

**Study on**  
**Actual Situation of Medicinal Plants in Ethiopia**

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## Acronyms

<b>AAU</b>	<b>Addis Ababa University</b>
<b>BC</b>	<b>Before Christ</b>
<b>Ca</b>	<b>About</b>
<b>CIDA</b>	<b>Canadian International Development Agency</b>
<b>ESTC</b>	<b>Ethiopian Science and Technology Commission</b>
<b>ETB</b>	<b>Ethiopian Birr</b>
<b>IAR</b>	<b>Institute of Agricultural Research</b>
<b>IBCR</b>	<b>Institute of Biodiversity and Conservation Research</b>
<b>IFS</b>	<b>International Foundation for Science</b>
<b>IHN</b>	<b>Institute of Health and Nutrition study</b>
<b>IUCN</b>	<b>International Union for Conservation</b>
<b>NGO</b>	<b>Non-Governmental Organization</b>
<b>MOH</b>	<b>Ministry of Health</b>
<b>RPO</b>	<b>Research and Publication Office</b>
<b>SAREC</b>	<b>Swedish Agency for Research and Education</b>
<b>SWOT</b>	<b>Strength, Weakness, Opportunity and Threats</b>

## **Executive summary**

**The Objectives of the present study include** relationship between human and medicinal plants in Ethiopia in terms of these plants’:

- usage
- collection/production
- conservation and
- growth situation constraints and potential

The contents of the study include:

-- Current situation and recent trends in medicinal plants’ sector development in Ethiopia.

--Historical overview and recent trends regarding medicinal plants in Ethiopia.

--Geographical overview of growth of medicinal plants in Ethiopia

--Salient features of usage of medicinal plants in Ethiopia

--Salient features of access to medicinal plants by Ethiopian people.

--Differentiation of usage and access to medicinal plants according to various ethnic Groups

-- Introduction of some specific medicinal plants where at least 1 herb, 1 spice in 5

Plants are included in terms of:

-Conservation

-Collection/ production

-Distribution

-Usage

The cultivation and use of spices, herbs, medicinal and other essential oil bearing plants is not new to Ethiopia. It is as old as the crop themselves, and its history can be traced back to the reign of Queen Sheba (ca.992 BC). Ethiopia is the origin and/or center of diversity for many of these plant species

The various literature available show the significant role of medicinal plant in primary health care delivery in Ethiopia where 70% of human and 90% of livestock population depend on traditional medicine similar to many developing countries particularly that of Sub-Saharan African countries. The traditional health care is culturally deep rooted

with oral and written pharmacopoeias.

Ethiopian plants have shown very effective medicinal value for some ailments of human and domestic animals thus medicinal plants and knowledge of their use provide a vital contribution to human and livestock health care needs throughout the country. Such plants include *Phytolacca dodecandra* and many species of *Maytenus*. The major reasons why medicinal plants are demanded in Ethiopia are due to culturally linked traditions, the trust the communities have in the medicinal values of traditional medicine and relatively low cost in using them. This is acknowledged for example by a result of recent study that was conducted and showed that the value of both imported and domestically produced pharmaceutical products were about ETB 1.05 billion. During the same year the value of medicinal plants including traded and non traded ones was ETB 423 million making average health coverage of 42% of Ethiopian expenditure on pharmaceutical products. This is not only a significant saving in terms of foreign currency but also availability assurance for the primary health care systems in the rural community. The volume of sales of medicinal plants has increased over years and this has been taken by some as the existence of disease prevalence requiring traditional Medicare causing increased demand which led to harvesting important medicinal plants. The expected increase in the cost of commercial drugs and their occasional impotency also increase demand of medicinal plants. The proportion of consumers who rely on harvesting medicinal plant is the highest in the rural area, since collecting from natural plantation is most accessible and cost affective.

There are 6500 species of higher plants in Ethiopia making the country one of the most diverse floristic regions in the world. There are large numbers of moderate to high value medicinal plants herbs and spices existing in the wild. However, of the existing medicinal herbs and spice plants only small % are traded. Being a land of diverse climatic and edaphic potentials, several of such indigenous and exotic species and essential oil bearing plants could luxuriously grow in Ethiopia and provide remarkable benefits to the national economy. However, so far only two of the major 18 agro-ecological zones defined as hot to warm humid lowlands and Tepid to cool humid midlands carry out some research and production activities of some herbs, spices and related aromatic plants.

The research made so far on Ethiopian medicinal plants has been mostly of producing inventories and checklists, some have been touched by modern research where their principal component has been analyzed and defined.

The bulk of the plant matter used for medicinal purposes is collected from natural vegetation stocks that are shrinking with degraded environment and is faced to substantial reduction or dwindling of species of medicinal plants.

Different vegetation types that are found in the various agro ecological zones of Ethiopia accommodate various types of medicinal plants. The available reports show that the woodlands, the montane vegetation including grasslands and forests and the evergreen scrubs and rocky areas contain more medicinal plants with higher concentrations in the woodlands. These reports indicate that the microphyllous vegetation of the wood lands contain more medicinal plants species followed by the montane grassland and riverine vegetation while the Afro alpine vegetation are the least of the group.

Ethiopian traditional life is painted with the hallmark of widespread use of traditional medicinal plants with various levels of sophistication within the indigenous medicinal lore. It is blended with religious thinking and various beliefs and need further investigation. The basic categories of practitioners also are difficult to define.

Some have described the traditional medical system of Ethiopia as medico-religious System (Dawit Abebe and Ahadu Ayehu, 1993) and others as Magical religious. Such description is due to close interaction of the Christian, Islamic and indigenous religions with the traditional medical system in the country which sometimes displays features related to magic, beliefs and faith in some areas. However, the enigmatic nature of the medical system does not make such relations clear in some parts of the country.

Ethiopian peoples have their own set of written and or oral pharmacopoeias with the medicinal use of some species being restricted to each ethnic group. The cultural and indigenous knowledge of medicinal plants in Ethiopia is unevenly distributed among each community members. Peoples in different zones/location with different religious, linguistic and cultural backgrounds have their own specific knowledge about use of plants which in part has gradually entered wide circulation in the country. The knowledge on medicinal plants is largely oral, however, Ethiopia's ancient church

practices have documented some of the knowledge as inscribed in Parchments which partly characterize the traditional medical system usually described as medico religious written in Geez manuscripts of the 15th century (Gelahun Abate, 1989; Dawit Abebe and Ahadu Ayehu, 1993). Other ancient written sources include the book of remedy (*Metsehafe Fews*) of the 17th century which contains a wide range of medicinal plants prescription (Fekadu Fullas, 2001). These are the medical traditions of the followers of Coptic Christianity. Other cultural groups in the country have their own written or oral traditions that could be associated with individual clans or groups as partly stated by Amare Getahun (1976) and Abbink (1995).

1000 identified medicinal plant species are reported in the Ethiopian Flora, however, many others are not yet identified. About 300 of these species are frequently mentioned in many sources. The greater concentration of medicinal plants are found in the south and south western Ethiopian parts of the country following the concentration of biological and cultural diversity (Edwards, 2001). The various citations made from various written records of medicinal plants from central, north and northwestern part of Ethiopia are thus small fractions of medicinal plants present in Ethiopia. Very recent study on the Bale Mountains National Park in the South East Ethiopia revealed that the area, as much as it is a biodiversity hotspot, also turned out to be a medicinal plant hotspot with 337 identified medicinal species of which 24 are endemic (National Herbarium, 2004; Ermias Lulekal, 2005; Haile Yineger, 2005). The species comprised of 283 used as human medicine, 47 used as livestock medicine and 76 species used for both human and livestock by the community healers, harvesters, traders and users. This work further suggested spots that could be considered medicinal plant micro - hotspots within the Bale Mountain area. The serious work on the Ethiopian flora with seven volumes published so far is not yet complete and hence the present figures and plant lists reported can not be taken as a final.

Some medicinal plant species of Ethiopia are reported to have been threatened by the overuse and over harvesting for marketing as medicine. A good example is *Taverniera abyssinica* whose slender roots that are swathed and small coiled bundles presented for market.

Environmental degradation, agricultural expansion, loss of forests and woodlands, over-harvesting, fire, cultivation of marginal lands, overgrazing and urbanization

appear to be the major threats to the medicinal plants of Ethiopia. Endemic medicinal species restricted to Ethiopia are of primary concern to Ethiopia and to the world as well and thus need serious attention.

The distribution of knowledge and services of medicinal plants are hierarchically placed. Services are obtained from the family, the neighborhood, the village or beyond. Further more there is very little ethno botanical documentation on most medicinal species of the country. The status of phytomedicine, preparation of crude extracts and isolation of active principles is very minimal. The data base for the recorded species of medicinal plants also needs special attention.

There is research made in the higher learning institutions on several aspects of medicinal plants in Ethiopia. Most studies on medicinal plants made, however, remained more of a survey nature and the outputs were mere listing of plants used as remedies for various ailments usually with incomplete description and mainly with uncertain recipes. But yet there are useful reports that can be cited.

Medicinal plants obtained from wild habitats are found in different natural ecosystems of the forests, grasslands, woodlands, wetlands, in field margins and garden fences, as weeds and in many other microhabitats from where they are harvested when the need arises. These are free access resources to all who want to use them for the family for practicing traditional medicine or for sales. In the traditional market place in Ethiopia, medicinal plants are usually associated with spices and herbs. They have to be looked for in the areas of the market where spices and herbs are displayed on roadsides during religious ceremonies around churches and mosques. In Ethiopia, the informal trade takes the major share in rural areas except at the level of healers who commercialize just the crude materials or charge together with the treatment they provide upon their diagnosis.

Although woodlands are where most of the medicinal plants are present, its resource capacity with reference to others, need to be worked out. The key issues to be engaged in this process include:

- The requirements of the users, i.e. demand for the resource
- The size and conditions of the resource

- The part of the plant that is harvested i.e. whether the harvesting is likely to kill the plant
- The response of the species to different harvesting practices
- Production and recovery rates of the species and affected habitat
- The options that are available for development of alternative resources and
- Land and resource ownership systems.

In the absence of regulatory control, product quality is variable. Inadequate post-harvest storage and processing techniques often lead to high levels of microbial contamination and significant stock/losses. Little attention is paid to product packaging and marketing, and the most significant value-adding takes place when the remedies are prescribed by traditional healers. Consumer safety is also an issue, although largely unmonitored at present.

In the country side, people may access medicinal plants products through informal information networks in addition to market days which take place weekly or twice a week. In rural areas of Ethiopia, medicinal plants treatments could also be given free of charge but some token is believed to be in order for the medicine to take effect. In rural areas of Ethiopia self medication using indigenous medicine, is the cheapest and mostly the only form of healthcare available. Friends, relatives and neighbors provide traditional treatment free of charge or paid in more flexible arrangement such as payment in cash or kind and on a credit basis. This is specifically prevalent in rural communities. The domestic supply sources are closely associated with the biodiversity and concentration of forest areas e.g. Jimma, Bale. Traders from Dire Dawa for example travel as far as to Bale, Jimma, Gonder, Menz, Assosa etc. to buy different types of medicinal plants.

Ethiopia has policies and strategies that support the development and utilization of plant resources in a sustainable manner. The policies are reflected under various sectors including environmental protection, development of the natural resources and diversification of the domestic and export commodities. The country also has developed policy and a guide line for intellectual property rights protection of

traditional medicine. The policy encourages and promotes the appropriate use and protections of traditional medicine knowledge in Ethiopia taking in to account the need of the traditional medicinal knowledge holders and the communities who benefit from the use of the knowledge. Medicinal plants fit in the development activities that support public efforts in meeting livelihood requirements. There are few institutions concerned with the medicinal plants and assisted through government budgetary support.

The status of phytomedicine, preparation of crude extracts and isolation of active principles in Ethiopia is very minimal. The data base for the recorded species of medicinal plants also needs special attention. There are however, differences in terms of prevalence of use of species overtime. e.g. *T. abyssinica* has now declined mainly because of over-harvesting and degradation of wild bush lands in Shewa and Tigray (Mesfin Tadesse, 1991).

Except in a few cases where a few food crops with medicinal value are cultivated, there is no organized cultivation of plants species for medicinal purposes in Ethiopia. The reason for this is that the quantities of medicinal plants traded are very small, and there is no organized large scale value addition and processing. However, there is a potential in the future for increased demand for some of the species and, therefore, it is important to identify them and start the necessary research on the propagation and cultivation techniques. Such program will also provide basis for small enterprises to improve the income generating capacity of the local people.

As the treatment of specific disease involves numerous plants and different house holds use different plant mix and there are variation across households in preferences, the cultural set up promotes not only conservation but also diversification of these resources. Increasing the population and diversity of medicinal plants in home gardens and other areas outside forests is a solution for avoiding human disturbance of forests and the supply shortage that usually goes with seasonal variation.

Marshall (1998) reported that Ethiopia had no legal export and import of products for medicinal use but plants of medicinal importance are exported to Djibouti and other countries as agricultural products.

The recent World Bank supported project on medicinal plants has the following

sub-components with the participation of IBCR, AAU, IHNS, ESTC Regional government of Oromia. Their work on the World Bank supported Medicinal Plant project have yielded

- Development of Intellectual property Guidelines
- Establishment of Database of medicinal plants
- Extraction, standardization, safety, Efficacy and dosage formulation on very few species not exceeding 3 to 4.
- In situ Conservation and sustainable use of medicinal plants with field gene banks in Bale Mountains and Wondo Genet

The researches made in the higher learning institutions on several aspects of medicinal in Ethiopia include: physicochemical studies, isolation of anti-parasitic, analgesic, molluscidal, insecticidal properties of some medicinal species with some standardization and tablet formulation of plant extracts.

In addition to the above lists the Department of Drug Research at Ethiopian Health, Nutrition Research Institute gives the following research outputs (Dawit Dikasso, 2007, personal communication)

- screening in vitro, in vivo antibacterial, antifungal and antiparasitic activity of local medicinal plants
- medicinal plants for their efficacy and safety
- evaluation of traditional anti-malarial, anti-helminthic, anti-hypertensive and
- anti-diabetic medicinal plants
- dosage form development from therapeutically established herbal remedies on
- crude extracts containing bioactive compounds
- compilation of check lists of medicinal plants of Ethiopia

The overall review shows that research areas in the study of medicinal plants are very little. The answers to the following questions are still pending:

- *What are the potential forest plants that could be grown on farm to generate income?*
- *How does the export market for medicinal plant products operate?*

- *Research in filling existing gap in knowledge regarding the biology and technical options for species as well as methods of harvest, species quantities, zones, seasons, extractable level, yield etc*
- *what are the ecological factors governing natural regeneration of woody species.... availability, status of soil, seed bank, edaphic factors, forest disturbances, the level of extraction and extraction zones and seasonal variation*

*Basic research on propagation and agronomic practices are practically non-existence*

- *What are the medicinal plant species with high market demand and value?*
- *What are the cultivation technology, quality standards, cost production, income and profits of suitable varieties marketed?*

The above problems of research should focus on those medicinal plants that are widely used by the society. Some times a single species of plant may appear in many treatments and alternatively various species can be used for the same treatment as exemplified by *Hygenia abyssinica* , *Glinus lotoides* and *Embelia species*.

Plantations of medicinal plants can be made in degraded and degrading areas. There are many medicinal plants of Ethiopia that have good properties for land rehabilitation and erosion control which could be planted in different agro ecological settings. Good economic opportunities exist in both the developed and developing countries as market are showing increasing growth, mostly as a result of increasing demand. Ethiopia has the potential to become an important source country, given the diversity of plants and the rich traditional knowledge regarding their use as medicine.

The issue of medicinal plant conservation in Ethiopia today calls for aggressive studies and documentation before the accelerated ecological and cultural transformation distort the physical entities and the associated knowledge base. Sometimes the same plants are given different names because of differing expressions of the same species at different areas by different people and due to different languages, dialects and cognates.

Innovative options like eco agricultural, maintenance of traditional farming systems and linking conservation with utilization by community need to be carefully developed

and implemented.

SWOT analysis show that there are many strong points and opportunities to make the sector more productive and improve the livelihood of poor farmers and people in general.

