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FACT FINDING AND PREPARATORY ASSISTANCE TO ACCESS  
THE POTENTIAL FOR THE INDUSTRIAL UTILIZATION  
OF MEDICINAL AND AROMATIC PLANTS

SIERRA LEONE

Technical report: Preparatory assistance mission\*

Prepared for the Government of Sierra Leone  
by the United Nations Industrial Development Organization,

Based on the work of K. H. C. Baser, pharmacist/team leader,  
and C. A. Mac Foy, botanist/plant biochemist

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\* This document has not been edited.

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### ABSTRACT

The objective of this fact-finding and preparatory assistance mission was to assess the potential of medicinal and aromatic plants of Sierra Leone for industrial utilization. The consultants were asked to assess the following: existing potential; the cultivation and post-harvest treatment practices; the current production of herbal pharmaceuticals and essential oils; rehabilitation of any existing phytochemical factories; institutional infrastructure; research capacity and capability; market potential and economic viability of industrial production of medicinal and aromatic plant products. The consultants were also asked to look into the possibilities of establishing small scale production units for essential oils and herbal preparations in rural areas, and to recommend on the mechanism and the modalities of a technical assistance project for the establishment of a processing plant and a R&D laboratory, and if feasible, small scale production units in rural areas.

Sierra Leone is a least developed country with one of the lowest Human Development Index in the World. The country supports 4.3 million people of which over 70% are engaged in agriculture. Industrial base in the country is very weak with the manufacturing sector contributing only 5% to the GDP.

Although the country is blessed with rich natural resources, there is at present no industry processing medicinal and aromatic plants in Sierra Leone. There is also not any degree of cultivation or collection from wild sources and export of such products.

Having visited 25 institutions and assessed the current situation in the country, the mission came to the conclusion that there is a potential in developing plant-based industries in Sierra Leone and that a steam distillation facility should be established at a rural district, Newton, which is within easy reach of Freetown for the production of essential oils from two aromatic plants to be cultivated in the area, and a quality control and research laboratory at the Chemistry Department of the Fourah Bay College of the University of Sierra Leone in Freetown for the analysis of the oils produced and also for research into aromatic plants of Sierra Leone to discover potential new sources of essential oils.

## 1. GENERAL INTRODUCTION

### 1.1 Objectives of the Fact-finding Mission

The objective of the fact-finding and preparatory assistance mission as stated in the job descriptions of the UNIDO consultants Chemical Technologist/Team Leader and Botanist are given in Annexes 1 & 2.

The programme concerning places and institutions to visit was drawn up by the host institution, the Department of Trade, Industry and State Enterprises in Freetown. Extra visits were programmed as requested by the mission to industries and rural areas.

Duration of the mission was four weeks which included three weeks in Sierra Leone. The Botanist member of the mission accompanied the Team Leader only during the first week of his stay, having spent one more week earlier before the arrival of the Team Leader in Freetown. The team leader was briefed in Vienna from 28 May to 1 June 1993. The mission was from 2-28 June 1993.

### 1.2 Brief Information on Sierra Leone

Sierra Leone is a West African state covering a geographic area of 72,300 sq.km (Annex 3) supporting a population of 4.3 million (1991 estimate). The population growth rate is 2.5% with a density of 58 persons per sq.km. Life expectancy at birth is 42 years and adult literacy rate is 13%. Children between 0 to 14 years of age constitute 41% of the population. Infant mortality rate is 20%. 70% of the workforce is in the agricultural sector. 68% of the population live in rural areas.

Agriculture accounts for 40% of gross domestic product (GDP) and 40% of export earnings. Industry contributes about 5% to the GDP. GNP in 1990 was \$964 million. GNP per capita was \$250 in 1991. the Breakdown of GNP- 44% (for agriculture), 19% (for industry), 37% (for services) and 0.5% for defence. According to Human Development Report of UNDP of 1993 Sierra Leone ranks second from the last in quality of life in the world (among 173 countries). 65% of the population is estimated to live in absolute poverty.

Principal exports include diamond, gold, bauxite, rutile, cocoa, coffee, palm kernel, piassava and ginger. Principal export markets are EC, USA and ECOWAS countries. Coffee and cocoa account for 90% of agricultural export earnings. Total export earnings in 1988-89 was \$79 million FOB as against total imports of \$134 million CIF in the same period. The total external debt for 1989 was \$1,057 million with the debt service payments of only \$4 million. The inflation rate is high (80.8% in 1992). The exchange rate for Leone (Le) to US\$ in June 1993 was 1US\$=560 Le.

83.9% of the land in Sierra Leone consists of uplands and 16.1% of lowlands. The land suitable for crop cultivation is estimated at 5.36 million hectares (74.2% of the total) of which 4.2 million ha are uplands of relatively low soil fertility and 1.6 million ha are more fertile swamps with considerable potential for increased cultivation under proper management. The

country is well watered with a mean precipitation of 3000 mm per annum. However, due to lack of water storage and conservation programmes, irrigated farming is non-existent.

8% of the country's arable land is cultivated. 10 forest and woodland types cover 80% of the land area (6,305,800 ha), major type being forest regrowth (3,774,400 ha). 80% of the population live close to forest or forest regrowth. In addition to fuelwood they rely on this forest type for food, building materials, medicines and many items of daily use.

Administratively the country is divided into 4 sectors: the Western area (which contains the capital Freetown) and 3 provinces (Northern, Southern and Eastern). The three provinces are divided into 12 districts and thence into 149 chiefdoms.

According to 1988-90 figures, access to safe water and sanitation is 43% (each). There are 112 hospitals, 1034 hospital beds, 262 physicians, 30 dentists, 8 pharmacists (faculty graduated) and 1758 nurses in Sierra Leone.

The country is governed by a military government consisting of young army officers who assumed power after a coup d'etat in April 1992. The National Provisional Ruling Council (NPRC) has managed a slow but steady improvement in the economy. The new government's enthusiasm seems to be voluntarily shared by youth groups who undertake a variety of local development projects.

