

**ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES**



**HOME-GARDENS AND AGROBIODIVERSITY CONSERVATION IN
SABATA TOWN, OROMIA NATIONAL REGIONAL STATE, ETHIOPIA**

**BY
HABTAMU HAILU**

**A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES, ADDIS ABABA
UNIVERSITY, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE IN ENVIRONMENTAL SCIENCE**

OCTOBER, 2008

ADDIS ABABA, ETHIOPIA

Acknowledgements

First and for most I would like to glorify and bring the greatest of all thanks to God for helping me start and finish this research work. I would like to express my heartfelt gratitude to my advisor Dr. Zemedu Asfaw, Department of Biology, Addis Ababa University (AAU) for his consistent invaluable advice, comment and follow up right from the start and completion of my work. He was sincere, genuine, approachable and respectful; with out his help this thesis could not have been written. I am thankful to Addis Ababa University (AAU) for the provision of financial assistance through out my thesis work. I am indebted to Environmental Science Program, Faculty of Science (AAU) for writing letters of co-operation to various institutions. I express my sincere gratitude to the technical staff of the National Herbarium (ETH) at AAU, for their substantial co-operation at the time of plant identification. I appreciate and thank the assistances of the Institute of Biodiversity Conservation (IBC), Central Statistics Agency (CSA), Oromia Finance and Economic Development Bureau, *Sabata* Town Administration Office and *Sabata* Health Center. I am also delighted to pass my genuine regard to the National Meteorological Service Agency (NMSA) for providing me the climate data of the area free of charge. I greatly acknowledge my brothers and sisters for giving me financial and moral support during my study. Finally, I am much grateful to Ato Tsegaye Demissie for his memorable help during field data collection.

Acknowledgements	i
Table of Contents	ii
List of Tables	iv
List of Figures	v
List of Appendices	v
Abstract	vi
1. Introduction	1
1.1 Objectives of the Study	
1.1.1 General Objective	3
1.1.2 Specific Objectives	3
1.2 Research Questions	3
2. Review of the Literature	
2.1 Brief History and Categories of Home-gardens	5
2.2 Characteristics of Home-gardens	
2.2.1 Structure and Composition	6
2.2.2 Species Diversity	8
2.2.3 Identifying Features	9
2.3 Agrobiodiversity Conservation of Plant Genetic Resources in the Home-gardens	10
2.4 Contribution of Home-gardens to Food Security and Nutrition	11
2.5 Indigenous Knowledge and Home-garden Management	12
2.6 Home-gardens and Agrobiodiversity Conservation Practices in Ethiopia	13
3. Materials and Methods	
3.1 Description of the Study Area	
3.1.1 Topography and Geographic Location	16
3.1.2 Climate	19
3.1.3 Soil.....	21
3.1.4 Vegetation	21
3.2.5 People and Livelihoods.....	22

3.2 Sampling Techniques -----	22
3.3 Data Collection	
3.3.1 Vegetation Data -----	23
3.3.2 Ethnobotanic Data -----	23
3.4 Data Analysis -----	26
4. Results	
4.1 The Type, Size and Vegetation Structure in Home-gardens of <i>Sabata</i> Town-----	29
4.2 Plant Diversity and Factors that Govern Plant Composition in the Home-gardens of <i>Sabata</i> Town -----	31
4.3 Comparisons of Most Desirable Food Crops of Home-gardens that have Market Utility-----	37
4.4 Important Home-garden Tree Species with Multiple Uses -----	39
4.5 Food Plants of Home-gardens for Nutrition and Food Security -----	40
4.6 Home-garden Plant Species of <i>Sabata</i> with Medicinal Uses -----	43
4.7 Indigenous Knowledge and Home-garden Management Practices in <i>Sabata</i> Town -----	47
5. Discussion	
5.1 General Characteristics of Home-gardens and Factors that Influence Their Plant Composition -----	50
5.2 The Role Home-gardens in Agrobiodiversity Conservation -----	52
5.3 Indigenous Management of Home-gardens in <i>Sabata</i> Town -----	55
5.4 The role of Home-gardens in Improving Family Livelihood: Food Security, Nutrition and Income -----	57
5.5 Impacts of Market Forces on Home-garden Agrobiodiversity-----	58
5.6 Environmental Contributions of Home-gardens Taking <i>Sabata</i> Town as a Case -----	59
6. Conclusion -----	62
7. Recommendations -----	64
8. References -----	66
9. Appendices -----	74

Table 1. The altitudes and geographic locations of the six research sites in the study area-----	17
Table 2. Frequency of home-gardens surveyed in the study area-----	29
Table 3. Eleven plant species with the highest frequencies and relative frequencies of occurrence in the 24 home-gardens of the study area-----	33
Table 4. Six tree species with the highest abundance (number), densities and relative densities of occurrence in the 24 home-gardens of the study area-----	35
Table 5. Shannon-Wiener Diversity Index (H') and Evenness (J) for the six research sites-----	35
Table 6. Sorensen's similarity index for plant species composition in the clustered home-gardens-----	36
Table 7. Factors that affect home-garden plant diversity and respondents' frequencies-----	36
Table 8. Ten key informants' pair wise comparisons for five most desirable food crops of home-gardens that have market utility (the total indicates the sum of the items that are given in bold face and which are also most preferred from each pair)-----	38
Table 9. Summary of the grand total scores and ranks for Table 8-----	39
Table 10. The results of ten key informants' direct matrix ranking for six home-garden tree species with multiple uses (6, best; 1, least)-----	39
Table 11. Simple preference ranking for widely used food crops in home-gardens (1-10): 10- most valuable, 1- least valuable-----	41
Table 12. Plant species with medicinal uses [All names are Oromo names except when indicated by asterisk(*) in which case Amharic names are used]-----	44
Table 13. Eighteen landraces (farmers' varieties) of <i>Ensete ventricosum</i> recognized by the house holds interviewed in <i>Sabata</i> town, <i>Walate 03 Kebele</i> -----	49

List of Figures

Page

Fig. 1. Map of the study area (Source: Ethio-GIS) -----	18
Fig. 2. Climadiagram of <i>Sabata</i> town based on 10 years data (1997-2006) from the National Meteorological Service Agency (NMSA), dry periods are dotted and wet periods are blackened -----	20
Fig. 3. Sketch of a common home-garden in Sabata Town-----	31
Fig. 4. Habit and percentage of all species-----	32
Fig. 5. Mean proportion of functional groups of plants per garden-----	34
Fig. 6. Dendrogram showing the similarity of responses to the widely used food plants-----	42

List of Appendices

Appendix I. List of plant species in the home-gardens of the study area-----	74
Appendix II. List of functional groups of plant species in the home-gardens of the study area-----	80
Appendix III. List of tree species from home-gardens of the study area-----	84
Appendix IV. List of food plants found from home-gardens of the study area-----	85
Appendix V. Semi-structured interview items for data collection-----	86

Abstract

*A field-based study of plant diversity in small scope traditional agroecosystem, widely known as home-gardens, was carried out in Sabata peri-urban town in the South Western Shewa Zone of Oromia National Regional State, Ethiopia. The study area is categorized as Tepid Humid Mid Highland (H₃) Agro-ecological Zone. In the present study, a total of two hundred forty houses were surveyed within the study area by employing random sampling technique for the presence of home-gardens. Twenty-four of these home-gardens were preferentially selected since they were considered manageable for detailed study (data collection and analysis). Data on vegetation (species record, frequency, and number of individuals) were recorded and the collected specimens were identified in the National Herbarium (ETH), Addis Ababa University. Ethnobotanic information was gathered using semi-structured interview, free listing, preference ranking, direct matrix ranking and paired comparisons. Descriptive statistical methods as Shannon-Wiener Diversity Index and Cluster analysis methods were also employed. A total of 135 plant species in 110 genera and 58 families were recorded. Thirty-seven plant species that are distributed among 29 genera and 22 families were documented as food plants. Family Rutaceae is represented by the highest number of food plants (13.51%) followed by Brassicaceae (10.81%). *Persea americana* Mill., *Citrus sinensis* (L.) Osb. and *Ensete ventricosum* (Welw.) Cheesman. were among the most preferred food plants of home-gardens of the area. Twenty four medicinal plants from 22 genera and 17 families were also recorded from home-gardens of the area. Species of the families Asteraceae and Lamiaceae were the most used and each accounted for 16.6% of the total medicinal plants. From this study diverse plant taxa and landraces belonging to various categories of food and non-food crops were identified and recorded which indicate the significance of home-gardening in conserving agrobiodiversity. In addition, the indigenous knowledge used to maintain plant diversity in home-gardens was also carefully considered and documented.*

Key words / phrases: *Agrobiodiversity, Home-gardens, Indigenous knowledge, Management practices*

1. Introduction

Environmental crisis like global warming, desertification and loss of biodiversity are becoming the major tribulations of human well-being. These could also be factors for rising food shortage problems of the world, which is strongly marked in environments modified by human activities. Hence, the prevailing loss of biodiversity calls for collection, investigation and conservation of natural resources of an environment (FAO, 1983). Equally important will be recording agrobiodiversity. As it is clearly suggested by FAO (1999a; quoted in FAO, 2004a) the term agrobiodiversity includes the variety and variability of plants, animals and micro-organisms that are indispensable for sustaining key functions of agro-ecosystem, comprising of its structure and processes for, and in support of food production and security. One among such traditional farming systems that promote diversity are the polycultural plots that are also referred to as home-gardens found in many parts of the world, encompassing tropical and subtropical areas of Central and South America, Southeast Asia, sub-Saharan Africa and Europe. Others are traditional agroforestry systems, such as the coffee plantations that are shaded and commonly found in Central and South America (Greenburg, 1994; cited in Thrupp, 1997) and Africa.

The general studies that are conducted on home-gardening in Ethiopia are very few. In this regard reference could be made to the works performed by Zemedu Asfaw and Ayele Nigatu (1995), Zemedu Asfaw (1997, 2001a and 2001b), Feleke Woldeyes (2000), Belachew Wassihum *et al.* (2003), Tesfaye Abebe (2005) and Talemoss Seta (2007). Careful examination on some aspects of home-gardens in Ethiopia (Westphal, 1975; Okigbo, 1990; Zemedu Asfaw and Ayele Nigatu, 1995) have given clues on the contribution of the farming system to food security and conservation of the biological diversity. It is stated by Zemedu Asfaw and Ayele Nigatu (1995) that traditional home-gardening is a sustainable agricultural practice; it is environmentally friendly and also allows the harvesting of diverse products to the satisfaction of farming families as well as urban dwellers.

Some researches are carried out on home-gardens in detail in certain localities of the country viz., Walayta and Guragie (Zemedet Asfaw and Zerihun Woldu, 1997), Bonga (Feleke Woldyes, 2000), Ochollo, Channo and Lantee (Belachew Wassihun *et al.*, 2003), Southern Ethiopia (Tesfaye Abebe, 2005), and Walayta (Talemos Seta, 2007). Nevertheless, such detailed studies are barely conducted in the *Sabata* peri-urban town located at about 24 km South West of Addis Ababa. Thus, the current alarming loss and threat to agrobiodiversity in the country and the research gap observed in the area compelled us to initiate a study on the plant diversity and conservation practices carried out in the home-gardens of the indicated site. Concomitantly, it was attempted to investigate the significance of this traditional farming system in sustaining food security and in providing polyvariety nutritional habits to the people of the study area. This study also tried to systematically investigate the contribution of the traditional knowledge owned by the indigenous people of the area to conserve plant diversity in the home-gardens.

Studies of home-gardens in the past have been more of free listing and qualitative assessment. In more recent years; however, there are more and more applications of quantitative ethnobotanical data collection and analysis methods. In the present study a number of these quantitative approaches were applied in order to come up with quantified data that could give some guides to the practical recommendations.

1.1 Objectives of the Study

1.1.1 General Objectives

The main objectives of the study are to gather and investigate the various plant species in the homesteads of the *Sabata* peri-urban town and to see how these farming systems are used to conserve agricultural biodiversity.

1.1.2 Specific objectives

1. To systematically inquire and record relevant contributions of the traditional knowledge and management practices of local people of the study area to conserve plant diversity in the home-gardens;
2. To document the garden flora of the study area;
3. To find out factors affecting floristic diversity in the home-gardens of the study area;
4. To show that home-gardening could be a viable option to tackle the loss of agricultural biodiversity, sustain food security and improve nutritional quality in the localities with declining plant diversity and famine prone areas of the country;
5. To document plants of medicinal value to humans and those of veterinary importance in the study area;
6. To identify tree species used by the people of the area for multiple purposes;
7. To quantify the frequency of home-gardens in the study area;
8. To describe spatial and temporal structures of home-gardens in the study area;
9. To identify the habits and percentages of plant species in the home-gardens of the study area;
10. To identify the functional groups of plants in the home-gardens of the study area and
11. To record the main products of home-gardens in the study area.

1.2 Research questions

This study addressed the following research questions:

1. How frequent are home-gardens in *Sabata* town?

2. How diverse are home-garden species and how this could be used to tackle the loss of agricultural diversity?
3. Which tree species are used for multiple purposes?
4. What are the major home-garden products in the study area?
5. What factors govern the plant composition of *Sabata* home-gardens (e.g. home uses, market, soil, climate)?
6. How does one describe the structure [temporal, spatial (vertical, horizontal)] of home-gardens?
7. What are the relevant contributions of the traditional knowledge and management practices of the local people of the area to maintain the diverse plant taxa in the homesteads?
8. How does one explain the relevance of home-gardening in terms of nutrition, in sustaining food security and poverty reduction?
9. What are the habits and percentages of plants in home-gardens?
10. What are the functional groups of home-garden plants?
11. What are the plant species of the study area that have traditional medicinal value to humans and veterinary?

2. Review of the Literature

2.1 Brief History and Categories of Home-gardens

It is estimated that early attempts to domesticate plants were practiced by sedentary and semi-sedentary families (Hadidi, 1984). Home-gardens are said to have been parts of human subsistence strategies since the Neolithic period (Soleri and Cleveland, 1989) and they played important roles in the process of early plant domestication and continue to be the avenue for introduction and adaptation of new crops. The earliest historical records of gardens are documented from the third millennium BC of the Near East (Brownrigg, 1985). These ancient gardens are said to have been attached to temples, palaces, and even to homes of the common people in their less elaborate forms. Traditional home-gardens (known by various vernacular designations in different cultures, viz., mixed gardens, house gardens, compound farms, kitchen gardens, dooryard gardens and homestead agroforestry) refer to the land surrounding a house on which a mixture of annual and perennial plants are grown together with or without animals and largely managed by the household members for home use or commercial purposes (Godbole, 1998).

Home-gardens appear to have developed independently in the Indian subcontinent, Indonesia and other parts of South East Asia, the tropical Pacific islands, the Caribbean, and various parts of tropical Latin America and Africa (Brownrigg 1985, Landauer and Brazil, 1990). The last couple of decades have testified an increasing world wide interest in home-gardens, exposing their potential for sustained subsistence farming and biodiversity conservation (Christanty, 1990; Marten, 1990; Okigbo, 1990; Padoch and de Jong, 1991; Godbole, 1998). In recent years tropical home-gardens have attracted much interest as sustainable agricultural systems (Rico-Gray *et al.*, 1990), and as ideal avenues for on-farm in-situ crop biodiversity conservation (Esquivel and Hammer, 1992). At present home gardens are wide-spread in the tropical and subtropical regions of Asia (Christanty, 1990; Marten, 1990; Godbole, 1998), Africa (Okigbo, 1990) and Central and South America (Padoch and de Jong, 1991). In the tropics, two types of home-

gardens are distinguished based on their contribution to the benefit of households. The first ones are small-scale supplementary food production systems around the house in areas where the subsistence of the owners is based on other land-use or other activities. The known home-gardens of Java that supplement monoculture rice production and home-gardens from Latin America belong to the first category (Marten and Abdoellah, 1988). The second category of home-gardens is stretched from fields around the houses that constitute the most important means of the livelihood for farming households. Most of the home-gardens in the highlands of eastern Africa belong to this category (Zemedede Asfaw, 2004). Home-gardens are further subdivided into two basic types: the city or urban and the village or rural home-garden. Sub-urban (peri-urban) home-gardens can be regarded as a transitional stage between the two main types (Christanty, 1990).

On the other hand, the retrospective review of Engels (2002) indicated that the garden is also a place for experimentation and even fundamental research, and the ground breaking genetic research of the monk Gregor Mendel during the 19th century in the Tjech Republic was done in the home-garden of the monastery and resulted in the formulation of the genetic laws that, among other advances, greatly facilitated plant breeding.

2.2 Characteristics of Home-gardens

2.2.1 Structure and Composition

Home-gardens are usually carefully structured systems with every component having a specific place and function (Wiersum, 1982; Soemarwoto and Soemarwoto, 1984; cited in Fernandes and Nair, 1990). However, significant variation is observed in home-gardens in terms of size, shape, intensity of cultivation and intricacy of species diversity (Okigbo, 1990). The layered canopy arrangement and harmonious admixture of species are the most noticeable characteristics of all home-gardens (Wiersum, 1982; Soemarwoto and Soemarwoto, 1984; cited in Fernandes and Nair, 1990). In this farming system, plants of

different heights and light requirements are grown together, giving the garden a complex vertical structure viz., upper storey, middle storey, and lower layer (Christanty, 1990; Okigbo, 1990)). Moreover, the patterns of cropping are decided by the type of crops grown, the size of land available for planting, the educational level of the gardener, and the housing quality. Several patterns are commonly found for home-gardens even though no particular cropping pattern has been developed (Brownrigg, 1985). Although environmental and socio-economic factors as well as dietary habits and local market demands determine the choice of species to a large extent, there is a remarkable similarity with respect to species composition among different home-gardens in various places (Fernandes and Nair, 1990). The structure and composition of these home-gardens are the outcomes of gardeners' efforts to increase yield from land based on their knowledge of the various requirements of the plant species. The system starts with annual crop plants and proceeds through different stages of complexity towards a relatively stable ecosystem consisting of trees and highly diverse under-storey crops (Feleke Woldeyes, 2000). However, each traditional farm is complex with each unit distinguished from others: physico-chemically (soil, water, climate, nutrients); biologically (crops, animals, pests); socio-economically (labor, markets, religion, customs, and personal preferences); technologically (tools, machines, practices), and managerially (knowledge, decision making) (Okigbo, 1990).

The spatial arrangement of these farming systems often reflects their functional adaptation in a number of factors comprising the use of plant-symbiotic relationships through mixed cropping. Moreover, the structure and composition of home-gardens vary across sites based on the ecological setting and socio-economic functions within different household economies (Christanty, 1985; Fernandes and Nair, 1986).

2.2.2 Species Diversity

Human kind had began to exploit the surroundings and cultivate plants for food, medicine and other purposes in home-gardens and this helped the progress of prehistoric humans (Maheshwari, 1988). The collection of useful plants and animals have gradually led to small-scale plant and animal husbandry, whose continued intensification resulted in the emergence of full-scale agriculture in gardens and fields (Zemedede Asfaw and Ayele Negatu, 1995). Home-gardens are microenvironments containing high levels of species and genetic diversity within larger farming systems (Eyzaguirre and Watson, 2002). In marginal environments, as stated by Engels (2002), where the predictability of growing conditions is low, the use of more genetic diversity tends to be beneficial to the people and this very situation is also applicable to home-garden production. The same author also noted that home-gardens have unique and rare genetic diversity that have evolved or developed locally and that is of interest not only to the developers but also to the conservationists within a given country as well as internationally. Diversity refers to many different species and their interactions, occurring in small space at one time (Hammer, 1991), and this definition holds the concept of diversity in home-gardens as there is great diversity of interactions taking place vertically, horizontally, and temporally within one garden often less than one hectare (Zemedede Asfaw, 1997; Millat-e-Mustafa, 1998). The amount of genetic diversity that exists in a crop in a home-garden can be described with a range of different approaches. Which ever methods are utilized, the three most significant characteristics that are measured are the richness, evenness and distinctness of the features. Richness is the measure of the number of different types, while evenness describes their distribution within and between the different populations (cultivars, home-gardens, areas). Distinctness can be particularly important for assessing whether some populations or areas have unique types (Hodgkin, 2002).

Padoch and Jong (1991) also recorded the main determinants of the biotic change and variation of home-gardens to be ecological (soil, altitude, water), personal (preferences, interest, knowledge), socio-cultural

and economic (household needs, gender, market, social groups, wealth status), and political factors (land use system, marketing policies, conservation policies, agricultural support systems). Among these, the ecological factors such as soil, climate, stress and abundance of crop species set limits to the occurrence and diversity of crop species to a large extent. The impact of these factors on the structure, composition and orientation of the species and varietal diversity in home-gardens in different agroecological zones need to be explored and compared (Shrestha *et al.*, 2002).