The sector also has weakness and threats that need to be checked. *The strength of the sector include: rich biological diversity of medicinal plants; existence of valuable indigenous knowledge with established tradition and healers. The weakness of the sector include: secrecy of indigenous medicinal plants knowledge; limited conservation activities and little scientific studies on medicinal plants; poor market information system and market infrastructures; lack of public-private sector investment. The country has no well developed technology infrastructure capacity to engage in product development. Nor it has efficient new production systems and active trade. Product development has been minimal. Supply chains are poorly developed with lack of effective trade network.*

The strength of the sector overweighs its weakness with the following *opportunities: enhancement of economic benefits with employment opportunities; preservation of cultural and natural assets with the improvements of health care systems.*

**The following strategies for Improving the Role of Traditional Medicine and Practitioners can be followed:**

- Identification and registration of the traditional medicine practitioners;
- Assess the need for training of the selected and registered traditional medicine practitioners and designing appropriate skill upgrading training programs;
- Encouraging the formation of a strong National Association for traditional medicine practitioners,
- Introduction of the role and importance of traditional medicine to the public

Those plants that are harvested for their roots, tubers and bulbs need special attention of conservation. Such attentions should be extended to the woodlands of Ethiopia which are the sources of most of the medicinal plants followed by the Montane grassland/dry Montane forest complex. To salvage indigenous knowledge from disappearing, the young generation has a very crucial role to play. Accordingly, it is highly recommended

to include in the school curriculum aspects of traditional medicine and medicinal plants. Based on the various surveys, following the objectives of the study several conclusions and recommendations are given. Also emphasis are given that research on medicinal plants should be in line with Primary Health Care system of the country and should address the disease prevalence in the country like *respiratory infections, diarrhoeal, malaria, tuberculosis, sexually transmitted diseases, trypanosomiasis, leishmaniasis, schistosomiasis and other parasitic diseases*. Attempt towards an appropriate utilization of traditional medicinal plants should include the followings:

- 1) An inventory of local plants which are claimed to have medicinal value. Particulars of the flora, as to common names, taxonomic names, patterns of their genetic distribution, habitat, parts of plant used, etc., would have to be carefully recorded.
- 2) Comprehensive documentation of traditional written and oral literature pertaining to medicinal plants, herbal drugs, disease entity, drug formulation and dosage regimes need to be practiced. This should include the whole range of exorcism, rituals, exaltation techniques, amulets, religious practices, cults, etc. so that factors that may contribute to the psycho-social condition of the patient will not be left out.
- 3) Compilation of equivalent medical terminology for the nebulous vernacular descriptions of disease. This would be necessary for experimental and clinical validation of traditional therapeutic claims.
- 4) Development of selected herbal drugs on the basis of the priority needs of the country with the help of pharmaceutical technology. Such attempts at development should incorporate the following:
  - Phyto-medicinal screening in order to separate, identify and characterize chemical ingredients that are responsible for the therapeutic effect.
  - Pharmacological and toxicological studies for purposes of assessing therapeutic effect and possible toxicities.
  - Formulations and standardization of crude extracts of herbal drugs for application in primary health care, subject to controlled clinical trial.
  - Development of appropriate dosage forms from pure crystalline compounds.

- Preparation for formulation for pilot plant and scaled up industrial production of crude extracts and purified compounds
  - Establishment of drug gardens for purposes of botanical studies (cultivation requirements), chemical investigation (variation in drug content) and teaching (for student and general public).
- 5) Identification, cultivation and propagation of medicinal plants that can be exported in Crude- form and/or after processing
  - 6) Identification of sustainable plant part harvesting option,
  - 7) Creation of an institutional and systematic approach that would facilitate applications
  - 8) On pharmaceutical technology towards an appropriate utilization of traditional herbal drugs.

As there is little data available for any of medicinal plants for large or small scale farming. The following need to be worked out:

- Types of soils preferred by each species
- Soil treatment and fertilizers requirements for each species
- Liming of soils for each if required
- Appropriate organic fertilizer for each species
- Types of pests and diseases on each species and their mode of control

Competition in the international trade for Ethiopia's major export products, such as coffee, is building fast and there is no absolute certainty to maintain current export earnings indefinitely. Such unstable situations can only be improved by a rational and co-ordinated policy of research and development at a national level towards identifying other additional candidate commodities. The position and contribution by the medicinal, spice and herb species is obvious.

Nowadays, individual spice farmers are flourishing at different corners of the country. Ginger and turmeric are becoming the main cash crops, next to coffee, for farmers in the South Western parts of the country. Besides, essential oils and oleoresin processing firms are expanding and hence increasing their production and export volumes. In addition to the widely recognized red pepper, spice crops such as fenugreek, coriander,

black and white cumin, are becoming important commodities, calling for immediate attention.

The cultivation and mode of propagation of root and tuber crops, vegetables, industrial crop plants, spices, herbs that are associated with a healing property, food and water purifications are provided in the present document with emphasis on seeds, tuber stem cuttings mode of propagation. As indicated in the body of this document there is little data available for any of medicinal plants for large and small scale farming in terms of types of soils preferred by each species, fertilizer requirements needed prevailing pests and diseases and packages of agronomic practices required. It is of importance to work out the micro propagation techniques to allow the propagation of large number of new plantlets in a relatively short space of time. Other challenges in sourcing seeds, seed germination, storing seed, seed cleaning, media preparation and seed pretreatment have to be developed for at least those species that are highly marketed and of medicinal values for various common ailments.

The diverse agro- ecologies available in Ethiopia allows production of many spices, herbs and medicinal plants. A large number of indigenous spices like korarima and long pepper are under better attention at present. Very useful exotic spices such as black pepper, cardamom, ginger, turmeric, cinnamon, are adapted to the hot humid lowland of Ethiopia and have been evaluated for yield and quality together with indigenous ones. Different agronomic/cultural practices and appropriate processing and drying procedures that well contribute to the various measures of quality have been developed through research. Since most of these spices are shade lovers, an appropriate level of shade needed is at hand and can be considered also as a good chance of promoting conservation of several forest species including the forest germ- plasm of *Cofea arabica*.

## **1. Introduction**

The medicinal plant of Ethiopia and the developing countries play major supplementary roles to the limited modern health care available. The development of useful and widely used drugs like Digoxin and Digitoxin, from *Digitalis* leaves; quinine

from the cinchona bark; reserpine from *Rauwolfia serpentine*; morphine from *Papaver somniferum*; cocaine from *Erythroxylon coca* and the anti cancer *Vincristine* and *Viblastine* from *Cartharothus troseus* of Madagascar and again anti-cancer compound, bruceatin, from the Ethiopian plant, *Brucea antidysenterica*, just to name a few, are examples of the contributions of traditional pharmacopoeia (Desta Belachew, 1984)

The various literature available show the significant role of medicinal plant in primary health care delivery in Ethiopia where 70% of human and 90% of livestock population depend on traditional medicine again similar to many developing countries particularly that of Sub-Saharan African countries. Those plants are part of the economic commodity for some members of the society which make their livelihood on their collection, trade and medicinal practices by practitioners or healers. It thus has a substantial potential to make contributions to the economic growth and alleviation of poverty in the country. Its proper management protect environment and conserve biodiversity. The traditional health care is deep rooted with oral and written pharmacopoeias. Ethiopian plants have shown very effective contributions for some ailments of human and domestic animals. Such plants include *Phytolacca dodencadra* (Aklilu Lemma, 1965), Many species of *Maytenus* studied by National Cancer Institute, USA see Kupchan et al. 1972 and many species that show antimalarials (see Nkunya, M. H. H., 1992).

The current demands for herbal remedies in both developed and developing countries is increasing. In developed countries this may be partly due to the dissatisfaction with conventional medicines while with the developing countries this is due to lack of medical doctors, shortage of pharmaceutical products and their unaffordable prices. In addition, the use of modern drugs to treat AIDS, cancers, and chronic complaints such as rheumatism, arthritis and asthma have been realized. What ever the reasons, it can not be denied that herbal remedies are currently enjoying widespread popularity throughout the world.

Medicinal plants and knowledge of their use provide a vital contribution to human and livestock health care needs throughout Ethiopia. The research made so far on Ethiopian medicinal plants has been mostly of producing inventories and checklists, only very few have been touched by modern research where their principal component has been analyzed and defined.

The bulk of the plant matter used for medicinal purposes is collected from natural vegetation stocks that are shrinking with degraded environment and to substantial reduction or dwindling of species of medicinal plants. According to Ensermu Kelbessa et al. (1992) and Edwards (2001), habitat and species are being lost rapidly as a result of the combined effects of environmental degradation, agricultural expansion, deforestation and over harvesting of species and this is further enhanced by human and livestock population increase thus hastening the overall rural livelihood impoverishment and loss of the biological diversity and indigenous knowledge which is also of global concern since some of this are endemic to Ethiopia. A full scale plan to conserve, develop and effectively utilize this resource needs investment commitments by government agencies, the private sector, and various global foreign aids for development. However, before such investments and support are realized, a clear indication of the resource condition and its economic values must be worked out. This needs a critical overview of medicinal plants in Ethiopia, their demands, trade, and economic benefits. Such an overview has to come up with a formulation of the strength, weakness and opportunities in the medicinal plant sector to forward conclusions and recommendation.

### **The Objectives of the present study include**

1. relationship between human and medicinal plants in terms of their
  - Usage
  - Collection/production
  - Conservation and
  - Growth situations
2. constraints and potential of medicinal plants

## **2. Definition of "medicinal plants" in the project being studied**

"The medicinal plants in this project study cover the useful plants for primary health care and as remedy for diseases and injury, and plants used traditionally for foods and drinks and which are believed that they are good for health; the medicinal plants include foods, drinks, herbs and spices".

### **3. Contents of the study**

The main content of the study is to collect data regarding actual situation of medicinal plants including herbs and spices in Ethiopia. The following points are considered:

- 1) Current situation and recent trends
  - Historical overview and recent trends regarding relationship between human and Medicinal plants in Ethiopia
- 2) Geographical overview of growth of medicinal plants in Ethiopia
- 3) Salient features of usage of medicinal plants in the whole country of Ethiopia
- 4) Salient features of access to medicinal plants by people in the whole country of Ethiopia
- 5) Differentiation of usage of and access to medicinal plants according to the ethnic groups
- 6) Introduction of some specific medicinal plants by including at least 1 herb, 1 spice in the
  - 5 Plants selected in terms of:
    - Conservation
    - Collection/ production
    - Distribution
    - Usage
- 7) Analysis of collected data and introduced plants

In order to achieve the objectives set in the study, the followings were performed:

- Review studies conducted in Ethiopia on medicinal plants
- Identify the medicinal system and medicinal plant resource in Ethiopia, source of supply and their utilization
- Study the current government policy on medicinal plants and other related sectors

### **4. Overview of medicinal plants situation in Ethiopia**

Ethiopia is believed to be home for about 6,500 species of higher plants with approximately 12% endemism, and hence one of the six plant biodiversity rich countries of Africa (UNEP, 1995). The diversity is also considerable in the lower plants but exact estimate of these have to be made. The genetic diversity contained in the various biotic make up is also high thus making the country a critical diversity hot spot for plants.

As one of the 12<sup>th</sup> Vavilovian centers of origin/ diversity for domesticated crops and their wild relatives, it is home of many endemic crops and genetic stocks (Vavilov, 1951; Harlan, 1969; Endashaw Bekele, 1978).

Ethiopia has a significant portion of two of the world's 25 biodiversity rich areas hot spot i.e. the eastern Afromontane Biodiversity Hotspot and the Horn of Africa-Biodiversity Hot Spot (Conservation International at [www.biodiversityhotspots.org](http://www.biodiversityhotspots.org)). These hotspots house a lot of the useful wild biodiversity, particularly that of medicinal plants. The biodiversity richness of Ethiopia was known since 5000 years ago when ancient Egyptians Greeks and Romans used it as a source of unique commodities like Frankincense, Myrrh and other plant products, which are also used for medicine preparation (Thulin, 2004).

French, British and Italian travelers, naturalists, pharmacogonists and plant collectors who visited Ethiopia between about 1830 and 1930 gave lists of plants used medicinally and their conception by the local traditional medicine men (Griaule, 1930). The most significant reports after the year 1930 on herbal medicine in Ethiopia are those of Lemordant (1960), Strelyn (1965, 1968, and 1973), Schoental and Coady (1968), Schoental (1972), Kloos (1976, 1978), Mercier (1979), Gelahun et al. (1976), Gebreegiabher et al.(1979), Mesfin Taddesse and Sebsebe Demissew (1992). Most Ethiopian traditional medicinal knowledge is kept in strict secrecy; however, it is dynamic in that the practitioners make every effort to widen their scope by reciprocal exchange of limited information with each other or through reading the traditional pharmacopeias (Dawit Abebe, 1986). Dawit Abebe (1986) gives three treatment features of Ethiopian traditional medicines i.e. curative, prophylactic and preventive. Sometimes, the treatment could have a curative as well as a prophylactic effect and it is occasionally claimed that the prophylaxis could even be genetically fixed and can

protect the offspring. Preventive remedies are usually prepared as ornamental, to be born by the patients against evil spirits or psychosomatic disorders. Other therapies of preventive nature are employed against snake bites, intestinal worms, and miscarriages. Regulatory drugs are also commonly used to correct the time and the amount of flow of the menstruation cycle of women. Rejuvenative and restorative remedies are also employed to counter the effect of aging, and to overcome impotence, malnutrition, infertility etc. Traditional medicine is an integral part of the local culture and is a major public health system; what we call modern medicine is an offshoot of traditional medicine.

## **5. Medicinal plant diversity and distribution in Ethiopia**

Different vegetation types that are found in the various agro ecological zones of Ethiopia accommodate various types of medicinal plants. Edwards (2001) reported that the woodlands, Montane vegetation including grasslands and forests and the evergreen scrubs and rocky areas contain more medicinal plants with higher concentrations in the woodlands. She observed that the microphyllous vegetation of the wood lands listed more medicinal plants species followed by the Montane-grassland and riverine vegetation while the afro alpine vegetation ranked last.

The number of different languages spoken in Ethiopia approaches 90 (Maffi, 1999) and each corresponds to its unique socio cultural population thus amounting to the high human cultural diversity. Each of these cultural domains has its own set of written and/or oral pharmacopoeias with the medicinal use of some species being restricted to that given culture.

1000 identified medicinal plant species are reported in the Ethiopian Flora, however, many others are not yet identified. About 300 of these species are frequently mentioned in many sources. Jansen (1981) asserts that Ethiopia has rich medicinal plant lore and points out that almost all plants of the Ethiopian flora are used somewhere somehow medicinally. Other workers on the other hand estimated about 60% of the flora to be medicinal, and most sources give about 10% of the vascular flora to be medicinal. The list cover plants that are widely used by the local communities in lowlands and

highlands for treating human ailments and some of them for livestock ailments as well as for prevention of pests and vectors.

Globally the estimate of medicinal plant species range from 35, 000 - 50, 000 species and out of this about 4000 - 6000 species have entered the world market of medicinal plants (Farnsworth and Soejarto, 1991), however, only about one hundred species having been used as a source of modern drugs. The greater concentration of medicinal plants are found in the south and south western Ethiopian parts of the country following the concentration of biological and cultural diversity (Edwards, 2001). The various citations made from various written records of medicinal plants from central, north and northwestern part of Ethiopia are thus small fractions of medicinal plants present in Ethiopia. Study on the Bale Mountains National Park in the South East Ethiopia revealed that the area, as much as it is a biodiversity hotspot, also turned out to be a medicinal plant hotspot with 337 identified medicinal species of which 24 are endemic (National Herbarium, 2004; Ermias Lulekal, 2005; Haile Yineger, 2005). The species comprised of 283 used as human medicine, 47 used as livestock medicine and 76 species used for both human and livestock by the community healers, harvesters, traders and users. This work further suggested spots that could be considered medicinal plant micro - hotspots within the Bale Mountain area.

Several studies albeit un synchronically, are reporting the rich medicinal flora and the knowledge around it (Zemedet Asfaw, 1999; Mirutse Giday et al., 2003; Kebu Balemie et al., 2004; Debela Hunde et al., 2005). Abiyot Berhanu et al. (2006) in their ethno botanical studies reported 8 insecticides and 11 species of plants used as anti-malarial agents in one of the districts in West Gojam, Ethiopia. These species of plants are among the widely used plants for medicinal purposes. Since malaria is a serious disease in Ethiopia and many developing countries, the list of traditionally used plants to control it must be backed by phytochemical studies to develop an appropriate phytomedicine. Other studies reported include ethnoveterinary medicine of Welenchi area presented by Debela Hunde, Zemedet Asfaw and Ensermu Kelbessa (2004). The serious work on the Ethiopian flora with seven volumes published so far is not yet complete and hence the present figures and plant lists reported can not be taken as a complete census.

