"	5000	
	11	"	1964	
	12	"	6300	
	13	"	1000	
	14	"	817	
Mera	15	Rectangular	4200	3023
	16	"	6000	
	17	Circular	1257	
	18	Rectangular	2475	
	19	"	2800	
	20	Circular	2829	
	21	Rectangular	1660	
Average				2774m^2

In the *daaddegoyo*, annuals, herbaceous perennials and woody perennials are grown in mixture giving it a complex architecture.

The vertical structure consists of an upper, a middle and a lower layer (though the stratification is not clear-cut), a ground cover and some emergents. The upper layer is made by plants of 4-6m in height such as *Ensete ventricosum, Musa paradisiaca, Cordia africana* and *Milletia ferruginea*. Plants that are 2-3.5m in height form the middle layer and these include *Coffea arabica, Rhamnus prinoides, Saccharum officinarum, Vernonia amygdalina, Cyphomandra betacea, Vernonia auriculifera* and *Ricinus communis*. The lower layer consists of plants that grow up to 2m high and these include *Xanthosoma sagittifolium, Colocasia esculenta,* Capsicum annuum, *Ruta Chalepensis, Ocimum basilicum, Brassica oleracea, Brassica carinata, Foeniculum vulgare, Nicotiana tabacum and Coriandrum sativum.* Trailing plants like *Cucurbita pepo, Ipomoea batatas, Lagenaria siceraria;* and other plants of small stature such as *Thymus schimperi, Celosia trigyna* and *Artemisia afra* cover the ground. It is common to find emergents which reach 10-20 m in the *daaddegoyo* and some of these are *Ficus sur, Cordia africana, Erythrina brucei, Ficus thoninggii, Dracaena steudneri and Phoenix reclinata.* The main climbers in the *daaddegoyo* are *Dioscorea sp, Coccinia abyssinica, Phaseolus lunatus, and Lablab purpureus.*

Fig 5 Sketch showing a view of the *Daaddegoyo* (home garden) from the back of the living house

The horizontal arrangement of plants in the *daaddeegoyo* follows a certain pattern though this may not be evident at a first sight. The home garden area is divided into parts with reference to the living house. Cattle are penned on the downhill side of the house, and a channel is cut in the ground to take the urine and droppings out; and this part of the garden is called *Boochoo.* The clean, plantless front side of the house is called Godo, and the remaining part of the garden is known as *Daaddo.* Plants like *Nicotiana tabacum, Coffea arabica, Ensete ventricosum* are planted close to the manure heap. Medicinals and spices such as *Ocimum basilicum, Ruta chalepensis, Coriandrum sativum, Cymbopogon citratus, Artemisia absinthium, and Foeniculum valgare* are planted close to the house on the clean side. Climbers such *as Lablab purpureus, Phaseolus lunatus, Coccinia abyssinica and Dioscorea sp.* are planted on either side of the pathway on the front side, and plants like *Xanthosoma sagittifolium, Colocasia esculenta, Brassica oleracea* are arranged next to them. The largest portion of the garden is planted with *enset* forming an *enset* - grove with some random interplanting. *Musa paradisiaca* is always planted close to the fence and a piece of land is deliberately left to make a gap between it and the *enset*-grove. The fence is made mainly by live plants of which *Dracaena fragrans, Erythrina abyssinica, E.brucei, Caesalpina decapetala, Vernonia auriculifera* and *Euphorbia ampliphylla* are the most common. The number of crop plant species in the garden is inversely related to distance from the house to the edge of the garden (see Fig..6).

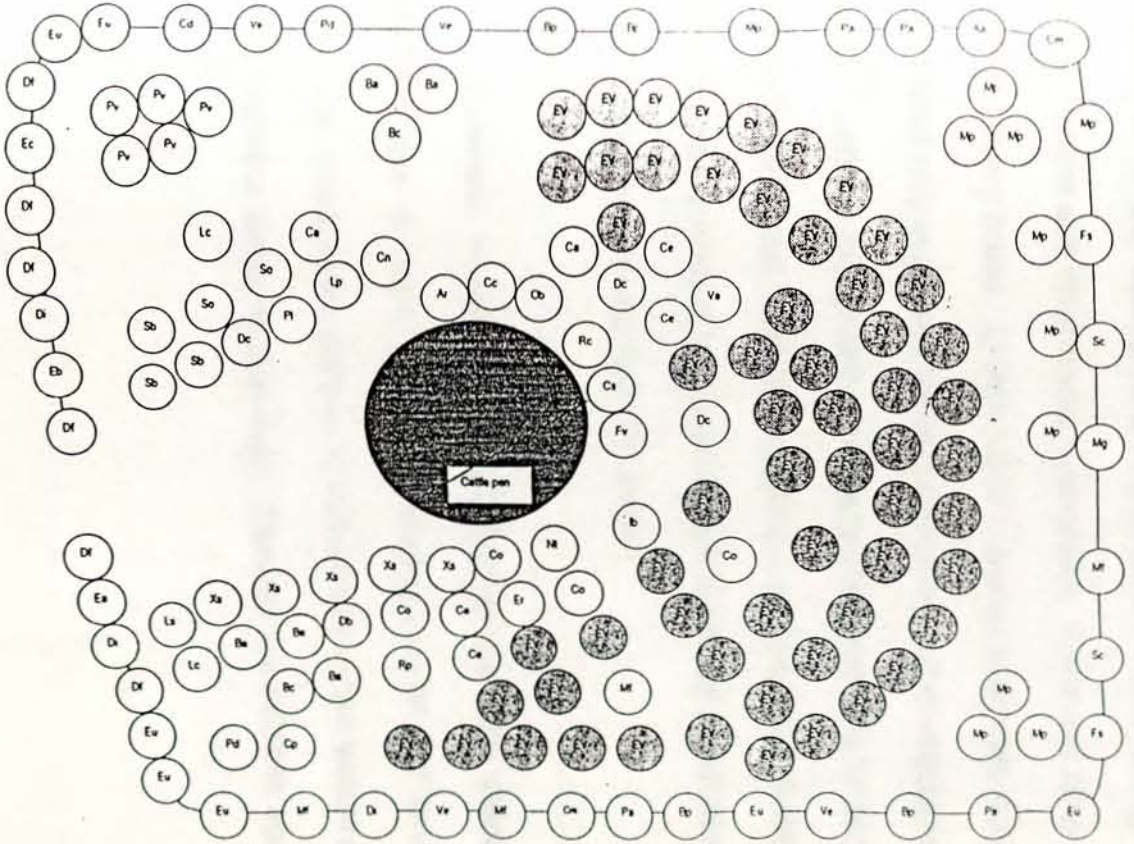


Fig. 6 Horizontal structure of the *Daaddegoyo* (home garden)

