

**Addis Ababa University
School of Graduate Studies**



**Local use of spices, condiments and non-edible oil crops in some selected
woredas in Tigray, Northern Ethiopia.**

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University in Partial Fulfillment of the Requirements for the Degree of
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(Dryland Biodiversity).

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Acronyms and Abbreviations

BoARD	Bureau of Agriculture and Rural Development
CSA	Central Statistics Authority
EEPA	Ethiopian Export Promotion Agency
EFY	Ethiopian Fiscal Year
ENMA	Ethiopian National Metrological Agency
EPA	Ethiopian Environmental Protection Authority
FAO	Food and Agriculture Organization
HMIS	Health Management and Information System
ILRI	International Livestock Research Institution
IPMS	Improved Productivity and Market Success
IUCN	International Union for Conservation of Nature and Natural
MoARD	Ministry of Agriculture and Rural Development
MUC	Mekelle University College
UNEP	United Nations Environment Programme
WRB	World Reference Base
WWF	World Wide Fund for Nature

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Abstract: The local use of spices, condiments and non-edible oil crops was studied in three selected *woredas* of Tigray, Northern Ethiopia. The study *woredas* were Degu'a Tembien, Alamata and Ofla. The specific localities in the study *woredas* include Mahbere silassie (Degu'a Tembien), Tumuga and Gerjelle (Alamata) and Zata and Hashenge (Ofla). This study is aimed to document the indigenous knowledge on use as well as threats to these spices, condiments and non-edible oil crops in the home gardens and cultivated fields in the study areas. The data were collected from garden holders (home garden owners), cultivated fields, spice vendors in market areas, agriculture experts and knowledgeable elders in the local communities of the study sites with their age ranging between 16 and 75 years, using semi-structured interviews, preference ranking, market survey and field observation. A sample comprising 25 home gardens and 25 cultivated fields (10 from each locality) were considered. The spices and non-edible oil crops were identified with informants by their Tigrigna names and the specimen were later authenticated at the National Herbarium (ETH), Addis Ababa University. A total of 21 useful plant species (18 spices and condiments and 3 non-edible oil crops) in 13 families and 20 genera were recorded. Of the plants documented 17 (80.9 %) were herbs, 3 (14.3 %) shrubs and 1 (4.8 %) trees. The results of study showed that the local people in the study area grow different herbs, spices and condiments which they use them to flavor food, beverages and for medicinal purposes. Hence they have a long tradition of using these plants in their traditional food system. They also use non-edible oil crops for several purposes. Preference rankings showed that the local people widely use *Capsicum annum*, *Allium cepa*, *Allium sativum*, *Nigella sativa*, *Ocimum basilicum*, *Trigonella foenum-graecum* and *Cuminum cyminum* in preparing stew. For medicinal purposes they widely use *Allium sativum*, *Nigella sativa*, *Lepidium sativum*, *Ruta chalepensis* and *Zingiber officinalis*. The threats owing to the less production of spices and condiments in home gardens are also noted as shortage of land, lack of knowledge on production and use of these plants, drought, crop pests and lack of seeds compounded by market access problems. Therefore it would be important for governmental, non-governmental organizations and other concerned bodies to give trainings to the farmers on: how to enhance home garden products, alternative means of obtaining water for home gardening activities, checking the increasing rate of population and preventing crop pests in home gardens and cultivated fields.

Keywords/Phrases: Indigenous knowledge, Ethnobotany, plant use values, Non-edible oil crops, Spices and condiments.

1. Introduction

1.1 Background

Biological Diversity or Biodiversity is defined as the variety of life in all its forms, levels and combinations. It includes ecosystem diversity, species diversity, and genetic diversity (IUCN, UNEP and WWF, 1991). The Ethiopian flora is estimated to contain nearly 7000 different higher plant species out of which about 12 percent are endemic (EPA, 2006). In the Convention on Biodiversity (CBD, 1992), Agro-biodiversity is also defined as the variability among living organisms associated with cultivation of crops and rearing of animals along with the ecological complexes of which they are a part. It is a part of biodiversity that embraces all components of relevance to food and agriculture. Local knowledge and culture can also be considered as integral parts of agro-biodiversity, because it is the human activity of agriculture that shapes and conserves this biodiversity. The significant geographical diversity of the country has favored the formation of different habitats and vegetation zones and hence diverse flora and fauna. Ethiopia is also a home to many languages, cultures and beliefs which have in turn contributed to the high diversity of traditional knowledge and practices of the people which, among others, includes the culinary and medicinal use of plants. This traditional knowledge and practices of indigenous people on plant use is studied in ethnobotany.

Ethiopia is known for its unique and multi-ethnic population with different languages, culture, and invaluable indigenous knowledge, innovations and practices which play a crucial role in biodiversity conservation and sustainable utilization. It is defined in the work of Martin (1995); Balick and Cox (1996) that ethnobotany is a broad term referring to the study of direct interrelations between humans and plants. The indispensable dependency of humans upon plants for their livelihood was primarily started by domestication and dates back 10,000 years (Martin, 1995).

Humans obtain food, pesticides, medicines, fuel, fodder, construction materials, tools, and also derive aesthetic and spiritual fulfillments from plants. Therefore, as it is stressed by Posey (1999), indigenous knowledge on plants appeared when humans started and learned

how to use plants. Over centuries, people have developed their own locality specific knowledge on plant use, management and conservation (Cotton, 1996). The same author also stressed that this complex knowledge, beliefs and practices generally known as indigenous knowledge (IK) or traditional knowledge develops and changes with time and space, with change of resources and culture.

Spices and condiments are plant parts or plant products, which are mostly used for seasoning, flavouring and thus enhancing the taste of foods, beverages and drugs (Jansen, 1981 ; Dziezak, 1989; Iwu, 1993).

Although spices have been important for centuries in food preparation throughout the world, we see considerable difference in the patterns of spice use among cultures and countries. The indigenous knowledge and use of plants as spices and condiments (culinary use) is as old as the history of mankind (Garland, 1972). Achinewu *et al.* (1995) pointed out that plants used as spices and condiments are usually aromatic and pungent. Iwu (1993); Billing and Sherman (1998) had also reported that spices and condiments owe these properties to the presence of varying types of essential oils. Many authors also mentioned the antiseptic and the preservative properties of these plants to the possession of the essential oils such as what is reported in the work of Macmillan (1984). Dziezak (1989) again indicated the rich presence of essential oils and oleoresins determine the aromatic, flavouring, colouring and pungent properties of spices and condiments.

It is also noted by Zemedet Asfaw (2001) that Ethiopian people have been using and still are using spices, condiments, additives and herbs in their traditional food system since a long period of time and have incorporated new crops into the farming systems and traditional recipes, for which home gardens play pivotal roles. Spices and condiments make a significant proportion of home garden plants in Ethiopia. The home gardens in Ethiopia are either located at the backyards, front yards, side yards or almost encircle the house.

Literatures on ethnobotany and ethnomedicine of spices and condiments in the study area are inadequate or are completely lacking. Therefore this study is aimed at providing data on the ethnobotanical use of spices, condiments and non-edible industrial oil crops in some selected *woredas* in Tigray- Northern Ethiopia. This present study is then initiated to contribute in the

documentation and provision of records of indigenous knowledge on use, management and conservation of spices, condiments and non-edible oil crops in the study area.

1.2 Objectives

1.2.1 General objective

To provide information on the local use of spices, condiments and non-edible industrial oil crops in selected *woredas* in Tigray, Northern Ethiopia, and to document the indigenous ethnobotanical knowledge of the local people for proper management, conservation and sustainable use of these plants in the study area.

1.2.2 Specific objectives

- To identify the use of spices and condiments by the local people in some selected *woredas* in Tigray – Northern Ethiopia.
- To identify the local use of non-edible industrial oil crops by the people in some selected areas in Tigray –Northern Ethiopia.
- To find out the anthropogenic threats and the local methods used by the indigenous people to conserve spices, condiments and non-edible oil crops in the study area.
- To document the indigenous knowledge on management and conservation of the aforementioned plants by the local community in the study sites.
- To generate ideas that would contribute to develop a strategy for conservation and sustainable management of spices, condiments and non-edible oil crops in home gardens and cultivated fields in the study area.

2. Literature Review

2.1 Origin and development of Ethnobotany

Human beings depend on other organisms to survive. As a result the traditional people around the world accumulated unique knowledge of plant resources on which they depend for food, medicine and general utility including remarkable botanical knowledge (Martin, 1995). Since the plant kingdom is the most essential to human well being especially in supplying his basic needs, there exists close interaction and dependency of humans on plants. Hence to study this interrelated dependency, the knowledge of the field of ethnobotany is indispensable.

Though it is difficult to tell when the term ethnobotany became part of modern science, as it is mentioned in several literatures, it is possible to assume that it can be traced back to the time when humans started making conscious interaction with plants and animals. As it is noted in Cotton (1996), ethnobotanical works seem to have started with Christopher Columbus in 1492, at a time when he discovered the use of tobacco plant (*Nicotiana spp*) by local people of Cuba and brought tobacco, maize, spices and other useful plants to Europe. Around 1858, British explorer, R. Spence noted for the first time the psychoactive properties of the vine plant (*Banisteriopsis cappa*) cited in Cotton (1996). Documenting food, medicine and other useful plants of the Aztec, Maya and Inca peoples by immigrants from the new world is also noted by Martin (1995). Such works and many others gradually yielded a firm base for the study of direct interaction between human and other organisms through documenting, analysis and use of indigenous knowledge of biological entity.

The term ethnobotany was for the first time used by John Harshberger in 1895 mentioned in Balick and Cox (1996), there he defined it as ‘the use of plants by aboriginal peoples’, yet from time immemorial, considerable attention has focused not only on how plants are used but also on how they are perceived, managed, and on the reciprocal relationship between people and plants (Shrestha *et al.*, 1997).

The above mentioned and other works on ethnobotany promoted this subject to be an independent field of study in biological sciences, despite that different authors used various

ways of defining ethnobotany. Martin (1995) broadly defined ethnobotany as the study of interactions between humans and plants whereas Balick and Cox (1996) included the use of plants as food, medicinal, forage and for any other economic purposes within field of ethnobotany. Cotton (1996) also noted that, ethnobotany encompasses all studies that concern the mutual relationships between plants and traditional people.

This interdisciplinary field incorporates techniques and researches from many fields such as anthropology, archaeology, biology, botany, chemistry, entomology, geography, history, linguistics, medicine, and zoology. Therefore it includes wide areas such as studying plants as wild foods and as agricultural crops, as constructs for houses and modes of transportation; as baskets, pottery and art; as clothing and types of weaving; as medicines and alternative methods for healing; and in the context of cultural myths and religious ceremonies. It may also deal with the cultural consequences of the extinction of a particular plant species on the diet of a culture, impacts of acculturation on a cultural uses of plants, and the transmission of ethnobotanical knowledge from one generation to the next. Ethnobotanists study all types of cultures, from the past to the present (Balick and Cox, 1996).

2.2 Indigenous knowledge

Indigenous knowledge has been defined in several literatures differently though the basic idea is the same or similar. To mention some: According to Thomas (1995), indigenous knowledge is defined as the local knowledge that is unique to a given culture or society and it is the base for agriculture, health care, food preparation, education, environmental conservation and a host of other activities. Quanash (1998) also noted that indigenous knowledge refers to the accumulation of knowledge, rules, standards, skills, and mental sets, which are possessed by local people in a particular area.

This complex knowledge, beliefs and practices generally known as indigenous knowledge, develops and changes with time and space. Therefore, such knowledge includes time-tested practices that developed in the process of interaction of humans with their environment (Alcorn, 1984). Today the development of indigenous knowledge systems, encompassing all

aspects of life, including management of natural environment, has been a matter of survival to the indigenous people who generated them (SLUM, 2006).

Indigenous knowledge is not built in a day it is rather a result of many generations, long years experiences, careful observations and trial and error experiments (Martin, 1995). As a result indigenous people of different localities have developed their own specific knowledge on plant resource use, management and conservation that developed over long period of time (Cotton, 1996).

Spices have been used for thousands of years in food preparation and preservation, medicinal purposes as well as for embalming, in areas where the plants are native (Govindarajan, 1985; Dillan and Board, 1994 cited in Sherman and Billing, 1999).

Zemedie Asfaw (2001) wrote that special places such as sacred places and places of worship –like compounds of churches and mosques, graveyards and monasteries-have been important sites for the protection of the indigenous flora. Other related works also noted that in Ethiopia religious believes have played and continued to play a crucial role in biodiversity conservation. Sacred trees, groves and forests exist throughout Ethiopia, and receive various degree of protection by relatively modern religions (i.e. Orthodox Christians and Muslims) and traditional religions.

A spice may be defined as "any dried, fragrant, aromatic, or pungent vegetable or plant substance, in the whole, broken, or ground form, that contributes flavor, whose primary function in food is seasoning rather than nutrition, and that may contribute enjoyment or spiciness to foods or beverages" (Farrell 1990:17 cited in Billing and Sherman, 1998).

Ethiopians have a long tradition of using spices and condiments for culinary as well as medicinal purposes. Here spices are important ingredients of foods and beverages of many ethnic cultures that are usually consumed in relatively large quantities and therefore can have significant health effects on a large sector of the Ethiopian population (Worku Abebe, 2006).

Abbebe Kifleyesus (2004) noted in his work that cereals (glutinous and non-glutinous), fresh or dried meats, pulses and lentils, locally available vegetables, condiments and spices are the

most basic ingredients in Ethiopian meals, in which garlic onions, green and red peppers, and a wide variety of herbs, leaves, stems and flowers flavor daily dishes. The *berbere'* (made of *Capsicum spp.* and usually blended with other spices such as *Nigella sativa*, *Aframomum corrorima*, and *Coriandrum sativum* and other spices) is a common ingredient, basic to all Ethiopian cooking in both urban and rural areas.

According to Farnsworth (1994) traditional medicine which is one of the widely used indigenous knowledge system in many countries involves traditional diagnosis, collection of raw materials, preparation of remedies and its prescription to patients.

Most spicy herbs do have traditional medicinal values. Some could be regarded as digestants, or carminatives and still others as bowel function improvers. Many spices and condiments are used in aromatherapy. A few herbs such as mint (containing menthol), basil, thyme and sage are often used to treat pharyngitis, coughs and bronchitis. The Papyrus Ebers, which was written in Egypt about 1500 B.C., mentions the medicinal use of some spices such as coriander, cumin, fenugreek and mint. Peppers were used as in wine as medication for stomach pain, and similarly spiced wines were used therapeutically for centuries afterwards by Greeks, Romans and medieval Europeans. These folk remedies and family traditions lead to many people favoring specific spicy beverages for various health purposes varying from aphrodisiacs and digestives to cold preventatives and bronchitis therapies (Anonymous, 2002).

There are reports indicating that ensuring equitable distribution of modern health care has become more serious in many developing countries, as the gap between supply and demand has continued to widen. Hence, in present day Africa including Ethiopia, the majority of people lack access to health care and even if available the quality is largely below standard (Abbiw, 1996).

Herbal medicine (traditional) medicinal plant use is common in Ethiopia. Dawit Abbebe (2001) mentioned in his work that nearly 80% of Ethiopian population use plant-based traditional medicines as their major health care system.

Jansen (1981) noted in his study that indigenous knowledge on remedies in many countries including Ethiopia, pass from one generation to the other verbally with great secrecy. As reported by Amare Getahun (1976), this secretive and crude transfer makes the indigenous ethnomedicinal knowledge vulnerable to distortion and in most cases, some of the lore is lost at each point of transfer. Therefore, systematic documentation of such useful knowledge through ethnobotanical research is required.

2.3 Home gardens

According to Shrestha *et al.* (2002), the term 'home garden' refers to the traditional land use practices around a homestead where several species of plants are planted and maintained by members of the household and their products are intended primarily for household consumption.

Home gardens are very important in fulfilling community and household needs which may range from food provision and food security to enhancing the family nutritional status, ensuring primary healthcare, income generation and other utility functions. They are also very important for *in situ* conservation of the valuable agro-biodiversity and the sustainability of the surrounding ecosystem. Therefore, threat of genetic erosion to plant resources for food and agriculture could be stopped by ensuring the worth value of home gardens, as they ensure conservation of useful plants through continued use (Gebremedhin Teklehaimanot and Mulubrhan Haile, 2007).

As is noted in the work of Gessler *et al.* (1997) home gardens are viewed as managed ecosystems with dynamic interplay between the biotic, abiotic and socio-cultural factors. Torquebiau (1992) in his work mentioned that these days a world-wide increase in the emphasis on home gardens showing the importance of their actual and potential values in the provision of food, medicine and other household necessities and conservation of plant genetic diversity is being emphasized.

According to some authors such as Jose and Shanmugaratnam (1993), the evolution of home gardens is reported as resulting from shifting cultivation when people tried to overcome resource constraints and to ascertain rights to land resources.

2.3.1 General characteristics of home gardens

Since home gardens are located around the home, family members are able to give more attention and care to the plants grown there and they often receive a heavy application of animal manure and the soil is more fertile than in the larger agro-ecosystem (Rana *et al.*, 1998).

According to Gessler *et al.* (1996) home gardens are important sources of biodiversity, income and food, especially for low-income households. Similarly FAO (1988) also noted that most projects on home gardens have sought to increase and diversify production mainly to improve the nutritional status of low-income households.

Home garden plant species have diverse and multiple uses and are maintained to provide food, vegetables, spices, medicines, fodder, firewood, timber, and a number of other uses. Though home garden production systems are usually subsistence-oriented, in those communities which have market access, their production is often semi-commercial and part of the produce is sold to the market to supplement the cash income of the family. In such home gardens, commercial vegetables, fruits and spices dominate the area, often gradually displacing the indigenous species (Rana *et al.*, 1998).

It is mentioned above that home gardens play a role in *in situ* protection and conservation of plant species that are threatened or endangered, and also they play an important role in food security. Similarly Gessler *et al.* (1998) noted that home gardens are important in biodiversity maintenance as refuges for many endangered species. Home gardens are therefore important for the survival and conservation of locally used plant species and varieties.

Besides, in the work of Eyzaguirre *et al.* (2001), it is reported that home gardens are considered to be a buffer maintaining the sustainability of rural livelihoods. Home gardens play an important role in protecting the environment. Most of the vegetables and fruits sold in local markets are produced in home gardens. Their produce is 'clean' because there is almost no use of pesticides in gardening, contributing to environmental protection as well as public health. Home gardens provide a place where plants, animals, insects, microorganisms and soil and air media mutually interact to maintain the agroecological balance.

2.3.2 Home gardens in Ethiopia

Ethiopia possesses diverse agroecologies with a long history of agriculture. It is an important world centre of domesticated plants and a primary centre of diversification for many important crops (Harlan, 1969 cited in Zemedu Asfaw, 2001). He also pointed out that, the country's rich crop resources that originated through domestication, introduction and adaptation have traditionally been conserved *in situ* in crop fields and home gardens. Several studies and literatures on home gardens in Ethiopia mentioned that one can get several useful plants in home gardens in Ethiopia.

The long history of agriculture in Ethiopia and the presence of ancient crops in home-gardens as noted in the works of (Brandt, 1984; Zemedu Asfaw, 1997 cited in Belachew Wassihun *et al.*, 2003) respectively would clearly show us that gardening was among the earliest forms of farming being practiced in Ethiopia.

2.3.3 Home gardens in Tigray

A large proportion of cultivated plant species of the region (vegetables, spices and condiments, herbs and non-food aromatic plants) are maintained in home gardens, which is locally named as *dhri bet* or *guaro*. As noted by Gebremedhin Teklehaimanot and Mulubrhan Haile (2007), in some areas in Tigray, fences confine the gardens while in others the home gardens are merged with crop fields and may be fenced together. The home garden area may have variable shapes and sizes and it may include the living house, animal houses, grain stores, and plots of garden species. Usually the fence that surrounds the home garden is reinforced by multipurpose live tree and shrub species. The same authors also reported that the diversity in the home gardens of the region's useful plants can be seen under four main categories of garden crops: live fence species, vegetables (leafy, fruit and root and tuber crops), spices and herbs and perennial fruit and fodder plants.

2.4 Spices and condiments

Spices are aromatic plant products used in flavoring foods and beverages. The unique aroma and flavor of a spice is derived from compounds called phytochemicals which evolved in plants to enable them to protect against herbivores, insects and vertebrates, fungi, pathogens and parasites (Fraenkel, 1959; Walker, 1994 cited in Sherman and Billing, 1999).