2.2.3 Identifying Features

Brownrigg (1985) stated that published analyses of home-gardens generally refer to four distinguishing features. First, the garden is situated close to the residence. Second, the garden holds large diversity of plants. To this criterion some add that the garden recycles nutrients in a sustainable manner that plants are planted densely, and that plants are layered to mimic natural forest. Third, garden production is a supplemental rather than a main source of family consumption or income. Fourth, the garden occupies a "small" area. A fifth identifying characteristic of home-gardens is proposed by Marsh (1998; cited in Mitchell and Hanstad, 2004), who suggested that home-garden is a production system that the poor can easily enter at some level since it may be done with virtually no economic resources, using locally available planting materials, natural manures and indigenous methods of pest control; to the extent a poor family can afford to make beneficial use of home-garden plots, the plots are more likely to make a sustainable contribution to the family's livelihood objectives. Soleri and Cleveland (1989) supplemented the key features of home-gardens to embrace the use of local knowledge and resources; locally adapted, genetically diverse crops with many varieties; crop rotation; mixed cropping; and the exploitation of different microenvironments, such as pockets of soil that hold water longer.

2.3 Agrobiodiversity Conservation of Plant Genetic Resources in Home-gardens

Agrobiodiversity is the result of interaction between the environment, genetic resources and management systems and practices used by culturally diverse peoples, and therefore land and water resources are used for production in different ways (FAO, 1999a; cited in FAO, 2004a). It is an essential characteristic of farming systems and includes several types of biological resources tied with agriculture. These encompass edible plants and crops (traditional varieties and cultivars, hybrids and genetic material developed by breeders), livestock and genetic resources all of which are biological resources linked with agriculture. In addition, soil organisms such as bacteria and fungi that are vital to soil fertility, insects that occur naturally and that are used to control insect pests and diseases of domesticated plants and animals are parts of agrobiodiversity. The components and types of traditional agroecosystem such as polycultural / monocultural, small / large scale and rain fed / irrigated are necessary for nutrient cycling, productivity and stability; wild resources of natural habitats and landscapes can provide ecosystem function and services (Thrupp, 2000). As suggested in FAO (2004a), agrobiodiversity has several distinctive features as compared to other components of biodiversity. Some among these are: (1) agrobiodiversity is actively managed by male and female farmers; (2) many components of agrobiodiversity would not survive without this human interference as local knowledge and culture are integral parts of agrobiodiversity management, and (3) many economically important agricultural systems are based on ‘alien’ crop or livestock species introduced from elsewhere (for example, horticultural production systems or Friesian cows in Africa). This creates high degree of interdependence between countries for genetic resources on which our food systems are based.

Because agrobiodiversity provides services to humankind as a whole and since information, market and policy fail to realize the full value of these services for their direct custodians (principally farmers), biodiversity is not utilized and managed in a sustainable way (Mugwara and Tewolde Berhan Gebre

Egziabher, 2002). Several authors have commented on the merits of home-gardens for agrobiodiversity conservation of plant genetic resources. Brookfield (2001) indicated that home-gardens are the valuable sources of agrobiodiversity notably with regard to plant diversity. Eyzaguirre and Linares (2001) mentioned that home-gardens are refuges for wild species that are threatened in the wild by deforestation and environmental changes. Thus, the significant role of agrobiodiversity in functioning of farming systems is meant that we are worried about the loss of genes which are the fundamental blocks of agrobiodiversity (Mugwara and Tewolde Berhan Gebre Egziabher, 2002).

2.4 Contribution of Home-gardens to Food Security and Nutrition

In most tropical home-gardens, food production is the first function and role. One major aspect of significant role of food production in home-gardens is to hold up continuous production throughout the year (FAO, 2004b). Most of this production is for home consumption (Christanty, 1990; FAO, 2004b), nevertheless, any marketable surplus can provide a safeguard against crop failure, as well as security for the interval between the harvests of other agricultural crops of the home-garden. The potential benefit obtained from integrating home-gardens into small holder farming system encompass: enhanced food security, income and improved rural employment through additional or off-season production, decreased risk and nutritional improvement by way food diversity, alleviation of seasonal food scarcity, and environmental gains from recycling water and waste nutrients, from shade, dust and erosion control and from maintaining or enhancing local biodiversity (FAO, 2004b). It is also stressed by Vasey (1990) that the ecological complexity of so many home-gardens favors nutritional diversity. The type of crops cultivated and the closeness of the garden to the house and kitchen assure that home-gardens contribute significantly to food security, notably because they are useful sources of micro-nutrients and vitamins, and thus play a critical role in the nutritional balance of human diet (Engels, 2002). If dietary standards are solely considered, every home-garden portrays a kind of nutritional calculus (cf. Marten, 1990) in which case starchy,

proteinaceous, oil bearing, leafy and other categories of crops are proportionately mixed to provide its primary home use function (Zemedede Asfaw and Zerihun Woldu, 1997).

2.5 Indigenous Knowledge and Home-garden Management

One of the most vital functions that home-gardens carry out is intergenerational preservation and perpetuation of indigenous knowledge of useful plants and their uses (Christanty, 1990). The term indigenous knowledge or folk knowledge refers to what local people know about the natural environment (Martin, 1995). World Bank (2006) also defined indigenous knowledge as a large body of knowledge, skills and practices that has been developed outside the formal educational system and that enables communities to survive. In emerging global knowledge economy a country's ability to build and mobilize knowledge capital, is equally essential for sustainable development as the availability of physical and financial capital. The basic component of any country's knowledge system is its indigenous knowledge. It encompasses the skills, experiences and insights of people, applied to maintain or improve their livelihood (World Bank, 1997). Home-gardens served as refuges in the tropics for the "heirloom crop varieties" that were valued and sustained by using their indigenous knowledge in the family but had little place in commercial markets. Households are also able to exchange their home-gardens varieties as part of social visits (Christanty, 1990). Many of the productive benefits of household gardens result from their small scale, diversity, and careful management (Soleri and Cleveland, 1989). In recent years, indigenous knowledge is perceived as pivotal discussions for the management practices of agrobiodiversity. Such ideas have activated the realization that agrobiodiversity conservation should cover the preservation of indigenous knowledge, cultural diversity and indigenous people. For that reason, biodiversity encompassing agrobiodiversity conservation plans should employ indigenous people as a starting point. Nowadays, many conservationists believe that conservation practices that are not assisted by the indigenous people living in the surrounding areas where conservation sites are demarcated are found unsuccessful

(Martinet and McNeely, 1992). In homesteads of tropical Africa for instance, different soil management and fertility maintenance methods are practiced by indigenous people. Usually these methods comprise of fallows, slash and burn clearance, production of varying numbers of crops and / or livestock in accordance with the farmers frequent practices and needs (Okigbo, 1990). The same author further examined that the fertility of home-garden, which is usually more intensively cropped than other field systems, is usually maintained with farmyard or pen manure, household manure, kitchen waste, compost, crop residues, and sometimes toilet waste.

2.6 Home-gardens and Agrobiodiversity Conservation Practices in Ethiopia

It is believed that agriculture to have been practiced for 5000-7000 years in the Ethiopian highlands (Brandt, 1984). The importance of Ethiopia as the center of domestication and diversification of various crop species was announced for the first time by N. I. Vavilov (Vavilov, 1951). The long history of crop domestication, adoption and diffusion is to date an on-going process in Ethiopia. Ethiopian farmers living in highlands (above 1500 m a.s.l), are engaged in traditional agriculture in which different farming systems have developed and diverse assemblage of crops / landraces are grown (Melaku Worede *et al*, 2000). However, there is no direct proof or testimony to specify a particular time as to when people began the practice of home-gardening in Ethiopia, yet a long history is assumed on the basis of agricultural heritage, crop composition, oral literature and rich vernacular designations in different languages (Zemedu Asfaw, 2002). Literature sources further strengthen the beginning of home-gardening in Ethiopia to be veiled in antiquity (e.g. the information given by the elderly people hinted that home-gardening was known to be undertaken throughout the early times of Christianity in Ethiopia, and later expanded probably through the assistance of missionaries and aliens from Russia, Portugal, Italy, and other nations who probably brought some aspects of home-gardening and crops along with them). A few of the present widely used garden crops like citrus and banana were formerly grown only in monasteries and isolated churches. These staple

food items together with some wild fruits were available to monks, nuns and hermits (Zemedede Asfaw, 1997). It is also reminded by Pankhurst (1993) that the study of past events serve as a proof for gardening to be much older in northern Ethiopia than in the south. Houses with fruit plant gardens were for long been regarded as symbols of good reputation and self-esteem (Zemedede Asfaw and Ayele Nigatu, 1995; Zemedede Asfaw, 1997).

Valuable knowledge about the general traits and significance of Ethiopian home-gardens has been recorded Westphal (1975), Okigbo (1990), Zemedede Asfaw and Ayele Nigatu (1995), Zemedede Asfaw (1997), Zemedede Asfaw and Zerihun Woldu (1997), Feleke Weldeyes (2000), and they are unique in their design, crop mix and the key (dominant) species, which include a considerable number of indigenous crop taxa and a few that are truly endemic (e.g. *Coffea arabica*, *Ensete ventricosum*, *Coccinia abyssinica*, *Brassica carinata*, *Plectranthus edulis* and many other lesser known species) (Zemedede Asfaw, 2002). A wide range of taxa of annual and perennial crop plants are preserved in the home-garden agroecosystem of this country. In a nationwide survey, 172 crop species were obtained under cultivation in home-gardens, of which about 52% were thought typical home-garden species while 28% were cultivated both in home-gardens and crop fields. In another study conducted in the Southwest, a total of 112 species were registered of which 85% were found in home-gardens and greater than 75% were food crops. The diversity of species is very high in well-managed climax home-gardens, and up to 60 different species were recovered from particular home-garden studied (Zemedede Asfaw, 1997).

In this country, home-gardens are prevalent in the high lands similar to the other tropical nations (Tesfaye Abebe, 2005) and they collectively house a large diversity of plant types that range from staple food crops to ornamental plants. Peri-urban towns found not far from the big urban centers have large gardens. These growing sub-urban towns have relatively more space around the houses to practice gardening, and the

demand for more vegetables and fruits in the nearby urban centers provides another reason for the more developed practice (Zemedede Asfaw, 1997). In home-gardening, the middle altitudes are more significant than the extremes. It has been realized that one way of tackling the recurrent problem of famine would be to promote gardening with the purpose that each family produces something either to eat or to sell (Okigbo, 1990). It is fascinating to note from various reports that in the parts of Ethiopia where enset is cultivated for food, famines are unknown, and hence it is a promising crop in this regard (Zemedede Asfaw, 1997). In general, both types of cereal and perennial crop-based home-gardens are found in this region. In cereal crop-based farming systems, staple food crops such as tef (*Eragrostis tef* (Zucc.) Trotter), barley (*Hordeum vulgare* L.), wheat (*Triticum sativum* L.), and sorghum (*Sorghum bicolor* L.) are cultivated in outer farm fields, while supplementary vegetables, fruits and spices are grown in home-gardens. Such gardens are also familiar in most of the urban areas of Ethiopia. The second category of home-garden is common in perennial crop-based farming systems of the South and Southwestern highlands. Here, staple food crops (enset and maize) as well as other cash and food crops are grown in home-gardens and these garden farms make the principal means of livelihood for almost all households (Tesfaye Abebe, 2005).

3. Materials and methods

3.1 Description of the study area

3.1.1 Topography and Geographic location

A field-based study of plant diversity was conducted in the home-gardens of *Sabata* peri-urban town. *Sabata* is the capital town of *Sabata Awas* District (formerly called *Alamganaa* District) of South West *Shewa* zone, *Oromia* National Regional State in Ethiopia (Fig.1). The elevation of the area ranges between 2194 m a. s. l. and 2302 m a .s. l. (Table 1). *Sabata* town is surrounded by different chains of hills and mountains including Mts *Wachacha* and *Hoche* and seasonal marshy plains including *Furi-Gara-Bello*, *Gejja Ballachis* and *Jammo*. It is also known for its streams including *Laga Nasi*, *Gasas* and *Laga Aba Marach* and springs like *Burqa Qerro* (Tesfaye Gutema, 1997). Some of these mountains such as *Furi* and others are important in *Oromo* culture and religion. *Furi* is one of the eight sacred mountains of *Oromo* “*Saddettan Tullluwwan Waaqaa*” (BATO, 2007). In the *Oromo* language the word *Sabata* means a piece of cloth that women tie round their waist to keep their body tight, strong and firm. Due to its current fast growing status, the two satellite towns of *Alamganaa* and *Walate* are considered as its administration part. Hence, based on the geographical location of these satellite towns administratively the town is subdivided into three local government *Kebeles*: *Sabata* as 01 *Kebele*, *Alamganaa* as 02 and *Walate* as 03.

The study area is located within geographic co-ordinates of 08^o54'.649"N to 08^o58'.137"N latitudes and 038^o37'.723"E to 038^o40'.579"E longitudes (Table 1) and 24 km Southwest of Addis Ababa. With regards to relative location, it shares common boundaries with Addis Ababa in the north, northeast and east, *Burayu* town in the north, and rural villages of *Sabata Awas* District in the south and west. The total area that is covered with the current base / topographic map of the town is estimated to be 99 km².

Table 1. The altitudes and geographic locations of the six research sites in the study area

Research sites	Altitude	Geographic location	
		Latitude (N)	Longitude (E)
S ₁	2222 m a.s.l.	08 ⁰ 55'.984"N	038 ⁰ 37'.723"E
S ₂	2194 m a.s.l.	08 ⁰ 54'.649"N	038 ⁰ 37'.790"E
A ₃	2290 m a.s.l.	08 ⁰ 55'.703"N	038 ⁰ 39'.414"E
A ₄	2243 m a.s.l.	08 ⁰ 55'.461"N	038 ⁰ 39'.522"E
W ₅	2302 m a.s.l.	08 ⁰ 58'.137"N	038 ⁰ 40'.397"E
W ₆	2270 m a.s.l.	08 ⁰ 57'.034"N	038 ⁰ 40'.579"E

Note: S₁ Represents home-gardens 1-4 found in *Sabata* (*Kebele* 01 North West of the Addis Ababa-Jima high way passing through the town)

S₂ Represents home-gardens 5-8 found in *Sabata* (*Kebele* 01 southeast of the highway)

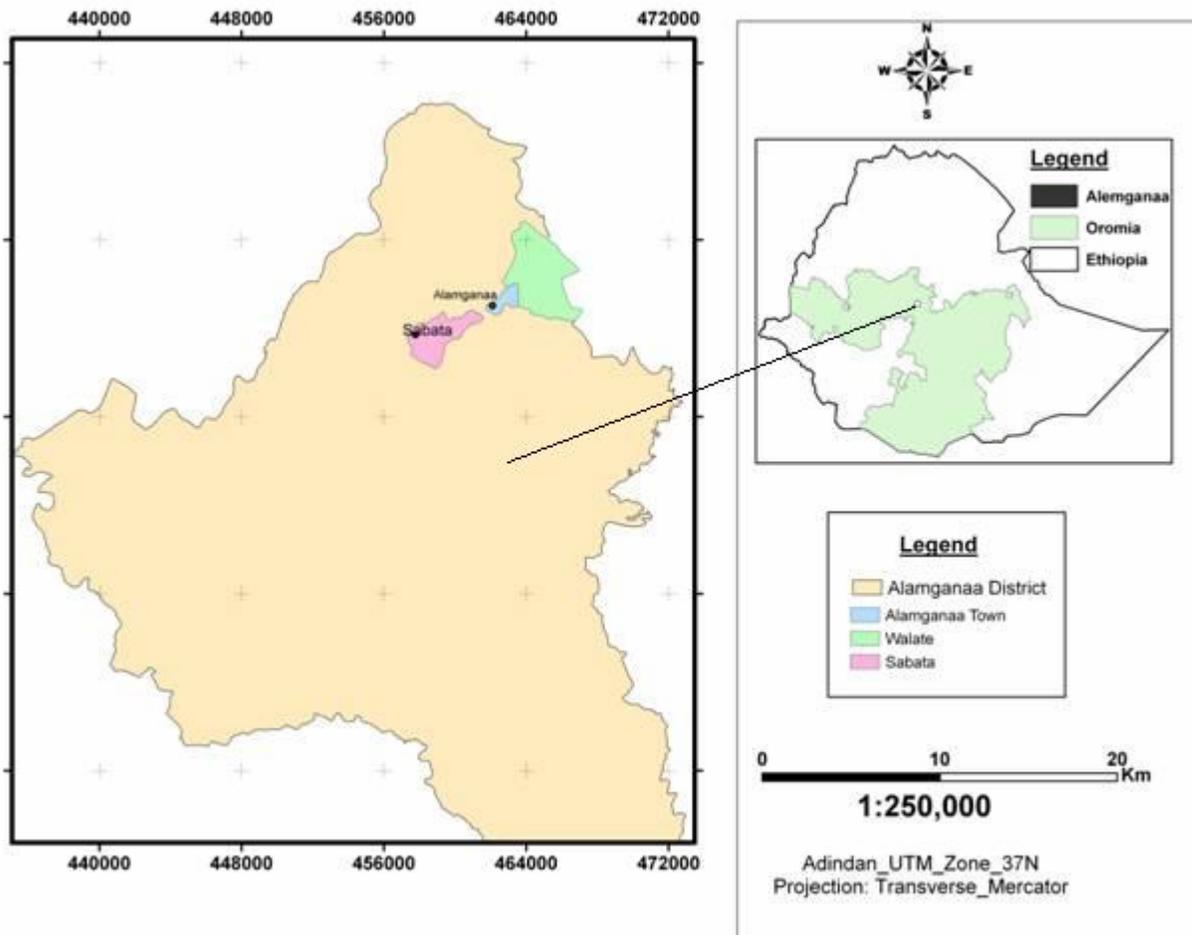
A₃ Represents home-gardens 9-12 found in *Alamganaa* (*Kebele* 02 northwest of the highway)

A₄ Represents home-gardens 13-16 found in *Alamganaa* (*Kebele* 02 southeast of the highway)

W₅ Represents home-gardens 17-20 found in *Walate* (*Kebele* 03 northwest of the highway)

W₆ Represents home-gardens 21-24 found in *Walate* (*Kebele* 03 southeast of the highway)

Fig. 1 Map of the study area (Source: Ethio:GIS)



3.1.2 Climate

The traditionally known agroecological zones of Ethiopia (AEZE) have been re-modified and mapped by the Natural Resource Management and Regulatory Department (NRMRD) of the then Ministry of Agriculture (MOA, 2002). Based on temperature, moisture regimes and number of growing days, 32 Major Agroecological Zones were delineated. In line with this approach, the study area is categorized in the Tepid-Humid Mid Highland (H₃) Agroecological Zone (MOA, 2000). The broad climatic characteristics of the study area, with its alternating wet and dry seasons, are determined largely by the annual movements across the countries of equatorial low pressure zones caused by the convergence of dry north-easterly winds with moist winds of the south-easterly or south-westerly origin. During October to February when north-easterly winds persist, long periods of dry weather are experienced. Between February and the ends of April the weather becomes more unsettled and a convergence of moist south-easterly air stream causes light rains – commonly referred to as the "Belg Rains". The main rains fall between June-September when moist winds from the Atlantic and Indian oceans converge over the Ethiopian highlands. Thus, the year is characterized by a major rainy season of four months long, from June to September, during which about 65% of the annual rain falls, followed by a dry season of four months long until the end of January and the second major rainy season from February to the end of April (OUPI, 2008).

The total mean annual rainfall from 1997 through 2006 is 955 mm and the highest rainfall is recorded in the month of July and the lowest in November. In terms of years, the maximum rain fall was registered in 2006 and the minimum in 2002. The actual temperature datum of the study area was not obtained and that of the *Bole* sub-city is considered. The rational is that the site is closer and elevation is nearly even to the *Bole* sub-city, i.e. 2302 m a.s.l. for *Sabata* town and 2354 m a.s.l. for *Bole* sub-city. According to this datum, the mean maximum and minimum temperatures for the years 1997 to 2006 are 21.99°C and 9.80°C respectively. The annual mean maximum and minimum temperatures were indicated in April and

November respectively. The climate data, rainfall and temperature, of the study area for the last 10 years obtained from the National Meteorological Service Agency are given in Figure 2.

