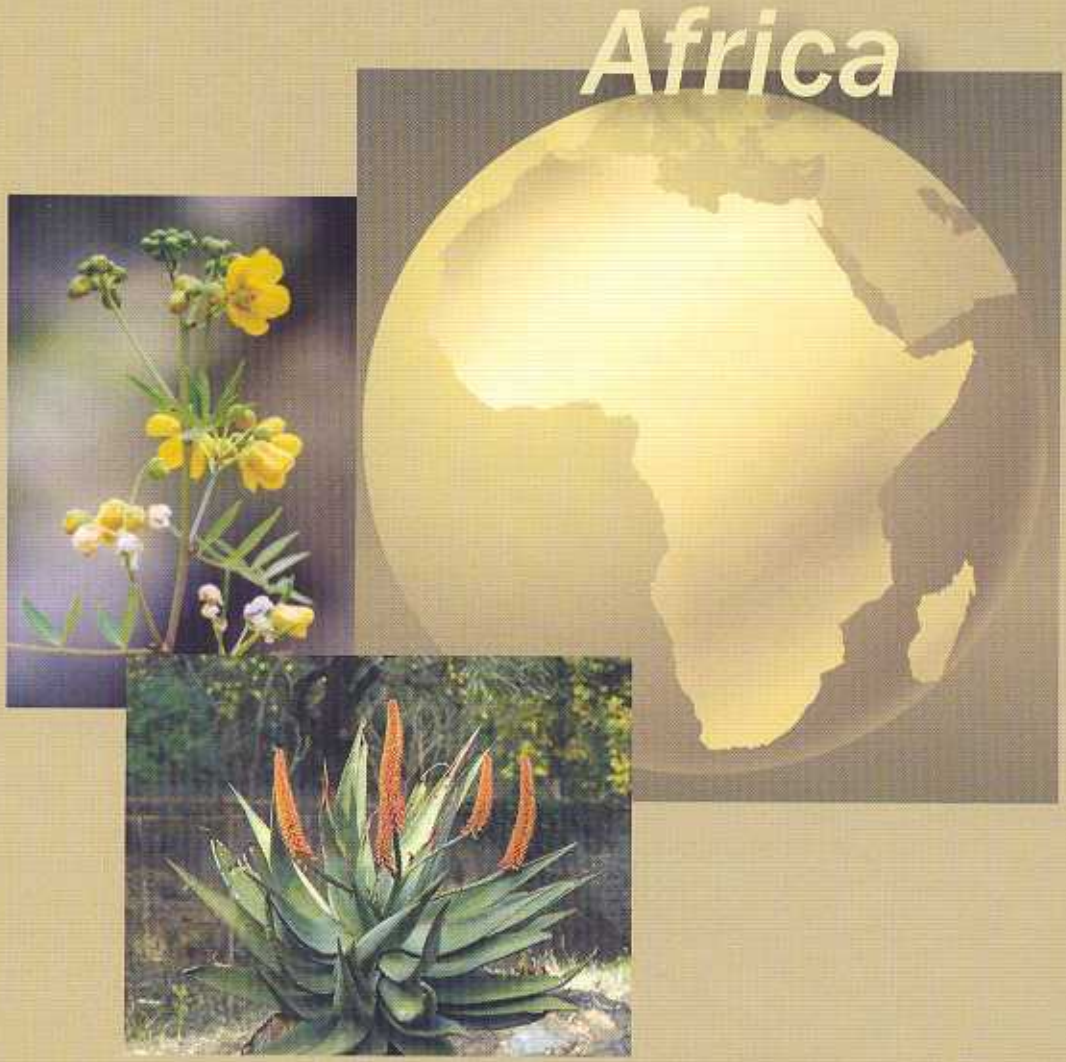
Compendium of

Medicinal and Aromatic Plants

Volume I



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Coverpage insets include pictures of:
Aloe ferox,
Senna alexandrina and
flowering spike of aloe

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Earth, Environmental and Marine Sciences and Technologies
ICS-UNIDO, AREA Science Park
Padriciano 99, 34012 Trieste, Italy
Tel.: +39-040-9228108 Fax: +39-040-9228136
E-mail: elisa.roa@ics.trieste.it

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Medicinal and Aromatic Plants

AFRICA

Karan Vasisht
Vishavjit Kumar

Preface

Africa is the world's second largest continent after Asia, both in terms of area and population. The continent has a unique diversity of geographic and climatic factors and exceptionally rich, varied flora with an estimated 68,000 plant species, of which about 35,000 are known to be endemic. Madagascar is renowned for the highest percentage of plant species endemism in the world.

Despite vast natural resources, most African countries are still struggling to provide basic amenities for their people. Health facilities are deplorable and most of the population continues to rely on traditional remedies derived from medicinal plants. The rich cultural heritage of using medicinal plants for health maintenance could have a wider ramification and potential in discovering new medicines.

Medicinal plant resources in Africa are also the major source of income. In addition to domestic trade, medicinal plants are widely exported in large volumes to the international market. The continent comes second to Asia in export figures. The increased awareness of medicinal plant potential has led to a rising demand for plant medicines in the USA, Europe and Japan. The global market of herbal drugs is estimated to be about US$ 60 bn per year, growing at a rate of 7%. Increasing demand has resulted in unsustainable use of medicinal plants all over the world and particularly in Africa where poverty is widespread, opportunities to make quick profits from the sale of medicinal plants abound, and there is a lack of regulatory mechanisms and their enforcement. Large-scale deforestation has added to the problem.

The situation in the medicinal plant sector has undergone a dramatic change in the last two decades. All over the world much importance is being given to the documentation of knowledge on traditional health remedies, conservation and sustainable use of biodiversity, cultivation, value addition, and development of standards for indigenous drugs. Unfortunately it is difficult to find comprehensive information in this sector at a global level. In an attempt to overcome this lack, the International Centre for Science and High Technology (ICS) is in the process of compiling a compendium of medicinal and aromatic plants for each continent.

The present and first volume in the series is devoted to Africa, that possesses a vast treasure of medicinal plants and has produced some exclusive materials such as *Prunus africana* and pyrethrum for the world market. The compilation, in addition to the resources and status of medicinal plants in each African country, presents an over-

view of the socio-economic importance and ecological impact of the use of medicinal and aromatic plants. The available qualitative and quantitative data on medicinal plant resources, R&D activities, the status of their use in traditional systems of medicine and the trade and marketing situation have been compiled for each country. Most of the information presented is of an indicative nature, primarily based on published and unpublished reports and does not necessarily reflect official views or statistics.

This volume is expected to strengthen the medicinal plant sector in African countries by making comprehensive information on medicinal and aromatic plants available to policy-makers and entrepreneurs to frame effective policies and create an environment conducive to the growth of the plant-based medicine industry, bringing economic benefit to African nations from the rising world demand for medicinal plants. It will help health organizations to improve the health of their people by using their own resources and a less expensive system of medicine, which is accepted by African society. It could also lead scientific communities to augment R&D activities in the field.

Gennaro Longo
Director of Environment Area
Special Adviser on Technology Development

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Introduction

Africa is the world's second largest continent after Asia, both in terms of area and population. The mainland and the island nations in the southwestern Indian Ocean and Atlantic Ocean constitute the floristically rich and diverse sub-Saharan Africa.

Africa has a rich diversity of flora with an estimated 68,000 plant species of which about 35,000 are endemic to the continent. Madagascar has the highest rate of species endemism. About 82% of a total of 10,000 to 12,000 species are endemic to the country. The lowland rainforests of Cameroon, Côte d'Ivoire, Gabon, Liberia and Nigeria; the montane forests of eastern Congo, Rwanda and western Uganda; the coastal areas of Kenya and Tanzania; and the arid lands of Ethiopia, Namibia and Somalia are known as the major centres of species endemism.

Medicinal plants, and the drugs derived from them, are the most important and readily available source of health-care remedies to rural people in Africa. In eastern Africa, many biological resources are used for obtaining pharmaceuticals that have a high national and international economic value. Western Africa is the home to one of the world's largest rainforests constituting many medicinal plant species of commercial importance. There are about 3,000 medicinal plant species in southern Africa of which 10% have found common and widespread uses in traditional health-care systems. Northern Africa has about 10,000 plant species of which around 70% are known to be valuable as food and medicines among other uses. Over 10% of the region's floristic diversity has potential for commercial exploitation and half of them are underutilized.

About 80% of the African population relies on traditional medicine for health-care needs. Some people use traditional medicine only, while others combine it with conventional drugs. The use of medicinal plants by local people accounts for 70% or more of basic health-care treatments in Africa. Traditional medical practitioners (TMPs) are a crucial component of the health-care delivery system. Medicinal plants are used mainly in local, traditional medicine rather than exported to foreign markets. Demand is increasing and often exceeds supply.

The health budget for Africa is largely spent on conventional medicine and

is not sufficient to meet requirements. Public expenditure on health is about 2% of gross domestic product (GDP) and access to health services and sanitation stands at 64 and 49% respectively. In addition, the ratio of modern medical doctors and facilities to population is inadequate. The State cannot afford to provide costly modern medicines for everyone. As a result, most of the rural population relies on TMPs.

Africa accounts for only 5% of global pharmaceutical trade. However, for crude drugs it is next to Asia for the export of medicinal and aromatic plants. Medicinal plants are a common item at urban markets. Most medicinal plant material is exported to Europe and the rest to the USA and Asia. In 1996 about 26,500 tonnes of medicinal and aromatic plant material were exported to Europe.

Most medicinal plant material is sourced from wild collection and some from cultivation. Over-exploitation and habitat destruction of commercially important medicinal plant resources threatens their existence in the wild. The World Bank, the International Development Research Centre (IDRC), and the Danish Agency for Development Assistance (DANIDA), among many other international agencies, are making considerable efforts to conserve African biodiversity. The Missouri Botanical Garden, St. Louis, the USA is collecting specimen samples of tropical flora from Cameroon, Congo, Equatorial Guinea, Gabon, Madagascar and Tanzania, and samples of temperate flora from South Africa for anticancer and anti HIV/AIDS screening programmes of the United States National Cancer Institute. The Royal Botanic Garden, Kew, London, the UK, has a similar project in Africa.

Many African countries have made efforts to formulate policies on traditional medicine, recognized the role of TMPs and established departments of traditional pharmacopoeia. Despite these efforts, many constraints and problems hinder the development of traditional medicine in Africa. Herbal medicines have not been officially recognized in most countries and their regulation and registration have not been established. In countries with apparent recognition, appropriate budgeting to facilitate the functioning of traditional medicine authorities is inadequate or totally lacking. The traditional medicine community operates outside the framework of national legislation for collection and trade in wild species. Many African countries do not have procedures to register medicinal plant preparations although these are widely used by the majority of population. Regulation, if any, is very stringent, requiring the same standards as modern medicines. In brief, it can be concluded that the medicinal plant sector in Africa is highly unorganized.

The increasing interest on medicinal and aromatic plants, the global resurgence of plant-based medicines and their potential to provide viable alternatives to conventional drugs prompted the International

Centre for Science and High Technology (ICS-UNIDO) to prepare a document on the status of medicinal and aromatic plants in Africa. The document presents in-depth information on medicinal plant resources including R&D activities, and the trade and marketing situation in African countries. The intention is to help policy-makers, the scientific community and entrepreneurs to frame effective policies, formulate projects to augment the R&D activities and create an environment conducive to the growth of plant-based medicine. It will help African countries to improve the health of their populations, using their own resources and a system of medicine which is less expensive than modern medicine and already accepted by African society.

Chapter 1

The Status of Medicinal Plants in North African Countries

1.1 Introduction

North Africa includes Algeria, Egypt, Libya, Morocco, Mauritania and Tunisia (Walter, 2001). The region consists of the biota of semi-closed Mediterranean and Red seas, with diverse ecosystems constituting about 10,000 vascular plant species (Hegazy, 2000, 2000a). It has arid, semi-arid and a range of sub-climatic zones. The Mediterranean basin is one of the 25 internationally recognized biodiversity hot spots in the world and it has extraordinary plant diversity and species endemism. Morocco has the highest rate of species endemism in the region (WCMC, 1992).

About 70% of plant species found in the wild have medicinal, aromatic and other uses. Over 10% of these have the potential for commercial exploitation as a source of drugs and pharmaceuticals (Ucko and Dimbleby, 1969; WWF and IUCN, 1994; UNESCO/UCO, 1998). There is potential for developing herbal-based industry in the region.

1.2 Algeria

In Algeria, there are about 3,164 species of vascular plants (EGA, 2001). Medicinal and aromatic plants are used by the local communities as well as by TMPs. The most widely used medicinal plant species include *Adansonia digitata* L., *Acacia albida* Delile, *A. nilotica* (L.) Delile, *Boscia senegalensis* (Pers.) Poir., *Balanites aegyptiaca* Del., *Anogeissus leiocarpa* (DC.) Guill. *et al.*, *Salvadora persica* L., *Commiphora africana* Engl., *Prosopis juliflora* (Sw.) DC. and *Sclerocarya birrea* (A. Rich.) Hochst. (FAO, 1992).

As regards the Algerian Public Health Code of 23 October 1976, the practice of medicine without a licence is an offence (Anonymous, 1978). Herbalists are allowed to practise traditional medicine without a licence under the Section 364 of the Code. This monopoly on the practice of medicine was retained and fortified in the Law 85-05 of 16 February 1985 relating to health protection and promotion, which replaced the Code from 1976 (Anonymous, 1985). The broad language of provisions contained in Section 214 emphasizes the exclusion of traditional medicine.

1.3 Egypt

Egypt has a long history of use of medicinal and aromatic plants and drugs, prevalent since the pre-dynastic Amratian, Badarian and Gerzean cultures. Egyptian knowledge of medicinal plants, their uses and methods of application was supposedly enriched in the period from 600 to 3000 B.C., following the migration of people from Abyssinia to the Nile Valley. Evidence of widespread use of medicinal and aromatic plants in ancient Egypt was found in the fossil studies of food remains in the intestinal tracts of the mummies of the Kings of the First Dynasty (3000 B.C.) and presence of flower essences coupled with medicinal herbs in the tombs of the Kings of the Fourth Dynasty. The earliest written record of herbal medicines practice in Egypt was found in the medical books "Ebers Papyrus", dating back to the sixteenth century B.C. These books contain 877 prescriptions and recipes based on many medicinal and aromatic plants. The medicinal plants mentioned (opium, cannabis, myrrh, frankincense, castor oil, fennel, senna, thyme, henna, juniper, linseed, aloe and garlic) are still in use. The ancient Egyptian herbal medicines were respected in the Mediterranean world and herbal knowledge was payed with gold, copper and slaves.

Ever since the days of Cleopatra, Egypt has been closely associated with the perfume and cosmetics industry, while Alexandria has long been the main schooling centre for herbal medicines.

Traditional Systems of Medicine

The practice of traditional medicine in Egypt is limited to very few TMPs (WHO, 1992). In Egypt, all herbal preparations and products should meet the same standards as manufactured chemical preparations. Herbal preparations and products are manufactured in a licensed pharmaceutical plant according to local and international good manufacturing practices (GMPs). These products are registered with the Central Administration of Pharmaceutical Affairs. The National Organization for Drug Control and Research is responsible for undertaking medicinal plant analysis and inspection of herbal preparations and products for safety. Herbal preparations and products are priced according to the law and are distributed exclusively to pharmacies.

Medicinal Plant Resources

The most impressive characteristic of Egypt is the presence of several oases that represent enclaves for special rare and endemic plants. In Egypt, a total of 2,121 species of native and naturalized vascular plants can be found and out of these, 54 are endemic (Madcour and Zeid, 1996). Egypt is home to many wild relatives of pastoral medicinal and aromatic plants and food crops.

The southern Sinai Peninsula is an important centre of plant diversity. It is strongly influenced by the continental flora and is one of the globally significant arid

and semi-arid ecosystems that capture high inter-specific endemism. Out of 316 plant species recorded in the plant inventories of the St. Katherine protectorate of the Peninsula, 102 are used for their medicinal, aromatic, cosmetic and culinary properties. Forty-seven species have been considered as potential medicinal plants for human use and nine species for veterinary purposes. Bedouins, the inhabitants of the St. Katherine protectorate, have ample knowledge of medicinal plants and their uses and rely on them as a source of income. Bedouin women traditionally collect and use these plants for medicinal, aromatic and culinary use (Hobbs, 1985). The over-exploitation of medicinal plant resources to meet increased demand from local consumption, traditional healers (Hakims) and medicinal plant traders threaten the existence of many important species of commercial value. Some important medicinal and aromatic plants are given in Table 1 (UNDP, 2001).

The Egyptian soil is world-famous for growing high-quality plants. Many medicinal plant species are cultivated in the country. About 35,000 feddans (2.52 mn hectare) of total arable land of 6 mn feddans (14,709 mn hectare) is under medicinal and aromatic plants cultivation (Anonymous, 2001). Medicinal plants cultivation is mainly concentrated in the regions of Assuit, Fayyoum, Aswan and Matrouh, Sharq al-Owainat and Siwa Oasis. Rosemary, wild thyme, sweet basil and henna are the commercially cultivated plant species. Organic production techniques have also been successfully tried. As organically produced medicinal plant material is in considerable demand on the international market, the organic production techniques could play an instrumental role in regaining the country's position on the international market.

The state has established an authority to make an inventory of wild plants of medicinal value, registering them as a means of protecting private property and introducing a mechanized farming system for their production. As a result of the efforts, more arable land has been brought under commercial cultivation of medicinal plants. Some cultivated medicinal plants of high economic value are given in Table 2 and 3 (UNDP, 2001).

The leaves and flowers of *Origanum majorana* L. are in considerable demand as flavouring agents in the food industry. They are sourced from the Nile Valley. Various aromatic herbs or undershrubs of the genera *Origanum* and *Majorana* are also called marjoram. A list of some commercially exploited medicinal and aromatic plants in Egypt is given in Table 4 (UNDP, 2001).

Herbal Drug Industry in Egypt

The demand for medicinal and aromatic plants is increasing both at domestic and international level. The Egyptian pharmaceutical industry was worth US$ 649.60 mn in 2000. The annual import of herbal medicines grew to US$ 1.9 mn in 2000 from

Table 1: Some important medicinal and aromatic plants of Egypt

Botanical name	Part(s) used	Therapeutical uses/indications
Achillea fragrantissima (Forssk.) Sch. Bip.	Leaf	Eye lotion, colic
Aerva javanica (Burm. f.) Juss. ex Schult.	Root	Acne like conditions of the face
Anabasis articulata Moq.-Tand. & DC.	Whole plant, branch	Skin diseases, soap industry
Apium graveolens L.	Fruit	Bladder diseases
Artemisia herba-alba Asso	Whole plant	Antispasmodic, antiflatulent
Artemisia judaica Lour.	Whole plant	Antispasmodic, anthelmintic, insect repellent
Atraphaxis spinosa L.	Whole plant	Antidiabetic, skin allergy
Balanites aegyptiaca Del.	Seed, fruit, flower, bark and root	Abdominal pain, purgative, antimalarial, antisyphilis, antirheumatic, skin and gastro-intestinal problems, cold, fever
Ballota undulata (Sieber ex Fresen.) Bentham	Whole plant	Skin allergy
Capparis cartilaginea Decne.	Whole plant, fruit	Antirheumatic
Capparis spinosa L.	Whole plant, branch	Antirheumatic
Citrullus colocynthis (L.) Schrad.	Fruit pulp and seed	Purgative, gastro-intestinal stimulant
Cleome chrysantha Decne.	Whole plant	Anthelmintic, infantile convulsions
Cleome droserifolia Delile	Whole plant	Anthelmintic, infantile convulsions
Coriandrum sativum L.	Fruit, leaf	Carminative
Crotalaria aegyptiaca Benth.	Whole plant	Antitumour
Cymbopogon proximus (Hochst. ex A. Rich) Stapf	Leaf	Antispasmodic
Fagonia mollis Del.	Leaf	Antibiotic
Foeniculum vulgare Mill.	Seed	Skin lotions, stomachache
Glinus lotoides L.	Whole plant	Diarrhoea, bilious attacks
Globularia arabica Jaub. & Spach	Whole plant, root	Burned skin, stomach diseases
Hammada elegans (Bunge) Botsch.	Leaf, seed	Labour problems
Haplophyllum tuberculatum (Forssk.) A. Juss.	Whole plant	Analgesic
Heliotropium supinum L.	Whole plant	Veterinary medicine
Hibiscus sabdariffa L.	Bud	Herbal tea
Hyoscyamus muticus L.	Leaf	Bronchial diseases
Jasione montana L.	Whole plant	Antispasmodic, kidney diseases, emetic
Juncus spp.	Seed	Labour problems
Matricaria recutita L.	Flower	Herbal tea
Mentha longifolia (L.) Huds.	Whole plant, leaf	Antispasmodic
Ochradenus baccatus Delile.	Whole plant	Hair tonic
Ocimum basilicum L.	Whole plant	Nausea, diuretic in kidney diseases
Ocinum menthaefolium Hochst. ex Benth.	Leaf, whole plant	Analgesic
Origanum syriacum L.	Seed, root	Urine retention, toothache

Continued

Table 1 continued

Botanical name	Part(s) used	Therapeutical uses/indications
Peganum harmala L.	Seed	Dental lotions
Pimpinella anisum L.	Dried powdered leaf	Kidney failure, cancer
Pimpinella schweinfurthii Aschers.	Leaf, flower and small branch	Herbal tea
Psoralea plicata Del.	Leaf, branch and bark	Antibiotic for wounds, antiemetic
Pulicaria spp.	Root	Antiemetic
Retama raetum (Forssk.) Webb	Branch	Antirheumatic, analgesic, stimulant and tonic in amenorrhoea
Rhus tripartita (Ucria) DC.	Flower, leaf	Expectorant,cold
Salvadora persica L.	Leaf and pod	Purgative
Salvia acetabulosa L.	Leaf	Urinary tract diseases, antiseptic
Senna alexandrina Mill.	Whole plant	Bronchial asthma
Solenostamma arghel Hayne	Whole plant, root	Digestion, skin diseases
Stachys aegyptiaca Person	Whole plant	Antispasmodic, antiallergenic
Teucrium polium L.	Whole plant	Antispasmodic, skin allergy
Thymus decussatus	Leaf, whole plant, flower and root	Antispasmodic, toothache

a range of US$ 0.43 to 0.64 mn in 1999. Most of the imports originate in China, Taiwan and India (Gutberelt, 2000).

In order to recover the lost glory of the herbal industry in Egypt, the government is promoting local production of herbal medicines by making importation more difficult. Recently, the government has raised non-tariff barriers on imports of herbal medicines in order to support the local pharmaceutical industry in the production of food additives and herbal medicines. There are about 150 herbal medicines currently registered at the Egyptian Ministry of Health as food additives. Since January 2000, in a bid to follow government policy, 45 herbal products registered as imported food additives have been re-registered as locally manufactured products.

Table 2: Cultivated medicinal plant species in Egypt

Achillea fragrantissima (Forssk.) Sch. Bip.
Apium graveolens L.
Artemisia herba-alba Asso
Citrullus colocynthis (L.) Schrad.
Coriandrum sativum L.
Foeniculum vulgare Mill.
Matricaria recutita L.
Mentha longifolia (L.) Huds.
Ocimum basilicum L.
Ocimum menthaefolium Hochst. ex Benth.
Origanum syriacum L.
Pimpinella anisum L.
Ziziphus spina-christi (L.) Willd.

Ragab Pharma is the major herbal importer in the country. Its pharmaceuti_

cal division imports herbal medicines from European manufacturers such as Alsitan (Germany), Cefac (Germany), Richelet (France) and Arkopharma (Switzerland). It is now taking the lead in home-based manufacturing of herbal medicine. In this direction, two new factories in Cairo and Alexandria have started production of five herbal medicines since October 2000.

Table 3: Potential medicinal plants of Egypt for commercialization

Capparis sinaica
Capparis spinosa L.
Hyoscyamus muticus L.
Lavandula coronopifolia Poiret.
Lavandula pubescens Decne
Moringa peregrina Fiori
Senna spp.
Solonostemma arghel Hayne
Thymus decassatus
Varthemia montana (Vahl) Boiss.

Sekem Biological Products Laboratories is the major herbal medicine manufacturer. The company produces a wide range of herbal medicines for a variety of illnesses including constipation, diarrhoea, cough and the common cold. Most of the medications are registered as food additives, only a few as herbal drugs. The medications registered as herbal drugs are for immunology and neuro-psychiatric disorders. Sekem relies on integrating locally available inputs in the manufacturing process. In a joint venture with Gebrueder Schaette, Germany the company manufactures an array of natural pharmaceutical products used in the treatment of heart disorders, cancer, hepatitis and psychological, immunological and gastrointestinal disturbances. It exports to U. Walter GmbH (Germany), and Euro Herb bio B.V. (The Netherlands).

Arasi Lawrence Company, based in Assiut, processes essential oils and absolutes for domestic use and export. It also exports crude drugs. There are several Cairo based companies dealing with herbal medicinal products, such as Chemical Industries Development (CID) and El-Kahiro Company that export medicinal herbal teas, natural products and cosmetics to most Arabian, some African and European countries. The Memphis Company manufactures and exports extracts, phytopharmaceuticals and crude drugs to Asia, Europe, the USA and Canada.

The Egyptian fragrance and flavour industry has become one of the most sophisticated industries in the region, with companies exporting raw materials and finished products to the Middle East, Africa and Europe. Products such as jasmine, geranium, basil and chamomile are exported.

In addition to jasmine, chamomile, geranium, myrrh, basil, mint, thyme, rosemary oils and henna, many other herbs have considerable industrial potential in Egypt. *Cymbopogon proximus* (Hochst. ex A. Rich) Stapf is used as a source of active constituent of proximal, an antispasmodic drug. It is interesting to note that the market value of *C. proximus* (Hochst. ex A. Rich) Stapf as a dry plant material exceeds

Table 4: List of some medicinal and aromatic plant species exported from Egypt

Botanical name	Common name	Part(s) used
Achillea fragrantissima (Forssk.) Sch. Bip.	Yarrow	Whole plant
Anethum graveolens	Dill	Seed
Artemisia herba-alba Asso	Wormwood	Leaf
Artemisia judaica Lour.	Judean wormwood	Leaf
Calendula officinalis L.	Calendula	Petal
Capsicum annuum L.	Hot red pepper	Fruit
Senna alexandrina Mill.	Senna	Leaf
Carum carvi L.	Caraway	Seed
Citrullus colocynthis (L.) Schrad.	Colocynth	Dry fruit
Citrus spp.	Small dried orange	Dry fruit
Corchorus olitorius L.	Jew's mallow	Leaf
Coriandrum sativum L.	Coriander	Seed
Eurca sativa	Rocket	Seed
Foeniculum vulgare Mill.	Common fennel	Seed
Glosrostemo bruigurei	Moghat	Root
Glycyrrhiza glabra L.	Liquorice roots	Root
Hibiscus sabdariffa L.	Hibiscus	Flower
Hyoscyamus muticus L.	Egy. henbane	Whole plant
Lactusa virosa L.	Lettuce	Seed
Lawsonia inermis L.	Henna (Egyptian)	Leaf
Ocimum basilicum L.	Basil	Leaf
Origanum majorana L.	Marjoram	-
Matricaria recutita L.	Chamomile	Flower
Mentha spicata L.	Spearmint	Leaf
Mentha piperita L.	Peppermint	Leaf
Portulaca oleracea L.	Regla	Seed
Punica granatum L.	Pomegranate	Dry fruit
Ricinus communis L.	Castor oil plant	Seed
Solenostemma arghel Hayne	Arghel	Flower
Tamarix spp.	Manna tamarisk	Whole plant
Urginea maritima (L.) Baker	Squill	Whole plant
Zygophyllum coccineum L.	Bean caper	Fruit

that of the processed extract. The price of the extract ranges from US$ 647.59 to 1,295.20 per tonne, depending on the level of processing.

Balanites aegyptiaca Del. has potential for industrial utilization of its saponins. Despite its nutritional and medicinal value, balanites is practically not used in Egypt, probably because of its scattered natural growth in relatively small areas (Belal *et*

al., 1998). *Hyoscyamus muticus* L. is known to contain a number of tropane alkaloids widely used for their mydriatic, antispamodic and antiasthmatic properties. It is a potential natural source of drugs for the pharmaceutical industry. Some drug companies have started to use *Salvadora persica* L. extract in the manufacture of toothpaste. *Jatropha curcas* L. is a promising and commercially viable alternative to diesel oil. It has desirable physicochemical and performance characteristics comparable to diesel (Reyagh, 1997).

Trade and Marketing

Medicinal, aromatic and spice crops have the potential to boost Egyptian exports. The potential export of these crops lies in growing world demand. Trade in medicinal plants plays only a small role in the Egyptian economy, although there is an expanding private sector, which cultivates and processes medicinal plants. Egypt is world famous for its high-quality raw material of over 150 medicinal and aromatic plants.

The annual export of medicinal plants is more than US$ 43.17 mn. High quality added value crops such as chamomile, fennel, and peppermint have the potential to boost Egyptian exports. The country is the main supplier of German chamomile (*Matricaria recutita* L.). About 500 to 600 tonnes of Egyptian henbane (*Hyoscyamus muticus* L.) are exported annually to Germany. Alexandrian senna (*Senna alexandrina* Mill.), which grows wild and is cultivated, is also a significant export item. Major markets for medicinal plants trade in Egypt are Attarin in Cairo, El-tour, Sharm El-Sheikh and Dahab. The small-scale pharmaceutical production units in El-tour also export some quantity of medicinal plant material.

In 1998, 5 tonnes plant material of each, *Artemisia herba-alba* Asso and *Senna alexandrina* Mill., were exported from St. Katherine protectorate. Most of the country's demand for medicinal plants is sourced from the wild. The cost data for medicinal plant cultivation in the Nile Valley indicate a net revenue that ranges between US$ 5,000 and 13,290 per hectare. The indicative prices of some medicinal plants on the Cairo market are shown in Table 5 (UNDP, 2001).

Table 5: Indicative prices of some medicinal plant species on the Cairo market

Botanical name	Average retail price (US$/kg)
Artemisia judaica Lour.	10.79
Artemisia herba-alba Asso	3.88
Cleome droserifolia Delile	6.47
Mentha longifolia (L.) Huds.	10.79
Origanum syriacum L.	3.88
Salvia acetabulosa L.	6.47
Senna alexandrina Mill.	2.81
Teucrium polium L.	8.63
Thymus decussatus	9.71

Egypt is one of the leading African exporters of medicinal and aromatic plant material to the international market. The

country is the fifth biggest exporter of medicinal plants worldwide. In the period between 1992 and 1995, Egypt exported 11,250 tonnes of medicinal plant material per year, worth US$ 12.35 mn (Lange and Mladenova, 1997). In 1995, the annual export of plants used for pharmaceutical, perfumery, insecticidal and fungicidal purposes (HS 1211) was valued at US$ 13.79 mn. During the period 1993-97, the export volume to the European Union registered an average of 4,266 tonnes. In 1999, 3,574 tonnes of dried basil leaf, worth US$ 5.1 mn, were exported to the USA, primarily from Egypt and Mexico. Egypt also supplies smaller amounts of Hibiscus to the international market. The main crops exported are mint (*Mentha* spp.), basil (*Ocimum* spp.), sage (*Salvia* spp.), plants for herbal teas and plants utilized for perfumery, insecticidal and fungicidal purposes. In 2001, Egypt exported 134.67 tonnes of mint leaves (fresh and dried) worth US$ 0.19 mn, 2,712 tonnes of basil (fresh and dried) worth US$ 3.61 mn, 740 kg of sage (*Salvia* spp.) worth US$ 4,000, 217.79 tonnes of plants and plant parts used as herbal teas worth US$ 0.47 mn, and 117.16 tonnes of plants used in perfumery, insecticidal, fungicidal or similar purposes worth US$ 0.25 mn.

1.4 Libya

Libya has a total area of 1,759,540 square km of which about 90% is Sahara desert, with scattered oases. The largest oasis, Alkufra, lies beneath the desert rock and has a huge underground water supply. The rest of the landmass is covered by a semi-desert region with sparse grazing lands for sheep, goats, camels and cattle, and natural farmland along the Mediterranean coast. On the northwestern plains and in the northeastern highlands, farmers use mainly traditional methods to grow crops such as oranges, olives, almonds, wheat and grapes.

Medicinal Plant Resources

In Libya there are about 1,825 vascular plant species, of which 134 are endemic. About 450 species are reported to be of medicinal value (Auzi, 1999). Some important plant families are Apiaceae, Asteraceae, Lamiaceae, Poaceae, Fabaceae, Brassicaceae and Abiaceae. Medicinal plants are distributed all over the country especially in the Al-Jabel Al-Akhdar, Ghadames, Gharian, Awbari and Tarhona regions. Many of these plants are associated with a long history of traditional use (Table 6) (Guenther, 1972; Rateeb *et al.* 1996). More than 100 species are extensively used by Bedouins and local people in folk medicine drinks, or chewed fresh or dry. They are used to cure dermal diseases, viral or bacterial infections, insect or animal bites, burns and sometimes to treat hair problems. These medicinal plants are very well documented in different floras (El-Gadi and Bshana, 1992; Kotb, 1985). Many species of medicinal plants such as *Cupressus sempervirens* L., *Pinus halepensis* Mill., *Juniperus phoenicea* L.,

Quercus coccifera L., *Asperula arvensis* L., *Tribulus longipetalus* Viv., *Veronica cymbalaria* Bodard and *Vahlia dichotoma* (Murray) Kuntze are threatened because of over-harvesting and diversion of forest land to agriculture (Faraj *et al.*, 1988; Al-Idrissi *et al.*, 1996). There is an urgent need to initiate programmes for collection and conservation of endangered and rare plant species to save them from extinction as a result of heavy grazing, human use and drought hazards that occur with increasing frequency.