Several cookbooks generally distinguish between seasonings (spices used in food preparation) and condiments (spices added after food is served), and culinary herbs (usually leaves of plants used in cooking). Spices are any other part of the plant, often dried and used for flavoring food.

As reported by Morton (1976:5) cited in Billing and Sherman (1998), sources of spices include: "1) aromatic lichens; 2) any part of a tree or woody shrub or vine used for flavoring; 3) roots, flowers, seeds, or fruits of herbaceous plants such as saffron and ginger, the leaves of which are not used for flavoring; and 4) extracts or essential oils of any of these plants".

A condiment is a prepared food, often preserved or fermented, that is added in variable quantities, most often at the table, to the diner's taste (McGee, 2004). Condiments may be served on the side or as a garnish (decorate food) or they may be added prior to serving. Some condiments may also be used during cooking to add flavour or texture. Condiments are usually sauces used to enhance the flavor of other foods and not normally eaten on their own. For example *Awaze* is taken as a condiment blended with many different ingredient spices and fermented by microorganisms to produce the semi-liquid seasoning. Jansen (1981) mentioned in his work that the words 'spice' and 'condiment' denote plants or plant products that are used to flavor foods or beverages before, during or after their preparation.

Different herbs, spices and condiments traditionally grow in various parts of Ethiopia. Its higher interior plains, cool nights and long growing season i.e., in general its diverse climate and soil type provide an abundant variety of food. Ethiopia is either a primary or a secondary center of origin of spices like kororima (*Aframomum c. orrorima*), long pepper (*Pepper longum*), black cummin (*Nigella s. ativa*), bishop's weed (*Carum c. opticum*), coriander (*Coriandrum s. ativum*), thyme (*Thymus sc. himperi*) and fenugreek (*Trigonella f. oenum*

graecum) (Ewnetu Derseh, 2006) . Spices have been extensively used in history for flavouring and seasoning foods, beverages and for medicinal purposes (Stethberger *et al.*, 1996). Therefore here one can understand that the culinary, medicinal as well as preservative use of herbs, spices and condiments has a long history in the world.

2.4.1 Spices for culinary purposes

Ethiopian cooking is marked by hot spices, thick stews and *injera*. The usually highly spiced thick sauce in Ethiopian cuisine is prepared either with Capsicum peppers (*berberé*) as the main spice or without Capsicum peppers in which both kinds are based either on meat or on pulses. This fiery spice mix *berberé*, though it is predominantly powdered form of *Capsicum spp.*, is a blend of several spices such as *Aframomum corrorima*, *Zingiber officinale*, *Nigella sativa*, *Trigonella foenum-graecum*, *Cuminum cyminum*, *Allium sativum*, *Coriandrum sativum* etc to mention some.

2.4.2 Spices as traditional medicinal plants

Plants in indigenous societies have multiple and diverse uses. FAO (1997) reported that more than 3.5 billion people in the world rely on plants for the treatment of both human and livestock diseases. As elsewhere in Africa, local people in Ethiopia, by large employed plant based traditional medicine to get cured from diseases arising from worms, fungi, virus and protozoa (Dawit Abebe, 2001). Due to its long history, traditional medicine has become an integral part of the culture (Pankhurst, 1965) . About 80% of the Ethiopian population depends on traditional medicine to treat ailments (Dawit Abebe and Ahadu Ayehu, 1993). More than 95% of traditional medical preparations are of plant origin (Dawit Abebe, 1986).

2.5 Non-edible oil crops

Oilseed crops, grown all over the world, are important sources of edible and non-edible oils and fatty acids (Röbbelen *et al.*, 1989). Non-edible oils have been traditionally used to light lamps and as lubricants. In industry they are used for manufacturing soaps, cosmetics, paints, varnishes and coatings (Lühs and Friedt, 1994). The use of vegetable oils for lighting and as lubricants declined with the availability of cheaper petroleum products. However, after the

“oil crisis” of the seventies, there was considerable interest to develop vegetable oils as a renewable source of hydrocarbons and as “Biofuels” (Quick, 1989; Anonymous, 1994).

2.5.1 Use of non-edible oil crops

Over the last century countries have become dependent on fossil fuels not just only as an energy source for transportation and heating but also for the provision of industrial feedstocks for a multitude of products that they use in every aspect of their daily lives (Lühs and Friedt, 1994).

The beneficial implications of using the energy produced from biomass is many which may include reduction in greenhouse gasses, improved energy security, income source for farmers and greater energy efficiency compared to fossil fuels. On the other hand biomass production for energy may compete with food crops for scarce land and water resources (Röbbelen, *et al.*, 1989).

As mentioned by Henning (2001), *J. curcas* is cultivated as a drought resistant plant in marginal areas to prevent soil erosion. He also noted that the seeds of *J. curcas* yield a semi-drying oil that has been commercially used for lighting oil, lacquer, soap and as a textile lubricant.

2.5.2 Non-edible oil crops as traditional medicinal plants

As to the medicinal use of the castor oil plant, the oil from the seed is a very well-known laxative that has been widely used over 2000 years (Foster and Duke, 1990). Chiej (1984) also reported the anthelmintic, cathartic, emollient, laxative, purgative uses of the castor bean seed. In some areas the seed is rubbed on the temple to treat headache and is also powdered and applied to abscesses and various skin infections (Duke and Ayensu, 1985).

According to Lans *et al.* (2001), hunting dogs may get trauma damage during the hunt as a result leaves of physic nut (*Jatropha curcas*) are boiled and the decoction used to clean the sores. It is also used for medicinal purposes for its strong purging effect; from which the name purging nut stems. The sap has blood clotting properties and the leaves are used in the treatment of malaria (Henning, 2001).

3. Description of the study area and people

3.1 Geographical location

The study has been carried out in Tigray, northern Ethiopia. The study sites (*kebeles/tabias**) are located in the following three *woredas**. Degu'a Tembien (Mahbere silassie), Alamata (Tumuga and Gerjelle) and Ofla (Zata and Hashenge) (Figure 1). In Mahbere silassie the altitudinal range of the surveyed home gardens and cultivated fields is from 2522-2639m a.s.l. The *tabia* is located on the geographic coordinates 13°39' North latitude and 39°09' East longitude. Gerjelle is located in the geographic coordinates of 12°28' North latitude and 39°36' East longitude. The altitudinal range of the surveyed home gardens and cultivated fields in Gerjelle is from 1456-1468m a.s.l. While the geographic coordinates for Tumuga, Zata and Hashenge are 12°18' North latitude and 39°35' East longitude, 12°30' North latitude and 39°16' East longitude, 12°36' North latitude and 39°31' East longitude respectively. The altitudinal range is also from 1449-1461m, 2331-2373m and from 2460-2492m a.s.l. respectively. Alamata is one of the 36 *woredas* in the Tigray region which is bordered on the south and west by the Amhara region, on the northwest by Ofla, and on the northeast by Raya Azebo. Degu'a Tembien is bordered on the south by the *Debubawi* (South) Zone, on the west by Abergele, on the north by Kolla Tembien, and on the east by the *Mibraqawi* (Eastern) Zone. Ofla is one of the 36 *woredas* in Tigray. It is bordered on the south by Alamata, on the west by the Amhara Region, on the north by Endamehoni, and on the east by Raya Azebo.

3.1.1 Description of Alamata Woreda

Alamata *woreda* is one of the five *woredas* in southern zone of Tigray located 600 km north of Addis Ababa and about 180 km south of the Tigray Regional capital Mekelle. Its altitude ranges from 1178 m to 3148 m and 75% of the *woreda* is lowland (*kolla*) (1500 or less m a.s.l.) and only 25% is found in intermediate highlands (*woina degu'a*) (b/n 1500 and 3148 m a.s.l.) (IPMS team, 2005). Its area is estimated to be about 550.32 km² (CSA, 2007).

**Tabia* is the lowest political administrative unit in Tigray administrative state usually comprising of 4-5 villages.

* *Woreda* refers to the third level of political administration (next to region and zone).

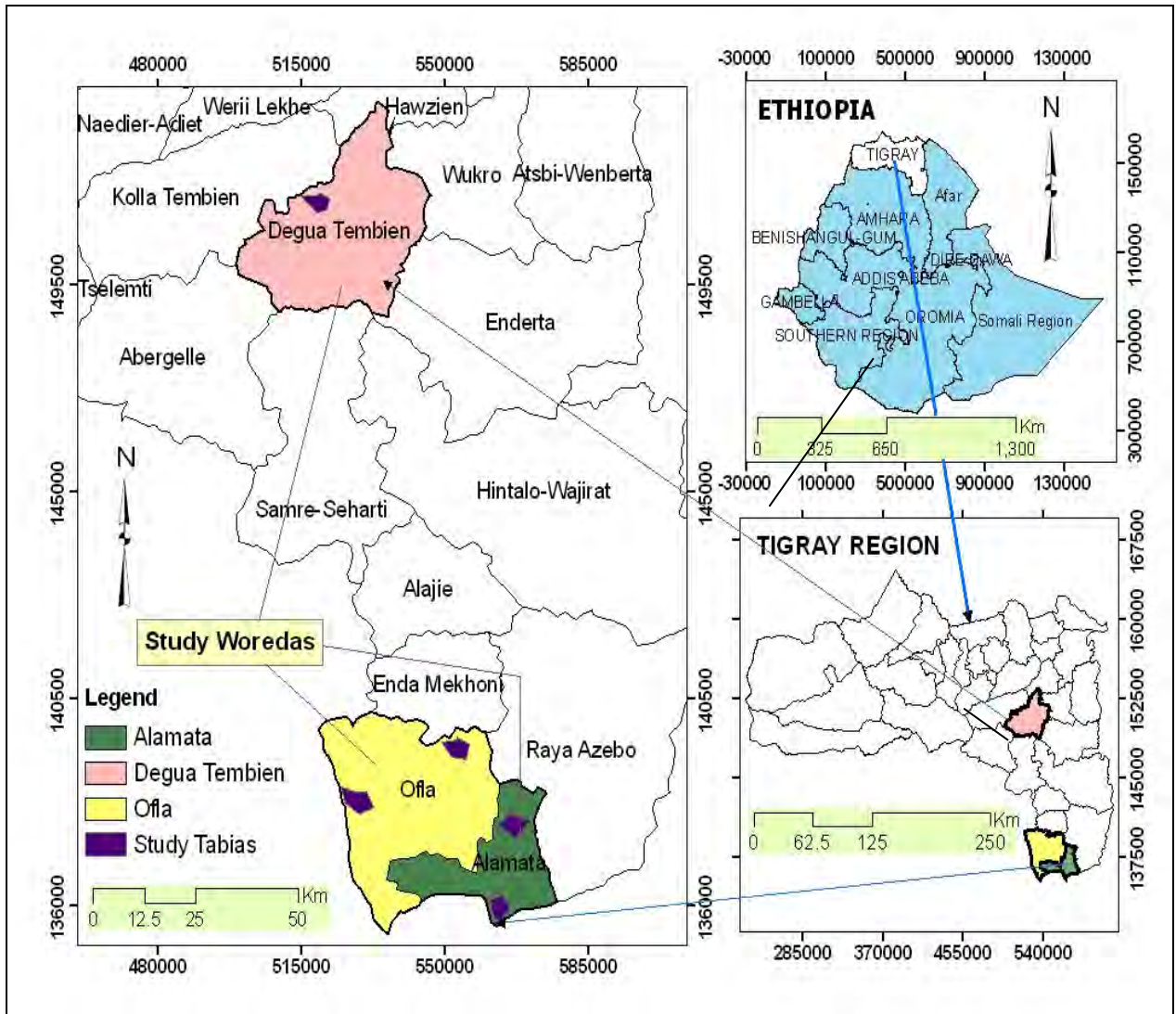


Figure 1. Map of the study area showing the study *woredas* (study *tabias* within them).

3.1.2 Description of Ofla Woreda

Ofla *woreda* is one of the five *woredas* of *debubawi* (southern) zone of Tigray. Korem is about 120 km south of the regional capital Mekele. The *woreda* is located on the geographic coordinates of 12^o31' North Latitude and 39^o33' East Longitude. The altitude varies between 1700-2800 m a.s.l. and the slope ranges to more than 15 percent. The total area of the *woreda* is about 133,300 ha, of which 42% of the area is *woina degu'a* (55,986 ha) and the rest are *degu'a* and *kolla* which accounts for 29% each and 77,314 ha in total (Kebede Manjur, 2006; Ofla *woreda* BoARD, 2006).

3.1.3 Description of Degu'a Tembien Woreda

The study was undertaken in the highland of Degu'a Tembien (Mahbere silassie) in Central Tigray, Northern Ethiopia. Hagereselam lies 50 kms southwest of Mekele, the capital of Tigray region. The climate of Degu'a Tembien is classified as *dega* - according to the traditional altitudinal climatic classification (The word *degu'a* is a Tigrigna term equivalent to the Amharic word *dega* referring to a high altitude). The area lies between 2,200 m a.s.l. and 2,800 m a.s.l. (MUC, 1996).

3.2 Geology and soils

According to Alamata *woreda* Office of Agriculture (2004), eutric vertisols, lithic leptosols (cambic) and lithic leptosols (orthic) are the soil types covering nearly 100% of the land in the *woreda*. The whole Alamata mountain area comprises volcanic rock.

Lake Hashenge and its surrounding area in Ofla *woreda* occupy an old volcanic crater between the Ambalgie range to the north and the Alamata mountains to the south.

The bedrock of Degu'a Tembien is derived from volcanics of the Tertiary age, and consists of deeply weathered thick basalt flows (MUC, 1996).

The local geology of Degu'a Tembien comprises a subhorizontal series of alternating hard and soft Antalo limestones, some 400 m thick, overlain by Emba Aradom sandstone. Two series of Tertiary lava flows, separated by silicified lacustrine deposits, bury these Mesozoic sedimentary rocks. Erosion in response to Miocene and Plio-Pleistocene tectonic uplifts, of the order of 2500 m, has resulted in the formation of tabular, stepped landforms. The highest areas at 2700–2800m a. s.l. are underlain by the basalt series. Other structural levels correspond to the top of the Emba Aradom Sandstone and to the top of hard layers within the Antalo Limestone (Nyssen *et al.*, 2002).

3.3 Climate

3.3.1 Temperature and rainfall

As can be seen from the climadiagram of Alamata *woreda* (data of ten years collected from ENMA), the rainfall pattern of the *woreda* shows that there is a small peak in March and April and a larger peak in July and August. The same is true to the rainfall patterns of Ofla *woreda* except that the rainfall in Ofla stays a little bit longer up to October as compared to that of Alamata *woreda* (Figures 2 and 3).

Ofla has two (bimodal) rainy seasons namely; *Keremti* where the main wet season is from June to September and *Belgi*; the small wet season that extends from February to March. The rainfall distribution of the study area is characterized by heavy and erratic in nature, like most highlands of the country. The annual rainfall varies from 450 mm to 800 mm during *keremti* and 18 mm to 250 mm during *Belgi* seasons (Ofla *Woreda* BoARD, 2006). The mean annual temperature of the study area is 22°C with minimum and maximum temperature of 6°C and 30°C respectively (Kebede Manjur, 2006; Ofla *woreda* BoARD, 2006).

The average yearly precipitation in Degu'a Tembien is 778 mm and the main rainy season (more than 80% of total rainfall) is from June to September. The rainfall is highly erosive which is due to large drop size (Nyssen *et al.*, 2005). Monthly average minimum temperatures range from 4 to 6°C and maxima from 20 to 22°C. Variation is less during the rainy season due to cloud cover.

The average annual rainfall at Hagere selam, which lies in the centre of Degu'a Tembien, from 1973 to 1982 and 1992 to 1994, was 749 mm. The mean annual temperature during the same period was 15°C (MUC, 1996).

From the climadiagram of Degu'a Tembien *woreda*, the rainfall pattern seems unimodal with the highest peak at August (Figure 4). The mean minimum and maximum temperatures of the study *woredas* include: 14.4°C, 30.3°C; 7.8°C, 22.4°C; 10.7°C, 22.5°C for Alamata, Korem and Hagere selam stations respectively.

Alamata (1580 m)

[10]

22.4°C 67.9 mm

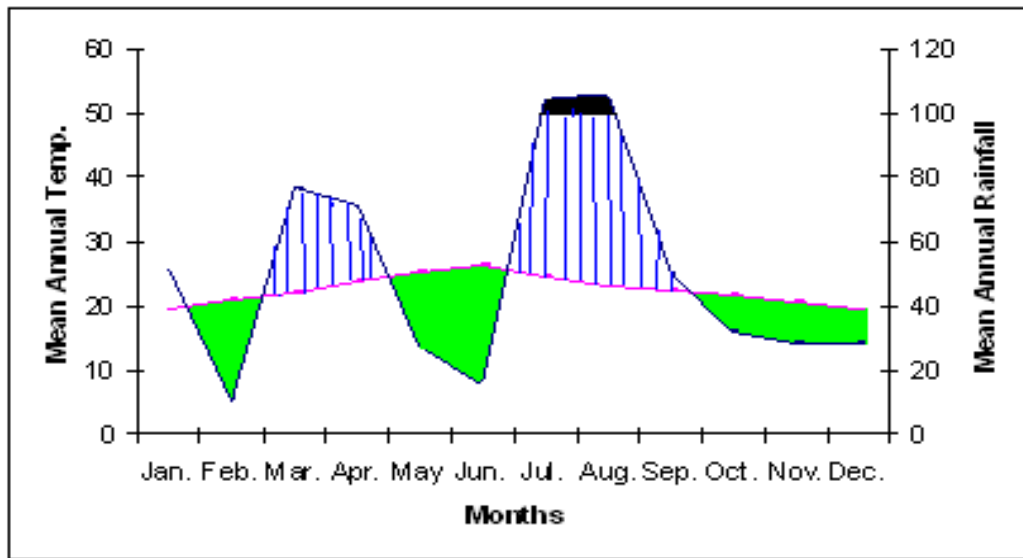


Figure 2. Climadiagram of Alamata *woreda* based on data of ten years from 1997-2006 (Alamata station) (Source: Ethiopian National Metreological Agency).