The international financial community appears to be regaining confidence. The world Bank has released the frozen funds, and the African Development Bank is also providing a structural adjustment package.

### 1.3 Medicinal and Aromatic Plants of Sierra Leone

There is a wide diversity of plants in Sierra Leone with multifarious medicinal, aromatic and other useful properties. Although many of these plant species have been identified, not enough work has been accomplished to date in disseminating information about their uses, chemistry or even availability as raw material for the manufacture of drugs, pesticides and other products.

There is no statistics available on the percentage of drugs with medicinal and aromatic plant parts as ingredient in them in Sierra Leone. Drugs of plant origin currently in the market include pure compounds from higher plants such as codeine, quinine, caffeine, atropine, digoxin, digitoxin, extracts such as castor oil, senna, ginseng, etc.

In Sierra Leone, more than 1000 plant species are estimated to be used for their medicinal or aromatic properties in various parts of the country. A list of possible plants for industrial development are given in Annex 4.

It is believed that more than 70 percent of the population utilize traditional medical practices which include the following: (1) Herbalists including bone setters and traditional birth attendants who utilize mainly

plant materials in their treatment, (2) Diviners who use prayers and mysticism, (3) A combination of both (1) and (2). Others combine both traditional medicine and western allopathic medicine simultaneously or consecutively depending on the illness. Usually a small fee is paid for the services rendered but of late a lot of commercialization is taking place and fees are gradually escalating. Practicing herbalist has to be registered with the City Council and be issued with a licence, but many do practice without such official mandates.

In the book "Medicinal Plants of Sierra Leone" by C. Mac Foy (1983) 120 plant species used in Pujehun district and Gloucester village, respectively, are listed according to the ailments or diseases cured and also in alphabetical order, by family, with their local and botanical names, plant location and methods of preparation of the drugs.

Recently a booklet has been published by DVV/SLADEA titled "Some Medicinal Plant Recipes of the Mende, Sierra Leone" by G. Barnish and S.K. Samai (1992) contains 145 medicinal plants listed by the diseases they cure.

These general surveys and other unpublished ones in dissertation form for other parts of the country such as Hastings, Kenema and Kono show that a large variety of illnesses present in Sierra Leone are treated by drinking plant extracts (maceration, infusion, decoction, etc ) or bathing with extracts, as enema, liniment or cupping. The level of technology is very low with poor hygienic and preservative practices being utilized.

Other investigations include research on the structure elucidation of chemical compounds in various Sierra Leonian plants as well as biological activity screening in the Chemistry and Botany Departments of Fourah Bay College.



## 2. INSTITUTIONS VISITED

### 2.1 The Department of Trade, Industry and State Enterprises

The mission visited Sierra Leone upon request of this Ministry. The Minister, Dr.A.Abraham as well as his Permanent Secretary and other ministry officials were contacted. The Minister expressed his Ministry's concern in developing industries utilizing locally available raw materials. The mission pointed out the fact that the country appeared to be rich in medicinal and aromatic plant resources and the mandate of the mission was to look into the possibilities of generating small or medium scale industries utilizing these resources for the production of extracts and essential oils. It was also emphasized that the cultivation of potential plants should not be overlooked since sustainable resources to support such industries could only be obtained through cultivation. It was also made clear to the mission that although experienced man-power was available, no stainless steel working capacity existed in Sierra Leone. The National Workshop which was said to have design engineering expertise as well as machine tools for manufacturing equipment would soon be closed down due to poor management.

A Ministry official, Mr.J.Jalloh, a design engineer who previously worked at the National Workshop told the mission that in 1986, he had designed and constructed a 25 liter capacity glass water distillation still with steel coil-condenser and glass receiver upon request of a UNIDO consultant, Mr.M.D.I.Gioiovassi, then working for a Palm Oil Sector Study in Southern Province. Experimental trials were carried out at the National Workshop and 1.5 tonnes of lemongrass were reportedly distilled. The results were said to be promising. No further information on the subject matter could be obtained.

### 2.2 The Department of Finance, Development and Economic Planning

The Ministry is responsible for formal relations of the Sierra Leone Government with UNDP. The mission met the Deputy Development Secretary and his experts at a meeting. The objectives of the mission were explained. The Secretary expressed his Department's interest in developing yet untapped resources of the country through introduction of new or appropriate technologies. The mission elaborated that through initiating a small scale essential oil industry at rural level, job opportunities would be created and women would be employed helping in integrated rural development as well as poverty alleviation programmes of the government. The Ministry officials showed concern and expressed the need to sensitize the public as well as private entrepreneurs to invest in the field of processing medicinal and aromatic plants through organization of a workshop.

### 2.3 The Department of Health and Social Services

At the Department of Health and Social Services, the mission met with the Secretary of State for Health and Social Services Lt.Col.Dr.Akim Gibril, Permanent Secretary for Health Mr. A.K.Kamara and Head of Planning, Management

Information and Statistics Unit (PMISU) Dr.C.M.Kamara. The Ministry wishes to implement an explicit health plan with well defined priorities such as human resources development, decentralization of the health care system, and solving the severe infrastructure problems.

It was made clear to the mission that the Ministry had no immediate plan to incorporate traditional medicine in the National Health Policy which is being formulated, rather the orthodox medicine system would be strengthened since the majority of the people of Sierra Leone was in need of primary health care. Under 5 mortality rate in Sierra Leone is 26.1% and according to a 1991 Health Sector Review 37% of the population has no access to basic health services.

#### 2.4 Pharmacy Board

The Pharmacy Board was established according to Pharmacy and Drug Act (1988). The Board consists of the following members: (1) The Chief Pharmacist (Chairman), (2) A legal practitioner appointed by the Attorney-General and the Minister of Justice, (3) A medical practitioner appointed by the Minister on the nomination of the Chief Medical Officer, (4) A medical practitioner approved by the Minister on the nomination of the Medical and Dental Association of Sierra Leone, (5) Three pharmacists nominated by the Pharmaceutical Society of Sierra Leone and approved by the Minister, (6) One dispensing technician appointed by the Minister, (7) The secretary of the Pharmaceutical Society of Sierra Leone, (8) The Dean of the Faculty of Pharmacy.