The most famous medicinal plant of Libya is *Silphium cyrenaicum* (now extinct). It existed during Greek and Roman times (900 to 100 B.C.). It was used for the treatment of many illnesses and was so important to the economy that was sold by weight with silver or gold and it was depicted on coins (Rateeb *et al.*, 1996). It has been reported that *Silphium* grew abundantly in Cyrenacia (Al-Jabel Al-Akhdar region) but heavy exploitation led to its extinction hundreds years ago. Many scientists such as Keith (1965), Abulugma (1985), Alganay (1994) and Kamal (1999) have suggested different species for *Silphium,* but their suggestions are questionable.

The herbal medicines most in demand are chamomile, thyme and rosemary. Libya exports medicinal plants to Egypt. Trade is handled by the private sector. About 30% of the population relies on traditional medicine in Libya. The Ministry of Health is planning to establish herbal medicine clinics as well as good manufacturing practices in the production of herbal medicinal products, which are mostly imported from Italy and other European countries. There is a lack of information on formal trade of medicinal and aromatic plants.

R&D Activities

Scientific studies of the Libyan flora began about 200 years ago when the Swedish scientist Joran Rothman (1773-1776) collected many plant samples from western Libya and stored them at the Riks Museum in Sweden. Since then, countless collectors and travellers have visited Libya, and there has been considerable interest in the plants of the region. A number of world scientists have undertaken botanical expeditions in the country. P. della Cella (1817) collected plants from the eastern part of the country (Bomba gulf), D. Viviani (1824) wrote the book *Flora Libycee Speciments* and included 1,200 plant samples, and Barratte & Durrand (1910) wrote a book on *Flora Libycee Prodromus* with 1,156 plant samples. During the Italian occupation, R. Pampanini published *Plantae Tripolitanae* in 1914 and *Predromo della Flora Cirenaica* in 1931. In 1942, R. Corti visited the southen parts of the country, Fezan and Ghat, and wrote a book about his visit. In 1965, H. G. Keith published two volumes of *A Preliminary Checklist of Libyan Flora* and during the period from 1976 to 1988, a group of Libyan scientist published *Flora of Libya* comprising 145

Table 6: Libyan medicinal and aromatic plants and main traditional use

Botanical name	Family	Therapeutical uses/indications
Achillea santolina L.	Asteraceae	Expectorant, carminative, anthelmintic
Ajuga iva Schreb.	Lamiaceae	Antiemetic, antidiarrhoeal
Alhagi maurorum Medik.	Fabaceae	Antirheumatic, laxative, diuretic
Aloe vera (L.) Burm. f.	Aloaceae	Emmenagogue, promotes hair growth
Ammi majus L.	Apiaceae	Carminative, antispasmodic
Anvillea garcinii (Burm. f.) DC.	Asteraceae	Hypoglycaemic
Artemesia herba-alba Asso	Asteraceae	Vermifuge (against worms for babies)
Artemesia judaica L.	Asteraceae	Common cold, hypoglycaemic, anthelmintic
Borago officinalis L.	Boraginaceae	Antirheumatic
Capparis spinosa L.	Capparaceae	Expectorant, diuretic, antirheumatic
Cassia obovata Collad.	Fabaceae	Purgative
Ceratonia siligua L.	Fabaceae	Tonic, demulcent
Citrullus colocynthis (L.) Schrad.	Cucurbitaceae	Purgative or hydragogue
Cynara cardunculus L.	Asteraceae	Diuretic, laxative, antianaemic
Cynara scolymus L.	Asteraceae	Hypoglycaemic, hypocholesterolemic
Cynomorium coccineum L.	Balanophoraceae	Laxative
Datura stramonium L.	Solanaceae	Antispasmodic, mydriatic, leaves smoked for asthma
Ecballium elaterium (L.) A. Rich.	Cucurbitaceae	Jaundice
Ephedra alata Decne.	Ephedraceae	Antiasthmatic
Eruca sativa Mill.	Brassicaceae	Tonic, aphrodisiac
Globularia vulgaris L.	Scrophulariaceae	Diuretic
Helichrysum stoechas (L.) Moench	Asteraceae	To clear small calculi
Hyoscyamus albus L.	Solanaceae	Sedative, analgesic (small dose), hallucinogenic (large dose)
Juniperus communis L.	Cupressaceae	Digestive, antiseptic, renal stimulant
Lavandula multifida L.	Lamiaceae	Insect repellent, perfume
Lepidium sativum L.	Brassicaceae	Expectorant
Lupinus albus L.	Fabaceae	Hypoglycaemic, hypotensive
Marrubium vulgare L.	Lamiaceae	Hypoglycaemic
Peganum harmala L.	Zygophyllaceae	Anthelmintic, antibacterial, protozoacidal
Plantago major L.	Plantaginaceae	Antimalarial, ear ache, dysentery
Ruta graveolens L.	Rutaceae	Expectorant, convulsion, jaundice
Salvia officinalis L.	Lamiaceae	Nervous disorders, dizziness, trembling
Teucrium polium L.	Lamiaceae	Hypoglycaemic, common cold
Thymus capitatus L.	Lamiaceae	Tonic, carminative
Trigonella foenum-graecum L.	Fabaceae	Tonic, anabolic and lactagogue
Urtica urens L.	Urticaceae	Haemostatic, antianaemic, hypoglycaemic
Viola tricolor L.	Violaceae	Urinary problems, diaphoretic
Withania somnifera (L.) Dunal	Solanaceae	Hypotonic, aphrodisiac

volumes, one for each family.

The Libyan Medicinal and Aromatic Plant Research Programme was set up in January 2001 (2001-2005) at the Faculty of Pharmacy, University of Elfateh, Tripoli (Auzi, 1999). The programme focuses on the chemical and biological evaluation of Libyan medicinal and aromatic plants. Agronomical studies are aimed at providing information on the growth of medicinal and aromatic plants and the properties of their oils and active constituents (El-Gadi and Bshana, 1992). These studies and investigations include the effect of radiation on the quality of medicinal plants, soil analysis and cultivation techniques.

The second programme for the establishment of a Libyan National Herbarium has been proposed by the Ministry of Environmental General Authority (EGA), Tripoli. The objectives of the programme are to provide a better understanding and wider knowledge of the systematics, evolution, ecology and conservation biology of major groups of Libyan native plants and their relatives.

The third programme, led by the Ministry of Environmental General Authority, started in January 2001 and concentrates on the creation of a database on Libyan Flora in order to make available and disseminate valuable knowledge to a wide client base.

The faculties of pharmacy of the University of Elfateh, Tripoli and the University of Garyounis, Bengazi are involved in phytochemical and biological screening of the country's medicinal and aromatic plants. The faculties of science of both the universities are involved in botanical explorations and identification of plants of economic importance. The Biotechnology Research Centre and the Agricultural Research Centre, under the Ministry of Environment and the Ministry of Agriculture respectively, are engaged in the conservation of genetic resources of plant species of medicinal value.

Opportunities and Constraints

Medicinal and aromatic plants are an important source of drugs in Libya. The country has a vast area and a variety of geographic conditions suitable for cultivation of aromatic and medicinal plants. There is scope for the establishment of small-scale phytochemical industries.

There is a lack of R&D activities in the field of medicinal plants. As a result of over-exploitation, some plants have become rare and endangered. There is also an imminent threat of genetic erosion of medicinal plant species because of an increase in heavy grazing, human use and drought hazards. The economic constraints of the country mean that international assistance is needed for collection and conservation of the genetic resources of endangered species of medicinal value.

1.5 Morocco

Morocco has about 3,675 vascular plants species, of these about 650 have been reported to be endemic (EGA, 2001).

In terms of export volume, in the late 1990s the country was the second largest exporter of medicinal plants material from Africa and the ninth at international level (Lange and Mladenova, 1997). The country predominantly exports aromatic plants and essential oils. In 1994, about 508,200 tonnes of aromatic plants and essential oils worth about US$ 168.91 (1.7 bn Moroccan Dirhams) were exported (Hmamouchi, 1997). The aromatic plant and essential oil sector account for a major share of the economy of the country and have great potential to earn more foreign revenue. In the period between 1992 and 1995, Morocco exported 6,850 tonnes of medicinal plants worth US$ 12.85 mn to the international market.

1.6 Tunisia

Tunisia has about 2,196 reported vascular plant species of which 151 are rare, threatened or endemic. It has an arid climate with steppe vegetation. The steppes are rich in aromatic and medicinal plant species traditionally used for health care by the local communities and TMPs. The Matmata mountain range, which runs across South Tunisia from east to west, is rich in medicinal plant resources. The Zammouris community makes use of these plants in the preparation of health remedies. The forest region of the El Feija mountain areas, located in northeastern Tunisia, constitutes about 700 vascular plant species, including a number of endemic species such as *Myrtus communis* L., *Arbutus unedo* L., *Erica arborea* L. and *Crataegus monogyna* Jacq. The collection of aromatic plants from the wild and distillation of essential oils, in particular of lavender (*Lavandula* spp.) and myrtle (*Myrtus communis* L.), are the traditional activities of the people of the El Feija region. The local authorities regulate myrtle collection and only small quantities of lavender are allowed to be harvested from the wild to meet local demand. Rosemary (*Rosmarinus officinalis* L.), myrtle (*Myrtus communis* L.) and other medicinal plants are products of high socio-economic importance. Rosemary is cultivated on 340,000 hectares of land and myrtle on 80,000 hectares. These essential oils are in considerable demand on the international market by the perfume industry. Eucalyptus (*Eucalyptus cinerea* f. Muell. ex Benth. and *Eucalyptus citriodora* Hook.) leaves are also collected for distillation of eucalyptus oil (El Adab, 1993).

The most widely used spices in the country are *Allium roseum* L., *Anethum graveolens* L., *Carthamus tinctorius* L., *Carum carvi* L., *Coriandrum sativum* L., *Cuminum cyminum* L., *Foeniculum vulgare* Mill., *Laurus nobilis* L., *Lavandula multifida* L., *Nigella sativa* L., *Origanum majorana* L., *Rosmarinus officinalis* L., *Sinapsis alba* L. and *Thymus capitatus* (L.) Hoffmanns. & Link (Table 7). Traditional herbal medicine is becoming a field of wide interest in the country.

Tunisia exports oils of orange and other citrus species, rosemary, mentha,

Table 7: Some important medicinal and aromatic plants of Tunisia

Agrimonia eupatoria L.
Ajuga iva (L.) Schreb.
Alchemilla arvensis (L.) Scop. [= *Aphanes arvensis* L.]
Alnus glutinosa (L.) Gaertn.
Aloe vera (L.) Burm. f.
Althaea officinalis L.
Ammi majus L.
Ammi visnaga (L.) Lam.
Anemone coronaria L.
Anethum graveolens L.
Apium graveolens L.
Artemisia campestris L.
Artemisia herba-alba Asso
Artemisia vulgaris L.
Asparagus officinalis L.
Asteriscus pygmaeus (DC.) Coss. & Dur.
Astragalus armatus Willd.
Astragalus caprinus L.
Ballota hirsuta Schult.
Bellis annua L.
Borago officinalis L.
Brassica nigra (L.) W. D. J. Koch
Calendula arvensis L.
Calamintha officinalis Monch
Carum carvi L.
Capparis spinosa L.
Capsella bursa-pastoris (L.) Medik.
Carthamus tinctorius L.
Centaurea calcitrapa L.
Centaurea cyanus L.
Centaurea nicaeensis All.
Centaurium umbellatum Gilib. [= *C. erythraea* Rafn]
Ceratonia siliqua L.
Chenopodium album L.
Cichorium intybus L.
Cistus crispus L.
Citrullus colocynthis (L.) Schard.
Clematis flammula L.
Cleome arabica L.
Crataegus oxyacantha L. [= *C. rhipidophylla* Gand.]
Cuminum cyminum L.
Cupressus sempervirens L.
Cynara cardunculus L.
Cynoglossum cheirifolium L.
Cynomorium coccineum L.
Datura metel L.
Datura stramonium L.
Diplotaxis harra (Forssk.) Boiss.
Dryopters filix-mas Schoot.
Ecballium elaterium (L.) A. Rich.
Elytrigia repens (L.) Desv. ex Nevski
Equisetum telmateia Ehrh.
Ferula communis L.
Foeniculum vulgare Mill
Fraxinus angustifolia Vahl
Fumaria officinalis L.
Geranium robertianum L.
Globularia alypum L.
Hedera helix L.
Hertia cheirifolia Kuntze
Hyosyamus albus L.
Hyoscyamus niger L.
Hypericum perforatum L.
Jasminum fruticans L.
Juglans regia L.
Juniperus oxycedrus L.
Juniperus phoenicea L.
Laurus nobilis L.
Lavandula dentata L.
Lavandula multifida L.
Lavandula stoechas L.
Lepidium sativum L.
Linum usitatissimum L.
Lippia citrodora Kunth.
Lithospermum arvense L. [= *Buglossoides arvensis* (L.) I. M. Johnst]
Morus spp.
Myrtus communis L.
Nerium oleander L.
Nicotiana glauca Graham.
Nitraria tridentata Desf. [= *Nitraria retusa* (Forssk.) Asch.]
Origanum glandulosum Desf.

Continued

Table 7 continued

Origanum majorana L.	*Rosmarinus officinalis* L.
Papaver rhoeas L.	*Ruscus aculeatus* L.
Papaver somniferum L.	*Ruta chalepensis* L.
Parietaria officinalis L.	*Ruta montana* L.
Peganum harmala L.	*Salix alba* L.
Pergularia tomentosa L.	*Salvia officinalis* L.
Periploca laevigata Aiton	*Salvia sclarea* L.
Phlomis spp.	*Sambuscus nigra* L.
Pinus halepensis Mill.	*Scilla maritima* L. [= *Urginea maritima* (L.) Baker]
Pistacia lentiscus L.	*Solanum dulcamara* L.
Pistacia terebinthus L.	*Solanum nigrum* L.
Pituranthos scoparius Benth.	*Solanum sodomaeum* L.
Plantago albicans L.	*Solidago virga-aurea* L.
Plantago lanceolata L.	*Sonchus tenerrimus* L.
Plantago major L.	*Stachys officinalis* (L.) Trevis.
Plantago psyllium L.	*Taraxacum officinale* Wigg.
Polygala spp.	*Teucrium capitatum* L. [= *Teucrium polium* subsp. *capitatum* (L.) Arcang.]
Polygonum aviculare L.	*Teucrium polium* L.
Populus alba L.	*Thymus capitatus* (L.) Hoffmanns. & Link [= *Coridothymus capitatus* (L.) Rchb. f.]
Populus nigra L.	*Thymus hirtus* ssp. *algeriensis* Boiss
Quercus coccifera L.	*Thymus vulgaris* L.
Quercus ilex L.	*Urtica* spp.
Quercus suber L.	*Valeriana tuberosa* L.
Reseda alba L.	*Verbena officinalis* L.
Retama raetam (Forssk.) Webb & Berthel.	*Viola odorata* L.
Rhamnus frangula L. [= *Frangula alnus* Mill.]	*Viola tricolor* L.
Rhus oxyacantha Schousb. ex Cav. [= *Rhus tripartita* (Ucria) DC.]	*Vitex agnus castus* L.
Ricinus communis L.	*Vitis vinifera* L.
Rosa canina L.	*Ziziphus lotus* L.
Rosa gallica L.	

white artemisia, lavender, terpenoid products, water of orange flowers to Germany, Belgium, Spain, France, Italy, the UK, Switzerland, the USA, Jordan, Saudi Arabia and to neighbouring countries such as Algeria, Libya, Benin and Senegal. From 168 tonnes in 1993, the total export of essential oils from Tunisia increased to 227 tonnes in 1996, earning foreign revenue of US$ 2.3 mn (3,253,100 Tunisian Dinars) and US$ 2.4 mn (3,321,100 Tunisian Dinars), respectively (Chemli, 1997). The sale of rosemary and myrtle in the early 1990s earned foreign revenue of US$ 0.43 mn (600,000 Tunisian Dinars) per annum (El Adab, 1993).

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Chapter 2

The Status of Medicinal Plants in West African Countries

2.1 Introduction

West Africa includes the countries of Benin, Burkina Faso, Cape Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo and Chad. The habitat diversity of the area ranges from semi-desert vegetation to savannahs, tropical rainforests and mangroves. It constitutes many plant species of medicinal value, especially in the rainforests. The upper Guinea forests are rich in species endemism with nearly 2,000 endemic plant species (Conservation International, 1999). The valuable West African biological resources are the basis of the survival of the region's indigenous societies who have developed a rich knowledge of medicinal plants. Through the practise of their traditions they have protected and conserved plants through the ages.

Medicinal plants are of socio-economic importance to rural population both as a source of raw material for health-care remedies and income. The local communities and TMPs make frequent use of most of these plants in their remedies.

Between 75 to 90% of the population in western Africa relies on traditional medical systems for primary health-care needs. In Burkina Faso, Niger and Ghana more than 80% of the population relies on traditional medicine and in Nigeria, over 90% of the rural and over 40% of the urban population depend on traditional medicine. The number of the TMPs is high compared to that of modern medical doctors. In the Kwahu district, Ghana and Benin City, Nigeria the ratio of modern medical doctors to TMPs has been estimated at 1 : 92 and 1 : 149, respectively. TMPs are officially recognized in Nigeria and Ghana, where 3,360 practitioners are registered, and in Burkina Faso there are about 300 traditional health-care providers. Traditional medicine is included in the health-care system of Nigeria and Mali.

Most of the medicinal plant material is sourced from wild collection and a small amount from cultivation. In the humid parts of Ghana and Nigeria, *Garcinia afzelii* Engl., *G. epundata* and in Guinea *Lophira lanceolata* Tiegh. ex Keay are the medicinal plant species of economic importance.

The over-exploitation of resources from the wild has threatened the existence

of many plant species including medicinal plants. Nigeria has the highest number of threatened species (119), followed by Ghana (115), Côte d'Ivore (101), Liberia (46) and Sierra Leone (43). Among these many are of medicinal importance. *Voacanga africana* Stapf*, Zanthoxylum zanthoxyloides* and *Brucea* species are medicinal plants that have been listed under the endangered species of the region.

In many countries efforts are being made to promote the use of herbal and traditional medicine. Traditional protection, conservation beliefs and practices exist in all the countries of western Africa. The importance of documenting the knowledge and implementing the traditional practices has been realized by many African countries. The United Nations University Institute for Natural Resources, Accra, Ghana has initiated a project to catalogue the local indigenous plants of medicinal value and other uses, and to promote homestead gardens (Baidu-Forson, 1999).

Very little work on ethnobotanical and taxonomical inventories for medicinal plant species has been done in West African countries. The sellers of herbal preparations describe some plants only in the local dialect. The pharmaceutical industry has given too low priority to research and development of drugs and other products from indigenous medicinal plants. When an economically viable plant product is identified, it is often shipped overseas to foreign companies for further development. There are only a few manufacturing units devoted to the production of drugs derived from indigenous plants. However, individual sellers and TMPs prepare herbal products.

2.2 Benin

Benin (formerly the Republic of Dahomey) is located between the Gulf of Guinea and the Niger River. The original rainforests, which used to cover most of the southern part of the country, have now largely been cleared, except near the rivers. In their place, many oil and rônier palms have been planted and food crops are cultivated (Adjademe, 1991).

About 80% of the population relies on traditional medicine for health care. People from other countries also use Beninese traditional medicine (Massougbodji and Tevoedjre, 1997).

In Benin there is a licensing process and a register of TMPs. Local officials authorize the practice of traditional medicine in administrative or health subdivisions. TMPs are involved in the primary health-care programme to some extent. There are national as well as provincial intersectoral councils and groups of traditional medicine (WHO, 1992). Section 3 of Code 3.4, Quality of Health Care and Health Technology, relates to the promotion of traditional pharmacopoeia through the updating and distribution of a national list of TMPs, and developing and distributing a guide for rational use of traditional pharmacopoeia (Anonymous, 1997). The

lack of means to evaluate the quality, safety, and efficacy of traditional medicine products and the lack of training in sanitation techniques for TMPs has led to unfavourable working conditions. The government has prioritized projects on the census of non-governmental organizations operating in the field of traditional medicine, on evaluation of the possibilities of integrating traditional medicine into the national health-care system, particularly health centres, and training of TMPs (Massougbodji and Tevoedjre, 1997).

2.3 Burkina Faso

Burkina Faso is a land-locked country situated north of Côte d'Ivoire, Ghana and Togo. The northern part of the country is covered by savannahs, with prickly shrubs and stunted trees, and in the south the prickly shrubs give way to scattered forests. In the north, climate conditions do not favour tree growth and in the south, farmers often allow only useful trees such as the karite (shea tree) or the baobab to survive. About 300 TMPs are registered at the Ministry of Health. Information on exploitation, application and marketing of medicinal plants is scarce (Zida and Kolongo, 1991).

Traditional Systems of Medicine

More than 80% of the population depends on traditional medicine. After independence, the government promoted traditional medicine and began to restore esteem to traditional medical practices. In 1983, the government emphasized the formation of TMP associations as well as pharmacopoeial units within the decentralized structure of the health system. The Natural Substances Research Institute and the Health Ministry Service were created in 1978 to promote traditional medicine and pharmacopoeia. In 1979, TMPs were officially recognized in Burkina Faso. A medical and scientific commission under the Ministry of Health is responsible for conducting studies on the practice of traditional medicine and undertaking investigations on traditional medicine therapeutics and mode of action of the drugs. Traditional medicine and TMPs are recognized by the Practice and Organization of Traditional Medicine Law of 1994 (Anonymous, 1995).

In 1997, the National Pharmaceutical Directive Plan was adopted to define the global objectives of the National Pharmaceutical Policy 1996, under the Ministry of Health. It was aimed at the development and promotion of traditional medicine and traditional pharmacopoeia within the official health-care system. The Plan was taken into consideration in the development of the National Sanitary Policies for the period between 2001 and 2010.

Burkina Faso has local and national intersectoral councils which take care of traditional medicine. Some TMPs are involved in the primary health-care programme (WHO, 1992). There is no official recognition of the qualifications of TMPs but there is a formal training pro-

gramme in traditional medicine (WHO, 1992).

2.4 Côte d'Ivoire

Côte d'Ivoire is situated on the west coast of Africa, between Ghana to the east and Liberia to the west, with Guinea, Mali and Burkina Faso to the north. Equatorial climate prevails, except for in the northwest where tropical climatic conditions prevail. The valuable rainforests endure only in the southwest, while elsewhere these have been replaced with plantations of coffee, cocoa, banana, pineapple, rubber and oil palm. The tropical rainforests in the south include many species of medicinal value along with timber species of African mahogany and teak.

Entada abyssinica Steud. ex A. Rich., *Terminalia glaucescens* Planch.ex Benth., *Cochlospermum planchonii* Hook f., *Cassia sieberiana* DC., *Combretum micranthum* G. Don, *Sarcocephalus latifolius* (Sm.) Bruce and *Khaya senegalensis* (Desr.) A. Juss. are common medicinal plants found in the savannah woodlands (FAO, 1998). Other significant plant species in the southern forests include *Garcinia* spp., *Allanblackia floribunda* Oliv., *Voacanga africana* Stapf and *Griffonia simplicifolia* (Vahl ex DC.) Baill.

There is no official recognition of traditional practices or remedies and no provision of official training for health workers in traditional medicine. TMPs are not involved in the national primary health-care programmes (WHO, 1992).

2.5 Gambia

In Gambia, the rural communities and TMPs have a vast knowledge of medicinal plants and their uses. Most of the trees and shrubs found in the Pirang forest are used in medicinal preparations (Sumser, 1988).

There are official legislative texts governing the practice of traditional medicine in the country and a licensing process for TMPs, who are involved to some extent in the primary health-care programmes. Gambia is also sustaining a training programme in traditional medicine for health workers (WHO, 1992).

2.6 Ghana

The government of Ghana has recognized traditional medicine in the national health-care system. TMPs use herbs, spiritual beliefs, and local wisdom in providing health-care services.

There are several TMP associations in the country. In 1999, the government brought all the associations under one main organization, the Ghana Federation of Traditional Medicine Practitioners Associations (Mensah, 2000). The Association helps to develop herbal medicine in the country and provides safe health care to the population alongside orthodox medicine.

About 70% of the population depends exclusively on traditional medicine for health care. There is approximately one TMP for every 400 people, compared to one modern medical doctor for every

12,000 patients (Commodore, 1995). Over 100,000 TMPs, uniformly distributed throughout the country, form the backbone of the health-care delivery system (Mensah and Sarpong, 1995).

The Medical and Dental Decree of 1972 and the Nurses and Midwives Decree of 1972 allow only indigenous inhabitants to practise traditional medicine, provided they do not practise life-endangering procedures.

Until 2000, when the Traditional Medicine Practice Act was passed, the government worked with the Ghana Psychic and Traditional Medicine Practitioners Association to license and register TMPs and ensure standards of care (Sanders, 1989; Le Grand and Wondergem, 1990). The Act has a provision for the establishment of a council to regulate the practice of traditional medicine, register practitioners and license them to practise and regulate the preparation and auction of herbal medicines.

In 1991, the Traditional Medicine Unit was created under the Ministry of Health (Oppong-Boachie, 1999; Bodeker, 2001). In 1999, the Unit was upgraded to the status of a directorate. The Ministry, in collaboration with the Ghana Federation of Traditional Medicine Practitioners Associations and other stakeholders, has developed a five-year (2000-2004) strategic plan for traditional medicine. The plan proposes, among other things, the development of a comprehensive training programme in traditional medicine from basic to tertiary levels.

The Ghana Herbal Pharmacopoeia, Volume 1, contains scientific information on 50 medicinal plants (Bodeker, 2001). A second volume is currently in preparation. Efforts are being made to integrate traditional medicine into the official public health system. It is expected that by the year 2004, certified efficacious herbal medicines will be prescribed and dispensed in hospitals and pharmacies. Local officials have the power to authorize the practice of traditional medicine in their administrative and/or health subdivisions (WHO, 1992). In 2000, the government declared the third week of March as the Traditional Medicine Week (Bodeker, 2001).

The Ministry of Health is working for the inclusion of traditional medicine in the curricula of allopathic medical schools and the introduction of a diploma course in traditional medicine at postgraduate level. As a step in this direction, the Ministry assessed the training needs for TMPs in 2000 (Mensah, 2000). Ghana recognizes a dual system of medical practice that admits both traditional and modern medical practices and promotes their co-existence in order to reach the largest number of people. There is a number of TMPs who are familiar with plants and their uses and practise herbalism with or without spiritual practices. Within the Ashante system of traditional healers both spiritualism and herbalism are practised. The key factor in training in and practising of traditional medicine is the integration of the practi-

tioners with the cultural tradition of the people. There are official training programmes for traditional birth attendants (Le Grand and Wondergem, 1990).

Medicinal Plant Resources

Medicinal and aromatic plant species play an important socio-economic role both in primary health care and source of livelihood (FAO, 1995). In Ghana, about 2,000 plants are used in traditional medicine. Medicinal plants, gums and mushrooms are exported to neighbouring countries and to the international market.

Both local communities and TMPs use a large variety of medicinal plants in their remedies. Most of the medicinal plant material is collected from the wild. In the Ho district, approximately 75% of trees on cultivated land have medicinal uses (FAO, 1990). Chew sticks are highly valued medicinal plants and constitute an item of national and regional trade. About 90% of the population in southern Ghana use chew sticks (*Garcinia* spp.) for dental care. *Griffonia simplicifolia* (Vahl ex DC.) Baill. is also commercially exploited (Cunningham, 1997). The exploitation of commercially important medicinal plant species is very extensive. In general, these species are indiscriminately cut down or uprooted to meet the demand (Cunningham, 1993).

Kumasi is the biggest urban market for medicinal plant trade. Gum Arabic production is concentrated in the northern woodlands.

R&D Activities

The Center for Scientific Research into Plant Medicine, Mampong-Akwapim conducts scientific investigations related to the improvement of phytomedicine to assure the purity of drugs extracted from plants. In addition to its research activity, the Centre also manages a hospital providing health care through both traditional and allopathic medicine. The Centre has a herbarium section, which is preserving 3,500 species of plant medicine for future uses. It makes use of 1,000 acres of land for growing medicinal seedlings. It also cooperates and liaises with the Ghana Physic and Traditional Healers' Association and other state research institutions and commercial organizations worldwide for documentation, dissemination of information and for the establishment of botanical gardens for medicinal plants.

The ethnobotanical survey, conducted by the World Conservation Monitoring Centre of the United Nations Environment Programme (UNEP) revealed that about 40,000 TMPs practise traditional medicine in the eastern part of the country (Evans-Anfom, 1984). In six selected localities, 86 persons were registered as herbalists, using 339 medicinal plant species (Table 1). In the preparation of remedies, the leaf is the dominant plant part in use, followed by the root and bark.

The destructive harvesting of medicinal plant species has reduced their number in the wild. Urbanization and changing housing patterns in rural areas have re-

Table 1: Results of an ethnobotanical survey in Ghana

Locality	Registered herbalists	Medicinal plants used for treatments	Part(s) used
Mampong	12	57	Root, bark
Kofisah	11	51	Leaf, bark, root
Adesio	25	47	Leaf, root, root-bark
Konkonorou	16	82	Whole plant, bark, root
Nkoranza	10	46	Root
Aburi	12	57	Leaf
Total	86	339	Leaf

duced many plant species in the areas surrounding villages. For example, *Bryophyllum pinnatum* (Lam.) Oken and *Jatropha curcas* L., earlier used as a fence for housing, cannot be found now. Forest clearance and easy access to wild resources of *Deinbollia pinnata* have threatened existence in its natural habitat. The over-harvesting of *Cryptolepis sanguinolenta* root, mainly sourced from the wild for the preparation of anticancer drug, has threatened its existence. The plant is exported to the USA.

The Environment and Health Sector is responsible for the promotion of application of science and technology in health development. The support for plant medicine development mainly comes from the Centre for Scientific Research into Plant Medicine (CSRPM), which is assisted by the Plant Genetic Resources Centre in the scientific identification of plants of medicinal value and the establishment of arboreta, and by the Animal Research Institute in conducting toxicity and efficacy tests of herbal products.

In 1996, the preparation of a document on ethnobotany in Ghana was initiated under the aegis of the Organization of African Unity and the Science and Technology Research Committee. Pictures of and recipes using about 600 plants are collected in this roster.

Most of the herbal preparations are sold as powders, concoctions or ointments. Although medicinal plants have been used extensively over the years, only a small amount of scientific data are available on the clinical uses of herbal medicine.

Phyto-Riker Pharmaceuticals Inc., a private company, has acquired Ghana's state-owned pharmaceutical plant to pioneer the commercial production of traditional herbal medicines.

Ghana imports almost all its essential oil requirement from Europe, Asia and North America. In 1998, the annual demand of lemongrass oil was 400 tonnes and the fabrication cost of a distillation unit from local material was US$ 8,200.

Traditional healers provide the most affordable and accessible form of health

care to the rural and poor urban populations. In Ghana, about 5% of the 20 mn population is HIV/AIDS positive. There is no functional national traditional healers association in the country. The government does not financially support TMPs and traditional medicine is not part of the curriculum in medical faculties. The Ministry of Health coordinates policy for traditional healers. The government has shown a positive attitude towards the conservation of medicinal plants. The Traditional Medicine Practice Act was passed in 2000.

The Aburi Botanic Garden cultivates medicinal plants. The botanical reserve covers an area of 64.8 hectares, of which 12.2 hectares have been developed into a formal garden. With the help of the Darwin Initiative of the UK Department for Environment, Food and Rural Affairs (DEFRA), London and the National Lotteries Board of the UK, a wide range of activities related to the conservation and sustainable utilization of medicinal plants have been undertaken through identification, cultivation and development of agrotechniques. The implementation of a computerized database is in progress to provide information on the scientific name and family, the common name and synonyms, and the ecology of the plant.

Models for biodiversity have been applied to the traditional grove system, using the resources in the most sustainable way (Oteng-Yeboah, 1996). A project at local level aims to establish and document baseline data, capacity building, raising awareness and relieving pressure from over-harvesting of plants in the wild. There are also plans to establish medicinal plant gardens and to train people to manage these gardens.

2.7 Guinea

Guinea is one of the least developed countries of Africa. It is rich in valuable plant species used in the traditional systems of medicine. There are large plantations of *Rauvolfia*, *Cinchona* and raw materials from these were collected and exported in the past. The pharmaceutical industry is a public sector industry and Pharmaguinea, the national agency responsible for pharmaceuticals, is engaged in the production of pharmaceuticals valued at over US$ 1 mn per year. In addition, there are galenicals from medicinal plants and preparations used in traditional medicine. There is, however, the need to develop the Central Analytical Laboratory in Matato as a national laboratory for analytical work and R&D activities connected with two projects, the development of an essential oil industry and the utilization of *Cinchona* and other indigenous medicinal plant species. There is good potential for oils of karo, jasmine, neroli, bigarade, bergamot and orange.

Lophira lanceolata Tiegh. ex Keay sticks are used as toothbrush. There is an active trade in these sticks on the urban markets. Their consumption is very high in the villages. More than 100 mn sticks are used per annum: about 75% of the

800,000 adults in urban areas makes use of 31.2 mn sticks per annum and 50% of the 3 mn adults in the rural areas makes use of 78 mn sticks per annum.