Korem (2500 m)

[10]

15.1°C 83.8 mm

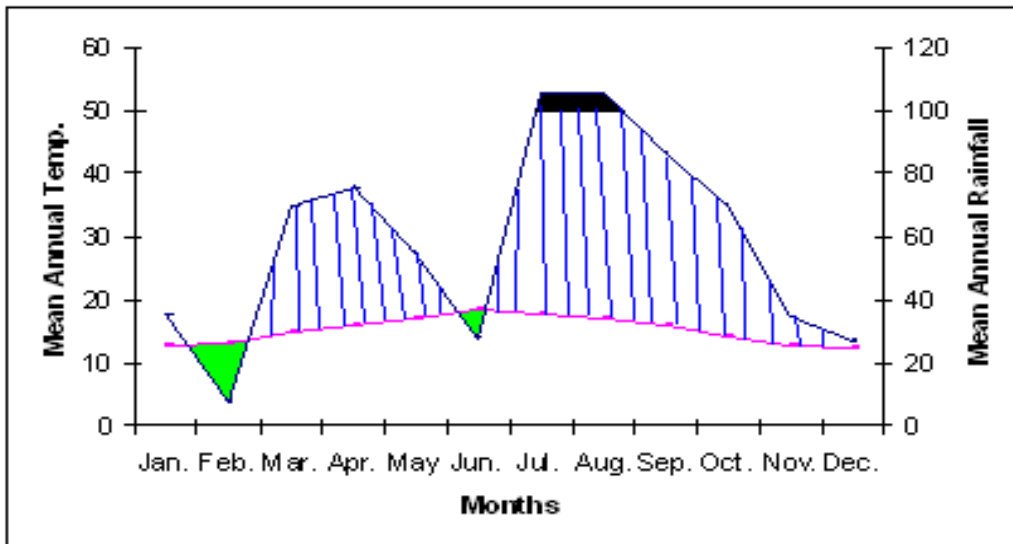


Figure 3. Climadiagram of Oflla *woreda* based on data of ten years from 1997-2006 (Korem station) (Source: Ethiopian National Metreological Agency)

Hagere-selam (2618 m)

[10]

16.6°C 58.6 mm

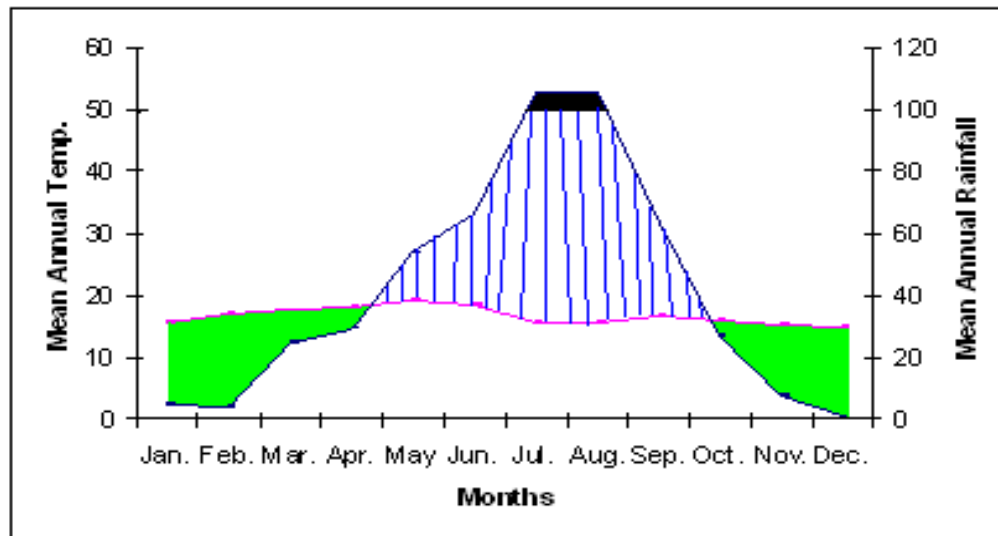


Figure 4. Climadiagram of Degu'a Tembien woreda based on data of ten years from 1997-2006 (Hagere-selam Station) (Source: Ethiopian National Metreological Agency)

3.3.2 Agro ecological zone of the study area

According to Gebremedhin Teklehaimanot and Mulubrhan Haile (2007), Tigray comprises seven of the Major Agro-ecological Zones. These are: Arid hot to very hot lowland plains, sub-moist tepid to cool mid-highlands, moist tepid to cool mid-lands, moist hot to warm lowlands, sub-moist hot to warm lowlands, sub-moist cold to very cold sub-alpine to alpine and semi-arid hot to warm lowlands. It also has eleven of the Sub-agro Ecological Zones (SAEZ) such as hot to warm arid plains, tepid to cool sub-moist plains, mountains and plateau, tepid to cool moist mountains and plateau, tepid to cool moist plateaus, hot to warm moist mountains, hot to warm moist plains, hot to warm sub-moist valleys and escarpments, hot to warm sub-moist river gorges, hot to warm sub-moist plains, cold to very cold sub-moist mountains and semi-arid hot to warm plains. According to EARO (2002), the agro ecological zone for Alamata is hot to warm sub-moist lowland (SM1). The agro ecology of Degu'a Tembien and Ofla woredas is tepid sub-moist mid highlands (SM3) (MoA, 2000).

3.4 Population and medical services

The total population of Alamata, Ofla and Degu'a Tembien *woredas* is about 145,967 (72,330 males and 73,637 females); 180,340 (87,998 males and 92,342 females); 124,589 (61,655 males and 62,934 females) respectively (Table 1) (CSA Abstract, 2007).

Table 1. Population size by sex, area and density of the Study *Woredas*.

No.	Study Woreda	Male	Female	Total	Area in sq. km	Density
1	Degu'a Tembien	61,655	62,934	124,589	1,109.72	112.3
2	Alamata	72,330	73,637	145,967	550.32	265.2
3	Ofla	87,998	92,342	180,340	1,297.50	139.0

Source: CSA (2007) Statistical Abstract

According to Tigray Health Bureau (1998 EFY) profile, Degu'a Tembien *woreda* has 18 *tabias* and possesses 1 health center, 4 nucleus health centers and 2 clinics. Alamata *woreda* has 26 *tabias* possessing 1 hospital, 1 health center, 3 nucleus health centers and 1 clinic. While Ofla *woreda* has 1 health center, 3 nucleus health centers and 3 clinics. The profile also reported top ten morbidity and mortality cases from hospitals and health centers in the region (Table 2).

3.5 Vegetation

The vegetation in Alamata *woreda* is mainly bush scrub and cactus with scattered acacia trees (Anonymous, 2007). According to Mirutse Giday and Gobena Ameni (2003), *Euphorbia abyssinica* and *Becium grandiflorum* are among the dominant plant species in Ofla *woreda*. While the vegetation of Degu'a Tembien *woreda* is largely dominated by *Acacia etabica* and *Euclea schimperi* (Wolde Mekuria and Veldkamp, 2005).

3.6 Livestock

In Degu'a Tembien the livestock are mainly cattle, especially oxen, sheep, goats, donkeys and mules. An average family in the Tembien highlands owns one or two oxen, five to six goats or sheep and sometimes a donkey. 'Livestock keeping is part of the permanent upland

system' (Ruthenberg, 1980). Cattle, goats and sheep (shoats) are reared in Alamata *woreda* (Anonymous, 2007).

Table 2. The top ten diseases (new outpatient cases) in the study *woredas*.

Ten top diseases in the three study <i>woredas</i>			
Rank	Alamata	Ofla	Degu'a Tembien
1	Fever of unknown origin	AURI	Infectious, parasitic,OT
2	Helminthes, other	Skin infection	Skin infection
3	Pneumonia, other	Infectious, parasitic,OT	AURI
4	Malaria, PF	Hypertrophy tonsil	Pneumonia, Broncho
5	Pneumonia, Broncho	Fever of unknown origin	Gastritis, duodenitis
6	Malaria, PV	Skin, other	Amoebiasis
7	Respiratory, other	Arthritis, spondylitis	Respiratory, other
8	Skin infection	Amoebiasis	Eye, inflammatory
9	Gastritis, duodenitis	Dysentery, unspecified	Bronchitis, chronic
10	Homicide, injury external	Gastritis, duodenitis	Homicide, injury external

Source: Tigray Health Bureau (1998 EFY) Profile.

3.7 Land use system

Land preparation and planting

Farmers in the study area use oxen for ploughing. Since many of them have no oxen, they usually rent from other farmers, even some lease their land to other farmers to solve this problem. Hand hoe cultivation is not common cultural practice in Tigray.

Most of the farmers in the study area use their own seeds from their stores for planting. They also buy them from the local markets or sometimes they can receive from the local government or from relatives. Planting times vary with the onset of rains and a availability of

oxen, but are generally set according to the traditional planting times that have been handed over from generation to generation (Wondimagegn, 1994).

Farming (cropping) systems

As noted by Tilahun Yibale (1996) farmers in the Hagere Selam uplands (Degu'a Tembien), Tigray conducted a land capability classification in 1989. The land was classified as areas suitable for cultivation, grazing land, or closure. The cultivable areas were further classified into degraded, medium and fertile land. A available land was then allocated to all farmers in the farmers' association (*tabias*) according to the land quality.

Goebel and Odeny (1984) also described the dominant land use in Degu'a Tembien as intensive rain-fed peasant cultivation of cereals and pulses, and the major land cover, besides cropland, as scattered scrub and grass vegetation as well as much bare rock.

Agriculture in Degu'a Tembien consists exclusively of small-scale family farms. Since the 1980s a land tenure regime has been introduced which has led to broad equality in size of landholdings (Hendrie, 1999; cited in Nyssen, J. *et al.*, 2007). On average, families in Degu'a Tembien use two or three parcels of cropland, with a combined area of between 0-5ha (Berhanu Gebremedhin, 2004; cited in Nyssen, J. *et al.*, 2007) and 0-75 ha (Naudts, 2002; cited in Nyssen, J. *et al.*, 2007). Grassland, rangeland and exclosures are communally owned. The most cultivated crops in the Degu'a Tembien *woreda* include common cereals like barley (*Hordeum vulgare*) and wheat (*Triticum* sp.), as well as tef (*Eragrostis tef*), a cereal with very fine grains endemic to Ethiopia. Grass pea (*Lathyrus sativus*) and horse bean (*Vicia faba*) are also important crops. Some fields are cultivated with lentil (*Lens culinaris*) or linseed (*Linum usitatissimum*). In the lower parts of Degu'a Tembien, maize (*Zea mays*) also grows. In addition, most households manage a small garden near their homestead for vegetables. The major crops growing in Alamata *woreda* are sorghum, *teff* and maize (Anonymous, 2007). And in Ofla *woreda* the commonly cultivated field crops are *teff*, barley and maize (Mirutse Giday and Gobena Ameni, 2003).

4. Materials and Methods

4.1 Selection of study sites and sampling frame

The study was conducted in 5 *Kebeles/Tabias* of 3 *Woredas* (in Alamata - Tumuga and Gerjelle, in Ofla –Zata and Hashenge and in Degua Tembien –Mahbere-silassie) in Tigray, Northern Ethiopia (Figure 1). Field data collection was carried out from 31/12/2007 to 10/02/2008 G.C. The sites were selected preferentially based on the information obtained from the *woreda* agriculture experts and development agents as well as local elders.

4.2 Informant selection

In this study, a total of 60 informants (35 males and 25 females) between the ages of 16 - 75 years of age were selected applying systematic random sampling techniques from the lists available in the respective *kebeles/tabias* in the study areas. Of these about 15 key informants (5 males and 10 females) were purposively selected based on the recommendation from development agents, local people and local authorities (*kebele* administrators) (Appendix 4; Here the asterisk (*) denotes key informants).

4.3 Data collection

4.3.1 Botanical data collection and identification

During the field study, spices, condiments and non-edible oil crops in home gardens and cultivated fields in the study sites were surveyed. Sample specimens of the plants (spices, condiments and non-edible oil crops) were also collected, pressed, dried, identified and labeled. For the identification of the collected specimens, preserved voucher specimens in the National Herbarium (AAU) and published volumes of Ethiopian Flora were used (Thulin, 1989; Vollesen, 1989; Friis, 1995; Demel Teketay, 2000; Gilbert, 1995; Jonsel, 2000; Tewolde Brehan Gebre Egziaber and Edwards, 1997; Hedberg, 2000; Polhill, 2000; Hedberg and Hedberg, 2003; Leewenberg, 2003; Mesfin Tadesse, 2004; Friis, 2006; Ryding, 2006; Sebsebe Demissew, 2006). Voucher specimens of the spices, condiments and non-edible industrial crops were stored at the National Herbarium (ETH.), Faculty of Science (AAU).

4.3.2 Ethnobotanical data collection

Ethnobotanical data were collected between December 31, 2007 to February 10, 2008 G.C. The data collection follows Martin (1995) and Cotton (1996). The different methods employed were Semi-structured interview, Market survey, Group discussion, Field observation, Preference ranking, Prepared questions for Agriculture experts or development agents in the *woredas* and owners of home gardens. Interviews and discussions were done based on questions prepared before hand in English and translated to Tigrigna during the interview/discussion (Appendices 5, 6, 7, 8, 9, 10 and 11). The methods were employed to obtain indigenous knowledge from the local community in the study area on the use, management and conservation of spices, condiments and non-edible industrial oil crops. Some of the interviews and discussions have been tape-recorded. The pictures of some home gardens, cultivated fields, and spice market areas and plant species have been taken.

Semi-structured interview

Using the semi-structured interview prepared questions were asked to the local informants individually to allow them to express their views without being interrupted by others.

Group discussion

During the group discussion informants have been encouraged to describe the types and list of the local names of the plants and parts of the plant utilized for different purposes were discussed. Following Martin (1995), indigenous methods and practices used to conserve those plants have been discussed and tape-recorded.

Preference ranking

Preference rankings have been conducted following Martin (1995):

1. For seven spices and condiments commonly used in making (preparing) food (usually the thick spiced sauce called *tsebhi* in Tigrigna/ *wät* in Amharic). Ten informants were purposively selected and were asked to rearrange seven spices based on their wide use in preparing food (making sauce). Here, the most widely used spice in preparing *tsebhi/wät* (local stew) is stated by the highest value (7) and the least by a value of (1).

2. For five spices and condiments most widely used for their medicinal purposes. The value (5) is given for most widely used spice and (1) is given for the least. Eight informants have been selected randomly.

3. For five factors that are most threatening (reasons for less productivity) to spices, condiments. The value (5) is for the most threatening factor and (1) is for the least threatening factor. Here also eight randomly selected individuals have been participated.

Finally the values given by respondents (informants) for each category were summed up and ranks for the most widely used spices in preparing sauce, the most widely used spices and condiments for medicinal purposes and the most threatening factors to those plant species have been calculated.

Frequency of citation as culinary spices, spices for medicinal purposes and threats were used as criteria to select the 7 most culinary spices, 5 most medicinal spices and 5 most threatening factors for the preference rankings.

Market survey

During the market survey, spices and condiments with commercial values were assessed in four market places. Two/three spices vendors from each market (with a total of ten) were selected and interviewed. Names of the commonly sold spices, uses and sources were recorded. Information on the methods and practices used to conserve those plants were also gathered following (Martin, 1995).

Home garden and cultivated fields

Data on the local use and of the plants under study were gathered from home gardens, cultivated fields and agriculture experts in the study sites. Spices, condiments and non-edible oil crops from either home gardens, cultivated fields or very few from the wild have been collected, pressed, dried, frozen and authenticated with the plant species in the National Herbarium, AAU.

Agriculture experts

Agriculture experts and/or development agents in the study areas have been interviewed. The location (longitude and latitude) and altitude of the areas (home gardens/cultivated fields) on which the plant species grow has been recorded from GPS readings.

4.4 Data Analysis

Information which has been gathered through different methodologies such as through interview (semi-structured interview), preference rankings, group discussion, field observation (cultivated fields) and market survey etc was summarized, described and tabulated.

The preference values/scores assigned by key informants for selected spices (for culinary and medicinal purposes) and treatments were added and ranked during the preference ranking activities.

In the data analysis, the fidelity level (FL) (Friedman *et al.*, 1986) calculated that demonstrates the percentage of informants claiming the use of a certain plant (spice/non-edible oil crop) for the same major purpose (medicinal), was calculated for the most frequently reported diseases or ailments as:

$$FL (\%) = N_p/N \times 100$$

Where N_p is the number of informants that claim a use of a plant species to treat a particular disease, and N is the number of informants that claim the plant as a medicine to treat any given disease.

5. Results and Discussion

5.1 Spices and condiments in and around home gardens in the study area

In the study area a total of 18 spices and condiments belonging to 17 genera and 11 families and 3 non-edible industrial oil crops belonging to 3 genera and 2 families have been identified from home gardens, crop fields and some from the wild (Tables 3). The spices, condiments and non-edible oil crops were in the families of Lamiaceae/Labiatae (4 species, 19%), Alliaceae, Brassicaceae, Asteraceae, Apiaceae and Euphorbiaceae (2 species each, 9.5%) and Solanaceae, Ranunculaceae, Rhamnaceae, Polygonaceae, Rutaceae, Fabaceae and Zingiberaceae (1 species each, 5%)

Table 3. Spices, condiments and non-edible oil crops found in home garden, cultivated fields or as wild in the study area. Key: H- herb, S- shrub, T- tree HG- home garden, W- wild, CL- cultivated land (Field).

No.	Scientific name	Family	Habit	Local name	Occurrence
1	<i>Allium cepa</i>	Alliaceae	H	<i>Qeyih shegurti</i>	HG, CL
2	<i>Allium sativum</i>	Alliaceae	H	<i>Tseada shegurti</i>	HG, CL
3	<i>Brassica nigra</i>	Brassicaceae	H	<i>Senafiche</i>	HG,CL
4	<i>Capsicum annum</i>	Solanaceae	H	<i>Berbere</i>	HG, CL
5	<i>Carthamus tinctorius</i>	Asteraceae	H	<i>Suf</i>	CL
6	<i>Cuminum cyminum</i>	Apiaceae	H	<i>Kemun</i>	CL
7	<i>Foeniculum vulgare</i>	Apiaceae	H	<i>Shilan</i>	HG
8	<i>Lepidium sativum</i>	Brassicaceae	H	<i>Sheanfai</i>	HG,CL
9	<i>Mentha spicata</i>	Lamiaceae	H	<i>Nae-nae</i>	HG
10	<i>Nigella sativa</i>	Ranunculaceae	H	<i>Awosuda/Tselim kemem</i>	HG,CL

11	<i>Ocimum basilicum</i>	Lamiaceae	H	<i>Seseg</i>	HG
12	<i>Rhamnus prinoides</i>	Rhamnaceae	S	<i>Gesho/Gosho</i>	HG, CL
13	<i>Rosmarinus officinalis</i>	Lamiaceae	S	<i>Azmarino</i>	HG
14	<i>Rumex abyssinicus</i>	Polygonaceae	H	<i>Meqmeqo</i>	HG,W
15	<i>Ruta chalepensis</i>	Rutaceae	H	<i>Chena adam</i>	HG,CL
16	<i>Thymus serrulatus</i>	Lamiaceae	H	<i>Tesne</i>	W, CL
17	<i>Trigonella foenum-graecum</i>	Fabaceae	H	<i>Abaeke</i>	CL
18	<i>Zingiber officinale</i>	Zingiberaceae	H	<i>Jinjibel</i>	HG
19	<i>Jatropha curcas</i>	Euphorbiaceae	T	Jatropha	CL
20	<i>Ricinus communis</i>	Euphorbiaceae	S	<i>Gulie</i>	HG,W
21	<i>Vernonia galamensis</i>	Asteraceae	H	Vernonia	CL

Of the collected plant species, five species (23.8 %) were collected from home gardens and cultivated fields only. Eight species (38.1 %) were collected from both home gardens and cultivated fields. Two species, 9.5 % were collected from both home gardens and from wild. And only one species (4.8 %) from both wild and cultivated fields (Table 3).

Most of the above mentioned spices and condiments are found in all of the study areas. But *Thymus serrulatus* and *Rumex abyssinicus* were only collected from the highlands of Mahbere-silassie. *Carthamus tinctorius* grows abundantly in the cultivated fields of Zata.

5.2 Non- edible oil crops in the study area

Of the 3 non-edible oil crops, *Ricinus communis* has been found in all study areas (home gardens, cultivated fields and in the wild). *Jatropha curcas* plants were found in some home gardens in Alamata town, in Tumuga and along the main road from Alamata to Tumuga. *Vernonia galamensis* was found in Alamata cultivated fields.

5.3 Culinary use of spices and condiments and their preparation

Traditionally the farmers in the study area grow different herbs, spices and condiments which they intensively use to flavor food, beverages and for medicinal purposes. Though the farmers produce the spices and condiments mostly for home consumption, sometimes they sell them in markets to earn money to be used for different expenses. The traditional dish in the study area mainly consists of the staple food *injera* (Amharic) or *injera/taita* (Tigrigna) and the thick stew called *wät* (Amharic) or *tsebhi* (Tigrigna). This thick stew called *tsebhi* is either prepared with *berbere* (ground capsicum peppers usually blended with other spices) or without it (*alicha wät*) (Amharic)/ *tsebhi alicha* (Tigrigna). *Berberere* accompanies many of the dishes in the study areas; be it *tsebhi siga* (beef stew), *dorho/tsebhi dorho* (chicken stew), *tsebhi birsin* (lentil stew), *kiki/tsebhi kiki* (pea stew) and *shiro/tsebhi shiro* (bean stew) and others.

As it is also reported in the works of Gebremedhin Teklehaimanot and Mulubirhan Haile (2007), farmers in Tigray have a long tradition of using spices, condiments, additives and herbs in their traditional food culture.

Mode of preparation of the spices and condiments in preparing food and beverages (culinary use) in the local community of the study area:

5.3.1 *Allium cepa*

The bulbs and leaves of *A. cepa* are used to prepare the thick stew called *tsebhi*. Fresh bulbs of the spice are chopped and put into a stew clay pot (locally called *tsahli*) while preparing *tsebhi shiro* (bean stew) or *tsebhi siga* (beef stew). Chopped bulbs are dried and ground

together with other spices and used to prepare the spice mix *berbere*, which is the important ingredient in many local dishes. It is also an important ingredient of *shiro* (powder made of dried and ground bean seeds blended with few or several spices). The culinary use of this plant in home and abroad has been described in many literatures. In Tewolde Berhan Gebre Egziabher and Edwards (1997), the bulbs of *Allium cepa* (onion) are used in preparing a wide variety of foods, including those for long storage. According to Coleman (1998) the onion bulbs are popular everywhere for their use both as a condiment and a vegetable in almost any pleasant (flavorful) food. The culinary use of *Allium cepa* (shallot) is also noted in the work of Endalew Amenu (2007), Fisseha Mesfin (2007), Paulos Abebe (2008) and Mathewos Agize (2008). The unique flavor compounds in onions (*A. cepa*) are formed when the enzyme alliinase acts upon the flavor precursor, S-alk(en)yl-L-cysteine sulfoxides to produce thiosulfinates (Block, 1992). Therefore the pungency of the spice that enables it to flavor the local stew (*wät* preparation) is attributed to the presence of these volatile sulfur compounds in onion bulbs.