According to the Registrar of the Pharmacy Board, there are 195 pharmacists in Sierra Leone. Of these, only 20 are university-educated pharmacists. The rest are upgraded dispensing technicians. There are more than 200 dispensing technicians who are also allowed to practice pharmacy. The dispensing technicians used to get a three-year course at the Dispensing School of Connaught Hospital in Freetown. One year course would suffice for those who had completed a 3-year male nursing course. The school has stopped teaching five years ago. The Act recognizes both the pharmacists and the dispensing technicians.

Two years ago, the Faculty of Pharmacy was established at the College of Medicine and Allied Health Sciences of the University of Sierra Leone, however is suffering from the lack of students. There are 5 students in the 1st year and 1 student in the 2nd year course. The pharmacy course is for 4 years and 1 term for practical training. The Faculty has 4 academic staff and lacks adequate teaching and laboratory facilities.

Except for six manufactured in Sierra Leone, all the bulk and finished drugs are imported. Many drugs are smuggled from neighbouring countries and many "fake drugs" are circulating in the market. There is a big black market in drugs. Although the sale of drugs outside health institutions, pharmacies and drugstores is illegal, a study has shown that 30% of the people with health problems obtained their drugs through drug pedlars. They operate on streets and offer drugs at lower prices than pharmacies. They are the main

outlets of fake drugs. According to the Health Sector Review of 1993, in rural areas about 50% of the illness episodes are treated by non-medical methods-traditional healers, drug pedlars and herbalists.

## 2.5 Central Medical Stores

Central Medical Stores (Government Medical Stores) is charged with the purchase, storage and supply of drugs and medical equipment to government institutions, such as hospitals, periferal health units (PHU), pharmacies, etc. All the drugs and equipment are imported by UNICEF through reimbursable procurement arrangement from UNIPAC in Denmark. There is a cost recovery of upto 80% for drugs dispensed in hospitals and PHUs upon prescription. 45 drugs in the essential drugs list and 155 drugs in the specialized list are regularly imported. A procurement committee under the Chief Pharmacist scrutinizes the request and forwards it to importing organization. When drug is imported it is handed over to Central Medical Stores for storage and distribution. This way reliable, high-quality drugs are imported. According to the Chief Pharmacist, the total purchase of drugs last year amounted to roughly US\$ 250.000. In his estimation, the country's overall requirement is five times more, and this is largely supplied by private pharmacies.

The number of drugs circulating in the country is not known, however the Chief Pharmacist's office has started keeping a record of all imports of drugs since the beginning of 1993.

Importation by the private sector is done by private importers who has to obtain a wholesaler licence from the Pharmacy Board before importing any drug. The conditions to get a licence are to have a licenced pharmacist and a dispensing technician in his staff and a warehouse. For importing drugs prior permission is not required, however when the drug comes to the customs, upon submission of necessary documents indicating quantity, proprietary name, composition, batch number and manufacturer, the Pharmacy Board sends an inspection team along. According to the team's report an import licence is issued or the lot is rejected. This licence is only valid for wholesale. For retail sale, a retail licence is required and it can also be obtained from the Pharmacy Board.

At present, there is no quality control facility for drugs in the country, therefore samples of imported materia\_s taken at customs are sent abroad for analysis or visual and organoleptical assessment is carried out. The Registrar of the Pharmacy Board indicated an urgent need to train drug inspectors; to acquire computers for record keeping; to establish a drug control laboratory which could also be used for the analysis of drugs of abuse, since the Pharmacy Board cooperates with the Police on drug abuse.

## 2.6 The University of Sierra Leone

The only University in the Country, the University of Sierra Leone, consists of three constituent colleges, that is Fourah Bay College, Njala University College and the College of Medicine and Allied Health Sciences, together with a number of institutes.

### 2.6.1 Fourah Bay College

#### 2.6.1.1 Botany Department

This department is a constituent of the Faculty of Pure and Applied Sciences and offers various botanical courses to undergraduates in the Faculty. There are 6 senior teaching staff and three research assistants in the department. A new course was initiated in the department in 1991-92 entitled "Economic Botany" which includes aspects of medicinal and aromatic plants. A Herbarium containing 12,000 mounted specimens of plants in the flora of Sierra Leone together with a botanical garden are attached to the department. Land is available for small scale field experiments for teaching purposes. Research interests of relevance to this mission include survey of medicinal plant habitat in relation to plant diversity, and bacteriostatic properties of some plants.

The Botany Department also collaborates with the Medical College and two of its staff members also lecture in the Faculty of Pharmacy teaching botany and biochemistry aspects in the pharmacognosy course.

#### 2.6.1.2 Chemistry Department

The Chemistry Department also in the Faculty of Pure and Applied Sciences has undertaken research in medicinal plants since 1960s. There is presently 10 senior teaching staff and one research assistant. Most research of relevance to this mission has concentrated on the extraction of secondary metabolites, purification and structure elucidation in collaboration with institutions outside Sierra Leone. Plants investigated to date include *Cymbopogon*, *Anthocleista*, *Habropetalum*, *Xylopi*a, *Cyanometra*, *Landolphia*, *Cassia*, *Lantana*, *Hyptis*, *Mellitia* and *Phyllanthus* species. Some amount of biological activity studies have also been undertaken usually in collaboration with the Botany and Zoology Departments. These include insect repellent and antifungal activities. Funding has been mainly from the IFS, NIH and the University.

In recent years, progress in the department has been slow, and in general, morale is low ostensibly due to lack of funds, poor facilities including basic ones such as water and electricity. The research facilities in the department include chromatographic equipment such as TLC outfit, flash chromatography, chromatotron and GLC (packed columns, FID and ECD detectors); spectroscopic equipment such as UV-VIS and IR are both out of order. The other equipment include rotary evaporators (2 pcs), freeze-dryer (out of order), Soxhlet apparatus, muffle furnace, basic laboratory glass ware, etc.