In Guinea, the practice of traditional medicine is not recognized by the Ordinance 189 PRG of 18 September 1984, which states that the profession of physician can only be practised by persons with a Guinean diploma of Doctor of Medicine (Anonymous, 1984). Guinea has official, applied and legislative texts governing the practice of traditional medicine. There is a licensing procedure, a register of TMPs and local and national intersectoral councils for traditional medicine (WHO, 1992). Local officials have the power to authorize the practice of traditional medicine in their administrative subdivisions. TMPs are also involved, to some extent, in the national primary health-care programme (WHO, 1992).

2.8 Guinea-Bissau

Guinea-Bissau has its local and national intersectoral councils for traditional medicine. However, the country does not have regulatory laws for the practice of traditional medicine and there is no licensing procedure for TMPs. Local officials are authorized to allow the practice of traditional medicine in their administrative subdivisions. TMPs are not involved in the national primary health-care programme (WHO, 1992).

2.9 Mali

The Republic of Mali is located south of the Sahara and two-thirds of its territory is desert. The greater part of Mali's economy relies on the utilization of its natural resources. There is a considerable biodiversity consisting of ecosystems rich in genetic diversity, but natural resources are under threat due to increasing anthropogenic pressure and climatic changes. There are about 1,739 species of vascular plants and eight endemic species, most of which are located in the Sudano-Guinean area. The most common medicinal plants are *Faidherbia albida* (Delile) A. Chev., *Prosopis africana* (Guill. et al.) Taub. and *Ziziphus mauritiana* Lam. Two plant species, *Parinari excelsa* Sabine, *Khaya nyasica* Stapf ex Baker f. [= *Khaya anthotheca* (Welw.) C. DC.], are reported to be rare and one is endangered (*Securidaca longipedunculata* Fresen.). Under article 17 of the Forest Law No. 95-005 of 1995, *Vitellaria paradoxa* C. F. Gaertn., *Acacia albida* Delile [= *Faidherbia albida* (Delile) A. Chev.], *Acacia senegal* (L.) Willd., *Elaeis guineensis* Jacq., *Bombax costatum* Pellegr. & Vuill., *Parkia biglobosa* (Jacq.) R. Br. ex G. Don, *Borassus aethiopum* Mart., *Pterocarpus erinaceus* Poir. and *Khaya senegalensis* (Desr.) A. Juss. are protected to save them from extinction. The gum, fruit and leaf of *Faidherbia albida* (Delile) A. Chev. are used as a remedy against influenza, toothache and as a cardiac tonic. Almost all parts of

Prosopis africana (Guill. et al.) Taub. are used in local medicine. The leaf is used for migraine, the bark for fever, and the root for toothache, dysentery and bronchitis. The jujube tree (*Ziziphus mauritiana* Lam.) is also commonly used in medicinal preparations (FAO, 1996).

Traditional Systems of Medicine

About 75% of the population of Mali relies on traditional medicine for health-care needs. There is approximately one TMP for every 500 inhabitants. Around 180 licences for herbalists, 200 for therapists and 1,000 Traditional Medicine Department certificates have been issued. There are 32 associations of TMPs in the country.

The Department of Traditional Medicine and the National Research Institute of Medicine and Traditional Medicine were created in 1973. The mandate is to demonstrate the value of traditional medicine resources through scientific research and differentiate the role of herbalists from those of other TMPs, and define their respective statuses, regulations, and code of ethics. In 1980, the Minister of Public Health and Social Affairs established a Scientific and Technical Committee to work in conjunction with the National Research Institute of Medicine and Traditional Medicine (Koumare, 1980; Sanders, 1989). The Committee drew up draft regulations on the practice of traditional medicine. The government has regulated the opening of private consultation clinics for traditional medicine and medicinal herb stores, and improved production units for traditional medicine through the Decree 94/282/P-RM of 15 August 1994.

Conventional pharmacists are allowed to sell herbs. Efforts have been made to improve the technical know-how of the semi-industrial and industrial units that transform raw material into herbal preparations and herbal products. The Decree 95/1319/MSS-PA/SG of 22 June 1995 establishes the organizational and functional rules for private consultation clinics, medicinal herb stores, and improved production units. Under this decree chartered TMPs, medical staff and retired traditional medicine paramedical staff are eligible to open private traditional medicine consultation clinics. Chartered medicinal plant sellers, graduates from the Katibougou Rural Polytechnic Institute or its equivalent, and graduates from the Superior Normal School or its equivalent are allowed to open medicinal herb stores.

The industrial exploitation of medicinal plants is authorized only when it involves herb, leaf, stem, bark, and/or fruit and is permitted only when the plants are cultivated. The collection of wild plants for industrial use is not permitted. Improved traditional medicine production units are supervised by a pharmacist, and a biologist, chemical engineer or pharmacist monitor the control procedures. Article 8 of Decree 95/009/P-RM of January 1995 provides permits for pharmaceutical products and outlines special rules for requests involving traditional medicines

made from plants. Local officials have the power to authorize the practice of traditional medicine in their administrative subdivisions. Some TMPs are involved in the primary health-care programme (WHO, 1992).

R&D Activities

The Faculty of Medicine, Pharmacy, and Odonto-Stomatology of the University of Mali was created in 1996. It is responsible for training allopathic physicians and pharmacists. Students and researchers are offered courses directly related to traditional medicine and traditional pharmacopoeia such as botany, pharmacognosy, vegetative substances, chemistry, pharmaceutical legislation, and public health. Other schools, faculties and institutes that collaborate with the Department of Traditional Medicine in the training for and research in traditional medicine include the Rural Polytechnic Institute, the Superior School of Health, the Central School of Commerce and Industry, the Rural Economy School, the Faculty of Science and Technology, and the Faculty of Arts, Languages and Human Sciences.

Periodic meetings, seminars and workshops are organized with TMPs through their associations. The national health programmes on AIDS, mental and family health were presented with the intention to make TMPs act as intermediaries, and in recognition of the fact that TMPs are involved in patient care. The Department of Traditional Medicine organizes and supervises exploratory meetings and missions between associations of TMPs and their foreign partners. Each year, the Department of Traditional Medicine organizes open houses on health information, education and communication in traditional medicine. Radio and television programmes on traditional medicine which host independent TMPs, representatives of associations or persons in charge of technical services, are regularly transmitted on public and private stations.

National health insurance does not cover traditional medical care.

2.10 Niger

According to WHO estimates, 80% of the population of Niger makes recourse to traditional pharmacopoeia. The most commonly used species are *Khaya senegalensis* (Desr.) A. Juss., *Guiera senegalensis* Gmel., *Cassia sieberiana* DC., *C. siamea* Lam. [= *Senna siamea* (Lam.) H. S. Irwin & Barneby)], *C. singueana* Delile [= *Senna singueana* (Delile) Lock], *Eucalyptus camaldulensis* Dehnh. and *Azadirachta indica* A. Juss. Rural communities collect medicinal and aromatic plant material for personal use and marketing purposes.

In Niger, a licence to practise traditional medicine is issued by the Ministry of Public Health upon recommendation of the chief physician of the National Hospital in Niamey (Ousseini, 1982). The Committee for Studies on Traditional Medicine and Traditional Pharmacopoeia was established in 1989 (Anonymous, 1990). Its

mandate includes the formulation of the basic premises for a national policy on traditional medicine, the preparation of statutes for a national institution to be responsible for improving and developing the regulation of traditional medicine, and the draft of legislation governing the practice of traditional medicine.

2.11 Nigeria

Nigeria ranks eleventh in Africa for its biological diversity. It has diverse vegetation types, ranging from arid to swamp vegetation with different forest types. There are over 4,600 plant species in Nigeria of which 205 are reported to be endemic. There are 39 endemic species in the north, 38 in the west and centre, and 128 in the east of the country (Sarumi *et al*., 1996).

Traditional Systems of Medicine

Over 90% of Nigerians in rural areas and about 40% in urban areas depend partly or wholly on traditional medicine for health-care (Osemeobo, 1993). A study in Ibadan has shown that traditional medicine is becoming popular in urban areas (Cunningham, 1997). Expensive western medicines and the scarcity of modern medical doctors and facilities make most of the population dependant upon traditional systems. TMPs are the first contact people want in case of any health problem. The trend is similar in the entire country, as in the case of Benin City where the ratio of TMPs to inhabitants is 1 : 110, in comparison to that of western medical doctors of 1 : 16,400 (Cunningham, 1993). About two-thirds of the health-care practitioners in Nigeria are TMPs (Odebiyi, 1990). The government has shown appreciation for the importance of traditional medicine in the health-care delivery system.

Traditional medical activities are protected under the provisions of Section 17.6 of the Nigerian Medical and Dental Practitioners Act of 1988 (Ajai, 1990). The Act authorizes members of the community who have been trained in the system of traditional therapeutics, to practise traditional medicine. The registration requirements are outlined in the Medical Rehabilitation Therapists Decree of 1988 (Anonymous, 1990a).

State Efforts in Development of Traditional Medicine

The informal interaction between government and TMPs started in the nineteenth century. Formal legislation, promoting the use of traditional medicine, dates back to 1966, when the Ministry of Health authorized the University of Ibadan to conduct research on the medicinal properties of local herbs. Efforts to promote traditional medicine continued throughout the 1970s in the form of conferences and training programmes. In the 1980s, policies were established to accredit and register TMPs and regulate the practice of traditional medicine. In 1984, the Federal Ministry of Health established the National Investigative Committee on Traditional and Alternative Medicine. A committee for re-

search and development of traditional medicine was formed by the Federal Ministry of Science and Technology in 1988 (Sule, 2000).

The National Primary Health-Care Development Agency was created by order of the Medical Rehabilitation Therapists Decree of 1992, with a broad mandate covering health matters, including the endorsement of traditional birth attendants (Anonymous, 1993). Among other duties, the Agency is responsible for supporting the rural health-care systems through special attention to and maximum support of the training, development, logistics, and supervision of village health workers and traditional birth assistants.

In 1994, all state health ministries were mandated to set up boards of traditional medicine in order to enhance the contribution of traditional medicine to the nation's official health-care delivery system (Sule, 2000). Since the establishment of the National Traditional Medicine Development Programme in 1997, the Federal Ministry of Health has been instituting measures to formally recognize and enhance the practice of traditional medicine. These include the constitution and inauguration of the National Technical Working Group on Traditional Medicine, the development of policy documents on traditional medicine (including the National Policy on Traditional Medicine, the National Code of Ethics for the Practice of Traditional Medicine, the Federal Traditional Medicine Board Decree, and the Minimum Standards for Traditional Medicine Practice in Nigeria) and the advocacy for traditional medicine at all levels including forums such as the National Council on Health (since 1997), the consultative meetings of the Minister of Health with state commissioners for health and local government chairmen (in 1999), and the presidential think tank forum (in 1999).

In 2000, the Traditional Medicine Council of Nigeria Act proposed the establishment of the Traditional Medicine Council. The Council works to facilitate the practice and development of traditional medicine, establish guidelines for the regulation of traditional medical practice to protect the population from quackery, fraud and incompetence, liaise with state boards of traditional medicine to ensure adherence to the policies and guidelines outlined in the Federal Traditional Medicine Board Act, establish model traditional medicine clinics, herbal farms, botanical gardens and traditional medicine manufacturing units in the geopolitical zones of the country, and collaborate with organizations with similar objectives within and outside of Nigeria. The Nigeria Medical Council is contemplating the integration of homeopathy into the country's health-care delivery system (Anonymous, 1998).

Medicinal Plant Resources

Many trees and shrubs in Nigeria have found common and widespread use in traditional systems of medicine (Youngs, 1989). Many rural people inherit knowl-

edge of a significant number of widely used medicinal plants. *Persea americana* Mill., *Ocimum gratissimum* L. (Efinrin), *Ficus platyphylla* Delile, *Parkia biglobosa* (Jacq.) R. Br. ex G. Don, *Vitellaria paradoxa* C. F. Gaertn., *Morinda lucida* Benth., and *Allium sativum* L. are of great medicinal value.

In ethnomedicine, *Vernonia amygdalina* Delile leaves are consumed as a vegetable for hypertension. *Vaccinium myrtillus* L. leaves and *Adansonia digitata* L. are used as antidiabetic and *Gladiolus psittacinus* Hook. f. [= *Gladiolus dalenii* Van Geel] as antiasthmatic. A seed of *Ricinus communis* L. swallowed after the menstrual flow is believed to have antifertility effects. A similar use is made of the fruit of *Lagenaria breviflora* (Benth.) Roberty. A climbing or creeping plant, *Momordica charantia* L., locally known as Igbo, Hausa or Yoruba has hypoglycemic and antipyretic properties. A compound isolated from *Rauvolfia vomitoria* Afzel. has proven to be very effective in inducing deep sleep. Some radioactive compounds have been found in plants such as *Carica papaya* L. *Chromolaena odorata* (L.) R. M. King & H. Rob. [= *Eupatorium odoratum* L.] and *Ageratum conyzoides* L. are effective in the treatment of fresh cuts. *Ageratum conyzoides* L. is also used as an effective antipoison among the Yorubas and in sickle cell anaemia. The use of herbs by the native inhabitants as anti-infective, antimalarial, anticancer drugs, as flavouring and sweetening agents and in drugs for other ailments have been widely reported. Among others, *Euphorbia hirta* L. [= *Chamaesyce hirta* (L.) Millsp.] is used for diarrhoea, *Senna alata* (L.) Roxb. [= *Cassia alata* L.] as a purgative, and the latex of *Ficus exasperata* Vahl for boils (Sarumi *et al.*, 1996).

Chew sticks (*Garcinia* spp.) are probably the most widely used medicinal plant material. Toothpaste consumption is low and the chew sticks provide dental care for most of the population. The most important species are *Garcinia afzelii* Engl. and *G. mannii* Oliver (Cunningham, 1993).

Nigeria is probably the second largest supplier of gum Arabic to the international market with an annual production of 4,000 to 10,000 tonnes (Nour, 1995). In northern Nigeria, gum Arabic is produced by tapping *Acacia senegal* (L.) Willd. and natural exudates of *A. seyal* Delile. Despite the large *A. senegal* (L.) Willd. afforestation schemes, most of the gum Arabic production comes from wild trees. There is no organized system for gum collection (Nour, 1995). It is a family business and according to a report a family can harvest a quantity equivalent to about US$ 630 (80,000 NGN) per annum (FORMECU, 1997). Other exudates exploited in Nigeria include gum combretum, obtained from *Combretum nigricans* Lepr. ex Guill. et Perr. and resins from *Boswellia* spp. used in the perfume industry and various lattices used in the leather industry.

2.12 Senegal

Medicinal plants of widespread use are *Cassia sieberiana* D.C., *Khaya senegalensis* (Desr.) A. Juss. and *Cola nitida* (Vent.) Schott & Endl. About 100 plants are used as a source of drugs in southern Senegal alone.

The Association for the Promotion of Traditional Medicine (PROMETRA) in Dakar, Senegal is a non-governmental organization working on the development of anti-AIDS and antidiabetic herbal drug formulations from African medicinal plants. The Association of the Sine Traditional Healers, Malango works in close cooperation with other healers' associations in Senegal and throughout Africa. They usually bring technical assistance to newly created associations and involve other healers in their projects.

Traditional Systems of Medicine

Almost every village in Senegal has a TMP (Balde and Sterck, 1994). In 1987, the Experimental Centre for Traditional Medicine was established to provide health-care facilities to the local people. It now has an active patient roster of over 30,000 persons and is made up of a professional staff of both allopathic medical doctors and TMPs (Floyd, 1997).

The government officially recognizes the practice of traditional medicine (Floyd, 1997). In Senegal there is a register of TMPs (WHO, 1992). The Ministry of Health advocates the promotion and rehabilitation of traditional medicine and traditional pharmacopoeia. Official strategies and activities encourage collaboration between traditional and allopathic medical practitioners. There are training facilities for laymen and health workers in traditional medicine (WHO. 1992).

2.13 Sierra Leone

Sierra Leone reaches from the south-western beaches to the broad plateau of the Atlantic/Niger watershed on the north-eastern frontier. Tropical evergreen forests, savannah-woodlands and semi-deciduous forests prevail. Savannah-woodlands are characterized by fire-resistant savannah trees and tall grasses. In most parts of the country medicinal plants are the most common source of health care, despite the proximity of the people to modern medicines. In a survey of a village, about 70 medicinal plants were reported to be used by TMPs as well as by villagers (FAO, 1990). In another village, 214 medicinal plants were reported to be in use (Arnold, 1995).

Traditional Systems of Medicine

In Sierra Leone, TMPs are involved in primary health-care programmes (WHO, 1992). The Traditional Medicine Act of 1996 regulates the profession of traditional medicine and controls the supply, manufacture, storage, and transportation of herbal medicines. The Act established the Scientific and Technical Board on Traditional Medicine and the Disciplinary Com-

mittee to advise the Board on matters relating to the professional conduct of TMPs, and the Drugs Committee to advise the Board on the classification and standardization of traditional medicines. The Scientific and Technical Board is charged with securing the highest practicable standards in the provision of traditional medicine by promoting proper training and examination of students of traditional medicine, controlling the registration of TMPs, and regulating the premises where traditional medicine is practised.

2.14 Togo and Chad

Chad is the most northern of the French equatorial African independent states and is the largest in terms of size and population. Traditionally it is a focal point for Saharan and equatorial African trade routes. In the south of the country savannah-woodlands prevail, while the north is covered by scrub vegetation.

There is a wet and dry tropical zone in the south characterized by shrubs, tall grasses and scattered broad-leaved deciduous trees, a semiarid tropical (Sahel) zone in which savannah vegetation gradually merges into a region of thorn bushes and open steppes, and a hot arid zone composed by dunes and plateaus where vegetation is scarce and only occasional palm oases are found.

Medicinal plants with widespread use in traditional medicine are *Acacia* spp., *Tamarindus indica* L., *Azadirachta indica* A. Juss., *Khaya senegalensis* (Desr.) A. Juss., *Butyrospermum parkii* (G. Don) Kotschy [= *Vitellaria paradoxa* C. F. Gaertn.], *Balanites aegyptiaca* Del., *Parkia biglobosa* (Jacq.) R. Br. ex G. Don, *Salvadora persica* L., *Guiera senegalensis* Gmel., *Diospyros mespiliformis* Hochst. ex A. DC., *Calotropis procera* (Aiton) W. T. Aiton, *Bauhinia rufescens* Lam. and *Combretum glutinosum* L. (FAO, 1999). Neem (*Azadirachta indica* A. Juss.) is used as insecticide. *Vitellaria paradoxa* C. F. Gaertn. flowers and *Eucalyptus camaldu-lensis* Dehnh. leaves are used for flavouring tea and *Commiphora africana* (A. Rich.) Engl. gum is used as incense (FAO, 1999).

Gum Arabic collection is done mainly in northern Chad.

Traditional Systems of Medicine

TMPs are involved in the national health-care programme. Chad does not have any official legislation governing the practice of traditional medicine. There are no official training facilities or programmes on traditional medicines for health workers (WHO, 1992).

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Chapter 3

The Status of Medicinal Plants in East African Countries

3.1 Introduction

The East African region constitutes the countries of Djibouti, Eritrea, Ethiopia, Kenya, Somalia, Sudan, Tanzania and Uganda (Walter, 2001). It has a variety of vegetation ranging from dense tropical forests and woodlands to dry savannahs. The Eastern Arc montane forests running through Kenya and Tanzania, and the Albertine Rift montane forests along the western border of Uganda are internationally known biodiversity hot spots (Iddi, 1998; Mittermeier *et al*., 2000). In Tanzania, 30 to 40% of the floristic diversity is found in the tropical forests. The forested areas are the abode of a large number of endemic plant species. The Abyssinian highlands of Ethiopia, Somalia and Sudan are known as the world's centre of genetic diversity of cultivated plants. The biological resources of the region have high national and global economic importance. In Uganda, the annual combined value of medicines derived from these resources and other non-wood forest products has been estimated to be worth about US$ 40 mn (Emerton and Muramira, 1999).

Traditional medicine caters for the health-care needs of about 80% of the population. Medicinal plants are widely used in remedies for human and veterinary use by the Maasai, Kipsigis, Turkana and other tribes inhabiting the region. The Maasai tribes make use of more than 60 plant species for ethnoveterinary purposes. They have a well-established pharmacopoeia for treating livestock diseases (Ole Lengisugi and Mziray, 1996). Several species used for treating livestock diseases have also been researched for their commercial application. Over-harvesting and habitat destruction of medicinal plant resources threaten their existence in the wild.

None of the East African countries maintains countrywide quantitative data on supply, consumer demand and economic benefits derived from medicinal plants and their contribution to health care. Similarly, most of the collectors, producers and end-users are unaware of the extent to which the rising demand is threatening the survival of the increasing number of these plant species. Free access to the resources and the low price paid to the collectors make commercial plant gatherers mine the resources rather than manage them. The country status of medicinal and aromatic

plant resources is given below.

3.2 Djibouti

In Djibouti, the frequently used medicinal plants are *Aloe* spp., *Dodonaea viscosa* (L.) Jacq., *Solanum incanum* L., *Terminalia* spp. and *Ziziphus* spp. With the exception of traditional birth attendants, the government tolerates but does not officially recognize traditional medicine. There is no clear regulation to control the practice of traditional medicine.

3.3 Eritrea

In Eritrea, 142 tree and shrub species are used for their medicinal and nutritional values (Benin *et al.,* 1996). Gum Arabic from *Acacia senegal* (L.) Willd. and olibanum resin from *Boswellia papyrifera* (Delile ex Caill.) Hochst. are traditional products of commercial importance. In 1997, forty-nine tonnes of gum Arabic and 543 tonnes of olibanum resin were exported from the country (Ministry of Agriculture, 1998).

3.4 Ethiopia

Ethiopia, a sub-Saharan country of the East African region, is one of the most ancient settlements and civilizations in the world. Its cultural and architectural heritage is considerably rich. A complex topography with diversified climate makes it a floristically diverse country. About 85% of the population, particularly in rural areas, depends on medicinal plants as a source for health-care remedies. The medicinal plant sector has the potential to make major contributions to economic growth and rural poverty alleviation.

Ethiopia has a rich practice and widespread use of medicinal and aromatic plants in traditional remedies and religious ceremonies. Written records of herbal medicine are almost absent even though the country has had a written language for over two thousand years. As with the European herbalists of the sixteenth century, bizarre stories, legends and beliefs developed in Ethiopia. Astrological implications were common and used to be incorporated as part of a cure. The gathering of medicinal herbs, their preparation and administration is still, in many cases, astrologically determined. The art of preparing and administering poisons is equally as rich in lore as in conventional medicine.

Ethiopia does not have countrywide quantitative data on supply, consumer demand, and economic benefits derived from medicinal plants and their contribution to health care. The talent and expertise of professionals in the fields of plant chemistry, pharmacognosy, pharmacology, natural resource management, and industrial utilization of plant-based medicinal products is underutilized. Professionals and TMPs need to work together to establish processes for managing and validating traditional medicine.

Traditional Systems of Medicine

In Ethiopia, plants have been used as a source of medicine from time imme-

morial to treat different ailments. Traditional medicine has become an integral part of the culture. About 80% of Ethiopians depends on traditional medicine for health care and more than 95% of traditional medicinal preparations is of plant origin. Over 85% of rural population and an increasing number of poor people in urban centres derives their livelihood from collection and trade of medicinal plant material.

The use of traditional medicine is increasing as the high cost of the modern medicines has made them unaffordable to most of the inhabitants. The value and role of traditional health-care systems will not diminish in future as they are culturally viable and affordable. The Ethiopian Ministry of Health has recognized the importance of medicinal plants and has formulated health and drug policies to enhance and develop the beneficial aspects of traditional medicine.

Ethiopia has a long history of traditional health care mostly based on rich and non-standardized pharmacopoeias used by the local population and traditional health practitioners. The efficacy of plants such as *Hagenia abyssinica* (Bruce) J. F. Gmel. and *Glinus lotoides* L. for the treatment of tapeworm infestation, and *Phytolacca dodecandra* L'Hér. as molluscicide in the control of schistosomiasis, has been scientifically determined while the safety and efficacy of many other plants remain underdeveloped.

Traditional medical practices and remedies have their roots in oral tradition and in medico-religious manuscripts and traditional pharmacopoeias dating back to the fifteenth century. The Ethiopian Traditional Healers Association reviews TMPs' qualifications.

Traditional medicine has received very little attention in modern research and development, and less effort has been made to upgrade the traditional medicine system. Recently, the Ethiopian health authorities have taken steps to promote and develop the traditional medicine sector.

Proclamation No. 100 of 1948, the Penal Code No. 512 of 1957 and the Civil Code No. 8 of 1987 regulate traditional medicine in the country. Official attention to the promotion and development of traditional medicine was given in the Primary Health-Care Strategy of 1978. In 1979, the Office for the Coordination of Traditional Medicine, now a full-fledged Drug Research Department under the Ministry of Health, was established to organize, train, and register TMPs (Bishaw, 1991; Ministry of Health, 1985). The Department is also responsible for identifying, describing, and registering traditional medicines with actual or potential efficacy. In addition, it is undertaking chemical screening of medicinal plants, coordinating activities on traditional medicine, and carrying out census on traditional medical practices and on the evaluation of traditional medicine.

Both the health and drug policies of 1993 emphasize the need to develop the

beneficial aspects of traditional medicine in the official health delivery services through research and use. The Drug Administration and Control Authority prepares standards for safety, efficacy and quality of traditional medicines and evaluates laboratory and clinical studies as per the standards laid down in the Proclamation of 1999, issued on the basis of the National Drug Policy. The Authority also issues licences for the use of traditional medicines in the official health services.

Officially, no recognized education is provided in traditional medicine in Ethiopia. There is no national or private healthcare insurance covering traditional medicine.

Medicinal Plant Resources

Ethiopia enjoys a great diversification of topographic, edaphic and climatic conditions. There are more than 45 vegetation types. The forests, savannahs, woodlands, steppes and grasslands comprise 75% of the vegetation cover. About 7,000 species of pteridophytes and spermatophytes can be found in the country.

According to the Ethiopian Biodiversity Institute, over 10% of Ethiopian vascular flora is valued for its medicinal properties. There are 600 medicinal plant species of which about 250 have common and widespread uses in the traditional systems of medicine. Medicinal plants are distributed all over the country, with greater concentration in the south and southwest. The root, bark, and whole plant are the dominant plant parts collected from the wild. Over-exploitation has threatened the existence of many plant species of medicinal value. Some important medicinal and aromatic plants are given in Table 1.

A considerable number of Ethiopian shrubs and trees also yield exudates of commercial importance. Olibanum resins (80% of total output of resin of this type), gum Arabic (14%) and myrrh (6%) play a significant role in the country's economy.

Olibanum resins are obtained from *Boswellia papyrifera* (Delile ex Caill.) Hochst. The plant is found in abundance in the Tigray, Gondar, Wollega and Gojjam provinces and sparsely spread in the Wello and Shewa areas. Other species yielding similar resins are *B. ogadensis*, *B. rivae*, *B. sacra* and *B. frereana* Birdw. Olibanum is used as a fragrance and flavouring agent.

Gum Arabic is obtained from *Acacia senegal* (L.) Willd. The tree is distributed in the Gojjam and Gondar provinces along the Sudan border. A lower quality gum Arabic is obtained from *A. seyal* Delile trees widely distributed in the Rift valley depressions. A gum of relatively low quality is also obtained from *A. drepanolobium* Harms ex Y. Sjöstedt, and *A. polyacantha* Willd. The gums are harvested through tapping in northern Ethiopia, whereas in the southwestern part of the country only natural gums are collected by the nomads. The Natural Gums Processing and Marketing Enterprise of Ethiopia controls the gum Arabic trade and regulates the prices (Nour, 1995).

Table 1: Some common medicinal and aromatic plants of Ethiopia

Botanical name	Vernacular name	Family	Plant part(s)	Therapeutical uses/indications
Acokanthera schimperi (A. DC.) Oliv.	Merz (A); Keraro (G)	Apocynaceae	Bark	Arrow poison
Adenium honghel A. DC. [=*A. obesum* (Forssk.) Roem. & Schult.]	-	Apocynaceae	-	Fish poison
Adenium multiflorum Klotzsch	-	Apocynaceae	-	Fish poison
Adenium somalense Baif. f.	-	Apocynaceae	-	Arrow poison
Adenium speciosum Fenzl.	-	Apocynaceae	-	Fish poison
Ageratum conyzoides L.	Gunyato, Arema (G)	Asteraceae	Whole plant	Wound and sore dressing
Adhatoda schimperiana Hochst. ex. Nees.	Sensel, Simiza Timisa (A); Dumoga (GK)	Acanthaceae	-	Excessive pelegra, laxative
Ajuga remota Benth.	Ungo-quasot (T); Tale (Wol); Akorarchigne (A)	Lamiaceae	Leaf	Dysentery, swelling of legs, hypertension
Albizia anthelmintica (A. Rich.) Brongn.	Rhaybit (Som); Shina (A); Kebita (K)	Fabaceae (Mimosoideae)	-	Tapeworm medicine
Allophylus zeylanicus L.		Sapindaceae	Fruit	Tapeworm expectorant
Aloe spp.	Erret (A); Argeber (Som)	Liliaceae	Leaf	Antipyretic, spleen and liver problems
Amaranthus caudatus L.	Lishalisho, Ferenjitef (A); Iyaso, Jololi (G); Gagabsa (W)	Amaranthaceae	-	Tapeworm expectorant
Amaranthus sylvestris	Aluma (A); Birnaheo (T)	Amaranthaceae	-	Tapeworm expectorant
Aristolochia bracteata Retz. [=*A. bracteolata* Lam.]	Ghaga (Ar); Boro, Grerbaad, Ged-hurguma (Som)	Aristolochiaceae	-	Leg itches in Kalaffo
Artemisia afra Jacq.	Ariti (A); Chukun, Jukun (GH); Kodo (G)	Asteraceae	-	Stomach pain
Asparagus spp.	-	Liliaceae	Tuber, root	Cooling medicine, venereal diseases
Bersama abyssinica Fresen.	Azamrr (A); Lolchissa (G)	Melianthaceae	Shoot tip	Dysentery and roundworm
Boerhavia plumbaginea Cav.	-	Nyctaginaceae	Leaf	Jaundice, wound healing
Boswellia papyrifera (Delile ex Caill.) Hochst.	Etan (A); Libanat (GH, Ar)	Burseraceae	-	Antipyretic, tranquilizer
Brucea antidysenterica Roxb.	Woinos, Kola-wanza (A); Mmeleta (T)	Simaroubaceae	Leaf, root bark, fruit	Skin diseases, leprosy, dysentery, fever
Cadia purpurea (G. Piccioli) Aiton	Kadi (Ar); Hasaus (T); Salema (Som)	Fabaceae (Papilionaceae)	Whole plant	Used by drug companies in Europe

Continued

Table 1 continued

Botanical name	Vernacular name	Family	Plant part(s)	Therapeutical uses/indications
Calotropis procera (Aiton) W. T. Aiton	Tobbeya, Yahara-zaf, Ghinda (A); Ghinda, Akalo, Tomfi (T); Gala, Boha (Som); Usher (Ar)	Asclepiadaceae	Root, whole plant	Leprosy, tonic, venereal diseases
Cannabis sativa L.	Hashish (G)	Cannabidaceae	Leaf	Narcotic
Capparis tomentosa Lam.	Gomor (Som); Gemaro (A); Andal (T)	Capparaceae	Root, stem	Poison
Capsicum annuum L.	Mitmitta (A)	Solanaceae	-	Spice
Carissa edulis Vahl	Akamba (B); Adishawel (Som)	Apocynaceae	-	Toothache, cough, stomach ulcer
Carum copticum (L.) C. B. Clarke [= *Trachyspermum ammi* (L.) Sprague ex Turrill]	Netch-azud (A); Kamon (G)	Apiaceae	Root	Stomach problems
Cassia floribunda Cav. [= *Senna floribunda* (Cav.) H. S. Irwin & Barneby]	Sornema (K)	Fabaceae (Caesalpiniaceae)	Seed	Laxative, snake bite
Catha edulis (Vahl) Forssk. ex Endl.	Chat (A); Gofa, Jima (G); Gat (Ar); Dat (Som)	Celastraceae	Root, leaf	Influenza, stomach problems, chest diseases, narcotic, stimulant, relieve fatigue and hunger
Catharanthus roseus (L.) G. Don	Madagascar Periwinkle (Eng)	Apocynaceae	Root, leaf	Poison
Celosia argentea L.	-	Amaranthaceae	Seed, flower	Diarrhoea, dysentery, menstrual problems
Chenopodium album L.	Nechillo (A)	Chenopodiaceae	Seed oil	Anthelmintic
Cissampelos pareira L.	-	Menispermaceae	Root, leaf	Snake bite, wounds
Coccinia abyssinica (Lam.) Cogn.	Anchote (G)	Cucurbitaceae	Tuber	Edible
Combretum paniculatum Vent.	Baye, Buggie (G); Gabai, Shaga (K)	Combretaceae	Flower	Conjunctivitis
Commiphora spp.	Habak-hidd, Didin, Hagar (Som)	Burseraceae	-	Aromatic, antiseptic
Conium maculatum L.	Chof-chof (GH)	Apiaceae	-	Poison
Cordia africana Lam.	Wanza (A); Auchi (T); Wodessa (G); Uddichio (Sid); Mokota (Wol.)	Boraginaceae	Wood	Skin problems (spider disease)
Croton macrostachyus Hochst. ex Delile	Bissana (A); Makanissa; Badessa; Alaleh, Dogoma (G); Wush, Masincho (Sid)	Euphorbiaceae	Fruit, root, seed	Venereal diseases, abortifacient
Cucumis prophetarum L.	Yemder-inbuyi (A)	Cucurbitaceae	Fruit, whole plant	Poison, expulsion of placenta in cows