Figure 5. *Allium cepa* (Onion) in Zata cultivated Fields



Figure 6. Onion bulb harvested by a farmer in garden fields Tumuga

5.3.2 *Rhamnus prinoides*

This spice is used extensively in local brewery especially in the preparation of the traditional alcoholic beverages known as *tella* (Amharic)/ *sewa* (Tigrigna), which can be considered as a local beer and *tedj* (Amharic)/*mies* (Tigrigna), which is the Ethiopian honey wine (Figures 7 and 8).



Figure 7. *Rhamnus prinoides* & *Capsicum annum* in the study area (cultivated field).



Figure 8. *Rhamnus prinoides* used in preparation of Ethiopian honey wine (*miess*) in Alamata.

Tella/sewa is prepared from malt (usually germinated barley), flour (of barley, wheat or corn is added to water and baked) and chopped leaves and woody parts (stems) of *R. prinoides*. *Tedj/mies* is also prepared from chopped stems of *R. prinoides*, water and honey. This is also explained in the research works of Siegenthaler (1963) and Jansen (1981). In the process of making the local beer (the common household beer for many Ethiopians), the plant is used as hops and therefore its leaves and young stems are chopped in to small pieces and sun dried for some days and are finally ground. Amare Getahun (1976), Etana Tolosa (2007), Paulos Abebe (2008) and Mathewos Agize (2008) also noted the use of *R. prinoides* in alcohol

preparation. Berhanu Abegaz and Nagadijui (1999) have reported several quinones, flavonoides and naphthalenic compounds from various parts of *R. pr inoides* and have established that geshoidine may be the flavoring principle of the plant responsible for the characteristic bitter tastes of the domestic beverages-*Tella* and *Tej*.

5.3.3 *Capsicum annum*

As is mentioned *berbere* is made of the powdered *C. annum* and other spices, and is the main constituent of hot sauces (*Keyih tsebhi*, translated as red pungent sauce) (Figure 7). It is a key ingredient in the cuisines of the local people. It is sometimes made with oil or water to form a semi-solid paste called *dilik* in the study area which can last a little bit longer unspoiled and can be eaten alone with *injera*.

The green fresh fruits of *C. annum* (*gu'e*, translated as raw in Tigrigna) are grabbed, hacked and eaten with *injera*, usually served with vegan dishes during fasting days or the Lenten season.

According to Siegenthaler (1963) and Jansen (1981) *Capsicum annum* is the most widely used spice in the Ethiopian cuisine. The grounded red chilies can be either used alone or ground with other spices such as *Nigella sativa* (black cumin), *Trachyspermum ammi* (white cumin), *Ocimum basilicum* (sacred basil), *Allium sativum* (garlic) and others. As cited in Jansen (1981), Kostalan (1913) called the spice *Capsicum annum*, the 'National spice of Ethiopia'. Spice use of *C. annum* is also reported in the work of Fisseha Mesfin (2007), Paulos Abebe (2008) and Mathewos Agize (2008). Capsaicin and dihydrocapsaicin are among the capsaicinoides (alkaloides) that account for about 90% of the pungency in the genus capsicum (Kawada *et al.*, 1991). The characteristic hot and pungent taste of *C. annum* makes it so good and widely used spice in the Ethiopian cuisine which is due to the essential oil that it possesses.



Figure 9. A **farmer** managing *Rhamnus prinoides* and *Capsicum annum* spices in his garden field.

5.3.4 *Allium sativum*

It is one of the important ingredients to prepare *berbere* as a spice mix. It can also be blended to *shiro*, including other spices. The bulbs of *A. sativum* are used either fresh (*tsebhi kiki*, *alicha*, *shiro* or *sig*) or dried (ingredient of *shiro* powder / *berbere*). The fresh bulbs of *A. sativum* can also be peeled off, wrapped with piece of *injera* and eaten raw.

According to Tewelde Berhan Gebre Egiabher and Edwards (1997), garlic is used in preparing food, particularly some kinds of stew and in making dried food for storage. Coleman (1998) also reported that the fresh or dried bulbs of *A. sativum* are used in cuisines throughout the world and it is indispensable in Chinese, Italian, and Mexican foods. The culinary use of garlic to give special flavor and taste to food and drinks is mentioned in the work of Endalew Amenu (2007) and Fisseha Mesfin (2007). Paulos Abebe (2008) and Mathewos Agize (2008) also reported the spice use of garlic in the area they studied. According to Newall *et al.* (1996), *A. sativum* contains a wealth of sulfur compounds and the main constituents are: alliin and its enzymatic products alliin (diallyl thiosulphinates), allylpropyl disulphide, diallyl disulphide, diallyl trisulphide, ajoene and vinyl dithiines (secondary products of alliin produced non-enzymatically from alliin); S-allylmercaptocysteine (ASSC) and S-methylmercaptocysteine (MSSC); terpenes include

citral, geraniol, linalool, alpha-and beta-phellandrene. Therefore the compound most responsible for the spiciness of garlic is allicin.

5.3.5 *Trigonella foenum-graecum*

Like other spices it is an ingredient of *berbere*. The seeds are grounded in to powder and blended with *berbere* including other spices. It is also an ingredient of *shiro* and *teff* flour. Together with other spices it is also important in preparing clarified butter (*kibe*, Amharic; *tesmi*, Tigrigna) (Figure 10).

The powder (fenugreek powder) mixed with honey or sugar is a good and nourishing drink (beverage) for adults. Muslims in the study area usually make this beverage (locally called *abaeke* which is also the name of the plant or the seeds that it produces) during Islamic ceremonies or occasions. It is non-alcoholic beverage and Christian neighbors are served with this beverage and wheat bread during these special occasions. This is because Muslims are prohibited from taking alcoholic beverages.

Suckling (breast feeding) mothers who cannot produce enough milk to their infants prepare this drink/beverage known as *abaeke* for their infants as a milk substitute. Fenugreek flour/seeds are also added to tea and boiled milk to provide good flavor and for its medicinal properties. According to Siegenthaler (1963), *Abish* flour (fenugreek flour) is mixed with water and honey and whipped until foamy and then drunk every morning for a period of about fifteen days and is considered a good food as well as a good appetizer. The liquid made from the *abish* flour and water is given in a bottle to babies as a milk substitute. It is widely used in Ethiopia as a food for infants. As a condiment it is usually roasted on a grill, finely ground and sprinkled in to *wät/tsebhi*. Similarly Amare Getahun (1976) and Paulos Abebe (2008) also noted the culinary use of fenugreek as a spice. Fenugreek seeds are aromatic, bitter and may be eaten raw or cooked. The bulk of the seed (50%) constitutes unavailable carbohydrates and the seeds bitterness is mainly due to the oil, steroidal saponins and alkaloids (Shankaracharya *et al.*, 1973). The flavoring and nutritious use of fenugreek seeds in the study area can also be associated to the presence of these steroidal saponins, alkaloids and other compounds.

5.3.6 *Ocimum basilicum*

The tender stems, leaves and flowers are dried, ground and added to sauces either alone or blended with other spices to provide good flavor to the stew. It is an important ingredient of *berbere* and *shiro* powders (Figure 11). It is also one of the ingredients used in the preparation of clarified butter (spiced butter). The fresh leaves can be cooked or roasted in preparing roasted beef locally called *tibsi*, when fast preparation is required. In Jansen (1981), it is explained that both dried and fresh inflorescences and leaves of basil are used as flavoring agent in the preparation of all kinds of *wät*. Dried ground basil is also used to flavor butter and is sometimes sprinkled in tea or coffee to add flavor. Coleman (1998) also wrote that the herb complements meat, vegetables, cheese, and egg dishes. Etana Tolosa (2007), Fisseha Mesfin (2007) and Mathewos Agize (2008) also noted the spice use of *O. basilicum*. Basil oil obtained from *Ocimum basilicum* L. is a useful source of compounds like methyl chavicol, eugenol, (E)-methyl cinnamate, thymol, linalool etc (Jansen, 1981) . It is the presence of this essential oil that enables the plant to provide good flavor to the *berbere*, *shiro*, or butter (clarified).

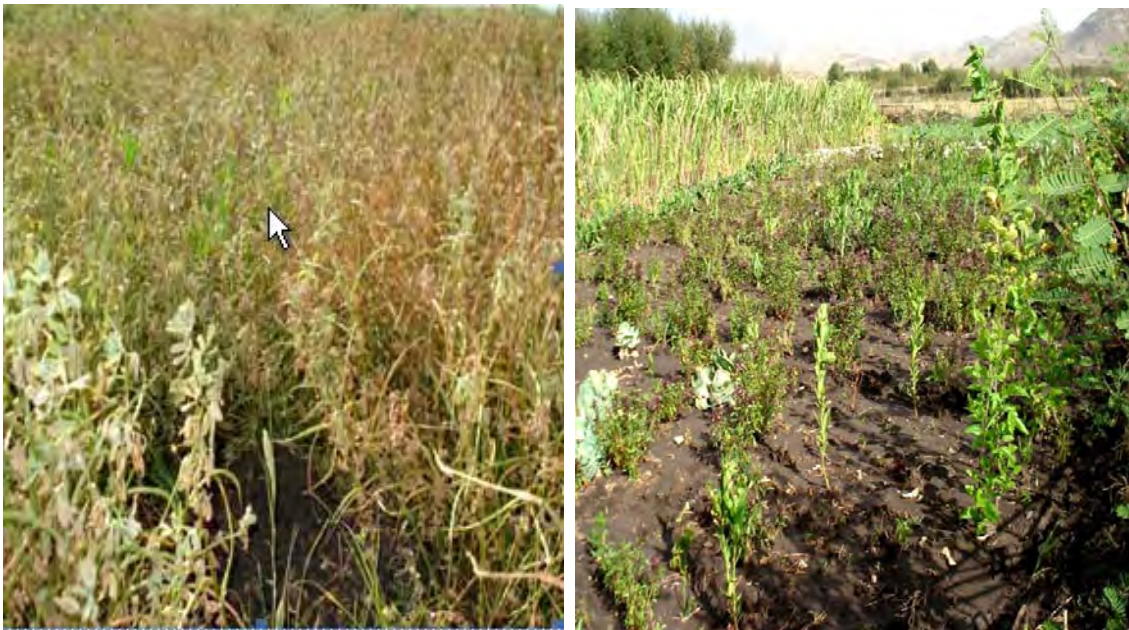


Figure 10. *Trigonella foenum-graecum* (Fenugreek) in Zata cultivated fields. Figure 11. *Ocimum basilicum* (Sacred basil) in Zata cultivated fields.

5.3.7 *Ruta chalepensis* (Rue)

The matured fruits (seeds) of *R. chalepensis* are ingredients of *berbere* and *shiro* i.e. seeds of *R. chalepensis*, chopped and dried bulbs of *A. sativum*, dried leaves, stems and flowers of *O. basilicum* and rhizomes of *Zingiber officinale* are ground together to make *shiro* or can be added to *berbere*. Fresh green leaves of *R. chalepensis* are also added to tea or coffee for extra flavoring or for their medicinal uses (Figure 12). According to Jansen (1981), the use of rue as a culinary herb is very common and therefore the ground mature fruits are ingredients of the spicy capsicum sauce *berbere*. Clean washed leaves of rue are added to sour milk to make a local cheese. *Ruta chalepensis* is added to coffee and cheese to improve flavor and taste (Endalew Amenu, 2007; Etana Tolosa, 2007). Baser *et al.* (1996) noted that the major constituents of oil from *R. chalepensis* grown in Arabia and Turkey were 2-undecanone, 2-nonanone and 2-nonyl acetate. It is the presence of the essential oil that results in the flavoring activity of the spice.

5.3.8 *Nigella sativa* (Black cumin)

The seeds of *N. sativa* are slightly roasted and ground and become ingredients of the fiery *berbere* which is the main constituent of the local sauces. The seeds are either ground with wheat flour or other grains or they are sprinkled on wheat dough and baked to prepare bread. Therefore they are used to flavor bread (Figure 13).

The culinary use of *N. sativa* is described in several literatures, which is similar to what is described by the local people in the study area. For example according to Amare Getahun (1976), it is reported that the spice was frequently used to flavor bread and now it is used more in beverages blended with other spices such as *Aframomum corrorima*, black pepper, ginger, et c.. The local strong alcoholic beverages, *areke'* and *katikala*, contain such preparation. The same is also reported in the works of Siegenthaler (1963) and Jansen (1981). They wrote that the seeds of *N. sativa* are used in the preparation of bread, *Capsicum* pepper sauce, curry sauce, 'wot' and local beverages. The use of *N. sativa* as a spice is also reported by Paulos Abebe (2008) and Mathewos Agize (2008).



Figure 12. *Ruta chalepensis* (Rue) in home garden in Hashenge Figure 13. *Nigella sativa* (Black cumin) in Zata cultivated fields

5.3.9 *Brassica nigra* (Mustard)

The seeds of *B. nigra* are used in the preparation of a slurry condiment called *Awaze/senafiche* which is added to germinated beans and eaten usually during fasting days (Figure 14). People drinking *tella/sewa* in *tella bets* (Amharic) / *enda-sewa* (Tigrigna) also use the condiment while eating germinated bean seeds.

The condiment is also served with *dulet* (This dish is made from chopped liver, kidney, heart, gastro-intestinal parts mixed with bile (*hamot*), garlic, black pepper, celery, and sautéed in vegetable oil or butter).

People who eat raw meat also use the *awaze* as a seasoning. To prepare *awaze/senafiche*, the seeds of *B. nigra* are ground and blended with chopped bulbs of *A. sativum* and chopped fruits of fresh green *C. annum* and allowed to ferment for almost 3-5 days or more. Or alternatively it can be prepared from chopped bulbs of *A. sativum*, ground seeds of *B. nigra* and *berbere* which is allowed to be fermented for 3-5 days or up to a week. Then finally the slurry condiment is made.

The leaves and tender stems of *B. nigra* are cooked and eaten like collards especially during rainy summer season.

About the plant, it is similarly reported in Anonymous (2006) that the young tender leaves and stem tips of the plant may be eaten raw in salads and older leaves and stouter stems cooked and eaten like collards (leafy vegetables). The seeds are also used for mustard preparation. Similarly Paulos Abebe (2008) and Mathewos Agize (2008) also noted that the young shoots and leaves of *B. nigra* are eaten cooked and the seeds used as a spice.

5.3.10 *Rosmarinus officinalis* (Rosemary)

The leaves of this plant are added while roasting beef of cattle such as sheep, goat or cow. Similarly, R yding (2006) described that the plant is native in the Mediterranean region, frequently cultivated elsewhere, used as a spice and also for distillation of volatile oils (Figure 15). Similarly Mathewos Agize (2008) reported the spice use of rosemary plant.



Figure 14. *Brassica nigra* (Mustard) in cultivated fields in Gerjelle



Figure 15. *Rosmarinus officinalis* (Rosemary) in Hashenge (Home garden)

5.3.11 *Foeniculum vulgare* (Fennel)

The young stems and leaves of *F. vulgare* are used in the preparation of strong local alcoholic beverages called *Areke'* or *katikala*.

The younger shoots of the plant are chewed and the liquid (extract) swallowed for its good flavor by young children in the study area.

According to Siegenthaler (1963), *F. vulgare* is used to flavor alcoholic beverage such as *areke'* and the seeds are used as 'wot' spice. In Amare Getahun (1976) and Jansen (1981), the seeds and dried plant parts of *F. vulgare* are used to flavor local drinks such as *areke'*, *katikala* and *tedj*. These plants have pleasant smell and taste and therefore are used in the preparation of variety of foods and beverages. Paulos Abebe (2008) and Mathewos Agize (2008) similarly reported the culinary use of *F. vulgare*.

5.3.12 *Cuminum cyminum* (Cumin)

The fruits (seeds) of *C. cyminum* are also ingredients of the flavoring foundation of the Ethiopian cuisine, *berbere*. It is also one of the ingredient spices used in the preparation of clarified butter.

Amare Getahun (1976) wrote that this cultivated spice plant is mixed with red pepper and other spices to make *berbere'* in which it tends to reduce the "hotness". The same author also reported that some people add the spice before fermentation and distillation of *katikala*.

Jansen (1981) also described the ground seeds of *C. cym inum* are used to flavor different kinds of 'wot' stew with only small amounts required.

5.3.13 *Thymus serrulatus* (Thyme)

The leaves of *T. serrulatus* are flavouring ingredients of *berbere* and *shiro* i.e. its leaves are dried, then chopped or ground and mixed with other spices to be added to *berbere/shiro*. Hence they flavor the *berbere* and *shiro* powder that are indispensable ingredients of the local stew (sauce).

Its leaves are also used as condiments to flavor tea and drunk as tea. i.e., they are boiled in water and served as tea.

This is also reported by Amare Getahun (1976), i.e. the leaves of this plant together with other spices are used in the preparation of *berbere* and *shiro* and in some areas the leaves are used to flavor tea or drunk alone as tea.

5.3.14 *Rumex abyssinicus*

A piece of the root (rhizome) of *Rumex abyssinicus* is dried, chopped and boiled in water and is added to flavor tea or can be drunk alone as tea. This is either to provide flavor or for its medicinal purpose (Figure 16).

Amare Getahun (1976) wrote about culinary use of *R. abyssinicus*. He explains that the cooked tuber of the plant is used to make a dye that gives yellow coloration to the clarified butter or other spice preparations.

5.3.15 *Mentha spicata*

The fresh green leaves of *M. spicata* are condiments used to flavor tea. For this purpose the fresh leaves are washed and put in to boiled tea and drunk. They have pleasant flavor.

As reported by Sebsebe Demissew (2006), the plant is grown in Ethiopia as a culinary herb and used medicinally and in confectionary for its essential oil. The culinary use of *M. spicata* as a condiment in tea is mentioned in the works of Poulos Abebe (2008) and Mathewos Agize (2008).

5.3.16 *Carthamus tinctorius*

The seeds of this plant are used in the preparation of Ethiopian roasted grain (*Qollo*). The seeds of safflower are slightly roasted and mixed with roasted barley (*qollo sigem*) or roasted (toasted) wheat grain (*qollo sirnay/qollo sinday*). It provides good flavor to the *qollo* (Figure 17). In addition a little water is added to ground seeds of the plant in to which mashed *injera* is thoroughly mixed to make *suffifit* served usually during fasting days.

According to Hiruy Belayneh (1991), similar results has been reported which said that in Ethiopia, finely pounded safflower kernels are mixed with water to prepare a drink which is used on fast-days or mixed with ‘teff’ bread and spices to form a porridge. The same authors also mentioned that the crushed seeds are used to grease the baking plate (*mitad/megogo*). Roasted seeds are mixed with chickpeas, barley or wheat and eaten as a snack food.



Figure 16. *Rumex abyssinicus* in Mahbere silassie
(Rhizomes of the plant)



Figure 17. *Carthamus tinctorius* (Safflower) in
Zata cultivated fields

5.3.17 *Zingiber officinale*

Ginger is cultivated in some home gardens for its spicy rhizome which can be used in the dried/ fresh form. It is one of the important ingredients to prepare *berbere* as a spice mix. The fresh rhizome of the plant is washed, scrapped, chopped in pieces and pounded to be used either immediately or after drying. Powdered rhizome is also used to prepare ginger tea locally called *keshir*. The culinary use of the spice is reported in several literatures including Amare Getahun (1978), Jansen (1981), Paulos Abebe (2008) and Mathewos Agize (2008)

5.3.18 *Lepidium sativum*

Even though the ground and powdered seeds of this plant are sometimes added to scrambled *injera* and eaten, it is widely used for its medicinal purposes than it is used for culinary purposes (Figure 18). The spice use of *L. sativum* is mentioned in the work of Paulos Abebe (2008) and Mathewos Agize (2008).

5.4 Medicinal use of spices and condiments and their preparation

5.4.1 *Allium sativum* (*Tsaeda shigurti*)

The tough prophyll of the bulb is removed (peeled off) and crushed and then mixed with honey. A spoonful of the blended mixture is taken every morning before breakfast. Or alternatively the bulb is pounded together with raw green pepper and eaten with *injera*. This is a treatment for cough (Appendix 2).

Crushed bulb of *A. sativum* (garlic) is smeared on to a bleeding body (skin) during physical damage; this is to prevent infection and it dries off the bleeding. Even crushed bulbs of garlic, seeds of *Lepidium sativum* (garden cress) diluted with water are sprayed on to a surface where the blood is sprinkled (Appendix 2).