At the Chemistry Department, the mission met an enterprising scientist. Dr.M.E.S. Koker's name had previously been communicated to the mission by several people both in ministries as well as private organizations as the person who is interested in developing a plant-based industry in Sierra Leone. He is a chemist with Ph.D. degree and a long history of research background in U.S.A., U.K. and Belgium in the field of medicinal plants. Apart from his lecturing responsibilities in the Department of Chemistry, he owns a company titled LUBA Pharmaceuticals Ltd. He plans to produce plant-based medicines utilizing the indigenous medicinal plants of Sierra Leone. His initiative seems to be supported by the Ministries of Trade, Industry and State Enterprises; Health and Social Services, and Finance, Development and Economic Planning. He has been leased a 10 ha land by the Ministry of Lands, Housing and the Environment for the next 21 years to construct a laboratory and to grow medicinal plants.

The Ministry of Trade, Industry and State Enterprises requested UNIDO to provide technical assistance to his project titled "Establishment of a Pharmaceutical Industry based on Biological Components from Local Plants, Herbs and Trees by Luba Pharmaceuticals Ltd" in 1991. The project intends to establish research laboratories, administrative offices, storage buildings, processing plants, nurseries for plants, animal testing facilities, recreational facilities, etc. The UNIDO inputs requested are (1) an expert for formulation and manufacturing of drugs from indigenous plants, (2) experts (number not specified) to look into the possibility of upgrading local drugs produced by traditional methods, (3) a biologist or chemist to prepare an inventory of the most promising medicinal and aromatic plants of Sierra Leone, (4) an expert in the production of pharmaceutical dosage forms and marketing; (5) provision of suitable equipment for manufacturing plant-based pharmaceuticals. National inputs by Luba Pharmaceuticals are identified as provision of counterpart staff, basis premises for research and training facilities and suitable accommodation for international experts. The total project cost was estimated to be US\$20 million.

According to the documents provided to the mission by Dr.Koker, project duration is not specified and it appears to start from basic research involving a survey to identify the potential medicinal plants of Sierra Leone to the establishment of a private research institute and other facilities. No plant name is given in the project document. The lack of clearly defined objectives and outputs renders the project unacceptable and unworkable. It, at this state, can only be defined as a very broad project concept. The mission explained the difficulties for its acceptance by UNIDO or any other donor organization to Dr.Koker.

## **2.6.2 The College of Medicine and Allied Health Sciences**

### **2.6.2.1 The Faculty of Pharmaceutical Sciences**

The College of Medicine and Allied Health Sciences (COMAHS) is a fairly new constituent college of the University, and the Faculty of Pharmaceutical Sciences was established only two years ago. The Faculty consists of the Departments of Pharmacognosy, Pharmaceutical Chemistry, Pharmaceutics and Clinical Pharmacology with a teaching staff of four. There are only 6 students of the Faculty which lack adequate teaching and research facilities.

## 2.7 Mano River Union

The Mano River Union (MRU) is basically an economic union between the three neighbouring countries of Sierra Leone, Guinea and Liberia. The Mission visited the Mano River Union headquarters in Freetown and had audience with the Secretary-General and three other senior officials.

Mano River Union has produced an outline proposal for studies leading to the identification, classification and assessment of the commercial potential of medicinal plants in the Mano River Union states. This proposal was prepared as an outcome of the Union's Ministerial Council 14th Ordinary Session in January 1990, mandating the Secretariat to seek external assistance for the execution of feasibility studies involving the collection, classification and the assessment of the commercial viability of therapeutic herbs currently available in the MRU states. The proposed study would focus on the following issues:

- (i) Ethnobotanical studies involving the collection, identification and classification of samples from the member states.
- (ii) Assessment of the status of ongoing research projects in the Member States relating to the identification and classification of medicinal herbs.
- (iii) Assessment of the commercial viability of identified herbs.
- (iv) Scientific testing of the medicinal properties of selected herbs based on phytochemistry and pharmacognosy studies
- (v) Elaboration of subregional approach to the development and commercial exploitation of selected medicinal herbs.

Mano River Union places a lot of interest in agroforestry, especially for the cultivation of trees with medicinal value so that during logging operations branches, leaves, fruits, seeds, barks, etc. can be collected for eventual use as drugs or as raw materials for industrial operations.

The mission was informed that the German Government showed interest in this proposal.

## 2.8 German Adult Education Association (DVV)

DVV, now transformed into Sierra Leone Partners in Adult Education Coordinating Office (PADECO) since 1991, is a NGO operating in Sierra Leone since 1982. Its main objective is adult education especially in rural areas and offers professional services as well as financial inputs (seed money).

One of their projects related to the mission has been the recent publication of a book on some medicinal plant recipes of the Mende, Sierra Leone. Another project concerns the distribution of neem tree (*Azadirachta indica*) seeds imported from Ghana to women's groups for planting in rural areas. For each seed germinated the planter gets a bonus. So far 50 kg of seeds have been distributed to groups in various parts of the country. The cultivation of this tree is promoted mainly for its fuel value as a firewood

as well as its multipurpose uses such as provider of shade, medicinal properties of the leaves, oil from the seeds as a natural insecticide, and for the production of soap, toothpaste and hair oil, etc. These projects are implemented by Sierra Leone Adult Education Association (SLADEA)

#### 2.9 Lachman Pharmaceuticals Ltd.

Formerly Sterling Products, Lachman Pharmaceuticals Ltd is a private pharmaceutical company, the only pharmaceuticals manufacturer in the country. The company produces six pharmaceutical items using imported bulk drugs, excipients and packing materials. The staff strength of the company is 35 including a managing director, a production manager (pharmacist), and engineer and a quality control manager (chemist). Five different analgesics i.e. Cafenol, Panadol, B+S-500, Acetytol and Stopache; an antimalarial, Chloroquine phosphate (Aralen), all in tablet form, and a round worm expeller in powder form (Worom) are produced. Plans are under way to launch a new tablet containing chloroquine phosphate and paracetamol. The factory has tableting, powder mixing and packaging machinery. A small quality control laboratory ensures that the requisite standards are maintained by analysing raw materials and finished products. Both titrimetric and UV-spectrometric methods are used. Tablet disintegration and hardness tests are also carried out.