Continued

Table 1 continued

Botanical name	Vernacular name	Family	Plant part(s)	Therapeutical uses/indications
Cucurbita maxima Duchesne	Duba (A)	Cucurbitaceae	Seed	Tapeworm expectorant, anthelmintic
Cynara scolymus L. [= *C. cardunculus* L.]	Kenchofe (G)	Asteraceae	Leaf	Liver diseases
Cyperus rigidifolius Steud.	Gicha (A)	Cyperaceae	Bulb	Antipyretic, diarrhoea, stomach problems
Datura stramonium L.	Attefaris, Astenagrt (A)	Solanaceae	Seed, leaf	Poison
Embelia schimperi Vatke	Ankoko (A); Enkoko (T); Unkoko (G)	Myrginaceae	Fruit	Purgative, vermifuge
Euphorbia hirta L. [= *Chamaesyce hirta* (L.) Millsp.]		Euphorbiaceae	-	Asthma
Evolvulus alsinoides (L.) L.	Erieaio (T)	Convolvulaceae	Whole plant	Tonic, vermifuge
Ficus glomerata Roxb. [= *F. racemosa* L.]	-	Moraceae	Latex	Dysentery
Ficus spp.	Shla (A)	Moraceae	Root	Urinary problems
Foeniculum vulgare Mill.	Ensilal (A); Kamuni, Insilal (G)	Apiaceae	Seed, root	Flavouring agent, gonorrhoea
Galinsoga parviflora Cav.	Yeshewa-arem (A)	Asteraceae	Leaf, inflorescence	Wound, cut, saddle sore
Glinus lotoides L.	Meterre (A); Terabit (T)	Aizoaceae	-	Tapeworm infestation
Gynandropsis speciosa (Raf.) DC. [= *Cleome speciosa* Raf.]	-	Capparidaceae	-	Kidney stones
Hagenia abyssinica (Bruce) J. F. Gmel.	Habbi (T); Duchia, Edo, Fieto (G); Heto (GK)	Rhamnaceae	Flower	Tapeworm infestation, abortifacient
Heliotropium ovalifolium Forssk.	Dubj-goreyalle (Som)	Boraginaceae	Whole plant	Scorpion poison
Heliotropium spp.	Habak-hid (Som)	Boraginaceae	Whole plant	Quick expulsion of placenta
Indigofera coerulea Roxb. var. *occidentalis* JB. Gillett & Ali	Darko (Som); Houer (Ar)	Fabaceae (Papilionaceae)	Leaf, root	Wound dressing
Jasminum abyssinicum DC.	-	Oleaceae	Root, leaf	Tonsillitis
Juniperus procera Hochst. ex Endl.	Tidh (T); Gttira (G)	Cupressaceae	Twig, bud	Stomach worms
Kalanchoe spp.	Bosoke (G); Indahula (A and G)	Crassulaceae	Leaf, root	Sore boils, malignant wounds, gonorrhoea, intestinal parasites and worms
Kigelia africana (Lam.) Benth.	African sausage tree (Eng)	Bignoniaceae	Fruit	Purgative, dysentery

Continued

Table 1 continued

Botanical name	Vernacular name	Family	Plant part(s)	Therapeutical uses/indications
Kleinia spp.	Kinchive (A)	Asteraceae	-	Poison
Lantana camara L.		Verbeanaceae	Leaf	Tonic, stimulant
Lepidium sativum L.	Fetto (A); Shimfi (G); Kotto, Shimfa (T); Shufu (GH)	Cruciferae	Seed	Stomach problems
Leonotis raineriana Vis. [=*L. ocymifolia* var. *raineriana* (Vis.) Iwarsson]	Ras-kimmir, Feres-zeng (A)	Lamiaceae	-	Menstrual problems
Linum usitatissimum L.	Telba (A); Flax seed (Eng)	Linaceae	Seed	Demulcent, laxative, wounds
Maerua angolensis (DC.)	Kadhi (Kon)	Capparidaceae		Fish poison
Maytenus ovata (Wall.) Loes.	Kambolcha (G); Atat (A)	Celastraceae	Leaf	Anticancer
Myrsine africana L.	Kechemo (A); Katchu (GH)	Myrginaceae	Fruit	Tapeworm infestation
Nicotiana glauca Graham	Tree tobacco (Eng)	Solanaceae	Leaf	Insecticide
Nigella sativa L.	Tikur-azmud (A)	Ranunculaceae	-	Flavouring agent
Opuntia vulgaris auct. mult. [=*O. monacantha* Haw.]	Kulkual (A); Beles (T); Tini (GH); Prickly pear (Eng)	Cactaceae	Fruit	Asthma
Oxalis semiloba Sond.	Micha-micho (A)	Oxalidaceae	Bulb	Tapeworm infestation
Paullinia pinnata L.		Sapindaceae	Leaf, root, seed	Nerve poison
Phytolacca dodecandra L'Hér.	Endod (A); Endoda(G); Endott, Shebeti, Shipiti, Sobet (T)	Phytolaccaceae	-	Pelegra, gonorrhoea, abortifacient
Polygala spp.	-	Polygalaceae	Root	Snake bite, expectorant, cough
Polygonum senegalense Meisn.	Gunnamilla (A); Chomo (G)	Polygonaceae	Leaf	Skin problems
Prunus africana (Hook. f.) Kalkman	Tikur-inchet (A); Homi (G)	Rosaceae	Leaf	Wounds
Pterolobium stellatum (Forssk.) Brenan	Keneteffa (A); Arangama (G)	Fabaceae (Caesalpiniaceae)	Leaf	Tuberculosis, respiratory problems
Punica granatum L.	-	Primulaceae	Fruit, leaf	Diarrhoea, vermifuge
Quisqualis indica L.	Rangoon-creeper (Eng)	Combretaceae	Fruit	Vermifuge
Rhoicissus erythroides Planch.	Hida-rafa (G)	Vitaceae	-	Rabies
Ricinus communis L.	Gullo (A); Kobo (G); Castor bean (Eng)	Euphorbiaceae	Seed oil	Purgative

Continued

Table 1 continued

Botanical name	Vernacular name	Family	Plant part(s)	Therapeutical uses/indications
Rosa abyssinica R. Br. ex Lindl.	Keqa (A); Wild Ethiopian rose (Eng)	Rosaceae	Fruit	Tapeworm and roundworm infestation
Rubia spp.	Enchibrr (A)	Rubiaceae	Leaf	Cough
Rumex nepalensis Spreng.	-	Polygonaceae	Leaf	Antidote, laxative
Rumex spp.	-	Polygonaceae	-	Rheumatism, stomachache
Salvadora persica L.	Adai (T); Dadaho, Adz (Som); Imu-gareh (G, Ar)	Salvadoraceae	Berries, whole plant	Cold, stomach problems
Scabiosa columbaria L.	Theiabi (T)	Dipsacaceae	Leaf, root	Constipation
Solanum incanum L.	Ingulla (T); Inboye (A); Hidi (G)	Solanaceae	Fruit	Gonorrhoea
Solanum marginatum L. f.	Heda, iddi-orabissa (G); Angulle (T)	Solanaceae	Seed	Weak heart, stomach problems
Sphaeranthus suaveolens DC.	Gubbisna (G); Ala-schina (GH)	Asteraceae	Whole plant	Cough, perfume
Tagetes minuta L.	-	Asteraceae	Oil	Insecticide
Tamarindus indica L.	Homar (A); Roka (G); Ragai (Sod)	Fabaceae (Caesalpiniaceae)	Fruit, leaf, seed	Refrigerant, digestive, carminative, laxative, antiscorbutic, poultice in boils, diarrhoea
Taverniera abyssinica A. Rich.	-	Fabaceae	Seed	Stomachache
Tephrosia vogelii Hook. f.	-	Fabaceae (Papilionaceae)	Leaf	Abortifacient
Thymus schimperi Ronn.	Tossigne (A)	Lamiaceae	-	Gonorrhoea, cough, liver diseases
Trichilia emetica Vahl	Kota, Gmmeh (T); Yahy (Som); Roka (Ar)	Meliaceae	Root, whole plant	Labour in pregnancy, antimalarial
Trigonella foenum-graecum L.	Abish (A); Sunko (G); Abacham, Abacheh (T)	Fabaceae (Papilionaceae)	-	Leprosy muscular dystrophy, rheumatism
Vernonia amygdalina Delile	Grawa (A); Ebicha (G); Dumoga (GH)	Asteraceae	Wood sap, flower, whole plant	Purgative, stomach problems, antimalarial
Withania somnifera (L.) Dunal	Gisewa (A); Agolla, Athmai (T); Gutita (GH)	Solanaceae	Whole plant	Cough, asthma, antiepileptic
Ximenia americana L.	Inkoy (A); Huda (G); Mellau, Maleta (T)	Oleaceae	Fruit	Vermifuge
Zehneria scabra (L. f.) Sond.	Areg-resa (A); Hafafelo (T)	Cucurbitaceae	Leaf	Skin rashes

Continued

Table 1 continued

Botanical name	Vernacular name	Family	Plant part(s)	Therapeutical uses/indications
Zingiber officinale Roscoe	Zingibil (A); Dendabil (T)	Zingiberaceae	-	Stomach cramps
Ziziphus mauritiana Lam.	Gava (T); Ghob, Gheb, Jumuba (Som); Kurkura (GH)	Rhamnaceae	Root	Astringent, scrofula

(A) Amarinya; (Ar) Arabic; (B) Bena; (Eng) English; (G) Galinya; (GB) Galinya, Bale; (GH) Galinya, Harar; (GK) Galinya, Kaffa; (GS) Galinya; (K) Kaffa; (Kon) Konso; (Sid) Sidama; (Sod) Soddu; (Som) Somali; (T) Tiigrinya; (Wol) Wollamo.

Myrrh, the third valuable exudate, is obtained from a small shrub *Commiphora myrrha* (Nees) Engl. that is principally found in the provinces of Ogaden, Bale and Sidamo.

Commonly used medicinal plants are *Ajuga* spp., *Artemisia rehan*, *Carissa edulis* Vahl, *Clerodendrum myricoides* (Hochst.) Vatke, *Hagenia abyssinica* (Bruce) J. F. Gmel., and *Myrsine africana* L. In addition, *Taverniera abyssinica* A. Rich., and *Thymus schimperi* Ron. [= *Thymus serpyllum* L.] can be mentioned. The endemic plants to the highland area are used extensively by the local communities and TMPs in their remedies.

Ethiopians possess an extensive knowledge of poisonous plants and the art of preparing poisons. A number of plants are used in the preparation of poison arrows. The important poisonous plants are *Acokanthera schimperi* Schweinf., *Adenium obesum* (Forssk.) Roem. & Schult., *A. somalense* Baif. f., *Cassia* spp., *Crotalaria retusa* L., *Euphorbia* spp., *Securidaca longipedunculata* Fresen. and *Tephrosia vogelii* Hook. f. Poisonous preparations are mostly used for homicidal purposes and are quite prevalent in the northern provinces of Ethiopia.

Habitat destruction, over-exploitation and destructive harvesting are the major threats to medicinal plant resources. *Dracaena steudneri* Schweinf. ex Engl., *Hagenia abyssinica* (Bruce) J. F. Gmel., *Securidaca longipedunculata* Fresen., *Clerodendrum myricoides* (Hochst.) Vatke, *Cucumis aculeatus* Cogn. and *Warburgia ugandensis* Sprauge are some of the threatened species in Ethiopia. Two plants, *Salsola* spp. and *Taverniera abyssinica* A. Rich, have become rare owing to their unsustainable use.

R&D Activities

The Institute of Biodiversity and Conservation Research, the Ethiopian Agricultural Research Organization and the Essential Oils Research Centre undertake R&D activities in conservation, cultivation and processing of medicinal and aromatic plants. The Traditional Medicine Depart-

ment, the Department of Drug Research of the Ministry of Health and the Institute of Pathobiology of Addis Ababa University undertake scientific validation of herbal medicines. The Ethiopian Science and Technology Commission supervises the patent protection and intellectual property rights on herbal medicinal products. The departments of Botany, Chemistry, Pharmacy and Veterinary Sciences of Addis Ababa University are involved in the development of cultivation practices of important medicinal and aromatic plants, development of databases, phytochemical screening, formulations of finished herbal products and biological screening.

In 1992, the Essential Oils Research and Development Unit of the former National Chemical Cooperation was upgraded to the Essential Oils Research Centre. The Centre works directly under the Ministry of Trade and Industry and receives research grants from the Ethiopian Science and Technology Commission and the Swedish Agency for Research Cooperation with Developing Countries/Swedish International Development Authority (SAREC/SIDA).

The Centre conducts research on agronomic, biological and chemical aspects and develops technological packages for pilot-scale production of essential oils. It has a pilot distillation unit for essential oils and about 80 hectares of farmland at Wondo Genete. Its laboratory at Addis Ababa caters for the quantitative and qualitative analysis of plant products. The agricultural trials, preliminary analysis and pilot-scale production of essential oils is carried out at Wondo Genete. So far the Centre has studied essential oils from over 150 plant species, including the exotic ones.

The Ethiopian Science and Technology Commission was first established in 1975 to initiate, organize, direct and promote the scientific and technological R&D activities in the country. The Commission was re-established in 1994 to enhance the scientific and technological awareness of the people of Ethiopia and to improve their knowledge with a view to promoting the development of traditional, new and emerging technologies.

The Institute of Pathobiology has undertaken extensive R&D activities on the molluscicidal plant *Phytolacca dodecandra* (Endod). Until 1996, its drug research department had collected and documented information on over 600 medicinal plants.

The Ethiopian Health and Nutrition Institute has conducted research on 700 species of medicinal plants used by Ethiopians for curing lung, venereal and other diseases. It has prepared an ointment from five traditional medicines called *topical ointment* to treat skin, blood and respiratory diseases.

An extensive collection of native Ethiopian medicinal plants has been undertaken by the United States Department of Agriculture (USDA) research service. It has also made preliminary anticancer screening of the plant samples and encouraging results have been found. A similar

screening programme has been developed to test Ethiopian plants by the Institute of Tropical Medicine in the UK.

Trade and Marketing

A list of the most common medicinal plants used in traditional medicine on the Ethiopian market are given in Table 2 (Dessisa, 1997).

Table 2: Most common medicinal plants on Ethiopian market

Botanical name
Adhatoda schimperiana
Asparagus africana
Bersama abyssinica Fresen.
Coriandrum sativum L.
Croton macrostachyus Hochst. ex. A. Rich.
Embelia schimperi Vatke
Euphorbia ampliphylla
Hagenia abyssinica (Bruce) J. F. Gmel.
Kalenchoe spp.
Lupinus albus L.
Olea africana Mill.
Ricinus communis L.
Rumex abyssinicus Jacq.
Rumex nervosus Vahl
Tamarindus indica L.
Ximenia americana L.

The average national annual output of exudates in the period between 1978 and 1991 was over 1,500 tonnes. Since 1992, production grew to over 2,000 tonnes. Reliable data on the production and utilization of exudates are not available.

Besides Sudan, Ethiopia is the world's largest producer of olibanum resin. According to 1981 estimates, the potential production was 23,000 tonnes of which nearly half was exported (FAO, 1995).

The collection of olibanum resin is one of the top employment generating activities in the remote areas of Ethiopia. The number of seasonal workers engaged in tapping and grading ranges from 20,000 to 30,000.

3.5 Kenya

Kenya is situated on the equator on the eastern coast of the African continent. Medicinal plants play an important role in the national health-care system and are the source of foreign revenue. At a national level, medicinal plant markets vary across the country and market development has reached various stages. About 37 medicinal plant species are in common and widespread use in traditional systems of medicine.

In common with many countries in Africa, Kenya is endowed with a rich varied indigenous flora, which is extensively used in traditional systems of medicine. There is great potential of setting up industries for the extraction and processing of medicinal plants and distillation of essential oils from aromatic plants. Favourable agro-climatic conditions make it ideally suited to the introduction and cultivation of a large number of medicinal and aromatic plants, which have established uses in the pharmaceutical and cosmetic industries. Among the medicinal plants,

the species deserving technology upgrading are *Cinchona succirubra* Pav. ex Klotzsch [=*Cinchona pubescens* Vahl], *Agave sisalana* Perrine, *Datura stramonium* L., *Rauvolfia* spp., *Juniper* spp., *Geranium* spp. *and Eucalyptus* spp. An alkaloid industry could be set up with a production of around 25 tonnes of cinchona alkaloids per year as the production of raw cinchona bark is estimated at around 500 tonnes per year. There are many more species worth further investigation.

Pyrethrum, *Tanacetum cinerariifolium* (Trevir.) Sch. Bip., is an important cash crop grown in the Kenyan Highlands at the Nakuru, Laikipia, Kisii, Kiambu and Bomet divisions. About 70% of global demand for pyrethrum is sourced from Kenya (Uwechue, 1996). Essential oil from *Juniperus procera* Hochst. ex Endl. is in high demand in the industry. Its intensive exploitation has led to a short supply of raw material to the industry (FAO, 1995).

Traditional Systems of Medicine

Traditional medicine has not been integrated into mainstream medicine but it is widely practised by local communities and TMPs in urban centres (Cunningham, 1997). The local communities of southern Nyanza districts have a rich knowledge of practices of traditional medicine. The insufficient number of modern medical doctors means that most of the population relies on TMPs for health care. For example, in the Rachuonyo area there is only one modern medical doctor for 40,000 inhabitants (BBC World Service, 2000).

State Efforts in Development of Traditional Medicine

The efforts for incorporation of traditional medicine into the national health policy were initiated in the late 1970s. Kenya's Development Plan 1989-93 recognized the practice and promotion of traditional medicine through TMPs (Anonymous, 1994). Only registered TMPs at the Ministry of Health and provincial authorities are allowed to practice traditional medicine. The patent law was revised in 1999 with the purpose of including legal protection of traditional medicines. Research has also been strengthened to find better treatments for diseases such as HIV/AIDS and cancer.

Medicinal Plant Resources

Kenya has over 10,000 species of indigenous flora of which about 1,200 are of medicinal value. There are about 42 ethnic groups that rely exclusively on medicinal plants for their health-care needs and livelihood. The Traditional Kikuyu Society makes use of medicinal plants to treat various human and livestock ailments. In western Kenya, the Luhya tribe use *Mondia whitei* (Hook. f.) Skeels to increase male libido. The *Maytenus* spp. are used throughout Africa as a tonic to relieve joint pains and abdominal discomforts. The *Warburgia ugandensis* Sprague is widely used by Kikuyus to flush out tapeworms and to improve appetite. The *Olea africana*

Mill. [=*O. europaea* subsp. *cuspidata* (Wall. ex G. Don) Cif.)] is used to cure different ailments. Its root, bark and leaf are used in the preparation of human and veterinary medicines. *Urtica massaica* Mildbr., stinging nettle, is used by the Kikuyus in making irio (a mixture of mashed maize, beans, potatoes, etc.), used to lower blood sugar level and to purify the blood. The leaf extract of *Vernonia brachycalyx* O. Hoffm., used against malaria, has shown strong antimalarial activity in bioassays. A community group, known as Community Development Centre for Kinoo (CODECK), gives education and training to young generations. The main topics are the value of herbal medicine in health care, and the ways and means of growing and using readily available herbs.

Prunus africana (Hook. f.) Kalkman grows wild in the hills of Cherangani, Timboroa, Taita, Chyulu, Tugen and Nyiro, in the Nandi forests, the eastern reaches of the Mau ranges, the Kakamega forest and in the montane forests of western Kenya.

R&D Activities

Kenya has a medium-sized research programme in herbal medicine. The Traditional Medicine and Drug Research Centre of the Kenya Medical Research Institute, Nairobi has been engaged to conduct research on the potential commercial application of *Azadirachta indica* A. Juss. for its antimalarial properties. The School of Alternative Medicine and Technology (Samtech), Ruring'u Nyeri is involved in R&D in herbal medicines for the treatment of diabetes and HIV/AIDS. It has developed 36 herbal medicine formulae and is also in the process of manufacturing herbal cosmetics, teas and tonics. The Institute of Herbs Treatment has undertaken studies on garlic (*Allium sativum* L.) and soya bean (*Glycine max* (L.) Merr.) against the replication of the HIV virus. The Miti Shamba Reserach Centre and the Winafya Research and Medicines Institute undertake research in the field of traditional medicine.

The Department of Chemistry of the University of Nairobi deals with the isolation of compounds from medicinal plants and supplies them to pharmaceutical companies such as Merck (USA) and Jansel (Belgium) to test these compounds for biological activity and process drugs from them. In collaboration with the International Centre for Insects Physiology and the Entomology and Medical Research Institute, university scientists are engaged to raise the level of biochemical research in order to obtain economic gains for the country. International donor agencies such as the United States Agency for International Development (USAID) and the International Foundation of Science (IFS) provide funds for undertaking research in the field of medicinal plants.

The Coffee Board and the Tea Board of Kenya are responsible for research on coffee and tea, respectively. In addition,

some agricultural research has been done by the universities, non-governmental organizations (NGOs) and the private sector.

Trade and Marketing

Kenya exports significant quantities of *Prunus africana* (Hook. f.) Kalkman, *Warburgia salutaris* (Bertol. F.) Chiov. and *Aloe* spp. to the international market. Since 1990, about 1,100 tonnes of *Prunus africana* (Hook. f.) Kalkman bark have been sold to the French firm Prosynthese, a subsidiary of the Fournier Group, which produces Tedenan tablets for prostate cancer. Kenya has exported annually about 300 tonnes of bark worth about US$ 0.57 mn. About 79 tonnes of *Warburgia salutaris* (Bertol. f.) Chiov. bark or extract worth US$ 0.14 mn and about 5 tonnes of *Aloe* extract worth US$ 5,986 were exported to Germany in 1992 and 1993, respectively (Lange, 1997).

Kenya is the major supplier of pyrethrum (*Tanacetum cinerariifolium* (Trevir.) Sch. Bip.) to the world market and has dominated world production since 1933, when it first started commercial production of pyrethrum. Owing to the lack of processing facilities and adverse conditions, production has declined from 16,000 tonnes in 1992 to 6,000 tonnes in 2000. Coil Products (K) Limited is the major producer of pyrethrum in Kenya. Besides supplying the local market, the company also exports mosquito coils to Tanzania, Uganda, Sudan, Zimbabwe, Malawi and Japan.

Problems and Constraints

There is a lack of information on standardization techniques for quality, safety and efficacy of finished products and regulation of trade in medicinal plant material and herbal products. The short self-life of herbal drugs poses a major problem in the supply chain. There is also a need to regulate legislation to accommodate traditional doctors within the Ministry of Health. They are currently under the Ministry of Culture and Social Services.

3.6 Somalia

In Somalia, the use of 151 medicinal plants has been documented. In the Lower Jubba region, 81 plant species are used for their medicinal value (Bowen, 1990). Somalia is the world's largest exporter of myrrh, (*Commiphora myrrha* (Nees) Engl.), opopanax (*C. kataf* (Forssk.) Engl., [=*C. erythraea* (Ehrenb.) Engl.] , olibanum resin (*Boswellia sacra* Flueck. [=*B. carteri* Birdw.]) and maidi (*B. frereana* Birdw.) brands. The export of these resins is declining due to the political instability in the country (EC, UNDP and FAO, 1998). The export value of these resins was estimated at US$ 156 mn on the international market, although official receipts for 1984 and 1985 showed only US$ 28 mn (Bowen, 1990). In all, more than 10,000 men are employed in the collection of resins in Somalia.

Myrrh and opopanax are used as flavouring agents and for mouthwashes and beverages. *Commiphora* spp. are found in

the dry inland locations from the north to the extreme south. However, much of the material exported from Somalia is believed to be collected in Ethiopia. At the end of the 1980s, the annual estimated volume of exports of *Commiphora* resins was 1,000 tonnes worth US$ 4 mn (Bowen, 1990). The export volume of myrrh dropped from 1,352 tonnes in 1976 to 421 tonnes in 1979 (Coppen, 1995).

Olibanum resin is exploited from the natural stands of *Boswellia* spp. It is used as incense in religious ceremonies and as a flavouring agent. There are two types of olibanum: olibanum maidi, produced from *Boswellia freeriani* and olibanum beyo obtained from *B. sacra* [=*B. carteri*]. Most of the exploitation of olibanum takes place in northeastern Somalia and for many collectors it is the principal source of income (Bowen, 1990).

3.7 Sudan

Among the number of indigenous species of medicinal and aromatic plants present in Sudan, about 18 species are available in abundant quantity. Many of these are well-known and included in recognized pharmacopoeias. Sudan's climatic features can be exploited for the cultivation of a variety of medicinal and aromatic plants. As the country possesses large areas of arable land and a good supply of labour, there are good prospects for industrial production of plant-derived pharmaceuticals. Furthermore, it is felt that cultivation could create export opportunities.

The well-known medicinal and aromatic plants found in Sudan are *Cassia acutifolia* Delile, *Ricinus communis* L., *Capsicum frutescens* L., *Datura stramonium* L., *Rauvolfia vomitoria* Afzel., *Catharanthus roseus* (L.) G. Don, *Foeniculum vulgare* Mill. and *Anethum graveolens* L.

Sudan has witnessed the fusion of Pharonic, Christian and Islamic cultures with the local indigenous cultures. This ethnic and cultural diversity led to the country becoming a melting pot of African cultures with respect to herbal medicine. The diversity is largely attributed to immigration from the rest of the continent, in particular from the west.

The country is well-positioned to play a leading role in the area of medicinal plants by virtue of its climate that varies from arid desert in the north to tropical in the south. The vegetation belts are representative of African vegetation and in particular west African with respect to medicinal plant resources.

With this unique history and varied climate, terrain, flora and fauna, the people of Sudan have developed their own traditional medical culture. Medicinal and aromatic plants are not only used to meet health-care needs but also for cosmetics and perfumery purposes.

Traditional medicine is both popular and important as a medical system and has been integrated into the national health-care schemes. Most of the medicinal herbs are gathered from the wild in unsustainable ways resulting in short supply and

quality deterioration of raw material that is exported from the country. The Sudanese government is giving more attention to the cultivation of medicinal plants in demand on the international market. As part of this effort, improved hybrids and varieties of medicinal and aromatic plants have been imported for commercial production.

Traditional Systems of Medicine

Traditional medicine has its roots in Islamic and west African medicine. People depend on herbal medicines, which are an integral part of the health-care system. There is vast experience in the use of herbs in medical treatments. Many families specialize in herbal medicines and this knowledge is conveyed from generation to generation. Patients travel from urban to rural areas to consult TMPs/herbalists, especially for chronic diseases. The Medicinal and Aromatic Herbs Research Institute has trained a considerable number of specialists in the various fields required for research in medicinal plants. Legislation is in force for the registration of herbal preparations and herbal products.

Medicinal Plant Resources

There are more than 3,132 vascular plant species, of which 50 are endemic. The *Sudan Atlas of Medicinal Plants* has records of more than 2,000 medicinal plants collected from different parts of the country. Several native plant species are in use in traditional medicine. At least 60 medicinal and aromatic plants, which either occur naturally or are cultivated, are widely used for their medicinal, aromatic and other health-giving properties. They are used in the preparation of traditional remedies as well as in industry for the preparation of derivatives. The main medicinal plant species are *Acacia nilotica* (L.) Delile*, Adansonia digitata* L.*, Cassia senna* L., *Grewia* spp. and *Tamarindus indica* L. A total number of 46 species from the White Nile provinces and about 68 species from central Sudan are reported to be of medicinal value. Some medicinal and aromatic plant resources of Sudan are given in Table 3 and the species under cultivation are listed in Table 4. There is great potential to increase the production of medicinal and aromatic plants. The species suitable for commercial production in different regions are given in Table 5 (Abdalla and Nour, 2001; Ethohami, 1999).

Gum Arabic Industry

Gum Arabic is one of the world's most useful natural substances, which has been in use since 4000 B.C. or before. The name, gum Arabic, is believed to describe the gum shipped from Arabian ports to worldwide distribution centres, mainly in Europe. It is sourced from acacia trees. There are over 1,100 species of *Acacia* worldwide, among them *Acacia senegal* (L.) Willd. and *A. seyal* Delile are commercially exploited for Hashab and Talh types of gum Arabic, respectively. These species are found in the gum Arabic belt

in Africa, which covers parts of Burkina Faso, Chad, Eritrea, Ethiopia, Mauritania, Nigeria, Senegal and Sudan. Gum from other species such as *Boswellia papyrifera* (Delile ex Caill.) Hochst. (Tarag Tarag) and *Sterculia setigera* Delile (Tartar or Karaya) also has good potential on the world market (Omer *et al*., 1993).

Gum Arabic is a tasteless, odourless substance used in a variety of medicinal and industrial applications. It is reported to reduce cholesterol levels, lower blood pressure, and encourage the body's absorption of iron, and is used as an ingredient in drugs for kidney diseases.

Gum Arabic is so important that when the USA imposed the economic sanctions on Sudan in 1997, it banned all trade and investment links between the two countries except gum Arabic.

The Hashab type of gum Arabic is the gummy exudate obtained through tapping the branches of the *Acacia senegal* (L.) Willd. while the Talh type is the exudate from *A. seyal* Delile which flows naturally out of cracks in the bark and branches. A tree between 7 and 12 years old yields a maximum of 10 kg gum in a season. When the production of Hashab gum is low, the cheaper Talh gum is used as a substitute. Hashab gum is exported mainly in crude forms under different grades: hand picked selected, cleaned gum, siftings and dust. Talh gum is also exported in crude form. The graded gum is sold to the Gum Arabic Company Ltd., which exports the packed gum in 50 or 100 kg burlap bags through to Port of Sudan, on the Red Sea.

The highest quality gum Arabic is found in Sudan, Chad and Nigeria. The Sudanese gum harvest accounts for more than 70% of the world's supply on an annual basis. It is the third largest export merchandize after cotton and sorghum. About 90% of gum exported from Sudan is Hashab (Anonymous, 2002).

The world's largest trader of gum Arabic, Gum Arabic Co. Ltd. was established in 1969 to provide order in the free-for-all gum trade of Sudan, to ensure consistent quality of exports and to protect the farmers' interests. The company purchases most of the gum produced in the country and exercises a monopoly on the export of the substance. Some of the production is smuggled out of the country, especially through Chad and Ethiopia, to the international market for higher prices. Apart from exporting different grades of Hashab and Talh gum Arabic, the company also exports kibbled gum Arabic (Hashab).

R&D Activities

In Sudan, research on medicinal and aromatic plants begun a long time ago, but it was scattered and unstructured until the establishment of the Medicinal and Aromatic Plants Research Institute (MAPRI). In 1973, the National Council for Research established the Medicinal and Aromatic Plants Research Unit, which was upgraded to the status of an institute in 1983. In 1992, the Traditional Medicine Research

Table 3: Some medicinal and aromatic plant species of Sudan

Botanical name	Local name(s)
Acacia nilotica (L.) Delile subsp. *nilotica*	Sunt, garad
Acacia nilotica subsp. *tomentosa*	Sunt, garad
Acacia senegal var. *senegal*	Hashab
Acacia seyal var. *seyal*	Talh
Acacia seyal var. *fistula*	Talh
Aloe spp.	Sabbar
Ambrosia maritima L.	Damsisa
Ammi majus L.	-
Argemone mexicana L.	Agresone
Balanites aegyptiaca Del.	Heglig, laloub
Boswellia papyrifera (Delile ex Caill.) Hochst.	Targ-targ, gafal, luban
Citrullus colocynthis (L.) Schrad.	Handal
Cymbopogon proximus (Hochst. ex A. Rich) Stapf	Mahareb
Datura innoxia Miller	Alsakran
Datura metel L.	-
Dioscorea spp.	Dioscoera
Haplophyllum tuberculata (Forssk.) A. Juss.	Haza
Rauvolfia vomitoria Afzel.	Rauwolfia
Solanum nigrum L.	Enab el deib, elmugad el aswad
Tamarindus indica L.	Aradib

Table 4: Medicinal and aromatic plant species under cultivation in Sudan

Botanical name	Local name(s)
Azadirachta indica A. Juss.	Neem
Brassica nigra (L.) W. D. J. Koch	Khardal aswad
Carica papaya L.	Babai
Datura stramonium L.	Sakran
Foeniculum vulgare Mill.	Shamur
Grewia tenax (Forssk.) Fiori	Godeim
Hibiscus sabdariffa L.	Karkadeh
Hyoscyamus muticus L.	Sakran musri
Moringa oleifera Lam.	Horesradish tree
Nicotiana rustica L.	Tuback, Gamsha
Nigella sativa L.	Kamoon Aswad
Ocimum basilicum L.	Reehan
Ricinus communis L.	Khirwi
Senna alexandrina Mill.	Senna maka
Solenostemma arghel (Del.) Hayne	Hargel

Table 5: Medicinal and aromatic plant species suitable for commercial production in Sudan

Plant species	Local name	Regions suitable for production
Aloe spp.	Sabbar	Northern Sudan
Carum carvi L.	Karawaya	
Citrullus colocynthis (L.) Schrad.	Handal	
Cymbopogon citratus (DC.) Stapf	Lemon grass	
Cymbopogon proximus (Hochst. ex A. Rich) Stapf	Mahareab	
Datura stramonium L.	Sekran	
Matricaria recutita L.	Babong	
Mentha spp.	Nanaa mint	
Moringa oleifera Lam.	Horseradish tree	
Nigella sativa L.	Black seed	
Plantago ovata Forssk.	Psyllium	
Senna alexandrina Mill.	Senna maka	
Alpinia spp.	Galangal	Western Sudan (Jabal Mara area)
Artemisia herb-alba Asso.	Sheeh	
Hibiscus sabdariffa L.	Karkadeh	
Mentha piperita L.	Pepper nanaah	
Senna alexandrina Mill.	Senna maka	
Zingiber officinale Roscoe	Zangabeel	
Allium sativum L.	Garlic	Eastern and central Sudan
Aloe sinkatana	Sabbar	
Aloe spp.	Sabbar	
Catharanthus roseus (L.) G. Don	Vinca	
Cymbopogon citratus (DC.) Stapf	Lemon grass	
Plantago ovata Forssk.	Psyllium	
Salvadora persica L.	Arak	
Alpinia spp.	Galangal	Southern Sudan (upper lands)
Piper nigrum L.	Black pepper	
Rauvolfia vomitoria Afzel.	Rauwolfia	
Zingiber officinale Roscoe	Zangabeel	

Institute also joined the MAPRI. The Institute undertakes activities on the development of medicinal and aromatic plants, traditional herbal medicine and other industrial aspects of medicinal plants. The industrial uses of some medicinal and aromatic plants in Sudan are given in Table 6.