Sabata 2302 m 15.90° 955 mm
[10]

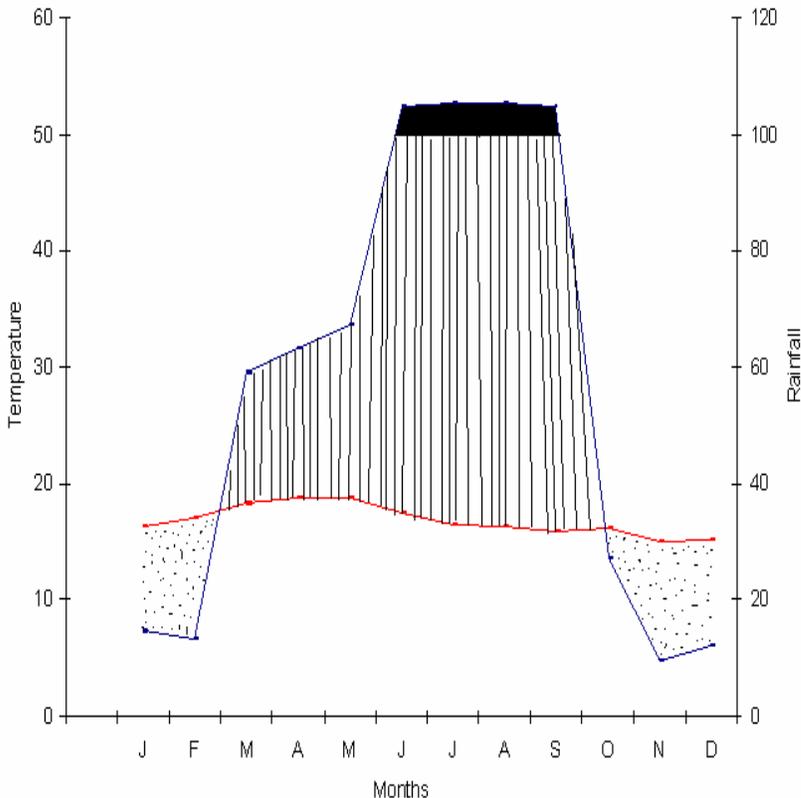


Fig. 2 Climadiagram of *Sabata* town based on 10 years data (1997-2006) from the National Meteorological Service Agency (NMSA), dry periods are dotted and wet periods are blackened

3.1.3 Soil

The soils of the study area as reported in OUPI (2008) are basically derived from Mesozoic sedimentary and volcanic rocks. Accordingly, the major soil types found in the area are Chromic and Orthic Luvisols (23.9%), and Chromic and Pellic Vertisols (76.1%). Chromic soils are soils with an argillic B-horizon, slight acid, high bases and low organic matter content. They occur in the highland areas of *Wachacha*, *Furi*, *Damota* and the northern and southern chains of ridges. Shallowness, stoniness, and erosion hazard and moisture limitations restrict their agricultural use. Luvisols are soils having an argillic B-horizon with a base saturation of 50% or more; lacking a mollic A-horizon, lacking an aridic moisture regime. They have good agricultural potentialities but stoniness and steep slopes are limiting factors of their agricultural uses (OUPI, 2008). Vertisols are dark montmorillonite-rich clays with characteristic shrinking / swelling properties. This group of soils with a high clay content (>30% to at least 50 cm from the surface) and in dry state with typical cracks which are at least 1 cm wide and reach a depth of 50 cm or more, are often also called heavy cracking clay soils (FAO, 2000). Chromic and Pellic Vertisols have relatively limited agricultural potentialities (RSIC, 2006).

3.1.4 Vegetation

The natural vegetation of the study area belongs to the montane forest only noticeable now from the limited remnants of adapted trees left as shade and fence genera like *Ficus* and *Olea*. *Eucalyptus* trees are found on hilly areas, in open spaces and within homesteads of *Sabata* town (OUPI, 2008). Only sparsely scattered vegetation types like shrubs, bushes, riverine woodlands along with planted and protected government and community forests are found dispersed in the *Sabata Awas* District (RSIC, 2006). There are nursery sites at *Sabata* River mouths owned by Finfinne Fuelwood Enterprise. In addition, in the absence of wildlife conservation area, the presence of diversified bird species and little wildlife was reported (OUPI, 2008). There is serious deforestation in the *Sabata Awas* District. This is because of rapid population growth, high

utilization of forest trees for construction and fuel wood purposes and rapid expansion of farm land in order to produce more crops to feed the rapidly growing population (RSIC, 2006).

3.1.5 People and Livelihoods

According to the 1994 Population Census of the Central Statistics Agency (CSA), the total population size of *Sabata* town was 14,076. Based on this size, the growth rate was computed by CSA for the consecutive years. Thus, in 2007 the total population of the town was projected to be about 26,342 (CSA, 1994). However, the *Sabata* Town Administration office reported that the current population size of the town (including *Dima*, *Alamganaa*, *Walate* and other rural villages that are administered under the local government of *Sabata* town) is estimated to be more than 110,000 (OUPI, 2008). The town has different ethnic composition. These include the *Oromo*, *Amhara*, *Guragie*, *Silte*, *Tigrie*, *Walayita*, *Dorzie*, *Gamo*, *Goffa*, *Konta*, *Dawro*, and others (CSA, 1994). This signified that the town is an area in which diverse ethnic groups live together in harmony and where there is dynamic flow and mix of cultures, practices and traditions for conserving agrobiodiversity. The people of the study area make their livelihoods on employment (in government offices and private organizations), small scale businesses (whole selling, retailing, grain & fruit shopping, grain milling), service related trade activities (hotels, restaurants, butcheries, clinics, pharmacies), occupations requiring skill (barbers and beauty salons) and urban agricultural activities (OUPI, 2008). In *Sabata*, families are known to produce surplus vegetables in home-gardens for the market in addition to the diverse products used for home consumption.

3.2 Sampling Techniques

A preliminary survey was undertaken by having a double trip to the study area to see if the prospective site is convenient to meet the objectives stated. The study site is selected due to the presence of well established traditional home-garden practices, easy accessibility and to cope with the expected financial restrains. A

total of two hundred forty houses were surveyed within the study area by employing random sampling technique for the presence of home-gardens, i.e. to quantify the frequency of home-gardens and to identify those with the front-yard, back-yard, side-yard and all round-gardens [80 houses from each of the three Kebeles, namely, *Sabata-01*, *Sabata-02 (Alamganaa)*, and *Sabata-03 (Walate)*]. Twenty-four of these home-gardens were preferentially selected since they were considered manageable for detailed study (data collection and analysis); eight from each of the three Kebele's where four of them were taken from Northwest of the highway and the other from Southeast of the highway in each case.

3.3 Data Collection

3.3.1 Vegetation Data

Sample plots of 10 m x 10 m (100 m²) were delimited in the study area giving a total of 24 quadrats (2400 m² or 0.24 ha). Plant specimens from twenty four of the representative home-gardens were collected, pressed, dried, and frozen, and were identified using the published volumes of the Flora of Ethiopia and Eritrea and by comparing them with the authenticated specimens housed at the National Herbarium (ETH), Addis Ababa University (AAU). Eventually, the accuracy of identification was checked and confirmed by a professional in the field. The vernacular names of plant species were recorded respective to their Latin names.

3.3.2 Ethnobotanic Data

Ethnobotanic techniques were employed to gather data from the peoples of the study area following Martin (1995). The techniques were semi-structured interview, informants' consensus, free listing, preference ranking, direct matrix ranking, paired comparison and market survey.

Semi-structured interview

Ethnobotanic data were gathered from the peoples of the study area by using pre-prepared semi-structured interviews comprising of twenty five questions (Appendix V). For interview and ranking purposes, 61 informants were selected from among home-garden owners. Ten of these were key informants that were chosen based on the information obtained from agricultural development agents of the Town Administration. The key informants were local experts that have better indigenous knowledge and management practices on home-garden plant species (planting practices, their nutritional and market values, and other traditional and socio-cultural activities). The ages of key informants ranged from 19 through 76 (8 males & 2 females). Discussions and guided home-garden tour took place with the informants as well.

Informants' consensus

Informant consensus is a group exercise in which local counterparts or collaborators reach consensus on the ranking of each item or vote according to their personal assessment (Martin, 1995). In order to confirm the reliability of information recorded during the interviews, the key informants were contacted at least twice for the likability of ideas and the validity of information. The idea of the informant that was inconsistent with the original version was rejected since it was considered unreliable.

Free listing

Free listing method was used in the present study in which case home-garden plant species were listed categorically that helped characterize variation in gardening knowledge and practices among gardeners. Consequently, fifty-one informants (seventeen from each site) were preferentially selected and allowed to freely list their garden flora.

Preference ranking

Preference ranking was made for ten widely used food crops in home-gardens by ten key informants. The food crops were selected based on their frequencies of occurrence in 51 home-gardens of the study area. Each rank is described by integer values 1 to 10. The most valuable food crop is rated the highest value of 10 while the least valuable is described by a value of one. The overall rank for the species was determined by adding up these values for all respondents.

Direct matrix ranking

Direct matrix ranking method was conducted wherein the key informants were requested to rank six home-garden tree species with multiple uses. The plant species were selected depending on the consensus of the key informants. Based on relative benefits obtained from each plant, the informants were asked to assign value (1 to 6: 6, best & 1, least) to each attribute. The list of attributes included were construction, implements, fuelwood, shade, live fence and medicine. By summing up the scores it was possible to compare the plant species with multipurpose and examine among the different use criteria.

Paired comparison

Paired comparison was carried out for five most desirable food crops of home-gardens that have market utility. The selection of these vegetable crops was based on collective opinion of the informants and by undertaking survey of markets in the study area. The five garden plants were alphabetized, have been randomized for the sequence of the pairs and the order within each pair. Then, the informants were requested to tell the items that have more market demand and value from the pairs. Normally, pair wise ranking is exercised with relatively small number of items since the time required to accomplish the task increases exponentially as one adds additional items. The total number of pairs needed is given by the algorithm $n(n-1)/2$, where n is equal to the number of items (Martin, 1995).

Market survey

Ethnobotanic market survey was carried out in the study area by talking with the producers, sellers and consumers in order to collect information on the condition as to how garden produces are sold (fresh, dried, preserved), management of the resources (cultivated, managed, wild) and availability of the products (ones or twice per year, year round). This information helps to find out about home-garden produce having market values in the local areas as well as outside *Sabata*, mainly in Addis Ababa.

3.4 Data analysis

The ethnobotanical data gathered following the methods described in Martin (1995) were analyzed and summarized using percentages and descriptive statistical methods like frequencies, relative frequencies, densities and relative densities. Shannon and Wiener (1949) index of species diversity, Sorensen's similarity coefficient and cluster analysis were also used.

Frequency

Frequency describes the distribution of a species through a stand. It is determined by calculating the percentage of plots / quadrats in a sample area on which a given species occurs.

$$F = \frac{\text{Number of quadrats in which a species occurs}}{\text{Total number of quadrats in the sample}} \times 100$$

This was applied to find out the frequency of home-gardens in the study area or the frequency of plant species in the quadrats of home-gardens; where the number of houses with home-gardens or the number of quadrats in which a species occurs was divided by the total number of houses or total number of quadrats respectively and multiplied by 100.

Relative frequency

Relative frequency is the distribution of one species in a sample relative to the distribution of all species.

$$\text{Relative frequency} = \frac{\text{Frequency of a species in the sample}}{\text{Total frequency of all species in the sample}} \times 100$$

This method was applied to calculate the frequency of plant species in the quadrats of 24 home-gardens of the study area divided by the total frequency of all plant species in the sample and multiplied by 100.

Density

Density is the average number of individuals of a species on a unit area basis.

$$\text{Density} = \frac{\text{Number of individuals in the sample}}{\text{Total area of the sample (m}^2\text{)}}$$

This method was used to compute the number individuals of tree species in the 24 quadrats of home-gardens of the study area divided by the total area of of the sample.

Relative density

Relative density is the density of one species relative to the density of all species.

$$\text{Relative density} = \frac{\text{Number of individuals of a species in the sample}}{\text{Total number of individuals of all species in the sample}} \times 100$$

This method was applied to compute the number individuals of tree species in the quadrats of 24 home-gardens divided by the total number of individuals of all tree species.

Shannon and Wiener diversity index

Shannon and Wiener (1949) index of species diversity was applied to quantify species diversity and richness. This method is one of the most widely used approaches to measure the diversity of species. The diversity of each cluster was calculated using this index based on the frequency of species as input source.

$H' = -\sum (p_i \ln p_i)$, where H' is Shannon and Wiener diversity index, ' P_i ' is the proportion of each species in the sample; ' \ln ' is the natural logarithm to the base e (\log_e). Values of the index usually lie between 1.5 and

3.5 although in exceptional cases, the value can exceed 4.5. The higher the value of H', the more diverse the species are within the site. Evenness J is equal to the H' divided by maximum possible diversity i.e. $J = H' / H' \text{ max}$, where 'J' is species evenness, H' is Shannon and Wiener diversity index and 'H max' is $\ln S$ where S is the number of species. The values for evenness range from 0 to 1. Equitability near zero shows the site to be dominated by one species, while a value near 1.0 shows it to have equal balance between all species.

Sorensen coefficient

Similarity indices measure the degree to which the species composition of quadrats or sample matches is alike. This coefficient of similarity (S_s) is defined using the formula: $S_s = 2a / 2a + b + c$, where

S_s = Sorensen's similarity coefficient, a = number of species common to quadrats / samples, b = number of species in quadrat / sample 1 and c = number of species in quadrat / sample 2. The coefficient values range from 0 (complete dissimilarity) to 1 (total similarity) (Kent and Coker, 1992).

Cluster analysis

The method of multivariate data analysis method called cluster analysis or similarity analysis was also used to cluster the informant's responses and confirm the degree of homogeneity. This clustering algorithm was implemented by using PC-ORD Version 4.0 Statistical Software Package (McCune, B. and Mefford M. J., 1999).

4. Results

4.1 The Type, Size and Vegetation Structure in Home-gardens of Sabata

The survey of home-gardens in the study area indicated that 78% of the households in *Sabata* town practice home-gardening with 32% having their home-gardens as front-yards only, 24% as a combination of front and side-yards, and back yards as well as others being of a lower proportion (1-9%). The frequency of home-gardens surveyed in the study area is given in Table 1. The sizes of home-gardens in the study sites ranged from 72 m² to 2520 m² and the average being 507.23 m². The extremes are 20 m² and 3570 m², the former in *Sabata 01 Kebele* and the latter in *Sabata 02 Kebele (Aalamganaa)*. Home-gardens of the area have different shapes. Some encircle the house; others are square, rectangular or irregular.

Table 2. Frequency of home-gardens surveyed in the study area

Site/ Keble	No. of houses surveyed	Houses with home-gardens	Front-yard gardens only	Back-yard gardens only	Side-yard gardens only	Front-yard and back-yard gardens	Front-yard and side-yard gardens	Back-yard and side-yard gardens	All round gardens
<i>Sabata-01</i>	80	65	30	3	8	2	19	1	5
<i>Sabata-02/ Alamganaa</i>	80	55	28	—	6	—	20	—	2
<i>Sabata-03/ Walate</i>	80	66	19	1	—	7	18	1	16
Total	240	186	77	4	14	9	57	2	23
%		77.5	32.1	1.66	5.83	3.75	23.75	0.83	9.58

Home-gardens of the study area house a collection of multi-purpose trees, shrubs, annual and perennial crops that are under the care and management of family members. These gardens are multi-layered as they

contain plants of different heights which give them a complex vertical structure. The height distribution of plant species of home-gardens of the study area was visually estimated as: the uppermost stratum (emergent layer) consisted of trees of approximately greater than 15 m like *Ficus sur*, *Eucalyptus camaldulensis* and *E. globulus*. Shade trees (*Cordia africana*, *Acacia abyssinica* and *Ficus thonningii*) and fruit trees (*Persea americana*, *Casimiroa edulis* and *Morus alba*) dominate the upper storey / canopy layer (10-15 m). *Citrus aurantifolia*, *Citrus sinensis*, *Malus sylvestris*, *Ensete ventricosum*, *Coffea arabica* and *Psidium guajava* occupy the middle-storey (5-10 m). The lower layer (1-5 m) constitutes *Buddleja davidii*, *Catha edulis*, *Salix mucronata*, *Lippia adoensis* var. *koseret* and *Ocimum lamiifolium*. Then, there is a ground layer / lowest layer (less than 1 m) of herbaceous species such as *Cyperus alternifolius*, *Brassica carinata*, *Solanum tuberosum*, *Ocimum basilicum*, *Cymbopogon citratus*, and *Mentha spicata*.

With regards to the horizontal structure, the diversity of plant species decline as one goes from home-gardens to the outfields particularly for those gardens which are located at the peripheral sites of the town. The spatial and temporal arrangement of plant species vary from one garden to the other. The representative sketch of a common home-garden from *Sabata 01 Kebele* is given in Figure 3. Accordingly, ornamental plants like *Iresine herbstii*, *Euphorbia milii* and *Nephrolepis undulata* occupied the veranda of a house as potted plants or the space closer to it. Medicinal plants such as *Ruta chalepensis* and *Ocimum lamiifolium*, spices like *Ocimum basilicum* and *Lippia adoensis* var. *koseret* are planted near the ornamental plants, vegetables like cabbage (*Brassica oleracea* var. *capitata*), onion (*Allium cepa*), garlic (*Allium sativum*), Ethiopian kale (*Brassica carinata*), chilies (*Capsicum annum*) and many others are placed on a terraced ground. Fruit trees such as casmir (*Casimiroa edulis*), avocado (*Persea americana*) and shade trees such as *Ficus elastica* and *Podocarpus falcatus* are planted on the inside margins next to the fence. Crop plants like enset (*Ensete ventricosum*) and banana (*Musa paradisiaca*) are grown on the depression close to

the live fences. Perennial trees like *Olea europaea* sub sp. *cuspidata*, *Cupressus lusitanica* and shrubs like *Dovyalis caffra* and *Justicia schimperiana* are used as live fences.

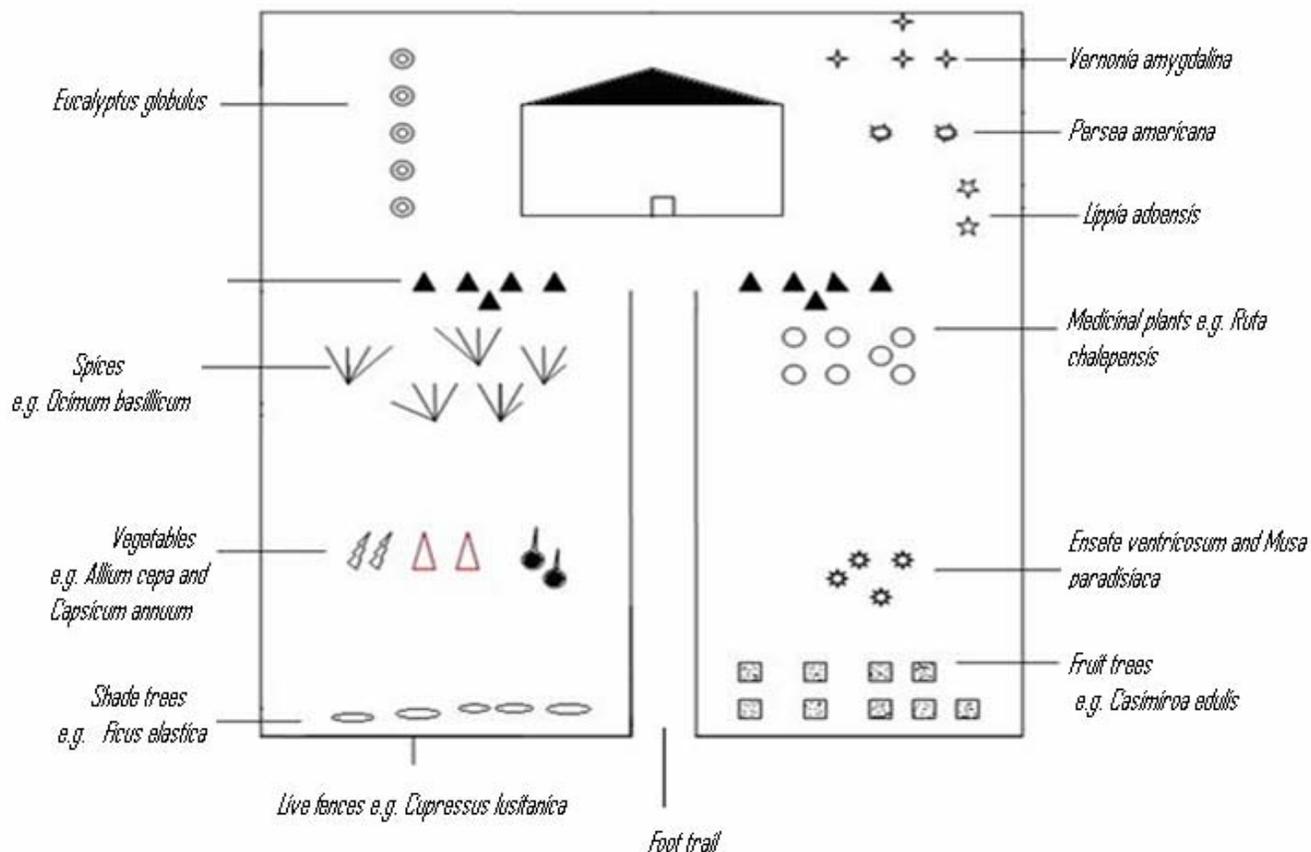


Fig. 3 Sketch of a common home-garden in Sabata town

4.2 Plant Diversity and Factors that Govern Plant Composition in the Home-gardens of Sabata Town

A total of 135 plant species were recorded from the study area (Appendix I). These plant species were classified into 110 genera and 58 families. Out of these, 132 were identified to the species level and 3 to the genus level. In terms of the number plant species home-gardens contain, the Fabaceae family stood first with 13 species (9.63%). Lamiaceae and Asteraceae with 9 (6.66 %) each, Rutaceae, Rosaceae and Solanaceae 6 (4.44 %) each, and Moraceae and Myrtaceae 5 each (3.70 %) assumed the second, third and fourth ranks respectively. Family Euphorbiaceae included 4 (2.96 %) plant species each followed by

Cupressaceae and Poaceae which contain only 3 (2.22 %) species each. The habits (trees, shrubs, herbs and lianas) and percent of all plant species recorded from the study area are summarized in Figure 4. Eleven plant species with the highest relative frequencies of occurrence in 24 home-gardens were also identified in this study. Among them, *Ensete ventricosum* had the highest frequency followed by *Rosa hybrida* and *Vernonia amygdalina* (Table 3).