In his Doctoral Thesis entitled “Integrating Indigenous and cosmopolitan medicine in

Ethiopia”, the late Dr. Mekonnen Bishaw (1988) gives the summary of his work that included the followings:

the feeling of large majority of indigenous healers and modern health practitioners where both feel the integration between indigenous medicines with that of other health care setting would be beneficial; Mekonnen Bishaw also considers quite rightly Ethiopian indigenous medicine as part of the cultural ethos of its ethnic groups; the need for a review of government policies and organizing indigenous healers, during the period of his study and at present some of the policy of the government he had suggested is realized; He also recommends the offering of short courses in medical anthropology and sociology in the various training programs

## **6. The traditional medical system and medicinal plant resources in Ethiopia**

Environmental degradation, agricultural expansion, loss of forests and woodlands, over-harvesting, fire, cultivation of marginal lands, overgrazing and urbanization appear to be the major threats to the medicinal plants of Ethiopia. Such a threat poses a significant threat to the future wellbeing of the human and animal populations that have for generations, relied on these resources to combat various ailments. Changing of cultures, habits and lifestyles further aggravate the situation.

Some medicinal plant species of Ethiopia are reported to have been threatened by the overuse over harvesting for marketing as medicine. A good example is *Taverniera abyssinica* whose slender roots are swathed and small coiled bundles presented for market. *T. abssynica* is a popular traditional medicine for what is known as sudden disease. The species is labeled as critically endangered in the Red List of Endemic Trees and Shrubs of Ethiopia (Vivero et al., 2003). It has been reported that Ethiopia has 40 species of Aloe where the sap of some species is used for medicinal, food and cosmetic application and is widely used internationally. Of these 20 species are endemic and 18 are threatened. The 1997 **IUCN Red List** gives threatened Plants by International trade in Kenya through smuggling and this might soon pose a threat to Ethiopia if appropriate control methods and propagation are not timely put in place. *Prunus africana* is another medicinal plant threatened like the *T. abyssinica*.

Endemic medicinal species restricted to Ethiopia are of primary concern to Ethiopia and to the world as well and thus need serious attention. This can be realized for example through various import and export of medicinal plants for various drugs production, egs in 1980 alone the European Economic Community and the United States respectively imported over 80,000 and 34,000 metric tons of plants for pharmaceutical production at a cost of 180 and 76 million U.S. dollars respectively. This partial market involving 400 different medicinal plants totaled 258 million and was mostly supplied by China and India.

Many species of Ethiopian medicinal plants have a long history of use as remedies. The traditional medicinal systems in different parts of the world have some distinctive features. Chinese traditional herbal medicine, the Indian Ayurvedic medicine, the Japanese traditional medicine system and the African system are recognized among others. The Ethiopian traditional medical system is mainly a subcategory of the African traditional medical system with some influence from Egypt and Greece and has its own characteristic features. Ethiopian traditional life is painted with the hallmark of widespread use of traditional medicinal plants with various levels of sophistication within the indigenous medicinal lore. It is blended with religious thinking and various beliefs and need further investigation. The basic categories of practitioners also are difficult to define.

The traditional health practitioners are generally categorized into:

- Herbalists
- Bone setters
- Traditional birth attendants
- Spiritual healers
- Diviners and magicians

Each of these categories is with mixed responsibilities and identities at times. Herbalists are considered to be the biggest group that uses medicinal plants. Practitioners use in one way or the other plants and plant products in their medical practices.

Some have described the traditional medical system of Ethiopia as medico-religious

System (Dawit Abebe and Ahadu Ayehu, 1993) and others as Magical religious. Such description is due to close interaction of the Christian, Islamic and indigenous religions with the traditional medical system in the country which sometimes displays features related to magic, beliefs and faith in some areas. However, the enigmatic nature of the medical system does not make such relations clear in some parts of the country.

Most of the written records on medicinal plant lack the coverage of oral tradition. The traditional healing system are well defined in each community with a given formal way of passing on knowledge which can be exemplified by the tradition of Borana Oromo's given below: According to Brehony (1998) there are two categories of healers in Borana namely Cirressa and Ayana. Cirressa or traditional healers have a knowledge formally passed on and different Cirressa have different specializations where Cirressa goorsa specialize on medicinal plant. Here it is believed that all healers are descended from two clan namely Ali Rees family of Karayoo clan and Oborsa family of Dambitoo clan. These families believe that they received their knowledge from God and passed it on to generations. The family wait for their sons to pick medicinal plants themselves before any one tells them. Once they are seen picking or cutting a medicinal plant the family realize that their son is interested. Their after their sons have to discover something new. He has to pick a new plant which the father did not before. If he does so the father knows that it is worth his while passing on knowledge. The healer begins to teach his/her pupil about the various plants when the pupil are at a young age. Once the pupil has picked up the knowledge the healer gives an oral examination to the pupil. The healer gives medicine to the pupil to make him/her sick. The healer then asks the pupil to make him better. If the pupil succeeds, the healer then formally hands over knowledge with its appropriate ceremony. It is generally believed that if knowledge is not passed on formally the medicinal plant does not work and as patients are the best witness, communities distinguish true healers. According to Boran custom a healer belongs to the community and is subjected to a serious punishment if any mal practice is noted.

## **7. Current government policy on medicinal plants development goals**

Ethiopia has policies and strategies that support the development and utilization of plant resources in a sustainable manner. The policies are reflected under various

sectors including environmental protection, development of the natural resources and diversification of the domestic and export commodities. Medicinal plants fit in the development activities that support public efforts in meeting livelihood requirements. There are few institutions concerned with the medicinal plants and assisted through government budgetary support. The Ethiopian Health and Nutrition Institute receives annual budget of about ETB 1.1 million while a Department at IBC concerned with medicinal plant conservation gets ETB 100, 000 per annum. The recent ongoing support made through the project funded by the World Bank namely the conservation and sustainable use of medicinal plants project has an annual budget of ETB 5.9 million per year during the project life. Such a support indicates the importance Ethiopia has given to the sector. The health sector strategy of Ethiopia declares that structural, functional traditional medicine into the official health care system is advantageous for improving the health coverage in the country (Ministry of Health, 1995). However suitable institutional mechanisms and detailed implementation strategies and action plans has to be put in place.

The Ethiopian government through IBC promoted the sustainable use; conservation and management of medicinal plants with the support of World Bank. This particular project aimed at coming up with three major human diseases (tapeworm infection, *broncho pneumonia*, and hypertension) and three livestock diseases (tapeworm infection, mastitis, and dermatophilosis) remedies.

The World Bank supported project on medicinal plants has the following sub-components with the participation of IBCR, AAU, IHNS, ESTC Regional government of Oromia.

Their work on the above World Bank supported Medicinal Plant project have yielded

- 1) Institutional strengthening, human resource development and project monitoring and evaluation
- 2) Development of Intellectual property Guidelines
- 3) Research on propagation and cultivation methods of very few selected indigenous medicinal plants for Human and Livestock
- 4) Establishment of Database on medicinal plants

- 5) Extraction, standardization, safety, Efficacy and dosage formulation of one or two species
- 6) In situ Conservation and sustainable use of medicinal plants in Bale Mountains
- 7) Establishment of medicinal plant field gene bank at Wondo Genet

There are several researches made in the higher learning institutions on several aspects of medicinal in Ethiopia.

**Table 1** Titles of some projects on Ethiopian medicinal plants extracted from "Information on 20 years of research on medicinal plants at AAU by Endashaw Bekele", RPO research and Publication Office

No.	Project title	Funded by	Faculty
1	Synthetic approaches of Kosotoxin from traditional Koso drug consumed by Ethiopians	AAU	Science
2	Phytochemical studies of Senna species of Ethiopia	AAU	Science
3	Isolation of antiparasitic and analgesic properties from <i>Teclea nobilis</i> and <i>Taverniera abyssinica</i> (dingetega) endemic to Ethiopia	AAU	Ethiopia
4	Investigation of <i>Glinus lotoides</i> , mettere on <i>Taenia saginata</i> , tapeworm	AAU	Science
5	Natural product chemistry Program , 1981- 2004	SAREC	Science
6	Documentation of aromatic plants in Ethiopia	IFS	Science
7	Prescreening of traditionally used plants against <i>Mycobacterium tuberculosis</i>	ESTC	
8	Screening traditionally used antifungal plants for their efficacy and safety	ESTC	
9	Efficacy and safety tests of traditionally used antifertility agents	Traditional medicine	
10	Effects of <i>Catha edulis</i> , chat extracts at the neurotesnion	AAU	
11	Studies on some plants traditionally used to treat hypertension	ESTC	
12	Kosso toxicity in mice	RPO	
13	The alkaloid content of gibto seed, <i>Lupins termis</i> and its diabetic effect	RPO	
14	Toxicity of Kosso, <i>Hagenia abyssinica</i> , and its antispasmodic effect	RPO	

No.	Project title	Funded by	Faculty
15	Utilization of traditional treatment among Ethiopian diabetic	RPO	
16	Survey of toxic plants of veterinary importance in the Ethiopian flora		
17	Studies on the molluscidal and insecticidal properties of endod, <i>phtolacca doadecandera</i>	RPO	
18	Studies of medicinal plants and products in Ethiopian market	RPO	
19	Medicinal plants in Shinesha and Pharmaceutical properties of extracts from <i>Lathyrus sativus</i>	RPO	
20	Comparative study of antimicrobial activity of different gum resins	RPO	
21	The study of physical properties of feto mucilage	RPO	
22	Alkaloids of crinum Moonei and <i>Stepania abyssinicum</i> leaves	RPO	
23	Preliminary chemical screening of a few indigenous medicines and antibacterial testing of <i>phyllanthus guineensis</i>	RPO	
24	Collection of medicinally useful crude drugs for pharmacy laboratory classes	RPO	
25	The behavioral toxicity of chat use, its influence on learning process and clinical chemistry in mice	ESTC	
26	The medicinal use of <i>Moringa stenopatala</i>	IFS	
27	Effects of Neem seed and extraction on the maize stalk borer and its potentials in pest management	AAU	
28	Effects of kchat administration on <i>Perinatal asphxia</i> combined effect of kchat and <i>Parinatal asphyxia</i> on the learning	AAU	
29	Phytochemical, antibacterial and toxicological investigation of some herbs traditionally employed in cleaning utensils used in milk and milk product preparations	AAU + ESTC	
30	Formulation of <i>Glinus lotoides</i> into "dosage forms"	AAU + ESTC	
31	Preliminary phytochemical and pharmacological investigation of <i>Plantago lanceolata</i> traditionally anti ulcer herbal medicine	AAU	
32	Preliminary phytopharmacological and toxicological investigation of traditionally claimed anti tumor herbal medicine	AAU	
33	Screening of some selected medicinal plants traditionally used in Ethiopia for the treatment of wounds and other dermatological disorders	AAU	
34	Standardization and tablet formulation of the extract of the seeds of <i>Glinus lotoides</i>	AAU	

No.	Project title	Funded by	Faculty
35	Super critical fluid carbon dioxide extraction, isolation of bioactive constituents and standardization of extract willow bark <i>Aalix spp.</i>	AAU	
36	Effects of Endod on ticks	AAU	
37	Control of <i>Schistosomiasis</i> by endod new immunological tool		
38	The use of medical plants in traditional health practice Ethiopia (visiting Researcher)	OXFORD Univ. April 2000	
39	Traditional medicine in Gondar (visiting Researcher)	Germany	

In addition to the above lists the Department of Drug Research at Ethiopian Health, Nutrition Research Institute gives the following research out puts in addition to the various publications made (Dawit Dikasso, 2007, personal communication)

- screening in vitro, in vivo antibacterial, antifungal and antiparasitic activity of local medicinal plants
- medicinal plants for their efficacy and safety
- evaluation of traditional anti-malarial, anti-helminthic, anti-hypertensive and
- anti-diabetic medicinal plants
- dosage form development from therapeutically established herbal remedies on
- crude extracts containing bioactive compounds
- compilation of check lists of medicinal plants of Ethiopia

Mirutse Giday (2007) studied the medicinal plants of Sheko, Bench and Meint ethnic groups of the South West Ethiopia. His study revealed a total of 124 medicinal plants belonging to 51 Families (the Family Asteraceae, Lamiaceae are more represented) and 104 Genera of which 71 species were reported by Sheko people, 51 by Meint and 35 by Bench people. Of the total 65% were herbs, 15 % were shrubs, 12% were trees and 9% were climbers (herbaceous or woody). The great majority of the recorded medicinal plants in each ethnic group were used to treat human ailments. Relatively higher proportions of Sheko and Meint medicinal plants were used to treat skin-related disorders and gastro- intestinal complaints. Bigger numbers of Bench medicinal plants were used for treatments of skin related ailments, eye-diseases and meningitis. For

Sheko and Bench people, leaf was the most frequently sought plant part for the preparation of remedies followed by the root. Among Meints root was the most frequently sought plant part used followed by leaves. A newly harvested (fresh plant) parts are mainly used accounting 86%, 85% and 57% of the Bench, Shekos and Meint group respectively.

The overall review shows that research areas in the study of medicinal plants are very little. The answers to the following questions are still meager:

What are the potential forest plants that could be grown on farm to generate income?

How does the export market for medicinal plant products operate?

Research in filling existing gap in knowledge regarding the biology and technical options for species as well as methods of harvest, species quantities, zones, seasons, extractable level, yield etc.

what are the ecological factors governing natural regeneration of woody species.... availability, status of soil, seed bank, edaphic factors, forest disturbances, the level of extraction and extraction zones and seasonal variation

Basic research on propagation and agronomic practices are practically non-existence

What are the medicinal plant species with high market demand and value?

What are the cultivation technology, quality standards, cost production, income and profits of suitable varieties marketed?

The above problems of research should focus on those medicinal plants that are widely used by the society. As some times a single species of plant may appear in many treatments and alternatively various species can be used for the same treatment as exemplified by *Hygenia abyssinica*, *Glinus lotoides* and *Embelia species*. The research priority needs to be worked out.

## **8. Accounts of traditional medicinal plant species of Ethiopia and its current Contexts**

Peoples in different zones/location with different religious, linguistic and cultural backgrounds have their own specific knowledge about use of plants which in part has

gradually entered wide circulation in the country. The knowledge on medicinal plants is largely oral, however, Ethiopia's ancient church practices have documented some of the knowledge as inscribed in Parchments which characterize the traditional medical system usually described as medico religious written in Geez manuscripts of the 15th century (Gelahun Abate, 1989; Dawit Abebe and Ahadu Ayehu, 1993). Other ancient written sources include the book of remedy (Metsehafe Fews) of the 17th century which contains a wide range of medicinal plants prescription (Fekadu Fullas, 2001). These are the medical traditions of the followers of Coptic Christianity. Other cultures in the country have their own written or oral traditions that could be associated with individuals or groups (Amare Getahun, 1976; Abbink, 1995).

Pankurst (1998) gives the four earliest Ethiopian indigenous medical texts known and available for study. They comprise

- 1) Three folios in Amharic with uncertain whereabouts dating from the time of the Gondarine Emperor Eyasu that reined from 1692 to 1706 and was produced in the Monastic area of Waldebba, in the North West of the country.
- 2) Fifteen folios in Geez that dated from the second half of the 18th century, this work, which is also of unknown provenance is currently based in the British Library in London.
- 3) Seventy five folios in Amharic dating in the 19th century with unknown provenance is also in the British Library in London.
- 4) A much more substantial work of no less than 420 folios in Amharic and belongs to King Wossen Seged of Shoa who reined from 1808 to 1813 is also housed in the British Library in London.

Dr. Haddis Gabra Maskel, in London, worked on the British Library collection of Ethiopian Medical Texts and has published his *Mashafa Madhanit* //London, 1980 EC. Fassil Kibebew (1998) lists some documents of various kingdoms in Ethiopia with the number of medicinal plants used and diseases treated.

The efficacy of some species like *Hagenia abyssinica* and *Glinus lotoides* in the treatment of tapeworm, and *Phytolaca dodecondra* as a mollucides in the control of Schistosomiasis has been verified. *Prunus africana* is a tree whose bark is known to be

the source of potent medicine internationally.