Chopped bulb of garlic and ground seeds of garden cress are mashed in *injera* and eaten as a remedy to stomachache.

Chopped bulbs of *A. sativum*, *A. cepa* and chopped fruits of green pepper (*C. annum*) are added to germinated chickpeas in a container with little water. The solution is drunk and the residue eaten. This is for the treatment of malaria (Appendix 2).

The medicinal use of Garlic has been reported in several literatures. Tewolde Berhan Gebre Egziabher and Edwards (1997) wrote that garlic is used medicinally for a range of skin and stomach problems. Its use as a treatment of malaria (Fisseha Mesfin, 2007), as a remedy to malaria and pneumonia (Abiyot Berhanu, 2002), as a remedy to common cold (Nigusse Tadesse, 2006), as a treatment for cough (Tesfaye Awas, 2007) and as a treatment of acute stomachache (Haile Yinger, 2005) and as a treatment of malaria, stomachache, common cold

and intestinal parasites (Endalew Amenu, 2007) is also reported in their works. Paulos Abebe (2008) and Mathewos Agize (2008) also noted the medicinal use of garlic. Much beneficial health related biological effects of garlic are due to its characteristic organosulfur compounds such as allicin (diallyl thiosulphate), the principal active substance of fresh garlic extract, which is responsible for garlic's typical pungent smell (Koch and Lawson, 1996).

5.4.2 *Lepidium sativum* (Shinfae)

It is crushed and pounded with *Ruta chalepensis*. Or alternatively seeds are crushed together with the bulb of *Allium sativum*, little water is added and mixed with scrambled *injera* and eaten. This is a local remedy to abdominal pain (stomachache) (Appendix 2).

Nigella sativa, *Allium sativum*, *Ruta chalepensis* and little *L. sativum* are mixed with honey and a spoonful of the mixture is taken before breakfast as a remedy for cough. *Lepidium sativum*, *Allium sativum* and lemon juice are mixed with water and sprinkled (sprayed) around the home compound or crop fields etc. This according to local community is an aid to repel evil spirit (Appendix 2). This is also applied during New Year celebration in the home compound and around backyards (*Meskerem* 1, According to Ethiopian calendar).

Crushed leaves and seeds of *L. sativum* are also applied (smeared) on the skin of cattle as a treatment to skin sore (skin complaint)



Figure 18. *Lepidium sativum* (Garden cress) in cultivated fields of Hashenge.

According to Belachew Wassihun *et al.* (2003), seeds of *L. sativum* is crushed and mixed with lemon to treat abdominal pain and toothache. The same is also reported by Tesfaye Awas (2007) and the seeds are used to treat abdominal pain. Jansen (1981) also reported that the seeds of the plant are considered as standardized medicine used to treat variety of skin complaints, cold, stomach upsets and swollen glands. Lev (2006) also reported in his research work on Ethiopian Jews (in Israel) that the seeds of *L. sativum* (garden cress) are used locally in the treatment of stomachache, and also used as hair strengthening and aphrodisiac. The medicinal use of *L. sativum* as treatment to various ailments is also noted by Endalew Amenu (2007), Fisseha Mesfin (2007), Paulos Abebe (2008) and Mathewos Agize (2008).

5.4.3 *Nigella sativa* (Tselim kimem/Awesuda)

It is crushed and pounded with *Ruta chalepensis*, *Lepidium sativum* and *Allium sativum* and mixed with honey and a spoonful of the blended mixture is taken before breakfast as a remedy for abdominal pain (stomachache). It is also important to treat cough. This is mentioned in the medicinal use of *L. sativum* (Appendix 2).

Pounded rhizome of *Zingiber officinale* and seeds of *N. sativa* are ground and made into powder and eaten with injera to treat stomach complaints (stomachache).

Tesfaye Awas (2007) also wrote that seeds of *N. sativa* are involved in the treatment of abdominal pain. Amare Getahun (1976) and Jansen (1981) reported that the seeds of black cummin are supposed to relieve headaches by mixing them with melted butter, wrapping it in a piece of cloth and sniffing.

Nigusse Tadesse (2006) said that the ground seeds of *N. sativa* are mixed with edible oil and taken orally as a remedy to swollen stomach. Paulos Abebe (2008) and Mathewos Agize noted the medicinal use of the plant.

5.4.4 *Rhamnus prinoides* (Gesho)

Young leaves are chewed and the juice is swallowed to treat tonsil usually in children and sometimes in adults (Appendix2).

It is noted in the works of Tilhaun Teklehaymanot and Mirutse Gidey (2007) that *Rhamnus prinoides* has medicinal uses. For example the leaf paste mixed with butter is applied in the form of ointment as a treatment to eczema (inflamed skin condition). The medicinal use of *R. prinoides* to treat different ailments is also reported in the work of Etana Tolosa (2007) and Mathewos Agize (2008).

5.4.5 *Ruta chalepensis* (*Chena adam*)

The leaves are boiled with tea or coffee and drunk. Alternatively, the leaves are crushed and pounded and mixed with cold water and drunk as a treatment to stomachache (Appendix 2).

Crushed seeds of *R. chalepensis* and seeds of *L. sativum* are added to water and sprayed in homes or home compounds or crop fields to repel evil (bad) spirits.

Crushed seeds and/or leaves of *R. chalepensis* and bulb of *A. sativum* are smeared or rubbed on bleeding head or forehead damaged during physical damage when someone falls over or beaten by someone, to prevent infection.

The medicinal use of *R. c halepensis* is reported in several research works. Among which Siegenthaler (1963), Abink (1995), Mirutse Giday (2001), Belachew Wassihun *et al.* (2003), Tesfaye Awas (2007), Endalew Mesfin (2007), Etana Tolosa (2007) and Fisseha Mesfin (2007) reported that the fresh leaves of *R. c halepensis* are either chewed and the extract swallowed or are boiled with tea or coffee and drunk for the treatment of stomach problems (stomachache).

5.4.6 *Trigonella foenum-graecum* (*Abaeke*)

Water is added to *abish* flour (fenugreek powder) and is made into paste and applied to the broken bone. This is done as a treatment to the broken bone (bone setting) (Appendix 2). This works both for human as well as livestock. The beverage made of fenugreek powder or the paste made of this powder is given to individuals who are constipated. This softens the intestines (alimentary canal).

Fenugreek powder is added to water and made into paste, whipped and given to weakened and malnourished cattle every morning (about 1 liter of the paste is given).

Tesfaye Awas (2007) wrote that the seeds of fenugreek are used in the treatment of abdominal pain, back pain and are also important during bone setting.

According to Siegenthaler (1963), fenugreek powder (*abish* flour) is mixed with water and honey and whipped until foamy and then drunk. This is highly recommended drink for underweight persons. The medicinal use of fenugreek as a remedy for various health problems is also mentioned in the work of Amare Getahun (1976).

5.4.7 *Rumex abyssinicus* (Mekmeko)

Rhizome of *R. abyssinicus* is pounded and added to tea or coffee and drunk. This is done to treat headache (Appendix 2). Similar results have been described in the work of Tesfaye Awas (2007). But here the part of the plant used to treat headache is different from what is reported by the local community in the study area. In the study area the bulb (rhizome) is used to relieve the problem but in Tesfaye Awas (2007), the leaf is used instead. The mode of administration of the remedy is also different. Mathewos Agize (2008) mentioned the medicinal value of *R. abyssinicus*.

5.4.8 *Allium cepa* (Keyih shigurti)

The bulb of *A. cepa* (shallot) is crushed and is added to a container with little water in it and the juice extract is poured through the nose of cattle little by little. This is to expel leech that entered in to the body of a cattle (Appendix 2). This can even be applied to humans to expel leech that accidentally entered in to the body while drinking river water (but the amount of the drops given is very few for human beings). The medicinal use of *A. cepa* is mentioned in the work of Mathewos Agize (2008).

5.4.9 *Capsicum annum* (Berbere)

Many informants believe that the predominant spice mix, which is the important component of many Ethiopian sauces, called locally *berbere* (composed of mainly *C. annum* powder mixed with other ground spices) is important to kill internal parasites. *Berebere* can be made in to paste known as *dilik* and eaten with *injera*.

Jansen (1981) described that in Ethiopia, people who eat raw meat believe that Capsicum (hot pepper) kills dangerous micro-organisms in the meat and the stomach. It is used also against amoeba infection and intestinal worms. The medicinal use of *C. annum* as a treatment to ascariasis is also noted in the research work of Fisseha Mesfin (2007). Medicinal value of *C. annum* is again mentioned by Mathewos Agize (2008).

5.4.10 *Brassica nigra* (Senafiche)

The slurry condiment known as (*Awaze/senafiche*) which is made of largely ground seeds of *B. nigra* (it also contains other spices), is eaten with *injera* or germinated beans in the morning before breakfast as a treatment for intestinal parasites (amoeba). It is also reported to be a treatment for malaria. Lev (2006) also noted the medicinal use of *Brassica nigra* among the Ethiopian Jews in Israel. Mathewos Agize (2008) also noted the medicinal use of *B. nigra*.

5.4.11 *Zingiber officinale* (Jinjibel)

Fresh rhizome of ginger plant is chewed and the juice extracts swallowed as a remedy to stomach complaints. Dried and powdered ginger rhizome is boiled and made into *keshir* and drunk as a treatment to cough (common cold). A similar result has been described in the work of Amare Getahun (1976). Siegenthaler (1963) also noted the medicinal use of the plant as a cure to uvula infection. The medicinal use of ginger plant is also mentioned in the works of Jansen (1981), Worku Abebe (2006), Etana Tolosa (2007), Fisseha Mesfin (2007), Paulos Abebe (2008) and Mathewos Agize (2008).

The fidelity level (FL) is used to calculate the percentage of informants claiming the use of a spice/non-edible oil crop for the same major purpose (medicinal) as:

$$FL (\%) = N_p/N \times 100$$

Where N_p is the number of informants that claim a use of a plant species to treat a particular disease, and N is the number of informants that claim the plant as a medicine to treat any given disease (Table 4). The medicinal spices that are widely used to treat a particular ailment by the local people have higher FL values than those that are less popular (Table 4).

Table 4. Fidelity level (FL) values of medicinal spices and non-edible oil crops.

Species name	Local name	Therapeutic uses	Fidelity level (FL)
<i>Allium sativum</i>	<i>Tsaeda shigurti</i>	Cough (common cold)	100%
		Prevents infection	93%
		Stomach ache	80%
		Malaria	70%
<i>Lepidium sativum</i>	<i>Shinfae</i>	Abdominal pain	81%
		cough	76%
		To repel evil spirit	92%
		Skin sore (cattle)	58%
<i>Nigella sativa</i>	<i>Tselim kimem/Awesuda</i>	Abdominal pain	82%
<i>Rhamnus prinoides</i>	<i>Gesho</i>	Tonsil	75%
<i>Ruta chalepensis</i>	<i>Chena adam</i>	Stomach ache	86%
		To repel evil spirit	90%
		Prevents infection	78%
<i>Brassica nigra</i>	<i>Senafiche</i>	Treatment of intestinal parasites	80%
		Malaria	74%

<i>Trigonella foenum-graecum</i>	<i>Abaeke</i>	Bone setting	78%
		Constipation	76%
		Malnourishment (human/cattle)	80%
<i>Rumex abyssinicus</i>	<i>Mekmeko</i>	Headache (<i>Aklaom</i>)	58%
<i>Allium cepa</i>	<i>Keyih shigurti</i>	Expel leech (Usually for cattle sometimes for humans)	42%
<i>Capsicum annum</i>	<i>Berbere</i>	To kill internal parasites	74%
<i>Zingiber officinale</i>	<i>Jinjibel</i>	Remedy to stomach complaints	90%
		Common cold	85%
<i>Ricinus communis</i>	<i>Gulie</i>	Ear ache	52%

5.5 Use of non-edible oil plants

5.5.1 Use of *Ricinus communis* (castor bean plant)

People in the study area use the castor bean plant (leaves, seeds, stems or the entire plant) for several purposes (Table 5).

Table 5. Use of castor bean plant in the study sites.

Plant part	Local use
Leaf	<ul style="list-style-type: none"> - To wrap (hold) butter for sale during market days (Figure 21). - To cover germinating barley seeds while preparing the local beer <i>sewa</i>. - Leaves crushed, squeezed and 2-3 drops of the juice extract applied to a diseased ear (as a treatment to earache). - Leaves are also crushed and put on a wound and tied with a <i>shash</i>.
Seed	<ul style="list-style-type: none"> - Seeds crushed and used to grease the heavy clay skillet (<i>megogo</i>). - Oily seeds are also important in softening the skin and hides of animals. - Oily seeds are also used as candles (Figure 20).
Stem	<ul style="list-style-type: none"> - Dried stems are used as firewood and for construction purposes (huts).
The whole plant	<ul style="list-style-type: none"> - Used to reinforce fences and decorate the home compound (Figure 22).

According to Amare Getahun (1976), the oil from the seeds of castor plant (castor oil) is used as a mild purgative and widely used in tannery works. Hoareau and Da Silva (1999) also reported that castor oil is used as a laxative. Kebu Balemie *et al.* (2004) and Etana Tolosa (2007), also reported that the leaf and stem infusion of castor plant is made and drunk or dropped into the ear as a treatment to swelling pain in ear. Tesfaye Awas (2007) also

mentioned eight uses of *R. communis* in his study. Such as the use of the plant as fence, food, fuel wood, greasing baking plate, hair-oil, medicinal, musical instruments and tanning. The medicinal use of *R. communis* for several ailments of the livestock is mentioned in the work of Endalew Amenu (2007) and Fisseha Mesfin (2007). In general there are several literatures that report the local and industrial use of castor bean plant.



Figure19. *Ricinus communis* (Castor plant) in home garden (Gerjelle).

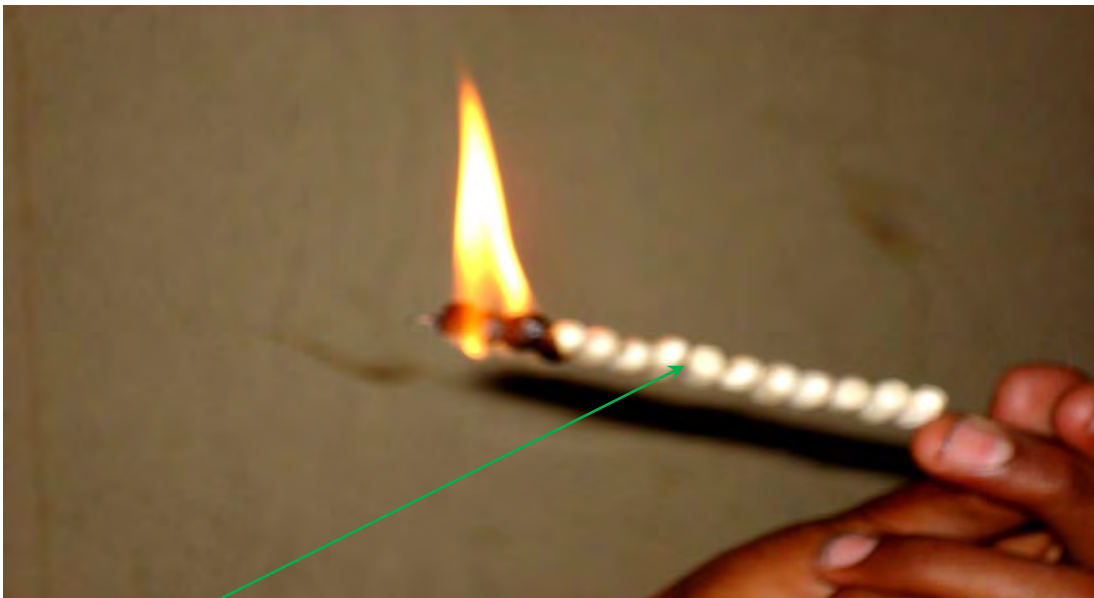


Figure 20. **Seeds** of *Ricinus communis* (Castor plant) arranged in a straw like beads used as a candle.



Figure 21. **Leaf of castor plant** being used to wrap or hold **butter** for sale during market days.



Figure 22. **Castor bean plants** (*Ricinus communis*) used as reinforcement for fences (Alamata).

5.5.2 Use of *Jatropha curcas*

Though it is not common, in some areas it is used as a live fence (Figure 23). These plants are also planted by the agriculture bureau of Alamata *woreda* to prevent soil erosion (Figure 24).



Figure 23. *Jatropha curcas* (physic nut) planted as live fence in Tumuga.



Figure 24. *Jatropha curcas* planted to prevent soil erosion (Near Tumuga).

According to Henning (2001), the plant is planted as a hedge (living fence) by farmers all over the world because it is not browsed by animals. Similar results are also reported in the work of Becker *et al.* (1999) that the plant is planted in the form of hedges around gardens or fields to protect the crops against roaming animals like cattle or goats. The same author also noted that *Jatropha* hedges are planted to reduce erosion caused by water and/or wind.

5.5.3 *Vernonia galamensis*

These oil crop plants have been collected from an area where the plants were planted by the Agriculture bureau of the woreda (Figure 25). Therefore it was not possible for the farmers to tell the local use of the plants. Of course some farmers who know it in its wild state in the Raya valley and in some farm lands consider it as a weed.



Figure 25. *Vernonia galamensis* in field garden in Alamata near Tabia Selam be kalsi.

5.6 Type and position of *Dhri-bet* and/or *Guaro* (Home garden)

The terms *dhri-bet* and *guaro* literally mean the backyard, this indicates the closeness of the home garden to the house. In the surveyed *kebeles/tabias* though the home gardens are located usually at the backyards, some are located at front yards and others at side yards and very few entirely encircle the house.

In the home gardens and cultivated fields, which vary in shape and size, several cultivated plant species such as vegetables, spices and condiments, medicinal plants and fragrances grow. They are fenced by either bunds of stones, plant wood materials or live fences (*Eucalyptus spp.*, *Opuntia ficus-indica*, *Euphorbia spp.*, *Ziziphus spp.* etc).

Gebre-medhin Teklehaimanot and Mulubirhan Haile (2007), who made studies on root crop production and biodiversity management in backyards of some selected *woredas* of Tigray regional state similarly reported that the home garden area with different shapes and sizes includes the living house, animal houses, grain stores, drying places and plots of garden species (typically of mixed type).

The information from most informants indicated that the main sources of seed for spice production in the home gardens or cultivated fields is from own stock, the local market, office of agriculture and rural development of the *tabias* (The bureau provided coriander, black cumin and cumin seeds to selected farmers).

The results of the study also revealed that the farmers produce such spices and condiments as *Capsicum annum*, *Rhamnus prinoides*, *Allium sativum*, *Allium cepa*, *Allium porrum*, *Nigella sativa*, *Ruta chalepensis*, *Rosmarinus officinalis*, *Brassica nigra*, *Thymus serrulatus* (in Mahbere silassie), *Ocimum basilicum*, *Carthamus tinctorius* (in Zata as field crops), *Cuminum cyminum*, *Lepidium sativum*, *Mentha spicata*, *Foeniculum vulgare*, *Trigonella foenum-graecum* and *Rumex abyssinicus* (in Mahbere silassie) in their home gardens or fields usually for home consumption and sometimes for marketing.

Similarly according to Millat-e-Mustafa (1997); Godbole (1998), the home gardens which are mixed gardens possess annual and perennial plants which may or may not be

accompanied by animals and are largely managed by members of the household either for domestic use or for commercial purposes.

Non-edible oil crops such as *Ricinus communis* (home garden, cultivated fields and wild), *Jatropha curcas* (home garden), and *Vernonia galamensis* (cultivated fields in Alamata) have also been found in the study areas.

Hoyeepoo (1990) and Zemedu Asfaw (2001) noted that the primary function of small-scale traditional farming systems practiced around the house i.e. in home-gardens is for growing various crops harvested for home consumption. This is also similar to what has been reported by Gebremedhin Teklehaimanot and Mulubirhan Haile (2007) which said that, immediately behind the house in a home garden, there is a small area maintaining more species per unit area that contains spices, medicinal plants, vegetables, fragrance plants and others, which are mostly grown for home consumption.

As informed by the respondents, Alamata, Ofla and D'agte woredas have about 40.30 %, 74.60 % and 42.70 % of 2-5 family sizes respectively. They also have 59.70 %, 25.40 % and 57.30 % of 6-8 family sizes respectively. On average about 75 % of the households in the study areas have about 4-7 family size. Therefore if special care and due attention is given to home gardens and cultivated fields, they can play an important role in fulfilling the food supply and commercial benefits for the farmers in the drought prone study areas.