Trade and Marketing

Sudan exports significant volumes of medicinal and aromatic plant material to the world market. Its export of other medicinal plants (HS 1211.90.80 and 1211.90.90) to Germany increased to

3,755 tonnes in 1994 from 1,655 tonnes in 1991 (Bank of Sudan, 2001).

The annual export value of medicinal and aromatic plants from Sudan was US$ 10 mn in the period between 1995 and 1999. The export of plants for herbal teas, except mint leaves, to the USA was worth US$ 0.26 mn in 1997 and Sudan's export of plant material for medicaments, perfumery, insecticidal and fungicidal purposes to the European Union was worth US$ 4.5 mn in the same year. Most of the crude drugs exported are destined to Germany, the UK and Italy. The leading medicinal plants exported from Sudan are given in Table 7 (US Department of Commerce, 2001). Hibiscus from Sudan is preferred on the world market for its perfect colour blends and taste. The German import market is dominated by Sudanese hibiscus as a herbal tea base.

Sudan is one of the main gum producing countries, and exports gum Arabic as a primary product to western European countries and the USA. The large markets for this commodity are the European Union, Switzerland and Scandinavia (40% of the world market), the USA (25%) and Japan (10%).

Sudan annually produces about 26,000 tonnes of gum Arabic and the USA imports about 5,000 tonnes. On the US market, the well-seasoned (gum which performs superbly in emulsions), low viscosity and low moisture gum is preferred for a wide variety of food and beverage applications. There is no complete, natural or synthetic, substitute for gum Arabic. Many US companies prefer Sudanese gum Arabic for its high quality and consistency. Spray-dried gum is the principal merchandize in the USA (Anonymous, 1997).

Despite world economic expansion in the last decades, total consumption of gum Arabic has declined internationally from 70,000 tonnes in the early 1960s to 30,000 to 40,000 tonnes in 2000. In the mid 1960s, gum Arabic was exported in huge volumes, around 50,000 tonnes per annum, but due to under-invoicing of gum, total exports revenue did not exceed US$ 12 mn (Paul, 2000).

In 2001, the Sudanese export volume of gum Arabic was 18,984 tonnes worth US$ 19.8 mn (11,192 tonnes of the Hashab type worth US$ 13.5 mn; 1,272 tonnes of the Talh type worth US$ 901,000; 6,520 tonnes of gum dust worth US$ 5.4 mn). Exports to the USA were worth US$ 2.8 m (2,840 tonnes) in the same year (Bank of Sudan, 2001).

3.8 Tanzania

The economy of Tanzania depends on agricultural exports including pyrethrum, coffee, tea, cloves and medicinal plants. Medicinal plants and their products are not recognized as a source of revenue to the nation but individuals and companies find the sector promising in terms of economic gains.

Traditional health practices in Tanzania have existed for a long time. The exploration of plants medicinal properties

Table 6: Some industrialized medicinal and aromatic plant species of Sudan

Plant	Use(s)	User industries
Acacia senegal (L.) Willd.	Emulsifying agent	Textile, confectionary
Aloe spp.	Healing substance	Cosmetic
Arachis hypogaea L.	Reduce bleeding tendency	Pharmaceutical
Balanites aegyptiaca Del.	Source of diosgenin	Pharmaceutical (precursor)
Boswellia papyrifera (Delile ex Caill.) Hochst.	Aromatic, binder	Incense, plasters and fuming pastilles
Capsicum frutescens L.	Antirheumatic and sciatica	As tinctures, ointments and plasters, food, pharmaceutical
Carum carvi L.	Flavouring agent	Food
Citrullus colocynthis (L.) Schrad.	Hydragogue catharic, anti-rheumatic	Indigenous medicine
Coriandrum sativum L.	Flavouring agent	Food
Cuminum cyminum L.	Carminative, stimulant	Food, pharmaceutical
Cymbopogon citratus (DC.) Stapf	Aromatic	Cosmetic
Cymbopogon proximus (Hochst. ex A. Rich) Stapf	Diuretic, colic painkiller and antipyretic	Indigenous medicine
Cyamopsis tetragonoloba (L.) Taub.	Stabilizer, thickener in food	Food, pharmaceutical and cosmetic
Eucalyptus globulus Labill.	Anti-asthmatic	Cigarettes (astringents)
Foeniculum vulgare Mill.	Aromatic, flavouring	Perfumery, food
Hibiscus sabdariffa L.	Hypotensive, antimicrobial	Beverage
Lawsonia inermis L.	Dye	Cosmetic
Nigella sativa L.	Flavouring, diurtic	Food, confectionary
Ocimum basilicum L.	Aromatic, flavouring	Perfumery, food
Pimpinella anisum L.	Flavouring agent, aromatic	Confectionary and perfumery
Ricinus communis L.	Disinfectant, lubricant	Cosmetic and automobile (lubricant)
Solenostemma arghel Hayne	Cough remedy	Indigenous medicine
Trigonella foenum-graceum L.	Demulscent	Food, veterinary medicine

Table 7: Medicinal plant export from Sudan

Goods	Volume (tonnes)		Value (million US$)	
	2000	2001	2000	2001
Hibiscus flowers	20,375	12,751	15.60	9.30
Senna pods	1,753	668	0.77	0.31
Henna	468	572	0.47	0.53

had created, through careful observation, trial and error, a vast heritage of knowledge and expertise among different ethnic cultures. Through the ages, most of such indigenous knowledge was handled down by oral tradition. The lack of written documents and rapid loss of biodiversity of medicinal plant resources have made the promotion of traditional medical practices difficult. There has also been a decline in the number of TMPs (Mhame, 1990). In the 1990s, other alternative systems of health care such as homeopathic medicine, and traditional Chinese, Korean, and Indian medicines have emerged in the country.

Tanzania is famous for the production of spices such as cardamom and clove, and medicinal plants such as *Cinchona succirubra* Pav. ex Klotzsch and *Agave sisalana* Perrine. The export of these and other species has already begun. Some plants of domestic pharmaceutical use that are also exported are *Acacia senegal* (L.) Willd., *Agave sisalana* Perrine, *Capsicum frutescens* L., *Cinchona succirubra* Pav. ex Klotzsch, *Chenopodium ambrosioides* L., *Citrus aurantium* L., *Datura stramonium* L., *Eugenia caryophyllata* Thunb. [=*Syzygium aromaticum* (L.) Merr. & L. M. Perry], *Foeniculum vulgare* Mill. and *Rauvolfia vomitoria* Afzel. There is a need to further develop agro-technology for about 23 medicinal and aromatic plants found in the indigenous flora of Tanzania. They merit additional investigation for their use in the production of pharmaceuticals. Many pharmaceutical products, already being prepared on a small-scale in an *ad-hoc* manner to meet the local traditional pharmacopoeial requirements, could undoubtedly be produced on a pilot plant scale.

Traditional Systems of Medicine

In Tanzania, over 60% of the population has a traditional healer as first contact in case of health problems. It is estimated that there are about 75,000 TMPs in the country. The ratio of TMPs to population is 1 : 4,000 compared to 1 : 20,000 for modern medical doctors. Although traditional medicines play a significant role in primary health care, there is still no effective utilization of the practice through modern science and technology.

The Medical Practitioners and Dentists Ordinance holds exemplary status for TMPs (Anonymous, 1974). In an effort to promote and standardize traditional medicine in the country, the Traditional Medicine Research Unit was established by the government in 1974 as part of the University of Dar es Salaam and the Muhimbili Medical Centre (Ministry of Health, 1999). The Unit is responsible for the unification of TMPs, formation of a traditional medicine policy, and to improve the state of health of people through the use of effective and safe traditional medicine. In 1985, the government initiated the process of developing a law to register and license TMPs.

In 1989, the governance of traditional health services was shifted from the

Ministry of Culture to the Ministry of Health (Mhame, 1990). Traditional health services are officially recognized in the National Health Policy of 1990 (Ministry of Health, 1999). They have not, however, been incorporated into the training curricula of allopathic medicine.

Medicinal Plant Resources

Most of the remedies in traditional medicine are prepared from plants. The secretiveness of traditional healers and the tendency to hide information makes it difficult to assess which species are of major medical importance. The local markets are the starting point for identifying species of local importance.

At least 150 medicinal plants are reported to be traded in the country. The common and widespread use of 86 medicinal and 8 aromatic plants have been documented in literature (Rulangaranga, 1989). Some important medicinal plant species are given in Table 8.

Most of the medicinal plant material is collected from the wild and few from cultivation. The most known medicinal plant species used as a source of antimalarial drug, *Cinchona* spp. (*C. calisaya* Wedd., *C. officinalis* L., *C. pubescens* Vahl) are cultivated in association with commercial tea estates in the Southern Highlands.

The over-exploitation of *Acacia farnesiana* (L.) Willd., *Xylopia aethiopica* (Dunal) A. Rich. and *Warburgia salutaris* (Bertol. f.) Chiov. has threatened their existence in the wild (Rulangaranga, 1989; Cunningham, 1997).

The cultivated non-indigenous medicinal plant, pyrethrum (*Tanacetum cinerariifolium* (Trevir.) Sch. Bip.), is the main crop with export potential. Pyrethrum was introduced on the slopes of Mount Kilimanjaro and Mount Meru in the late 1930s. Cultivation was started in 1941 in the Southern Highlands and by 1949, the country was exporting 274 tonnes of dried flowers to the world market. The production of pyrethrum increased from 2,220 tonnes in 1992 to 4,000 tonnes in 2000. The Southern Highlands area produces a higher yield of pyrethrum than the Northern Highlands. Pyrethrum processing and marketing is undertaken by the Tanzania Pyrethrum Processing and Marketing Company Limited, now a subsidiary of M/S International Chemical Producers of the Republic of South Africa.

Many tribes in Tanzania have a rich knowledge of traditional remedies which are unknown to the western world. There are around 33 plant species alone used to treat malaria. Over 50% of plants in the country have potential for some type of medicine.

According to the Tanzanian Association of Traditional Healers, Tanzania has a large number of TMPs. Most medicinal plants and their products are not certified by the Ministry of Health, but herbal medicine and TMPs are receiving attention from the mainstream health officials and medical research centres.

Table 8: Some important medicinal and aromatic plants of Tanzania

Abrus precatorius L.	*Euphorbia gossypina* Pax
Acacia mellifera (Vahl) Benth.	*Faidherbia albida* (Delile) A. Chev.
Acacia polyacantha Willd.	*Ficus bussei* Warb. ex Mildbr. & Burret
Achyranthes aspera L.	*Grewia sulcata* Mast.
Adansonia digitata L.	*Hyptis suaveolens* (L.) Poit.
Adenia gummifera Harms	*Jateorhiza palmata* (Lam.) Miers.
Albizia versicolor Welw. ex Oliv.	*Lantana camara* L.
Albizia glaberrima (Schum. & Thonn.) Benth.	*Margaritaria discoidea* (Baill.) Web.
Annona senegalensis Pers.	*Opilia celtidifolia* (Guill. & Perr.) Endl.
Artemisa afra Jacq.	*Ozoroa insignis* Delile
Azadirachta indica A. Juss.	*Parquetina nigrescens* (Afzel.) Bullock
Bridelia micrantha (Hochst.) Baill.	*Pluchea dioscoridis* DC.
Cassia didymobotrya Fresen. [= *Senna didymobotrya* (Fresen.) H. S. Irwin & Barneby]	*Prunus africana* (Hook. f.) Kalkman
Centella asiatica (L.) Urb.	*Rhus natalensis* Bernh.
Cinchona spp.	*Rumex usambarensis* (Dammer) Dammer
Cinchona hybrid [= *C. ledgerianna x C. succirubra*]	*Sarcostemma viminale* (L.) R. Br.
Cinchona ledgeriana (Howard) Bern. Moens ex Trimen [= *C. calisaya* Wedd.]	*Scutia myrtina* (Burm.f.) Kurz
Cinchona succirubra Pav. ex Klotzsch [= *C. pubescens* Vahl]	*Securidaca longepedunculata* Fresn.
Cissampelos pareira L.	*Schrebera alata* (Hochst.) Welw.
Coleus barbatus (Andrews) Benth. [= *Plectranthus barbatus* Andrews]	*Solanum incanum* L.
Combretum molle R. Br. ex G. Don	*Spirostachys africana* Sond.
Combretum zeyheri Sond.	*Teclea simplicifolia* Verdoorn
Crossopteryx febrifuga Benth.	*Uvaria acuminata* Oliv.
Dichrostachys cinerea (L.) Wight & Arn.	*Vernonia brachycalyx* O. Hoffm.
Diplorhynchus condylocarpon (Muell. Arg.) Pichon.	*Vernonia colorata* (Willd.) Drake
Dodonaea viscosa (L.) Jacq.	*Vernonia galamensis* (Cass.) Less.
Ehretia cymosa Thonn.	*Vernonia hildebrandtii* Vatke
	Voacanga africana Stapf
	Waltheria indica L.
	Zanthoxylum chalybeum Gessler

R&D Activities

The Institute of Traditional Medicine of the Muhimbili Medical Centre, and the departments of the University of Dar es Salaam are involved in R&D. The Institute of Traditional Medicine has worked in the field of systematics and standardization of herbal drugs. The researches from the National Plant Genetic Resources Centre in Arusha have identified about 200 medicinal plants in the Uluguru mountains in the Mogoro region.

The National Herbarium of Tanzania collaborates in training and conservation programmes with the Missouri Botanical Garden.

The Natural Uwemba System for Health (NUSAG), a privately owned company, manufactures herbal products ranging from the uwemba pastilles and tablets to food supplements. A food supplement made from *Artemisia annua* L. and nine other medicinal plants grown in the village of Uwemba, in the Iringa region, Southern Highlands has been proved to be effective against malaria. The plants used in this formulation are exported to Switzerland for the production of food supplements. Switzerland has allowed the sale of the uwamba pastilles in the country as a food supplement.

Trade and Marketing

With the free market economy, the country is experiencing economic gains from medicinal plant sector. Medicinal plants export is growing as demand in the international market is growing exponentially. In 1999, Tanzania exported medicinal products worth about US$ 6.9 mn. In the same year, Tanzanian share in the international market for herbal remedies in terms of retail sale value was about US$ 0.36 mn. Tanzanian export incomes in the period between 1997 and 1999 are given in Table 9.

Other medicinal plants traded on the world market are *Prunus africana* (Hook. f.) Kalkman and *Warburgia salutaris* (Bertol. f.) Chiov. About 120 tonnes of *Prunus africana* (Hook. f.) Kalkman bark are collected annually from the natural montane forests. Among the exported bark, some comes from the Republic of Congo (Cunningham, 1997). Another item of export potential from the country is gum Arabic. The commodity is tapped from wild *Acacia* woodlands in the Singida, Arusha, Shinyanga and Tabora regions. In 1994, about 1,000 tonnes of gum Arabic were harvested. In order to increase the production of gum Arabic, new plantations have been established. The important medicinal plants on the market are given in Table 10.

Problems and Constraints

The sector is not fully developed owing to the absence of suitable mechanism of herbal medicine control and lack of a systematic way of organizing the market, trade and integration of medicinal plants development from production to consumption, in order to boost the export of herbal formulations. The medicinal plant sector has a number of stakeholders having divergent interests. Several constraints exist due to inadequate awareness and R&D investments, manufacturer-exporter dissonance, lack of quality and standardization norms, and lack of adequate marketing and trade information. The lack of technical know-how on the processing of medicinal plants is a considerable obstacle for the development of traditional medicine.

3.9 Uganda

In Uganda, about 300 plant species are used in the traditional systems of medicine and nine medicinal plants are collected for sale (Naluswa, 1993; Cunningham,

Table 9: Export incomes of Tanzania between 1997 and 1999

Export goods	1997		1998		1999	
	Volume (tonnes)	Value (million US$)	Volume (tonnes)	Value (million US$)	Volume (tonnes)	Value (million US$)
Plants and plant parts used in perfumery, pharmacy, etc.	363.9	0.47	287.6	0.48	370.9	0.90
Natural gums, resins, gum-resins, balsams	1506.5	0.42	943.2	0.22	870	0.36
Garlic	1007.4	0.07	1071.2	0.12	537	0.07

Table 10: Important medicinal plants in Tanzanian local markets

Botanical name	Plant part(s)	Therapeutical uses/indications
Grewia bicolor Juss.	Bark, root	Cold, stomach problems, snake bite
*Lannea schweinfurthii v*ar. *stuhlmannii* (Engl.) Engl.	Root, bark	Hernia, ulcer, stomach problems
Lonchocarpus capassa Rolfe [= *Philenoptera violacea* (Klotzsch) Schrire]	Stem, root bark	Impotency, hookworm
Olea europaea L.	Bark	Vermifuge
Parinari curatellifolia Planch. ex Benth.	Root	Epilepsy
Salvadora persica L.	Twig	Toothbrush
Warburgia salutaris (Bertol. f.) Chiov.	Bark	Malaria, cold, diarrhoea, body aches

1996). Traditional medicine is extensively practiced in urban areas (Cunningham, 1997). Commercial trade in traditional medicines in the country is low. Information on international trade in medicinal plants is lacking. The only information available is on the exploitation and export of *Prunus africana* (Hook. f.) Kalkman (Cunningham *et al*., 1997).

Traditional medicine is integrated into government health-care schemes. The International Development Research Centre, Ottawa has funded a project of the Ministry of Health to identify valuable medicinal plants with potential to cure malaria, dysentery and other diseases with the help of herbalists from the Iganga district. Under this project, 10 diseases to be handled by TMPs, have been identified.

In Uganda, the National Chemotherapeutics Research Laboratory (NCRL), Kampala is taking on researches of many indigenous plant species (Cunningham, 1997). The Laboratory is under the Ministry of Health and has been involved in the ethnobotanical survey of the area, encouraging TMPs and herbalists to provide information and materials on medicinal plants for registration, classification and chemical and pharmacological tests. The

herbarium of the Laboratory has a collection of about 2,000 specimens of medicinal and other plant species.

The state-controlled National Environment Management Authority (NEMA) has set up a germplasm centre in Kampala, which serves as a germplasm repository for all biodiversity specimens in the country. The NEMA, together with the Uganda National Council of Science and Technology, is in the process of enacting a law prohibiting the illegal export of biological specimens.

Traditional Systems of Medicine

TMPs outnumber allopathic doctors. The Traditional and Modern Health Practitioners Association is an indigenous non-governmental organization dedicated to the improvement of a mutual and respectful collaboration between traditional and allopathic health practitioners in Uganda (Clarke, 1998). The Association collaborates with TMPs and provides improved clinical care to people with sexually transmitted diseases, including HIV/AIDS. The Association also organizes training programmes for TMPs. It has established a resource and training centre to facilitate the collection and dissemination of information on traditional medicine (Clarke, 1998). The National Traditional Healers and Herbalists Association has started a 20-bed traditional health-care hospital at Mengo (Amooti-Kyomya, 1994).

In Uganda, the Ministry of Women's Development, Culture and Youth preside over TMPs. The government has set up the Natural Chemotherapeutics Research Laboratory under the Ministry of Health to study the therapeutic potential of natural products with the intention of recognizing traditional medicine in the national health-care system (Amooti-Kyomya, 1994). All the research activities are conducted jointly with TMPs.

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Chapter 4

The Status of Medicinal Plants in Insular East African Countries

4.1 Introduction

Insular eastern Africa covers the Indian Ocean island nations of Comoros, Madagascar, Mauritius, Mayotte, Reunion and Seychelles. Information on medicinal and aromatic plants and their uses is scarce in Mauritius, Mayotte, Reunion and Seychelles compared to Madagascar. Madagascar, located off the southeastern coast of Africa, is the world's most fascinating centre of plant diversity and species endemism. It is home to highly threatened flora and fauna.

Many species of medicinal and aromatic plants are found in the area, especially in Madagascar. These plants are of great socio-economic importance for both health care and livelihood. The local population and TMPs make use of many plant species in their remedies. A number of species are under cultivation, including *Cinnamomum aroma-ticum* Nees (cinnamom) is cultivated in Seychelles, and *Vanilla planifolia* Jacks. (vanilla) and *Syzygium aromaticum* (L.) Merr. & L. M. Perry (Malagasy clove) in Madagascar, Comoros and Reunion. The *Catharanthus roseus* (L.) G. Don (Madagascar rosy periwinkle) is cultivated in the southern part of Madagascar. The cultivation of *Prunus africana* (Hook. f.) Kalkman has been incorporated into the agro-forestry systems in the northern part of Madagascar.

Most of the medicinal plant material is sourced from wild collection. The collection and trade of medicinal plants are an important source of income generation to the rural population. The use of medicinal plants for subsistence is of greater importance than the trade in selected species.

Almost 90% of Madagascar's forests have been cleared for logging and agricultural purposes (World Resources Institute, 1998). Habitat destruction and over-exploitation of plant resources has endangered species such as *Prunus africana* (Hook. f.) Kalkman in Madagascar, and *Cycas thouarsii* R. Br. ex Gaudich and *Cyathea* spp. in Comoros.

4.2 Madagascar

Madagascar is the fourth largest island in the world. It has diverse vegetation types: pre-humid tropical forests, semi-arid vegetation and rainforests in the eastern coast, dry forests in the south and de-

ciduous forests in the west (Koechlin *et al*., 1974). Since its separation from the African mainland, Madagascar has undergone a separate evolutionary route to produce one of the richest floristic diversities. The eastern coast has more than 170 species of palms, many kinds of ferns, bamboos, orchids and medicinal plants, while the southwestern zone is home to six of the eight species of baobabs (*Adansonia* spp.), spiny plants reminiscent of columnar cacti and *Pachipodium* spp. In the extreme southwest and across the south, where conditions are even drier, the vegetation is dominated by the members of the endemic family Didiereaceae, and by the shrubby and arborescent species of *Euphorbia*.

Madagascar with 2% of Africa's landmass has about 10,000 to 12,000 species of vascular flora not found elsewhere in the world (Phillipson, 1994). It is home to 25% of African plant species, and many still have to be discovered. Despite the rich and unique biodiversity, it is one of the poorest African nations.

Traditional Systems of Medicine

Traditional medicine is an affordable alternative to costly and scarce modern medicine to the more than 15 mn people of Madagascar. The majority of the rural population depends on medicine derived from the Malagasy plant (also known as tambavy) for health-care needs.

TMPs are involved in the national health-care system. The National Traditional Therapist Association of Madagascar has more than 10,000 registered TMPs authorized to practise traditional medicine. There is no official training programme in traditional medicine (WHO, 1992).

State Efforts in Development of Traditional Medicine

Until 1992, there was no legal framework for the licensing of TMPs to practise traditional medicine, and no official approval for traditional remedies (WHO, 1992). In 1996, a commission was created to study the legal aspects of traditional medicine in the country. The legal recognition of traditional medical practice began in the eastern and northern parts of Madagascar in 1998. In 2000, the regulations for herbal medicines were approved by the government.

Medicinal Plant Resources

Madagascar is a vast reserve of plant resources of medicinal value. In the continued botanical inventories in Madagascar, information on 10,000 to 12,000 species of Malagasy plants with their taxonomical details have been recorded by the Missouri Botanical Garden.

There is a wide range of medicinal plants used by TMPs. The people of Betsimisaraka and Tanala in eastern Madagascar make use of 68 medicinal plant species in traditional medical practices.

The *Catharanthus roseus* (L.) G. Don is traditionally used in many regions of Madagascar to treat diabetes, blood cancer, tumors, diarrhoea and malaria, through

the use of different plant parts, dosages, and traditional preparations. It is now effectively used in modern medicine to treat childhood leukemia. In southeastern Madagascar, *Tephrosia purpurea* Pers. is widely used by the Malagasy (Antanosy) people to cure stomach disorders, diarrhoea, backache, and as a blood purifier.

Cananga odorata (Lam.) Hook. f. & Thomson (ylang-ylang), *Syzygium aromaticum* (L.) Merr. & L. M. Perry (clove) and *Vanilla planifolia* Jacks. (vanilla) have been cultivated in the northern parts of the country since the colonial period. The Biolandes Madagascar, a privately owned company, cultivates ylang-ylang, vetiver, cocoa beans, tuberose and jasmine, and collects spices such as pepper, cinnamon and cloves from the wild. In addition, the company is engaged in the extraction of ylang-ylang oil, vanillin extracts and processing of spices for local use and export.

Expam Limited processes essential oils from *Croton anisatus* Baill., *Ocimum basilicum* L., *Pelargonium incrassatum* (Andrews) Sims, *Melaleuca viridiflora* Sol. ex Gaertn., and *Helichrysum gymnocephallum*. It also manufactures extracts, and personal care and hygiene products.

Some of the important medicinal and aromatic plant species of Madagascar are given in Table 1.

R&D Activities

The Missouri Botanical Garden (MBG) is compiling botanical inventories in collaboration with the Botanical and Zoological Park of Tsimbazaza and the National Center for Applied Pharmaceutical Research (NCAPR). In 2001, the MBG was awarded a fourth contract for the collection of plant samples from Madagascar and tropical Africa for the drug discovery programme of the National Cancer Institute (NCI) of the USA. The Faculty of Sciences of the University of Antananarivo is the major hub of research activities on natural products chemistry, molecular and cellular pharmacology and general pharmacology and pharmacokinetics of medicinal and aromatic plants.

In 1998, the biodiversity conservation project of the International Cooperative Biodiversity Groups (ICBG), initiated in the Republic of Suriname, was expanded to Madagascar. Botanical inventories and sample-collection activities were undertaken in collaboration with the National Center for Applied Pharmaceutical Research (NCAPR) and the National Center of the Industrial Research for Rural Development. Dow AgroSciences Inc. then joined the group to evaluate plants for potential agricultural applications. In 1999, the Malagasy government approved another proposal for ICBG activities jointly submitted by the NCAPR, the Conservation International, and the Missouri Botanical Garden.

The NCAPR works directly under the Ministry of Scientific Research and is engaged in the isolation of bioactive compounds and in development of phytophar-

Table 1: Some medicinal and aromatic plant species of Madagascar

Abrus precatorius L.
Acacia senegal (L.) Willd.
Acokanthera ongiflora Stapf
Adansonia digitata L.
Agave sisalana Perrine.
Ageratum conyzoides L.
Albizia anthelmintica (A. Rich.) Brongn.
Allium sativum L.
Aloe ferox Mill.
Alstonia boonei de Wild.
Ammi visnaga (L.) Lam.
Anchomanes difformis Engl.
Arachis hypogaea L.
Aristolochia bracteata Retz.
Astralagus gummifer Labill.
Azadirachta indica A. Juss.
Balanites aegyptiaca Del.
Boerhavia diffusa Engelm. & A. Gray
Borreria verticillata L. G. F. W. Mey
Calotropis procera (Aiton) W. T. Aiton
Capsicum frutescens L.
Carapa procera DC.
Carica papaya L.
Carum carvi L.
Catharanthus roseus (L.) G. Don
Chenopodium ambrosioides L.
Cinchona succirubra Pav. ex Klotzsch
Cinnamomum zeylanicum Blume
Centella spp.
Crinum jagus (J. Thomps.) Dandy
Cryptolepis sanguinolenta (Lindl) Schtlr.
Cymbopogon citratus (DC.) Stapf
Datura stramonium L.
Euphorbia kamerunica pax
Funtumia elastica (P. Preuss) Stapf
Glinus lotoides L.
Harrisonia abyssinica Oliv.
Heliotropium indicum L.
Hyoscyamus muticus L.
Jatropha curcas L.
Kalanchoe crenata (Andr.) Haw.
Lawsonia inermis L.
Mitragyna stipulosa (DC.) Ktze
Momordica charantia L.
Morinda lucida Benth.
Moringa oleifera Lam.
Nauclea latifolia Sm.
Nicotiana tabacum L.
Nymphaea lotus L.
Ocimum gratissimum L.
Olea europaea L.
Parquetina nigrescens (Afz) Bulloch
Peganum harmala L.
Pergularia daemia (Forssk.) Chiov.
Physostigma venenosum Balf.
Phytolacca dodecandra L. Herit.
Piper guineense Schumach. & Thonn.
Plumbago zeylanica L.
Rapanea melanophloeos Mez.
Rauvolfia vomitoria Afzel.
Ricinus communis L.
Securidaca longipedunculata Fresen.
Securinega virosa (Roxb. ex Willd.) Baill.
Senna alexandrina Mill.
Solanum nigrum L.
Spondias mombin L.
Strophanthus kombe Oliv.
Strychnos nux-vomica L.
Syzygium aromaticum (L.) Merr. & L. M. Perry
Tanacetum cinerariifolium (Trevir.) Sch. Bip.
Terminalia glaucescens Planch. ex Benth.
Thalictrum rhynchocarpum Q. Dillon A. Rich
Thea sinensis L.
Theobroma cacao L.
Trema orientalis Bl.
Triclisia gilletii (De Willd.) Staner
Voacanga africana Stapf
Warburgia ugandensis Sprague
Withania somnifera (L.) Dun.
Ximenia americana L.
Zanha golungensis Hiern
Zanthoxylum zanthoxyloides Waterman
Zingiber officinale Roscoe

maceutical products from indigenous plant resources in the areas surrounding the Zahamena Nature Reserve. In collaboration with Conservation International, it coordinates the collection of ethnomedical data on medicinal and aromatic plants.

The Malagasy Institute of Industrial Researches (IMRA) is working to develop new drugs from Malagasy medicinal plants, and to popularize and safeguard the medicinal plant species. In 1993, it was given the status of Regional Research Centre by the Organization of African Unity (OAU).

In 1989, a joint venture between the Agricultural Products Department of the Dow Chemical Company and the Plant Sciences Business of Eli Lilly resulted in the creation of DowElanco. In 1997, The Dow Chemical Company acquired DowElanco and the new subsidiary was renamed Dow AgroSciences in 1998. The company undertakes the screening of phytocompounds within the International Cooperative Biodiversity Groups (ICBG) project.

Conservation International undertakes ethnobotanical surveys, conservation, and development programmes in Madagascar. Azafady, a charity NGO based at Fort Dauphin (Tolagnaro), southeastern Madagascar, aims to raise conservation awareness and preservation of traditional knowledge in the country.

Trade and Marketing

Madagascar exports significant quantities of medicinal plant material to the international market. The important medicinal plant species exported include *Catharanthus roseus* (L.) G. Don, *Centella asiatica* (L.) Urb., *Drosera madagascariensis* DC., *Eugenia* spp., *Harungana madagascariensis* Lam. ex Poir., *Hazunta* spp., *Medemia nobilis* (Hildebrandt & H. Wendl.) Drude, *Moringa* spp., *Prunus africana* (Hook. f.) Kalkman, *Rauvolfia vomitoria* Afzel., *R. confertiflora* Pichon and *Voacanga thouarsii* R. & S. In 1995, the medicinal plant export volume was 860 tonnes worth US$ 4.64 mn, while it was 402 tonnes in 1990 (Walter, 1996; FAO, 1997).

In Madagascar, *Prunus africana* (Hook. f.) Kalkman trees are found in the northern tropical forests. Officially there are no figures on the value and quantity of the bark exploited or the extract exported from the country. In addition to crude bark, bark extract is also exported. Since 1976, *Prunus africana* (Hook. f.) Kalkman bark is mainly exported to France. According to an estimate, about 180 tonnes per annum of bark were exploited in the period between 1988 and 1994. About 300 tonnes of bark were exploited in 1993 with an export value of approximately US$ 1.44 mn (Walter, 1996). The over-exploitation of bark threatens the existence of *Prunus africana* (Hook. f.) Kalkman (Walter, 1998; Walter and Rakotonirina, 1995). In order to safeguard this tree from extinction, its exploitation has been put under the provisions of Appendix II of the Convention on Trade in Endangered Spe-

cies of Flora and Fauna (CITES) (Cunningham *et al.*, 1997).

Catharanthus roseus (L.) G. Don, and *Rauvolfia vomitoria* Afzel. were the main export items to Europe in 1996. *Catharanthus roseus* (L.) G. Don, traditionally used as antidiabetic, is the source of anticancer drugs, vinblastine and vincristine, widely used in the treatment of childhood leukemia. In the late 1980s, an annual average of 1,000 tonnes of plant material was exported to the international market (Rasianaivo, 1990). Formerly, this plant used to be collected from the wild; however, owing to increasing demand, the plant is now cultivated on a commercial scale in southern Madagascar.

Centella asiatica (L.) Urb. is a pantropical plant found in the rainforests around Antananarivo. Traditionally it was used in the treatment of leprosy. In modern medicine it has found use as a treatment for wounds. Madagascar is the main producer and supplier of plant material, sourced mainly from wild collections, to the world market.

Voacanga seeds (*Voacanga Africana* Stapf and *V. thouarsii* R & S) have an annual demand of 150 tonnes (Rasianaivo, 1990). *Drosera madagascariensis* DC. is found in the Antananarivo area and is in considerable demand for the treatment of the respiratory system infections. In addition, there is considerable demand for *Ilex mitis* (L.) Radlk., *Eugenia jambolana* Lam. and *Aloe vahombe* Decorse & Poiss. (Rasianaivo, 1990). Since 1985, *Areca madagascariensis* Mart., nom. dub., *Medemia nobilis* (Hildebrandt & H. Wendl.) Drude, and *Ravenea rivularis* Jum. & H. Perrier have also been exported.