**Table 2** The number of human diseases and medicinal plants registered for various Ethiopian kingdoms

<b>Kingdoms</b>	<b>No. of human diseases treated</b>	<b>No. of medicinal plants used</b>
Axumite	1500	800
Zagwe	280	2800
Gondar	305	900
Kaffa	200	596
Libnedengel (Gondar)	800	500
King Hailemeleket of Shoa	500	700

Indigenous knowledge of medicinal plants in Ethiopia is unevenly distributed among community members (Zemedu Asfaw, 2001). The distribution of knowledge and services are hierarchically placed. Services are obtained from the family, the neighborhood, the village or beyond. A common saying related to the knowledge goes as follows "leave alone human beings, even a goat knows which twig to nibble when bitten by snake" (Hareya Fassil, 2005).

Under my (Endashaw Bekele) own overall coordination Zemedu Asfaw (1999) studied the Ethno botany of Nations, Nationalities and Peoples in Gambella, Benshangul/Gumuz and Southern regions of Ethiopia. The study targeted Kefficho, Wolaita, Dawro, Gamo, Dizi and Hammar people in Southern Ethiopia, the Anywa, Nuer, Komo Majanger and Opuo people in Gambela and the Mao, Berta, Gumuz, Shinasha, and Komo people in Benshangul and Gumuz region. Plants used by these people under different categories of food, medicine, craft implements, construction were documented. The number of medicinal plants for each group is presented below

Anywa	28
Berta	25
Dawro	18
Gamo	13
Gumuz	12

Kefficho	20
Komo	9
Majanger	5
Nuer	21
Shinasha	18
Wolaita	13
Sheko	71
Bench	35
Meinit	65

The above lists were made within a short research period and can be further enriched. Further more there is very little ethno botanical documentation on most medicinal species of the country. The status of phytomedicine, preparation of crude extracts and isolation of active principles is very minimal. The data base for the recorded species of medicinal plants also needs special attention. There are, however, differences in terms of prevalence of use of species overtime. e.g. *T. abyssinica* has now declined mainly because of over-harvesting and degradation of wild bush lands in Shewa and Tigray (Mesfin Tadesse, 1991).

In Ethiopia some ethnomedicininal studies were conducted in the recent past in different parts of the country as seen in Amare Getahun (1976), Wilson and Gebremariam Wolde (1979), Jansen (1981), Dawit Abebe (1986), Mesfin Tadesse (1986), Dawit Abebe and Estifanos Hagos (1991), Mesfin Tadesse and Sebsebe Demissew (1992), Dawit Abebe and Ahadu Ayehu, (1993), Abbink (1995), Miruste Giday (1999), Debela Hunde (2001), Zemedede Asfaw (2001), Fekadu Fullas (2001) and Kebu Balemi et al. (2004). A few of these papers Wilson and Gebremariam Wolde (1979), Abbink (1995), Miruste Giday (1999), Debela Hunde (2001), Kebu Balemi et al. (2004) and many others dealt with specific socio cultural groups in distinct areas. But considering the countries varied flora and socio cultural diversity, these studies are of very limited coverage as ethnomedicinal healing systems vary across culture.

In Ethiopia Ethno veterinary medicine is highly practiced by various local groups. The coverage is quite high and the National Health Research document emphasized the importance of traditional practices and recommended research undertakings. In

addition to veterinary medicine in the universities and agricultural research institutes some of the ongoing research activities include:

- Study of ethno veterinary medicine in East Shoa zone
- Anthelmintic effects of some traditionally used
- Herbal remedies (IAR, in Sheno area)
- Trail on efficacy of traditional herbal remedy in
- Treatment of mastitis (in Sebeta area)
- Study on effects of selected herbal remedies on octoparasite (Sebeta).

Most studies on medicinal plants made remained more of a survey nature and with mere listing outputs of plants used as remedies for various ailments usually with incomplete description and mainly uncertain recipes.

## **9. Sources of supply of medicinal plants**

In Ethiopia, most of medicinal plants used by the herbalists are collected from the natural vegetation. Home based medicinal plants use relies on plants of the home garden crops, weeds and that grow wild around human habitation. The cultivated medicinal plants are mostly produced in home gardens either for medicinal or rather primary purposes. Medicinal plants of home garden are known to the public as the knowledge on them is open or public (Zemedet Asfaw, 1999, 2001). Medicinal plants obtained from wild habitats are found in different natural ecosystems of the forests, grasslands, woodlands, wetlands, in field margins and garden fences, as weeds and in many other microhabitats from where they are harvested when the need arises. These are free access resources to all with appropriate knowledge and who want to use them for the family for practicing traditional medicine or for sales. Many medicinal plants are also harvested for non medicinal values such as for timber implements, fuel wood and other purposes and hence they are subjected to multiple pressures like *Hagenia abyssinica* and *Prunus africana* are facing at present. Conservation measures should target habitats of such vulnerable species. Most traders purchase medicinal plants from collectors. Consumers get their supply from different sources including from own garden, purchasing from traders and healers. Medicinal plants are also imported informally from e.g. Sudan through border towns like Assosa, Dire Dawa etc. The

domestic supply sources are closely associated with the biodiversity and concentration of forest areas e.g. Jimma, Bale. Traders from Dire Dawa for example travel to Bale, Jimma, Gonder, Menz etc.

In Ethiopia, except in a few cases where a few food crops with medicinal value are cultivated, there is no organized cultivation of plants species for medicinal purposes. The reason for this is that the quantities of medicinal plants traded are very small, and there is no organized large scale value addition and processing. However, there is a potential in the future for increased demand for some of the species and, therefore, it is important to identify them and start the necessary research on the propagation and cultivation techniques. Such program will also provide basis for small enterprises to improve the income generating capacity of the local people.

## **10. Trade in medicinal plants**

Very early in the history of ancient Ethiopia, spices, myrrh and Frankincense were the first trade items and partly these products were used for medicinal purposes. To date, the medicinal use of Frankincense and Myrrh is well documented (see Mulugeta Lemenih and Demel Teketay, 2003).

Some surveys report on marketing of medicinal plants conducted in Ethiopia arrived at different conclusions depending on the location of the studies. A market survey of medicinal plants in rural markets around Bahr Dar (North western Ethiopia) came up with no products entirely targeted for medicine but only a collection of food spices and plant products for cosmetics use including many products used as incense or fumigants or steam bath (Hareya Fassil, 2005) perhaps due to inappropriate seasons for sampling since seasonal variation exists in the products sampled. Most of the local trade of open market is dominated by a few species including *Hagenia abyssinica*, *Embelia Schimperi* and *Glinus lotides*. The export trade includes *caltha edulis* and gums from various species of *Boswellia* and *Commiphora* but these plants are known to be primarily traded for their non medicinal uses the former as stimulants or narcotics and the latter species for cosmetics and other industries.

Survey on socioeconomic study of medicinal plants (Table 3) by Abdulhamid Bedri

Kello et al. (2004) has compiled the various uses of medicinal plants using local names in Bale. The plants include *Allium sativum*, *Ruta chalepensis*, *Zinger officianale*, *Nigella sativa*, and *Artemisia* spp. All these are cultivated plants and households have reported that many of them are maintained regularly at home. This is supplemented with complimentary study in the forest by B and M Development Consultants PLC 2001. This consulting firm has conducted a socioeconomic study on the medicinal plants of Bale and reported 112 species for which the local names and other features have been described and thoroughly analyzed. This work reported extensive socioeconomic data on medicinal plants and results of botanical identification. The medicinal plants reported for different Woredas were presented with their ethno medicinal descriptions. They have listed plants used commonly by households in the treatments of various diseases. They also list medicinal plants that are routinely available in Bale at home, those that are cultivated and bought by households. The accessibility of these plants in the region is reported to be easy either through local market, their backyards and adjacent forests. However, the supply shows seasonal variation. As the treatment of specific disease involves numerous plants and different house holds use different plant mix and there are variation across households in preferences, the cultural set up promotes not only conservation but also diversification of these resources. Increasing the population and diversity of medicinal plants in home gardens and other areas outside forests is a solution for avoiding human disturbance of forests.

The most frequently used medicinal plants changed little over the years, egg., Kloos et al. (1978) made interview based survey in 19 markets of town and villages distributed in the central plateau (including Addis Ababa) and Rift valley covering 416 vendors and found that three taenicides (*Hagenia abyssinica*, *Embelia Schimperii* and *Glinus lotiodes*) were the most frequently found species on sale by 241 234 and 202 vendors respectively. The plants sold as medicine added to 41 species and these are common in markets to date.

A market survey undertaken in Jimma, Bonga, Gambella and Addis Ababa in 1998 reported on some of the common medicinal plants and their trade routes within the country and to external markets indicating that there are no exports particularly for medicinal purposes (Dessalegn Disassa, 2001). Marshall (1998) also reported that

Ethiopia had no legal export and import of products for medicinal use but plants of medicinal importance are exported to Djibouti and other countries as agricultural products.

**Table 3** Unit purchase and sales price of the most common medicinal plants

Species	Purchase price (Birr/ kg)	Sales price (Birr/ kg)
<i>Aloe</i> spp.	2.13	27.50
<i>Carisa spinarum</i>	0.67	15.67
<i>Croton macrostachyus</i>	4.02	262.64
<i>Cucumis prophetarum./ C ficifolius</i>	1.63	4.80
<i>Echinops kebericho</i>	7.85	51.02
<i>Embelia schimperii</i>	6.96	56.61
<i>Glinus lotoides</i>	8.87	37.81
<i>Hagenia abyssininca</i>	7.58	47.78
<i>Myrsine africana</i>	12.71	35.62
<i>Olea europeae</i> ssp. <i>Cuspidate</i>	5.53	15.01
<i>Rumex absynnica</i>	3.40	93.86
<i>Securidaca longepedunculata</i>	11.39	218.33
<i>Senna occidentalis/ S. italica</i>	12.05	52.90
<i>Silene macrosalen</i>	4.13	49.22
<i>Taverniera abssynnica</i>	4.43	76.02
<i>Withania somnifera</i>	5.28	50.55
<i>Ximenia americana</i>	3.34	582.08
<i>Ocimum lamifolium</i>	1.11	90.29
<i>Hydnora johannis</i>	14.84	299.17
<i>Jasminium abssynicum</i>	21.33	594.39
Average	7.50	106.75
Number of cases	385	263

Another market study was directed to medicinal plants with other agricultural products in eastern, central and western Ethiopia (Letchamo and Storck, 2006). This study analyzed the trade that is going on medicinal plants products in Dire Dawa, Jimma, Aggaro and Hossaina. For individuals in rural settlements, herbalist's clinics, village markets, town etc are major retail outlets where people buy their plant medicines.

In the traditional market place in Ethiopia, medicinal plants are usually associated with spices and herbs. They have to be looked for in the areas of the market, where spices and herbs are displayed on roadsides during religious ceremonies around churches and mosques. In Ethiopia, the informal trade takes the major share in rural areas except at the level of healers who commercialize just the crude materials or charge together with

the treatment they provide upon their diagnosis.

In the country side people may access medicinal plants products through informal information networks in addition to market days which takes place weekly or twice a week. In rural areas of Ethiopia, medicinal plants treatments could also be given free of charge but some token is believed to be in order for the medicine to take effect. In rural areas of Ethiopia self medication using indigenous medicine, is the cheapest and mostly the only form of healthcare available. Friends, relatives and neighbors provide traditional treatment free of charge or paid in more flexible arrangement such as payment in cash or kind and on a credit basis. This is specifically prevalent in rural communities.

## 11. Classification of medicinal plants and ailments treated

Table 4 and 5 show classification of medicinal plants based on use and the ailments treated respectively.

**Table 4** Medicinal plants grouped under use categories and agents

Medicinal plants categorized by their uses	Medicinal plants categorized as agents
Plant medicine for Gastrointestinal problems	Anti-infective anti-bacterial; anti-parasitic (anti-metazoan, anti-protozoa); anti-fungal; anti-viral
Plant medicine for pain and inflammation	Anti-inflammatory
Plant medicines for respiratory/oral problems	Anti-respiratory disorder
	Cardiovascular
	Anti-hyperglycemia
plant medicines for urological problems	
Plant medicines for gynecological problems	
Plant medicines spiritual functions	Nervous system
Plant medicines for skin condition	Dermatological
	Pesticides
	Anti-neoplastic
	Anti-diarrhoeal
	Anti-constipation
	Anti-emetic

Source Adapted from Dawit Abebe et al. (2003) and Guyo (2002)

**Table 5** Various categories of ailments treated with medicinal plants as gathered from southern and western Ethiopia

<b>Very commonly mentioned</b>	<b>Fairly commonly mentioned</b>	<b>Occasionally mentioned</b>	<b>Very rarely mentioned (mostly healer domain)</b>	
Stomach ache	Ascaris	Repelling mosquito	Abortion	Prevention of sterility
Tapeworm	Snake bite	Toothache	Anal tumor	Hemorrhoids
Malaria	Dysentery	Rheumatism	Animal sickness	General remedy
Eye Disease	Headache	Gastritis	Asthma	Expel placenta in cow
Wound	Sore	Anemia	Broken bone	Tongue disease
Cold	Helminthes/ worms	Constipation	Insect bite	Snake bite of domestic animals
Cough	Hypertension	Impotence	Insect repellent	Liver disease
Abdominal pain	Diarrhea		Insect borne disease	Sexually transmitted diseases
	Gonorrhea		Insecticide	Dandruff
			Leech	Lung disease

Source : Zemed Asfaw (1999)

## 12. Sustainable medicinal plant utilization and conservation

Sustainable use of medicinal plants has now grown to be a timely issue in Ethiopia because of resource degradation in the lowlands and highlands alike. Ecosystem conservation will ensure in situ conservation of medicinal plants so as to apply sustainable harvesting methods for collecting medicinal plants from wild habitats. Experience from South Africa would be essential to develop innovative methods for harvesting individual plants (Geldenhuys and Mitchell, 2006). According to the socioeconomic survey conducted by Abdulhamid Bedri Kello and Sebsib Belay (2004) and Abdulhamid Bedri Kello et al. (2004), most of the respondents expressed willingness to cultivate medicinal plants. The shift from cereal cultivation to medicinal plants could support forest development by changing the livelihood systems from cereal cultivation to alternative income generation schemes including medicinal plant cultivation. However, one has to see the high opportunity lost attached to the shift in the production system.

The issue of medicinal plant conservation in Ethiopia today calls for aggressive studies

and documentation before the accelerated ecological and cultural transformation distort the physical entities and the associated knowledge base. Innovative options like eco agricultural, maintenance of traditional farming systems and linking conservation with utilization by community need to be carefully developed and implemented.

The following can be suggested for In situ conservation approach to medicinal plants

- 1) Medicinal plant conservation as part of nature conservation (with local knowledge, innovations and practices)
- 2) Conservation of medicinal plants in special medicinal plant areas (e.g. medicinal plant hotspot areas)
- 3) Medicinal plants in special places within the cultivated landscape e.g. places of worship, sacred groves, farm margins, river banks etc.

Ex situ approach to medicinal plant conservation

- 1) genebanks and field genebanks
- 2) botanical gardens
- 3) IBC's effort in Wondo Genet need to be expanded
- 4) Cultivate in homegardens e.g. *Ocimum lamifolium*, *Thymus serrulakus* etc. are maintained in homegardens in urban and rural areas

Plantations of medicinal plants can be made in degraded and degrading areas. There are many medicinal plants of Ethiopia that have good properties for land rehabilitation and erosion control which could be planted in different agro ecological settings.

In situ and ex situ conservation strategies work well when they complement one another since what is not achievable by one method is backed by the other method. In addition to this scheme that would enable sustainable use of medicinal plants and the associated indigenous knowledge should be developed with the best practice of benefit sharing.

In the previous sections medicinal plant species in use in Ethiopia is highlighted.

Sometimes the same plants are given different names because of differing expressions of the same species at different areas by different people and due to different languages,

dialects and cognates. There are some species that are frequently traded and applied in healing that are endemic. Such species need to be given top priority in conservation as they are subjected to multiple pressure of erosion. *Taverniera abyssinica* and *Solanum maginatum* are two such species. It is reported that about 90% of the collectors sell plants to earn income. The economic role of the collectors play in medicinal plant sector in terms of employment and income generation is significant. The volume of sales of medicinal plants has increased over years and this has been taken that by some as the existence of disease prevalence requiring traditional Medicare has caused increased demand which led to harvesting important medicinal plants. The expected increase in the cost of commercial drugs and their occasional impotency also increase demand of medicinal plants. The proportion of consumers who rely on harvesting medicinal plant is the highest in the rural area. This is reasonable since collecting from natural plantation is most accessible and cost affective particularly for the rural communities.