Symbols representing plants in *Daddegyoo*

Df	*Dracaena fragrans*	Cc	*Cymbopogon citratus*
Eb	*Erythrina brucei*	Rc	*Ruta chalepensis*
Di	*Datura innoxia*	Ob	*Ocimum basilicum*
Ec	*Euphorbia cottonifolia*	Cs	*Coriandrum sativum*
Ea	*Euphorbia ampliphylla*	Fv	*Foeniculum vulgare*
Cd	*Caesalpina decapectala*	Nt	*Nicotiana tabacum*
Pd	*Pytolacca dodecandra*	Co	*Coffea arabica*
Va	*Vernonia auriculifera*	Xs	*Xanthosoma sagittifolium*
Bp	*Buddleja polystachya*	Ls	*Lagenaria siceraria*
Mg	*Maytenus gracilipes*	Ba	*Brassica oleracea*
Pa	*Pycnostachys abyssinicus*	Bc	*Brassoca carinata*
Aa	*Allophylus abyssinicus*	Db	*Dioscoria bulbifera*
Cm	*Croton macrostachyus*	Re	*Ricinus communis*
Fs	*Ficus sur*	Ib	*Ipomoea batatas*
Mf	*Millettia ferruginea*	Ce	*Colocasia esculenta*
Ea	*Erythrina abyssinica*	Va	*Vernonia amygdalina*
Sb	*Sorghum bicolor*	Rp	*Rhamus prinoides*
Dc	*Dioscorea cayenensis-rotundata*	Ca	*Capsicum annum*
Pl	*Phaseolus lunatus*	So	*Saccharum officinarum*
Lp	*Lablab purpureus*	Pv	*Phaseolus vulgaris*
Ca	*Coccinia abyssinica*	Ev	*Ensete ventricosum*
Aa	*Artemisia afra*	Mp	*Musa paradisiaca*

5.4 *Management practices in* daaddegoyo

A number of management practices are performed in the *daaddegoyo*, and one of which is the endeavor to maintain as high as possible plant types in the garden. High diversity of plant species in the *danddegoyo* is achieved through planting and protecting annual and perennial herbs, and woody perennials in mixture. From the home gardens studied, a total of 170 plant species were recorded, the maximum number of plant species in a *daagegoyo* being 59 and the minimum 28.

Soil fertility in the *daaddegoyo* is maintained mainly through the incorporation of animal manure and other house hold wastes. Cattle and other small stock are found in almost every house. Unless found in excess quantities, dung from sheep and got is sprinkled only in corners where cabbage and other vegetables are cultivated - and this is to achieve fast growth of the vegetables and also for sanitary reasons. Plants like *Erythrina brucei, Milletia ferruginea* and *phytolacca dodecandra* are praised by farmers to be important in increasing soil fertility and maintaining soil moisture, and therefor encouraged to grow in the garden.

Crop protection involves practices such as weeding, placing plants in specific locations, use of traps, scarecrows/scaring sounds and fences. A locally made xylophone, which helps children to remain alert when watching out for large animal pests from the forest, is also used. Farmers are helpless against the bacterial wilt

that attacks *enset* and causes a heavy crop loss. In an attempt to prevent the establishment and spread of this disease, farmers perform different practices that range from religious rituals to elimination of an infected *enset* plant. An ant's nest is placed in grain-stores to prevent post harvest damage by rats. Methods to preserve seeds for future use include smoking and thoroughly mixing with ash, animal manure, or a powder from *Croton macrostachyus*.

Crop selection is the other practice performed in the *daaddegoyo*. Yield quality and quantity, time length required from planting to harvesting, resistance to diseases and drought and some socio-cultural reasons are the farmers' criteria for selection.

Farmers also perform practices such as propagation, thinning, transplanting and harvesting. Although there exist some practices such as harvesting which are mainly carried by women, and specific women's corners like the immediate back of the house, both heads of a household are involved in managing the gardens.

5.5 Vegetation classification

Five clusters can be recognized from the SYNTAX output (Fig 7) which is based on composition and cover-abundance of species, at dissimilarity level above 0.4. The clusters encompass 19 of the 21 releves, and the remaining two stood by themselves. Each cluster is named after the genera of species, which have the highest cover abundance value. Each community type is described as follows:

1. *Ensete-Xanthosoma* community: *Ensete ventricosum* (Welw) Cheesman and *Xanthosoma saggitifolium* (L.) Schott dominate this community. *Capsicum annum* L., *Brassica carinata* A.Br., *Coffea arabica* L., *Lablab purpureus* (L.) Sweet and *Ocimum basilicum* L. are also abundant. This community type occurs in Kayakella village.

2. *Ensete-Coffea* community: The dominant species of this community type are *Ensete ventricosum* (Welw) Cheesman and *Coffea arabica* L. *Brassica carinata* A.Br., *Brassica oleracea* L., *Colocasia esuculenta* (L.) Schott and *Xanthasoma saggitifolium* (L.) Schott are also abundant. This community type is confined to Gidi village.

3. *Ensete-Brassica* community: *Ensete ventricosum* (Welw) Cheesman and *Brassica carinata* A.Br. are the dominant species of this community. *Brassica oleracea* L. and *Colocasia esculenta* (L.) Schott are also abundant. *Coffea arabica* L., which is found in all the rest community types, is absent. This community type is found in Mera village.

4. *Ensete-Xanthasoma-Saccharum* community: *Ensete ventricosum* (Welw) Cheesman, *Xanthosoma saggitifolium* (L.) Schott and *Saccharum officinarum* L. dominate this community type. *Brassica oleracea* L. and *Coffea arabica* L. are also abundant. This community occurs in two of the study sites; Kayakella and Gidi villages.