In the study area almost 82.53 % of the informants (house holds), said that the woman (wife) is responsible to work in the home garden. And 11.10 % said that the man (husband) is responsible to work in the home garden. About 4.53 % also responded that both parents are responsible to work in the home garden and the rest 1.83% said that children work in the home gardens. Therefore as to the day-to-day activities in the home garden, much responsibility of managing the garden lies on the shoulder of women in the study areas. Though sometimes women are assisted by their husbands and children.

As to the decision on which plants to grow in the home gardens, about 70.03% of the households responded that women decide what plants to grow in their home gardens, while

3.60 %, 23.80 %, 2.57 % responded both the husband (man) and the woman, only the man (husband), and children decide which plants to grow in the home garden respectively. Advice (assistance) is also provided by the development agents of the *tabias* this is because seeds of some spices are provided by the bureau of agriculture and rural development of the respective *tabias*. This clearly would show that women have profound knowledge on the use and cultivation of culinary herbs, spices and condiments that grow in the home gardens.

People in the study areas usually purchase *Aframomum corrorima*, *Zingiber officinale*, *Nigella sativa*, *Curcuma domestica*, *Allium cepa*, *Capsicum annum*, *Trigonella foenum-graecum*, *Cuminum cyminum*, *Syzgium aromaticum*, *Cinnamomum cassia* etc from the local market places. Here one can understand that some spices do not grow in the study areas and they are exported from other areas. Whereas some are cultivated either in their cultivated fields or in their home gardens.

Respondents also indicated that they use spices and condiments while preparing food and beverages for the following reasons: - 1. Provide flavoring and color to the food and beverages; hence would have good taste and attractive color for good appetite.

2. Spices provide them good health condition.

3. The spices and condiments enable the food not to be easily spoiled (food preservation).

According to Purseglove *et al.* (1981), spices can improve the palatability and the appeal of dull diets or spoiled food. Piquant (hot) flavors stimulate salivation and promote digestion. Spices along with salt, can be applied in mixtures to pickle and preserve meats (food); they are also used as perfumes and medicines (Farrington, 1999). Aromatic spices such as cloves, cardamom and mint, would be useful to disguise the foul breath of onion and garlic eaters who were likely to have additional halitosis from caries and gingivitis.

5.7 Preference ranking of the widely used spices for culinary purposes

The results of preference rankings showed that the most widely used spices and condiments in preparing the local stew called *tsebhi* (Tigrigna)/*wät* (Amharic of) are *Capsicum annum* (birds eye pepper), *Allium cepa* (onion), *Allium sativum* (garlic), *Nigella sativa* (black

cumin), *Ocimum basilicum* (sacred basil), *Trigonella foenum-graecum* (fenugreek) and *Cuminum cyminum* (cumin) ranked 1 to 7 respectively (Table 6).

Table 6. Preference ranking of widely used spices and condiments in food preparation.

No.	List of spices and condiments widely used in food preparation (<i>Tsebhi</i>)	Respondents										Total	Rank
		R1	R2	R3	R4	R5	R6	R7	R8	R9	R10		
1	<i>Allium cepa</i>	6	5	6	7	6	7	5	5	7	6	60	2 nd
2	<i>Allium sativum</i>	5	7	5	6	5	6	7	6	5	5	57	3 rd
3	<i>Capsicum annum</i>	7	6	7	5	7	5	6	7	6	7	63	1 st
4	<i>Cuminum cyminum</i>	1	1	1	2	1	2	1	2	1	2	14	7 th
5	<i>Nigella sativa</i>	4	4	3	4	4	3	2	4	4	3	35	4 th
6	<i>Ocimum basilicum</i>	3	2	4	1	2	1	3	1	2	1	20	5 th
7	<i>Trigonella foenum-graecum</i>	2	3	2	3	3	4	4	3	3	4	31	6 th

This confirms the expression by Jansen (1981) indicating that ‘there is probably no spice so popular as capsicum, and no spice has become such indispensable ingredient of the daily food of so many people of the world’.

The results of preference ranking on the spices and condiments that are widely used for medicinal purposes showed that: *Allium sativum* (Garlic), *Nigella sativa* (Black cumin), *Lepidium sativum* (Garden cress), *Ruta chalepensis* (Rue) and *Zingiber officinale* (Ginger) are ranked 1 to 5 respectively (Table 7).

Table 7. Preference ranking of spices and condiments widely used for medicinal purposes.

No.	List of widely used spices and condiments for medicinal purposes	Respondents										T o t a l	R a n k
		R1	R2	R3	R4	R5	R6	R7	R8	R9	R10		
1	<i>Allium sativum</i>	5	5	5	4	5	4	5	5	5	4	47	1 st
3	<i>Lepidium sativum</i>	3	4	3	3	2	3	3	3	3	3	30	3 rd
2	<i>Nigella sativa</i>	4	3	4	5	4	5	4	4	4	5	42	2 nd
4	<i>Ruta chalepensis</i>	2	3	2	2	3	3	1	3	2	2	23	4 th
5	<i>Zingiber officinale</i>	1	3	2	1	3	2	2	2	3	1	20	5 th

The medicinal use of *Allium sativum*, *Lepidium sativum*, *Nigella sativa*, *Ruta chalepensis* and *Zingiber officinale* has been described in Siegenthaler, 1963; Jansen, 1981; Tewolde Berhan Gebre E gziabher and E dwards, 1997; D ebela H unde *et a l.*, 2001; M irutse G iday, 2001 ; Abiyot B erhanu, 2002; B elachew Wassihun *et a l.*, 2003; N igusse T adesse, 2006; E tana Tolosa, 2007; Fisseha Mesfin, 2007; Tesfaye Awas, 2007, indicating the strong evidences of the medicinal value of the species.

Treats to spices and condiments in home gardens

The most threatening factors that p revent s ufficient p roduction and variety o f s pices a nd condiments in h ome g ardens ar e found t o b e s hortage of land, lack o f k nowledge o n production and use o f t hose crops, dr ought (water shortage especially during dry seasons), crop p e sts and lack o f seeds c ompounded by market p roblems have been r anked 1 t o 5 respectively by the respondents (Table 8).

Table 8. Major threats of spices and condiments in the home gardens, cultivated fields and wild in the study areas.

No.	Major threats of spices and condiments	Respondents										Total	Rank
		R1	R2	R3	R4	R5	R6	R7	R8	R9	R10		
1	Lack of knowledge on production and use of the spices	4	3	5	3	5	4	5	4	3	4	40	2 nd
2	Lack of seeds associated with market access problems.	1	2	1	2	2	2	1	2	1	1	15	5 th
3	Drought (water shortage).	3	4	3	4	3	4	2	3	2	2	37	3 rd
4	Crop pests	2	1	2	1	2	3	4	2	4	3	27	4 th
5	Shortage of land	5	5	4	5	4	5	3	5	5	5	47	1 st

5.8 Soil, land form, plant and season classification in the study area

The local people of the study area classify the soil based on color and size of the soil as *tselim hammed/tselim meriet* or *walka* (black soil), *keih hammed/keih meriet* (red soil), *hutsa* (sandy soil), *chinchu* (stony soil), *delel* (loamy fine soil) and *baekel* (white lime soil) (Table 9). Similarly Corbeels *et al.* (2000) reported that farmers in central Tigray traditionally classify their soil based on fertility, color and texture as *keyih* and *andeleway* (red and brown soil), *andeleway* (brown soil), *baekel* (white soil) and *walka* (black soil). The authors also noted that the red and brown soil is categorized in the most fertile soil type (*Reguid meriet*), the brown soil in the moderately fertile soil (*Maekelay meriet*) and white and black soils in

the poorly fertile *rekik meriet*. Similar results have been described on the local classification of soil by Mitiku (1996) as mentioned in Nyssen *et al.* (2007).

Table 9. Emic classification of soil by the farmers in the study area

No.	Soil type	Emic (local) soil categories
1	Black soil	<i>Tselim hammed/tselim meriet</i> or <i>walka</i>
2	Red soil	<i>Keih hammed/keih meriet</i>
3	Sandy soil	<i>Hutsa</i>
4	Stony soil	<i>Chincha</i>
5	Loamy fine soil	<i>Delel</i>
6	White lime soil	<i>Baekel</i>

The land forms are locally classified based on height, steepness, plainness and depth of the area as *Emba*, *Shintro* and *Golgol* for Mountain, Valley and Plain land respectively.

The indigenous people in the study area also classify plants depending on their height as *oam* (tree), *qutquato* (shrub) and *tsahyay* (herb) and *saeri* (grass).

Farmers in the study area locally classify seasonal periods into three. These are: *Kewie* (a period from October to February, a dry season when crops are harvested and stored); *Belgi* (a period from March to June, when farmers use the season to prepare their land) and *Kiremti* (a period from July to September, this is the main rainy season when crops and rain fed spices and condiments are planted).

5.9 Market survey

From the four market areas that have been surveyed during the study (Hagereselam, Alamata, Falla and Korem), these list of spices and condiments were found (Table 10). The market areas are in the study *woredas* (Hagereselam in Degu'a Tembien, Alamata town in Alamata *woreda*, Falla and Korem in Ofla *woreda*). According to the spice vendors in those market areas, most spices sold in the markets are home produced (cultivated either in their home gardens or cultivated fields or cultivated by the farmers in the nearby villages including the study *tabias/kebeles*). But some spices are imported from other regions. Such spices include *Zingiber officinale*, *Cinnamomum cassia*, *Curcuma domestica*, *Pepper longum*, *Syzygium aromaticum*, *Carum copticum*, *Coriandrum sativum*. Some spices though can grow in the home gardens and cultivated fields in the study areas, they are also imported from other areas such spices as *Nigella sativa*, *Cuminum cyminum*, *Coriandrum sativum*, and *Zingiber officinale*.

Table 10. Surveyed market areas with parts sold (spices and condiments) and non-edible oil crop in the study areas. (Key: Sp- spice, Ne- non edible oil plant)

		Spices in the surveyed market areas			Hagereselam	Alamata	Korem	Falla
Scientific Name	Common Name (English)	Parts Sold	plant	Source				
<i>Aframomum corrorima</i>	False cardamom	Capsule	Sp	Imported from other areas	✓	✓	✓	
<i>Allium cepa</i>	Shallot	Bulb	Sp	Cultivated	✓	✓	✓	✓
<i>Allium sativum</i>	Garlic	Bulb/Chopped leaves	Sp	Cultivated	✓	✓	✓	✓
<i>Brassica nigra</i>	Mustard	Seeds	Sp	Cultivated	✓	✓		
<i>Capsicum annum</i>	Hot pepper	Fruit	Sp	Cultivated	✓	✓	✓	✓
<i>Carthamus tinctorius</i>	Safflower	Seed	Sp	Cultivated		✓	✓	

<i>Cinnamomum cassia</i>	Cassia	Bark	Sp	Imported from other areas	✓	✓	✓	
<i>Coriandrum sativum</i>	Coriander	Seed	Sp	Imported from other areas	✓	✓	✓	
<i>Cuminum cyminum</i>	White cumin	Seeds	Sp	Cultivated	✓	✓	✓	
<i>Curcuma domestica</i>	Turmeric	Rhizome	Sp	Imported from other areas	✓	✓		
<i>Lepidium sativum</i>	Garden cress	Seed	Sp	Cultivated		✓		✓
<i>Nigella sativa</i>	Black cumin	Seeds	Sp	Cultivated	✓	✓		✓
<i>Ocimum basilicum</i>	Sweet basil	Leaf and flower	Sp	Cultivated	✓	✓		✓
<i>Piper capense</i>	Long pepper	Spike	Sp	Imported from other areas	✓	✓		
<i>Rhamnus prinoides</i>	Buckthorn	Stems and leaves	Sp	Cultivated	✓	✓	✓	
<i>Ricinus communis</i>	Castor plant	Seed	Ne	Wild/cultivated	✓		✓	✓
<i>Rumex abyssinicus</i>	Spinach rhubarb	Rhizome	Sp	Wild/cultivated	✓	✓		
<i>Ruta chalepensis</i>	Rue	Seeds and leaves	Sp	Cultivated	✓		✓	✓
<i>Syzygium aromaticum</i>	Clove	Flower buds	Sp	Imported from other areas	✓	✓		
<i>Trachyspermum ammi</i>	Bishop's weed	Fruit	Sp	Imported from other areas	✓	✓		
<i>Thymus sp.</i>	Thyme	Leaves	Sp	Wild	✓	✓	✓	
<i>Trigonella foenum-graecum</i>	Fenugreek	Seed	Sp	Cultivated	✓	✓		✓
<i>Zingiber officinale</i>	Ginger	Rhizome	Sp	Imported from other areas	✓	✓	✓	✓



Figure 26. A woman selling **spices** in Hagere selam market.

5.10 Plant part (spices and condiments) used for culinary purposes

The plant parts used widely for culinary purposes usually in making the Ethiopian spicy sauce known as *wät* (in Amharic) and *tsebhi* (in Tigrigna) include seed, leaf, stem, root and fruit arranged in the order of their wide utilization in the Ethiopian cuisine (Table 11).

Table 11. Plant part/parts (of spices and condiments) used for culinary purposes.

No.	Plant part used	No. of species	Percentage (%)
1	Seed	6 species	33.33
2	Leaf	2 species	11.11
3	Root (rhizome)	2 species	11.11
4	Stem (bulb)	2 species	11.11
5	Fruit	1 species	5.56
6	Stem and leaf	3 species	16.67
7	Seed and leaf	2 species	11.11

5.11 Description of spices and condiments

***Allium cepa* L. Alliaceae, Shallot, *Qeyih shigurti* (Tigrigna)**

It is a cultivated herb; bulb single, 2-10 (-15) cm wide, broadly ovoid to globose and flattened, or bulbs several and smaller, ovoid to lanceolate, attached at the root, or single and hardly distinguished from the base of the shoot except in colour. It is cultivated on large farms and by vegetable growers' cooperatives with irrigation facilities; 500-2400 m. Only known from cultivation with a center of genetic diversity in SE Asia (Afghanistan) (Tewolde Brehan Gebre Egziabher and Edwards, 1997). Both bulbs and leaves are used in cooking. In the study area it is one of the widely used culinary spices which is an important ingredient of the local stew (*tsebhi*). It is cultivated either in home gardens or cultivated fields. It is also available in market areas (Section 5.3.1 and 5.4.8).

***Allium sativum* L. Alliaceae, Garlic, *Tsaeda shigurti* (Tigrigna)**

It is a cultivated herb with an ovoid to somewhat globose bulb; covered in a white or purple sheath enclosing more or less equal cloves (bulblets) each enclosed in a tough prophyll; leaves are 4-10 in number in two ranks, often blue green; inflorescence stalk solitary, longer than leaves straight or coiled towards the apex, covered in leaf sheath for more than half of its length (Tewolde Brehan Gebre Egziaber and Edwards, S., 1997). It is cultivated in home gardens and in irrigated fields. It grows best with in altitude ranges of 1800-2800 m a.s.l. throughout the cooler parts of Ethiopia. Currently, it is being grown in all parts of the world (Tewolde Brehan Gebre Egziaber and Edwards, S., 1997). In the study area it is cultivated in home gardens or cultivated fields (highlands). It is used in the treatment of abdominal ache, cough, preventing infections during damage and malaria in the study area (section 5.6.1). In cooking it is an ingredient of the spice mix berbere as well as shiro, which are indispensable in making *wät/tsebhi* (sauces) (Sections 5.3.4 and 5.4.1).

***Capsicum annum* L., Solanaceae, hot pepper, *Berbere* (Tigrigna)**

Annual or perennial herb or sub shrub, up to 1 m tall, almost glabrous, cultivated 250-2400 m, indigenous in Mexico and South America but now naturalized in almost all tropical countries. The entire and the cut fruits are used green as ingredients in cooking dishes and

raw as a component of the mixed spice BERBERE (Friis, 2006). It is cultivated in home gardens and cultivated fields in the study area. It is the main component of the spice mix *berbere* (Sections 5.3.3 and 5.4.9).

***Brassica nigra* L., Brassicaceae, Mustard, *Senafiche* (Tigrigna)**

It is an annual erect herb, up to 100 cm tall, glabrous (Bengt Jonsel). Local name is *senafich* (Amharic) or *senafiche* (Tigrigna) and its common name is mustard. It grows successfully at altitudes of 1600-2450 m (Jonsel, 2000). *B. nigra* species grows in Gonder, Tigray, Shewa upland, Arsi, Harar and most likely throughout the Northern highlands (EEPA, 2003). Farmers in the study area cultivate it in the home garden or in their fields. Mustard seed is used to prepare the semi-liquid condiment known as *senafiche/awaze* which is used to season germinated beans or can be served with raw meat (*tire siga*) or with *dulet* (Sections 5.3.9 and 5.4.10).

***Cuminum cyminum* L., Apiaceae (Umbelliferae), Cumin, *Kemun/Tsaeda kimem* (Tigr.)**

It is a slender herb, 5-50 cm tall, branched near the base. Leaves up to 50 mm long, 1-2-pinnate, lobes 0.5-1 mm wide. *C. cyminum* is thought to be indigenous to Central Asia, but it is now cultivated in many countries as a spice and has often become naturalized (Hedberg and Hedberg, 2003). The fruits are used in the preparation of *berbere*. Ground seeds are used to flavor different kinds of *wät* sauces. It is also used in the preparation of clarified butter in the study area (Section 5.3.12).

***Nigella sativa* L., Ranunculaceae, Black cumin, *Tselim Kimem (Awesuda)* (Tigrigna)**

It is an erect, usually profusely branched herb up to 70 cm tall (Demel Teketay, 2000). It is cultivated as rain fed crop in the highlands at an altitude of 1500-2500 m (Jansen, 1981). It is used as a spice (ingredient of *berbere*) to flavor food and as a traditional medicine in the treatment of abdominal pain (stomachache). The seeds are also used in preparing bread in the study area (Sections 5.3.8 and 5.4.3).

***Ruta chalepensis* L., Rutaceae, Rue, *Chena-adam* (Tigrigna)**

It is a sub shrub up to 1 m height; leaves bipinnate, alternate. In Ethiopia it is very widely cultivated throughout the highlands above 1500m. It originated from the Mediterranean area or Middle east. It is a culinary herb used to flavor milk, cottage cheese and coffee and in the preparation of BERBERI (Gilbert, 1998). In the study area it is used both as a spice and as a medicinal plant (Sections 5.3.7 and 5.4.5).

***Ocimum basilicum* L., Lamiaceae, Sweet basil, *Seseg* (Tigrigna)**

Annual herb, up to 40 cm tall, moderately pubescent. Leaves usually prominently, but more or less remotely crenate-serrate. Cultivated as a spice; 1000-2600 m altitude. It is widely cultivated in tropical to temperate regions (Ryding, 2006).

The plants are more herbaceous and probably shorter lived, but might despite that be taller and stouter, and have always a strong fragrance. Anterior stamens are shorter, exerted only 1-3 mm beyond the lower lip of the corolla (Ryding, 2006) (Section 5.3.6).

***Rumex abyssinicus* Jacq., Polygonaceae, Spinach rhubarb, *Mekmeko* (Tigrigna)**

Perennial herb, up to 3 m tall, with thick, somewhat fleshy, rhizome. Stem erect, stout, grooved, pale green or reddish. It is a common and tolerated weed in fields and plantations, by paths, in secondary scrub; 1200-3300 m. It grows in Tigray, Gonder, Gojam, Shewa, Arsi, Welega, Kefa, Illubabor, Gamo Gofa, Sidamo, Bale and Harar regions, Africa and Madagascar. The tender shoots are edible. The rhizomes are used to refine butter and give it a rich yellow color. They are also used medicinally and extracts are drunk to control mild forms of diabetes (Hedberg, 2000) (Sections 5.3.14 and 5.4.7).

***Carthamus tinctorius* L., Asteraceae (Compositae), Safflower, *Suf* (Tigrigna)**

It is an erect stiff annual herb, up to 75 cm high; stem much branched, glabrous, smooth and white. It is cultivated for the edible oil-producing fruits (cypselas), sometimes an escape in wasteland; 1000-2400 m. It grows in previous administration of Tigray, Gonder, Wello, Shewa, Arsi, Welega, Kefa and Harar regions; widely cultivated. Not known in the wild state;

widely cultivated in the East Mediterranean area, Afghanistan, India and California (U.S.A.) for its oil bearing fruits; sometimes also cultivated as an ornamental; it is also reported that the flowers are used in cosmetics for making rouge (Mesfin Tadesse, 2004) (Section 5.3.16).