In one survey made a total of 56,410 tons of medicinal plants were demanded by the consumers during the year 2005. Of this 42,260 tones, 75% was traded through different marketing channels while 25% was not traded, i.e. collected and consumed by the consumers.

It is interesting to note that proportion of medicinal plant consumers continue to be high including in Addis Ababa where 75% of the population continue to use medicinal plants regardless of access to modern clinic. It has been indicated that some disease such as tumor "Almaz balechira" are well cured by traditional medicine.

The major reasons why medicinal plants are demanded is due to the trust the communities have in the medicinal values of traditional medicine and relatively low cost using them.

Although collectors are mostly (86%) are men than women (14%) the customers of medicinal plants are equally male and female. Educational level of users for medicinal plant has little effect. Both rich and poor use equally medicinal plants. The traditional health care appears to be dominated by men (89%) in some of the study area made.

Traditional healers are relatively more educated than the collectors and the traders except in smaller towns and rural areas. A result of recent study conducted showed that the value of both imported and domestically produced pharmaceutical products were about ETB 1.05 billion. During the same year the value of medicinal plants including traded and non traded ones was ETB 423 million making average health coverage by 42% of Ethiopian expenditure on pharmaceutical products. This is a significant saving in terms of foreign currency as well.

### **13. Overview of medicinal plant industry and relevant experience for the promotion of the sector in Ethiopia**

The traditional medicinal plant industry is one of the few industries that have escaped large scale commercialization by both foreign and domestic interests, and consequently it remained as a largely informal industry with virtually no official trade industries in Ethiopia. Even in developed countries it is only recently that tremendous interest in bioprospecting, with pharmaceutical companies and universities is moving forward. Most of the research has been seeking commercially useful chemicals, with little investment in the development of existing industry.

The global value of plant based pharmaceuticals in OECD countries in 2000 was estimated to be USD 500 billion. Most of the demand for medicinal plants is for the production of the following three groups of pharmaceutical products .

- 1) Modern allopathic medicines
- 2) Herbal remedies
- 3) Processed traditional medicines

China is a major source country with India, Chile and Egypt playing a big role. Hong Kong is a leading consumer probably due to majority of the botanical drug being processed in Hong Kong's large pharmaceutical industry. Japan and Korea are also major consumer countries with large manufacturing industries. The products are either sold in country or exported. Both USA and Germany are important importers and exporters as well as consumers with large processing industries. No developing country is a major importer.

## **14. International markets of medicinal markets**

### **a. Europe's medicinal plant trade**

Europe imports about 25% (132,000 tonnes) of all the medicinal plants traded internationally. 27,000 tonnes plant material comes from Africa. Wild collection is still very important and around 90% of all Europe's medicinal plants are harvested from the wild. Germany is the most important country in Europe that is involved in the medicinal plant trade. About 33% of the plant material imported in Germany is re exported.

### **b. Asia's medicinal plant market**

Asia is a very important international market player for medicinal plant. Since in most Asian countries traditional health care systems are officially recognized and operate, at least, in parallel with allopathic medicine. In modern China alone, some 800 million people use around 5000 species of plants medicinally. The annual demand for plant material in China is around 700,000 tonnes.

India is a major exporter of medicinal plant materials but unlike other developing countries it also exports processed plant based drugs. The Indian Ayurveda medicine has a 70% share of the formal medicine market in India and it serves the need of more than 600 million people.

### **c. Africa's medicinal plants**

In some African countries the traditional healthcare systems enjoy official status and in these countries a more formal trade exists. e.g. Botswana, Mozambique. The interest in plant derived allopathic drug in Africa has risen recently following the international trend by some pharmaceutical companies of investing in new drug discovery program in Africa. Botswana, Namibia, Mozambique, Zimbabwe and Malawi import medicinal plants from South Africa. The South African medicinal plant market trade in raw material alone worth around R270 million annually. The international demand for African medicinal plants is growing and major importers are European countries like Germany, France, Italy, Spain and U.K. Egypt and Sudan are the Major exporters to Europe.

Competition in the international trade for Ethiopia's major export products, such as

coffee, is building fast and there is no absolute certainty to maintain current export earnings indefinitely. Such unstable situations can only be improved by a rational and coordinated policy of research and development at a national level towards identifying other additional candidate commodities. The position and contribution by the medicinal, spice and herb species is obvious.

Nowadays, individual spice farmers are flourishing at different corners of the country. Ginger and turmeric are becoming the main cash crops, next to coffee, for farmers in the South Western parts of the country. Besides, essential oils and oleoresin processing firms are expanding and hence increasing their production and export volumes. In addition to the widely recognized red pepper, spice crops such as fenugreek, coriander, black and white cumin, are becoming important commodities, calling for immediate attention.

From the above we realize that good economic opportunities exist in both the developed and developing countries as market are showing increasing growth, mostly as a result of increasing demand. Ethiopia has the potential to become an important source country, given the diversity of plants and the rich traditional knowledge regarding their use as medicine.

## **15. Future Scenario of medicinal plants in Ethiopia**

### ***a. Acquisition and transfer of indigenous knowledge on traditional medicine***

The acquisition and transfer of indigenous knowledge on traditional medicine, in most developing countries including Ethiopia, is passed from one generation to the next by word of mouth. Results of studies by B and M Development Consultants PLC in Bale Area, Ethiopia also indicate that 70% of the practitioners have acquired the traditional knowledge either from their parents or close relatives. 65% have reported that they have either already trained a member of their family or that they have plans to do so. Although the majority (70%) believes that oral transfer of indigenous knowledge is effective, they have also expressed their serious concern about future validity of the method. The main reason for this concern is the unwillingness of the young generation to acquire indigenous knowledge. The young generation has other ambitions and priorities than seeking knowledge on traditional practices. As a result, collecting and compiling indigenous knowledge as written

accounts seems to be a necessity. The government and, particularly NGOs involved in ethno botanical studies can play important roles in sponsoring ethno botanical and ethno pharmaceutical studies to collect compile and preserve such crucial indigenous knowledge for future generations before it is too late.

This unwillingness of the young generation originates from the fact that modern schools, health professionals and the so-called educated sector of the community tend to look down upon the practice of traditional medicine. However, today, more than ever, researchers of natural products-based drugs are going back to nature for the search of more effective and safe new drugs.

To salvage indigenous knowledge from disappearing, the young generation has a very crucial role to play. Accordingly, it is highly recommended to include in the school curriculum aspects of traditional medicine and medicinal plants. School children should be introduced to the vital role traditional medicine. They have to be instilled that traditional medicine is still valid and important and that medicinal plants have been sources of several important drugs and are still potential sources of more wonder drugs. In addition, students and pupils alike should be encouraged to ask and learn from their parents and community elders about the indigenous knowledge and the practice of traditional medicine.

#### ***b. Future prospects of traditional medicine***

The whole array of knowledge of medicinal plants is not some thing to be acquired only from formal and informal schooling. Individuals who have the interest in traditional medicinal plants as well as in their collection or in healing practices need to learn from professional practitioners. But these professionals are not willing to disclose their knowledge because they might be afraid of competition that may arise if the number of practitioners increases.

Integration of traditional and modern medicine in Ethiopia, following either the Chinese, Japanese or Indian pattern or a combination of these, would help the promotion and development of local traditional medicine, which has been significantly contributing and is expected to contribute to the health care system and economic development of the country.

## **16. Strength, Weakness and Opportunities (SWOT Analysis) in medicinal plant sector**

SWOT analysis show that there are many strong points and opportunities to make the sector more productive and improve the livelihood of poor farmers and people in general. The sector also has weakness and threats that need to be checked to effect.

**a. Strengths**

- 1) Rich biological diversity of medicinal plants for which candidate plants can be selected for cultivation
- 2) Untapped valuable indigenous knowledge on medicinal plants
- 3) Easily available medicinal plants can be used for home consumption
- 4) Well established tradition of plant cultivation and domestication
- 5) Existence of many traditional healers who could be easily taken on board to develop the medicinal plant
- 6) Many religious institutions and healers that could collaborate to promote the sector
- 7) If opportunities could be exploited farmers could cultivate medicinal plants
- 8) Demand for medicinal plant is high due to emergence or re-emergence of certain disease, cost of modern drug and their limitations, environmentally friendly of medicinal plants, chance of discovery of new drug
- 9) Biomedical benefits: medicinal plant use is the result of Centuries accumulated knowledge.

**b. Weakness**

- 1) Efforts to conserve biological diversity are not bringing the desired results
- 2) The indigenous medical knowledge is enigmatic and hence the secrecy prevents free knowledge sharing
- 3) Isolation of active principles from medicinal plants is deterred by low scientific capacity
- 4) Poor mode of presentation of medicinal plants to patients
- 5) No market infrastructure
- 6) Poor developed market information system
- 7) The dependence of trading plants may constrain conservation actions.

**c. Opportunities**

- 1) Further enhancement of economic benefits
- 2) Further development of employment opportunities
- 3) Can be a driving force for conserving biodiversity in natural and man made ecosystem
- 4) Can help to preserve indigenous botanical and medicinal knowledge through active use
- 5) Can help to maintain community's cultural and natural assets preserving their cultural and spiritual values passing to future generation
- 6) The rich indigenous knowledge on medicinal plants can be optimally utilized
- 7) Developing the sector generate income to poor households
- 8) Improves health care of the country
- 9) Tapping external markets
- 10) International high valued species like *Prunus africana*, *Aloes*, *Walburgia ugandensis*, *Mystenus* species and many others are potential resources for the market and can help Ethiopia to have high share in the international market of medicinal plants

#### **d. Threats**

- 1) Ecological degradation
- 2) Loss of indigenous knowledge
- 3) Loss of cultural assets
- 4) Danger on medicinal plant through smuggling and misuse of resources
- 5) Lack of suitable scheme for equitable sharing of benefits arising from biological resources
- 6) Poor market situation may prevent enthusiastic cultivators from producing medicinal plants for the market
- 7) Traditional healers may not participate and fully collaborate

### **17. Strategies for Improving the Role of Traditional Medicine and Practitioners**

- Identification and registration of the traditional medicine practitioners; Encouraging the formation of a strong National Association for traditional medicine practitioners,

- Assess the need for training of the selected and registered traditional medicine practitioners and designing appropriate skill upgrading training programs;
- Introduction of the role and importance of traditional medicine to the public
- Include medicinal plants and indigenous knowledge in the school curriculum

Those plants that are harvested for their roots, tubers and bulbs need special attention of conservation. Such attentions should be extended to the woodlands of Ethiopia which are the sources of most of the medicinal plants followed by the Montane grassland/dry Montane forest complex.

The followings thirteen points are of practical importance to be undertaken:

- I. Increase cultivation of plants. The following need cultivation in the short term
  - a. *Echinops kebericho*
  - b. *Hagenia abyssinica*
  - c. *Silene macrosalene*
  - d. *Taverniera abyssinica*
  - e. *Hydnora johabbis*
  - f. *Olea europehe ssp cuspidata*
  - g. *Glinus lotoide*
  - h. *Withania somnifera*
  - i. *Sewridaca longe pedunculata*
  - j. *Ximenia americana*
  - k. *Aloe spp.*
  - l. *Cucumis prophetarum*
- II. Develop propagation and harvesting techniques
- III. Establish the farming required, to maintain and enhance the wild plant stock
- IV. Identify more sustainable plant part harvesting option, mining medicinal plant resource should be coupled with management
- V. Establish sustainable harvesting practices in wild areas
- VI. Establish optional harvesting regimes for cultivated plants
- VII. Identify appropriate standards for product quality

- VIII Identify optimal storage methods for bulk volumes, processed products
- IX. Identify optimal methods for processing plant material
- X. Identify appropriate packaging for processed plant material
- XI. Transfer the technologies to the market players and strength communication between them
- XII. Establish market information system and business linkages between markets players, build capacity of stakeholders
- XIII Establish market sites and hygienic retail outlets

**18. Based on the above the following are Conclusion and recommendations made**

- Medicinal plants have both social and economic values to the community in ETHIOPIA. The users of medicinal plants gain economic benefits in the form of lower costs and reduced time in looking for treatment.
- Practices of traditional medicine also create employment and means of income for practitioners and vendors. Most vendors totally depend on the practice as means of their livelihood.
- Users and practitioners of traditional medicine encounter a number of constraints such as, their seasonal availability, and shortages of finance and lack of technical know-how.
- Despite the potential benefits derived from the practice of traditional medicine, a sizable number of the rural community and the importance of the practice seem to have been ignored. There is a limitation of coverage on the part of the Government on the extent of potential socio-economic benefits of medicinal plants, which is evidenced by the lack of interventions targeted to improve the use of medicinal plants, and to address the problems encountered by the community, and most importantly failure to provide information to the farmers on the commercial values of medicinal plants.
- Practitioners of traditional medicine do not have any form of training in the agronomy of the plants. Therefore, there is a need to provide training for improving their skill and also testing the effectiveness and selection so that the selected plants can be commercially cultivated.
- Medicinal plants or the services provided by traditional practitioners do not have formal market in the country. Therefore, there is a need to formalize the market for the plants as well as for the services provided by practitioners and vendors.

- Improve traditional medicines and practices by identifying true and knowledgeable practitioners.
- Create a conducive environment for traditional medicine practitioners and modern medicine so that they will work together hand in hand complementing each other;
- Provide basic training to traditional practitioners with the objective of adding value to their traditional skill;
- Identify genuinely effective medicinal plants and encourage their production and cultivation.
- Formalize the activities of traditional medicine practitioners through licensing.
- The comparison of the costs/ benefits of traditional and modern medicine should be included in future studies.

From several studies on conservation and sustainable use of medicinal plants it can be safely proposed that the requirements of a sustainable harvesting of medicinal plants be included in the collaborative/community based natural resource management plan and implement it in partnership with the stake holders and relevant agencies.

The majority of traditional medicines used in the developing countries have not been evaluated for quality, safety, and efficiency to the same standard as those in developed countries. Research on medicinal plants should be in line with Primary Health Care system of the country and should address the disease prevalence in the country like respiratory infections, diarrhoeal, malaria, tuberculosis, sexually transmitted diseases, trypanosomiasis, leishmaniasis, schistosomiasis and other parasitic diseases.

## **19. Cultivation and Mode of Production of Some, Root, Tuber, Vegetables, Industrial Crop, Herbs and Spice of medical importance**

Ethiopia has diverse climate and soil types that enable growth of several indigenous and exotic spices, herbs, medicinal as well as other essential oil bearing plants. These plants have enormous economic benefits. However, despite the existing enormous potentials of production and subsequent benefits from these commodities, no strong attention has been given to improve their cultivation, production and processing technologies. Available fragmented reports indicate the existence of different spices, herbs,

medicinal, as well as other essential oil bearing plants growing through the country. The country is currently growing endemic spices including korarima, ginger, black and white cumin, coriander, fenugreek, chilies mustard, etc. In addition, recently introduced exotic species including black pepper, cardamom, turmeric and cinnamon are widely adapted to the south western humid and sub humid areas of the country. Of these, turmeric has already gained a strong hold in the farming system and is currently produced at a wider scale by the local farmers in different parts of the country, as a supplementary cash crop. Besides, different herbs, as well as medicinal and essential oil bearing plants are also growing widely in the country. The prominent potential herbs successfully growing include thyme, white mugwort, fennel, dill, basil, mint, rosemary, Lippia spp. etc. Of the medicinal plants, endod, rue, Hygenia, garden cress, croton, Africa black pepper, Embelia are some of the endemic species that are commonly used for the prevention and cure of different diseases. Others, including quinine tree, periwinkle, cenna, dandelion, foxglove, etc. have also been introduced from abroad. In addition to these, certain essential oil bearing plants with considerable demand at local and international market like lemon grass, Palma Rosa, vetiver grass are also growing. In all these appropriate cultivation, propagation and several other agronomic practices are needed to effect their prolific growth and distribution.

In the following few pages mode of propagation, cultivation and use value of some root and tuber crops, vegetables, industrial crops, spices, herbs and medicine plants of primary relevance for survival and economic benefits are given. The following Table gives an example of good representation of list of spices, herbs and medicinal plants with the exotic spices introduced and maintained. Such a list can not be over generalized since such holdings do differ between various institutions and regions considered.