The export of essential oils increased from 960 tonnes in 1991 to 1,141 tonnes worth US$ 3.88 mn in 1994 (FAO, 1997). Clove and ylang-ylang account for more than 90% of the production of essential oils and the rest consists largely of vetiver, geranium, lemon and lemon grass oil.

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Chapter 5

The Status of Medicinal Plants in Central African Countries

5.1 Introduction

The central African region is made up of Burundi, Cameroon, the Central African Republic, the Democratic Republic of Congo (D. R. Congo), Equatorial Guinea, Gabon, the Republic of Congo, Rwanda, and the island nation of Sao Tome and Principe. The region has a wide diversity of habitats, spanning from tropical rainforests and savannahs to mangrove woods. The tropical forests are rich in floristic diversity and species endemism.

Most of the central African countries converge in the Congo basin, which represents the second largest contiguous rainforest in the world after the Amazon. The Congo basin forests cover 20% of the world's tropical moist forests and 80% of the tropical moist forests in Africa. It is also one of the most biologically diverse and poorly understood ecosystems of the African continent (IUCN, WWF and GTZ, 2000).

There are about 40,850 plant species of which about 6,500 are reported to be endemic and 175 of these are reported to be rare (WRI, UNED and UNDP, 1992). Cameroon and the D. R. Congo have the highest number of endemic species. Among the 11,000 plant species in the D. R. Congo, over 3,000 are endemic. Cameroon and the Central African Republic have 8,000 and 1,000 endemic species, respectively (IUCN, WWF and GTZ, 2000). The number of threatened plant species is highest in Cameroon (155), followed by Gabon (71) and the D. R. Congo (33) (World Bank, 2000). The central African forest ecosystems are home to about 250 ethnic groups. Medicinal plants generate the major source of remedies for health care and income (WRI, 2001).

The flora of central Africa is rich in medicinal and aromatic plant species. Most of the medicinal plant trade takes place between neighbouring countries. Some medicinal plant material is also exported to the international market. Cameroon, the D. R. Congo and Equatorial Guinea export *Prunus africana* (Hook. f.) Kalkman to European countries. Additionally, Cameroon exports *Pausinystalia johimbe* (Schuma.) Beille, *Physostigma venenosum* Balfour, *Strophanthus gratus* Baill. & Franch. and *Voacanga africana* Stapf. The over-exploitation of *Prunus africana* (Hook. f.) Kalkman, *Pausinystalia*

johimbe (Schuma.) Beille, *Gnetum* spp. and *Baillonella toxisperma* Pierre has led to their extinction.

The bark of *Prunus africana* (Hook. f.) Kalkman is traditionally used to treat malaria, stomachache and fever (Nsom and Dick, 1992). The bark and the leaves are used locally in traditional pharmacopoeia for the production of beer (Cunningham and Mbenkum, 1993). During the 1960s, the *Prunus africana* (Hook. f.) Kalkman bark extract was proved effective in the treatment of benign prostatic hypertrophy (Debat, 1966). Since then, the bark of the plant is in high demand in European countries and its trade earns annual revenue of US$ 150 mn. In Europe, the Laboratories Debat, France, and Indena Spa, Italy, manufacture and market the drug from bark extract under the trade names of Tadenan and Pygenil, respectively. The bark is mainly sourced from the Afromontane forests of Cameroon, the D. R. Congo, Kenya and Madagascar.

Medicinal and aromatic plants are an important component of traditional medicine. About 63% of the rural population is dependent on traditional medicine for their health-care needs. The local population and TMPs make use of many medicinal plant species to prepare remedies. In Cameroon, TMPs and communities utilize more than 500 medicinal plant species in their remedies.

5.2 Burundi

There is rich and varied flora in Burundi. Medicinal plants are of high socio-economic importance in the country. There are about 12 well-established species with definite use in the pharmacopoeias: *Chenopodium ambrosiodes* L., *Ricinus communis* L., *Ocimum basilicum* L. *Sesamum indicum* L., *Phytolacca dodecandra* L'Her, *Capsicum frutescens* L., *Datura stramonium* L., *Cinchona succirubra* Pav. ex Klotzsch, *Eucalyptus globulus* Labill., *Cymbopogon citratus* (DC.) Stapf., and *Catharanthus roseus* (L.) G. Don. A variety of medicinal plant species grow on the Imbo plains. More than 90% of medicinal plant material is sourced from wild collection. The leaf is the most used plant part in the preparation of traditional remedies, followed by the stem, bark and root bark. The majority of the population relies on traditional medicine for their primary health-care needs. Over-exploitation and degradation of habitats as a result of deforestation has threatened 19 plant species in the country (FAO, 1999). The Ministry for the Interior and Public Safety recognizes the TMPs and approves the Associations of Traditional Medicine Practitioners of Burundi (ATRAPRABU), but the country has no official or legislative texts regulating the practice of traditional medicine. However, under the Burundi's Public Health Code of 1982 and the regulations of the Ministry of Public Health, only licensed practitioners with formal training

in tropical medicine are allowed to practise traditional medicine (Anonymous, 1984). There are neither official training facilities nor programmes for traditional medicine (WHO, 1992).

There are two premier institutes, Burundi's Pharmacological Laboratories (Laboratoires Pharmacologiques du Burundi) and the Institute for Agronomic Science of Burundi (ISABU), which are undertaking R&D activities in medicinal and aromatic plants. There is, however, no specific agency or institution committed to promote the utilization of medicinal and aromatic plants.

5.3 Cameroon

Cameroon is situated on the west coast of Africa and bordered by Gabon, Equatorial Guinea and Congo to the south, the Central African Republic to the east, Chad to the north and Nigeria to the west. It shares a significant amount of the biological diversity of threatened flora and fauna of the Congo basin. About 45% of the total population in southern Cameroon utilizes tropical moist forest resources for their health-care needs and as a source of income (Ndoye *et al.*, 1999).

Cameroon has a large variety of ecological zones, from Sahel in the north to the equatorial forests in the south. The variety of climatic zones and the diversity of natural conditions give rise to rich and varied flora. As regards medicinal plants, even if a very wide range is available, none of them is cultivated on a large scale. Collections of wild plants have been organized for export purposes. There is, therefore, ample scope for transferring technology in order to augment the export of medicinal plants. Cameroon imports about 3,000 tonnes of pharmaceutical products per year valued at over US$ 20 mn. Part of these imports could be substituted with locally manufactured plant-derived pharmaceuticals. The United Nations Industrial Development Organization (UNIDO) experts have recommended the cultivation of *Cephaelis ipecacuanha* (Brot.) Tussac, *Chenopodium ambrosioides* L., *Digitalis lanata* Ehrh., *Atropa acuminata* Royle, *Hyoscyamus muticus* L., and *Cassia acutifolia* Delile.

Traditional Systems of Medicine

The Traditional Medicine Service of the country operates within the Community Medicine Unit of Yaounde Central Hospital. A separate Office of Traditional Medicine at the Ministry of Public Health looks after the traditional medicine sector. This office was founded under the Fifth Five Year Social, Economic and Political Development Plan (1981-1986). Local officials have the authority to allow or restrict the practice of traditional medicine in their administrative or health sub-divisions. TMPs are involved in primary health-care programmes.

Medicinal Plant Resources

Cameroon has a great diversity of vegetation ranging from mangroves to rain-

forests in the south, tropical montane forests and grassland in the west, and savannahs and semi-deserts in the north. The Cameroonian rainforests are amongst the most species-rich and diverse ecosystems in the world and represent outstanding scientific, social and economic value. The tropical montane forest systems are important centres of plant endemism. Mount Cameroon has more than 45 endemic plant species. Cameroon has about 8,000 vascular plant species and 155 of them have been reported threatened (IUCN, 2000).

More than 250 ethnic groups inhabit the tropical forests in Cameroon and have a rich knowledge of medicinal plants and their uses. More than 500 medicinal plants are used in ceremonies and traditional practices (FAO, 1999a). Of the 35 most important tree species of timber value, 23 are also used in the traditional pharmacopoeia (Laird, 1999). The indigenous plants with therapeutically useful constituents are *Voacanga africana* Stapf for tubersonine, *Rauvolfia vomitoria* Afzel. for ajmaline, *Pausinystalia johimbe* (Schum.) Pierre ex Beille for yohimbine, *Cola nitida* (Vent.) Schott & Endl. for caffeine, *Theobroma cacao* L. for theophylline and *Physostigma venenosum* Balf. for physostigmine.

The Korup National Park in the southwest province is home to many species of medicinal value. The Park covers a large tract of rapidly dwindling rainforest with about 400 tree species and more than 90 medicinal plants. Of these, 36 are new to science, and the medicinal vine, *Ancistrocladus korupensis* D. Thomas & Gereau, has shown positive *in-vitro* results against HIV/AIDS virus. Important medicinal plant species found in the park area include *Irvingia* spp., *Ricinodendron heudelotii* (Baill.) Heckel and *Afrostyrax lepidophyllus* Mildb. Other items of commercial significance are essential oils from *Piper guineense* Schumach. & Thonn., chewing sticks from *Garcinia* spp. and *Massularia acuminata* (G. Don) Bullock ex Hoyle. In the Bipindi-Akom II region in the southern province, the main medicinal plant species of commercial value are *Irvingia gabonensis* (Aubry-Lecomte ex O'Rorke) Baill., *Strophanthus gratus* (Wall. & Hook.) Baill., and *Dacryodes* spp. Most of the medicinal plant material is collected from the wild. In the Nyangong region, medicinal plants are gathered independently of ownership rights. Some medicinal plants of commercial importance are given in Table 1 (FAO, 1999a).

R&D Activities

The Institute of Agricultural Research for Development (IRAD) under the Ministry of Scientific and Technical Research undertakes inventories of plant genetic resources, documentation and biodiversity conservation. The National Herbarium of Cameroon, a principle research unit of the Institute, has a collection of 66,500 plant specimens belonging to 1,800 genera of 232 families. The National Herbarium is also compiling a pub-

Table 1: Some important medicinal and aromatic plant species of Cameroon

Botanical name	Part(s) used
Aframomum melegueta K. Schum.	Leaf, fruit
Allanblackia floribunda Oliv.	Oil
Antrocaryon klaineanum Pierre	Fruit
Autranella congolensis (de Wild.) A. Chiv.	Grain
Baillonella toxisperma Pierre	Grain
Butyrospermum parkii (Don) Kotschy	Grain
Cola acuminata Schott & Endl.	Fruit
Cola nitida Schott & Endl.	Fruit
Coula edulis Baill.	Seed
Elaeis guineensis (L.) Jacq.	Fruit
Garcinia kola Heckel	Bark, grain
Gnetum africanum Welw.	Leaf
Irvingia gabonensis Baill.	Fruit
Ocimum basilicum L.	Leaf
Pausinystalia johimbe (Schuma.) Beille	Bark
Piper guineense Schum. & Thonn.	Fruit
Prunus africana (Hook. f.) Kalkman	Bark
Ricinodendron heudelotii (Baill.) Pierre ex Heckel	Seed
Scorodophleus spp.	Bark
Tetrapleura tetraptera (Schum. & Thonn.) Taub.	Pod
Voacanga africana Stapf	Seed

lication, Flora of Cameroon. Thirty-four volumes have been completed covering plant specimens belonging to 109 families.

The National Herbarium is also developing a plant species database in collaboration with the Limbe Botanic Garden Herbarium and the Royal Botanic Gardens of Kew. The database provides information on life form, ecology, plant distribution, abundance, phenology and literature references for each species of the 66,500 specimens, as well as new collections from recent inventories.

The Association of Commonwealth Traditional Medicine Practitioners for West Africa was established in 2000. It promotes the exchange of traditional knowledge and experience between TMPs at national and regional levels. Cameroon has also constituted a coordinating committee that supports TMPs in the country.

Trade and Marketing

Prunus africana (Hook. f.) Kalkman, *Pausinystalia johimbe* (Schum.) Pierre ex Beille, *Voacanga africana* Stapf, *Strophanthus gratus* (Wall. & Hook.) Baill. and *Physostigma venenosum* Balf. are the main medicinal plant species exported from Cameroon (Nkuinkeu, 1999). Other me-

dicinal plant species traded are *Allanblackia floribunda* Oliv., *Carapa procera* DC., *Myrianthus arboreus* P. Beauv., *Tabernanthe iboga* Baill. and *Garcinia* spp. Chewing sticks of *Garcinia* spp. are exported to Nigeria. Some important medicinal and aromatic plants exported to European countries are given in Table 2.

Cameroon has been the major source of *Prunus africana* (Hook. f.) Kalkman bark ever since its commercial exploitation started in 1972. The bark was mainly sourced from the southwest and northwest provinces of Cameroon, Mount Cameroon, Mount Kupe, and the Bamenda highlands including Mount Oku and Nso. In 1976, about 10 tonnes of bark were exported to France. About 11,537 tonnes from 1986 to 1991 and 600 to 920 tonnes in the period 1994-1995 were processed by Plantecam Medicam, a subsidiary of Laboratories Debat in southwestern Cameroon (United Republic of Cameroon, 1981; Cunningham and Mbenkum, 1993).

The bark is exported both as bark and bark extracts. In the period between 1985 and 1994, the annual export of bark extract was 8,990 kg corresponding to 1,116 to 3,900 tonnes of bark. World trade was worth US$ 220 mn in the late 1990s (Cunningham *et al.*, 1997). The Fournier Group was the principal bark trader. Its subsidiary companies, Laboratories Fournier and Plantecam, undertook all activities includ-

Table 2: Medicinal and aromatic plants exported from Cameroon to Europe

Botanical name	Common name	Part(s) used	Ecology
Afrostyrax lepidophyllus Mildbr.	Omi	Bark	Wild
Aframomum spp.	Maniguette	Fruit	Wild
Ananas comosus (L.) Merr.	Anana	Fruit	Wild, cultivated
Cola nitida Schott & Endl.	Kola	Grain	Wild, cultivated
Dacryodes edulis (G. Don) Lam.	Safou	Fruit	Wild, cultivated
Elaeis guineensis (L.) Jacq.	Nut of palm	Fruit, oil	Wild, cultivated
Garcinia kola Heckel	Small cola	Grain	Wild
Gnetum spp.	Fumbua	Leaf	Wild
Hua gabonii Pierre	Omi	Fruit	Wild
Irvingia gabonensis Baill.	Sioko, mango	Grain	Wild
Landolphia spp.	Malombo	Fruit	Wild
Lippia adoensis Hochst.	Bulukutu	Leaf	Wild
Monodora myristica Dun.	Pepe	Grain	Wild
Monodora tenuifolia Benth.	Pepe	Grain	Wild
Ricinodendron heudelotii (Baill.) Pierre ex Heckel	Djansan	Grain	Wild
Tetrapleura tetraptera (Schum. & Thonn.) Taub.	Caroube	Leaf	Wild
Vernonia amygdal Del.	Ndole	Tuber	Cultivated
Xanthosoma sagittifolium (L.) Schott	Macabo	Grain	Cultivated
Xylopia aethiopica (Dunal) A. Rich	Ekolababa	Fruit	Wild

ing exploitation, marketing and transformation of the bark into extract. Most of the bark exploitation was undertaken in the Cameroon montane areas and the Bamenda highlands (Cunningham *et al.,* 1997). Professional collectors employed by Plantecam and local people collected the bark from the trees.

Plantecam was the only licence-holder for bark collection in Cameroon until 1987. During the last few years, over 50 new contractors have received a licence for exploitation of *Prunus africana* (Hook. f.) Kalkman bark. Consequently, exploitation has intensified because of competition among a number of companies. Some collectors have started to cut down and debark the entire tree causing its death (Cunningham *et al.*, 1997). The over-exploitation of *Prunus africana* (Hook. f.) Kalkman resources in Cameroon and elsewhere (e.g. in Madagascar and Kenya) led to the registration of this species in the Appendix II of the Convention on the International Trade of the Species of Fauna and Flora (CITES) in 1994. The destructive harvesting of the bark in combination with the considerable value of the resources has led to the cultivation of this tree.

Pausinystalia johimbe (Schuma.) Beille is also a medicinal tree of economic importance on the international market. The tree is native to the coastal forests of Central Africa and is found from south-eastern Nigeria to the Congolese Mayombe (Vivan and Faure, 1985). The tree bark is the source of an alkaloid yohimbine used for the treatment of erectile dysfunctions. Traditionally, the bark is used as an aphrodisiac, local anaesthesic, mild stimulant, hallucinogen, general tonic and performance-enhancer for athletes. The bark is harvested during the rainy season when the yohimbine content is at its highest.

In addition to widespread local use, the plant has long been exported to Europe for the preparation of yohimbine-based prescription drugs for the treatment of diabetes-related male organic impotency.

The bark is obtained from wild populations and most of the bark exploitation currently takes place in Cameroon. There is the possibility of exploitation in Equatorial Guinea and Gabon. Plantecam, the sole supplier of bark to Europe, supplied around 100 tonnes of bark annually until 1996.

The seeds of *Voacanga* spp. are also exported to Europe. In the mid 1970s, *Voacanga africana* Stapf seed export exceeded *Prunus africana* (Hook. f.) Kalkman bark. In 1976, five hundred tonnes of *Voacanga africana* Stapf seeds were sold for the production of alkaloid tabersonine, which is a starting material for the manufacture of vincamine and vinpocetin, used in the treatment of Alzheimer's disease and epilepsy.

Cosmetic products used in Cameroon include essential oils of *Monodora myristica* (Gaertn.) Dunal and *Xylopia aethiopica* (Dunal) A. Rich. The oil of moabi (*Baillonella toxisperma* Pierre) and

the shea tree butter (*Butyrospermum parkii* (G. Don) Kotschy [= *Vitellaria paradoxa* C. F. Gaertn.]) are used for the manufacture of soap and beauty lotions. The oil of cabbage tree (*Elaeis guineensis* Jacq.) is also used in cosmetics (FAO, 1999a).

5.4 Central African Republic

Medicinal plants have gained a high socio-economic value in the country. They are generally collected from the wild and used by the local communities. Traditional medicines are not sold on the market (FAO, 1993). The supply of *Rauvolfia vomitoria* Afzel. and *Xylopia aethiopica* (Dunal) A. Rich. is sourced from the eastern part of the country (FAO, 1999b). *Piper guineense* Schumach. & Thonn., *Xylopia aethiopica* (Dunal) A. Rich., and *Afromomum* spp. are exported to neighbouring countries (Cameroon, Chad, Nigeria and Sudan). The roots of *Rauvolfia vomitoria* Afzel and *Parinari excelsa* Sabine are internationally traded. These two species are exploited in all of the agro-climatic zones of the country (FAO, 1999b). The *Rauvolfia vomitoria* Afzel roots are exported to Italy. Gum Arabic is sourced from the northern parts of Bangani. From 1996 to 1999, an annual volume of 300 to 400 tonnes of gum Arabic was exported to European Union. In addition, a private company exported 98 tonnes of gum Arabic in 1999 (FAO, 1999b).

Traditional Systems of Medicine

In the Central African Republic, local inter-sectoral councils have been constituted to look after the practice of traditional medicine. Only registered TMPs are allowed to practise traditional medicine. There is no official legislative or regulatory body governing the practice. There are no licensing procedures for TMPs or traditional remedies in the country. TMPs are not involved in the primary health-care programme at local or national level. There is no official training facility or programme for traditional medicine (WHO, 1992).

5.5 D. R. Congo

The Democratic Republic of Congo (D. R. Congo) lies across the Equator. The equatorial wet tropical climate makes it the most biologically diverse country of the Congo basin. It is one of the world's rare rainforests, constituting about 10,000 species of flowering plants of which 3,000 have been reported to be endemic to the central basin, the mountainous area of the east and the high plateaus of Shaba region. The equatorial rainforests contain plant species of high commercial importance like *Cinchona* and *Rauvolfia*. The important medicinal plant species on the Kisangani and Beni markets are given in Table 3 (Bauma, 1999).

A research programme has been initiated with the support of the International Development Research Centre (IDRC), Ottawa to study the potential of traditional medicine. A new department has been established within the Congo National Research and Development Board, which

Table 3: Medicinal and aromatic plants species of DR Congo (Kisangani and Beni markets)

Botanical name	Common name (dialect)	Plant part(s)
Aframomum spp.	Ndehe (Nonde), tondolo (Swahili), soso (Topoke)	Fruit, grain
Cola acuminata (P. Beauv.) Schott & Endl.	Ngongoka (Nonde), libelu (Topoke), gbongbolia (Swahili)	Grain
Elaeis guineensis Jacq.	Nganzi (Swahili)	Fruit
Garcinia cola Heckel	Bobale (Topoke), olale (Lokele)	Grain
Gnetum africanum Welw.	Fumbwa (Kikongo)	Leaf
Pentadiplandra brazzeana Baill.	Geene (Topoke), etekele (Lokele)	Root
Piper guineense Schumach. & Thonn.	Bokango (Nonde), toketu (Lokele)	Fruit
Raphia spp.	Mabondo (Swahili)	
Scorodophloeus zenkeri Harms	Bumba (Topoke)	Bark
Thaumatococcus daniellii (Benn.) Benth. ex B. D. Jacks.	Longodo (Ngelema), mangongo (Swahili)	Leaf

deals with botany, pharmacology, ethnomedicine, psychopathology and anthropological aspects of medicinal plants. The botany and pharmacology sections record and analyze medicinal plants used by healers and the ethnomedicine section conducts exhaustive studies on the causes of diseases and on the effectiveness of traditional treatments. The establishment of a herbarium is under plan.

The D. R. Congo exports *Cinchona* spp. and *Prunus africana* (Hook. f.) Kalkman, mainly to the European countries. At national level, there is no regulation for the protection of threatened plant species such as *Millettia laurentii* De Wild., *Afrormosia elata* Harms, *Diospyros* spp. and *Eremospatha* spp.

5.6 Equatorial Guinea

Medicinal plants are of high socio-economic significance in providing health care and employment to the rural population. The important medicinal plant species are *Prunus africana* (Hook. f.) Kalkman, *Garcinia kola* Heckel, *G. lucida*, *Aframomum* spp., *Enantia chlorantha* Oliv. [=*Annickia chlorantha* (Oliv.) Setten & Maas], *Irvingia gabonensis* (Aubry-Lecomte ex O'Rorke) Baill., *Piper guineense* Schumach. & Thonn., *Ricinodendron heudelotii* (Baill.) Heckel, *Monodora myristica* (Gaertn.) Dunal, *Afrostyga* spp., *Xylopia aethiopica* (Dunal) A. Rich. and *Tetrapleura tetraptera* (Schumach.) Taub. Most of the medicinal plants on the domestic market are imported, although they are available in the country (Sunderland and Obama, 2000). The exported medicinal plant species are *Prunus africana* (Hook. f.) Kalkman, *Piper guineense* Schumach. & Thonn. and *Irvingia gabonensis* (Aubry-Lecomte ex O'Rorke) Baill.

Most of the rural population depends on traditional medicine for health care. Medicinal plants are generally collected and sold by specialists. On the Bata and Mbini markets, at least 17 medicinal plants have been identified (Sunderland and Obama, 2000). The bark of *Prunus africana* (Hook. f.) Kalkman is much in demand on national and international markets. The bark is used in the preparation of traditional medicine and is also exported to Europe for benign prostate hyperplasia. From 1992 to 1998, 210 tonnes per annum of *Prunus africana* (Hook. f.) Kalkman bark were exported to Spain (Sunderland and Tako, 1999).

Equatorial Guinea consists of three diverse territories: the mainland territory of Rio Muni, the island of Annobon and the island of Bioko. The *Prunus africana* (Hook. f.) Kalkman trees are found in the montane forests of Bioko, where the bark is harvested. The company, Aprovechamiento Agricola (APRA), is a subsidiary of the Spanish company Natra and is registered in Equatorial Guinea to export *Prunus africana* (Hook. f.) Kalkman bark from Equatorial Guinea to Europe. The importance of this relatively unexploited resource of the island of Bioko has grown as the supplies from other countries have become scarce or subject to strict regulations (Sunderland and Tako, 1999).

Commercial harvesting of the bark in Bioko began in 1992-93. Official export data estimates that 200 tonnes of dried bark per annum were exported between 1992 and 1994. In 1997, the APRA started exporting *Prunus africana* (Hook. f.) Kalkman bark in powder form directly to Spain.

Traditional Systems of Medicine

Equatorial Guinea officially regulates the practice of traditional medicine through a licensing and registration process of TMPs. It does not have a procedure for the official approval of traditional medical practices or remedies. TMPs are not part of the national primary health-care programme. The country offers training facilities and programmes in traditional medicine for health workers and local people. The consultation fee of TMPs has been standardized although it is still not reimbursable (WHO, 1992).

5.7 Gabon

In Gabon, the local communities make use of a number of medicinal plants in the preparation of traditional remedies. Demand for medicinal plant material is met either through collection from the wild or importation from neighbouring countries. The *Garcinia kola* Heckel. bark and the *Irvingia* spp. seeds are imported from Cameroon (Ndoye *et al.*, 1999). Some important medicinal plants are given in Table 4 (Manembet, 2000).

Bouet Mount and Akebe at Libreville are the principal markets for trade of medicinal plants. The medicinal plant species *Aframomum giganteum* (Oliv. & D. Hanb.) K. Schum. and *A. melegueta* K.

Schum. are widely used in the traditional systems of medicine to cure influenza, cough and diarrhoea (Manembet, 2000).

Table 4: Some important medicinal plant species of Gabon

Aframomum spp.
Afrostyrax lepidophyllus Mildbr.
Antrocaryon klaineanum Pierre
Cola spp.
Dacryodes spp.
Dacryodes edulis (G. Don) H. J. Lam
Garcinia spp.
Gnetum africanum Welw.
Guibourtia tessmannii (Harms) J. Léonard
Irvingia gabonensis (Aubry-Lecomte ex O'Rorke) Baill.
Monodora myristica (Gaertn.) Dunal
Panda oleosa Pierre
Pseudospondias longifolia Engl.
Pteridium aquilinium (L.) Kuhn
Raphia spp.
Tetrapleura tetraptera (Schumach.) Taub.

TMPs are part of the national primary health-care programme. Gabon does not have official legislative or regulatory texts governing the practice of traditional medicine. There are no licensing procedures or official approvals for traditional medical practices and remedies. The Gabon government does not provide any official training facilities or programmes for traditional medicine (WHO, 1992).

5.8 Republic of Congo

Medicinal and aromatic plants are a natural resource of high socio-economic importance to the people of the Republic of Congo. Over-exploitation of resources and habitat destruction are the major factors for rarefaction of medicinal plant species in high demand. On the Point Black market, more than 100 medicinal and aromatic plants and condiments such as *Piper guineense* Schumach. & Thonn. and *Xylopia aethiopica* (Dunal) A. Rich. are sold (Kimpouni, 1999).

Traditional Systems of Medicine

In Congo, about 90% of the population relies on traditional medicine for health care. In rural areas, herbalists and spiritualists are the common practitioners of traditional medicine while in urban areas, natural medicine providers are more frequent. Scientific studies have confirmed the efficacy of a number of Congolese traditional medical products distributed throughout Africa.

In 1982, the Traditional Medicine Branch of the Ministry of Health and Social Affairs expanded to become the Traditional Medicine Service. It was given the responsibility for conducting research in traditional medicine, enriching the national herbarium with medicinal plant specimens, gathering medicinal formulae, popularizing traditional medicine, and integrating traditional and allopathic medicine.

The National Centre of Traditional Medicine was established in 1987 to promote research, manufacture traditional medical products, exchange information with other traditional medicine institutions, train allopathic doctors and students in tra-

ditional medicine, and educate TMPs in the aseptic preparation of medicines.

Congo has official legislative and regulatory documents governing the practice of traditional medicine and it has local and national inter-sectoral councils for traditional medicine. Local officials authorize the practice of traditional medicine in their administrative sub-divisions. TMPs are involved in the primary health-care programme. However, in certain centres this integration is extremely weak.

A licensing process, a national association and a register of TMPs are effective in the country. The Health Services Management of the Ministry of Health, the National Union of Traditional Therapists, and other professional traditional medicine associations are reviewing the qualifications of TMPs although there are no set criteria for these evaluations.

The country has an established structure for the TMPs' consultation fees, although there is no procedure for the reimbursement of such expenditures (WHO, 2001).

Medicinal Plant Resources

TMPs make use of about 800 medicinal plants in the preparation of more than 1,500 drug formulations (FAO, 1999c). About 51 medicinal plants were reported to be traded at the Brazzaville market (Diafouka and Bitsindou, 1993). About 67% of medicinal plant species are found in the wild, of which 42% in forests and the rest in savannah woodlands. The root and bark are the dominantly utilized plant parts. Medicinal plants have great potential of development and will maintain their presence in Congo due to low levels of income and the high cost of modern drugs (FAO, 1999c).

5.9 Rwanda

Rwanda has made an organized effort to study the traditional pharmacopoeia and the medicinal and aromatic plants used as medicaments.

Traditional Systems of Medicine

There are local and national intersectoral councils for traditional medicine in Rwanda. Only registered TMPs are allowed to practise traditional medicine. There are no official legislative or regulatory procedures for governing the practice of traditional medicine, licensing TMPs or granting official approval of traditional medical practices and remedies. However, the country offers traditional medicine training facilities for local people (WHO, 1992).

Medicinal Plant Resources

The ethnobotanical studies have identified hundreds of medicinal plants exploited in Rwanda (Lewis, 1992). FAO has enumerated 59 medicinal plants used in traditional medicine for both human and veterinary use (FAO, 1999d). There are sufficient quantities of medicinal plant species to initiate a pilot scale production of medicaments that are much in demand.

About 20 such medicinal and aromatic plant species (Table 5) can be used for indigenous systems of medicine to manufacture herbal medicines.

Table 5: Leading medicinal and aromatic plants of Rwanda

Acacia senegal (L.) Willd.
Agave sisilana Perrine
Capsicum annuum L.
Capsicum frutescens L.
Carica papaya L.
Cathranthus roseus (L.) G. Don
Chenopodium ambrosioides L.
Cinchona ledgeriana (Howard) Bern. Moens ex. Trimen
Cucurbita pepo L.
Cymbopogon citratus (DC.) Stapf
Datura stramonium L.
Eucalyptus globulus Labill.
Lycopodium clavatum L.
Melaleuca leucadendron (L.) L.
Nerium oleander L.
Ocimum basilicum L.
Rheum officinale Baill.
Ricinus communis L.
Sesamum indicum L.

In Rwanda, there are more species available in sufficient quantities that warrant further assessment. Medicinal species include *Erythrina abyssinica* Lam. ex DC., *Hagenia abyssinica* (Bruce) J. F. Gmel., *Thalictrum rhynchocarpum* Quart.-Dill. & A. Rich. and *Ranunculus multifidus* Forssk. Most of the medicinal and aromatic plant species are collected from the grasslands and some are cultivated such as *Allium sativum* L., *Clematis hirsuta* Perr. & Guill. and others. Rwanda has a millenary pastoral tradition of practising traditional veterinary medicine. There are 39 species that are widely used in veterinary medicine (FAO, 1999d). Some medicinal and aromatic plants used in human and veterinary medicine are given in Table 6 (FAO, 1999d).

R&D Activities

R&D activities are concentrated in the Traditional Pharmacopoeial Aromatic and Medicinal Plant Centres at the faculties of Science and Medicine of the National University of Rwanda, the National Institute of Scientific Research (INRS), the Rwanda's Institute of Agronomic Sciences (ISAR), and the National Pharmaceutical Laboratory (LABOPHAR). The National Institute of Scientific Research (INRS) and the Institute of the Scientific and Technological Research (IRST) are engaged in R&D activities on development of technologies for essential oil extraction and processing of plant material for the production of drugs (FAO, 1999d).

5.10 Sao Tome and Principe

The use of over 93 medicinal plants has been documented in Sao Tome and Principe by the Royal Botanic Gardens of Kew. The most common medicinal plant species include *Allophylus africanus* P. Beauv, *Chenopodium ambrosioides* L., *Bryophyllum pinnatum* (Lam.) Oken, *Ocimum gratissimum* L., *Rauvolfia* spp.