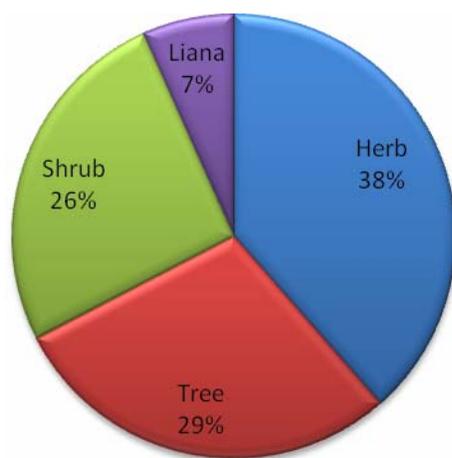


Fig. 4 Habit and percentage of all species

The proportions / percentages of functional groups in the study area were calculated in which case live fences indicated an average of 5.8 (17.3 %) species, medicinal plants 4.56 (13.6%) and shade trees 4.36 (13%) which accounted for the first, second and third ranks respectively. Utility plants constituted an average of 3.62 (10.82%), fruits 3.58 (10.7 %), ornamentals 3.35 (10 %), vegetables together with roots, stems and sugars make up 3.96 (11.8%), while the other groups (pulses, fuelwoods and non-food spices) occurred in small proportions. However, when the proportion of food plant groups was considered viz., fruits, vegetables, spices, roots, tubers and sugars altogether make the functional groups with the highest species proportion 7.98 (23.85 %). The mean proportions of functional groups per garden which are

obtained by the free listing of 51 home-garden owners from the three *Kebeles* of the study area are given in Figure 5 based on Appendix II.

Table 3. Eleven plant species with the highest frequencies and relative frequencies of occurrence in the 24 home-gardens of the study area

Scientific name	% Frequency	Relative % frequency
<i>Ensete ventricosum</i>	91.60	2.71
<i>Rosa hybrida</i>	87.50	2.59
<i>Vernonia amygdalina</i>	87.50	2.59
<i>Cupressus lusitanica</i>	75.00	2.22
<i>Cyperus alternifolius</i>	70.83	2.09
<i>Nephrolepis undulata</i>	70.83	2.09
<i>Ruta chalepensis</i>	70.83	2.09
<i>Dovyalis caffra</i>	66.60	1.97
<i>Lippia adoënsis</i>	66.60	1.97
<i>Persea americana</i>	62.50	1.85
<i>Rhamnus prinoides</i>	62.50	1.85

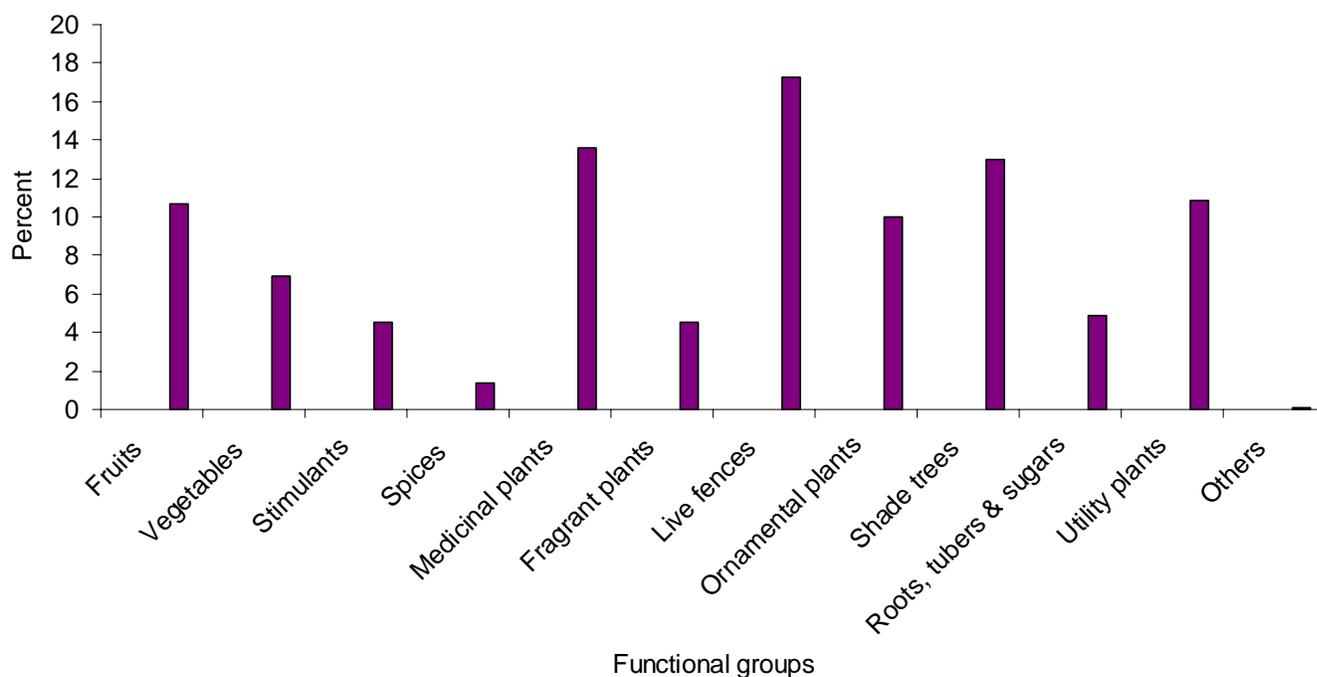


Fig. 5 Mean proportion of functional groups of plants per garden

From the total tree species identified in this study (Appendix III) *Cupressus lusitanica* is the most abundant (1500 individuals) and has the highest relative density (0.019) followed by *Eucalyptus camaldulensis* with an abundance of 1125 individuals and relative frequency of 0.014. However, *Persea americana*, *Eucalyptus globulus*, *Casimiroa edulis* and *Juniperus procera* showed lower densities but equal relative densities. Eleven tree species with the highest abundance (number), densities and relative densities of occurrence in the 24 home-gardens of the study area are given in Table 4. From the computation of vegetation data in the home-gardens of *Sabata* town Shannon Wiener diversity index revealed the out put in Table 5. The six sites of the study area attained diversity indices greater than 4.0. Sites S_1 and A_4 are the most diversified with the diversity indices of 4.357 next to site W_5 ($H'= 4.394$). Smaller diversity indices were indicated in the S_2 and W_6 sites with $H'= 4.290$ and $H'=4.234$ respectively, the lowest being in A_3 ($H=4.174$). Sites W_5 and A_3 have the highest and smallest number of species respectively. Equal evenness values ($J= 1.000$) were

obtained for the six research sites. In addition, highest floristic similarity index (0.43) was observed in the clustered home-gardens at sites A₄ and W₅. However, relatively the weakest similarity coefficient (0.35) was obtained for sites S₁ and W₆ (Table 6).

Table 4. Six tree species with the highest abundance (number), densities and relative densities of occurrence in the 24 home-gardens of the study area

Scientific name	Abundance/ Number	Density	Relative density (%)
<i>Cupressus lusitanica</i>	1500.000	0.625	0.019
<i>Eucalyptus camaldulensis</i>	1125.000	0.469	0.014
<i>Persea americana</i>	63.000	0.026	0.001
<i>Eucalyptus globulus</i>	58.000	0.024	0.001
<i>Casimiroa edulis</i>	53.000	0.022	0.001
<i>Juniperus procera</i>	41.000	0.017	0.001

Table 5. Shannon-Wiener Diversity Index (H') and Evenness (J) for the six research sites

Research sites	Species richness	Shannon's index (H')	Evenness (H' / H' max)
S ₁	78	4.357	1.000
S ₂	73	4.290	1.000
A ₃	65	4.174	1.000
A ₄	78	4.357	1.000
W ₅	81	4.394	1.000
W ₆	69	4.234	1.000

Note: For S₁, S₂, A₃, A₄, W₅ and W₆ refer to Table 1

Table 6. Sorensen's similarity index for plant species composition in the clustered home-gardens

Clustered home-gardens	S ₁	S ₂	A ₃	A ₄	W ₅	W ₆
S ₁	1.00					
S ₂	0.40	1.00				
A ₃	0.38	0.39	1.00			
A ₄	0.40	0.41	0.41	1.00		
W ₅	0.38	0.40	0.38	0.43	1.00	
W ₆	0.35	0.38	0.37	0.40	0.42	1.00

Various factors affect the diversity of plant species in the study area. Fifty-one home-garden owners of the area on the average identified more than two factors which they considered to affect plant composition in their gardens. Garden size, water availability, agricultural support system, land-holding system, management system, socio-economic condition, biological determinants and lack of awareness are among the factors that were frequently mentioned by the owners of home-gardens. Factors that affect home-garden plant diversity and respondents' frequencies are given in Table 7. In addition, pollution, stream cuts, erosion, rugged topography and quarry were also observed in the study area as potential environmental constraints.

Table 7. Factors that affect home-garden plant diversity and respondents' frequencies

Factors	Frequency	Remark
Garden size	19	
Water availability	31	
Agricultural support system	15	
Land-holding system	26	Land tenure

Factors	Frequency	Remark
Management system	11	
Socio-economic condition	22	
Biological determinants	8	Insect pests
Lack of awareness	3	
Total frequency	135	

4.3 Comparisons of Most Desirable Food Crops of Home-gardens that have Market Utility

There are two market centers in *Sabata* town (*Sabata Gebeya* in *Sabata 01 Kebele* and *Aalamganaa Gebeya* in *Sabata 02 Kebele*) where plant products and germplasm are marketed. There is no market center in *Sabata 03 Kebele / Walate*; producers of this *Kebele* mostly sell their garden produces in Addis Ababa on account of its proximity and cost of the products. Plant products of home-gardens of the area and field crops of the immediate vicinities are exchanged in these markets. These include fruit crops like *Casimiroa edulis*, *Psidium guajava*, *Citrus sinensis*, *Citrus aurantifolia*, *Mangifera indica*, and *Musa paradisiaca*; vegetables like *Brassica oleracea var. capitata*, *Lycopersicon esculentum*, *Capsicum annuum*, *Cucurbita pepo*, *Allium cepa*, and *Allium sativum*; tubers like *Solanum tuberosum*; medicinal plants like *Ruta chalepensis*, *Withania somnifera*, *Artemisia absinthium* and *Artemisia afra*; spices like *Ocimum basilicum*, and *Lippia adoensis* var. *koseret*; fragrant plants like *Rosmarinus officinalis* and *Olea europaea* sub sp. *cuspidata* and utility plants like *Cyperus alternifolius*. The sellers of garden products asserted during the survey of markets and discussions that most of their produces are cultivated. The abundance and diversity of these plant species decrease during dry season and increase in the rainy season especially for the herbaceous ones. Moreover, some home-garden owners of the study area accounted that on the average

about 5 quintals of potato, 6 quintals of carrot, 50 bundles of Ethiopian kale, 50 kg of tomato and 1000 heads of cabbage were estimated to be produced per garden per growing season.

Pair wise comparisons, using ten key informants, of five most desirable food crops of home-gardens that have market utility gave potato (*Solanum tuberosum*) in the first rank with a score of 30. Ethiopian kale (*Brassica carinata*) with a score of 22, and cabbage (*Brassica oleracea var. capitata*) with 19 in the second and third places respectively (Table 8 and 9).

Table 8. Ten key informants' pair wise comparisons for five most desirable food crops of home-gardens that have market utility (the total indicates the sum of the items that are given in bold face and which are also most preferred from each pair)

Pair	Order	Items	Respondents (R)										Total
			R ₁	R ₂	R ₃	R ₄	R ₅	R ₆	R ₇	R ₈	R ₉	R ₁₀	
4	1, 5	Carrot, Tomato	To	To	To	To	To	To	To	Ca	Ca	Ca	7
6	2, 4	Ethiopian kale, Potato	Eth ka	Po	Po	Eth ka	Po	Po	Po	Eth ka	Po	Po	7
5	2, 3	Ethiopian kale, Cabbage	Eth ka	Cab	Eth ka	Cab	Eth ka	Cab	Eth ka	Eth ka	Eth ka	Cab	6
7	2, 5	Ethiopian kale, Tomato	Eth ka	Eth ka	To	Eth ka	Eth ka	To	To	Eth ka	Eth ka	To	6
1	1, 2	Carrot, Ethiopian kale	Eth ka	Eth ka	Ca	Eth ka	Eth ka	Eth ka	Eth ka	Eth ka	Ca	Ca	7
8	3, 4	Cabbage, Potato	Po	Cab	Po	9							
2	1, 3	Carrot, Cabbage	Cab	Cab	Cab	Cab	Cab	Cab	Cab	Ca	Ca	Ca	7
10	4, 5	Potato , Tomato	To	To	Po	Po	To	Po	Po	Po	Po	Po	7
3	1, 4	Carrot, Potato	Po	Ca	Po	Po	Po	Po	Po	Po	Ca	Ca	7
9	3, 5	Cabbage , Tomato	Cab	Cab	Cab	Cab	To	Cab	To	To	To	Cab	6

Ca=Carrot, Cab=Cabbage, Eth ka=Ethiopian kale, Po=Potato, To=Tomato

Table 9. Summary of the grand total scores and ranks for Table 8

Items	Total score	Rank
Carrot	12	5
Cabbage	19	3
Ethiopian Kale	22	2
Potato	30	1
Tomato	18	4

4.4 Important Home-garden Tree Species with Multiple Uses

People of the study area have the tradition of using various tree species found in their home-gardens for different purposes viz., building materials, house furniture and equipment / tools, fuelwoods, shades, compound enclosures, and for their therapeutic importance. The results of 10 key informants direct matrix ranking for six home-garden tree species with multiple uses i.e. based on six use criteria is given in Table 10. The tree species were chosen depending on the key informants' consensus. Accordingly, *Eucalyptus globulus* with a total score of 240 (19.05 %) ranked first. *Acacia abyssinica* and *Juniperus procera* with 233 (18.49 %) and 226 (17.94 %) assumed the second and third positions respectively. *Eucalyptus globulus* was given the highest score for construction, *Cordia africana* for implements / tools, *Acacia abyssinica* both for fuel wood and shade, *Juniperus procera* for live fence and *Croton macrostachyus* for its medicinal use.

Table 10. The results of ten key informants' direct matrix ranking for six home-gardens tree species with multiple uses (6, best; 1, least)

Use criteria	Tree species					
	<i>Cordia africana</i>	<i>Croton macrostachyus</i>	<i>Eucalyptus globulus</i>	<i>Juniperus procera</i>	<i>Acacia abyssinica</i>	<i>Acacia mearnsii</i>
Construction	32	15	59	49	21	34

Use criteria	Tree species					
	<i>Cordia africana</i>	<i>Croton macrostachyus</i>	<i>Eucalyptus globulus</i>	<i>Juniperus procera</i>	<i>Acacia abyssinica</i>	<i>Acacia mearnsii</i>
Implements	59	30	18	37	45	21
Fuelwood	30	18	48	17	55	42
Shade	50	31	14	30	53	32
Live fence	27	20	49	53	30	31
Medicine	19	58	52	40	29	12
Total score	217	172	240	226	233	172
Rank	4	5	1	3	2	5

4.5 Food Plants of Home-gardens for Nutrition and Food Security

The cultivated garden plants are composed of both food and non-food species. Thirty-seven species that are distributed among 29 genera and 22 families were documented as food plants in the present study (Appendix IV) and these accounted for 27.40% of the total species identified. Among these, 45.95% of the species were fruit crops and 29.73% were vegetables. Pulses together with spices constituted 13.51% and root, tuber and sugar crops comprised 10.81%. The largest number for these cultivated plants goes to herbs (48.65%), and the fruits are the most usable parts (54.05%). Family Rutaceae is represented by 5 species, Brassicaceae by 4 species, Rosaceae, Fabaceae and Solanaceae by 3 species each. Alliaceae and Musaceae by 2 species each and all the rest are represented by only 1 species each. The diverse food crops of home-gardens of *Sabata* have relevant significance to increase household food production and to improve the nutritional status of low income households. According to information obtained from *Sabata* Health Center, Oedema (Kwashiorkor), Wasting (Marasmus), iron and vitamin A deficiencies are the most frequently recurring problems of malnutrition for children under age five from 2007 to 2008. Based on growth monitoring and promotion chart (scale), the body weights of these children dropped below 60% which

signifies severe malnutrition. Severe under nutrition cases were often reported from *Sabata 03 Kebele* (*Walate*). In accordance with the evidence obtained from families with well established home-gardens and those who sell their surplus produce in the market, there are significant improvements on their income and on the status of food security as well.

Ten key informants' were also asked to rank ten widely used food crops that were selected based on their consensus and by tallying the most frequent species in the free listing of 51 home-garden owners. The scores given to each species as per informants' preferences were added and ranked. Consequently, *Persea americana* ranked first (Table 11). Cluster analysis was made to confirm this result and the degree of similarity between the responses of informants' and shown in Figure 6.

Table 11. Simple preference ranking for widely used food crops in home gardens (1-10): 10- most valuable, 1- least valuable

Species name	Scores given by Key Informants / Respondents (R)										Total score	Rank
	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆	R ₇	R ₈	R ₉	R ₁₀		
<i>Casimiroa edulis</i>	4	1	6	1	6	7	4	1	2	7	39	8
<i>Citrus sinensis</i>	10	7	5	8	5	10	9	5	6	9	74	2
<i>Ensete ventricosum</i>	1	6	10	7	1	4	5	10	10	10	64	3
<i>Malus sylvestris</i>	6	2	7	10	10	6	10	3	4	2	60	5
<i>Mangifera indica</i>	2	9	8	5	8	9	8	4	3	6	62	4
<i>Musa paradisiaca</i>	7	10	1	3	4	8	6	9	5	3	56	6
<i>Persea americana</i>	5	8	9	9	9	5	7	8	9	8	77	1
<i>Prunus domestica</i>	8	5	2	6	7	1	1	2	1	1	34	10

Species name	Scores given by Key Informants / Respondents (R)										Total score	Rank
	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆	R ₇	R ₈	R ₉	R ₁₀		
<i>Psidium guajava</i>	3	4	3	2	3	2	2	6	7	5	37	9
<i>Saccharum officinarum</i>	9	3	4	4	2	3	3	7	8	4	47	7

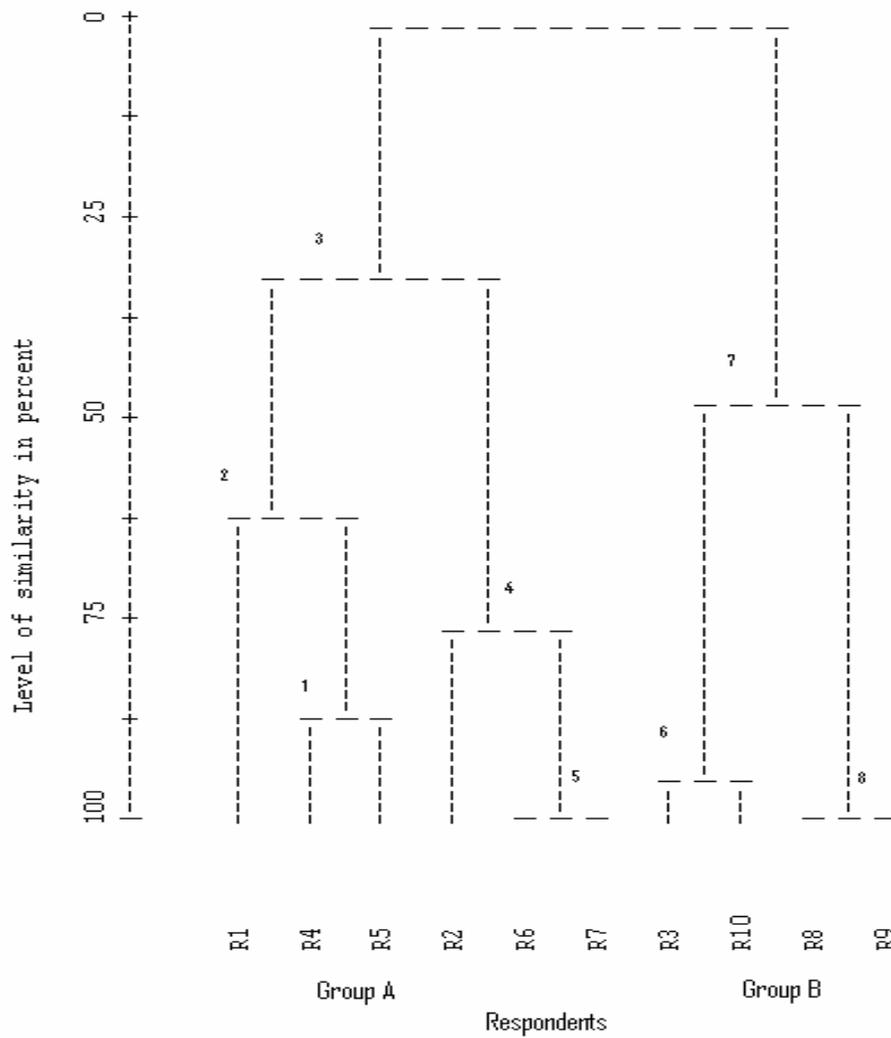


Fig. 6 Dendrogram showing the similarity of responses to the widely used food plants

4.6 Home-garden Plant Species of Sabata with Medicinal Uses

From the total plant species recorded in this study about 24 species (17.77%) from 22 genera and 17 families serve the community as traditional medicinal plants. Species of the families of Asteraceae and Lamiaceae were the most used and each accounted for 16.6% of the total medicinal plants. Herbs were the major medicinal plants (54.16 %) succeeded by shrub species (29.16 %) and leaves (75%) were the most frequently used plant parts. The common traditional medicinal plants utilized by people of the study area are given in Table 12 along with health problems, method of preparation and use.