5. *Ensete-Xanthosoma-Nicotiana* community: The dominant species of this community are *Ensete ventricosum* (Welw) Cheesman, *Xanthosoma saggitifolium* (L.) Schott and *Nicotiana tabacum* L. *Coffea arabica* L. and *Colocasia esculenta* (L.) Schott are also abundant. This community type is found in Kayakella village.

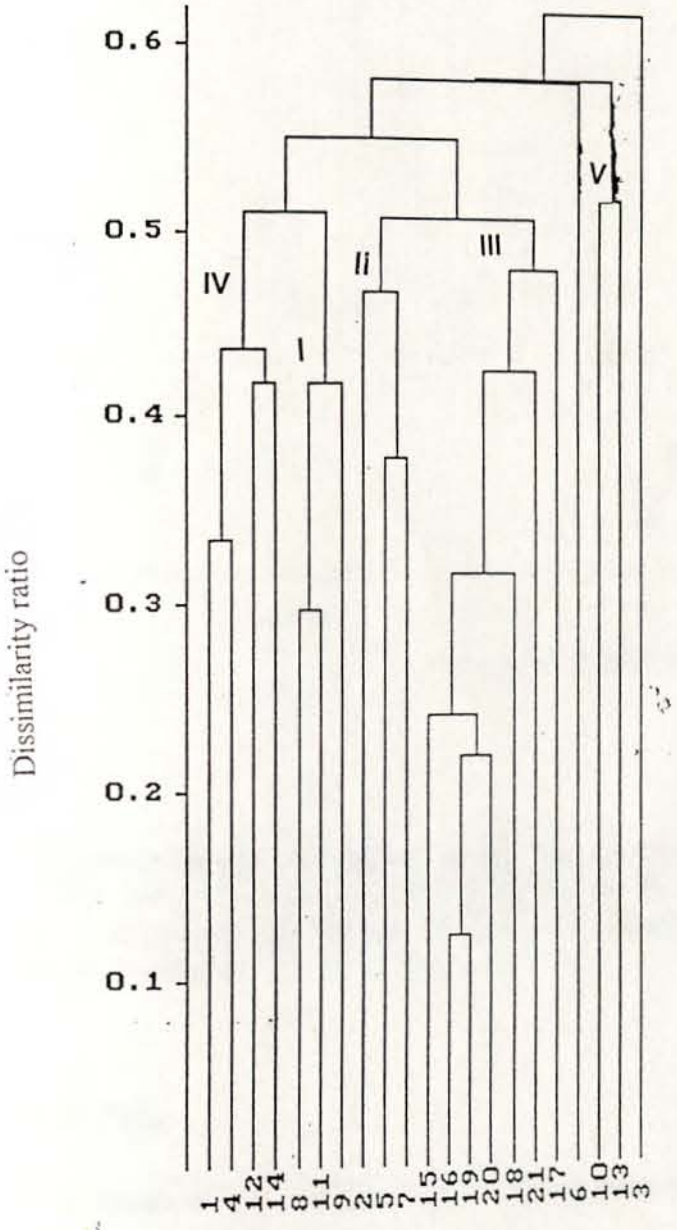


Fig. 7 Dendrogram of the releve group of *Daaddegoyo* (home gardens).

Numbers desiginate community type.

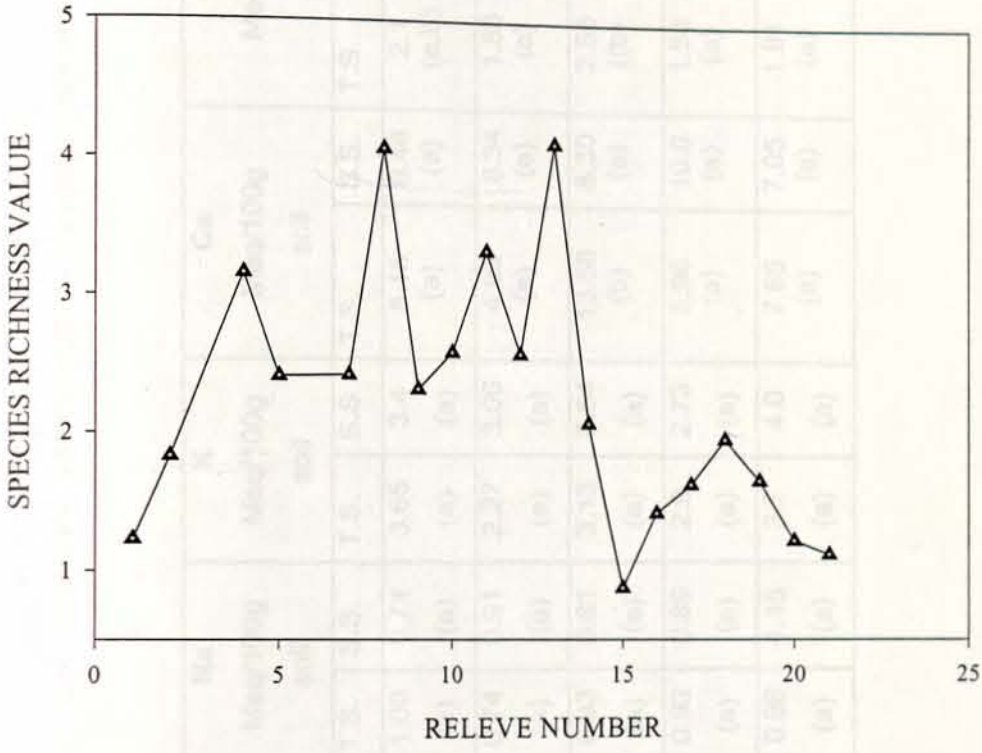


Fig.8 Species richness of releves of the five community types [Releve 8, 9, 11 (Community 1), Releve 2, 5, 7 (Community 2), Releve 15, 16, 17, 18, 19, 20, 21 (Community 3), Releve 1, 4, 12, 14 (Community 4), and Releve 10, 13 (Community 5)].

5.6 Soil Data

The result of the ANOVA test of comparison of soil properties indicated that the soils of the 5 communities differed only on 5 of the parameters: Ca, Mg, Cation exchange capacity (CEC), total nitrogen and organic carbon content.Table7 shows the soil test results.