Table 6: Medicinal plants used in human and veterinary traditional medicine in Rwanda

Botanical name	Vernacular name	Therapeutical uses/indications	Ecology
Acacia abyssinica Hochst. ex Benth.	Umunyinya	Mastitis	Sa
Acacia brevispica Harms	Umugeyo	Febrifuge, snake bite, antimalarial, broncho-pneumonia	Sa
Acacia hockii De Wild.	Umunyinya	Veterinary use	Sa
Acanthus pubescens Engl. [=*Acanthus polystachyus* var. *pseudopubescens* Cufod.]	Igitovu	Poliomyelitis, eczema	Sa
Aloe volkensii Engl.	Igikakarubamba	Gastritis, haematurea	Sa
Apodytes dimidiata E. Mey. ex Bernh.	Umusibya	Uterine prolapse	Sa
Bersama abyssinica Fresen.	Umukaka	Veterinary use	F
Blepharispermum pubescens S. Moore	Umunyuragisaka	Veterinary use	Sa
Bridelia micrantha (Hochst.) Baill.	Umugimbu	Veterinary use	-
Cassia didymobotrya Fresen. [=*Senna didymobotry*a (Fresen.) H. S. Irwin & Barneby]	Umubagabaga	Purgative, anthelmintic, haemorrhoids, pneumonia, cough, rheumatism, eye problems, stiff neck	Sa
Cassia occidentalis L. [=*Senna occidentalis* (L.) Link]	Umuyoka	Enteritis, ascariasis, snake bite	Sa
Chrysophyllum gorungosanum Engl.	Umubombwe	Poliomyelitis	F
Cinchona ledgeriana (Howard) Bern. Moens ex Trimen	Ikinini	Antimalarial, veterinary use	P
Clausena anisata (Willd.) Hook. f. ex Benth.	Umuno	Poliomyelitis	F
Clerodendrum bucholzii Guerke	Umukuzanyana	Nervous disorders, threatened abortion	Sa
Clerodendrum johnstoni Oliv.	Ikinyakurwe	Veterinary use	F
Clerodendrum myricoides (Hochst.) Vatke	Umukuzanyana	Articular pain, neuralgia, dysentery, veterinary use	Sa
Clutia abyssinica Spach	Umutalishonga	Hepatitis, urethral flow, rheumatism, gastritis, veterinary use	Sa
Coleus spp.		Cough, haemorrhoids, ascariasis	Sa
Crotalaria incana L.	Umuyogera	Mastitis, otitis	Sa
Crotalaria intermedia Kotschy [=*Crotalaria brevidens* var. *intermedia* (Kotschy) Polhill]	Umuyogera	Burns	Sa
Dodonaea viscosa (L.) Jacq.	Umusasa	Veterinary use	Sa
Dombeya goetzenii K. Schum. [=*Dombeya torrida* subsp. *torrida*]	Umukore	Veterinary use	F
Dracaena afromontana Mildbr.	Umuhati	Colics (kidney and bladder), wounds, veterinary use	O
Dracaena steudneri Schweinf. ex Engl.	Umuhati	Postpartum haemorrhage, veterinary use	O
Entada abyssinica Steud. ex A. Rich.	Umusange	Urethral flow, cough, veterinary use	Sa
Erythrina abyssinica Lam. ex DC.	Umuko	Meningitis, gastritis, dysentery, asthma, hepatitis, hepato-splenomegalia, veterinary use	Sa

Continued

Table 6 continued

Botanical name	Vernacular name	Therapeutical uses/indications	Ecology
Erythrococca bogensis Pax	Umutinski	Anthelmintic, placental retention, veterinary use	O
Eucalyptus spp.	Inturusu	Whooping-cough, haemorrhoids, prolapsus, pneumonia	P
Euphorbia candelabrum Kotschy	Umuduha	Hydrocele, anthelmintic, wounds	Sa
Euphorbia tirucalli L.	Umuyenzi	Veterinary use	O
Fadogia spp.	Umutanoga	Purgative, ascariasis, broncho-pneumonia, hepatitis	Sa
Ficus spp.	Umuvumu	Mastitis, cholera	O
Harungana madagascariensis Lam. ex Poir.	Umushayishayi	Ascariasis, taeniasis, veterinary use	F
Hibiscus spp.	Umutozo	Threatened abortion, poliomyelitis, cough, rheumatism, snake bite	Sa
Indigofera erecta Thunb.	Umusororo	Gastritis, anthelmintic, ulcers, epilepsy, stiff neck, veterinary use	F
Lantana trifolia L.	Umuhengeri	Cough, snake bite, mastitis, veterinary use	Sa
Lobelia gibberoa Hemsl.	Intomvu	Veterinary use	F
Macaranga spp.	Umusekera	Nervous disorders, veterinary use	F
Maesa lanceolata Forssk.	Umuhanga	Epilepsy, whooping-cough, dysentery, acne, oozing dermatosis, delivery, abdominal colic, stiff neck, veterinary use	F
Maesopsis eminii Engl.	Umuhumura	Laxative	F
Markhamia lutea (Benth.) K. Schum.	Umusave	Cough	Sa
Microglossa spp.	Umuhe	Veterinary use	F
Millettia dura Dunn	Umuyogoro	Veterinary use	F
Myrica spp.	Isubyo	Nervous disorders, gastritis	Sa
Mitragyna rubrostipulata O. Ktze.	Umuzibaziba	Oxytocic	Sa
Ocimum americanum L.	Isonga	Cough, heart, broncho-pneumonia, veterinary use	Sa
Ocimum suave Willd. [=*Ocimum gratissimum* L.]	Umwenya	Febrifuge, antimalarial, pleuropneumonia, ascariasis	Sa
Olea europaea L.	Umunzenze	Broncho-pneumonia, cough, burns, eyes problems, febrifuge, veterinary use	Sa
Pavetta spp.	Umumenamabuye	-	F
Pennisetum purpureum Schumach.	Urubingo	Mastitis, burns	O
Phytolacca dodecandra L'Hér.	Umuko	Nervous disorders, anal prolapsus, otitis, burns, scale, wrench, abortions; veterinary use	Sa
Plectranthus spp.	Icyegera	Aromatic, abortifacient	Sa
Polyscias fulva (Hiern) Harms	Umwungo	Arthralgia	F
Protea madiensis Oliv.	Igihungeri	Headaches, anthelmintic, broncho-pneumonia	Sa
Psidium guajava L.	Ipera	Cholera, gastritis	O

Continued

Table 6 continued

Botanical name	Vernacular name	Therapeutical uses/indications	Ecology
Psorospermum febrifugum	Ishangi	Anal haemorrhoids, prolapsus, broncho-pneumonia, leprosy, ulcers, hepatitis	-
Rhus spp.	Umumara	Oxytocic, leprosy, haemorrhoids	Sa
Rhamnus prinoides L'Hér.	Umunanira	Nervous disorders	F
Ricinus communis L.	Ikibonobono	Threatened abortion, amoebiasis, anal prolapsus, veterinary use	O
Rubia cordifolia L.	Umukarara	Colics (kidney and bladder), rheumatism, otitis	F
Rumex usambarensis (Dammer) Dammer	Umufumbegeshi	Hepatitis	-
Senecio spp.	Umutagara	Nervous disorders, hydrocele, veterinary use	O
Sesbania sesban (L.) Merr.	Umunyegenyege	Veterinary use	O
Solanum abyssinicum Jacq. ex Vitm.	Umutobotobo	Eyes problems	Sa
Solanum incanum L.	Umucucu	Whooping-cough, urethral flow, veterinary use	Sa
Solanum terminale Forssk.	Umuhanurankuba	Abortifacient	Sa
Synadenium grantii Hook. f.	Umukoni	Cough, burns, leprosy, warts, pain	Sa
Tetradenia riparia (Hochst.) Codd	Umuravumba	Cough, headache, scab, laryngitis, haematurea, veterinary use	O
Vernonia amygdalina Delile	Umubilizi	Amoebiasis, hepatitis, renal colics, febrifuge, antimalarial, anti-ulcerous, veterinary use	Sa
Vernonia lasiopus O. Hoffm.	Igiheriheri	Rheumatism, ascariasis, taeniasis, wounds	F

F=forests; Sa=shrubby savannahs; P=plantations; O=others

and *Voacanga africana* Stapf, among others. Approximately two-thirds of these plants are cultivated on degraded land and the rest are collected from secondary forests, including *Rauvolfia* spp., *Voacanga africana* Stapf, and *Allophylus africanus* P. Beauv. The medicinal plant species found in primary forests are only known to a few elderly natives and TMPs (FAO, 1996).

In Sao Tome and Principe, local and national inter-sectoral councils are active in the field of traditional medicine. However, there are no official legislative or regulatory texts governing the practice of traditional medicine, no licensing process for TMPs, no official training facilities or programmes and no procedures for the official approval of traditional medical practices or remedies. TMPs are not involved in the primary health-care programme (WHO, 1992).

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Chapter 6

The Status of Medicinal Plants in South African Countries

6.1 Introduction

Southern Africa includes Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe. They possess a rich diversity of medicinal and aromatic plants as well as knowledge of their use. Despite this richness of biological resources, most of the countries in the region are poor. Governments are not able to afford the high cost of modern drugs for their growing populations. As a result, most of the rural population has to rely on traditional medicine for their health-care needs. Medicinal plants are the essential component of traditional remedies and also an important source of income for rural people. There are about 24,000 vascular plants in the region and 4,000 of them are medicinal and aromatic. About 350 plants are widely used in traditional remedies. Some common medicinal and aromatic plant species are given in Table 1.

Botswana, Lesotho, Namibia, South Africa and Swaziland are floristically rich countries. Cape Floristic Province in South Africa has the greatest extratropical concentration of higher plant species in the world. This province alone has 8,600 species and 68% of them are reported to be endemic.

Over 70% of the population in the region relies on traditional medicine derived from local plant species for health-care needs. Traditional medicine is both a popular and dominant health-care system in Malawi, Mozambique and Swaziland and its popularity is increasing in South Africa. Countries with an established structure, budgetary support and training facilities in traditional medicine are given in Table 2.

Most R&D activities revolve around ethnobotanical studies. Efforts are underway to market medicinal and aromatic plants in high demand. The root and bark of *Warburgia salutaris* (Bertol. f.) Chiov. has yielded antimicrobial sesquiterpenes warburganal and polygodial. Tubers of Swaziland species *Hypoxis rooperi* Moore have been investigated for antitumour and anti-inflammatory properties, and hypoxicide has been characterized from the plant (van Wyk *et al*., 1997; Drewes *et al.,* 1984). These two plant species have been marketed in Europe.

Demand for medicinal plant material

Table 1: Some common medcinal and aromatic plants of South African countries

Botanical name	Common name	Plant part(s)	Therapeutical uses/indications	Country(ies)
Acacia amythethophylla Steud. ex A. Rich.	-	Root	Convulsions	Zimbabwe
Acacia karoo Hayne	Karoo, thorn tree	Root, bark	Convulsions, diarrhoea, antimalarial	Zimbabwe, Mozambique
Acacia nilotica (L.) Willd. ex Del.	Gum Arabic tree	Root, gum	Diarrhoea, antimalarial, respiratory problems	Mozambique
Acalypha sinensis Klotzsch.	-	-	Diarrhoea	Malawi
Acridocarpus natalitius Juss.	Mobophe	Pod, root	Diarrhoea	Mozambique
Adansonia digitata L.	Baobab tree	Bark, leaf	Diarrhoea, antimalarial	Mozambique
Agathosma betulina (Berg) Pill.	Buchu	Leaf	Kidney and urinary tract diseases, rheumatic pain	South Africa
Albizia antunesiana Harms	-	Root	Aphrodisiac	Zimbabwe
Alepidea amatymbica Eckl. & Zeyh.	Kalmoes	Root	Tuberculosis, diarrhoea, headache, antimalarial	Lesotho, Zimbabwe, Mozambique
Aloe ferox (L.) Burm. f.	Bitter aloe	Leaf	Conjunctivitis, venereal sores	South Africa
Aloe marlothii A. Berger	Aloe	Leaf	Sexual complaints	Mozambique
Annona senegalensis Pers.	Custard apple	Bark	Diarrhoea, respiratory and sexual complaints	Mozambique
Annona stenophylla Engl. & Diels.	-	Root	Antiemetic, syphillis	Zimbabwe
Ansellia gigantean Reichb. f.	Orchid	Stem	Antiemetic, respiratory complaints	Zimbabwe, Mozambique
Aristolochia petersiana Klotzsch.	-	Root	Antimalarial	Malawi, Zimbabwe
Artemisia afra Jacq.	Wormwood	Leaf	Antimalarial	South Africa, Lesotho, Zimbabwe
Aspilia pluriseta Schweinf.	-	Root	General pain	Zimbabwe
Balanites maughamii Sprag.	Torchwood	Root	Emetic	South Africa
Bersama tysoniana Oliv.	White ash	Bark	Fever, hysteria	South Africa
Blumea alata (D. Don) DC.	-	Leaf	Fever	Zimbabwe
Boophane disticha Herb.	Tumbleweed	Bulb scales	Rheumatic pain	South Africa
Bowiea volubilis Harv. ex Hook. f.	Climbing lily	Corm	Oedema, female sterility	South Africa
Bridelia cathartica Bertol. f.	-	Leaf	Antimalarial, sexual complaints	Mozambique
Capparis tomentosa Lam.	-	Root	Respiratory problems	Mozambique
Carpobrotus edulis (L.) N. E. Br.	Hottentot's fig	Leaf	Oral and genital thrush	South Africa
Casearia aspera	-	-	Tuberculosis	Lesotho
Cassia abbreviata Oliv.	Senna	Bark, root, fruit	Diarrhoea, abdominal pain, constipation	Zambia, Zimbabwe
Cassia petersiana Bolle	Dwarf cassia	-	Syphilis, pneumonia	Malawi

Continued

Table 1 continued

Botanical name	Common name	Plant part(s)	Therapeutical uses/indications	Country(ies)
Cassine papillosa (Hochst.) Kuntze	Common saffron	Bark	-	South Africa
Ceratotheca sesamoides Endl.	False seasame	-	Measles	Malawi
Chenopodium ambrosioides L.	Worm seed	Leaf	Convulsions, nervous disorders	Zimbabwe
Cissampelos pareira L.	Velvet leaf	Root	Abdominal pains, backache, infertility, diarrhoea, sexual complaints	Zimbabwe, Mozambique
Clausena anisata Hook. f.	Bois d'anis	-	Cold, fever	South Africa
Clematopsis scabiosifolia Hutch.	-	Root	Headache	Zimbabwe
Clerodendrum myricoides (Hochst.) Vatke	Butterfly bush	Leaf	Convulsions	Zimbabwe
Clivia miniata (Lindl.) Bosse	Bush lily	Root	Snakebite, fever	South Africa
Combretum molle R. Br.	Velvet leaf bush willow	Root	Diarrhoea	Zimbabwe, Mozambique
Cryptocarya latifolia Sond.	Broad leaved quince	Bark	Respiratory problems	South Africa
Curtisia dentata (Burm f.) C. A. Smith	Assegaai	Bark	-	South Africa
Cyathea capensis (L. f.) J. E. Sm.	Tree fern	-	-	Swaziland
Datura stramonium L.	Datura	Leaf	Asthma	Zimbabwe
Dialiopsis africana Radlk.	-	Root	Antimalarial	Zambia
Dianthus mooiensis Williams subsp. *kirkii* (Burtt Davy) Hooper	-	-	-	Swaziland
Dicerocaryum zanguebaricum Merr.	Boot protector	Leaf	Measles	Zimbabwe
Dichrostachys cinerea (L.) W. & A.	-	Fruit	Syphillis, sexual complaints	Zimbabwe, Mozambique
Dicoma anomala Sond.	Uzara	Tuber	Skin infections, abdominal pain, anti-emetic, backache	Lesotho, Zimbabwe
Dioscorea sylvatica (Kunth) Eckl.	Elephant's foot	Tuber	Chest complaints	South Africa, Malawi
Elephantorrhiza elephantina Skeels	-	Root	Diarrhoea, sexual complaints	Mozambique
Elephantorrhiza goetzei (Harms) Harms	-	Root	Constipation, diarrhoea	Zimbabwe
Eriosema cordatum E. Mey.	-	-	Sexual complaints	Mozambique
Erythrina abyssinica DC.	-	-	Gonorrhoea	Malawi, Zambia
Erthrophleum suaveolens (Guill & Perrot) Brenan	Red water tree	Bark	Sexual problems	Malawi
Euclea natalensis DC.	-	Root	Antimalarial, respiratory problems, ulcers	Mozambique, Malawi

Continued

Table 1 continued

Botanical name	Common name	Plant part(s)	Therapeutical uses/indications	Country(ies)
Eucomis autumnalis (Mill.) Chitt.	Wild pineapple	Bulb	Anti-inflammatory	South Africa
Eulophia spp.	Orchid	-	Anaemia	Malawi
Euphorbia ingens E. Mey.	Candelabra tree	Latex	Asthma	Zimbabwe
Garcinia livingstonei T. Anders.	-	-	Diarrhoea	Mozambique
Geranium caffrum	Cranesbill	-	Wounds, diarrhoea, childhood vomiting	Lesotho
Gladiolus dalenii Van Geel	Gladiolus	Corm	Diarrhoea	Mozambique
Gnidia kraussiana Meissn.	-	Root, tuber	Abortifacient, constipation	Zimbabwe
Grewia flavescens Juss.	Donkey berry	Seed	Measles	Zimbabwe
Harpagophytum procumbens DC. ex Meiss.	Devil's claw	Tuber	Rheumatism	South Africa, Namibia
Harpagophytum zeyheri Decne.	Devil's claw	Tuber	Rheumatism	Namibia
Helichrysum caespititum Sond.	-	-	Tuberculosis	Lesotho
Heteromorpha trifoliata Eckl. & Zeyh.	-	Root	Infertility	Zimbabwe
Hypoxis rooperi Moore	African potato	Root	Immunostimulant	South Africa, Mozambique
Indigofera arrecta Hochest. ex A. Rich.	Java indigo	Root	Abortifacient	Zimbabwe
Kigelia africana (Lam.) Benth.	Sausage tree	Fruit	Diarrhoea	Mozambique
Lannea discolor (Sond.) Engl.	-	-	Sexual complaints	Mozambique
Lannea edulis (Sond.) Engl.	Wild grape	Root	Bilharzia	Zimbabwe
Lippia javanica (Burm. f.) Spreng.	-	Leaf	Convulsions, fever, antimalarial, respiratory problems	Zimbabwe, Mozambique
Malva parviflora L.	Little mallow	-	Bodyache, arthritis, rheumatism	Lesotho
Mangifera indica L.	Mango	-	Bronchitis	Zambia
Maytenus senegalensis (Lam.) Excell	Confetti tree	Root	Threatened abortion, backache, diarrhoea	Zimbabwe, Mozambique
Melia azedarach L.	-	-	Diarrhoea	Mozambique
Melolobiun alpinium	-	-	Hypertension, diabetes	Lesotho
Momordica balsamina L.	-	-	Antimalarial	Mozambique
Mondia whitei (Hook. f.) Skeels	-	Root	Aphrodisiac, constipation	Zimbabwe
Myrothamnus flabellifolia Welw.	-	Leaf	Asthma	Zimbabwe, Mozambique
Ocotea bullata (Burch.) Baill.	Stinkwood	-	Anti-inflammatory	South Africa
Ozoroa insignis Del.	-	Root, bark	Threatened abortion, backache	Zimbabwe

Continued

Table 1 continued

Botanical name	Common name	Plant part(s)	Therapeutical uses/indications	Country(ies)
Ozoroa obovata (Oliv.) R. & A. Fern.	-	-	Diarrhoea	Mozambique
Pelarginium sidoides DC.	Umkcaloabo	-	-	South Africa
Peltophorum africanum Sond.	-	Root	Threatened abortion	Zimbabwe
Pittosporum viridiflorum Sims	Cheesewood	-	-	South Africa
Prunus africana (Hook. f.) Kalkm.	-	-	Sexual complaints	Mozambique
Pterocarpus angolensis DC.	-	-	Antimalarial, mouth ulcers	Zambia
Rapanea melanophloeos (L.) Mez.	Cape beech	-	-	South Africa
Rauvolfia caffra Sond.	-	-	Antimalarial, respiratory problems	Mozambique
Rhoicissus tridentata (L. f.) Wild & Drum.	-	-	Sexual complaints	Mozambique
Ricinus communis L.	-	Leaf, root	Abortifacient, syphillis, measles	Zimbabwe
Salacia kraussii Harv.	-	-	Diarrhoea, antimalarial	Mozambique
Salic mucronata Thunb.	-	-	Rheumatism, fever	South Africa
Sarcostemma viminale R. Br.	-	-	Sexual complaints	Mozambique
Scabiosa columbaria	-	-	Tuberculosis	Lesotho
Schotia brachypetala Sond.	-	-	Diarrhoea	Mozambique
Scilla natalensis Planch.	Blue hyacinth	-	-	South Africa
Sclerocarya birrea (A. Rich.) Hochst. subsp. *caffra* (Sond.) Kokwaro	-	-	Diarrhoea, sexual complaints	Mozambique
Securidaca longipedunculata Fres.	-	Root	Backache, headache, nervous disorders, respiratory problems	Zimbabwe, Mozambique, Malawi
Senna occidentalis (L.) Link	-	-	Antimalarial	Mozambique
Siphonochilus aethiopicus (Schweinf.) Bl. Birtt.	African ginger	-	-	South Africa, Swaziland
Spirostachys africanus Sond.	-	-	Diarrhoea, antimalarial	Mozambique
Stangeria eriopus Nash	Natal grass cycad	-	Anti-inflammatory	South Africa
Steganotaenia araliacea Hochst.	-	Root	Amenorrhoea	Zimbabwe
Strychnos cocculoides Bak.	-	Root	Amenorrhoea	Zimbabwe
Sutherlandia frutescens (L.) R. Br.	-	-	Hypertension, diabetes	Lesotho
Swarizia madagascariensis Desv.	-	Pod	Syphillis	Zimbabwe
Tabernaemontana elegans Stapf.	-	-	Antimalarial, respiratory problems	Mozambique

Continued

Table 1 continued

Botanical name	Common name	Plant part(s)	Therapeutical uses/indications	Country(ies)
Tamarindus indica L.	-	-	Sexually transmitted diseases	Malawi
Tephrosia semiglabra Sonder	-	-	Hypertension, diabetes	Lesotho
Terminalia sericea Burch.	-	Root, bark	Threatened abortion, antiemetic, bilharzias diarrhoea	Zimbabwe, Mozambique
Trichilia emetica Vahl.	-	Bark	Abortifacient, diarrhoea	Zimbabwe, Mozambique
Trichodesma ambacense Wall. Excell	-	Tuber	Syphillis	Zimbabwe
Trichodesma physaloides (Fenzl.) A. DC.	-	Tuber	Aphrodisiac	Zimbabwe
Trifolium burchelianum	-	-	Hypertension, diabetes	Lesotho
Triumfetta welwitschii Mast.	-	Tuber	Threatened abortion	Zimbabwe
Tulbaghia leucantha Bak.	-	Whole plant	Nervous disorders	Zimbabwe
Urginea altissima Bak.	-	Bulb	Rheumatism	Zimbabwe
Vernonia amygdalina Del.	Vernonia tree	Root	Amenorrhoea, infertility	Zimbabwe
Vernonia colorata (Willd.) Drake	Bitter leaf	-	Respiratory problems	Mozambique
Warburgia salutaris (Bertol. f.) Chiov.	Pepperbark tree	Bark	Headache, respiratory problems	South Africa, Zimbabwe, Mozambique, Swaziland
Xysmalobium undulatum R. Br.	Uzara	Root, seed	Cardiac problems, diarrhoea	South Africa
Zanha africana (Radlkof.) Engl.	-	Root	Headache	Zimbabwe
Zanthoxylum capense (Thunb.) Harv.	Fever tree	-	Antimalarial	Mozambique
Ziziphus mucronata Willd.	Cape thorn	Root	Diarrhoea, sexual complaints	Mozambique

often exceeds supply. Local consumption dominates the export volume except for some plant species. Medicinal plant trade is informal, generally it takes place within and between neighbouring countries. South Africa exports *Swartzia madagascariensis* Desv. to Lesotho; Swaziland exports *Warburgia salutaris* (Bertol. f.) Chiov. to South Africa and Mozambique; and Malawi exports *Jateorhiza* spp. to Zambia, Zimbabwe, Mozambique and South Africa. Some countries also export medicinal plant material to the international market. Botswana, Namibia and South Africa are the major exporters of medicinal plant material. The major medicinal plant species internationally traded are *Aloe ferox* (L.) Burm. f., *Harpagophytum procumbens* DC. ex Meiss., and *H. zeyheri* Decne. In addition, South Africa also exports *Panax ginseng* C. A. Mey., *Glycyrrhiza, Origanum* and *Salvia* species.

Table 2: Traditional medicine structure in South African Countries

Country	Legal framework	National management body	Association(s) of TMPs	Directory of TMPs	National budget allocation
Angola	No	Yes	-	Yes	No
Botswana	No	No	Dingaka Society, Botswana Dingaka Association, Kwame Traditional Association, United Herbalists Association	No	No
Lesotho	Natural Therapeutic Practitioners Act, 1976 (Section 2), Lesotho Universal Medicinemen and Herbalists Council Act, 1978 (Section 5)	Universal Medicinemen and Herbalists Council	Natural Therapeutic Practitioners Association	Yes	No
Malawi	No	Yes	Herbalists Association of Malawi, Asing'anga of Malawi, Chizgani Ethnomedical Association of Mzuzu	No	No
Mozambique	Yes	No	Association dos Medicos, Tradicionais de Mocambique	No	No
Namibia	Traditional Healers Bill, 1998	Namibian Traditional Medical Practitioners Board, Traditional Healers Council	Namibia Eagle Traditional Healers Association	No	No
South Africa	No	No	Traditional Healers Organization	No	No
Swaziland	No	No	-	No	No
Zambia	National Drug Policy	Traditional Health Practitioners Association of Zambia (THPAZ)	-	Yes	No
Zimbabwe	Natural Therapists Act, 1981, Traditional Medical Practitioners Council Act, 1981	Traditional Medical Practitioners Council	Zimbabwe National Traditional Healers Association (ZINATHA)	Yes	No

Some important medicinal and aromatic plants in international trade are given in Table 3. There is, moreover, a wide range of medicinal plants specific to respective countries and used locally in traditional medicine.

Table 3: Common medicinal and aromatic plants exported from Southern Africa

Plant species	Plant part(s)	Exporting country(ies)
Agathosma betulina (Berg) Pill.	Leaf	South Africa
Aloe ferox Mill.	Leaf	South Africa
Bracenridgea zanguebarica	Bark	Mozambique
Gloriosa superba L.	Seed	Mozambique
Glycyrrhiza spp.	Root	South Africa
Harpagophytum procumbens DC. ex Meiss.	Root	Botswana, Namibia, Mozambique, South Africa
Harpagophytum zeyheri Decne.	Root	Botswana, Mozambique, Namibia
Hypoxis ropperi Moore	Root	Swaziland
Jateorhiza palmata Miers	Root	Mozambique
Origanum spp.	Leaf	South Africa
Pelargonium sidoides DC.	Leaf	South Africa
Rauvolfia vomitoria Afz.	Root	Mozambique
Ricinus communis L.	Seed	Mozambique
Salvia spp.	Flower	South Africa
Siphonochilus aethiopicus (Schweinf.) Bl. Birtt.	Rhizome, root	Namibia, South Africa, Swaziland
Sutherlandia frutescens (L.) R. Br.	Leaf	South Africa
Tabernaemontana elegans Stapf.	Seed	Mozambique
Terminalia sericea Burch.	Bark	Mozambique
Warburgia salutaris (Bertol. f.) Chiov.	Bark	Mozambique, Zimbabwe, South Africa, Swaziland
Xysmalobium undulatum R. Br.	Root	South Africa

Malawi and South Africa import plant drugs from neighbouring countries because of their dwindling resources.

Most of the plant material is sourced through wild collection, while only a few species are cultivated. Efforts have been made to cultivate *Warburgia salutaris* (Bertol. f.) Chiov., *Siphonochilus aethiopicus* (Schweinf.) Bl. Birtt. and *Agathosma* spp. in South Africa, and *Harpogophytum procumbens* DC. ex Meiss in Namibia and Botswana. Leaf, root and bark are the most commonly collected parts (Cunningham, 1997; Scholes and Walker, 1993).

The region has the highest concentration of threatened plants in the world (Cowling and Hilton-Taylor, 1994). Among the 17,000 endemic species, the existence of 13% of these species is threatened with extinction due to over-exploitation and habitat destruction. South Africa (45) registers the highest number of threatened plant species followed by Mozambique (36), Angola (19), Malawi and Zimbabwe (14 species each), (IUCN, 2000). These figures continue to grow. It has been estimated that 58 species had become extinct

by 1995, compared to 39 by 1980. The number of endangered species has grown from 105 to 250 during the same period (Hilton-Taylor, 1996). In Cape Floristic Province of South Africa alone there are 1,430 threatened species and 26 species are already extinct.

Many threatened plants are of medicinal importance: *Harpagophytum procumbens* DC. ex Meiss. from Botswana; *Siphonochilus aethiopicus* (Schweinf.) Bl. Birtt. from Namibia; and *Warburgia salutaris* (Bertol. f.) Chiov., *Ledebouria hypoxidoides*, *Mystacidium millaria*, *Ocotea bullata* E. Mey., *Aloe ferox* (L.) Burm. f. from South Africa. Other threatened medicinal species are *Artemisia afra* Jacq., *Harpagophytum zeyheri* Decne., *Hypoxis rooperii* Moore and *Sutherlandia frutescens* (L.) R. Br.

6.2 Angola

Angola is located on the Atlantic coast of southern Africa and is bordered by Namibia to the south, Zambia to the east and the Democratic Republic of Congo to the north. The climate varies from tropical in the north to subtropical in the south. The natural vegetation consists of humid tropical forests, savannahs and deserts.

Most of the population in the country suffers from malnutrition and HIV/AIDS. Access to modern medicine and treatments is limited. Medicinal plants meet the needs of rural people for healthcare and are also a source of supplementary income. Among 235 classified tree species found in Angola, 40 species are used in traditional medicine (Zola, 1999).

TMPs are the main health-care providers in the country but they are not part of the national health-care programme. There are no official legislative or regulatory texts, training facilities or programmes governing the practice of traditional medicine and no licensing procedure for TMPs. Only a registry of TMPs is maintained (WHO, 1992).

6.3 Botswana

The Republic of Botswana is nestled between Namibia, South Africa, Zambia and Zimbabwe. In terms of biological diversity, it is a relatively unexplored country. Besides the Kalahari Desert, the country has vegetation in the zones neighbouring the desert, where the rainy conditions favour the rich forest vegetation. A number of species from these zones are used for medicinal purposes in traditional medicine. There are seven species of medicinal plants, which on the basis of phytochemical analysis, are considered to be suitable for obtaining pharmaceuticals. These species are *Achillea millefolium* L., *Chenopodium ambrosioides* L., *Datura inoxia* Mill., *Datura stramonium* L., *Ocimum americanum* L., *Ricinus communis* L. and *Strophanthus kombe* Oliv. This list is not comprehensive, and in addition, there are over 20 plants growing wild in Botswana which merit evaluation from the industrial viewpoint.

Devil's claw (*Harpagophytum procumbens* DC. ex Meiss.) is an endemic

medicinal plant of commercial importance in the Kalahari Desert. Its roots and rhizomes have been sold on the European market as a source of raw material for antirheumatic medicaments (Lewington, 1993). The commercial harvesting of the species has depleted up to 66% of the plant population in its natural habitat (Cunningham, 1997).

TMPs, popularly known as *Ngakas,* provide health-care services primarily to the rural population. About 95% of the 3,100 TMPs comes from rural areas and is officially accepted under the National Development Plan of 1976-81 (Staugard, 1989). Traditional medicine has not been integrated into the modern health-care system. The Medical, Dental, and Pharmacy (Amendment) Act of 1987 outlines the registration requirements for TMPs in Botswana.

6.4 Lesotho

Lesotho is a small country surrounded on all sides by South Africa. About two-thirds of the country is mountainous and the rest is temperate grassland. Medicinal plants play a crucial role in fulfilling the health-care needs of rural communities. Among the many medicinal plant species found in the flora of Lesotho, *Dianthus* spp., *Eucomis autumnalis* (Mill.) Chitt. and *Berkheya setifera* DC. are of great importance in the traditional medicine system. *Dianthus* spp. are traditionally used to promote cleaning of the blood stream. *Eucomis autumnalis* (Mill.) Chitt. is used for curing sexually transmitted diseases. Many medicinal plants have become endangered due to over-exploitation for domestic use and export (Walter, 2001).

Traditional medicine is integrated into the national health-care system. The Natural Therapeutic Practitioners Act of 1976 regulates the practice of traditional medicine in the country (Anonymous, 1978). The Lesotho Universal Medicine and Herbalist Council is responsible for promoting, controlling and improving the facilities for and training of the TMPs (Anonymous, 1981).

6.5 Malawi

Malawi registers a wide range of climatic, edaphic and geographic conditions. It has a great diversity of vegetation ranging from savannah in the dry lowlands to open woodland on infertile plateaus and escarpments, and evergreen forests on the highlands. Human activities have significantly altered the natural vegetation, the swamp vegetation has given way to agricultural species and much of the original woodlands have been cleared.

Traditional Systems of Medicine

Traditional medicine is the most popular and dominant medical system in Malawi, especially in the rural areas (Maliwich, 1997). Limitations to government health services like drug shortage, an insufficient number of hospitals, and an unfavourable modern medical doctor-to-patient ratio of 1 : 50,000 have contrib-

uted to the reliance on traditional medicine. The state government has recognized the contribution of TMPs and the benefits of collaboration between modern and traditional medical communities to the nation's health-care system (Hauya, 1997). TMPs are involved in the national health-care programme and health workers are trained in traditional medicine (WHO, 1992). There are traditional medicine associations, the largest of which is the Herbalists' Association of Malawi with about 2,000 members (Maliwich, 1997).

Medicinal Plant Resources

In Malawi, local consumption of medicinal plants is more important than their sale on the market. However, these plants constitute an important source of income for rural communities (Nyirenda, 1993). Most of the population prefers to consult TMPs who use a variety of medicinal plants in their preparations. In southern Malawi, local communities use 20 plant species as medicine.

Securidaca longipedunculata Fres. is an important medicinal plant of common and widespread use in Malawi. Its fresh leaves are traditionally used for wound healing, cough, bilharzia, venereal diseases and snakebites, and dry leaves are used for headaches.

Accelerated deforestation is the major factor for loss of biodiversity in Malawi. It is also causing the loss of potential medicinal plants. The over-exploitation of *Dioscorea sylvatica* Eckl., *Cassia petersiana* Bolle., *Erythrophleum suaveolens* (Guill & Perrot) Brenan and *Erythrina abyssinica* DC. is an emerging problem in the country.