Table 12. Plant species with medicinal uses [All names are Oromo names except when indicated by asterisk (*) in which case Amharic names are used]

Species name	Vernacular name / Afaan Oromo	Part used	Health problems	Method of preparation and use
<i>Ajuja integrifolia</i>	Armaguussa	Leaf	Lack of appetite, Abdominal pain	Leaf extract is taken with water for stomach complaint
<i>Allium sativum (Nc)</i>	Qullubbii-adii	Bulb	Flue, Malaria, Headache, Abdominal pain	The bulb is eaten (raw or boiled)
<i>Artemisia absinthium</i>	Arritti	Leaf	Evil-eye	The fragrant leaves are used to be protected against the evil eye
<i>Artemisia Afra</i>	Jukunn	Leaf	Evil-eye, Abdominal pain, Cough	The fragrant leaves are used to be protected against the evil spirit Leaf extract is used to treat stomach disorder in children
<i>Calpurnia Aurea</i>	Ceekaa	Root	Hemorrhoid	The roots are pounded, mixed with water and are taken orally to give medical care for hemorrhoid
		Seed	Veterinary diseases	The seeds are crushed, mixed with food and are given to rabid dogs
<i>Commelina sp.</i>	Hoolaagabbis	Stem sap	Ring worm (Tinea corporis)	The sap extracted from the stem is rubbed on the infected skin
		Stem	Amoebiasis	The stem is chewed to relieve amoebiasis
<i>Croton macrostachyus</i>	Bakkannissa	Leaf sap	Ring worm (Tinea corporis)	The sap extracted from the stem is rubbed on the infected skin
<i>Cymbopogon citrates</i>	Tejsar*	Root	Abdominal pain	The root is chewed to treat abdominal colic
			Evil-spirit	The fragrance of leaves is used to safeguard from the evil spirit

Table 12 (Continued)

<i>Datura stramonium</i>	Asangira	Leaf	Wounded scalp	The leaf is squeezed and the extract is smeared on the wounded scalp especially in children
<i>Ensete ventricosum (Nc)</i>	Kocho-dimma / Warqee	Corm	Broken limbs	The underground corm is boiled and is eaten to recover from injured limbs
		Leaf	Expel after birth (placenta) in cattle	Juice of the plant is employed
<i>Eucalyptus globulus</i>	Baargamoo-adii	Leaf	Flue, Cough	The leaf is boiled and the steam is inhaled
<i>Foeniculum vulgare</i>	Insilaalaa	Leaf	Abdominal pain, Hypertension	The leaves boiled with tea or coffee is drunk for stomach complaint and hypertension
			Flue, Evil-eye	The fragrant leaves are used against flue and the evil-eye
<i>Hagenia abyssinica</i>	Heexoo	Flower	Tape worm Expellant	Dried and pounded female inflorescence (flower) is mixed with water and taken orally as a taenicide against <i>Taenia saginata</i>
<i>Juniperus procera</i>	Gaattiraa	Leaf	Flue	The leaves are boiled together with <i>Eucalyptus globulus</i> and <i>Ocimum lamiifolium</i> , and the steam is inhaled
<i>Justicia schimperiana</i>	Dhummuugaa	Leaf / Root	Skin rash	The body is washed with boiled leaves to treat skin rash
			Sexually Transmitted Diseases (STDs), Jaundice	The root is grinded, mixed with water and is drunk to treat venereal diseases and jaundice
<i>Lepidium sativum</i>	Feechoo	Seed	Constipation, Diarrhoea, Skin rash	The seeds are grinded, mixed with lemon and water and are taken orally to cure constipation and diarrhoea or rubbed on the skin to treat skin rash
<i>Mentha spicata</i>	Nana*	Leaf	Constipation, Hemorrhoids, Difficulty in urination	The leaves are boiled with tea and are taken orally
<i>Ocimum lamiifolium</i>	Qoricha-michii Yeken damakese*	Leaf	Headache, Abdominal pain	The infusion of leaf is snuffed or the extracted fluid is taken orally with coffee and used as analgesic and amoebicide agents

Table 12 (Continued)

<i>Ocimum urticifolium</i>	Qoricha- michii (Anchabbii) Yelelit damakese*	Leaf	Abdominal pain, Evil-spirit	The leaves are squeezed and the fluid is taken orally with coffee to recover from abdominal pain or rubbed on the skin to be protected from the evil spirit
<i>Punica granatum (Nc)</i>	Romaana	Leaf	Expel tape worm	Decoction of the leaf is reported to be used as a tape worm remedy
<i>Ruta Chalepensis</i>	Ciraakkota / Chilatamaa	Leaf	Abdominal pain Evil eye, Evil-spirit	Leaf extract is taken orally or the leaves are chewed to heal abdominal pain The fragrance of leaves are also used to be protected from the evil-eye and evil-spirit
<i>Vernonia amygdalina</i>	Eebicha	Leaf	Abdominal pain, Intestinal parasites, Veterinary diseases	Leaf extract (fluid) is taken orally
<i>Withania somnifera</i>	Gizawa*	Leaf	Abdominal pain	Leaf extract (fluid) is taken orally
<i>Xanthium strumarium</i>	Deha-nikel*	Leaf	Cutaneous candidiasis	The inflicted skin is rubbed with the leaves

Nc – Nutraceutical

- For authorities, family names and habits refer to Appendix I

4.7 Indigenous Knowledge and Home-garden Management Practices in Sabata Town

Various management practices are carried out in the home-gardens of *Sabata* town which manifests their indigenous knowledge. These activities helped to grow high diversity of plant species in their traditional gardens. From a total of 135 species identified in the present study, the maximum number of these species per garden is 57, the minimum is 13, and the average being 33.29 (23.61 %). The diverse plants in home-gardens of the study area are selected according to the needs and preferences of the family members. Plant species with priority importance such as food and medicinal or for market purpose are duly cultivated in their gardens to satisfy their immediate or long-term requirements. The sources of plants for the area are small scale commercial nurseries, through exchange with other gardeners (friends or relatives), and the provision of local government body, mainly seedlings of some plant species such as *Coffea arabica*, *Malus sylvestris*, and *Grevillea robusta* targeting nutritional benefits, environmental protection (climate change) and aesthetic value.

Management activities are also carried out with minimal ecological cost due to the low utilization of chemical inputs. The fertility of soil is maintained by incorporating organic fertilizers such as house refuses, animal manures (where ever there are barnyards) and crop residues. Garden pests like termites that damage tuber crops such as *Solanum tuberosum* are controlled by spreading ash on the soil. Some gardeners forwarded that plant species like *Sesbania sesban* are also used to enrich the fertility of soil. Home-garden owners of the study area do have accumulated indigenous knowledge on seed selection methods. These include color of seeds (e.g. black for *Eucalyptus* spp., red for *Cupressus lusitanica*), maturity (mature seeds are preferable as in the case of *Brassica carinata*), crop yield, quality, disease and drought resistance.

Some home-garden owners of the study area have a profound traditional knowledge on the classification scheme and methods of preparation of *Ensete ventricosum*. They stated that the plant is beneficial for different purposes such as food, medicine, fiber and wrapping material for food and non-food items. The corm (modified under ground stem) of a mature plant is chopped, boiled and is eaten. Both pseudostems and corms are scraped by the skilled women and are used for *Bulla* porridge or the chopped and grated pulp of the corms and leaf sheaths is fermented and used as flour in making *kocho* bread (as baked flat cake). If it is not required for immediate use, the scraped material is buried and allowed to ferment being wrapped by *enset* leaves and can be preserved for about seven years without spoilage. Some gardeners of the area, particularly those from the *Guragie* ethnic group, suggested that there are about 70 varieties of *Ensete ventricosum*. Eighteen landraces (farmers' varieties) of these nutritionally and culturally valued crop plant identified by the owners of home-gardens are given in Table 13 along with their uses. The classification was based on the color of pseudostem, leaf midribs, early maturity, function, product quality and disease resistance.

There is good collaboration among the households with regards to home-garden management. In some home-gardens where women are house wives and husbands are engaged in other activities (as employees of government / private institutions or manage their own businesses), women and children shoulder most of the gardening tasks and the husbands participate during their spare times. However, in places where both husbands and wives make their livelihoods on gardening, the husbands fully devote their due time and energy on garden works such as home-garden design / architecture, soil preparation, bringing the required plant materials, deciding cropping pattern, sowing and planting, pruning (esp. *Coffea arabica* and flowers) and the wives take part mostly in the indoor activities eventhough they assist by watering, dumping of animal manures and kitchen wastes, weeding, harvesting, and selling garden products. During their extra

times the children also engage in garden activities like soil preparation, weeding, watering, harvesting and in selling the produce.

Table 13. Eighteen landraces (farmers' varieties) of *Ensete ventricosum* recognized by the house holds interviewed in Sabata town, Walate 03 Kebele

Local variety name	Use
<i>Agadie</i>	Food, Fiber, Fodder
<i>Ankefye</i>	Food, Fiber, Fodder
<i>Astara</i>	Medicinal, Fiber, Fodder
<i>Badediet</i>	Food, Fiber, Fodder
<i>Beneshe</i>	Food, Fiber, Fodder
<i>Chehuye</i>	Food, Fiber, Fodder
<i>Cheswe</i>	Food, Fiber, Fodder
<i>Deriye</i>	Medicinal, Fiber, Fodder
<i>E'herye</i>	Food, Fiber, Fodder
<i>E'kuafye</i>	Food, Fiber, Fodder
<i>Fereziye</i>	Food, Fiber, Fodder
<i>Guariye</i>	Medicinal, Fiber, Fodder
<i>K'ebena</i>	Medicinal, Fiber, Fodder
<i>Kembat</i>	Fodder, Fiber
<i>Netch'we</i>	Food, Fiber, Fodder
<i>Shertye</i>	Medicinal (cattle), Fiber, Fodder
<i>Yehereye</i>	Food, Fiber, Fodder
<i>Yehirafereye</i>	Food, Fiber, Fodder

The names are given in *Eshe* language of the *Sebatbet Guragie* Nationality

5. Discussion

5.1 General Characteristics of Home-gardens and Factors that Influence Their Plant Composition

The home-gardens of the study area are of different types (Table 2). In this respect, Zemedede Asfaw and Ayele Nigatu (1995), Zemedede Asfaw (1997), Zemedede Asfaw and Zerihun Woldu (1997), Feleke Woldeyes (2000), and Talemoss Seta (2007) also arrived at the same conclusion that front-yard, side-yard, back-yard and all round gardens to exist in the Ethiopian home-gardens and Zemedede Asfaw (1997) added various combinations of these gardens to exist as back and sides, back and one side, and front and sides. Home-gardens of the study area have different sizes and shapes. Zemedede Asfaw and Ayele Nigatu (1995), Zemedede Asfaw (1997), Talemoss Seta (2007) verified home-gardens to have varying sizes and shapes. Multi-storied vegetation structure with upper, middle, lower and ground strata is prevalent in the home-gardens of the area. Similar understanding of the vertical canopy arrangement of home-gardens approaching the four storied structure of the tropical rain forest is also shared by Fernandes, *et al.* (1984), Christanty (1990), Okigbo (1990) and Talemoss Seta (2007). The composition of plant species in home-gardens of the study area decreases as one goes towards the edge. The research done on the diversity of enset-based home-gardens in Wolayta (Southern Ethiopia) by Talemoss Seta (2007) agrees with this finding.

The spatial and temporal arrangement of crops and other plant species differ from one garden to the other. As it is depicted by the sketch of a common home-garden of the study area (Fig. 3), ornamental plants are placed on the veranda of the house as potted plants or the space closer to it, the spices are grown near the decorative plants, vegetables are planted on a raised plots, fruit and shade trees occupied the inner edge next to the live fence, enset (*Ensete ventricosum*) and banana (*Musa paradisiaca*) are cultivated on the depressions close to the live fences, and shrubs intermingled with perennial trees are utilized as live fences. The same case was reported by Zemedede Asfaw and Ayele Nigatu (1995) with regard to variation in the spatial and temporal arrangements of plant species among home-gardens. It is also stated by Okigbo (1990)

that the spatial arrangement of crops in home-gardens may be connected to the functions of the crop, micro-environmental adaptation, habit of the crop, and other incidental or accidental factors.

The composition of plant species in the home-gardens of the study area is affected by different factors (Table 7). The low availability of water or a decreasing rain fall pattern during the dry spell is the major factor affecting off-season production of their garden crops and for the reduction of plant diversity in general. Soleri and Cleveland (1989), Padoch and Jong (1991), Zemedede Asfaw (1997) and Talemoss Seta (2007) confirmed that the diversity of plant species in home-gardens is limited by the availability of adequate water. The second main claim (political factor) that is threatening the thriving of plant diversity is the insecure land-holding system. Accordingly, some have already lost their big gardens as the site is required for investment purposes and others have the fear of their holdings being reduced especially in *Walate* and *Alamganaa* sites. This is a comparable result with that of Padoch and Jong (1991); Eyzagurrie and Watson (2002).

In contrast to the polycultural cropping nature of home-gardens, the sole emphasis given to the production of income generating vegetable crops by some gardeners could be the third major factor (socio-economic factor) for waning plant diversity in the area. This finding confirms earlier report made by Talemoss Seta (2007) who indicated that home-garden plants / crops were being replaced by some cash crops in order to get good amount of money in return. As *Sabata* is a peri-urban town situated near the big city, the sizes of most gardens are relatively larger. However, some gardeners complain for the smaller sizes of their gardens in order to cultivate diverse taxa of food and non-food crops. Moreover, the declining trend in gardening size for the construction of additional houses for renting as the demand is increasing because of population growth, urbanization and intensification of development projects is also another constraint on the richness

of plant diversity. In this regard reference could be made towards Zemedu Asfaw (1997) who described that garden space tends to reduce due to urbanization and population growth.

Even though there are some efforts being undertaken in promoting home-gardening in the area, the agricultural support system provided by governmental or non-governmental sectors is minimal. Padoch and Jong (1991) included agricultural support systems among their lists of the chief constraints of the biotic change and variation of home-gardens. Though dependence on donations from the government and NGOs is not a viable solution, intermediate forms such as the purchase of inputs (high quality vegetable seed, fencing material) at subsidized prices from government agencies may be preferable (Frankenberger, *et al.*, 1989). In addition, the species richness is negatively affected in the area as there are some physically weak, sick and lonely women leaders of the household, who failed to manage their gardens diligently.

The occurrence of pests which destroyed the seedlings of edible and non-edible plant species that are used for market and home consumption is also considered as a biological factor. Since chemical pest control is no real alternative in smallholder cropping systems (home-gardens), information is required on crop and species combinations with a greater potential to reduce pests, diseases, and weeds. The effectiveness of the plant species with anti-pest properties that are already used by the Chagga people are investigated as a first step (Fernandes, *et al.*, 1984). Intentional removal of certain plant species like *Justicia schimperiana* due to the fear that they will attract some furious wild animals such as snakes is also another limitation to garden plants diversity. Eyzaguirre and Watson (2002) have shown that lack of local awareness on the importance of biodiversity to be the threat that should not be overlooked as it affects their richness.

5.2 The Role of Home-gardens in Agrobiodiversity Conservation

The sustainable use of plant genetic resources in agriculture is inseparable from agrobiodiversity

conservation. Home-gardens are vivid examples of production systems with rich diversity that serve both a development and a conservation function (Eyzaguirre and Watson, 2002). They are micro-environments within a larger farming system containing high level of species and varietal diversity (NHGW, 2004). Das and Das (2005) further advocated that home-gardens are the sites of conservation of a large diversity of plants both wild and domesticated, because of their uses to the households. This is confirmed by the occurrence of a total of 135 plant species in the home-gardens of *Sabata* town (Appendix I) and that are classified into different categories / functional groups (Appendix II). Home-gardens are considered, by some scientists, as “living gene banks” and are characterized by containing numerous species, which have economical, food and aesthetical, psychological and spiritual benefits (Hetterschijt, 2001). In the present study, among the functional groups, live fences occurred with the highest mean proportion (Fig. 5) and hedging is known to be an important tradition of the people of the area. However, little modification is required on the definition of home-garden forwarded by Christanty (1990), Okigbo (1990) and Godbole (1998) which emphasized on horticultural crops in which fruits, nuts and vegetables predominate in order to incorporate the planting of live fences for compound enclosure as one of the major objectives of this system.

Ensete ventricosum is the most frequently maintained crop in the home-gardens of the area followed by *Rosa hybrida* and *Vernonia amygdalina* (Table 3). *Enset* is an indigenous root-crop cultivated and processed for human food as a main source of carbohydrate only in Ethiopia (Brandt, 1996) and its key position in the country’s home-gardens as a dominant species is mentioned by Zemedu Asfaw (2002). Zemedu Asfaw and Ayele Nigatu (1995) also commented that the Ethiopian home-gardens house many indigenous taxa of crops as *Ensete ventricosum*. Of a total of 135 species identified from the 24 home-gardens, 57 species were recorded in one garden alone and 33 species were represented per garden on the average; the lowest being 13 species. The species richness of the study area per garden is higher than the 22

species recorded in more than half of the gardens in *Wolayta* (Talemos Seta, 2007). Moreover, the values of Shannon-Wiener diversity computed for the six sites of the study area lied between 4.174 and 4.394. The plant species of the six research sites indicated equal distribution ($J=1$). This might be because of the fact that the practitioners intentionally cultivated plant materials in their gardens following certain patterns. Site W_5 has even distribution and showed the highest species diversity indicating that the garden plants are well managed (Table 5). According to Shaw (2003), the concept of diversity contains two elements: richness and balance (evenness); the first and most obvious measurement to make is the species richness (i.e. the count of the the total number of species within the sample) which is a valid index of diversity in its own right and the other indices of diversity are also constructed as a measure of the evenness with which species are distributed. In the sites S_2 , A_3 and W_6 lower species diversity indices were recorded and this may be related to the shifting of polycultural gardening practices towards few income generating food crops like cabbage, carrot, lettuce, garlic, onion and tomato. Thus, in the poorer regions of the developing world, agrobiodiversity conservation is a goal and a means to secure the livelihoods and well being of farming families (Eyzaguirre and Watson, 2002). Furthermore, from the 39 (27.66% of the total number) tree species encountered in the home-gardens (Appendix III), *Cupressus lusitanica* and *Eucalyptus camaldulensis* were the most abundant and with the highest relative densities respectively (Table 4).

The tradition of using plants for treating different health problems is among the widely practiced indigenous cultural habits in the study area. From the total of plant species identified in the present study, 24 (17.77 %) were used as traditional medicinal plants and distributed among 22 genera in 17 families and three (12.5 %) of these medicinal plants (garlic, enset, pomegranate) have nutraceutical values (Table 12). Nutraceutical plants are food plants which also have medicinal uses. The term nutraceutical means food or parts of food that offer medical or health benefits (Felice, 1999; cited in Tigist Wondimu *et al.*, 2006).

These medicinal plants are believed to be good remedies for various ailments such as dermatological, gastro-intestinal, neurotic, respiratory impairments of the body functions, spiritual vexations and veterinary diseases. Fifteen (62.5%) of the medicinal plants are used by the local people to treat abdominal pain including intestinal parasites. The therapeutic benefits of these traditional medicines are mentioned by Amare Getahun (1976), Jansen (1981), Zemedede Asfaw and Ayele Nigatu (1995), Belachew Wassihun *et al.* (2003), Dawit Abebe *et al.* (2003), Tizazu Gebre (2005), Tigist Wondimu *et al.* (2006), Endalew Amenu (2007), Fisseha Mesfin (2007) and Talemoss Seta (2007).

5.3 Indigenous Management of Home-gardens in Sabata Town

A number of indigenous management practices are carried out in the home-gardens of the study area and the maintenance of diverse taxa of plants is one among the major endeavors. Rich diversity of plant species in the home-gardens were obtained by cultivating and protecting a mixture of annual and perennial herbs, and woody perennials based on the need and decision of the family members. Similar case was reported by Belachew Wassihun *et al.* (2003). Soil enrichment is maintained mainly by using animal manure, house rubbish and crop residue. Comparable finding was noticed by Zemedede Asfaw (1997), Belachew Wassihun *et al.* (2003) and Talemoss Seta (2007). In some of the gardens, pests (e.g. termites) are managed by the application of wood ash to the soil. The addition of a little wood ash to the soil in order to control insect pests that damage rose plant has been suggested by VGW (2006). Seed selection is another practice performed in the home-gardens of the study area and the criteria for selection were based on color, maturity, yield, quality, and disease and drought resistance. Belachew Wassihun *et al.* (2003) and Talemoss Seta (2007) reported the same results.