The Managing Director expressed concern at the present situation in which he is forced to compete with substandard medicines imported into the country, sometimes with the same or similar names as his products. He also expressed dissatisfaction about the lack of government policies to protect the local pharmaceutical industry. He welcomed the missions objectives and indicated his desire to formulate any locally produced standardized extract and essential oil into pharmaceutical formulations. He also informed the mission that he would soon start marketing imported senna leaves as laxative tea.

#### 2.10 Chanrai Chemicals Ltd

Chanrai Chemicals is a part of the Kewalram Chanrai Group currently operating in 16 countries around the globe. The company in Sierra Leone was established over a century ago. It operates in a 6.3 acre manufacturing complex to produce laundry soaps, medicated soaps, toilet soaps and soap powders. Annual production volume is 4000 tonnes of which 1/2 is exported mainly to neighbouring countries. The company imports all raw materials. Saponification and compressing is done at the premises. Annual demand of 16 tonnes of essential oils used as fragrance is also obtained by import from Europe. The company manager expressed his company's interest to use locally produced essential oils if they are made available.

### 2.11 Shankerdas Ltd.

A local company in Freetown, Shankerdas produces vaseline, ointments, plastics, wines, gin, rum and brandy products. The company presently produces unscented vaseline, although interest has been expressed and preliminary investigations have been undertaken to initiate the production of scented vaseline, containing different types of imported jasmine and rose fragrances. In this regard, Shankerdas would be extremely pleased to utilize any locally produced essential oils in its products.

### 2.12 Sierra Leone Traditional Healers Association (SLENTHA)

SLENTHA was established in 1990. The association has been registered with the Department of Health and Social Services. It has 350 members consisting of various trades of traditional healers, namely diviners who heal through psychic powers and prayers; herbalists who heal mainly with herbs, and herbalist-cum-diviners who practice the both in their healing. SLENTHA estimates the number of traditional healers in the country at 40-50,000. It has reportedly submitted a project proposal to ODII for funding. The project reportedly involves organization of symposia and workshops, establishment of traditional health clinics, herbal farms and production units for herbal pharmaceuticals. The Director-General of SLENTHA estimated the total cost of the project for Phase I at US\$1.5 million. SLENTHA also wishes to establish a College of Traditional Medicine and wants to focus on community based training programmes as well. According to DG, since 85% of the populace of Sierra Leone resort to traditional methods of healing, SLENTHA wants to play a constructive role in the improvement of the country's health record especially in rural areas utilizing the centuries old techniques and experiences of traditional healers.

### 2.13 Appropriate Technology/Community Resource Centre (Newton Initiative), Newton

This resource centre is situated in Newton which is about 25 miles from Freetown in the Koya rural district. The district has a population of about 30,000 with Newton being the district capital. The ecology of the area is mainly savanna and some mangrove swamps. Agricultural products of the area includes rice, mango, orange, lime, vegetables, etc. Mainly bush fallow type agriculture is practiced.

The main activity of the Centre is to coordinate the activities of several community based groups operating in the district. These groups are involved in activities such as agriculture, local food processing, gara dying, carpentry, blacksmithry, handicraft and other business activities.

One of the strongest groups is Samuyu Women's Group (Samuyu means patience and dedication in Temne language). This group is 15 women strong, having been trained in several areas, train the other women in the community



in subjects such as agriculture, gara dying, sewing, baby food processing, bee keeping and other business activities, thereby creating jobs and income for the members of their community. The Centre collaborates with Njala University College in agricultural practices. The Resource Coordinator of the Centre, Mr.S.E.K. Harding is a certificate-holder of Njala University College in agriculture.

Such community based groups could play an important role in rural area development. They seem to be a potential vehicle for implementing or facilitating a wide range of activities including input supply; output marketing; organization of credit for members on a group-responsibility basis; mobilization of rural savings; dissemination of extension information; feedback to extension and research organizations; collection and dissemination of other types of information and community self-help.

Their importance in Sierra Leone lies in the fact that most agricultural and other rural activities are carried out on a very small scale and therefore a large number of individuals are engaged in such activities. Apart from poor infrastructure and low literacy rate, there is also a lack of capital and collateral for loans. Such community based groups are believed to achieve what an individual could not, through increased access and bargaining power to purchase inputs, obtain credit and market agricultural and other produce, and enhanced capability to acquire and use those types of technology that would be difficult for an individual or a single family to obtain. According to the Agricultural Sector Review/Programming Mission Report by FAO (1992), there is also a tendency to see the voluntary organizations as a genesis of private sector operations in the agricultural sector that have not hitherto attracted the interest of the business community.

When the mission inquired about the Centre's interest in the possible cultivation of aromatic plants and their eventual processing to obtain essential oils, Mr.Harding said quite enthusiastically that they would definitely be interested in any new activity for the community. Since lemongrass (*Cymbopogon citratus*) and other aromatic plants like teabush (*Ocimum gratissimum*), lime (*Citrus aurantiifolia*), etc. grow in the area, he said he could easily and effectively sensitize people to grow them in large quantities if the technology of producing essential oils was made available to them. The mission elaborated that the distillation technology and equipment could be brought into the area and the possible end-users of the products had already been identified. The Leader of the Samuyu Women's Group and the Secretary of the Local Farmers Association shared Mr.Harding's enthusiasm and interest in seeing the project as a potential one.