**Table 6.** Lists of spices, herbs and medicinal plants collected in collaboration with IBCR, and introduced exotic spices maintained at Tepi and Jimma Research Centers

No.	Botanical name	Vernacular name	Growing sites	Parts used	Uses
1	Korarima ( <i>Aframomum corrorima</i> )	Offio (K)	Natural vegetation	Seed	Spices/condiment
2	Wild Korarima ( <i>Aframomum spp.</i> )	Sheeti Ogio (K)	Natural Vegetation	-	-
3	Turmeric ( <i>Curcuma domestica</i> )	Irdo (K)	home garden	rhizome	spice cosmetics
4	Basil ( <i>Ocimum basilicum</i> )	Diro	home garden	leaf, soft stem	herb
5	Mustard ( <i>Lepidium sativum</i> )	Shipho	home garden	seed	spice
6	Coriander ( <i>Coriandrum sativum</i> )	Depo	home garden	seed, fruit, leaf	spice condiment
7	Rue ( <i>Ruta chalepensis</i> )	Chedramo	home garden	seed, soft stem	herbs, spice, medic. condiment
8	Long pepper ( <i>Piper cappanase</i> )	Turfo	Natural vegetation	seed	spice, condiment
9	Ginger ( <i>Zingiber officinale</i> )	Yanjibelo	Cultivated	rhizome	spice, medicinal
10	Chillies ( <i>Capsicum frutescence</i> )	Mito	home garden	fruit	spice
13	Wild black pepper ( <i>Piper guineense</i> )	-	Natural vegetation	-	close relative to pepper
14	Anethum ( <i>Anethum graveolens</i> )	Mechwolago	home garden	seeds, soft stem	spices, herbs
15	Black cumin ( <i>Nigella sativa</i> )	Aefo	Field	seed	spices, condiment, medicinal
16	Fenugreek ( <i>Trigonella foenum graecum</i> )	Abish	Field	seed	spices, medicinal
17	Ethiopian caraway ( <i>Trachspemem ammi</i> )	-	home garden	seed	herb
18	Laurel or bay leaf ( <i>Laurel nobilis</i> )	-	research center	leaf	spices, condiment, medicinal
20	Pepper ( <i>Piper nigrum</i> )	-	research center	fruit, seeds	spices, condiment
21	Rosemary ( <i>Rosemarinus officinalis</i> )	-	home garden	leaf soft stem	herbs /condiment
22	Cinnanmon ( <i>Cinnamomum verum</i> )	-	research center	bark, leaf	spices /condiment
23	Cardamom ( <i>Ellettaria cardamoum</i> )	-	research center	seed	spices
24	<i>Majorama spp.</i>	-	research center	leaf, soft stem	herbs, spices
25	Vanilla ( <i>Vanilla fragrance</i> )	-	research center	seed bean	spices /condiment
26	Annato ( <i>Bixa orellana</i> )	-	research center	seed outer part	dying, cosmetics
27	Cocoa ( <i>Theobroma cacao</i> )	-	research center	bean	stimulant
28	Lavender ( <i>Lavandulla spp.</i> )	-	research center	leaf	condiment, herb, cosmetics
29	Mint ( <i>Mentha spp.</i> )	-	home garden	leaf	condiment
30	Majoram ( <i>Origanum spp.</i> )	-	research center	leaf	medicinal, cosmetics

No.	Botanical name	Vernacular name	Growing sites	Parts used	Uses
31	Camum or Bishops weed or Ethiopian caraway ( <i>Trachyspurnem ami Sprague ex Turill</i> )	-	home garden	seed	condiment
32	Garlic ( <i>Alliums spp.</i> )	-	home garden	bulb, leaf	condiments, medicinal
33	Sage ( <i>Saliva officinalis</i> )	-	home garden	leaf	medicinal
34	Lemon grass ( <i>Symbopogon spp.</i> )	-	research garden	leaf	medicinal
35	Thyme ( <i>Thymus spp.</i> )	-	home garden	leaf	condiments, medicinal
36	Vetivar grass ( <i>Vetivaria zizanioides</i> )	-	research center	rhizome	cosmetics

## I. ROOT AND TUBER CROPS

### a) Anchote, *Coccinia abyssinica* (W and A) Cogn.

*C. abyssinica* is a member of the family Cucurbitaceae. It is a tuberous perennial, with shoots having simple tendrils. The plant dies after the fruit have matured. The underground tubers produce new shoots at the onset of the wet season. There are about 10 species of *Coccinia* in Ethiopia, however, only *C. abyssinica* is cultivated for human consumption.

Cultivation of anchote is mainly in the Western and South Western region of Ethiopia. It grows at altitudes ranging from 1, 300 to 2,800 mm to 1016 mm (Amare Getahun, 1976). It also occurs in the wild state in drier region. It is also found growing in cooler and higher altitudes

#### [Uses]

- It is a valuable food source and according to local farmers, it helps in fast mending of broken bones due to its good content of calcium.
- Dawit and Estifanos (1991) reported that the juice prepared from roots of anchote has saponin as an active substance and is used to treat gonorrhoea, tuberculosis and tumor cancer.
- Tubers of the wild form of *C. abyssinica* are inedible but the fruits can be eaten. However fruits of cultivated anchote are not normally eaten.

### **[Propagation]**

Anchote can be propagated both vegetatively and from seeds although it is propagated by seed that is commonly employed. Vegetative propagation is achieved by planting either the whole tuber or by slicing it in to two or more pieces, each piece having rootlets and an external covering. This is usually done to establish mother plants, called GUBOO, to serve as a seed source for further plantings. Vegetative propagation is usually practiced on anchote tubers purchased from the market for consumption. Few tubers are planted and produce new shoots usually more than one. These newly emerging shoots depend on the reserve food within the tuber making the tuber less suitable for consumption, especially during the early growth. But after the stems are well grown, the shoots start manufacturing their own food, and the tubers again become suitable for consumption. Stem cutting also are effective for propagating anchote.

Seed propagation involves taking out of seeds from fully mature red-ripe fruits which are harvested before they start rotting. Such fruits are macerated or sliced to separate the seeds from the fleshy juicy part. The seeds are then mixed with an equal quantity of wood ash, and dried in sun. The moisture content of the seeds, for storage, is based on subjective assessment by the woman of the household. When it has dropped to the desired level, the woman takes the seeds indoors and stores them until the next growing season comes. During this storage period the seeds are usually kept in either clay or wooden pots or wrapped in a sheet of cloth.

All these operations, from harvesting of the fruits to seed extraction and storage, are usually carried out exclusively by women. The women also purchase seeds of sowing if they have failed to store seeds. As practiced, it is the women's responsibility to harvest, prepare, process and store anchote seeds and/or either purchase or request seeds from their friends and make them available for sowing well ahead of the beginning of the rainy season. It is after having the seeds that the women urge their male partner to plough the land.

### **b) *Coleus edulis* Vatke**

The genus *Coleus* is a member of the family Labiate, subfamily Ocimodeae. Fifteen

species have been recorded in Ethiopia, including *C. edulis* which is cultivated on a small scale in highly localized areas of south western Ethiopia and the surrounding regions. It is a small, hairy, rather succulent herb about 50 to 60 cm high, with ovate and shallowly serrate leaves. The inflorescence is a raceme of small flowers which are usually purplish blue. The leaves vary from dark green to purplish green.

The plant is cultivated in small holdings at altitudes varying from 1,880 to 2,200 m and is regarded as a highland root crop. Tubers and stem cuttings are used for propagation. Planting is usually undertaken in April. The tubers come in many shapes, size and colors.

#### [Uses]

- The tubers are usually boiled and consumed as vegetable.
- On some areas, rhizomatous roots are often roasted on live charcoal and eaten with the skin on.

The leaves are often eaten as a green vegetable in some regions.

## II. VEGETABLES

### a) Cabbage tree, haleko or Shiferaw, *Moringa Stenopetala*

Moringa belongs to the unigeneric family *Moringaceae* and consists of 10 species. *Moringa stenopetala*, known locally as haleko, which is a soft wooded deciduous tree with a smooth gray bark. In Konso area (South Ethiopia) it is a perennial source of leaf vegetable in drier regions.

#### [Uses]

- It is used as a leaf vegetable.
- The young leaves are eaten after boiling. The leaves are used as market vegetable, second in importance to brassica in Konso area.
- It is reported to be of medicinal value. It has been reported that local peoples use boiled leaves as tea or chopped and mixed it with water to treat malaria,

hypertension, stomach problems, expelling of retained placenta, asthma and diabetes. People around lake Turkana use the leaves for treatment of Leprosy

- It is used in purifying muddy water. Dried and crushed seeds of the plant are used to clarify muddy and turbid waters analogous to the chemical coagulant Aluminium sulphate. However, the local people in Konso and Goffa area use the roots of *Maerua subcordata* (which could be poisonous) for water purification. It also has bactericidal and fungicidal properties.
- It is also used as bee forage

In Konso area, *M. stenopetala* is cultivated in terraced fields, gardens and small towns. It also grows in riverine and in woodlands and rocky grounds. The plant also grows in dry climates where most of the native trees hardly survive. Its leaves are sold in vegetable markets and can serve as a source of income for moringa farmers.

*M. stenopetala* propagates from seeds most of the time but the local people regenerate it also from a stem. Its regeneration from a stem is very slow unlike *M. oliefera* which can propagate highly both from seeds and stem cuttings (Jahn, 1991). Moringa farmers of Konso area select the mother tree to collect seeds for propagation. The optimal temperature for germination is 25 °C

### III. INDUSTRIAL CROP PLANTS

#### a) Endod, *Phytolacca dodecandra*

It belongs to Phytolaccaceae family. It is a dioeciously plant and can be propagated readily from berries and cuttings (stem and roots).

#### [Uses]

- The berries are used as delight and soap for washing.
- The roots and leaves, despite their toxicity have been reported to have medicinal value for various ailments, including termination of unwanted pregnancies.
- It has molluscicidal and spermicidal properties and is used to control schistosomiasis, Zebra mussels and mosquito larvae

### **[Cultivation of Endod]**

Endod is a dioeciously plant consisting of long staminate (male) and short staminate (female) plants and it is the later which produce the berries. Propagation from seeds results in both long and short staminate plants, within the group of short staminate (female) plants, considerable variations exists in the molluscicidal potency of berries. In vegetative reproduction stem cuttings from mature plants are treated with the hormone powder indol acetic acid and planted in compost. The cuttings are transplanted 6 weeks later and sprayed every three weeks with 2 % Lebaycid and 1 % adrin emulsion to prevent insect damage.

It propagation is from seed in most cases. Seed germination is maintained for one year old seeds. Plants of different sex look the same when they are very young. They may be distinguished only on flowering. Endod grows wild at the edges of forests, along roads, on river banks, and in barren areas near dwellings. When ripe, endod berries are generally orange or red in color.

With support from international donors like CIDA, endod has been the subject of agrobotanical and other studies in Ethiopia, Zambia, Swaziland and Zimbabwe. These countries have undertaken research on large scale cultivation of endod, processing and distribution of the plant extract for the dual purposes of producing a locally available molluscicidal, and as a detergent for village level use. In Ethiopia with the support from the Netherlands government, over 500 varieties of Ethiopian soapberry plants were collected. Sixty five varieties of Endod were cultivated, and 3 selected for their exceptional high molluscicidal potency and high berry yields. One variety, E - 44 was identified as the most promising candidate for molluscicidal properties, and has been cultivated on experimental basis with support from IDRC of Canada extensive toxicity studies of Endod have been undertaken.

Since the discovery of the molluscicidal property of endod in 1964 by the late Dr. Aklilu Lemma, extensive research work has been carried out on various aspects of endod (*Phytolacca dodecandra*) and its application on the control of Schistomiasis in Ethiopia. Several collaborative studies have elucidated the safe and sustainable use of endod for mollusciciding the intermediate host snails of human Schistomiasis and for detergent purposes (Shibru Tedela, 1994). Saponins derived from *Phytolacca*

*dodecandra* exhibit, in addition to their molluscicidal activities, larvicidal, hirudinicidal, fungicidal and spermicidal activities (Lemma, A. et al. 1979). Mosquito larvae are also susceptible to the lethal effect of endod.

In addition to the use of Endod to control the spread of a tropical disease affecting million of people in the Third World, Endod promises to become one of the most effective means of preventing Zebra mussels from clogging water intake pipes in North American waters. In other words, a Third World Technology comes to the rescue of industrialized nations. Safety of Endod has been evaluated by a consortium of laboratories in Canada, the Netherlands, Denmark, and Ethiopia and in the USA.

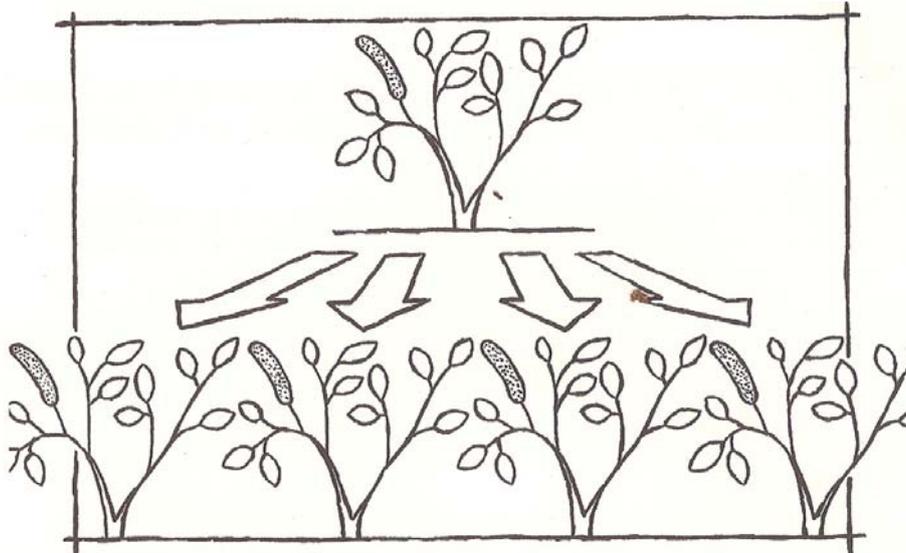
The Zebra mussels (*Dreissena polymorphica*) are black and white striped native around Caspian Sea. It disrupts municipal water facilities because they restrict water flow by attaching themselves to pipes and other hard surfaces. In addition, they are serious threat to fisheries because the mussels cover rocks in spawning areas and remove algae (a source of nutrient) from water.

Endod may be propagated by seed or by cutting. These are the advantages and disadvantages of both methods.

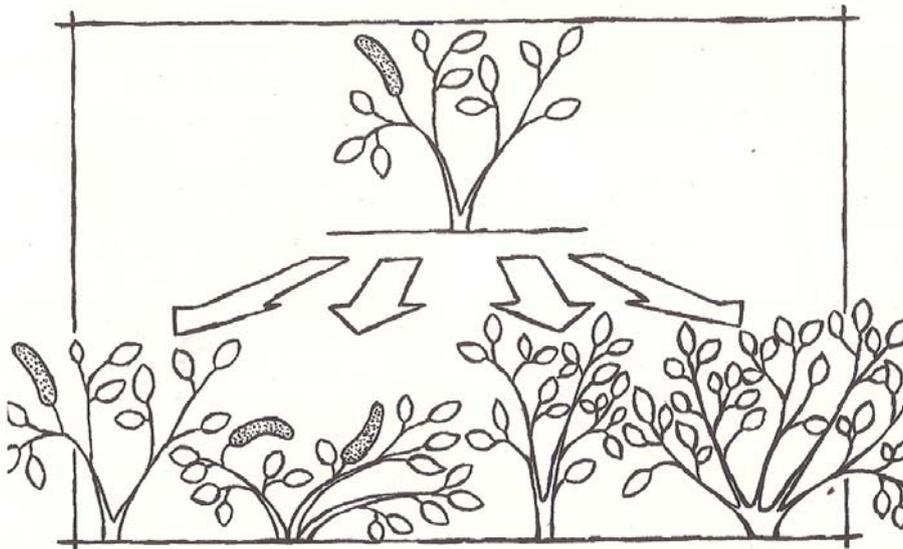
Reproduction by seed (sexual propagation)	Multiplication by cuttings (vegetative propagation)
 - From a single plant, many plantlets may be obtained	 - Less plantlets are obtained from the mother plant
 - It is quite simple	 - It is more laborious
 - Plants do not have the same characteristics as the mother plant	 - All plants look the same as the mother plant
 - Plants from seed are not uniform	 - Plantlets are uniform
 - About half of the plants are female and half of them male (unproductive)	 - All plants have the same sex as the mother plant
 - Plants are not damaged by the collection of berries for reproduction	 - Mother plants may suffer when branches are removed to prepare cuttings.
 - Plants reproduced by seed require a long time to produce the fruits (about 1 year).	 - Plants propagated by cuttings give berries in a shorter time (about 6 months).