Table 7 Comparison of mean values of the soil chemical properties among five plant communities. EC, electrical conductivity; CEC, Cation exchange capacity; Bas. Sa., base saturation; T.N., total nitrogen; Av.P., available phosphorous; T.S., top soil; S.S., sub soil. Two values under the same column that do not have a common letter in parenthesis are siginificantly different. (ANOVA, P<0.05)

COMMUNITY	P^H		EC (ds/m)		Na Meq/100g soil		K Meq/100g soil		Ca Meq/100g soil		Mg Meq/100g soil	
	T.S.	S.S.	T.S.	S.S.	T.S.	S.S.	T.S.	S.S	T.S.	S.S.	T.S.	S.S.
Ensete-Xanthosoma	6.75 (a)	6,31 (a)	0.09 (a)	0.09 (a)	1.00 (a)	0.71 (a)	3.65 (a)	3.4 (a)	6.15 (a)	6.48 (a)	2.1 (a,b)	1.95 (a)
Ensete-Coffea	5,89 (a)	5.97 (a)	0.06 (a)	0.06 (a)	0.74 (a)	0.91 (a)	2.27 (a)	3.06 (a)	4.99 (a)	.6.34 (a)	1.88 (a)	2.16 (a)
Ensete-Brassica	6.23 (a)	6.62 (a)	0.07 (a)	0.10 (a)	0.93 (a)	0.81 (a)	3.13 (a)	2.54 (a)	13.58 (b)	8.30 (a)	2.65 ((b)	1.90 (a)
Ensete-Brassica- Saccharum	6.45 (a)	6.2 (a)	0.06 (a)	0.05 (a)	0.93 (a)	0.89 (a)	2.9 (a)	2.73 (a)	5.96 (a)	10.0 (a)	1.58 (a)	1.59 (a)
Ensete-Xanthosoma-Nicotiana	6.86 (a)	6.60 (a)	0.08 (a)	0.05 (a)	0.98 (a)	1.15 (a)	3.7 (a)	4.0 (a)	7.68 (a)	7.05 (a)	1.91 (a)	1.69 (a)

Table. 7 contd...

COMMUNITY	CEC Meq/100g soil		Bas.Sa (%)		T.N. (%)		O.C. (%)		C/N -		Av.P. ppm	
	T.S.	S.S.	T.S.	S.S.	T.S.	S.S.	T.S.	S.S	T.S.	S.S	T.S.	S.S.
Ensete-Xanthsoma	23.0 (a)	19.25 (a,c)	55.0 (a)	56.5 (a)	0.42 (a,b,c, e)	0.14 (a)	3.21 (a,b)	1.14 (a)	8.0 (a)	7.0 (a,b, c)	42.6 (a)	8.85 (a)
Ensete-Coffea	27.0 (a)	25.1 (a)	37.5 (a)	49.5 (a)	0.18 (d)	0.22 (a)	1.81 (a)	1.69 (a,b)	9.5 (a)	.8.0 (a,b, c)	14.0 (a)	17.42 (a)
Ensete-Brassica	36.9 (b)	30.66 (b)	54.8 (a)	44.0 (a)	0.53 (e)	0.34 (a)	4.74 (b)	3.16 (b)	8.7 (a)	9.33 (b)	53.0 (a)	16.96 (a)
Ensete-Brassica- Saccharum	27.2 (a)	27.3 (b,d)	43.0 (a)	56.0 (a)	0.33 (a,b,c, d)	0.25 (a)	2.83 (a)	1.79 (a,b)	8.5 (a)	7.5 (a,b, c)	50.8 (a)	10.58 (a)
Ensete-Xanthosoma-Nicotiana	24,6 (a)	23.73 (a)	57.7 (a)	57.66 (a)	0.39 (a,b,c)	0.16 (a)	3.05 (a)	0.93 (a)	8.0 (a)	5.6 (.c)	41.2 (a)	6.87 (a)

6. DISCUSSION

6.1 *Floristic diversity of the* daaddegoyo

Biological diversity is a cardinal trait of traditional home gardens (Brownrigg, 1985). This fact is well confirmed by the occurrence of 170 plant species in the 21 *daaddegoyo* studied, with a total area of 58256 m^2 (less than 6 ha). This number of plant species can be compared to an earlier record (139 species of vascular plants from the tree, shrub and field layers) from a study on 6 forests of southwestern Ethiopia (Kumelachew Yeshitila, 1997). The result, therefore, indicates that the species richness of traditional home gardens can reach to that comparable to natural forests.

The occurrence of such high number of plant species in the *daaddegoyo* resulted from the farmers' attempt to have as much as high crop plant diversity in their gardens. This need of maintaining high plant diversity in the home garden stems from objectives such as self sufficiency in producing almost all products required for subsistence, minimizing crop loss from hazards, producing diverse food products that meet the nutritional demands of the household, and the need to have something harvestable throughout the year.

Plant diversity in the *daaddegoyo* is optimized in two ways: by a continuous introduction of new plant species, and by protecting those which grow by themselves. There is a flow of diversity into the *daaddegoyo* from different

sources: market, neighborhood, managed forest (*Kubbo*), intact forest (*Guudo*), schools and other institutions. Since home gardens are observation plots for farmers (Soleri and Cleveland, 1989; Gillespic *et al.*, 1993), different plant types are introduced into them.One successful story is that *of Xanthosoma sagittifolium* which was introduced some 10-15 years ago, and now became a dominant species of the home garden vegetation. On the other hand, *Euphorbia cottonifolia* was introduced and used to be planted amid tuber crops for its supposed effect against moles that attack enset tubers, but later on it was discovered that the plant has no effect on the animal pest and now it is used as a live fence.

Out of the 170 plant species encountered, 80 (47%) are not cultivated, but protected or tolerated. This is in agreement with the conventional wisdom that the concept of weeds is narrow in traditional agriculture (The NAVDANYA Team, 1993). Each of these protected/ tolerated plant species has a specific function such as medicinal, shade providing, maintaining soil fertility, or as a live fence. Out of the 80 protected/ tolerated plants, 39 (48.81%) are integrated to the live fences.

Placing plants in their proper niches in the garden has also contributed to the existing high plant diversity because this facilitates the establishment and success of a species. The Kafichos have a detailed knowledge with regard to this. For example, they plant leafy vegetable in the part of the garden where sunlight reaches the ground surface, coffee under shade, *Aframomum* arround tree bases and young *enset* plants in areas where the soil fertility is high.