Newton has no electricity, however a diesel generator can be installed for operational activities, such as pumping of water. A well would have to be drilled at the plant site for cool ground water. Mr. Harding, as another indication of his interest, said he could approach PLAN International, a NGO operating in the district, to drill a well. He also indicated his wish to start cultivating 1 acre of lemongrass in his own land immediately. According to the inquiries of the mission there is no shortage of firewood in the area, although spent plant materials after distillation would also be used as fuel.

The mission was delighted to see the enthusiasm and cooperation of every person contacted at Newton.

## 2.14 Other Short Visits

The mission also paid short visits to the following institutions:

### 2.14.1 UNDP

The Deputy Resident Representative Ms.Z.Nuru briefed the mission on the 5th Country Programme for Sierra Leone. According to the information given, the Fifth Country Programme focuses on the following three areas:

(i) Development planning, management and governance which aims at building and strengthening the country's national capabilities with a view to attaining sustainable development and providing the basis for building a sustainable democratic system by formulation of macroeconomic policy framework; introduction of economic liberalization and restructuring of free market mechanism; and reform of public service and state enterprises.

(ii) Human resources development with a view to achieving sustainable development particularly in education and health sectors.

(iii) Integrated rural development, agriculture and natural resources management. In order to ensure an environmentally sustainable development emphasis is given to build a national capacity in developing and promoting this sector with special focus on participatory and community approach involving women in development, poverty alleviation and environment management. Priority areas identified are as follows: increasing food crop production; reduction of deforestation, soil erosion and over exploitation of marine resources; prevention of air and water pollution; improving the poor housing and unsanitary environmental conditions particularly in urban areas, etc.

In the Fifth Country Programme no emphasis seems to be given to industrial development.

### 2.14.2 WHO

The WHO representative Dr.E.K.Njelesani gave information on the WHO activities and indicated that there was no WHO activity in Sierra Leone in the field of medicinal plants or traditional medicine.

### 2.14.3 FAO

The FAO assistant-representative Mr.G.B.Mashinkila explained that the FAO activities in the country was geared at the development of agriculture and forestry, mainly in terms of food crop production, agroforestry and firewood availability. FAO does not have any project or any future plan to deal with

the cultivation of medicinal and aromatic plants in Sierra Leone. FAO is acquiring the major proportion of IPF in the Fifth Country Programme for integrated rural development projects.

**2.14.4. Forest Conservation Section, Department of Agriculture, Forestry and Fisheries**

Mr.A.P.Koroma, Chief, Conservation of Forests, pointed out that there was no individual or company engaged in collection and export of any medicinal and aromatic plant in large quantities from forest areas. He only remembered one occasion when a company was interested in collecting for export of a number of medicinal plant parts (Annex 3) in 1992 from Sierra Leone. However, this has not been materialized.

**2.14.5 National Workshop**

The workshop covers a large area and has a large number of machinery such as turning lathes, milling machines, shapers, planners, drilling machines, metal cutting, rolling and welding equipment. There is also a foundry as well as a carpentry workshop. Almost all the machinery are outdated and most are not functioning. No activity was visible at the time of the visit, possibly due to government's plan to close it down in near future.

**2.14.6 Bank of Sierra Leone**

The Deputy Governor of the Bank of Sierra Leone Mr.S.Swaray provided information on the availability of funds for lending by the Bank for commerce and mining, but not for development.

**2.14.7 Sierra Leone Chamber of Commerce, Industry and Agriculture (SLCCIA)**

The mission was received by the Executive Secretary of the Chamber. She confirmed the mission's previous inquiries that there is no company in Sierra Leone engaged in collection, cultivation, export, extraction or distillation of medicinal and aromatic plants.

**2.14.8 Sierra Leone Export Promotion Council (SEPC)**

The Council was established according to a law enacted in 1981, which never became operational. The governing body of SEPC met only twice in 1981 and 1984. The Council is now operating in a small room at the ground floor of the Department of Trade, Industry and State Enterprises, seeking its autonomy by means of a law which is being enacted.

SEPC will soon implement a 3-year UNDP/TIC project titled "Exports Development, Diversification and Promotion", jointly with Sierra Leone Chamber of Commerce, Industry and Agriculture (SLCCIA) to assist the SEPC and SLCCIA to stimulate, develop and promote exports from Sierra Leone through strengthening of their capacities and capabilities.

#### 2.14.9 Freetown Cold Storage Company Ltd.

Apart from bottling soft drinks like Coca Cola, the Swiss-based company has a fruit juice extraction facility. This facility was first installed in Mabole during 1980 at the site of a 40 ha orange plantation but was closed down. Then the machinery was transferred to this factory.

It is a simple crushing equipment which crushes the peeled fruits such as pineapple, mango, guava, grapefruit, and the juice is filtered through stainless steel fine mesh filters. It is then pasteurized at 65°C for 5 minutes / 85°C for 20 minutes / 65°C for 5 minutes and bottled. The bottled juices are said to have a shelf-life of min. 6 months.

According to the General Manager of the company, due to low internal demand, production of peel oil from grapefruits is not considered, and orange juice is not produced due to low quality of Sierra Leonean oranges. He thinks Mediterranean oranges should be introduced to the country.

The annual production output of the factory is 30.000 liters (4000 cases or 96.000 bottles) of fruit juices. Although this cannot be considered a big amount, the company has 80% share of the fruit juice market in Sierra Leone.

Aureol Tobacco Company, Palm-oil Factory and the Freetown Cold Storage Company are the only agro-based industries in Sierra Leone.

### 3 CONCLUSIONS AND RECOMMENDATIONS

Having visited twenty five places (Annex 5) including ministries, institutions, factories, government departments and organizations, and having reviewed related documents (Annex 6), the mission has reached the following conclusions.

The conclusions and recommendations are covered under separate headings based on the objectives stated in the Job Description of the consultants (Annex 1 & 2).

1. Assessment of the potential of medicinal and aromatic plants indigenous to Sierra Leone for industrial utilization

Sierra Leone is a West African country with tropical climate. 10 different forest types cover 80% of the land.