**To establish an Endod plantation vegetative propagation is recommended. Cuttings should be collected from the best female plants.**

**Figure 1. Comparison of propagation methods**



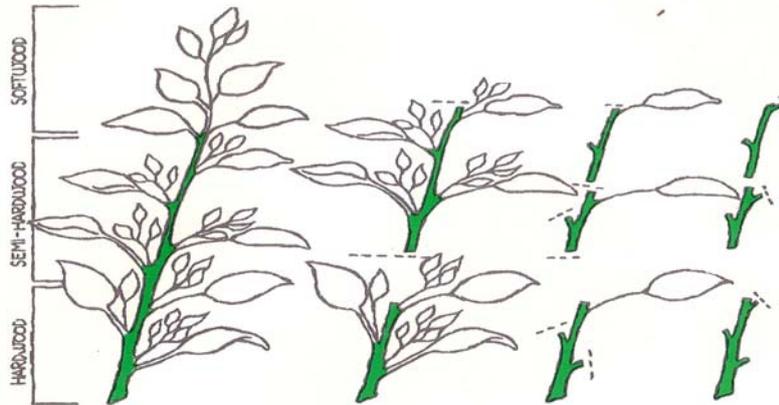
Propagation by cuttings: all plants look similar to the mother plant. If the mother plant is female, all plants will be female as well.



Propagation by seed: the plants will not necessarily be similar to the mother plant. Some of them will be female, some male.

**Figure 2. Illustration of propagation methods**

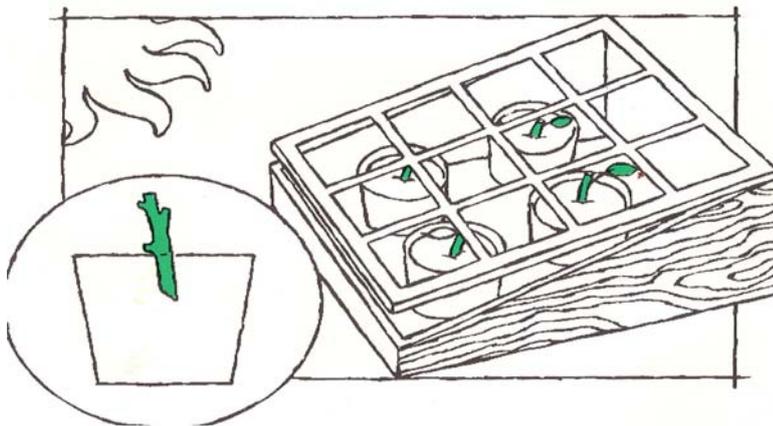
Cuttings are taken from woody or semiwoody branches. Branches are cut in setts 20-30 cm long, to include 2-3 nodes (2-3 leaves each). All leaves will be removed, although if the cuttings are placed in a hotbed for rooting the upper leaf may be left.



The plant from which cuttings are collected is called the "mother plant".

**Figure 3. How to collect and plant cuttings**

Once the setts are taken from the mother plants, care must be taken not to plant them upside down or remove the top leaves instead of the lower ones; otherwise the cutting will develop roots with great difficulty! The cuttings are planted in a pot, in a plastic bag filled with soil, or in a hotbed.



**Figure 4 Planting cuttings**

#### **IV. SPICES, HERBS and MEDICINAL PLANTS**

Production and utilization of spices, herbs and medicinal plants in Ethiopia is since ancient time. A number of indigenous species such as korarima and long pepper grow under natural forest. Korarima and long pepper received research attention just recently and there is good effort to domesticate them into cultivation. Valuable exotic species such as black pepper, cardamom, ginger, turmeric, and cinnamon adapted to the hot humid lowlands of Ethiopia and cultivation for yield, quality etc. have been run for most of them including the indigenous ones.

**Table 7.** List of recommended spices and relevant information on propagation methods, special requirements, commercial products, yields, planting and harvesting time.

Lists of species	Recommended				Special requirements (shade\support)	Commercial product	Yield (ha <sup>-1</sup> )
	Propagation	Planting time	Harvesting time	Spacing			
Black pepper	Cutting	March – cutting June, July - planting	February March	2.4m X 2.4 m	Support	fruits/ berries	19.7 - 28.5 Q (dry)
Ginger	Rhizome	March up to mid April	December January	30 cm X 15 cm	open sun	rhizomes	116 - 197 Q (fresh)
Cardamom	Seed	November, December- (nursery seed sowing) June, July - planting	November, December	3 m X 3 or 2.5 m X 2.5 m	shade	capsules	1.4 - 1.8 Q (dry)
Korarima	seed (clump)	October, November (nursery seed sowing) June, July - planting	August, September, October, November	2 m X 2 m	shade	capsules	5 - 8 Q (fresh)
Turmeric	Rhizomes	March up to mid April	December, January	30 cm X 15 cm	open sun, partial intercrop , shade	rhizomes	max. 200 Q (fresh)
Cinnamon	Seed	May, June, July nursery June, July - planting	Summer season	2 m X 2 m	open sun	bark	-

**a) Korarima (*Aframomum corrorima*)**

It is indigenous to Ethiopia. It is an important cash crop and during favorable period a kilo of dry korarima capsule costs about 120 ETB. Korarima is an obligate shade loving plant like cardamom (*Ellataria cardamomum*) under natural forest condition. Shade level management is one of the key agronomic practices in korarima production.

Korarima can be propagated both by using seeds and by cuttings clumps. The suitable propagation technique is by using seed. The capsules that ripened well are collected during the peak of harvest and seeds are removed from capsules and rubbed with ash to ease handling during sowing. The seeds are kept in shade for to five or more days and sown in a polyteen bag filled with forest solid under shade or if there is no polyteen bag seeds can be put directly in prepared bed. Germination and seedling emergence will be complete during 1 to 2 months time in temporary shade. After establishment the seedling will be transplanted to permanent shade (secondary nursery). Seedlings are transplanted to the field after 8 to 9 months when the summer season starts. Suitable spacing for korarima is 2m x 2 m planting is performed in 30 - 45 cm depth and width hole.

The color of capsules is green first and when it matures and ready for harvest it turns to deep red color. There should be great care while harvesting the capsules of korarima not to create any opening on the capsules since through this opening important components (aroma and flavor) will be quickly lost.

After harvest the capsules should be dried in the sun either in cemented surface or on raised bed, which is clean from any contamination. The capsules should be frequently turned over to have uniform drying. The dried capsules with no cracking are packed with local sack and stored like that of coffee. The storage should be clean, cool and well ventilated place and frequently there should be rechecking of the product to prevent fungus development or decaying by remoistening.

**b) Cardmom (*Electtaria caramoum*)**

Cardamom is indigenous to South India and Sri Lanka, where it grows in evergreen rain

forest. Its introduction and adaptation in Ethiopia is about three decades. Its utilization in Ethiopia is very high and is used in a variety of special foods, vegetables and meat dishes, for flavoring tea, butter, coffee, bread and cakes in ground or whole forms as sole or mixed with other spices. Cardamom is one of the species put as market oriented and can generate a good income for farmers. Cardamom grows in wet climates, in altitudes ranging from 700 to 1400 m and annual rainfall of 1500 to 1700 mm with day temperature of 10 to 35 C. It is a shade obligate plant.

Propagation of cardamom is mostly by seed but can be done vegetatively by clumps. The fruits should be fully ripe and the mucilaginous material covering seed should be removed by washing seeds in water. The washed seeds are drained, mixed with ash and dried under shade for 2 to 3 days and are sown shallow, just buried under surface in prepared beds or preferably in polyteen bag filled with decomposed forest soil. The best time for sowing cardamom is from end of October and in November when fresh seeds are available. Seedlings will be ready for transplanting the next rainy season almost 8 to 9 months age in nursery.

Cardamom can be planted with 2 m x 2 m spacing. Planting is perfumed during the start of the rainy season when there is reliable moisture in the field. Cardamom can start giving yield after 3 years if clumps are used for planting and it takes up to 4 years to give yield if it is raised from seeds.

The main pollination agent in Cardamom is honey bee (*Apis cerana indica*). Maintaining 4 bee colonies per hectare during the flowering season is recommended for increasing fruit set and thereby production of capsules. Cardamom can be intercropped with other horticultural crops like enset, banana and coffee.

The capsules of cardamom are green first and turn to yellow color when ripe. As both ripe and unripe capsules can be found at the same time only ripe ones are collected and the farmer has to visit his field 3 to 4 days interval until final picking.

The harvested fruits are dried on clean surface and are cleaned to remove all stalks and dried remains of floral parts. Its quality is assessed based on appearance, aroma and flavor. These quality criteria are influenced by variety grown, harvesting stage and

drying processes. Cardamom seeds lose their valuable flavor component at a faster rate and should thus be packed in airtight tins.

Long pepper (*Piper longum* L.) apart *P. nigrum* L. is widely used in Ethiopia and provides an oil which to small extent is used as an aromatic in the drinks industry and medicinally. Long pepper is found in the natural forest like korarima and it requires the same environmental factors like that of korarima. It can be propagated using either vegetative (by cutting) or seed. Cutting is preferred since it reduces the period for production. Cuttings can be planted directly to the field. Relatively younger cuttings (clumps) are suitable for propagation. Cuttings with two stems each can be planted in a well prepared pit of 20 cm x 20 cm depth and width.

Harvesting of long pepper is done by picking (cutting) each spike without disturbing the perennial stand. Harvesting is effected when the spike matures. After harvesting the spikes are dried in sun. After drying the spikes turn to dark brown or black in color.

#### **c) Long pepper (*Piper longum* L.)**

Apart *P. nigrum* L. is widely used in Ethiopia and provides an oil which to small extent is used as an aromatic in the drinks industry and medicinally. Long pepper is found in the natural forest like korarima and it requires the same environmental factors like that of korarima. It can be propagated using either vegetative (by cutting) or seed. Cutting is preferred since it reduces the period for production. Cuttings can be planted directly to the field. Relatively younger cuttings (clumps) are suitable for propagation. Cuttings with two stems each can be planted in a well prepared pit of 20 cm x 20 cm depth and width.

Harvesting of long pepper is done by picking (cutting) each spike without disturbing the perennial stand. Harvesting is effected when the spike matures. After harvesting the spikes are dried in sun. After drying the spikes turn to dark brown or black in color.

#### **d) Ginger and Turmeric**

Ginger and turmeric rarely produce inflorescence, if produce seed production is very

seldom, thus these crops reproduce purely vegetative. Both ginger and turmeric are always propagated by division of rhizomes known as seed pieces or sets each having at least one good bud or growing point. The seed pieces or sets are obtained from healthy and disease free plants and plants of good quality and higher yield. The sets should be of uniform size, usually about: 20-50gm in weight depending on the availability of planting material and size of the area.

**Table 8.** Percent essential oil and oleoresin yield for two cardamom varieties at Tepi

Variety	Essential-oil yield (%)	Oleoresin yield (%)	Importing-countries volatile oil content (%)
Tan-82/72	6.1	8.2	3.5 - 7
Ind- 14/79	5.8	7.9	3.5 - 7

Source : Chemistry department of AAU. The solvent used was acetone.

**Table 9.** Comparative importance of individual spices in world trade in the decreasing order

World rank	Spices	Trade (thousand tonnes) (1983-1985)
I	Black and white pepper	125 - 130
II	Capsicums Chilies and paprika	55 - 60
III	Seed spices	55 - 60
IV	Cinnamon and cassia	33 - 34
V	Turmeric	15 - 20
VI	Ginger	15 - 16
VII	Nutmeg and mace	12 - 15
VIII	Cardamom	9 - 10
IX	Curry powder	5 - 6
X	Cloves	3 - 4
XI	Pimento allspice	3 - 4
XII	Vanilla	2 - 3
XIII	Saffron	30 - 50 (tones)

Source : Pruthi, 1998, page 20

**Table 10.** Records on important parameters for promising spices cultivated in Ethiopia

Common name	Scientific name	Varieties	Physical characteristics at 20°C			Colour	Oleoresin yield (%) (w/w)	Essential oil yield (%) (v/w)
			Refractive index	Specific gravity	Optical rotation			
Black pepper	<i>Piper nigrum</i> L.	Bra. 32/79	1.4947	0.9189	-	Light yellow	10.1	2.55
		Pan.4/80	-	-	-	-	9.1	3.20
		Sri.3/80	-	-	-	-	10.0	2.29
		Kuch.5/80	-	-	-	-	10.3	2.49
		T4.17/79	-	-	-	-	10.4	2.53
Ginger	<i>Zingibere officinale</i> Rosc.	Miz.180/73	1.4929	0.9145	-	Light yellow	6.53	1.33
		Mau.37/79	1.4897	0.8838	-34.221	Yellowish	9.22	1.27
		Mar.38/79	1.4918	0.9102	-14.665	Light yellow	7.29	1.47
Cardamom	<i>Elettaria cardamomum</i>	Tan.82/72	1.4655	0.9494	+16.799+9.005	Pale yellow	8.2	6.1
		Ind.14/79	1.4621	0.9368		Light yellow	7.9	5.8
Turmeric	<i>Curcuma domestica</i>	Pak.6/82	-	-	-	-	-	-
		Ind.48/72	-	-	-	-	-	-
Korarima	<i>Aframomum korarima</i> Braun Jansen comb. nov.	Jimma local collection	1.4697	0.9403	-4.747	Light yellow	-	3.5

## References

- 1) Abbink, J. 1995. Medicinal and ritual plants of the Ethiopian South West. An account of recent research, *Indigenous knowledge and development Monitor* 3(2): 6 - 8.
- 2) Abdulhamid Bedri Kello and Sebsib Belay 2004. Promoting production of medicinal plants for human and animal health in and around Bale Mountains National Park. Institute of Developments Research, Addis Ababa University.
- 3) Abdulhamid Bedri Kello, Sebsib Belay, Workneh Negatu and Addisu Asmare 2004. Survey Results. Socioeconomic study of medicinal plants. Institute of Developments Research, Addis Ababa University.
- 4) Abiyot Berhanu 2002. Use and conservation of human traditional medicinal plants by indigenous people in Jabtechnan District, west Gojam, M.Sc. thesis (unpublished).
- 5) Abiyot Berhanu, Zemedede Asfaw and Ensermu Kelbessa 2006. Ethnobotany of plants used as insecticides, repellents and antimalarial agents in Jabitehnan district, West Gojjam\_SINET, *Ethiopian Journal of Science* 29(1): 87-92.
- 6) Akerela, O. 1993. Nature's medicinal bounty: Do not throw it away. *World Health Forum* 14: 390-395.
- 7) Aklilu Lemma 1965. A preliminary report on this Molluscicidal property of *Endod* (*Phytolaca dodecandra*). *Ethiopian Medical Journal* 3: 187-190.
- 8) Altieri, M.A. and Merrick, L.C. 1987. In situ conservation of crop genetic resources through maintenance of traditional farming systems. *Economic Botany* 41(1): 86-96.
- 9) Amare Getahun 1976. Some common medicinal and poisonous plants used in Ethiopian folk medicine. Addis Ababa University.
- 10) B and M Development Consultants PLC. 2001. Socioeconomic and biological survey on the medicinal plants in and around the Bale Mountains National Park, IBCR (unpublished).
- 11) Brehony, E.G. 1988. A study to determine a methodology for linking indigenous community practices in East Africa with outside development intervention strategies. Ph.D. Thesis submitted to National University of Freeland, Department of Agricultural extension, Agribusiness and Rural Development, faculty of