Banana plants are located close to the edge of the garden so that there is a gap between them and *enset* plants. There are two reasons behind this. One reason is that the rapidly expanding banana plant can severely affect the growth of *enset* by competing for space and nutrients. The other reason is that the rhizomes of banana plants provide an ideal hiding site for *enset* attacking moles making the task of locating them difficult during hunting. Therefore, farmers always try to keep banana plants away from *enset* and create a buffer zone.

The *daaddegoyo* shares 55 useful plant species with the managed forest and 36 species with the intact forest in common, and 33 species are common to all three (Tables 1,2 and 3). This shows that the managed forests are close to the home gardens in species composition. This is attributed to their relative proximity and some management practices

Out of the 33 plant species common to the three systems, *Coffea arabica, Milletia ferruginea, Bersama abyssinica, Maesa lanceolata* and *Prunus africana* were found to exhibit the highest frequency of occurrence in the sample plots of each system (Table 4). This indicates that the mentioned species are the basic elements that form the close link among the systems.

Coffea arabica occurred at about the same frequency in the sampled plots of the three systems and this shows the extent to which it grows wild in the area. Species such as *Cordia africana, Vernonia auriculifera* and *Millettia ferruginea* had a greater frequency in both or either of the *daaddegoyo* (home garden)

and *Kubbo* ('managed forest) than the *Guudo* ('intact forest'), and this is related to the growth habit of the species and the attention given to them by farmers because of their specific uses.

The number of plant species used in the local diet and as medicinal is 94 (55.3% of the total) in the *daaddegoyo*, 19 (22.9% of the total) in the *Kubbo*, and 10 (17.5% of the total) in the Guudo (Fig.4). This result clearly shows the attempts farmers have been making to concentrate plants of immediate need close to the living quarter ensuring easy access.

The number of plant species recorded from a home garden ranged fom 28-59. The total number of plant species encountered in the study (170) is comparable to the total of 168 species reported from 21 home gardens in Santa Rosa (Peru) by Padoch and de Jong (1991). The total number of species per village showed a decrease with an increase in altitude, i.e.120 species were recorded from Kayakella village (1760m a.s.l.), 111 species from Gidi village (1870m a.sl.) and 92 species from Mera village (2210m a.s.l.). Similar results were reported by Christianity (1990) from the study made on fruit tree species of home gardens of west Java (Indonesia). Zemede Asfaw and Ayele Nigatu (1995) also reported a greater number of crop plant species from the home gardens of 'weyna-dega' agroecological zone than 'Dega' agroecological zone.

Though there is a decrease in the total number of plant species with increasing altitude, the ANOVA test result (P = 0.104, at 0.05 level of

significance) confirms that there is no significant difference among the mean numbers of plant species of the home gardens of the three villages. This shows the farmers' tendency of incorporating as many as possible useful plants from the available diversity in the locality.

6.2 *Vegetation structure of the daaddegoyo.*

In all of the community types *Ensete ventricosum* is the predominant species and this is attributed to the priority given to plant the species because of the major role it plays in fulfilling the subsistence needs .Its use value was found to be 5.4 (siginificantly higer than that of the other plants) and it is the most important plant of the daaddegoyo (Table 5).

Community 1 (*Ensete-Xanthosoma* community), which consists of releves 8, 9, and 11 (all from Kayakella village), occurs on soils of neutral p^H. This community is characterized by *Xanthosoma sagittifolium* that stands second in cover abundance. This species is reported to have been introduced to the area from Mizan Tefferi in recent years. The success of this species to dominance in this site (unlike the other two villages) could be attributed to an earlier introduction and similarities in ecological conditions of the source and recepient localities.

Releves 2, 5 and 7 (all from Gidi village) comprise community 2 (*Ensete-Coffea* community) that occurs on slightly acidic soils and characterized by *Coffea arabica* - a second dominant species of the community. Since farmers' of this village do not have their own managed forest (*Kubbo*), unlike those of

the other two, they are inclined to incorporate more coffee plants in their *daaddegoyo*.

Community 3 (*Ensete-Brassica* community) that consists of releves 15, 16, 17, 18,19, 20, and 21(all from Mera village) occurs on slightly acidic soils. This community differs from all the rest by the absence of *Coffea arabica*; exhibits the lowest averaged species richness value (see Fig.8), and has significantly higher values of exchangeable cations (Ca and Mg), total nitrogen and organic carbon and CEC. The absence of *Coffea arabica* must have been related to elevation since the species does not grow also in the forest (which is not the case in the other two villages of the lower altitudes). The low species richness value could also be explained in terms of altitude, and remoteness from Bonga town (limited access to planting material from market and other sources) could also be considered. The significantly higher values of exchangeable cations, nitrogen and CEC exhibited by the soil could be related to the higher organic matter conten of the soil (estimated from the value of organic carbon) that might have resulted from reduced mineralization due to the impact of low temperature.

Releves 1, 4, 12 and 14 (two from Kayakella and two from Gidi villages) comprise community 4 (*Enset-xanthosoma - Saccharum* community) that occurs on slightly acidic soil. *Sccharum officinarum* ranks third in cover abundance value in this community, and this seems to be caused by farmers' need to generate income. Since both of the villages where this community is found are located close to Bonga town at approximately equal distance,

farmers can sell some of the produce of the *daaddegoyo* and obtain money that would be used for household consumption.

Community 5 (*Ensete-Xanthosoma-Nicotiana* community) that consists of releves 10 and 13 (both from Kayakella village) occurs on soil of neutral p^H. *Nicotiana tabacum* ranks third in cover abundance values in this community and this is attributed to its use for smoking and medicine for cattle in both of the households. This community exhibited the highest value of species richness and this could be explained in terms of environmental suitability and closeness to Bonga town which permits access to planting materials from market and some institutions.

Two of the releves studied (releve 3 and 6) were found to be outllying groups. This seems to be related to sociolocial reasons. In releve 3, whose owner is a widow, the cover-abundance value of *Ensete ventricosum* is exceded by *Brassica oleracea* and equal to that of *Sorghum bicolor*. Releve 6 is a garden which was started only three years ago , and except enset most of the other species exhibited a proportional abundance.