FOREST TYPE	000 ha
Closed high forest	365.2
Secondary forest	261.0
Forest regrowth	3,774.4
Savanna woodland	622.6
Mixed tree savanna	732.0
Lophira tree savanna	264.6
Mangrove	171.60
Fringing swamp forest	28.8
Raphia swamp forest	35.5
<b>Total</b>	<b>6,305.8</b>

*Ref.: Tropical Forestry Action Plan, Inter-agency Forestry Sector Review  
Sierra Leone, Mission Report, FAO, DP/SIL/87/010 (1990)*

No reliable figure could be obtained for the total number of flowering plants and ferns of the country, however one rough estimation put the figure as 15-20.000.

It is estimated that at least 1000 native plants are used for medicinal purposes by traditional healers whose number was said to be around 40.000. Recently established Sierra Leone Traditional Healers Association (SLENTHA) has 350 members. According to SLENTHA more than 85% of the population of

Sierra Leone are believed to be treated by traditional healers. Since reliable statistical data is lacking all these figures should be read with caution.

No medicinal and aromatic plant is collected from the wild sources or cultivated at large scale either for industrial utilization or for export.

Publications on the medicinal plants of Sierra Leone are also very scarce. A stencil reproduced book "Medicinal Plants of Sierra Leone" (Mac Foy, 1983) lists 120 plant species used in Pujehun district and Gloucester village.

Another book published recently by DVV/SLADEA titled "Some Medicinal Plant Recipes of the Mende, Sierra Leone" (Barnish & Samai, 1992) gives medicinal uses of 145 plants belonging to 63 families. The book also lists the following 16 medicinal plants on sale in Bo markets in March 1990.

Plant name	Part on sale
<i>Aframomum melegueta</i>	seed
<i>Allium ascolonicum</i>	whole plant
<i>Anthocleista nobilis</i>	root
<i>Cassia sieberiana</i>	root
<i>Cassia</i> sp.	root
<i>Citrus aurantifolia</i>	fruit
<i>Citrus aurantium</i>	fruit juice
<i>Marsdenia latifolia</i>	rope
<i>Microdesmis puberula</i>	leaves
<i>Nauclea latifolia</i>	root
<i>Ocimum viride</i>	leaves
<i>Salacia senegalensis</i>	root
<i>Tamarindus indica</i>	fruit
<i>Uvaria chamae</i>	root
<i>Xylopia aethiopica</i>	seed
<i>Zingiber officinale</i>	rhizome

A book titled "Useful Plants of Sierra Leone" has been drafted by B.M.S. Turey and J.L. Boboh but not published yet. The mission was given the opportunity to examine the manuscript. It contains information on medicinal and other uses of more than 500 plants of Sierra Leone.

There are also unpublished dissertations by several students of the Fourah Bay College on the medicinal plants of various regions, e.g. Hastings, Kenema, Kono.

An inquiry of a company in 1992 with the Forestry Conservation Section of the Ministry of Agriculture, Forestry and Fisheries demanded permission to collect 35 plant parts from Sierra Leone forests (Annex 3). But according to the information provided this initiative has not been materialized.

Mano River Union seeks financial support from the German Government for a project titled "Identification, Classification and Assessment of the Commercial Potential of Therapeutic Herbs in the Mano River Union States".

2. Assessment of the progress in cultivation and post harvest treatment of medicinal and aromatic plants

Except for ginger (*Zingiber officinale*) which is cultivated as a food crop, no other medicinal and aromatic plant is cultivated in Sierra Leone at large scale. Extensive inquiries by the mission led to the conclusion that there is also no research into cultivation of medicinal and aromatic plants in the country. Some aromatic plants such as lemongrass (*Cymbopogon citratus*) and teabush (*Ocimum gratissimum*) are grown at home gardens as tea plants, and traditional healers grow medicinal plants in small quantities at their backyard.

Ginger is grown on a wide range of upland soils, especially in parts of Moyamba, Bo and Kambia districts. It is not harvested every year, but is kept in the soil and harvested only when the price is attractive. Exports amounted to 1000 tonnes in early 1980s, but had fallen to 9 tonnes by 1986/87.

Citrus is mainly grown in the northern districts of Port Loko, Kambia, Bombali and Koinadugu. Mainly sweet orange (*Citrus sinensis*, syn.: *C. aurantium* var. *dulce*) is cultivated. According to Agricultural Sector Review/Programming Mission Report (FAO, 1992), a processing factory was established at Mabile during 1980 at the site of a 40 ha plantation, but was closed down. The machinery is now with Freetown Cold Storage which produces fruit juices from several crops.

3. Assessment of the progress in the current production of herbal pharmaceuticals and essential oils and the specific needs for improvement particularly in terms of rehabilitation of existing factories

At present there is no phytochemical industry in Sierra Leone. In fact, there is only one pharmaceuticals plant producing only six drugs using imported bulk drugs, excipients and packing materials. The country imports all the drugs it needs in finished form. Although many drugs containing plant based ingredients are known to be imported mainly from India and China, no information is available on the number and volume of such drugs.

Traditional healers produce and prescribe their secret formulations, and even sell them in the markets. There is no state control over their practices. The Ministry of Health pretends to ignore their existence. Although, the Sierra Leone Traditional Healers Association (SLENTHA) seeks recognition by the Ministry of Health, the Government seems reluctant to legalize their practices or to promote the utilization of medicinal plants for therapeutical uses.

Preparations of Traditional healers lacking standardization and hygiene pose added danger to the public since their safety and efficacy are questionable.

Despite numerous inquiries, no information was available as to the whereabouts of any supposedly existing phytochemical plant in need of rehabilitation in Sierra Leone.

4. Assessment of industrial and institutional infrastructure related to medicinal and aromatic plants in the country and the development of pharmaceuticals based on traditional preparations and essential oils

As already explained above there is no industry based on medicinal and aromatic plants producing extracts, essential oils or herbal preparations.