- Agricultural, University College of Dublin.
- 12) Berthaud, J. 1997. Strategies for conservation of genetic resources in relation with their utilization. *Euphytica* 96: 1-12.
  - 13) Conservation International. <http://www.biodiversityhotspots.org/xp/hotspots/Pages/default.aspx>
  - 14) CSA 2004. Statistical Abstracts. Ethiopian Statistical Authority. Addis Ababa. Ethiopia.
  - 15) Dawit A. and Estifanos H. 1991. Plants as a primary source of drugs in the traditional health practices of Ethiopia. In: Engels, J.M.M., Hawkes, J.G and Melaku Worede (eds.), *Plant Genetic Resources of Ethiopia*. Cambridge University Press.
  - 16) Dawit Abebe 1986. Traditional Medicine in Ethiopia. The attempt being made to promote it for effective and better utilization. *SINET. Ethiopian Journal of Sciences*, 9 (supp): 61-69. Faculty of Science, Addis Ababa, Ethiopia.
  - 17) Dawit Abebe 2001. The role of medicine plants in Healthcare coverage of sustainable use of medicinal plants in Ethiopia. *Proceedings of National Workshop on Biodiversity conservation and sustainable use of medicinal plants in Ethiopia*. pp. 6-21.
  - 18) Dawit Abebe and Estifanos Hagos 1991. Plants as a primary source of drugs in the traditional health practices of Ethiopia. In *PGRE*, Engels, Jmm Hankes J.G. and Keleer Worede (eds.) Cambridge University, pp. 101-113.
  - 19) Dawit Abebe and Ahadu Ayehu 1993. Medicinal plants and enigmatic health practices of northern Ethiopia, *BSPE*, Addis Ababa.
  - 20) Dawit Abebe, Asfaw Debella and Kelbessa Urga 2003. Illustrated checklist of medicinal plants and other useful plants of Ethiopia. *Ethiopian Health and Nutrition Research Institute, Camerapix publishers International, Nairobi*.
  - 21) Debela Hunde, Zemedet Asfaw and Ensermu Kelbessa 2004. Use and management of ethnoveterinary medicinal plants by indigenous people in Boosat, Welenchi area, *Ethiop. J. Biol. Sci.* 3 (2): 113-132.
  - 22) Debela Hunde 2001. Use and management of traditional plants by indigenous people of Boosat District Welenchiti area. *MSC Thesis, AAU, (unpublished)*.
  - 23) Dessalegn Desissa 2001. A preliminary economic valuation of medicinal plants in Ethiopia trade, volume and price, pp 176-187, In: Medhin Zewdu and Abebe Demissie (eds.) *Conservation and sustainable use of medicinal plants in Ethiopia. Proceedings of the National Workshop on Biodiversity Conservation and*

- Sustainable Use of Medicinal plants in Ethiopia, Institute of Biodiversity Conservation and research, Addis Ababa.
- 24) Desta Belachew 1988. Ethiopian traditional herbal drugs potentiality and appropriate utilization pp. 763-765, In the proceedings of the 8th International Conference of Ethiopian Studies Vol. I, IES, AAU.
  - 25) Diederichs, N. ed. Commercializing medicinal plants. A southern African Guide, Sun Press.
  - 26) Edwards, S. 2001. The ecology and conservation status of medicinal plants on Ethiopia. What do we know? pp. 46-55, In: medhin Zewdu and Abebe Demissie (eds.) Conservation and Sustainable use of medicinal plants in Ethiopia, Proceedings of National Workshop on Biodiversity Conservation and Sustainable use of medicinal plants in Ethiopia, Institute of Biodiversity Conservation and Research, Addis Ababa.
  - 27) Endashaw Bekele 1978. Biochemical and morphological studies of the relationship of *Eragrostis tef* and some other *Eragrostis* species. M. Sc. Thesis, University of Birmingham, U. K.
  - 28) Ensermu Kelbessa, Sebsebe demissew, Zerihun Woldu and Edwards S. 1992. Some threatened endemic plants of Ethiopia. In Sue Edwards and Zemedede Asfaw (eds.). The status of some plant resources in parts of tropical Africa Botany 2000 East and Central Africa NAPRECA Monograph Series No. 2: 35-55.
  - 29) Ermias Lulekal 2005. Ethnobotanical study of medicinal plants floristic composition of Manna Angetu Moist Montane Forest, Bale, Ethiopia. MSc Thesis. Department of Biology, Addis Ababa University.
  - 30) Faransworth, N.R. and Soejarto, D.D. 1991. Global importance of medicinal plants. In Conservation of medicinal plants (Akerele, O, Heywood, N. Synge, H. eds.) Cambridge University Press, Cambridge, U.K.
  - 31) Fassil Kibebew 1998. The status and availability of data of oral and written knowledge on traditional health care in Ethiopia. A base line study. In: Conservation and sustainable use of medicinal plants in Ethiopia, IBCR.
  - 32) Fekadu Fullas 2001. Ethiopian traditional medicine. Common medicinal plants in perspective. USA.
  - 33) Franz, C 1993. Domestication of wild growing medicinal plants. Plant research and development 37: 101-111.
  - 34) Gebreegziabher, T.B.G. Tadesse, M. Abate, G. Abegaz B, and Biftu, T. 1979. The

- potentiality of traditional healers and indigenous drugs in health care in Africa. 13th Annual meeting of the Association of medical Schools in Africa, April 23-27, 1997, Mimeographed 14 pages.
- 35) Gelahun Abate 1989. Etse Debdabe (Ethiopian traditional medicine) (in Amharic), Pp 244.
  - 36) Gelahun, A., Gebreegziabher, T.B., and Tadesses, M. 1976. A study of the medicinal plants of Ethiopia, Part IA: The identity of some of the plants. Memeographd, Department of Biology, Faculty of Science, Addis Ababa University (in Amharic).
  - 37) Geldenhuys, C and D. Mitchell 2006. Sustainable harvesting technologies. In N. Diedericchs ed. Commercializing medicinal plants. A southern African Guide, Sun Press.
  - 38) Getachew Desalegn and Wubalem Tadesse 2004. Socio-economic importance and resource potential of non-timber forest products in Ethiopia, pp. 13-36. In Proceedings of the first National Workshop on Non-Tiber Forest Products in Ethiopia eds Wubalem Tadesse and Michael Mbogga, Ethiopian Agricultural Research Organization and IPGRI, 5-6 April 2004, Addis Ababa, Ethiopia.
  - 39) Griaule, M. 1930. Le lives, de recettes dun dabtara abyssinien, Paris Institute of de ethnologie
  - 40) Girma Deffa 2003. Non-timber forest products in Ethiopia EC-FAO partnership programme-EC Rome.
  - 41) Guyo, H. 2002. Ethno medicinal study with some phytochemical screening of medicinal plants in Osiolo district, Kenya.
  - 42) Haile Yineger 2005. A study of the Ethno botany of medicinal plants and floristic composition of the dry Afromontane Forest at Bale Mountains National Park. MSc Thesis. Department of Biology, Addis Ababa University.
  - 43) Hareya Fassil 2005. Beyond plants, professionals and parchments. The role of home-based medicinal plant use and traditional health knowledge in primary healthcare in Ethiopia. *Ethnobotany Research and Applications* 3: 037-049.
  - 44) Harlan J.R. 1969. Ethiopia A center of Diversity. *Econ. Bot.* 23: 309-314.
  - 45) Jahn, SAA 1991. The traditional domestication of a multipurpose tree *Moringa stenopetala* (Bak.F.) Cuf. In the Ethiopian rift valley. *Ambio* 20: 244-247.
  - 46) Jansen, P.C.M. 1981. Spices, Condiments and Medicinal Plants in Ethiopia. Their Taxonomy and Agricultural Significance. College of Agriculture. Addis Ababa

- University, Ethiopia and the Agricultural University, Wageningen, the Netherlands, Centre for Agricultural Publishing and Documentation, Wageningen.
- 47) Kebu Balemie 2002. Indigenous medicinal plant utilization and management by kereyu pastoralists in Fentalle, Eastern Shoa. MSc Thesis (unpublished)
  - 48) Kebu Balemie, Ensermu Kelbessa and Zemedede Asfaw 2004. Indigenous medicinal plants utilization, management and threats in Fentale area eastern Shewa, Ethiopia, *Ethiop. J. Biol. Sci.* 3: (1) 37-58.
  - 49) Kloos, H. 1976. Preliminary studies on medicinal plants and plant products in markets of central Ethiopia. *Ethnomedizin* 4(1): 63-103.
  - 50) Kloos, H., Tekle, A., Yohannes, L., Yosef, A. and Lemma, A. 1978. Preliminary studies of traditional medicinal plants in nineteen markets in Ethiopia. *Ethiopian Medical Journal* 16: 33-43.
  - 51) Kupchan, S.M., Komoda, Y., Court, W.A. Thomas, G.J., Smith, R.M., Karin, A., Gilmore, C.J., Haltiwagner, R.C. and Bryan, R.F. 1972. Maytansine, a novel anti-leukemia Ansa macrolida from *Maytenus ovatus*. *Journal of the American Chemical Society* 94: 1354-1356.
  - 52) Lambert, John D.H., Ryden, Per A. and Esikuri, Enos E. 2006. Capitalizing on the Bio-economic value of multi-purpose medicinal plants for the rehabilitation of dry lands in Sub-Saharan Africa. Global Environment Facility. The World Bank.
  - 53) Lemma, A., Heyneman, D. and Kloos, H. 1979. Studies on molluscicidal and other properties of the Endod plant *Phytolacca dodecandra*. special publication, IPB, Addis Ababa University and Department of Epidemiology and International Health, University of California, San Fransisco, California, 194143.
  - 54) Lemordant, D. 1960. *Les plantes ethiopiennes*. Addis Ababa, Central Printing Press.
  - 55) Letchamo, W. and Storck, H. 2006. Spices, aromatic and medicinal plants tarde in eastern Ethiopia. *Acta Horticulturae* 270(1)
  - 56) Maffi, L. 1999. Linguistic Diversity. pp. 19, In: *Cultural and spiritual values of Biodiversity*.
  - 57) Mander, M 1998. Marketing of indigenous medicinal plants in South Africa a case study in Kwazulu-Natal and Agriculture Organization of the United Nations, Rome.
  - 58) Marshall, N.T. 1998. Searching for a cure, conservation of medicinal wildlife resources in East and Southern Africa. TRAFFIV network report.
  - 59) McNeely, J.A. and Scherr, S.J. 2001. *Common Future How Ecoagriculture can help*

- feed the World and Save Wild Biodiversity, IUCN.
- 60) Meknonnen Bishaw, 1988. Integrating indigenous and cosmopolitan medicine in Ethiopia. Ph. D. Thesis, Graduate School, Southern Illinois, University of Carbondale, U.S.A.
  - 61) Meknonnen Bishaw 1990. Promoting traditional medicine in Ethiopia. A brief historical review of government policy social sciences and medicine 33: (2) 193-200.
  - 62) Mercier, J. 1979. Approche de la medicine des debteras. *Abbay* 10: 11-127.
  - 63) Mesfin Tadesse 1991. Some endemic plants of Ethiopia. Ethiopian Tourism Comission, Addis Ababa
  - 64) Mesfin Tadesse 1986. Some medicinal plants of central Shoa and South Western Ethiopia.- *SINET, Ethiopian Journal of Science* 9: 143-167.
  - 65) Mesfin Tadesse and Sebsebe Demissew 1992. Medicinal Ethiopian Plants. Inventory, identification and classification. In Sue Edwards and Zemedede Asfaw eds. *Plants used in African traditional medicine as practiced in Ethiopia and Uganda. Botany 2000, east and Central Africa, NAPRECA, Monograph Series, No.5, Published by NAPRECA, Addis Ababa University, Addis Ababa, Ethiopia.*
  - 66) Ministry of Health 1995. Health sector strategy. Ministry Health, Ethiopia, Addis Ababa.
  - 67) Mirutse Giday 1999. An ethno botanical study of medicinal plants used by the Zay people of Ethiopia. *MSC. Thesis, Uppsala, Sweden.*
  - 68) Mirutse Giday 2007. Medicinal plant of the Bench, Meinit and Sheko cultural groups in Ethiopia with emphasis on use diversity, informant consensus, abundance and habitat. Ph. D Thesis submitted to Addis Ababa University
  - 69) Mirutse Giday, Zemedede Asfaw, Thomas Elmqvist and Zerhun Woldu 2003. An ethnobotanical study of medicinal plants used by the Zay people in *Ethiopian Journal of Ethnopharmacology* 85(1): 43-52.
  - 70) Mulugeta Lemenih and Demel Teketay 2003. Frankincense and myrrh resources of Ethiopia: II. Medicinal and industrial uses. *Ethiopian Journal of Science* 26(2): 161-172.
  - 71) National Herbarium 2004. Biodiversity assessment of the Bale Mountains National Park and surrounding areas. Conservation and Sustainable Use of Medicinal Plants Project.
  - 72) Nkonya, M.H.H. 1992. Progress in the search for anti malarial. NAPRECA

Monograph Series No. 4. Published by NAPRECA, Addis Ababa University, Addis Ababa

- 73) Pankhurst, Richard 1998. The status and availability of written and oral knowledge on traditional health care in Ethiopia. In Conservation and sustainable use of medicinal plants in Ethiopia, Proceedings eds. Medhin Zewdu and Abebe Demisse, 2001. IBCR.
- 74) Pearce, D. and Moran, D. 1975. The economic value of biodiversity. IUCN. Earth Plants Project.
- 75) Pruth, J.S. 1998. Major Spices of India: Crop management Post Harvest Technology. New Delhi: Indian Council of Agricultural Research.
- 76) Schoental, R. and A. Coady 1968. The hepatotoxicity of some Ethiopian and East African plants, including some used in traditional medicines. East African Medical Journal, 45(8): 557-580.
- 77) Schoental, R. 1972. Herbal medicines to avoid. Nature 238: 5359: 106-107.
- 78) Shibru Tedela ed. 1994. Endod Phytolacca dodecandra prospectus Thirty years of development as a molluscicide and detergent. Endod Foundation, Addis Ababa, Ethiopia.
- 79) Strelsyn, S. 1965. Les lecrits medicaux ethiopiens. Journal of Ethiopian Studies 3(1): 82-103.
- 80) Strelsyn, S. 1968. Medicines et plantes d Ethiopie I; Les traits medicaux. Vasovie, Pastowowa Wydawnictwo Naukowe.
- 81) Strelsyn, S. 1973. Medicines et plantes d Ethiopie II: Enquetes sur les noms et l'emploi des plantes en Ethiopie. Intituto Universitario Orientale, Napoli.
- 82) Tesfaye Awas 1997. A study of the plants in Gambella region. MSC. Thesis, Addis Ababa University, Graduate School.
- 83) Thulin, M. 2004. Horn of Africa. In: Hotspots Revisited Earth's biologically richest and most endangered terrestrial ecoregions (eds. Russell A. Mittermier, Patrico Robles Gil, Michael Hoffmann, John Pilgrim, Thomas Brooks, Cristna Goettsch Mittermeier, John Lamoreux and Gustavo A.B. Da Fonseca).
- 84) UNEP 1995. Global biodiversity assesment. United Nations Environment Programme.
- 85) Vavilov, N.I. 1951. The origin, variation, immunity and breeding of cultivated plants, Chronica Botanica 13: 1-366.
- 86) Vivero, J.L. Ensermu Kelbessa and Sebsebe Demessew 2003. The red list of

- endemic trees and shrubs of Ethiopia and Eritrea. IUCN.
- 87) WAAS International 2003. Midterm review report, Conservation and sustainable use of medicinal plants (CSMPP, IBCR).
- 88) WAAS International 2005. Review and analysis of studies made on Bale Mountains National Park, Conservation and sustainable use of medicinal plants (CSMPP, IBC).
- 89) Wilson, R.T. and Gebremariam Wolde 1979. Medicine and Magician Tigre: A contribution to the ethnobotany of the Ethiopian plateau. *Economic Botany* 33: 29-34.
- 90) Zemedet Asfaw 1999. Ethnobotany of Nations Nationalities and Peoples in Gabella, benishagul-Gumuz and Southern regions of Ethiopia (A research Report submitted to the Research and Publications Office of Addis Ababa University, Addis Ababa, pp. 172.
- 91) Zemedet Asfaw 2001. The role of home gardens in the production and conservation of medicinal plants. Pages 76-91. In: Medhin Zewedu and Abebe Demissie eds., Conservation and sustainable use of medicinal plants in Ethiopia. Proceedings of the National Workshop on Biodiversity Conservation and Sustainable Use of Medicinal Plants in Ethiopia, Institute of Biodiversity Conservation and Research. Addis Ababa.