***Lepidium sativum* L., Brassicaceae, Cress, *Shinfae* (Tigrigna)**

This spice is an annual, aromatic, erect, glabrous annual herb up to 70 cm tall, not much branched. In Ethiopia this plant species is cultivated usually mixed with other field crops, at an altitude of 1800-2700m (Jonsel, 2000). According to Fichtl and Admasu Adi (1994) it is grown scattered in and with other crops, mostly with *Eragrostis tef* at altitudes between 750 – 2900 m. *Lepidium sativum* is used as a spice and medicinal plant which is cultivated in home gardens and cultivated fields, in the study areas (Sections 5.3.18 and 5.4.2).

***Foeniculum vulgare* Mill., Apiaceae, Fennel, *Shilan* (Tigrigna)**

It is an erect glabrous herb, up to 2 m tall. It has strong aromatic odor (Hedberg and Hedberg, 2003). According to Jansen (1981), in Ethiopia it is a common perennial weed of the highlands, growing at altitude of 1500-2500 m. Even if it is grown abundantly in the wild, it may also be cultivated around houses for direct use (Hedberg and Hedberg, 2003). It has a pleasant smell. The ground fruits are constituents of some *wät* sauces and the fruits together with young stems and leaves are also used in the preparation of alcoholic beverages like KATIKALA or AREKE and TEDJ, to give the typical flavor (Section 5.3.11).

***Trigonella foenum-graecum* L., Fabaceae, Fenugreek, *Abaeke* (Tigrigna)**

Erect aromatic annual to 50 cm tall, sparsely pubescent, cultivated at altitude between 1600-2300 m all over Ethiopia for various but mainly for its edible seeds; native in South Europe and Asia. Other uses include its uses in making an unfermented drink, as spice or condiment in baking, and in treating skin and stomach disorders (Thulin, 1989). In the study area it is used as both a spice and medicinal plant (Sections 5.3.5 and 5.4.6).

***Rhamnus prinoides* L'Herit, Rhamnaceae, Buck thorn, Gesho (Gosho) (Tigrigna)**

Shrub or tree to 6 m, unarmed branchlets grow in upland forest (usually on edges or in clearings & former cultivations), riverine forests, secondary forests and scrub, also widely planted in hedges & gardens 1400-3200m. It adds flavor to the local alcoholic beverages - *Tej* & *Tella*. (Both wild & garden plants of the species are equally used for making beverages) (Vollesen, 1989). Traditionally *Gesho* is prepared by cutting it then chopped, sun dried & sold on the local market. It is both a spice and medicinal plant (Section 5.3.2 & 5.4.4).

***Rosmarinus officinalis* L., Lamiaceae (Labiatae), Rosemary, Azmarino (Tigrigna)**

Shrub, up to 2 m tall, fragrant, pubescent with whitish stellate hairs. It is cultivated plant; 1700-2400 m. It grows in Shewa, Arsi, Illubabor, Kefa, Sidamo, Harar regions, probably also elsewhere in Ethiopia: native in the Mediterranean region, frequently cultivated elsewhere. Used as a spice and also for distillation of volatile oils (Ryding, 2006). In the study area the leaves of this spice are added in preparing roasted beef (Figure 14) (Section 5.3.10).

***Mentha spicata* L., Lamiaceae (Labiatae), Mint, Nae-nae (Tigrigna)**

Perennial, rhizomatous herb with stems ascending to 30-50 cm high, strong scented. Stems purplish glabrous. Leaves green above, pale green below, glabrous on both sides. It is a cultivated plant. It can grow in the altitude 1700 -1800 m. It is widely cultivated and consequently naturalized in most parts of the world. It is grown as culinary herb and used medicinally and in confectionary for its essential oil (Ryding, 2006). The local people in the study area use the leaves of the plant as a condiment in tea (Section 5.3.15).

***Thymus Serrulatus*, Lamiaceae (Labiatae), Thyme, Tesne/Tesno (Tigrigna)**

Perennial herb, woody at the base, 5-40 cm long. It grows in the open grassland, on bare exposed rocks, on slopes and tops of mountains, sometimes growing near ditches in afro-montane & afro-alpine vegetation zones; 2250-4000 m (Ryding, 2006). In the study area it also grows in home gardens as well as in the wild and is used as a condiment in tea (Section 5.3.13).

5.12 Description of the non-edible oil crops in the study area.

***Jatropha curcas* L., Euphorbiaceae, Physic nut , *Jatrofa* (Tigrigna)**

It is shrub or small tree up to 4.5 (-8) m high, \pm glabrous throughout; bark smooth, pale, peeling off in translucent scales; latex \pm milky. Mostly cultivated as live fencing, apparently naturalized in riverine forest and deciduous woodland; 450 -1300 m. It grows in S hewa, Illubabor, Kefa, Sidamo and Bale; probably a native of tropical America but long introduced in to the old world tropics where it is now widely cultivated and naturalized (Gilbert, 1995).

The seed provides a purgative ('physic nut') but it is so violent in its effects that its use is dangerous. In the study area, the plant is used to prevent soil erosion and as live fences in some home compounds (Section 5.5.2).

***Ricinus communis* L., Euphorbiaceae, Castor plant, *Gulie* (Tigrigna)**

Varying from ephemeral less than 1 m high to tree-like herb 5 (-10) m high with trunk to 15 cm thick; stems hollow; young shoots often pruinose, purplish. It is a wide spread plant of home gardens in both rural and urban areas, also common along seasonally dry rivers; 400-2500 m.

The oil from the seeds has many recorded medicinal and industrial uses and is produced commercially. The plant itself contains a very dangerous toxin, a few molecules of which are capable of killing any cell in to which they are introduced (Gilbert, 1995).

Ricinus communis -juice extracted from leaves is used to increase secretion of milk and oil obtained from seeds is used to treat stomach ache. In the study area *R. communis* has several functions (Section 5.5.1).

***Vernonia galamensis* (Cass.) Less., Asteraceae (Compositae), Vernonia/ironweed,
Vernonia (Tigrigna)**

Annual herb, c 0.75-1.5 m high (up to 3 m high in cultivation). Stem striate or narrowly ribbed. Leaves alternate, sessile, up to 25x5 cm, elliptic to lanceolate; base narrowly cuneate, apex acuminate; margins irregularly dentate, serrate to serrulate. Florets bright blue to almost white, sometimes flushed pale yellow or green, narrowly funnel shaped. Corolla 13-14 mm long, sessile glandular, 5-lobed, lobes c 5 mm long (Mesfin Tadesse, 2004) (Section 5.5.3).

6. Conclusion

According to the results of the study, people in the study area practice home gardening and have good understanding of the culinary and medicinal use of spices and condiments. Here several cultivated plant species including spices and condiments are maintained mostly for home consumption and some farmers produce excess products to be sold in markets to earn money for the family.

The decision on which crop type to grow and the whole activity of managing the vegetables, aromatics, spices, condiments and other crops in the home gardens is a burden left to women though they are sometimes helped by men and children.

The local people use spices and condiments while preparing food and beverages for the reasons that they flavor and preserve the food and beverages and make them suitably palatable, delicious and stay longer without spoiled.

In preparing local stew (sauce), though the local community uses several spices, the most widely used are (not including the purchased ones) *Capsicum annum*, *Allium cepa*, *Allium sativum*, *Nigella sativa*, *Ocimum basilicum*, *Trigonella foenum-graecum* and *Cuminum cyminum*. They also have a long tradition of using spices and condiments for medicinal purposes. For example they widely use *Allium sativum*, *Nigella sativa*, *Lepidium sativum*, *Ruta chalepensis* and *Zingiber officinale* for the treatment of different ailments.

The most threatening factors that contributed to less production and/or prevent production of spices and condiments in the home gardens in the study areas are noted as shortage of land, lack of knowledge on production and use of those spices and condiments, drought (water shortage especially during dry seasons), crop pests and lack of seeds compounded by market access problems.

The indigenous knowledge of the local people in classifying the soil type and land form, plant type, seasonal periods etc of their locality can provide better understanding of the people to their environment and hence can contribute in the conservation and management of natural resources.

7. Recommendation

Based on the results of the study the following recommendations are forwarded:

Since the burden of heavy work is left to women in managing the home gardens, every member of the family (men and adult children) is better to equally participate and assist the women in home gardening activities.

Educating the local people especially women in managing home gardens which may include land preparation, soil and water conservation methods, seed selection and other related activities is very important to the family in particular and to the country in general. Therefore it would be better if the agriculture bureaus of the *woredas* in the study areas and other concerned governmental and non-governmental organizations participate in giving trainings or workshops that enable the local community to enhance home garden products including spices and condiments both for home consumption as well as for marketing purposes.

Ethiopian population including the population of the community in the study areas is increasing at an alarming rate. This is resulting in shortage of land for cultivation and home gardening. Therefore, the population policy of the country has to be revised and the increasing rate has to be checked.

To increase the production of spices and condiments waiting only until the rain comes should not be the only option of the home gardeners. They should have other alternative means of obtaining water for home gardening activities such as the construction of ponds to supplement the home gardens with water stored in the ponds.

Provision of effective assistance and trainings to home gardeners and the community in general on ways of avoiding and preventing crop pests that attack home garden plants is indispensable.

Though there is a little assistance in the provision of seeds of spices from the agriculture bureaus in the study sites, this assistance has to be sustainable and should include several indigenous as well as exotic plant species.

To maintain the moisture content of the soil, integrating home gardening with soil and water conservation activities is very essential.

Advising the home gardeners to produce the best marketable spices, condiments and non-edible oil crops would help to enhance the income of the poor farmers.

Governmental and non-governmental agencies could assist the farmers in finding market access for the home garden products.

Since the inhabitants have either some or no knowledge on the use of the non-edible oil crops such as *Vernonia galamensis*, *Jatropha curcas*, *Ricinus communis* etc as an alternative energy sources or biofuels, there is a need to give enough training on production, use, management and conservation activities of these non-edible industrial oil crops.

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9. Appendices

Appendix 1. A list of spices and condiments including scientific name, family, local name, parts used and their culinary uses (mode of preparation).

No.	Scientific name and authority	Family	Local name	Parts used	Spices for cooking purpose (food and drinks)and their preparation
1	<i>Allium cepa</i> L.	Alliaceae	<i>Qeyh shegurti</i>	Bulb and leaves	Spice used in preparing thick sauce (<i>wat</i>) it can be used fresh or dried (mix of <i>Berbere</i>).
2	<i>Allium sativum</i> L.	Alliaceae	<i>Tsaeda shegurti</i>	Bulb	The bulb is used as a spice. It is pounded, dried and ground together with other spices and added to <i>berbere</i> or <i>shiro wat</i> .
3	<i>Brassica nigra</i> L.	Brassicaceae	<i>Senafiche</i>	Seed and leaves	The seeds are used to make a slurry condiment blended with other spices (<i>Awaze</i>). The young shoots and leaves are cooked and used as collards.
4	<i>Capsicum annum</i> L.	Solanaceae	<i>Berbere</i>	Fruit	The fruit is sun dried and ground together with other spices to make the fiery <i>berbere</i> (a blend of several spices used in cooking)
5	<i>Carthamus tinctorius</i> L.	Asteraceae	<i>Suf</i>	Seed	Seeds are slightly roasted and added to roasted barley/wheat grains.
6	<i>Cuminum cyminum</i> L.	Apiaceae	<i>Kemun</i>	Seed	Ground seeds of <i>C. cyminum</i> Are ingredients of the spice mix <i>berbere</i> .
7	<i>Foeniculum vulgare</i> Mill.	Apiaceae	<i>Shilan</i>	Arial part and seeds	The arial part (dried and crushed) is used in making <i>areke</i> or <i>katikala</i> (local alcoholic beverages).
8	<i>Lepidium sativum</i> L.	Brassicaceae	<i>Sheanfæ</i>	Seed	Crushed seeds are added to mashed <i>injera</i> and eaten.

9	<i>Mentha spicata</i> L.	Lamiaceae	<i>Nae-nae</i>	Leaves	The leaves are added to flavor tea. (tea condiment).
10	<i>Nigella sativa</i> L.	Ranunculaceae	<i>Awosuda/Tselim kemem</i>	Seed	It is used either singly or mixed with other spices (<i>berbere mix</i>) used to make <i>wät</i> . Seeds also sprinkled on bread dough.
11	<i>Ocimum basilicum</i> L.	Lamiaceae	<i>Seseg</i>	Arial part	It may be used singly or together with other spices in preparing <i>wat</i> (mix of <i>berbere</i>)
12	<i>Rhamnus prinoides</i> L'Herit	Rhamnaceae	<i>Gesho/Gosho</i>	Stem and leaves	The leaves and stems are chopped and ground in preparing <i>tella</i> (local beer) or <i>tedj</i> (honey wine).
13	<i>Rosmarinus officinalis</i> L.	Lamiaceae	<i>Azmarino</i>	Leaves	Leaves sprinkled on roasted beef (<i>tibsi</i>).
14	<i>Rumex abyssinicus</i> Jacq.	Polygonaceae	<i>Meqmeqo</i>	Rhizome	The rhizome is crushed and put to water and boiled and taken as tea.
15	<i>Ruta chalepensis</i> L.	Rutaceae	<i>Chena adam</i>	Arial part	The arial part (usually) the seeds are ground with other spices (<i>berbere mix</i>) used in making <i>wät</i> .
16	<i>Thymus serrulatus</i> Hochst.ex Benth.	Lamiaceae	<i>Tesne</i>	Leaves	The leaves are boiled in water and drunk as tea.
17	<i>Trigonella foenum-graecum</i> L.	Fabaceae	<i>Abaeke</i>	Seed	The seeds are roasted and ground together with other spices and added to <i>wat</i> . <i>Abish</i> flour can also be prepared as a drink for both adults and babies.
18	<i>Zingiber officinale</i> Rosc.	Zingiberaceae	<i>Jinjible</i>	Rhizome	The dried rhizomes pounded and added spice mix <i>berbere</i> to flavor the local sauce (stew).

Appendix 2. Medicinal use of spices and condiments in the study area

No.	Scientific name and authority	Family	Local name	Parts used	Medicinal use of spices and condiments and their preparation
1	<i>Allium cepa</i> L.	Alliaceae	<i>Qeyh shegurti</i>	To expel leech (in cattle)	The bulb is crushed and is added to a container with little water in it and the juice is poured through the nose.
2	<i>Allium sativum</i> L.	Alliaceae	<i>Tsaeda shegurti</i>	Cough Prevent infection	The skin of the bulb is removed and crushed and mixed with honey. A spoonful of the blended mixture is taken every morning before breakfast. Or alternatively the bulb is pounded with green pepper and eaten with <i>injera</i> . Crushed garlic (bulb) is smeared on to a bleeding body (skin) during physical damage.
3	<i>Brassica nigra</i> L.	Brassicaceae	<i>Senafiche</i>	Intestinal parasites (amoeba) Malaria	The semi-liquid condiment made of <i>B. nigra</i> called <i>awaze/senafiche</i> is eaten with either <i>injera</i> or germinated bean seeds.
4	<i>Capsicum annum</i> L.	Solanaceae	<i>Berbere</i>	Internal parasites (amoeba)	<i>Berbere</i> is the main ingredient of <i>wät</i> and is eaten with <i>injera</i> .
5	<i>Zingiber officinale</i> Rosc.	Zingiberaceae	<i>Jinjible</i>	Stomach ache	Fresh rhizome of ginger is chewed and juice swallowed.

6	<i>Lepidium sativum</i> L.	Brassicaceae	<i>Sheanfae</i>	Abdominal pain/ stomach ache To repel evil spirit	It is crushed and pounded with <i>Ruta chalepensis</i> , Or alternatively seeds are crushed together with the bulb of <i>Allium sativum</i> , little water is added and mixed with scrambled injera and eaten. <i>Nigella sativa</i> and <i>Allium sativum</i> and mixed with honey and a spoonful of the mixture is taken before breakfast. <i>Lepidium sativum</i> , <i>Allium sativum</i> and lemon juice are mixed with water and sprinkled (sprayed) around the home compound (crop fields).
7	<i>Nigella sativa</i> L.	Ranunculaceae	<i>Awosuda/Tselim kemem</i>	Abdominal pain/ stomachache.	It is crushed and pounded with <i>Ruta chalepensis</i> , <i>Lepidium sativum</i> and <i>Allium sativum</i> and mixed with honey and a spoonful of the mixture is taken before breakfast.
8	<i>Rhamnus prinoides</i> L'Herit	Rhamnaceae	<i>Gesho/Gosho</i>	Tonsil	Young leaves are chewed and the juice is swallowed.
9	<i>Rumex abyssinicus</i> Jacq.	Polygonaceae	<i>Meqmeqo</i>	Headache (<i>aklaeom</i>)	The piece of a rhizome is pounded and added to tea or coffee and drunk.
10	<i>Ruta chalepensis</i> L.	Rutaceae	<i>Chena adam</i>	Abdominal pain/ stomach ache.	The leaves are boiled with tea or coffee and drunk. Or the leaves are crushed and pounded and mixed with cold water and drunk.
11	<i>Trigonella foenum-graecum</i> L.	Fabaceae	<i>Abaeke</i>	Bone setting	Water is added to <i>abish</i> flour and made in to paste and applied to the broken bone.

Appendix 3. The use of non-edible oil crops (three) in the study area.

No.	Scientific name	Family	Local name	Parts used	Use values of the non-edible oil crops
1	<i>Jatropha curcas</i> L.	Euphorbiaceae	jatrofa	The entire plant	Though it is not common, in some areas it is used as a live fence. These plants are also planted by the agriculture bureau to prevent soil erosion.
2	<i>Ricinus communis</i> L.	Euphorbiaceae	Guile'	Seeds, leaves, stems	<p>Seeds are used to polish the <i>mitad</i> (in Amh.), <i>megogo</i> (in Tigrigna). Seeds can also be arranged in a straw like beads to be used as a candle (Fig. 17).</p> <p>Leaves used to wrap (hold) butter for sale during market days (Fig. 18). They are also used to cover germinating barley (malt) to be used for preparing <i>tella</i>.</p> <p>Dried stems are used as fire wood and as construction materials in making hut.</p>
3	<i>Vernonia galamensis</i> (Cass.) Less.	Asteraceae	vernonia	_____	People in the study area couldn't mention any local use of the plant.

Appendix 4. List of informants participated in the ethnobotanical study.