People of the study area have indigenous knowledge for utilizing different tree species encountered in their home-gardens for various purposes. As a result of direct matrix ranking (Table 10), *Eucalyptus globulus* is the most widely used multipurpose tree in the area followed by *Acacia abyssinica* and *Juniperus procera*

respectively. The maximum scores per use criterion were given to *Eucalyptus globulus* and *Cordia africana* (59 each) concerning their uses for construction and implements respectively pursued by *Croton macrostachyus* with the score of 58 for its medicinal use. Though, *Eucalyptus globulus* is an introduced tree species and is believed to exert some ecological impacts (on the undergrowth plant species and soil water availability, especially in the dry areas), it is a widely used plant in the study area as well as in many parts of the country for construction purpose since it has relatively shorter growing period and for its erect trunk. Moreover, *Cordia africana* is also the most preferred tree species for implements / tools as it can be shaped easily into different forms. Home-gardens can be considered as land use system involving deliberate management of multipurpose trees and shrubs in intimate association with annual and perennial agricultural crops (Fernandes and Nair, 1990).

Home-garden owners of the study area, particularly those in *Walate*, have accumulated traditional knowledge in classifying and preparing *enset*, *Ensete ventricosum*. *Enset* is a multipurpose crop that is used for food, medication, cordage and wrapping of materials. Talemso Seta (2007) got similar perception with regard to the functions of this valuable crop. Some gardeners in *Walate* identified many landraces (farmers' varieties) of *Ensete ventricosum* (Table 13). Some of these varieties were recognized by Asnaketch Woldetensaye and Linden (1997) in their list of cultivars found in the *Sodo* and *Butajera* Districts.

There is affirmative involvement of households in managing home-gardens of *Sabata* town. In those families who earn their income from garden produce, laborious tasks such as, digging, crop patterning, sowing and planting, and other duties as garden designing are the responsibilities of the male heads or husbands. Nevertheless, women and children also participate in minor / light garden activities. Zemedu Asfaw (2002) remarked that the male family head is often accountable for designing home-garden structure, identifying suitable places for positioning the major crops, and monitoring and strongly

impacting the structure and direction of home-garden development. The same author explained that with the exception of arduous works, women take part in many activities and children also assist in home-garden tasks.

5.4 The role of Home-gardens in Improving Family Livelihoods: Food Security, Nutrition and Income

In the present study, 37 (27.40 % of the total) species of food plants (Appendix IV) were recorded in which case *Persea americana*, *Citrus sinensis* and *Ensete ventricosum* assumed the 1st, 2nd and 3rd ranks respectively (Table 11). This reflects that these crops are the most preferred food plants in the study area. Abdoellah (1990) accounted 39 cultivated crop plant species in the home-gardens of Java that is comparable with the 37 food plants in the present study. In addition, some of the food crops (e.g. *Allium sativum*, *Ensete ventricosum* and *Punica granatum*) have nutraceutical (both food and medicinal) values for the indigenous people. The nutraceutical uses of plant species around *Dheeraa* town and in *Darkuwa* (home-gardens) of *Wolayta* were also mentioned by Tigist Wondimu *et al.* (2006) and Talemso Seta (2007) respectively.

Moreover, home gardens of the study area embrace a genuine portion of agrobiodiversity which represent a supplementary source of food and a privileged basis for nutritional quality that are helpful to cope with food shortage periods and failures of staple crops. Particular instance was reported by FAO (2004b). It is reported that high prevalence of PCM (Protein Calorie Malnutrition) occurs in the area. The malnutrition cases, mainly kwashiorkor, marasmus, anemia and vitamin A deficiency were diagnosed and administered by the *Sabata* Health Center for children under age five. These health problems might be linked to those households without home-gardens and who couldnot afford the required food items or to those with home-gardens but who lack the awareness of the values of nutrition. A wide prevalence of under nutrition cases were shown by the study conducted in the home-gardens that specialize in tea plantation in West Java, Indonesia (Husaini *et al.*, 1990).

Different food plants belonging to various categories were exchanged in the markets of the study area. The markets were predominated by vegetables as data was collected during the longer fasting period (*Hudade*) of the Ethiopian Orthodox Church. At that time from among the five most desirable food crops selected for pair-wise comparisons, the highest score (30%) goes to potato (*Solanum tuberosum*) followed by Ethiopian kale (*Brassica carinata*) with 22 % score which indicated high market demand (Tables 8 and 9). Besides their nutritional benefits (diet diversification / improving micronutrient intake), the home-gardens of the study area do have considerable contribution in generating income for the family and in enabling them to afford other staple crops / food items that are not cultivated in their gardens. Moreover, there is a promising improvement on the status of food / economic security in those families with good garden practices. According to FAO (2001) home-gardens have an established tradition and offer great potential for improving household food security, in alleviating micronutrient deficiencies and they enhance food security in several ways, most importantly through direct access to a diversity of nutritionally-rich foods, increased purchasing power from savings on food bills and income from sales of garden products, and fall-back food provision during seasonal lean periods.

5.5 Impacts of Market Forces on Home-garden Agrobiodiversity

There is a general tendency or inclination towards the production of few income generating food crops (vegetables) in *Sabata* town particularly in the peripheral areas of S₂ and W₆ sites. In these sites the richness of species and diversity indices were relatively lower (Table 5). This market driven agricultural activity resulted in bulk production of few crops and reduced agrobiodiversity to some degree or forces diversity to concentrate more in non-irrigated parts (North West) of the town. The production of food crops in the home-gardens are known to improve the status of food security and enhance the quality of nutrition for people of the area but it should be done without devastating biodiversity which is the natural wealth of the present and future of the locality in particular and of the country in general. The present study revealed

that tuber crop like potato (*Solanum tuberosum*) and vegetables like carrot (*Daucus carota*), Ethiopian kale (*Brassica carinata*), cabbage (*Brassica oleracea* var. *capitata*) and tomato (*Lycopersicon esculentum*) were among the widely cultivated food crops of home-gardens of the area with high market forces which brought good monetary return to the households.

Currently, investment activities are also progressing in the area. This could have negative effect on the future fate of home-gardening and agrobiodiversity conservation if these aspects are totally neglected. According to Altieri (1995), in agricultural systems, beyond the production of food, fiber, fuel, and income, biodiversity performs ecosystem services as recycling of nutrients, control of local microclimate, regulation of local hydrological processes, and detoxification of noxious chemicals.

5.6 Environmental Contributions of Home-gardens Taking Sabata Town as a Case

Based on the physical observation conducted during field work, pollution (water, soil, air and noise), stream cuts, erosion, rugged topography and quarry were identified as the potential hazards / constraints of biotic resources in the study area. Water and soil pollutions emanated from improper disposal of urban and poorly regulated industrial wastes from major industries especially; *Afede* tannery, National and *Balezaf* Alcohol and Liquor factories, *Meta Abo* Brewery and other urban runoff. In *Sabata*, almost all of the generated solid wastes are indiscriminately dumped into drainage channels, streams, open surfaces, culverts, and residential compounds and even on the road including highway passing through the town. Open air combustion of wastes and emission of gases from factories in the area without effective treatment design can be the cause for air pollution. However, the contribution of home-gardens of the study area in sustaining the environment is promising. These agroforestry systems, developed and nurtured by farmers through generations of innovation and experiment, are often cited as the epitome of sustainability, yet have been long neglected by the scientific community. Today, however, these age-old systems are receiving increasing attention owing to their perceived potential to mitigate environmental problems such as loss of

biodiversity and rising levels of atmospheric CO₂ (Kumar and Nair, 2006). Kuchelmeister and Braatz (1993) supplemented to this by saying that garden plants help remove pollutants from the air in three ways: absorption by the leaves or the soil surface; deposition of particulates and aerosols on leaf surfaces; and fallout of particulates on the leeward (downwind) side of the vegetation because of the slowing of air movement. In line with this, home-gardens of the study area offer relevant service in mitigating the currently aggravating trend of climate change and in rehabilitating soil degradation. Soil erosion is minimized because of vegetation cover that prevented the exposure of bare ground to heavy rainfall. On this regard, suggestion forwarded by Kuchelmeister and Braatz (1993) underlines that the shades of trees, shrubs and other vegetation help to control temperature extremes by modifying solar radiation.

Moreover, trees in the homesteads are also used to intercept dust: a belt of trees measuring 30 meters in width has been found to interrupt almost all dust in the air. Noise is often referred to as invisible pollution. Excessive noise levels contribute to both physical and psychological damage and trees can help both by absorbing and refracting or dissipating noise such as that produced by the heavy vehicular traffic (Kuchelmeister and Braatz, 1993). The integration of home-gardens in the study area to small holder farming system has environmental gains from reuse of water and waste nutrients. Since environmentally benign inputs (bio-fertilizers) are used and as synthetic fertilizers / synthetic pesticides are abandoned or much minimized in this farming system, the produces are clean. Furthermore, the biological inputs are cost effective and the poor households can possibly use them. Altieri (2008) commented that as a general rule, organic farming systems tend to minimize energy and resource use, by recycling resources within the farming system, or at least by using resources found near the farm and by enhancing biodiversity which in turn mediates ecological functions such as pest regulation, soil fertility and productivity. A larger portion of vegetables and fruits circulating in local markets are home-garden produce. Since there is almost no use of pesticides in gardening, their produce is 'clean' contributing to environmental protection as well as public

health. Home-gardens employ the character of the surrounding ecological system, and provide a place where plants, animals, insects, microorganisms and soil and air media mutually interact to maintain the agroecological balance (Trinh *et al.*, 2002).

6. Conclusion

From the study of floristic composition of *Sabata* home-gardens, it can be concluded that the locality is rich in plant diversity. However, the composition of agrobiodiversity of this vicinity is tackled by various detrimental factors as garden size, water availability, management system, socio-economic condition, biological determinants, limited agricultural support system, shifting of polycultural farming to few income generating food crops due to market drives, unstable land-holding system and lack of awareness. If these challenges are given due attention by the local government body and other concerned institutions, the area is believed to maintain its present agrobiodiversity and is predicted to have a promising future prospects.

A number of indigenous management practices were customarily performed in the home-gardens of the study area. One major endeavor is the maintenance of diverse taxa of plant species in the home-gardens that are grown for food, medication and others. These were obtained by cultivating and protecting a mixture of annual and perennial herbs, and woody perennials depending on the need and decision of the family members. There is also collaborative involvement of households in managing home-gardens of *Sabata* town. Thus, the indigenous knowledge and management practices that are accumulated through out centuries by people of the area can possibly be abandoned unless thoughtful attention and proper documentation is underway.

Home-gardens of the study area embody a genuine portion of agrobiodiversity which represent a supplementary source of food and a privileged basis for nutritional quality that are helpful to cope with food shortage periods and failures of staple crops. Other than their nutritional values, the home-gardens of the study area provide significant contribution in generating income for the family, in enabling them to afford other staple crops that are not cultivated in their gardens and in improving the status of food security. If they are further strengthened and managed well, home-gardens of *Sabata* town do have great potential to

be widely utilized and to become good models for the local communities in other peri-urban towns in the vicinity of Addis Ababa to follow the *Sabata* strategy to upgrade their livelihoods.

Biotic resources of the study area have potential constraints like pollution, stream cuts, erosion, rugged topography and quarry. However, the contribution of home-gardens of the area is promising for resilience of environmental degradation. Since environmentally sound inputs are used and as synthetic fertilizers / synthetic pesticides are abandoned or much reduced in this farming system, the agricultural products are clean. Home-gardens of the area also offer good service in mitigating the currently aggravating trend of climate change and in rehabilitating soil erosion. Hence, there is a clear need to capture the resources of the area and maintain the quality of the environment on the whole from obliteration by enhancing home-gardening in the study area.

7. Recommendations

The following main recommendations are drawn from the research work:

1. Traditional conservation practices that promote agrobiodiversity could be recommended for intensification of the practice and transfer of the knowledge to the peri-urban towns in the vicinity of Addis Ababa.
2. The practice of traditional farming system (home-gardening) which establishes improvements on the status of food security, on nutritional quality and that generates income for the household should be strengthened in the study area and could be suggested as an alternative plan of action in famine prone areas of the country. However, *Sabata* Town Administration is kindly advised to design safe ways, strategies and policies that maintain trade-off between the progression of investment activities and lucrative return from few home-garden products with long-term sustenance of agricultural diversity in the home-gardens of the study area.
3. Important contributions of home-gardens with respect to biotic resources should be encouraged by *Sabata* Town Agricultural Office Environmental Protection Section to alleviate the potential hazards or constraints of the environment such as pollution, stream cuts, erosion, rugged topography and quarry.
4. Special consideration and endeavors must be made by *Sabata* Town Administration and other concerned governmental or non-governmental sectors to provide unreserved agricultural support in promoting home-gardening and in motivating the practitioners of the study area.

5. The traditional knowledge owned and practiced by the indigenous people of *Sabata* town in maintaining plant diversity in the home-gardens for multiple purposes should be emboldened and protected by the Agricultural Office of the town.

8. References

- Altieri, M. A. (1995). *Agroecology: the science of sustainable agriculture*. Westview Press, Boulder.
- Altieri, M. A. (2008). *Agroecology: Environmentally Sound and Socially Just Alternatives to the Industrial Farming Model*. University of California, Berkeley, 16 pp. Retrieved from: <http://www.agroeco.org/doc/.pdf>.
- Amare Getahun (1776). *Some Common Medicinal and Poisonous Plants Used in Ethiopian Folk Medicine*. Addis Ababa University, Ethiopia, 63 pp.
- Asnaketch Woldetensaye and Linden, B. (1997). Cultivation and Utilization of *Ensete ventricosum* in Two Regions of Ethiopia. **In:** *The Ecology and Production of Ensete ventricosum in Ethiopia*, pp. 1-45. Doctorial Thesis, Swedish University of Agricultural Sciences. Asnaketch Woldetensaye, Uppsala.
- BATO (2007). Sirna Gadaa Siyaasaa Oromoo Tuulamaa, Jildii 1^{FFAA}. *Biroo Adaaqi Turizimii Oromia, Finfinnee*.
- Belachew Wassihun, Zemedede Asfaw and Sebsebe Demissiew (2003). Ethnobotanical Study of Useful Plants In Daniio Gade (Home-Gardens) In Southern Ethiopia. *Ethiop. J. Biol. Sci.*, 2(2): 119-141.
- Brandt, S. A. (1984). New perspectives on the origins of food production in Ethiopia. **In:** *From Hunters to Farmers: the causes and consequences of food production in Africa*, pp. 173–190 (Clark, J. D. and Brandt, A. eds.). University of California Press, Berkeley, USA.
- Brandt, S. A. (1996). A model for the origin and evolution of *enset* food production. **In:** *Enset-based Sustainable Agriculture in Ethiopia*. Proceedings of the International Workshop on *Enset* (1993), pp. 36-46 (Tsedeke Abate, Steven, C. H., Brandt, A. and Seifu Gebremariam, eds.), Addis Ababa, Ethiopia.
- Brookfield, H. (2001). *Exploring Agrobiodiversity*. Columbia University, New York.
- Brownrigg, L. (1985). *Home-gardening in International Development*. League for International Food Education, Washington.
- Christanty, L. (1985). Home-gardens in Tropical Asia: A special reference to Indonesia. Proceedings of the First International Workshop on Tropical Home-garden, 2-9 December, 1985, Bandung, Indonesia.
- Christanty, L. (1990). Home-gardens in Tropical Asia, with special reference to Indonesia. **In:** *Tropical Home-Gardens*, pp. 9-20 (Landauer, K. and Brazil, M., eds.). United Nations University Press, Tokyo.

- CSA (1994). Central Statistics Agency. The Population and Housing Census of Ethiopia Results for Oromia Region. Volume I: Part VI. Addis Ababa, Ethiopia.
- Das T. and Das, A. K. (2005). Inventorying plant biodiversity in home-gardens: A case study in Barak Valley, Assam, North East India. *Current Science*, 89 (1), 155-163.
- Dawit Abebe, Asfaw Debella and Kelbessa Urga (2003). Medicinal Plants and Other Useful Plants of Ethiopia. Ethiopian Health and Nutrition Research Institute, 312 pp.
- Endalew Amenu (2007). Use and Management of Medicinal Plants by Indigenous People of Ejaji Area (Chelya Woreda), West Shoa, Ethiopia: An Ethnobotanical Approach. M. Sc. Thesis, 101 pp.
- Engels, J. (2002). Home gardens_ a genetic resources perspective. **In:** *Home-gardens and in situ conservation of plant genetic resources in farming systems*. Proceedings of the Second International Home-Gardens Workshop, 17-19 July 2001, Witzenhausen, Federal Republic of Germany, pp. 3-9 (Watson, J. W. and Eyzaguirre, P. B. eds.). International Plant Genetic Resources Institute, Rome, Italy.
- Esquivel, M. and Hammer, K. (1992). The Cuban home-garden “conuco”; A perspective environment for evolution and in- situ conservation of plant genetic resources. *Genetic Resources and Crop Evolution* 39 (1): 9-22.
- Eyzaguirre, P. B. and Linares, O. F. (2001). A new approach to the study and promotion of home-gardens. *People and Plants Hand book* 7:30– 33.
- Eyzaguirre, P. and Watson, J. (2002). Home-gardens and agrobiodiversity: an overview across regions. **In:** *Home-gardens and in situ conservation of plant genetic resources in farming systems*. Proceedings of the Second International Home-Gardens Workshop, 17-19 July 2001, Witzenhausen, Federal Republic of Germany, pp. 10-18 (Watson, J. W. and Eyzaguirre, P. B. eds.). International Plant Genetic Resources Institute, Rome, Italy.
- FAO (1983). Selected Medicinal Plants. **In:** *FAO Plant Production and Protection Paper* 53 (1), pp. 1-94 UN, Rome.
- FAO (2000). Land and Plant Nutrition Management Service. FAO, Rome, Italy. Retrieved from: <http://www.fao.org/ag/agL/agll/prosoil/verti.htm>
- FAO (2001). Improving Nutrition through Home Gardening: A training package for preparing field workers in Africa. FAO, Rome, Italy. Retrieved from: http://www.fao.org/ag/agn/nutrition/household_gardens_en.stm

- FAO (2004a). Building on Gender, agrobiodiversity and local knowledge. Retrieved from: <http://www.fao.org./sd/links>
- FAO (2004b). Livelihoods grow in gardens: FAO Diversification booklet 2. Rome, Italy.
- Feleke Woldyes (2000). A Study on Biodiversity Management in Daddegoyo (Traditional Home-gardens) by Kaficho People of Bonga Area (South western Ethiopia): An Ethnobotanical Approach. M. Sc. Thesis, Addis Ababa University, 89 pp.
- Fernandes, E. C. M., Oktingati, A. and Maghembe, J. (1984). The Chagga Home gardens: A multi-storied Agroforestry Cropping Systems on Mount Kilimanjaro (Northern Tanzania) *Agroforestry Systems* 2:73-86.
- Fernandes, E. C. M. and Nair, P. K. R. (1986). An Evolution of the structure and function of tropical homegardens. *Agricultural Systems* 21: 279-310.
- Fernandes, E. C. M. and Nair, P. K. R. (1990). An Evaluation of the Structure and Function of Tropical Home Gardens. **In:** *Tropical Home gardens*, pp. 105-114 (Landauer, K. and Brazil, M., eds.). United Nations University Press, Tokyo.
- Fisseha Mesfin (2007). An Ethnobotanical Study of Medicinal Plants in Wonago Woreda, SNNPR, Ethiopia. M. Sc. Thesis, Addis Ababa University, 72 pp.
- Frankenberger, T. R., Stone, M. P. and Tejada, S. S. (1989). Household Vegetable Gardens in Africa: Case Studies from Mauritania and Lesotho, *Arid Lands Newsletter* Vol. 29:21–24. University of Arizona, USA.
- Godbole, A. (1998). Maintenance of biodiversity. **In:** *Applied Ethnobotany in Natural Resource Management*, pp. 9-12 (Rastogi, A., Godbole, A. and shengii, p., eds.). International Center for Integrated Mountain Development, Nepal.
- Hadidi, M.N.E. (1984). Food plants of pre-historic and pre-dynastic Egypt. **In:** *Plants for arid lands*, pp. 87-92, (Wickins, G. E., Goodin, J.R. and Field, D.V., eds.).
- Hammer, K. (1991). The Potential of Mixed Orchards in Britain, Undergraduate Thesis, University of Wales, Bangor, UK.
- Hetterschijt, T. (2001). Our Daily Realities: A Feminist Perspective on Agrobiodiversity in Urban Organic Home-gardens in Lima, Peru. Thesis submitted for partial fulfillment of the M. Sc. degree in Environmental Sciences. Wageningen University, Netherlands, 111 pp. Retrieved from: <http://www.cipotato.org/urbanharvest/documents/pdf/ThesisWageningen.pdf>

- Hodgkin, T. (2002). Home-gardens and the maintenance of genetic diversity. **In:** *Home-gardens and in situ conservation of plant genetic resources in farming systems*, pp. 14-18 (Watson, J. W. and Eyzaguirre, P. B., eds.). Proceedings of the Second International Home-Gardens Workshop, 17-19 July 2001, Witzenhausen, Federal Republic of Germany. International Plant Genetic Resources Institute, Rome, Italy.
- Husaini, M. A., Megawangi, S. R., Nurhadi, E., Supardi, D., Djojosoebagio, S. and Karyadi, D. (1990). Diet, Nutritional Status, and Potential Need for Home Gardens in the Tea Plantation. **In:** *Tropical Home gardens*, pp. 119-125 (Landauer, K. and Brazil, M., eds.). United Nations University Press, Tokyo.
- Jansen, P. C. M. (1981). Spices, Condiments and Medicinal Plants in Ethiopia, Their Taxonomy and Agricultural Significance. Center for Agricultural Publishing and Documentation. Wageningen, Netherlands, 327 pp.
- Kent, M. and Coker, P. (1992). Vegetation Description and Analysis: A Practical Approach. Belhaven Press, London, 263 pp.
- Kuchelmeister, G. and Braatz, S. (1993). Urban forestry revisited. *International journal of the forestry and food industries*, 44:13-18. FAO, Rome. Retrieved from: <http://www.fao.org/>
- Kumar, B. M. and Nair, P. K. R. (2006). Tropical Home Gardens: A Time-Tested Example of Sustainable Agroforestry. *Environmental Experts S. L.*, 377 pp. Retrieved from: <http://www.environmental-expert.com/resultteachpublication>
- Landauer, K. and Brazil, M. (eds.) (1990). Tropical Home Gardens. Selected papers from an international workshop held at the Institute of Ecology, Padjadjaran University, Bandung, Indonesia, 2-9 December 1985.
- Maheshwari, J. K. (1988). Ethnobotanical research and documentation. *Acta Univ. Ups. Symb. Bot. Ups.*, 28 (3): 207-217.
- Marten, G. G. (1990). Nutritional calculus for home-garden design: Case study from West Java. **In:** *Tropical Home-gardens*, pp. 147-168 (Landauer, k. and Brazil, M., eds.), UNU, Tokyo.
- Marten, G. D. and Abdoellah, O. S. (1988). Crop diversity and nutrition in West Java. *Ecology of Food and Nutrition* 21: 17-43.
- Martin, G. J. (1995). Ethnobotany: A Method Manual. Chapman and Hall, London, 268 pp.
- Martinet, C. and McNeely, J. (1992). Managing parks for the 21 century. A device from the parks congress. *Parks* 3: 13-21.