6.3 Symbolism of the daaddegoyo *to the Kaficho people*

The *daaddeegoyo* provides a number of services to the local people: it is a source of food, medicine, construction materials, animal feed, and it is also a symbol of social status. For the Kaficho farmers, the *daaddegoyo* is the most important treasure. Whenever they are asked to choose between the daaddegoyo and the crop field, they always went for the former (though it is

significantly smaller in size). Some changes could be made on the structure and plant composition of the *daaddegoyo*, but as farmers strongly mention, converting it into other land use systems is unlikely (Fig.3)

Even though it is generally agreed that the evolution of tropical home gardens is closely related to resource constraints, mainly population pressure and a consequent reduction in available land (Nair, 1990; Thaman, 1990; Rugalema *et al.*, 1994), this does not appear to be the case in the study area where the current zonal population density is 66.6 persons/km (CSA, 1998). Instead, it might mainly be tied to the biological nature of *enset* such as its perenniality, vegetative propagation, drought resistance and the massive and diverse products it offers. The practice of planting *enset* as a first plant of the *daaddegoyo* whenever a new household settles on a newly cleared land can be taken as a supporting evidence for this speculation.

Enset makes the structural framework of the *daaddegoyo* unlike the home gardens in some parts of the world such as Maya (Mexico), West Java (Indonesia), and Santa Rosa (Peru) whose structural framework is made by fruit and other trees (Karyono, 1990; Padoch and de Jong, 1991; Caballero, 1992). Farmers mention up to 9 functions of enset and it is unanimously agreed that it is the most important plant of the *daaddegoyo*. This is reflected by its dominance in the garden and the high number of local varieties. The intimate association between the people and enset has led to the development of a kind of belief. For example, an *enset* plant felled by wind is never used as food because it is considered as a carcass; and it is taken as a bad omen

when the flower of *enset* points towards the house gate. Leaving *enset* in the garden until flowering (which takes 5-7 years) is taken as a sign of relative wealth, and the community respects an owner of such garden.

A wild relative of *enset* (which is locally called *eppoo*) grows close to the home garden. The wild-*enset* can easily be distinguished from the cultivated one by its cylindrical pseudostem, creamy-green leaf appearance, and the dark-staining juice. It is not used as a food and different stories are told in relation to this. However, its leaves are used for different purposes mainly during the drier period of the year. Farmers mention that seeds from a cultivated variety of *enset* can give rise to different varieties including the wild-*enset;* and during the study period a seedling which was mentioned as wild-*enset* was observed amidst several cultivated varieties that have germinated from fallen seeds of a cultivated variety. It was also observed that bees were visiting the flowers of both the wild and cultivated *enset*, and this lays the ground for speculating genetic exchange between the two forms.

8. CONCLUSION

The *daaddegoyo* is a stable agroecosystem that serves the function of fulfilling the majority of subsistence requirements of the Kaficho household. Biological diversity (specifically plant diversity) forms the foundation of this special quality of the *daaddegoyo*; and it occurs both at specific and infraspecific levels. For example, there exist quite a number of local varieties (clones) of enset and this signifies the role of *daaddegoyo* in harbouring genetic variability.

It is the intimate association between the local people and plants for generations that led to the occurrence of such diversity in the *daaddegoyo*. For the Kaficho people plant diversity is a resource that fulfils their material and spiritual requirements. In addition to providing food, the *daaddegoyo* serves as the drugstore of the family (out of the 170 species encountered, 34[23.5% of the total] are mentioned to have medicinal values). Local people hold genuine belief on the healing power of the plants and therefore not want to lose them. Trees such as *Ficus vasta* are revered for magico-religious reasons and protected in the surrounding. The protection of plant species even goes beyond the home garden area. For example, some section of the society uses poles only made from *Syzygium guineense* as the main supporting post of the house for cultural reasons. Therefore, members of this group mark and encourage individuals of this species in the wild. Similar protection is made for plant species on which farmers place beehives. All these processes have contributed and are contributing for conservation of diversity.

Farmers have an extensive knowledge of cultivated and wild plants. However, the knowledge on plants cultivated in the garden, particularly that on *enset* varieties and medicinals appears to be the domain of women. This indigenous knowledge, however, is currently under threat form the trend of modernization that undermines local knowledge.

Although the effect of recent introduction of new species on the floristic diversity of the *daaddegoyo* is not significantly felt at the moment, the potential danger of local extinction of some species and varieties is more likely. *Xanthosoma sagittifolium* and *Psidium guajava* (which are new to the area) are not only well established in the gardens but are also on the 'escape' to the wild; and they may cause far reaching effects. The recent introduction of more and more fruit trees such as *Mangifera indica* and *Persea americana* can lead to changes in the floristic composition of the *daaddegoyo*. However, the replacement of *enset* (that is responsible for the sustainability of the system) by any other plant is unlikely.

8. RECOMMENDATION

Since the *daaddegoyo* harbours diverse plant species and varieties, its role in the conservation of biodiversity is evident. Maintaining this traditional agro-ecosystem is a strategy for complementary *in situ – ex situ* conservation of biodiversity, and therefore it should be considered as a priority area of conservation.

If the erosion of the traditional knowledge (the knowledge that has been employed to conserve the existing biodiversity so far, and that could provide information about strategies for biodiversity conservation elsewhere) continues, a collapse of the *daaddegoyo* system is more likely. Therefore, there is an urgent demand for thorough study and documentation of indigenous knowledge.

The introduction of exotic species may lead to diminishing of biological diversity in the *daaddegoyo*. Therefore, concerned institutions, specifically the agricultural department that usually provides farmers with planting materials of species new to the area,and the biodiversity institute should estabilish a feedback mecanism that monitors the impact of exotic species.

The major constraint of production in the *daaddegoyo* is the loss caused by the bacterial wilt of *enset* and the attack by moles. These problems prevented the expansion of the *daaddegoyo* area. Research directed towards alleviating these problems is mandatory.

The wild-*enset* exhibits some important traits from production point of view such as resistance to diseases. These traits may be used for increasing the productivity of *enset* and researches that involve genetic analysis can contribute to that end.