No.	Name	Sex	Age	Marital Status	Educational Status	Occupation	Locality
1	Shashu Hailay	F	16	Single	Grade 8	Spice vendor	Hagere-selam
2	Medhin G/Kidan	F	55	Single	No	Spice vendor	Hagere-selam
3	Tekien T/Haimanot*	F	60	Single	No	Spice vendor	Hagere-selam
4	Meseret Atakilty	M	24	Single	B.Sc.	Fruit expert	Hagere-selam
5	Hailay G/Mariam*	M	47	Married	No	Farmer	Hagere-selam
6	Fatima Awol*	F	36	Married	No	Farmer	Hagere-selam
7	Zafu Wolday	F	41	Married	No	Farmer	Hagere-selam
8	G/mariam Abraha	M	44	Married	No	Farmer	Hagere-selam
9	G/kirstos Reda	M	55	Married	Preist	Farmer	Hagere-selam
10	Mohammed Abdu	M	47	Married	No	Farmer	Hagere-selam
11	Zeru G/Medhin	M	65	Married	Priest	Farmer	Mahbere-silassie
12	Letehawaria Amaze	F	26	Married	Grade 4	House wife	Mahbere-silassie
13	Kahsay Berhe	M	42	Married	Grade 2	Farmer	Mahbere-silassie
14	G/medhin Abraha	M	52	Married	No	Farmer	Mahbere-silassie
15	Hagos Tesfay	M	47	Married	Preist	Farmer	Mahbere-silassie
16	Letesilassie Amaha*	F	36	Married	No	House wife	Mahbere-silassie
17	Letekiros Abraha	F	32	Single	No	Farmer	Mahbere-silassie
18	Berihu Hagos	M	50	Married	No	Farmer	Mahbere-silassie
19	G/giorgis Atsbaha*	M	61	Married	Preist*	Farmer	Mahbere-silassie
20	Semere Kassaw	M	63	Married	No	Farmer	Alamata

21	Zinabu Shekole	M	43	Married	No	Farmer	Alamata
22	Dagnaw Beyene*	M	74	Married	Grade 4	Farmer	Alamata
23	Kahsay Kidanu	M	33	Married	Grade 7	Farmer	Tumuga
24	Mohammed Hussien	M	75	Married	No	Farmer	Tumuga
25	Tilaye Sileshi	M	40	Married	Grade 9	Carpenter	Tumuga
26	Jano Beyene*	F	49	Married	Grade 3	Kebele secretary	Tumuga
27	Zerfe Kahsay*	F	24	Married	Grade 12	Home economics	Tumuga
28	Muleta Asmamaw	M	35	Married	Grade 8	Farmer	Timuga
29	Asfaw Niguse	M	50	Married	Grade 7	Farmer	Tumuga
30	Asefa Birhanu	M	22	Married	Diploma	Dev. Agent	Tumuga
31	Siraj Ibrahim	M	67	Married	No	Farmer	Gerjelle
32	Niguse G/Hiwot	M	50	Married	Grade 4	Farmer	Gerjelle
33	Hadas Abreha*	F	37	Married	No	House wife	Gerjelle
34	Jano Abdella	F	32	Married	No	House wife	Gerjelle
35	Haftu Etsay	M	22	Single	Diploma	Dev. agent	Zata
36	Asefa Berhe*	M	36	Married	No	Farmer	Hashenge
37	Solomon Kelelew	M	37	Married	Grade 3	Farmer	Hashenge
38	Mengistu Gidey	M	46	Married	No	Farmer	Hashenge
39	Seyoum Semere*	M	35	Married	Grade 3	Farmer	Hashenge
40	Asefu Berhe*	F	60	Married	No	Farmer	Hashenge
41	Helfti Abreha*	F	35	Married	No	Farmer	Hashenge
42	Hagos Alemayoh	M	32	Married	Grade 4	Farmer	Gerjelle

43	Abraha Berhe	M	29	Married	No	Farmer	Hashenge
44	Berihu Tamene	M	49	Married	No	Farmer	Hashenge
45	Omer Mussa	M	27	Married	Grade 3	Spice vendor	Hashenge
46	Belaynesh Abebe	F	26	Single	Grade 1	Farmer	Hashenge
47	Almaz Afework	F	24	Single	Diploma	Crop expert	Gerjelle
48	Tesfay G/egziabher	M	27	Single	Degree	Fruit expert	Alamata
49	Afeworki G/Mariam	M	25	Single	Degree	Irrigation team leader	Alamata
50	Taddesse Beyene	M	50	Married	Priest	Farmer	Zata
51	Gidey Dinkayehu	M	42	Married	Priest	Farmer	Zata
52	Ambaye Girmay	M	35	Married	Priest	Farmer	Zata
53	Deribo Seyoum	M	73	Married	Priest	Farmer	Zata
54	Berihu Darge	M	45	Married	No	Farmer	Zata
55	Abrehet Teka*	F	61	Married	No	Farmer	Zata
56	Hagos Mebrahtu	M	45	Married	No	Farmer	Zata
57	Tekien Berhe*	F	53	Married	No	Farmer	Zata
58	Dagnaw Abebe	M	54	Married	No	Farmer	Alamata
59	Yirga Tegegne	M	47	Married	No	Farmer	Alamata
60	Azmera Teshome*	F	45	Married	No	Farmer	Alamata

* Key informants in the study areas.

Appendix 5. Checklist of Questions for Semi-structured Interview

1. Date _____ ‘Wereda’ _____ ‘Kebele’ or ‘Tabia’ _____
2. Name of respondent _____ Age _____ Sex _____
- Occupation _____ Educ. status _____ Religion _____
3. What is the local name of each plant? _____ (In Tigrigna)
4. Habitat of each plant: Where it grows in the study area? _____
5. Habit of each plant: Tree ____, shrub ____, herb ____, parasite ____ or others ____?.
6. The local use of each plant other than for medicinal purposes? How and what part/parts of each plant is used? _____

7. If each plant is used for medicinal purposes:
 - a) Type of ailment treated _____
 - b) Part/parts of each plant used for medicinal purposes _____
 - c) How it is prepared? _____
 - d) Do you mix some other ingredients such as water, soup, milk, or sugar etc with the medicine? If so why? _____
 - e) How is it taken? (Route of administration) _____
 - f) What amount do you take? Cup, spoon etc _____
 - g) Where do you collect the medicinal plant? _____
 - h) Is the plant marketable? _____
 - i) Modernization and traditional medicine (interface) _____

 - j) Threats to the plant _____
 - k) What traditional conservation methods are used? _____

 - l) Is each plant under cultivation? (Wild, home garden) _____
 - m) The reciprocal impact of plant –human interaction _____

 - n) How best do you think people could participate in conservation of useful plants?

Appendix 6. Ethnobotanical Market Survey/

Date _____

1. Location and Name of the Market Place _____

2. Information on the spice vendor

a) Name _____

b) Age _____ c) Marital status _____ d) Location _____

3. Do you have another source of income? Yes _____ No _____ If yes, specify _____

4. Information on the collection

i) Local Name _____

ii) Source/Origin _____, What type of soil _____

iii) Cultivation Status: Cultivated _____ Wild _____

iv) Part of plant used: Leaf ____, Seed ____, Stem ____, Root ____, or Others _____

v) Method of preparation _____

vi) Part of the plant used: Fresh _____ Dried _____

vii) Conservation methods by the people _____

5. Additional information _____

Thank you!

Appendix 7. Group Discussion

1. What are the wide uses of spices, condiments and non-edible industrial oil crops in the study area?

2. In what types of habitats do the plant species grow? _____

3. What are the threats to those plant species? _____

4. Are there traditional beliefs associated with methods of conserving those plants?

5. Have you ever attended in any meetings or workshops organized by either governmental or NGOs concerning conservation of natural resources (plant species)?

Appendix 8. Preference Ranking

1. What are the most commonly used spices in preparing food/drinks in your area?(Order them 1-7)

- 1) _____
- 2) _____
- 3) _____
- 4) _____
- 5) _____
- 6) _____
- 7) _____

Remark if any _____

2. What are the most widely used spices or condiments for medicinal purposes? (Order them 1-5)

- 1. _____
- 2. _____
- 3. _____
- 4. _____
- 5. _____

Remark if any _____

3. Mention the factors that are most threatening to spices, condiments and the non-edible industrial oil crops(order them 1-5)

- 1. _____
- 2. _____
- 3. _____
- 4. _____
- 5. _____

Remark if any _____

Appendix 9. Field Observation

1. Name of the spice/ non-edible industrial oil crop _____

2. Translation _____

3. Habitat: Soil type _____ Altitude _____ Temperature _____

4. The use of the plant species _____

5. Preparation _____

6. Is the plant found in abundant quantities or not as compared to recent years?

7. Any threat to the plant species? _____

8. Any additional suggestions _____

Appendix 10. Home Gardens

1. What are the main uses of the home garden?-----

2. What types of spices and condiments do you grow in your home garden?-----

3. How many household members are there? 3.1. Adults: -----
3.2. Children (list children under 15 years old and their ages):-----
4. Who works in the home garden? -----
5. Who decides what is grown in the home garden? -----
6. Who manages the day-to-day activities in the home garden? -----
7. Which spices do you use on a daily basis?-----

8. Which of these spices and condiments come from the home garden?-----

9. Which major spices do you purchase?-----

10. What are the three most important problems you have in producing a greater variety of spices in the home garden?-----

11. What changes/improvements would you like to make to produce a greater variety of spices and condiments? -----

12. Arrange in order at least five of the most widely used spices in preparing food/drinks that grow in your home garden. 1. ----- 2. -----
3. ----- 4. ----- 5. -----
13. Why do you use spices in preparing food?-----

14. Do spices have medicinal values? Mention at least five.
1. _____ 2. _____ 3. _____
4. _____ 5. _____

● Mode of preparation and route of administration-----

Appendix 11. Agricultural Experts

1. Could you mention spices that grow in the home gardens of farmers or that grow wild in your area? _____

2. In what type of habitats do they grow? _____

3. What is the use of those spices? _____

4. Is there any sort of overexploiting the plants? _____

5. Are there any threatening factors? _____

6. Do you train the community with methods of conserving plant species?

7. The rain fall of the area? _____
8. Temperature of the area? _____
9. Altitudinal range of the area? _____

Appendix 12. Location and altitude of plants that grow in home gardens and cultivated fields in the study area.

Mahbere silassie (Home gardens)			Gerjelle (Home gardens)		
Home garden 1	Lat. /Long.	Altitude	Home garden 1	N12 ⁰ 28.948'	1465
		m (asl)		E039 ⁰ 36.594'	
<i>Rumex abyssinicus</i>	N 13 ⁰ 39.426'	2587	<i>Capsicum annum</i>		
<i>Ricinus communis</i>	E 039 ⁰ 08.776'		<i>Trigonella foenum-graecum</i>		
<i>Allium sativum</i>			<i>Cuminum cyminum</i>		
<i>Rhamnus prinoides</i>			<i>Nigella sativa</i>		
Home garden 2	N 13 ⁰ 39.389'	2592	Home garden 2	N12 ⁰ 28.952'	1458
<i>Rumex abyssinicus</i>	E 039 ⁰ 08.838'		<i>Zingiber officinale</i>	E039 ⁰ 36.671'	
<i>Allium cepa</i>			<i>Trigonella foenum-graecum</i>		
<i>Allium sativum</i>			<i>Ocimum basilicum</i>		
<i>Brassica nigra</i>			<i>Lepidium sativum</i>		
			Home garden 3	N12 ⁰ 28.965'	1462
Home garden 3	N 13 ⁰ 39.505'	2522	<i>Capsicum annum</i>	E039 ⁰ 36.692'	
<i>Rhamnus prinoides</i>	E 039 ⁰ 08.940'		<i>Ricinus communis</i>		
<i>Thymus serrulatus</i>			<i>Ocimum basilicum</i>		
<i>Brassica nigra</i>			Home garden 4	N12 ⁰ 28.993'	1468
			<i>Ocimum basilicum</i>	E039 ⁰ 36.657'	
Home garden 4	N 13 ⁰ 39.519'	2525	<i>Allium cepa</i>		
<i>Rhamnus prinoides</i>	E 039 ⁰ 08.866'		<i>Nigella sativa</i>		
<i>Allium sativum</i>			<i>Carthamus tinctorius</i>		
<i>Capsicum annum</i>			Home garden 5	N12 ⁰ 28.974'	1466
Home garden 5	N 13 ⁰ 39.580'	2539	<i>Allium cepa</i>	E039 ⁰ 36.682'	
<i>Rumex abyssinicus</i>			<i>Cuminum cyminum</i>		

<i>Rhamnus prinoides</i>	E 039 ⁰ 08.837'		<i>Ruta chalepensis</i>		
			Gerjelle (Cultivated fields)		
<i>Capsicum annum</i>			Cultivated fields 1	N12 ⁰ 28.855'	1459
<i>Brassica nigra</i>			<i>Ricinus communis</i>	E039 ⁰ 36.697'	
			<i>Capsicum annum</i>		
Mahbere silassie (Cultivated fields)			<i>Ruta chalepensis</i>		
Cultivated fields 1	N 13 ⁰ 39.481'	2562			
<i>Trigonella foenum-graecum</i>	E 039 ⁰ 08.802'		Cultivated fields 2	N12 ⁰ 28.888'	1456
<i>Capsicum annum</i>			<i>Capsicum annum</i>	E039 ⁰ 36.779'	
<i>Ocimum basilicum</i>			<i>Trigonella foenum-graecum</i>		
<i>Allium cepa</i>			<i>Ocimum basilicum</i>		
<i>Brassica nigra</i>			<i>Zingiber officinale</i>		
<i>Thymus serrulatus</i>			Cultivated fields 3	N12 ⁰ 29.063'	1465
Cultivated fields 2	N 13 ⁰ 39.433'	2579	<i>Capsicum annum</i>	E039 ⁰ 36.799'	
<i>Allium sativum</i>	E 039 ⁰ 08.890'		<i>Zingiber officinale</i>		
<i>Ocimum basilicum</i>			<i>Allium cepa</i>		
<i>Thymus serrulatus</i>			<i>Nigella sativa</i>		
			Cultivated fields 4	N12 ⁰ 29.012'	1462
			<i>Cuminum cyminum</i>	E039 ⁰ 36.839'	
Cultivated fields 3	N 13 ⁰ 39.339'	2594	<i>Allium cepa</i>		
<i>Cuminum cyminum</i>	E 039 ⁰ 08.925'		<i>Lepidium sativum</i>		
<i>Brassica nigra</i>			Cultivated fields 5	N12 ⁰ 29.025'	1463
<i>Ruta chalepensis</i>			<i>Capsicum annum</i>	E039 ⁰ 36.811'	
<i>Ocimum basilicum</i>			<i>Zingiber officinale</i>		
<i>Allium cepa</i>			<i>Ruta chalepensis</i>		

			<i>Lepidium sativum</i>		
Cultivated fields 4	N 13°39.279'	2605	<i>Brassica nigra</i>		
<i>Ruta chalepensis</i>	E 039°09.081'		<i>Carthamus tinctorius</i>		
<i>Rhamnus prinoides</i>					
			Zata (Home gardens) (continued)		
<i>Allium cepa</i>			Home garden 4	N12°30.572'	2362
<i>Barssica nigra</i>			<i>Carthamus tinctorius</i>	E039°17.466'	
<i>Thumus serrulatus</i>			<i>Ocimum basilicum</i>		
			<i>Trigonella foenum-graecum</i>		
			Home garden 5	N12°30.517'	2373
Cultivated fields 5	N 13°39.149'	2639	<i>Allium sativum</i>	E039°17.605'	
<i>Capsicum annum</i>	E 039°09.132'		<i>Allium cepa</i>		
<i>Ruta chalepensis</i>			<i>Foeniculum vulgare</i>		
<i>Rhamnus prinoides</i>			Zata (cultivated fields)		
<i>Ocimum basilicum</i>			Cultivated fields 1	N12°30.511'	2344
<i>Brassica nigra</i>			<i>Lepidium sativum</i>	E039°17.210'	
<i>Thymus serrulatus</i>			<i>Carthamus tinctorius</i>		
			<i>Allium sativum</i>		
Tumuga (Home gardens)			Cultivated fields 2	N12°30.441'	2331
Home garden 1	N12°18.903'	1461	<i>Capsicum annum</i>	E039°17.012'	
<i>Rhamnus prinoides</i>	E039°35.846'		<i>Allium sativum</i>		
<i>Nigella sativa</i>			<i>Allium cepa</i>		
<i>Allium cepa</i>			Cultivated fields 3	N12°30.335'	2332
<i>Capsicum annum</i>		<i>Ocimum basilicum</i>	E039°16.963'		
Home garden 2	N12°18.965'	1461	<i>Rosmarinus officinalis</i>		
<i>Allium cepa</i>	E039°35.837'		<i>Brassica nigra</i>		
<i>Ricinus communis</i>			<i>Foeniculum vulgare</i>		

<i>Lepidium sativum</i>			Cultivated fields 4	N12 ⁰ 30.278'	2338
<i>Zingiber officinale</i>			<i>Capsicum annum</i>	E039 ⁰ 16.913'	
Home garden 3	N12 ⁰ 18.931'	1459	<i>Carthamus tinctorius</i>		
<i>Ruta chalepensis</i>	E039 ⁰ 35.768'		<i>Lepidium sativum</i>		
<i>Ocimum basilicum</i>			Cultivated fields 5	N12 ⁰ 30.144'	2340
<i>Rhamnus prinoides</i>			<i>Lepidium sativum</i>	E039 ⁰ 16.841'	
<i>Brassica nigra</i>			<i>Allium sativum</i>		
<i>Trigonella foenum-graecum</i>			<i>Rosmarinus officinalis</i>		
Home garden 4	N12 ⁰ 18.871'	1457	<i>Brassica nigra</i>		
<i>Capsicum annum</i>	E039 ⁰ 35.727'		<i>Foeniculum vulgare</i>		
<i>Rhamnus prinoides</i>			Hashenge (Home gardens)		
<i>Ricinus communis</i>			Home garden 1	N12 ⁰ 36.316'	2482
Home garden 5	N12 ⁰ 18.652'	1450	<i>Capsicum annum</i>	E039 ⁰ 31.002'	
<i>Trigonella foenum-graecum</i>	E039 ⁰ 35.869'		<i>Ocimum basilicum</i>		
<i>Cuminum cyminum</i>			<i>Allium sativum</i>		
<i>Foeniculum vulgare</i>			<i>Mentha spicata</i>		
Tumuga (Cultivated fields)					
Cultivated field 1		1454	Home garden 2	N12 ⁰ 36.571'	2482
<i>Ruta chalepensis</i>	N12 ⁰ 18.545'		<i>Brassica nigra</i>	E039 ⁰ 30.979'	
<i>Ocimum basilicum</i>	E039 ⁰ 35.839'		<i>Allium sativum</i>		
<i>Lepidium sativum</i>			<i>Lepidium sativum</i>		
<i>Allium cepa</i>			Home garden 3	N12 ⁰ 36.576'	2460
Cultivated fields 2	N12 ⁰ 18.452'	1449	<i>Brassica nigra</i>	E039 ⁰ 30.873'	
<i>Capsicum annum</i>	E039 ⁰ 35.795'		<i>Allium cepa</i>		
<i>Ruta chalepensis</i>			<i>Ocimum basilicum</i>		

<i>Ocimum basilicum</i>			Home garden 4	N12 ⁰ 36.301'	2486
Cultivated fields 3	N12 ⁰ 18.535'	1451	<i>Trigonella foenum-graecum</i>	E039 ⁰ 31.032'	
<i>Brassica nigra</i>	E039 ⁰ 35.937'		<i>Lepidium sativum</i>		
<i>Trigonella foenum-graecum</i>			<i>Capsicum annum</i>		
<i>Ruta chalepensis</i>			Home garden 5	N12 ⁰ 36.253'	2492
<i>Ricinus communis</i>			<i>Allium cepa</i>	E039 ⁰ 30.977'	
Cultivated fields 4	N12 ⁰ 18.818'	1460	<i>Trigonella foenum-graecum</i>		
<i>Nigella sativa</i>	E039 ⁰ 35.971'		<i>Allium sativum</i>		
			Hashenge (Cultivated fields)		
<i>Lepidium sativum</i>			Cultivated fields 1	N12 ⁰ 36.403'	2474
<i>Zingiber officinale</i>			<i>Capsicum annum</i>	E039 ⁰ 30.976'	
<i>Allium cepa</i>			<i>Ruta chalepensis</i>		
<i>Jatropha curcas</i>			<i>Ocimum basilicum</i>		
Cultivated fields 5	N12 ⁰ 18.792'	1455	<i>Mentha spicata</i>		
<i>Trigonella foenum-graecum</i>	E039 ⁰ 35.786'		Cultivated fields 2	N12 ⁰ 36.498'	2485
<i>Ruta chalepensis</i>			<i>Capsicum annum</i>	E039 ⁰ 30.977'	
<i>Capsicum annum</i>			<i>Foeniculum vulgare</i>		
<i>Ricinus communis</i>			<i>Allium sativum</i>		
Zata (Home gardens)			Cultivated fields 3	N12 ⁰ 36.546'	2468
Home garden 1	N12 ⁰ 30.577'	2360	<i>Lepidium sativum</i>	E039 ⁰ 30.918'	
<i>Trigonella foenum-graecum</i>	E039 ⁰ 17.303'		<i>Allium sativum</i>		
<i>Mentha spicata</i>			<i>Ruta chalepensis</i>		
<i>Allium cepa</i>					
<i>Ocimum basilicum</i>					

			Cultivated fields 4	N12 ⁰ 36.663' E039 ⁰ 30.992'	2479
			<i>Allium cepa</i>		
Home garden 2	N12 ⁰ 30.664' E039 ⁰ 17.318'	2358	<i>Trigonella foenum-graecum</i>		
<i>Carthamus tinctorius</i>			<i>Ocimum basilicum</i>		
<i>Nigella sativa</i>			<i>Foeniculum vulgare</i>		
<i>Lepidium sativum</i>			<i>Ruta chalepensis</i>		
<i>Brassica nigra</i>			Cultivated fields 5		
Home garden 3	N12 ⁰ 30.747' E039 ⁰ 17.232'	2353	<i>Capsicum annum</i>	N12 ⁰ 36.761' E039 ⁰ 31.038'	2480
<i>Trigonella foenum-graecum</i>			<i>Lepidium sativum</i>		
<i>Mentha spicata</i>			<i>Ruta chalepensis</i>		
<i>Rosmarinus officinalis</i>			<i>Trigonella foenum-graecum</i>		
<i>Allium cepa</i>					

DECLARATION

I, the undersigned, declare that this thesis is my original work and has not been presented for a degree in any other university and that all sources of materials used for the thesis have been duly acknowledged.

Atey G/Medhin

Signature

Date

This thesis has been submitted for examination with our approval as advisors:

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