- McCune, B. and Mefford M. J. (1999). PC-ORD. Multivariate Analysis of Ecological Data, Version 4.0. MjM Software Design Gleneden Beach, OR 97388 USA.
- Melaku Worede, Tefaye Tesema & Regassa Feyissa (2000). Keeping diversity alive: an Ethiopian perspective. In: *Genes in the Field: On-farm conservation of crop diversity*. (Brush, S. B.; ed.). IDRC, Lewis Publishers, USA.
- Millat-e-Mustafa, M. (1998). Overview of Research in Home-garden Systems. **In:** *Applied Ethnobotany in Natural Resource Management Traditional Home-gardens*, pp. 13-19 (Rastogi, A., Godbole, A. and Shengji, P., eds.). International Center for Integrated Mountain Development, Kathmandu, Nepal.
- Mitchell, R. and Hanstad, T. (2004). Small Home-garden Plots and Sustainable Livelihoods for the Poor. LSP Working Paper 11. Rural Development Institute (RDI), USA, 43 pp.
- MOA (2002). The Agro Ecological Zones of Ethiopia (AEZE). Natural Resource Management and Regulatory Department, Ministry of Agriculture, Addis Ababa.
- Mugwara, R. T. and Tewolde Berhan Gebre Egziabher (2002). Incentive Measures to Enhance the Sustainable Use of Agrobiodiversity. **In:** *Incentive measures for sustainable use and conservation of agrobiodiversity*. Experiences and Lessons from South Africa, pp. 15-34 (Almekinders, C. J. M., Comp.). Proceedings of a Workshop, 11-14 September, 20001. Lusaka, Zambia.
- NHGW (2004). Enhancing the contribution of home-gardens to on-farm management of plant genetic resources and to improve the livelihoods of Nepalese farmers: Lessons learned and policy implications. Nepal Home Garden Workshop, August 6-7, 2004 Pokhara, Nepal. Retrieved from: <http://www.ipgri.cgiar.org/>.
- NMSA (1997-2006). National Meteorological Service Agency. Addis Ababa, Ethiopia.
- Okigbo, N. B. (1990). Home-gardens in tropical Africa. **In:** *Tropical Home gardens*, pp. 21- 40 (Landauer, K. and Brazil, M., eds.). United Nations University Press, Tokyo.
- OUPI (2008). Physical and Socioeconomic Study of Sabata Town. Oromia Urban Planning Institute, Finfinne, Ethiopia.
- Padoch, C. and de Jong, W. D. (1991). The house garden of Santa Rosa: Diversity and variability in an Amazonian agricultural system. *Econ. Bot.*, 45 (2): 166 – 175.
- Pankhurst, R. (1993). ENSET as reported by Ethiopian royal chroniclers and early European travelers. International workshop on ENSET, A.A., Ethiopia, December, 1993, p.5.

- Rico–Gray, V., Garcia–Franco, J. R., Chemas, A., Puch, A. and Sima, P. (1990). Species composition, similarity, and structure of Mayan home-gardens in Tixpeual and Tixcacaltuyub, Yucatan, Mexico. *Econ. Bot.*, 44 (4): 470 – 487.
- RSIC (2006). Physical and Socio-Economic Profile of *Alamganaa* of South West *Shewa* Zone (Draft). Bureau of Finance and Economic Development. Regional Statistics and Information Center, *Finfine*, Ethiopia.
- Shannon, C. E. and Wiener, W. (1949). *The Mathematical Theory of Communication*. University of Illinois, Chicago, USA.
- Shaw, P. J. A. (2003). *Multivariate Statistics for the Environmental Sciences*. London: Arnold, 228 pp.
- Shrestha, P., Gautam, R., Rana, R. B. and Sthapit, B. (2002). Home gardens in Nepal: status and scope for research and development. **In:** *Home-gardens and in-situ conservation of Plant Genetic Resources in Farming Systems*, pp. 105-124 (Watson J. W. and Eyzaguirre, P.B., eds.). Proceedings of the Second International Home-Gardens workshop, 17-19 July, 2001, Witzenhausen, Germany. International Plant Genetic Resources Institute, Rome, Italy.
- Soleri, D and Cleveland, D. A. (1989). Dryland household gardens in development. *Arid Lands Newsletter* Vol. 29:5–9. University of Arizona, USA.
- Talemoss Seta (2007). Diversity in Enset-Based Home-Gardens and Its Significance to Household Supply in Wolayta (Southern Ethiopia): An Ethnobotanic Approach. M. Sc. Thesis, Addis Ababa University, pp. 105.
- Tesfaye Abebe (2005). Diversity in Home-garden Agroforestry Systems of Southern Ethiopia. Ph. D. dissertation, Wageningen University, Netherlands.
- Tesfaye Gutema (1997). Agricultural Land use in Alamganaa Woreda, BA Senior Essay, Geography Department, Addis Ababa University.
- Thrupp, L. A. (1997). Linking Biodiversity and Agriculture: Challenges and Opportunities for Sustainable Food Security. World Resource Institute, 19 pp.
- Thrupp, L. A. (2000). Linking Agricultural Biodiversity and Food Security: the valuable role of agrobiodiversity for sustainable agriculture. *International affairs* 76 (2): 265-281.
- Tigist Wondimu, Zemedu Asfaw and Ensermu Kelbessa (2006). Ethnobotanical Study of Food Plants Around *Dheeraa* Town, Arsi, Ethiopia. *SINET: Ethiop. J. Sci.*, 29 (1): 71-80.
- Tizazu Gebre (2005). An Ethnobotanical Study of Medicinal Plants in *Konso* Special *Woreda*, Southern Nations, Nationalities and Peoples Regional State, Ethiopia. M. Sc. Thesis, Addis Ababa University, 102 pp.

- Trinh, L. N., Hue, N. T. N., De, N. N., Minh, N. V., and Chu, P. T. (2002). Role of home-gardens in the conservation of plant genetic resources in Vietnam. **In:** *Home-gardens and in-situ conservation of Plant Genetic Resources in Farming Systems*, pp. 97-104 (Watson J. W. and Eyzaguirre, P. B., eds.). Proceedings of the Second International Home-Gardens workshop, 17-19 July, 2001, Witzenhausen, Germany. International Plant Genetic Resources Institute, Rome, Italy.
- Vasey, D. E. (1990). On Estimating the Net Social and Economic Value of Urban Home Garden. **In:** *Tropical Home gardens*, pp. 203-213 (Landauer, K. and Brazil, M., eds.). United Nations University Press, Tokyo.
- Vavilov, N. I. (1951). *The Origin, Variation, Immunity and Breeding of Cultivated Plants: Selected Writings*. Translated from the Russian by Chester, S. K. The Ronald Company, New York.
- VGW (2006). Rose Insect Pest Control. Village Garden Web. Retrieved from: <http://forums2.gardenweb.com/.html>
- Westphal, E. (1975). Agricultural systems in Ethiopia. Agricultural Research Report No. 826, College of Agriculture, Haileselassie I University, Addis Ababa and Agricultural University of Wageningen, Wageningen.
- Wiersum, K. F. (1982). Tree gardening and Taungya on Java: Examples of Agroforestry Techniques in the Humid Tropics. *Agroforestry Systems* 1: 53-70.
- World Bank (1997) "Knowledge and Skills for the Information Age, The First Meeting of the Mediterranean Development Forum"; Mediterranean Development Forum, URL: <http://www.worldbank.org/html/fpd/technet/mdf/objectiv.htm>
- World Bank (2006). Linking Agricultural Innovations to Knowledge Sharing in Africa. IK Notes. Retrieved from: <http://www.worldbank.org/afr/ik/default.html>.
- Zemedet Asfaw (1997). Indigenous African Food Crops and Useful Plants. Survey of Food crops, Their Preparations and Home-Gardens in Ethiopia. UNU / INRA No. B₆, ICIPE. Science Press, Nairobi, 65 pp.
- Zemedet Asfaw (2001a). The role of home-gardens in the production and conservation of medicinal plants. **In:** *Conservation and Sustainable use of Medicinal plants in Ethiopia*, pp. 76-91 (Medhin Zewdu and Abebe Demissie, eds.). Proceedings of the National Workshop on Biodiversity Conservation and Sustainable Use of Medicinal Plants in Ethiopia. 28 April-1 May, 1998. Institute of Biodiversity Conservation and Research, Addis Ababa, Ethiopia.

- Zemedede Asfaw (2001b). Origin and Evolution of Rural Home-gardens in Ethiopia. **In:** *Biodiversity Research in the Horn of Africa Region*, pp. 273-286 (Friis, I. and Ryding, O. eds.). Proceedings of the Third International Symposium on the Flora of Ethiopia and Eritrea at the Carlsberg Academy, August 25-27, 1999. Copenhagen.
- Zemedede Asfaw (2002). Home-gardens in Ethiopia: Some Observations and Generalizations. **In:** *Home-gardens and In-situ Conservation of Plant Genetic Resources in Farming Systems*, pp. 125-139 (Watson J. W. and Eyzaguirre, P. B., eds.). Proceedings of the Second International Home-Gardens workshop, 17-19 July, 2001, Witzzenhausen, Germany. International Plant Genetic Resources Institute, Rome, Italy.
- Zemedede Asfaw (2004). Home-Garden and Agrobiodiversity. **In:** *The enset-based home-gardens of Ethiopia*, pp. 123-147 (Eyzaguirre and Linares eds.). Smithsonian Institution, Washington.
- Zemedede Asfaw and Ayele Nigatu (1995). Home-gardens in Ethiopia: Characteristics and plant diversity. *SINET: Ethiop. J. Sci.*, 18 (2): 235-266.
- Zemedede Asfaw and Zerihun Woldu (1997). Crop association of home-gardens in Walayta and Gurage in Southern Ethiopia. *SINET: Ethiop. J. Sci.*, 20 (1):73-90.

Appendix I List of plant species in the home-gardens of the study area

Scientific name	Family	Vernacular name	Habit	Coll. No.
<i>Acacia abyssinica</i> Hochst.ex Benth.	Fabaceae	Lafto (O)	Tree	HB60
<i>Acacia mearnsii</i> De Willd.	Fabaceae	Yetmnja-zaf (A)	Tree	HB122
<i>Acacia melanoxylon</i> R.Br.	Fabaceae	Omedlla (A)	Tree	HB140
<i>Agave americana</i> L.	Agavaceae	Qacha (A)	Herb	HB68
<i>Ajuga integrifolia</i> Buch.- Ham. ex D. Don	Lamiaceae	Armaguusaa (O, A)	Herb	HB139
<i>Albizia schimperiana</i> Oliv. var. <i>schimperiana</i>	Fabaceae	Mukka-arba (O)	Tree	HB81
<i>Allium cepa</i> L.	Alliaceae	Qullubbii-diimaa (O)	Herb	HB86
<i>Allium sativum</i> L.	Alliaceae	Quulubbii-adii (O)	Herb	HB85
<i>Aloe pubescens</i> Reynolds	Aloaceae	E'ret (A)	Herb	HB52
<i>Annona cherimola</i> Mill.	Annonaceae	Gishta (A)	Tree	HB115
<i>Artemisia absinthium</i> L.	Asteraceae	Arrittii (O)	Herb	HB136
<i>Artemisia afra</i> Jacq. ex Willd.	Asteraceae	Jukunn (O)	Herb	HB132
<i>Arundo donax</i> L.	Poaceae	Shambako (O)	Herb	HB104
<i>Asparagus africanus</i> Lam.	Asparagaceae	Seriti (A)	Herb	HB72
<i>Begonia cucullata</i> Willd.	Begoniaceae	X	Herb	HB59
<i>Begonia rex-cultorum</i> Hort.	Begoniaceae	X	Herb	HB21
<i>Beta vulgaris</i> L.	Chenopodiaceae	Qosta (A)	Herb	HB83
<i>Bidens rueppellii</i> (Sch. Bip. ex Walp.) Sherff	Asteraceae	Kello (O), Adey-abeba (A)	Herb	HB51
<i>Bougainvillea x buttiana</i> Holtum & Standl.	Nyctaginaceae	Bugambe (A)	Liana	HB123
<i>Bougainvillea glabra</i> Choisy	Nyctaginaceae	Bugambe (A)	Liana	HB125
<i>Brassica carinata</i> A. Br.	Brassicaceae	Yeguragie gomen (A)	Herb	HB56
<i>Brassica oleracea</i> L.	Brassicaceae	Goommana (O)	Herb	HB84
<i>Brassica oleracea</i> L. var. <i>capitata</i>	Brassicaceae	Tql-gomen (A)	Herb	HB102

Appendix I (continued)

<i>Buddleja davidii</i> Franch.	Longaniaceae	Necho (A)	Shrub	HB133
<i>Caesalpinia decapetala</i> (Roth) Alston	Fabaceae	Arangamaa (O)	Liana	HB89
<i>Callistemon citrinus</i> (Curtis) Skeels	Myrtaceae	X	Tree	HB17
<i>Calpurnea aurea</i> (Ait.) Benth.	Fabaceae	Ceekaa (O)	Shrub	HB93
<i>Canna indica</i> L.	Cannaceae	Siet-akuri (A)	Herb	HB14
<i>Capsicum annuum</i> L.	Solanaceae	Barbaree (O)	Herb	HB31
<i>Carissa spinarum</i> L.	Apocynaceae	Hagamsa (O)	Liana	HB90
<i>Casimiroa edulis</i> La Llave	Rutaceae	Shasho (A), Kazmir (O, A) (derived from its Latin name)	Tree	HB75
<i>Catha edulis</i> (Vahl) Forssk. ex Endl.	Celastraceae	Cati (O)	Shrub	HB82
<i>Catharanthus roseus</i> (L.) G. Don	Apocynaceae	X	Shrub	HB76
<i>Citrus aurantifolia</i> (Christm.) Swingle	Rutaceae	Lomii(O)	Shrub	HB129
<i>Citrus aurantium</i> L.	Rutaceae	Komtatie (A)	Shrub	HB108
<i>Citrus medica</i> L.	Rutaceae	Trngo (A)	Shrub	HB116
<i>Citrus sinensis</i> (L.) Osb.	Rutaceae	Burtukana (O)	Shrub	HB127
<i>Coffea arabica</i> L.	Rubiaceae	Buna (O, A, G)	Shrub	HB30
<i>Colocasia esculenta</i> (L.) Schott	Araceae	Godaaree (O)	Herb	HB65
<i>Commelina</i> sp.	Commelinaceae	Hoolaa-gabbis (O)	Herb	HB15
<i>Cordia africana</i> Lam.	Boraginaceae	Wedecha (O)	Tree	HB97
<i>Crinum abyssinicum</i> Hochst. ex A. Rich.	Amaryllidaceae	Yejb-shnkurt (A)	Herb	HB113
<i>Croton macrostachyus</i> Del.	Euphorbiaceae	Bakkannisa (O)	Tree	HB64
<i>Cucurbita pepo</i> L.	Cucurbitaceae	Dabaaqula (O)	Liana	HB57
<i>Cupressus lusitanica</i> Mill.	Cupressaceae	Gatira (O)	Tree	HB45
<i>Cymbopogon citratus</i> (Dc.) Stapf	Poaceae	Tej-sar (A)	Herb	HB121
<i>Cyperus alternifolius</i> L.	Cyperaceae	Quietema (A)	Herb	HB10
<i>Cyperus</i> sp.	Cyperaceae	Qunnii (O)	Herb	HB94
<i>Dahlia pinnata</i> Cav.	Asteraceae	X	Herb	HB50

Appendix I (continued)

<i>Datura stramonium</i> L.	Solanaceae	Asangiraa (O)	Herb	HB55
<i>Daucus carota</i> L.	Apiaceae	Kaarota (O)	Herb	HB138
<i>Dodonaea angustifolia</i> L. f.	Sapindaceae	Ktktta (A, G)	Shrub	HB135
<i>Dovyalis caffra</i> (Hook. f. & Harv.) Hook. f.	Flacourtiaceae	Koshommii (O)	Shrub	HB69
<i>Dracaena steudneri</i> Engl.	Dracaenaceae	Yuka (A)	Tree	HB07
<i>Ensete ventricosum</i> (Welw.) Cheesman.	Musaceae	Kocho (A), Aset (G)	Herb	HB16
<i>Erythrina brucei</i> Schweinf.	Fabaceae	Korch (A)	Tree	HB111
<i>Eucalyptus camaldulensis</i> Dehnh.	Myrtaceae	Bargamo-diimaa, Baarzaafii diimaa (O)	Tree	HB62
<i>Eucalyptus globulus</i> Labill.	Myrtaceae	Baargamoo-adii, Baarzaafii-adii (O)	Tree	HB63
<i>Euphorbia inaequilatera</i> Sond.	Euphorbiaceae	X	Herb	HB01
<i>Euphorbia milii</i> Des Moulins	Euphorbiaceae	Ye' aklil-eshoh (A)	Shrub	HB19 HB46
<i>Ficus elastica</i> Roxb.	Moraceae	Yegoma-zaf (A)	Tree	
<i>Ficus populifolia</i> Vahl	Moraceae	Yekebrit-inchet (A)	Tree	HB112
<i>Ficus sur</i> Forsk.	Moraceae	Harbu (O)	Tree	HB98
<i>Ficus thonningii</i> Blume	Moraceae	Dembi (O)	Tree	HB91
<i>Foeniculum vulgare</i> Mill.	Apiaceae	Insilaala (O)	Herb	HB24
<i>Gomphocarpus fruticosus</i> (L.) Ait. f.	Asclepiadaceae	X	Herb	HB54
<i>Grevillea robusta</i> R.Br.	Proteaceae	Gravillia (O, A,G - derived from its Latin name)	Tree	HB42
<i>Hibiscus rosa-sinensis</i> L.	Malvaceae	X	Shrub	HB77
<i>Hagenia abyssinica</i> (Bruce) J. F. Gmel.	Rosaceae	Heexoo (O)	Tree	HB100
<i>Hyphaene thebaica</i> (L.) Mart.	Arecaceae	Peakcock-zenbaba (A)	Tree	HB37
<i>Iresine herbstii</i> Hook. f.	Amaranthaceae	X	Herb	HB47

Appendix I (continued)

<i>Jacaranda mimosifolia</i> D. Don.	Bignoniaceae	Yetemnja zaf (A)	Tree	HB43
<i>Juniperus procera</i> Hochst. ex Endl.	Cupresaceae	Gaattiraa (O), Ye' abesha tsed (A)	Tree	HB44
<i>Justicia schimperiana</i> Hochst. ex Apos	Acanthaceae	Dhummuugaa (O)	Shrub	HB80
<i>Lactuca sativa</i> L.	Asteraceae	Selata (A)	Herb	HB92
<i>Lepidium sativum</i> L.	Brassicaceae	Feechoo (O)	Herb	HB130
<i>Leucanthemum vulgare</i> Lam.	Asteraceae	X	Herb	HB22
<i>Lippia adoënsis</i> Hochst. ex Walp. var. <i>koseret</i> Sebsebe	Verbenaceae	Kusaye (O), Koserete (A)	Shrub	HB06
<i>Liqustrum vulgare</i> L.	Oleaceae	Yeterse-mefakia (A)	Shrub	HB25
<i>Lycopersicon esculentum</i> Mill.	Solanaceae	Timatimi (O)	Herb	HB20
<i>Malus sylvestris</i> Miller	Rosaceae	Apple / Pome	Tree	HB110
<i>Mangifera indica</i> L.	Anacardiaceae	Mango (O, A, G)- use the common English name	Tree	HB33
<i>Melia azedarach</i> L.	Meliaceae	Neem (A)	Tree	HB40
<i>Mentha longifolia</i> (L.) Hudson	Lamiaceae	Samhal (T)	Herb	HB12
<i>Mentha spicata</i> L.	Lamiaceae	Nana (A)	Herb	HB48
<i>Millettia ferruginea</i> (Hochst.) Bak.	Fabaceae	Hortessa (O)	Tree	HB105
<i>Morus alba</i> L.	Moraceae	Njorie (A)	Tree	HB103
<i>Musa paradisiaca</i> L.	Musaceae	Muzii (A)	Herb	HB35
<i>Myrtus communis</i> L.	Myrtaceae	Ades (A, G)	Shrub	HB107
<i>Nephrolepis undulata</i> (Afz. ex SW.) J. SM.	Nephrolepidaceae	Zenbaba abeba (A)	Herb	HB27
<i>Nicotiana tabacum</i> L.	Solanaceae	Timibo (O)	Herb	HB88
<i>Ocimum basilicum</i> L.	lamiaceae	Besobilla (A)	Herb	HB38