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Appendix

Plants encountered in three land use systems (Daaddegoyo, Kubbo, Guudo) Arround Bonga.

Scientific name	Family name	Collection number
Aframomum corrorima (Braun) Jansen.	Zingiberaceae	0014
Albiza schimperiana Oliv.	Fabaceae	0051
Allium cepa L.	Alliaceae	
Allium sativum L.	Alliaceae	
Allophylus abyssinicus (Hochst.) Radlk.	Sapindaceae	0146
Amaranthus dubius Mart	Amaranthaceae	0028
Amaranthus hybridus L.	Amaranthaceae	0082
Ananas comosus (L) Merr.	Bromeliaceae	
Apodytes dimidiata E.Mey. ex Arn.	Icacinaceae	0147
Artemisia absinthium L.	Asteraceae	0156
Artemisia abyssinica Sch. Bip ex A.Rich.	Asteraceae	0077
Artemisia afra Jack. ex Wild.	Asteraceae	0120
Arundinaria alpina K. Schum.	Poaceae	
Asparagus africanus *Lam.*	Asparagaceae	0159
Bersama abyssinica Fresen.	Melianthaceae	0150
Beta vulgaris L.	Chenopodiaceae	
Bidens prestinaria (Sch. Bip.) Cuf.	Asteraceae	0011
Brassica carinata A. Br.	Brassicaceae	0040
Brassica nigra (L.) Koch.	Brassicaceae	0032
Brassica oleracea L.	Brassicaceae	0039
Brassica oleracea L. var. capitata L.	Brassicaceae	
Brassica sp.	Brassicaceae	0103
Brucea antidysenterica J.F Mill.	Simarubaceae	0086
Buddleja polystachya Fresen.	Loganiaceae	0123
Caesalpinia decapetala (Roth.) Alston	Fabaceae	0079
Cajanus cajan (L.) Mil.l	Fabaceae	0089
Calpurinia aurea (Art.) Benth.	Fabaceae	0109
Canna indica L.	Cannaceae	
Canthium oligocarpum Hiern	Rubiaceae	0180
Capsicum annum L.	Solanaceae	0043
Capsicum frutescens L.	Siolanaceae	0133
Cardamine trichocarpa A.Rich.	Brassicaceae	0098
Carduus leptacanthus Fresen.	Asteraceae	0080
Carica papaya L.	Caricaceae	
Catha edulis (Vahl.) Forssk. ex Endl.	Celastraceae	0074
Caylusea abyssinica (Fresen.) Fisch. &Mey.	Resedenceae	0052
Celosia trigyna L.	Amaranthaceae	0130

Celtis gomphophylla Bak.	Ulmaceae	0134
Chionanthus mildbraedii (Gilg & Shell.) Stern	Oleacea	0179
Cineraria abyssinica Sch. Bip. ex A.Rich.	Asteraceae	0144
Citrus aurantium L.	Rutaceae	0173
Citrus sinensis (L.) Osbeck	Rutaceae	
Clausena anisata (Willd.) Hook.f. ex Benth.	Rutaceae	0113
Clerodendron myricoides (Hochst.) R.Br. ex Vatke	Verbenaceae	0092
Coccinia abyssinia (Lam.) Cogn.	Cucurbitaceae	0007
Coffea arabica L.	Rubiaceae	
Colocasia esculenta (L.) Schott	Araceae	0063
Convolvulus Kilimandscharii Engl.	Convolvulacea	0162
Coriandrum sativum L.	Apiaceae	0029
Cordia africana Lam.	Boraginaceae	
Croton macrostachyus Del.	Euphorbiacea	
Cucurbita pepo L.	Cucurbitaceae	0065
Cucurbita sp.	Cucurbitaceae	0168
Cupressus lucitanica Mill.	Cupressaceae	
Cyathea manniana Hook	Cyatheaceae	0172
Cymbopogon citratus (DC.) Stapf.	Poaceae	
Cyperus fischerianus A. Rich.	Cyperaceae	0125
Cyphomandra betaceae (Cav.)Se.	Solanaceae	0044
Datura innoxia Mill.	solanaceae	
Dicliptera laxata C.B.Cl.	Acanthaceae	0002
Didymochlaena truncatula (Sw.) J. Sm.	Aspidiaceae	0187
Dioscorea bulbifera L.	Dioscoreaceae	0075
Dioscorea cayenensis-rotundata complex	Dioscoreaceae	0076
Dracaena afromontana Mildbr.	Dracaenaceae	0056
Dracaena fragrans (L.) Ker-Gawl.	Dracaenaceae	0055
Dracaena steudneri Engler	Dracaenaceae	0178
Ehretia cymosa Thonn.	Boraginaceae	0101
Ekbergia capensis Sparm.	Meliaceae	0148
Embelia schimperi Vatke	Myrsinaceae	0204
Englerina woodfordioides (Scheweinf) Balle	Loranthaseae	0038
Ensete ventricosum (Welw.) Cheesman	Musaceae	
Erythrina abyssinica Lam. ex DC.	Fabaceae	0170
Erythrina brucei Schweinf.	Fabaceae	0114
Eucalyptus sp.	Myrtaceae	0224
Euphorbia ampliphylla Pax	Euphorbiacea	0171
Euphorbia cottonifolia L.	Euphorbiaceae	0072
Ficus sp.	Moraceae	0046
Ficus sur Forssk.	Moraceae	0118
Ficus thonningii Blume	Moraceae	0070
Ficus vasta Forssk	Moraceae	0083
Foeniculum vulgare Mill.	Apiacea	0078
Galiniera saxifraga (Hochst) Brids.	Rubiaceae	0203
Grewia ferruginea Hochst. ex A.Rich.	Tiliaceae	0110