R&D Activities

The National Herbarium and Botanic Gardens (NHBG) is the principle authority on botanical and related research in Malawi. The National Herbarium, located in Zomba, was established in 1987 by merging the herbaria of the University of Malawi and the government Department of Forestry. It has two regional herbaria located at Lilongwe and Mzuzu, and three botanic gardens in Zomba, Lilongwe and Mzuzu. The NHBG is the head of the National Biodiversity Committee and Clearing House Mechanism of the Convention of Biodiversity for accessing and exchange of information on biological diversity. The National Herbarium houses a collection of over 90,000 plant specimens, with information on their phenological details, geographical distribution and uses. These botanic gardens are also involved in the conservation of rare and endangered plant species.

The NHBG conducts research on economic botany, medicinal plant biodiversity and assessment of the efficacy of plant pesticides, ethnobotanical studies on medicinal plants used in maternal and child health care. In addition, it is also working on the documentation of medicinal and aromatic plant diversity and traditional knowledge of their use.

Trade and Marketing

Trade in medicinal plants in Malawi is less open. Most of the trade takes place at local markets. The country exports significant quantities of *Jateorhiza* spp. particularly to neighbouring countries such as Mozambique, South Africa, Zambia and Zimbabwe. In a survey, a total of 44 medicinal plant species were found at the Limbe market for export to South Africa (Maliwich, 1997). Malawi also imports raw material from neighbouring countries as a result of depletion of its own resources.

6.6 Mozambique

The Republic of Mozambique is situated on the eastern coast of southern Africa. The dominant vegetation types of the country are savannahs and secondary forests which cover about 70% of the total area. It is one of the eight poorest countries in the world with an average gross domestic products (GDP) growth rate of 3.8% (estimate, 2000). Modern health-care facilities are scarce and limited, and most of the population relies on traditional medicine for their health-care needs. Even major diseases such as diarrhoea, malaria, sexual and respiratory complaints are treated with traditional medicine.

Traditional Systems of Medicine

In Mozambique, about 80% of the population uses traditional medicine for health-care needs (Nhatumbo and Soto, 1994). Traditional medicine is both a popular and dominant system of health care. The ratio of modern medical doctors to patients is 1 : 50,000, in contrast to TMPs to patients ratio of 1 : 200.

Mozambique does not have a legal framework for governing the practice of traditional medicine, and no licensing procedure exists for official approval of traditional medical practices and remedies (WHO, 1992). The Department of Health is responsible for undertaking collaborative programmes with TMPs. A number of collaborative programmes with district or provincial health authorities have been sponsored by non-governmental organizations (Clarke, 1998a).

Medicinal Plant Resources

The country has approximately 5,500 plant species and about 10% of them are used in the traditional systems of medicine. TMPs handle a wide range of diseases (WCMC, 1992). A countrywide survey of common and broadly used medicinal plant species in local remedies recorded the use of 39 species in the Tonga region and 46 in the Tinonganine, Kumbane Nirte, Tanga and Jabula regions. Among these, the most common are *Warburgia salutaris* (Bertol. f.) Chiov., *Balanites maughamii* Sprague, *Tarenna* spp., *Securidaca longipedunculata* Fres., *Zanthoxylum* spp., *Bridelia cathartica* Bertol. f., *Swartzia madagascariensis* Desv., *Indigofera* spp., *Xylotheca kraussiana* Hochst., *Acridocarpus natalitius* Juss., *Brachylaena huillensis* O. Hoffm., *Ochna* spp. and *Garcinia livingstonei* T. Anders.

Medicinal plants are considered to

play a decisive role in slowing down infections (diarrhoea, pneumonia and skin infections) related to the opportunistic AIDS virus. In Mozambique and elsewhere in Africa, *Sarcostemma viminale* R. Br. is widely used against impotency. *Prunus africana* (Hook. f.) Kalkm. and *Hypoxis rooperi* Moore are used in prostate hypertrophy. The root and bark of *Acacia nilotica* (L.) Willd. ex Delile, *Annona senegalensis* Pers., *Elephantorrhiza elephantina* Skeels. and *Sclerocarya birrea* (A. Rich.) Hochst. are frequently used by local people to treat diarrhoea (Gelfand, 1985; Scott *et al*., 1996; van Wyk *et al*., 1997). Traditional medicine has proved effective in treating malaria, the second main cause of the high mortality rate in the country. *Rauvolfia caffra* Sond. and *Bridelia cathartica* Bertol. f. are traditionally used to treat headaches and pains in bone articulation associated with malaria. The leaves of *Bridelia cathartica* Bertol. f. and *Salacia kraussii* Harv. have shown some antimalarial activity in scientific investigations (Jurg *et al*., 1991; Figueiredo *et al*., 1998).

The whole *Ansellia gigantea* Reichb. plant is used in the treatment of asthma in southern Mozambique, and *Opuntia* spp. are largely used as expectorants against bronchitis and coughs (Fato, 1995). The bark of *Warburgia salutaris* (Bertol. f.) Chiov. is used against coughs and colds, *Momordica balsamina* L. for emesis associated with fever, and *Spirostachys africanus* Sond. against headaches.

Aloe spp., *Ansellia gigantea* Reichb., *Ceropegia ampliata* (E. Mey.), *Diospyros mespiliformis* Hochst ex A. DC., *Dalbergia melanoxylum* Guill. & Perr. and *Spirostachys africanus* Sond. are the most threatened medicinal plant species in the country (Bandeira *et al*., 1999; Fato, 1995; Diallo *et al*., 1999).

R&D Activities

Despite a long history of medicinal plant use in Mozambique, research in this field is still in its infancy and concentrated mostly in ethnobotanical work (Jansen and Mendes, 1990, 1991). Special focus is on the plants traditionally used in curing major disorders like diarrhoea, malaria, respiratory complaints and sexual diseases. The Office of Medicinal Plant Studies of the Ministry of Health and the Eduardo Mondlane University are gathering information on plant species used by local people to treat common diseases. Some phytochemical works on antimalarial plants and essential oils have been undertaken and published (Jurg *et al*., 1991; Figueiredo *et al*., 1998; Pagula *et al*., 2000). Future research in medicinal plants should cover species with antibacterial and molluscicidal activity (Ndamba *et al*., 1994; Oketch-Rabah and Dossaji, 1998; Eloff, 1999).

The main constraint in developing the traditional medicine sector is the reluctance of TMPs to disclose information on medicinal plant species and the methods used to prepare remedies. And there is a lack of planned research in the field of phy-

tochemistry, pharmacology and pharmacognosy.

Trade and Marketing

Mozambique, has a fairly large number of medicinal plants, but provides only a few species to the international market. On a domestic level, medicinal plants play a key role in primary health care, particularly in rural areas (Verzar and Petri, 1987; Jansen and Mendes, 1991). Medicinal plants are gathered from forests in small quantities by the rural communities and sold to traders at the main markets located in urban centres: Nampula, Beita, Quelimane and Maputo. High transportation costs result in low profits in medicinal plant trade. Informal trade takes place among neighbouring countries, mostly South Africa and Zimbabwe (Birgham *et al.*, 1996). In the southern part of the country, *Warburgia salutaris* (Bertol. f.) Chiov. and *Securidaca longipedunculata* Fres. are the medicinal plants most in demand (Halafo, 1996; Adamo *et al.,* 1997). Most of the medicinal plant material used in traditional medicine is traded on the urban market (Cunningham, 1997). The increased demand for raw material on the herbal market has resulted in over-exploitation of plant resources.

6.7 Namibia

The Republic of Namibia is a vast and sparsely populated country, situated along the south Atlantic coast of Africa and bordered by South Africa to the south, Angola and Zambia to the north and Botswana and Zimbabwe to the east. Its landscape varies from vast expanses of desert and sand dunes to rock formations in the south, contrasting starkly with the savannahs and woodlands of the central region and the lush and forested scenery of the northeast. The oldest desert in the world, the Namib Desert, stretches along the entire western coast of the country, while the Kalahari Desert runs along the southeastern border with Botswana.

The climate varies from arid and semi-arid to subtropical with the generally temperate desert coast sometimes offering fog-ridden days with temperatures between 5 and 20°C. The central, southern and coastal areas constitute some of the most arid landscapes south of the Sahara.

The sustainable use of natural products is an important but underdeveloped sector in Namibia. Medicinal plants are used by rural people to a large extent to fulfill their health-care needs and to provide income to local communities. In the Tsumkwe district in the Otjozondjupa region, for example, more than 80 plant species are used for treating about 30 ailments (Leger, 1998).

Devil's claw (*Harpagophytum procumbens* DC. ex Meiss. and *H. zeyheri* Decne.) is a significant biological resource, which has been exported from Namibia for several decades. *Harpagophytum procumbens* DC. ex Meiss. grows exclusively in the regions bordering the Kalahari Desert,

whereas *H. zeyheri* Decne. grows in the northern part of the country (Schmidt *et al.,* 1998). These plants are traditionally used in analgesic and anti-inflammatory remedies. In recent decades, there has been a growing international demand for the roots of *Harpagophytum procumbens* DC. ex Meiss. and *H. zeyheri* Decne. for antirheumatic use. The increased demand of pharmaceutical companies is mostly met from wild collections and a little from cultivation (Schmidt *et al*., 1998; Kuipers, 1997). This has resulted in reduction of plant population of *Harpagophytum procumbens* DC. ex Meiss. on its natural sites from 1,000 to 2,000 plants per hectare in the 1970s to less than 10 plants per hectare in 1986 (Cunningham, 1997).

Traditional Systems of Medicine

Traditional medicine is a popular health-care system in Namibia, which was legalized in 1990. The Namibia Eagle Traditional Healers Association was created as a result of major restructuring in 1990 and since then, the Ministry of Health and Social Services has been trying to integrate traditional medicine into the modern health-care system.

TMPs are the major health-care providers in the country. Their importance can be seen from their number, which ranges from 1 per 300 to 1,000 people in different regions of the country (Anonymous, 2000).

In 1996, the Namibian Traditional Medical Practitioners Board was established to facilitate the registration process of TMPs. The Ministry of Health and Social Services and the World Health Organization jointly conducted studies on scientific evaluation, standardization and regulation of traditional medicine practices in Namibia in 1997, which led to the development of the 1998 draft of the Traditional Healers Bill. The Bill established the Traditional Healers Council. The Council should oversee the registration and regulation of traditional medicine, supervise and control the practice of TMPs, foster research in traditional medicine and provide loans to TMPs (WHO, 1992).

TMPs in Namibia, who are mostly natives of other African countries, are not registered and are operating without guidelines from the Ministry of Health and Social Services. All TMPs, except traditional birth attendants, undergo one to three years of apprenticeship.

Trade and Marketing

The annual medicinal plant trade is worth about US$ 5.8 mn. Namibia is the biggest exporter of devil's claw (*Harpagophytum procumbents* DC. ex Meiss.) with over 90% of the trade, and the annual export value is US$ 0.95 mn (Raimondo, 2002; Cole, 2001). The export of dried roots of devil's claw from Namibia started in 1962. Since then, the annual export volume has risen rapidly from 28 tonnes in 1973, to 600 tonnes in 1998, 400 tonnes in 2000 and 700 tonnes in 2002 (Cole, 2001; Raimondo, 2002).

In 1998, the devil's claw trade earned foreign revenue of approximately US$ 1.6 mn (FAO, 1998). The main importers are France, Germany and South Africa and the demand in Spain, Switzerland and the UK is also increasing significantly.

Most devil's claw is harvested in communal areas, where an estimated 10,000 to 12,000 families depend on its trade for their livelihood. About 4 to 5 kg of fresh tubers yield one kg of dry material. The international price for dried devil's claw tubers was US$ 2.5 per kg in 2000. Over the past two decades, the international price has dropped by 85% in US$ terms.

6.8 South Africa

South Africa is located at the southernmost tip of the African continent and shares its border with Botswana, Mozambique, Namibia and Zimbabwe. It is classed as the third richest country in biodiversity in the world and the fifth economically richest region in Africa (DEAT, 1997). The country encompasses a range of vegetation types, from arid shrub land and semi-desert, through savannahs and woodlands, to coastal and alpine forests. Cape Floristic Province (with 45% of the region's plant species) and Succulent Karoo are the two internationally recognized hot spots for biodiversity in South Africa (Cowling and Hilton-Taylor, 1994).

South Africa has the potential to become a world leader in the development of medicinal products from indigenous plants. Demand for medicinal plants generally exceeds supply and thereby puts more pressure on the indigenous genetic resources of medicinal value.

Traditional Systems of Medicine

In South Africa, traditional medicine is a parallel system to western health care and rising in popularity. TMPs are deeply interwoven into the fabric of cultural and spiritual life in South Africa. They play a crucial role in providing health care to about 80% of the population (Clarke, 1998). The increasing importance of traditional medicine in the country can be seen from the number of TMPs, which has increased from 200,000 in the early 1990s to 350,000 in the late 1990s (Maliehe, 1993). The ratio of TMPs to population is 1 : 700 to 1 : 1,200 as compared to 1 : 17,400 for modern medical doctors. The cost of traditional medicine is reimbursable under health insurance plans.

In order to practise traditional medicine, TMPs from South Africa and a number of neighbouring countries are registered with the Traditional Healers' Organization (Hess, 1998; Ministry of Health, 1990).

Complementary medicines (dietary supplements, vitamins and herbal remedies) are regulated under the South African Medicines and Medical Devices Regulatory Authority, 1998.

The National Department of Agriculture, through the National Plant Genetic Resource Committee, governs traditional medicine in the country. Under the Reconstruction and Development Pro-

gramme, the National Department of Health formulates drug policy to promote the safe and effective use of quality essential traditional medicines, to document and scientifically validate traditional medicines, and educate and train TMPs.

Unregistered traditional healers practising traditional medicine are liable to be fined and/or imprisoned for up to one year. The National Department of Arts, Culture, Science and Technology provides funds for research in traditional medicines (Mayeng, 1999).

State Efforts in Development of Traditional Systems of Medicine

In 1998, the South African parliament decided to involve TMPs in achieving major goals in primary health care. In the same year, the parliament passed Act 132 of the South African Medicines and Medical Devices Regulatory Authority Bill, covering the registration and regulation of traditional medicines (Gray, 1998). Efforts are being made to introduce separate legislation to control herbal and traditional medicine. Registers have been opened for herbalists, Ayurvedic and Chinese medicines, and many others. South Africa allows the importation of traditional Ayurvedic and Chinese medicines. The National Reference Centre for Traditional Medicine was also established under the National Department of Health.

The Medical Research Council has opened a research centre for traditional healers in Delft, Cape Town to survey their craft and to test their remedies. It has also signed an agreement with the healers to ensure that traditional remedies remain affordable to the poor and do not get patented by multinational pharmaceutical companies.

In order to popularize medicinal and aromatic plants, the South African Post Office has issued postage stamps bearing South Africa's indigenous medicinal plants such as stalked bulbine (*Bulbine frutescens* (L.) Willd.), wild dagga (*Leonotis leonurus* Ait. f.), wild garlic (*Tulbaghia violacea* Harv.), pig's ear (*Cotyledon orbiculata* L.), wild ginger (*Siphonochilus aethiopicus* (Schweinf.) Bl. Birtt.), red paintbrush (*Scadoxus puniceus*), cancer bush (*Sutherlandia frutescens* (L.) R. Br.), African potato (*Hypoxis rooperii* Moore), bitter aloe (*Aloe ferox* (L.) Burm. f.) and sour fig (*Carpobrotus edulis* (L.) N. E. Br.).

Medicinal Plant Resources

Of the 68 vegetation types in South Africa, there are 22,000 species of vascular plants, of which 80% are endemic (DEAT, 1997; Low and Rebelo, 1996). Approximately 3,000 species are of medicinal value and are used by an estimated 200,000 indigenous TMPs (van Wyk *et al.,* 1997).

Most of the medicinal plant material is sourced from wild collection. Only a few medicinal plants are cultivated. The cultivated species include *Warburgia salutaris* (Bertol. f.) Chiov., *Siphonochilus aethiopicus* (Schweinf.) Bl. Birtt. and *Agathosma* spp.

The practice of over-harvesting and habitat destruction has endangered the existence of many medicinal and aromatic plants of high commercial importance. The endangered plants are *Siphonochilus aethiopicus* (Schweinf.) Bl. Birtt., *Warburgia salutaris* (Bertol. f.) Chiov., *Ledobouria hypoxidoides, Mystacidium millaria, Ocotea bullata* E. Mey. and *Aloe ferox* (L.) Burm. f.

Siphonochilus aethiopicus (Schweinf.) Bl. Birtt. is a slow growing plant with limited distribution and its demand exceeds supply. *Warburgia salutaris* (Bertol. f.) Chiov. is the most valuable traditional medicine. About 95% of the resource base of *Ocotea bullata* E. Mey. has been depleted for its bark. *Aloe ferox* (L.) Burm. f. is a species of international importance in the cosmetic and personal care products industry.

The unsustainable and intensive harvesting from wild stocks is a serious threat to the biodiversity of medicinal plants in South Africa and its neighbouring countries. There is a lack of significant resource base management, and plant production and economics of associated markets. The conditions at the markets are generally poor. The lack of storage facilities and trading infrastructures frequently results in spoiled raw material as well as wastage and deterioration of the products quality. There is no legislation regarding the registration and certification of traded products.

The processing and development of products is extremely limited. Value addition to the products and efforts to ensure standardization are scarce. The entire industry uses simple technology.

The scarcity of popular plants has led to their undersupply, with considerable increase in product prices, imports and use of substitutive plants. Furthermore, there has been an increase in the use of destructive harvesting techniques, which aim to maximize the harvest from declining plant stocks in order to maintain income levels.

R&D Activities

National Botanical Institute (NBI)

The National Botanical Institute was established in 1989–the result of merging the Botanical Research Institute and the National Botanic Gardens. The Institute is engaged in the exploration of the South African biodiversity for its sustainable utilization and conservation. The ethnobotany programme of the Institute includes natural products research on important Zulu medicinal plants. It also takes care of the conservation of over-exploited medicinal plants, their sustainable use and development, and the documentation of medicinal and economic uses of these plants. The National Medicinal Plants Database (MEDBASE), developed by the Institute, holds floristic, phytochemical and ethnopharmacological information on the 300 most important plants of South Africa.

Council for Scientific and Industrial Research (CSIR)

The Council for Scientific and Industrial Research is the largest community and

industry-oriented scientific organization. It was established in 1945 as a statutory scientific research council for R&D work. Currently it undertakes approximately 10% of all R&D activities and acts as a key source of information and technology solutions for South Africa and member countries of the Southern African Development Community.

South African Traditional Medicines Research Group (SATMeRG)

The South African Traditional Medicines Research Group was established in 1997 to promote the rational use of traditional medicine. It is a joint venture of the Division of Pharmacology of the University of Cape Town and the School of Pharmacy of the University of the Western Cape. The South African Medical Research Council funds the activities of the Group. The School of Pharmacy of the University of the Western Cape runs the Pharmacopoeia Monograph Project aimed at the development of monographs of medicinal plants used in traditional medicine. Two monographs on *Leonotis leonurus* and *Olea africana* herbs have been developed and published and 58 others are being developed. A project on antimalarial drugs from medicinal plants of southern Africa has been undertaken by a consortium consisting of the Medical Research Council, the universities of Cape Town, Pretoria and Western Cape, the National Botanical Institute, and the Council of Scientific and Industrial Research of South Africa. The project has been funded by the Department of Arts, Culture, Science and Technology of South Africa (DACST), which has recently been divided into the Department of Arts and Culture and the Department of Science and Technology.

Technology and Human Resources for Industry Programme (THRIP)

The Technology and Human Resources for Industry Programme strives to improve the competitiveness of South African industry by supporting scientific research, technology development and technology diffusion activities, and enhancing the quality and quantity of appropriately skilled people. It is managed collectively by the National Research Foundation (NRF) and the Department of Trade and Industry (DTI) of South Africa.

Traditional Medicine Programme (TRAMED)

The Traditional Medicine Programme was started in 1994 at the University of Cape Town, in collaboration with the University of Durban-Westville, the Kenya Medical Research Institute in Nairobi, Kenya, the WHO Collaborating Centre for Adverse Drug Event Monitoring in Uppsala, Sweden and the Royal Botanic Gardens, Kew, the UK. It aims at promoting cultural, health, environmental, scientific and socio-economic benefits from the development, conservation and sustainable use of east and southern African medicinal plants. The main activities of the

Programme include the development of an all-Africa network of traditional medicines, inventories of indigenous rural and tribal knowledge of traditional medicines, and articulation of national policy for the conservation, control, regulation and use of traditional medicine in South Africa.

The Department of Botany of the Rand Afrikaans University, Johannesburg, is working on the identification of South African plants of medicinal value. In association with South Africa Druggists Ltd., a privately owned company, the University is exploring African medicinal plants for the development of new products and the preparation of standards for quality, safety and efficacy of finished products. It is also developing agro-techniques for commercial cultivation of industrially important medicinal and aromatic plants (van Wyk *et al.*, 1997). The privately owned company, BioNatural, in collaboration with CSIR is carrying out scientific research on African medicinal plants. Moreover, in collaboration with Biochemical and Scientific Consultants and Biomox Pharmaceuticals companies, it is fostering R&D in African medicinal plants.

Trade and Marketing

Traditional medicine is a growing industry and forms the basic source of health care and livelihood. More than 700 plant species are actively traded for their medicinal uses throughout South Africa. Multimillion-dollar trade takes place between rural sources and urban markets (Maliehe, 1993). National annual demand registers 20,000 tonnes of medicinal plant material worth US$ 60 mn (Manders, 1998). Demand for medicinal plant material in indigenous medicines often exceeds supply.

There are estimated 27 mn consumers of indigenous medicine in the country. Each household spends between 4 to 6% of annual income on indigenous medicine and services. Massive demand is generated in terms of number and volume of plant material. Plant products are marketed either as self-medications or as prescription products. These products are traded in residential areas dominated by black consumers or at transport nodes in urban areas.

Durban is an important market in South Africa, which forms the hub of an active regional trade in indigenous medicine popularly known as *muthi* plants. One thousand and five hundred tonnes of traditional medicines are sold annually. The industry is worth about US$ 0.22 mn per year. There are approximately 1,500 TMPs and 14,000 people employed in the trade. Indigenous healers prescribe annually 4 mn products worth US$ 14.58 mn. The nine most popular medicinal plants sold at the Durban market are *Alepidea amatymbica* Eckl. & Zeyh., *Bowiea volubilis* Harv. ex Hook. f., *Curtisia dentata* C. A. Smith, *Eucomis autumnalis* (Mill.) Chitt., *Haworthia limifolia* Marloth, *Ocotea bullata* E. Mey., *Scilla natalensis* Planch., *Siphonochilus aethiopicus* (Schweinf.) Bl. Birtt., and *Warburgia salutaris* (Bertol. f.) Chiov.

At the Faraday market in Central Johannesburg, traders sell 400 tonnes of finished herbal medicines annually at a turnover of US$ 0.52 mn. Most of the plant material is harvested from KwaZulu Natal province and over 4,000 tonnes of medicinal plant material worth US$ 13 mn is traded annually. Out of a total of 1,000 species used for medicinal purposes in the area, more than 400 are traded at the urban markets in KwaZulu Natal (Kuipers, 1997). About 20,000 to 30,000 people derive their livelihood from medicinal plant trade. Most of the people involved are black rural women, the most marginalized sector in South African society. The medicinal plant industry therefore plays a critical role in empowering a large number of rural women. The plant collectors sell medicinal plant material to TMPs worth US$ 5.76 mn a year. In the province, the dispensed value of the medicine made from these plants is estimated at about US$ 48.02 mn a year. If these values were extrapolated to South Africa, the traditional medicine industry could be generating up to US$ 220 mn revenue. Apart from these large quantities of plants, extracts are also sold in an informal way.

The underground parts (roots, tubers, rhizomes and bulbs) are the dominant medicinal plant material sold at the markets. African potato (*Hypoxis* spp.), wild ginger (*Siphonochilus aethiopicus* (Schweinf.) Bl. Birtt.), cape bush willow (*Sutherlandia frutecens*) and devil's claw (*Harpagophytum procumbens* DC. ex Meiss.) have aroused the interest of pharmaceutical companies for their medicinal value.

Although short supply has not alarmingly raised the prices, the country's 400 medicinal plants are in danger unless cultivation is encouraged. The shortage of domestic supply has encouraged imports from neighbouring countries, particularly from Mozambique. The drugs prepared from medicinal plants are sold directly to the patient by the traditional healers, but are also available at the muthi shops or at open-air muthi markets.

Pharma Natura, Bioforce International and Natura Homoeopathic Company are the three main South African companies involved in the herbal product business. The South African subsidiary of Solgar, USA markets about 140 dietary supplements, vitamins and herbal remedies in South Africa out of 530 different products that it manufactures.

Aloe ferox (L.) Burm. f., *Agathosma* spp., *Harpagophytum procumbens* DC. ex Meiss., *Pelargonium sidoides* DC., *Xysmalobium undulatum* R. Br., *Glycyrrhiza* spp., *Origanum* spp., *Salvia* spp., *Euphorbia resinifera* Berg. and *Siphonochilus aethiopicus* (Schweinf.) Bl. Birtt. are the medicinal plants in the international trade. Quantities of *Swartzia madagascariensis* Desv. are exported mainly to Lesotho (Lange, 1997; Cunningham, 1993). South Africa also imports raw material from neighbouring countries as a result of depletion of its own natural resources.

South Africa is one of the tea pro-

ducing countries of the world and about half of the domestic demand is met from its own production. Annual tea production is up to 4 tonnes per hectare, compared to the famous Darjeeling tea, which produces a quarter of this yield. South African tea has lower levels of aroma and flavour and is therefore ideal for ice-tea making.

6.9 Swaziland

Swaziland is a small, land-locked country bordered by South Africa and Mozambique. The country surprisingly supports a wide range of ecological zones, from savannah scrublands in the east to rain forests in the northwest. Hardwood forests dominate the western highlands.

Traditional medicine is the dominant system of health care. The ratio of TMPs to total population is 1 : 110, in comparison to 1 : 10,000 for modern medical doctors (Cunningham, 1993). The practice of traditional medicine in the country is regulated by the Natural Therapeutic Practitioners Regulations of 1978 (Ministry of Health, Swaziland, 1978) and TMPs are integrated with the primary health-care programme of the country (WHO, 1992). However, there is no official training or programme in traditional medicine (WHO, 1992).

The Ministry of Agriculture and Cooperatives has carried out studies on medicinal properties of indigenous tree species within the National Forest Research Plan (1993-2002). The Swaziland National Trust Commission, in collaboration with the Swaziland Genetic Resources Centre at the Malkerns Research Station, has undertaken studies on *in-situ* conservation of *Hypoxis rooperi* Moore, a plant used for HIV/AIDS (Dlamini, 1999). A nursery of medicinal plants has been established in the Hhohho region in the Nkomati River valley. The important medicinal plant species in the nursery are *Euphorbia ingens* E. Mey., *Callilepis leptophorbia, Ficus thonningii* Bl. and *Phoenix reclinata* Jacq.

Medicinal plants of commercial importance are *Warburgia salutaris* (Bertol. f.) Chiov., *Alepidea amatymbica* Eckl. & Zeyh. and *Siphonochilus aethiopicus* (Schweinf.) Bl. Birtt. *Warburgia salutaris* (Bertol. f.) Chiov. is exported to South Africa and Mozambique (Cunningham, 1993 and 1997). *Hypoxis rooperi* Moore (African potato), which is used locally for the treatment of HIV/AIDS, is smuggled to South Africa. Wild ginger (*Siphonochilus aethiopicus* (Schweinf.) Bl. Birtt.) is much in demand in Europe.

6.10 Zambia

Zambia borders with Angola to the west, Congo to northwest, Tanzania to the northeast, Malawi to the east and Botswana, Mozambique, Namibia and Zimbabwe to the south. Most of the country is covered by moist savannah woodland where broadleaf deciduous trees grow far enough apart to allow grasses or other plants of medicinal value to grow on the woodland floor.

The inability to afford and access

modern health facilities has strengthened the utilization of medicinal plants. Traditional medicines are used and accepted by about 70% of the population, regardless of ethnic, religious or social background. Traditional medicine is widely practised in urban centres (Cunningham, 1997). Practice is recognized and supported by the Traditional Healers Practitioners Association, founded in 1978. The Association has more than 35,000 registered members (Mudondo, 2000). It controls the practice of traditional medicine. Traditional medicines are not integrated with mainstream medicines or the national health-care system. However, the Traditional Birth Attendants and the Community Health Care Workers practise at the level of primary health care. The National Drug Policy has a chapter on traditional medicines, which discusses the *materia medica* but not the practice of traditional medicines (Mudondo, 2000).

TMPs provide health care to economically weak, rural, poor and urban populations. In 2001, Zambia had about 900 modern medical doctors and a very large number of traditional healers (40,000) for a population of 10 mn. As a result, most of the Zambian population rely upon TMPs for their health care (Nswana, 1996). About 60% of registered traditional healers are women. An estimated 20 to 25% of the population is HIV positive. Traditional healers are part of the Technical Committee on Natural Remedies for HIV and Other Related Diseases and are under the direct control of the Head of State (Naur, 2001). There is no formal training in traditional medicine at the medical institutes and traditional medicine is not covered by insurance.

Medicinal Plant Resources

Zambia has about 6,000 species of vascular plants many of which have found common and widespread use in rural and urban centres for their medicinal values (IPGRI, 2002). About 78 medicinal plant species have been identified in the Central Copperbelt and Luapula provinces, with common use in traditional systems of medicine. The root and bark are plant parts in demand for the preparation of traditional remedies. As a consequence of deforestation and population growth, many valuable medicinal plant species are collected from very distant places (Nswana, 1996).

Trade and Marketing

In Zambia, annual trade in traditional medicine is worth over US$ 43 mn (Nswana, 1996). Trade generally takes place within and between neighbouring countries. *Pterocarpus angolensis* DC. is used by TMPs and is also exported. Its supply to traditional healers is affected by competing uses such as timber logging (Cunningham, 1997). Other locally used medicinal plants are *Eulophia petersiana* and *Selaginella imbricata* (Forssk.) Spring ex Decne. (Cunningham, 1993).

Zambia has vast potential to develop its production of essential oils. SDK Essential Oils Company, based at Kitwe, pro-

duces lemon grass, eucalyptus, geranium and pine oils. The company has also developed herbal balm with proved efficacy in the treatment of skin diseases such as herpes zoster and kaposis sarcoma. There are many other companies involved in essential oil production in Zambia. In 1997, the Traditional Healers and Practitioners Association (THPAZ) signed a five-year contract with an American company to assist research in traditional medicine and herbs under the auspices of the United States Agency for International Development (USAID).

6.11 Zimbabwe

Zimbabwe is located between South Africa and Zambia. Its 11,3 mn population registers the highest number of HIV/AIDS cases. The deterioration of the public health-care system and the escalating cost of drugs mean people rely on TMPs. Around 10% of the country's flora is utilized in the preparation of traditional remedies (Birgham *et al.,* 1996).

Traditional Systems of Medicine

Traditional medicine has been integrated into the national health-care system. The Zimbabwe National Traditional Healers Association (ZINATHA) acts within the framework of the TMPs Council Act of 1981. The Association is responsible for promoting research, developing knowledge of traditional medical practice and granting loans to associations or persons. It also supervises the practice of traditional medicine to prevent abuse or quackery, and cooperates with the Ministry of Health to establish better working relations between traditional and medical practitioners (Cavender, 1988; Ushewokunze, 1984; Chavundka, 1986).

In 1994, there were 24,000 TMPs in Zimbabwe that increased to over 55,000 in 2000 (Amooti-Kyomya, 1994; Matondo, 2000). In 1981, the Natural Therapists Act and the TMPs Council Act were enacted to regulate the practice of traditional medicine (Ministry of Health, 1982, 1982a).

TMPs are registered with the TMPs Council under the responsibility of the Ministry of Health. Only registered TMPs are entitled to practise traditional medicine. The practice of an unregistered TMP is an offence and punishable by up to two years imprisonment and/or a fine. The Council has the authority to cancel or suspend the registration of TMP if found guilty of improper or disgraceful conduct.

Medicinal Plant Resources

Zimbabwe has more than 500 plant species of medicinal value. The Zimbabwe National Traditional Healers Association (ZINATHA) deals with the production of herbal medicinal products and, apart from fulfilling domestic demand, it exports to the European Union. Zimbabwe has the capacity to give a meaningful contribution to the fight against HIV/AIDS and to come up with local solutions through research, evaluation and development of promising

traditional remedies.

The practice of over-harvesting, deforestation and the lack of appropriate propagation techniques of commercially used medicinal plants has hampered their sustainable use. The 70,000 hectares of woodland cleared for agricultural purposes during the last few decades have adversely affected medicinal plant diversity.

R&D Activities

The Traditional Medicinal Plant Research and Development Trust of the state-owned Blair Research Institute carries out bio-medical and clinical trials on promising local natural herbal therapies for HIV/AIDS and other diseases. The Trust also undertakes activities of protection, preservation and developing of indigenous medicinal knowledge and know-how for present and future generations.

There is, unfortunately, a non-conducive legal and policy environment, inadequate scientific information on medicinal plants, and a lack of formal links between traditional medicine and biodiversity.

Trade and Marketing

One of the most important medicinal plants of Zimbabwe is *Warburgia salutaris* (Bertol. f.) Chiov., which has become both expensive and endangered due to high demand and limited distribution (Cunningham, 1997). Other medicinal plants with limited distribution in the eastern highlands are *Spirostachys africanus* Sond., *Erythrophleum suaveolens* (Guil & Perrot) Brenan and *Phyllanthus engleri* Pax (Cunningham, 1993).

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