Appendix I (continued)

<i>Ocimum lamiifolium</i> Hochst. ex Benth.	Lamiaceae	Qoricha-michii (O), Yeken-damakese (A)	Shrub	HB39
<i>Ocimum urticifolium</i> Roth	Lamiaceae	Qoricha-michi (O), Yeletit-damakese (A)	Shrub	HB67
<i>Olea europaea</i> L. subsp. <i>cuspidata</i> (Wall. ex G. Don) Cif.	Oleaceae	Ejersa (O)	Tree	HB96
<i>Opuntia cylindrica</i> (Lam.) D. C.	Cactaceae	Qulqwal (A)	Shrub	HB70
<i>Opuntia stricta</i> (Haworth) Haworth	Cactaceae	Qulqwal (A)	Shrub	HB71
<i>Passiflora edulis</i> Sims	Passifloraceae	Yezenjero- Kolet (A)	Liana	HB118
<i>Pelargonium glechomoides</i> Hochst. ex A. Rich.	Geraniaceae	X	Shrub	HB08
<i>Persea americana</i> Mill.	Lauraceae	Abukado (O, A, G)	Tree	HB34
<i>Phaseolus lunatus</i> L.	Fabaceae	Adengwarrie (A)	Liana	HB99
<i>Phaseolus vulgaris</i> L.	Fabaceae	Boloqqie (A)	Liana	HB131
<i>Phoenix reclinata</i> Jacq.	Arecaceae	Zenbaba (A)	Tree	HB36
<i>Phytolacca dodecandra</i> L.	Phytolaccaceae	'Ndod (A)	Shrub	HB126
<i>Pinus patula</i> L.	Pinaceae	Shew-shewwie (A)	Tree	HB126
<i>Plectranthus</i> sp.	Lamiaceae	X	Herb	HB02
<i>Podocarpus falcatus</i> (Thunb.) Mirb.	Podocarpaceae	Birbirssa (O)	Tree	HB09
<i>Prunus x domestica</i> L.	Rosaceae	Prim (A)	Tree	HB119
<i>Prunus persica</i> (L.) Batsch	Rosaceae	Koki (O)	Tree	HB124
<i>Psidium guajava</i> L.	Myrtaceae	Zeyitunnaa (O)	Tree	HB78
<i>Punica granatum</i> L.	Punicaceae	Romaana (O)	Shrub	HB109

Appendix I (continued)

<i>Rhamnus prinoides</i> L' Herit.	Rhamnaceae	Giesho (O, A)	Shrub	HB29
<i>Rhamnus stado</i> A. Rich.	Rhamnaceae	Teddo (O)	Shrub	HB120
<i>Ricinus communis</i> L.	Euphorbiaceae	Qobboo (O)	Herb	HB95
<i>Rosa abyssinica</i> Lindley	Rosaceae	Qega (O, A)	Shrub	HB134
<i>Rosa hybrida</i> Hort.	Rosaceae	Sgie-rada (A)	Shrub	HB11
<i>Rosmarinus officinalis</i> L.	Lamiaceae	Siga-metibesha (A)	Shrub	HB18
<i>Ruta chalepensis</i> L.	Rutaceae	Ciraakkota (O)	Shrub	HB04
<i>Saccharum officinarum</i> L.	Poaceae	Shenkor-ageda (A)	Herb	HB79
<i>Salvia microphylla</i> Kunth.	Lamiaceae	X	Shrub	HB28
<i>Salix mucronata</i> Thunb.	Salicaceae	Aleltu (O)	Shrub	HB26
<i>Schinus molle</i> L.	Anacardiaceae	Kundo-berberie zaf (A)	Tree	HB66
<i>Senna didymobotrya</i> (Fresen.) Irwin & Barneby	Fabaceae	Akayi-warabessa (O)	Shrub	HB128
<i>Sesbania sesban</i> (L.) Merr.	Fabaceae	X	Shrub	HB49
<i>Solanum tuberosum</i> L.	Solanaceae	Dinichaa (O)	Herb	HB141
<i>Spathodea campanulata</i> P. Beauv. sub sp. <i>nilotica</i> (Seem.) Bidgood	Bignoniaceae	Espathoda (O, A) derived from its latin name)	Tree	HB41
<i>Tagetes patula</i> L.	Asteraceae	Yeresa-abeba (A)	Herb	HB87
<i>Thuja orientalis</i> L.	Cupresaceae	Shimelese tsed (A)	Tree	HB61
<i>Verbena hybrida</i> Voss.	Verbenaceae	X	Herb	HB23
<i>Vernonia amygdalina</i> Del.	Asteraceae	Eebicha (O)	Shrub	HB13
<i>Vicia faba</i> L.	Fabaceae	Baqiela (A)	Herb	HB32
<i>Vitis vinifera</i> L.	Vitaceae	Weyn (A)	Liana	HB117
<i>Withania somnifera</i> (L.) Dunal in Dc.	Solanaceae	Gizawa (A)	Herb	HB137
<i>Xanthium strumarium</i> L.	Asteraceae	Deha-nikel (A)	Herb	HB58
<i>Zantedeschia aethiopica</i> (L.) K.P.J. Sprengel	Araceae	Yetrumba abeba (A)	Herb	HB03

Note: O = Oromo name, A = Amharic name, G = Guragie name, T = Tigrie name

X = No local name

Appendix II List of functional groups of plant species in the home-gardens of the study area

Scientific name	Remark
Food crops	
Fruit crops	
<i>Annona cherimola</i> Mill.	
<i>Casimiroa edulis</i> La Llave	
<i>Citrus aurantifolia</i> (Christm.) Swingle	
<i>Citrus aurantium</i> L.	
<i>Citrus medica</i> L.	
<i>Citrus sinensis</i> (L.) Osb.	
<i>Malus sylvestris</i> Miller	
<i>Mangifera indica</i> L.	
<i>Morus alba</i> L.	
<i>Musa paradisiaca</i> L.	
<i>Passiflora edulis</i> Sims	
<i>Persea americana</i> Mill.	
<i>Prunus x domestica</i> L.	
<i>Prunus persica</i> (L.) Batsch	
<i>Psidium guajava</i> L.	
<i>Punica granatum</i> L.	Also medicinal
<i>Vitis vinifera</i> L.	
Vegetable crops	
<i>Allium cepa</i> L.	
<i>Allium sativum</i> L.	Also medicinal
<i>Beta vulgaris</i> L.	
<i>Brassica carinata</i> A. Br.	
<i>Brassica oleracea</i> L.	
<i>Brassica oleracea</i> L. var. capitata	
<i>Capsicum annuum</i> L.	
<i>Cucurbita pepo</i> L.	
<i>Daucus carota</i> L.	
<i>Lactuca sativa</i> L.	
<i>Lycopersicon esculentum</i> Mill.	
Root, tuber and sugar crops	
<i>Colocasia esculenta</i> (L.) Schott	
<i>Ensete ventricosum</i> (Welw.) Cheesman.	Also medicinal
<i>Saccharum officinarum</i> L.	
<i>Solanum tuberosum</i> L.	
Pulses	
<i>Phaseolus lunatus</i> L.	
<i>Phaseolus vulgaris</i> L.	
<i>Vicia faba</i> L.	

Appendix II (Continued)

Spices	
<i>Lepidium sativum</i> L.	Also medicinal
<i>Ocimum basilicum</i> L.	
Non-Food Crops	
Spices	
<i>Lippia adoënsis</i> Hochst. ex Walp. var. <i>koseret</i> Sebsebe	
<i>Mentha longifolia</i> (L.) Hudson	
Stimulants	
<i>Catha edulis</i> (Vahl) Forssk. ex Endl.	
<i>Coffea arabica</i> L.	
<i>Nicotiana tabacum</i> L.	
Fragrant plants	
<i>Cymbopogon citratus</i> (Dc.) Stapf	Also medicinal
<i>Mentha spicata</i> L.	Also medicinal
<i>Myrtus communis</i> L.	
<i>Olea europaea</i> L. subsp. <i>cuspidata</i> (Wall. ex G. Don) Cif., L' Olivicoltore	
<i>Rosmarinus officinalis</i> L.	
Medicinal Plants	
<i>Ajuga integrifolia</i> Buch.- Ham. ex D. Don	
<i>Artemisia absinthium</i> L.	
<i>Artemisia afra</i> Jacq. ex Willd.	
<i>Calpurnea aurea</i> (Ait.) Benth.	
<i>Commelina</i> sp.	
<i>Datura stramonium</i> L.	
<i>Foeniculum vulgare</i> Mill.	
<i>Hagenia abyssinica</i> (Bruce) J. F. Gmel.	
<i>Ocimum lamiifolium</i> Hochst. ex Benth.	
<i>Ocimum urticifolium</i> Roth	
<i>Ruta chalepensis</i> L.	
<i>Withania somnifera</i>	
<i>Xanthium strumarium</i> L.	
Ornamentals	
<i>Asparagus africanus</i> Lam.	
<i>Begonia cucullata</i> Willd.	
<i>Begonia rex-cultorum</i> Hort.	
<i>Bidens rueppellii</i> (Sch. Bip. ex Walp.) Sherff	
<i>Bougainvillea x buttiana</i> Holtum & Standl.	
<i>Bougainvillea glabra</i> Choisy	

Appendix II (Continued)

<i>Canna indica</i> L.	
<i>Catharanthus roseus</i> (L.) G. Don	
<i>Crinum abyssinicum</i> Hochst. ex A. Rich.	
<i>Dahlia pinnata</i> Cav.	
<i>Dracaena steudneri</i> Engl.	
<i>Euphorbia inaequilatera</i> Sond.	
<i>Euphorbia milii</i> Des Moulins	
<i>Gomphocarpus fruticosus</i> (L.) Ait. f.	
<i>Hibiscus rosa-sinensis</i> L.	
<i>Hyphaene thebaica</i> (L.) Mart.	
<i>Iresine herbstii</i> Hook. f.	
<i>Leucanthemum vulgare</i> Lam.	
<i>Nephrolepis undulata</i> (Afz. ex SW.) J. SM.	
<i>Pelargonium glechomoides</i> Hochst. ex A. Rich.	
<i>Plectranthus</i> sp.	
<i>Rosa hybrida</i> Hort.	
<i>Salvia microphylla</i> Kunth.	
<i>Tagetes patula</i> L.	
<i>Thuja orientalis</i> L.	
<i>Verbena hybrida</i> Voss.	
<i>Zantedeschia aethiopica</i> (L.) K.P.J. Sprengel	
Live fences	
<i>Aloe pubescens</i> Reynolds	
<i>Buddleja davidii</i> Franch.	
<i>Caesalpinia decapetala</i> (Roth) Alston	
<i>Callistemon citrinus</i> (Curtis) Skeels	
<i>Carissa spinarum</i> L.	
<i>Cupressus lusitanica</i> Mill.	Also for fuel wood
<i>Dodonaea angustifolia</i> L. f.	
<i>Dovyalis caffra</i> (Hook. f. & Harv.) Hook. f.	
<i>Grevillea robusta</i> R.Br.	
<i>Jacaranda mimosifolia</i> D. Don.	
<i>Justicia schimperiana</i> Hochst. ex Apos	Also medicinal
<i>Opuntia cylindrica</i> (Lam.) D. C.	
<i>Opuntia stricta</i> (Haworth) Haworth	
<i>Phytolacca dodecandra</i> L.	
<i>Pinus patula</i> L.	

Appendix II (Continued)

<i>Rosa abyssinica</i> Lindley	
<i>Schinus molle</i> L.	
<i>Sesbania sesban</i> (L.) Merr.	
<i>Senna didymobotrya</i> (Fresen.) Irwin & Barneby	
Shade trees	
<i>Acacia abyssinica</i> Hochst.ex Benth.	Also for implements and fuel wood
<i>Acacia melanoxylon</i> R.Br.	
<i>Albizia schimperiana</i> Oliv. var. <i>schimperiana</i>	
<i>Cordia africana</i> Lam.	Also for implements and fuel wood
<i>Croton macrostachyus</i> Del.	Also for medicine and fuel wood
<i>Erythrina brucei</i> Schweinf.	
<i>Ficus elastica</i>	
<i>Ficus populifolia</i> Vahl	
<i>Ficus sur</i> Forsk.	
<i>Ficus thonningii</i> Blume	
<i>Hyphaene thebaica</i> (L.) Mart.	
<i>Jacaranda mimosifolia</i> D. Don.	
<i>Melia azedarach</i> L.	
<i>Millettia ferruginea</i> (Hochst.) Bak.	
<i>Podocarpus falcatus</i> (Thunb.) Mirb.	
<i>Spathodea campanulata</i> P. Beauv. subsp. <i>nilotica</i> (Seem.) Bidgood	
Construction, crafts and implements	
<i>Acacia mearnsii</i> De Willd.	Also for shade and fuel wood
<i>Arundo donax</i> L.	Also live fence
<i>Eucalyptus camaldulensis</i> Dehnh.	Also for fuel wood and live fence
<i>Eucalyptus globulus</i> Labill.	Also for medicine, live fence and fuel wood
<i>Juniperus procera</i> Hochst. ex Endl.	Also for medicine and fuel wood
<i>Phoenix reclinata</i> Jacq.	Also ornamental
Utility plants	
<i>Agave americana</i> L.	
<i>Cyperus alternifolius</i> L.	
<i>Cyperus</i> sp.	
<i>Liqustrum vulgare</i> L.	
<i>Rhamnus prinoides</i> L' Herit.	
<i>Rhamnus stado</i> A. Rich.	
<i>Ricinus communis</i> L.	
<i>Salix mucronata</i> Thunb.	
<i>Vernonia amygdalina</i> Del.	Also medicinal

Appendix III List of tree species of the study area

Scientific name	Abundance / Number of individual plants
<i>Acacia abyssinica</i> Hochst.ex Benth.	15
<i>Acacia mearnsii</i> De Willd.	12
<i>Acacia melanoxylon</i> R.Br.	1
<i>Albizia schimperiana</i> Oliv. var. <i>schimperiana</i>	1
<i>Annona cherimola</i> Mill.	10
<i>Callistemon citrinus</i> (Curtis) Skeels	23
<i>Casimiroa edulis</i> La Llave	53
<i>Cordia africana</i> Lam.	12
<i>Croton macrostachyus</i> Del.	14
<i>Cupressus lusitanica</i> Mill.	1500
<i>Dracaena steudneri</i> Engl.	15
<i>Erythrina brucei</i> Schweinf.	6
<i>Eucalyptus camaldulensis</i> Dehnh.	1125
<i>Eucalyptus globulus</i> Labill.	58
<i>Ficus elastica</i> Roxb.	4
<i>Ficus populifolia</i> Vahl	4
<i>Ficus sur</i> Forsk.	2
<i>Ficus thonningii</i> Blume	2
<i>Grevillea robusta</i> R.Br.	26
<i>Hagenia abyssinica</i> (Bruce) J. F. Gmel.	5
<i>Hyphaene thebaica</i> (L.) Mart.	17
<i>Jacaranda mimosifolia</i> D. Don.	20
<i>Juniperus procera</i> Hochst. ex Endl.	41
<i>Malus sylvestris</i> Miller	27
<i>Mangifera indica</i> L.	28
<i>Melia azedarach</i> L.	1
<i>Millettia ferruginea</i> (Hochst.) Bak.	1
<i>Morus alba</i> L.	5
<i>Olea europaea</i> L. sub sp. <i>cuspidata</i> (Wall. ex G. Don) Cif., L' Olivicoltore	15
<i>Persea americana</i> Mill.	63
<i>Phoenix reclinata</i> Jacq.	12
<i>Pinus patula</i> L.	34
<i>Podocarpus falcatus</i> (Thunb.) Mirb.	4
<i>Prunus x domestica</i> L.	7
<i>Prunus persica</i> (L.) Batsch	3
<i>Psidium guajava</i> L.	26
<i>Schinus molle</i> L.	12
<i>Spathodea campanulata</i> P. Beauv. sub sp. <i>nilotica</i> (Seem.) Bidgood	21
<i>Thuja orientalis</i> L.	14

Appendix IV List of food plants found from home-gardens of the study area

Scientific name	Family	Part consumed
<i>Allium cepa</i> L.	Alliaceae	Bulb, leaves
<i>Allium sativum</i> L.	Alliaceae	Bulb, leaves
<i>Annona cherimola</i> Mill.	Annonaceae	Fruit
<i>Beta vulgaris</i> L.	Chenopodiaceae	Leaves
<i>Brassica carinata</i> A. Br.	Brassicaceae	Leaves
<i>Brassica oleracea</i> L.	Brassicaceae	Leaves
<i>Brassica oleracea</i> L. var. capitata	Brassicaceae	Leaves
<i>Capsicum annuum</i> L.	Solanaceae	Fruit
<i>Casimiroa edulis</i> La Llave	Rutaceae	Fruit
<i>Citrus aurantifolia</i> (Christm.) Swingle	Rutaceae	Fruit
<i>Citrus aurantium</i> L.	Rutaceae	Fruit
<i>Citrus medica</i> L.	Rutaceae	Fruit
<i>Citrus sinensis</i> (L.) Osb.	Rutaceae	Fruit
<i>Colocasia esculenta</i> (L.) Schott	Araceae	Root
<i>Cucurbita pepo</i> L.	Cucurbitaceae	Fruit
<i>Daucus carota</i> L.	Apiaceae	Root
<i>Ensete ventricosum</i> (Welw.) Cheesman.	Musaceae	Stem, corm
<i>Lactuca sativa</i> L.	Asteraceae	Leaves
<i>Lepidium sativum</i> L.	Brassicaceae	Seeds
<i>Lycopersicon esculentum</i> Mill.	Solanaceae	Fruit
<i>Malus sylvestris</i> Miller	Rosaceae	Fruit
<i>Mangifera indica</i> L.	Anacardiaceae	Fruit
<i>Morus indica</i> L.	Moraceae	Fruit
<i>Musa paradisiaca</i> L.	Musaceae	Fruit
<i>Ocimum basilicum</i> L.	lamiaceae	Leaves, flowers
<i>Passiflora edulis</i> Sims	Passifloraceae	Fruit
<i>Persea americana</i> Mill.	Lauraceae	Fruit
<i>Phaseolus lunatus</i> L.	Fabaceae	Seed
<i>Phaseolus vulgaris</i> L.	Fabaceae	Seed
<i>Prunus x domestica</i> L.	Rosaceae	Fruit
<i>Prunus persica</i> (L.) Batsch	Rosaceae	Fruit
<i>Psidium guajava</i> L.	Myrtaceae	Fruit
<i>Punica granatum</i> L.	Punicaceae	Fruit
<i>Saccharum officinarum</i> L.	Poaceae	Stem
<i>Solanum tuberosum</i> L.	Solanaceae	Tuber
<i>Vicia faba</i> L.	Fabaceae	Seed
<i>Vitis vinifera</i> L.	Vitaceae	Fruit

Appendix V Semi-structured interview items for data collection

Personal Information

District _____ Town _____ Kebele _____ Specific site _____
 Informant's name _____ Gender _____
 Age _____ Educational background _____ Occupation _____

1. Refer to the names of plants / crops in your home-garden.

Local name	Coll. No.	Habit	Use	Part used

2. List the multipurpose tree species in your home-garden

Local name	Coll. No.	Habit	Use

➤ Rank the top six tree species

3. Which plants are utilized as live fence and shade tree species in your home-gardens?

Local name	Coll. No.	Habit	Additional use

4. Mention the edible fruit crops, spices, aromatic plants, ornamentals or others that are grown in your home-garden.

Local name	Coll. No.	Habit	Remark

18. Do you give or sell planting material to others?
19. Do you exchange plant material with others?
20. How do you manage your home-garden plants? How do you enhance the fertility of your garden soil?
How do you control pests? How do you select seeds for planting?

Market Survey

1. Are these plant products cultivated, managed or wild?
2. In what condition are these surplus home-garden products sold in the local market?
 - i. Fresh
 - ii. Dried
 - iii. Preserved in _____
3. The home-garden products are brought to the market
 - i. daily
 - ii. weekly
 - iii. at irregular interval
4. Accessibility per year
 - i. Jan.- April
 - ii. May- August
 - iii. Sept.- Dec.
5. Does the vending of surplus home-garden products bring any significant change on your annual earnings? (Yes / No)