Hagenia abyssinica (Brucie) J.F.Gmel.	Rosaceae	
Hibscus berberidifolius A.Rich.	Malvacea	0181
Hippocratea goetzei Loes.	Celastraceae	0190
Hypericum quartinianum A. Rich.	Hyperiaceae	0201
Indigofera arrecta Hochst.ex A.Rich.	Fabaseae	0001
Ipomoea batatas (L.) Lam.	Convolvulaceae	
Iresine herbstii Hook. f.	Amaranthaceae	0121
Jasminum abyssinicum Hochst. ex DC.	Oleaceae	0022
Lablab purpureus (L.) Sweet	Fabaceae	0061
Lagenaria siceraria (Molina) Standl.	Cucurbitaceae	
Laggera crispata (Vahl) Hepper & Wood	Asteraceae	0091
Landolphia buchananii (Hall. f.) Stapf	Apocyanaceae	0054
Lantana trifolia L.	Verbenaceae	0143
Lepidium sativum L.	Brassicaceae	0124
Lepidotrichilia volknsii (Guerke) Leroy	Meliaceae	0199
Linum usitatissimum L.	Linaceae	0050
Lippia adoensis Hochst. ex.Walp.	Lamiaceae	0045
Lucas martinicensis (Jacq.) R.Br.	Lamiaceae	
Lycopersicon esculenta L.	Solanaceae	
Macaranga capensis (Baill.) Sim	Euphorbiaceae	0183
Maesa lanceolata Forssk.	Myrsinaceae	0173
Mangifera indica L.	Anacardiaceae	
Manihot esculenta Granz	Euphorbiaceae	
Maytenus gracilipes (Welw. ex Oliv) Exell	Celastraceae	0139
Mentha aquatica L.	Lamiaceae	0166
Mentha spicata L.	Lamiaceae	0164
Milletia ferruginea (Hochst.) Bak.	Fabaceae	
Momordica foetida Schumach.	Cucurbitaceae	0047
Musa paradisiaca L.	Musaceae	
Nicotiana tabacum L.	Solanaceae	0081
Ocimum basilicum L. var.Hawli	Lamiaceae	0025
Ocimum basilicum L. var. *thyrsiflorum*	Lamiaceae	0026
Ocimum gratissimum L.	Lamiaceae	0087
Ocimum lamiifolium Hochst . ex Benth.	Lamiaceae	0105
Olea welwitschii (Knobl.) Gilg & Schell.	Oleaceae	0048
Oncoba routledgei Sprague	Flacourtiaceae	0217
Passiflora edulis Sims.	Passifloraceae	0135
Paullinia Pinnata L.	Sapindaceae	0057
Pavonia urens Cavan.	Malvaceae	0141
Pentas lanceolata (Firsk.) Defl.	Rubiaceae	0199
Peponium vogelii (Hook-f.) Engl.	Cucurbitaceae	0115
Percea americana Mill.	Lauraceae	
Persicaria senegalensis (Meisn.) Sojak.	Polygonaceae	0126
Phaseollus coccineus L.	Fabaceae	0152
Phaseolus lunatus L.	Fabaceae	0069
Phaseolus vulgaris L.	Fabaceae	0062

Phoenix reclinata Jacq.	Arecaceae	
Physalis micrantha Linle	Solanaceae	0138
Physalis peruviana L.	Solanaceae	0158
Phytolacca dodecandra L'Heirt	Phytolaccaeae	0093
Piper capense L.f.	Piperaceae	0052
Pisum sativam L.	Fabaceae	
Pittosporum viridiflorum Sims	Pittosporaceae	0193
Plectranthus edulis (Vatke) Agnew	Lamiaceae	0023
Poa sp.	Poaceae	0177
Polyscias fulva (Hiern) Harms	Araliaceae	0117
Pouteria adolfi-friederici (Engl.) Rob. & Gilb.	Sapotaceae	
Premna schimperi Engl.	Verbenaceae	0104
Prunus africana (Hook.f.) Kalkm	Rosaceae	0085
Psidium guajava L.	Myrtaceae	
Psychotria orophila Petit	Rubiaceal	0185
Pycnostachys abyssinica Fresen.	Lamiaceae	0012
Rhamnus prinoides L'Herit	Rhamnaceae	
Rhus ruspolii Engl.	Anacardiaceae	0107
Ricinus communis L.	Euphorbiaceae	0215
Rosa sp.	Rosaceae	0225
Rothmannia urcelliformis (Hiern) Robyns	Rubiaceae	0188
Rubus apetalus Poir.	Rosaceae	0021
Rumex abyssinicus Jacq.	Polygonaceae	0137
Rumex nepalensis Spreng	Polygonaceae	0004
Ruta chalepensis L.	Rutaceae	0073
Rytigyina neglecta (Hiern) Robyns	Rubiaceae	0088
Saccharum officinarum L.	Poaceae	
Sapium ellipticum (Krauss) Pax	Euphorbiaceae	0017
Satureja punctata (Benth.)Briq.	Lamiaceae	0164
Satureja paradoxa (Vatke) Engler	Lamiaceae	0199
Schefflera abyssinica (Hochst ex A.Rich.) Harms.	Araliaceae	0223
Schefflera volkensii (Eng.) Harms	Araliaceae	0219
Sechium edule Sw.	Cucurbitaceae	
Sesbania melanocaulis Bidgood & Friis	Fabaceae	0128
Solanecio gigas (Vatke) C. Jeffrey	Asteraceae	0153
Solanum americanum Miller	Solonaceae	0066,0155
Solanum tuberosum L.	Solanaceae	
Sorghum bicolor (L.) Moench	Poaceae	0175,0182
Syadenium compactum N.E.Br.	Euphorbiaceae	0131
Syzygium guineense (Willd.) DC.	Myrtaceae	0016
Tacazzia apiculata Oliv.	Asclepiadaceae	0163
Tagetes miniuta L.	Asteraceae	
Teclea nobilis Del.	Rutaceae	0218
Thymus schimperi Ronn.	Lamiaceae	0096
Triumfetta brachyceras K.Schum.	Tiliaceae	0142
Urera hypselodendron (A.Rich.) Wedd.	Urticaceae	0108

Vepris dainellii (Pichi-Serm.) Kokwaro	Rutaceae	0184
Verbena officinalis L.	Verbenaceae	0090
Vernonia amygdalina Del.	Asteraceae	
Vernonia auriculifera Hiern	Asteraceae	0129
Vicia faba L.	Fabaceae	
Vigna memberanacea A.Rich.	Fabaceae	0100
Xanthosoma saggitifolium (l.) Schott	Araceae	0006
Zea mays L.	Poaceae	
Zingiber officinale Rescoe	Zingiberaceae	

Declaration

I, the undersigned, declare that this thesis is my own work and all sources of materials used for this thesis have been duly acknowledged.

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