There is also no government department specifically mandated to deal with medicinal and aromatic plants or traditional medicine. The mission feels strongly about the need to establish a National Research Centre for Medicinal and Aromatic Plants. Such a Centre can help the government to draw policies towards a better utilization of the country's medicinal and aromatic plant resources. It can be established at the University where some infrastructure for research exists. Ministries, such as Health and Social Services; Trade, Industry and Public Enterprises; and Finance, Development and Economic Planning; Pharmacy Board, and similar bodies can be represented at the Governing Board.

It was brought to the attention of the mission that, in 1986, a 25 liter capacity glass water distillation apparatus had been designed and manufactured at the National Workshop to distil 1.5 tonnes of fresh lemongrass with apparently satisfactory results. Nobody seems to know the motive of its construction, its fate and the whereabouts of the unit.

5. Assessment of the current research capabilities and status of equipment for natural product based drug development

The University of Sierra Leone consists of three colleges, namely Fourah Bay College and College of Medicine and Allied Health Sciences in Freetown, and Njala University College in Njala.

The Chemistry and Botany Departments of the Fourah Bay College have been engaged in research into medicinal plants of Sierra Leone. Field studies by several students and researchers have aimed at compiling data on the local uses of medicinal plants in various regions. Other investigations conducted have been on structure elucidation of the compounds isolated from medicinal plants and on biological activity (e.g. antibacterial, antifungal) of medicinal herbs, e.g. Taylor-Smith (1966) on *Anthocleista*; Crawford, Hanson and Koker (1975 and 1976) on *Cymbopogon citratus*; Hanson (1977) on *Habropetalum dewei*; Waterman and Faulkner (1979) on *Cassia sieberiana*; Faulkner, Mac Foy and Waterman (1985) on *Cymbopogon*, *Xylopi*a and *Cyanometra*; and an antibacterial activity screening study by Mac Foy and Cline (1986).

The Chemistry Department lacks modern teaching and research facilities. Equipment such as UV-VIS and IR spectrophotometers and freeze dryer are said to be out of order. Chromatotron and GC are apparently in working condition. The Department was said to have a small steam distillation facility, but the mission did not see it.

Research activities in the Department are hampered by inconsistent electricity and water supply as well as the lack or paucity of adsorbents, solvents and chemicals. The existing chromatographic (except for chromatotron)



and spectroscopic equipment are too old and most of them are not functioning. badly in need of spare parts and repairs.

The Botany Department has modest facilities for research. It also keeps a herbarium which has 12000 mounted specimens in its holdings as well as an arboretum.

The Faculty of Pharmaceutical Sciences at the College of Medicine and Allied Health Sciences is only two years old and has no research facility of its own yet.

The Njala University College is an agricultural college. Agricultural research is carried out both at the Faculty of Agriculture of NUC and the Institute of Agricultural Research at Njala. Research into cultivation aspects of medicinal and aromatic plants has not in the past and is not presently carried out in any of these institutions.

Government funding for all the above mentioned institutions has been very low, and has mainly had to be used to pay staff salaries and allowances, leaving little for purchases of equipment, supplies and documentation, and not permitting investment to maintain and upgrade physical facilities. Therefore, only collaborative research with institutions or scientists abroad has enabled Sierra Leonean chemists to make a few publications on the chemistry and biological activity of medicinal plants.

6. Assessment of the market potential and economic viability of industrial production of plant based products

Cultivation is an important aspect of the development of plant based industries, because without a steady supply of standard quality raw materials sustainable development of phytochemical industries cannot be achieved. Collection of raw materials from wild resources can not only create rapid depletion of natural resources but also makes it highly difficult for the user industries to produce products of consistent quality.

Although the country has great potential in this respect, at present, no medicinal and aromatic plant product is readily available for industrial processing in Sierra Leone.

Several potential end-user industries contacted clearly indicated their willingness to utilize locally produced essential oils in their products. Chanrai Chemicals alone is planning to use 18 tonnes of essential oils in its soap production next year. Presently the company is purchasing the oils from abroad.

Therefore, priority must be given to essential oil production using cultivated aromatic plants of Sierra Leone, since the technology for their processing does not require the use of imported solvents, expensive equipment and large power supply.

7. Preparation of a priority list of plants for industrial utilization based on raw material availability, market potential and economic viability of their industrial use

Due to reasons already explained emphasis should be given to the production of essential oils from aromatic plants. Although a list is provided in Annex 2 for indigenous medicinal and aromatic plants with development potential focus will be on the aromatic plants mentioned in the next chapter.

8. Study of the feasibility of establishing small scale production units for essential oils and herbal preparations in rural areas

It is estimated that there are some 70-100 Farmers' Associations in each district and more than 30 in Western area where the capital Freetown is located. Such community based groups as well as cooperatives play an important role in the development of rural economics as well as in mobilizing the potential hidden work force of rural areas which constitute almost 80% of the population of Sierra Leone to contribute to the national economy by producing goods using indigenous resources of the country.

Women play a strong role in such so called voluntary associations. The Appropriate Technology/Community Resource Centre in Newton coordinates the activities of such groups and supply them training materials, resource documents and organize community self-help at grassroots level.

The mission identified Newton in Koya Rural District which is about 25 miles away from Freetown as a possible site for developing a rural essential oil industry as a pilot project.

There are several reasons for choosing Newton:

- (1) There is an Appropriate Technology/Community Resource Centre which is managed by a highly enthusiastic local resource coordinator with apparent entrepreneurial skill.
- (2) There is an active Women's Group called Samuyu Women's Group consisting of 15 women who promote income-generating activities such as gara dying, food processing, sewing/weaving, soap making and other business activities among the women in their community.
- (3) There is a local Farmers Association which showed great interest in the prospect of cultivating essential oil bearing plants in the district.
- (4) The site is not far from the capital Freetown and is linked with an asphalt-surfaced road.
- (5) Lemongrass (*Cymbopogon citratus*) grows wild in the region and is grown in home gardens as a tea herb.

Some disadvantages detected can easily be overcome such as the lack of electricity and non-availability of a bore well for the supply of ground water.

Electricity will be needed for lighting and for water-pump. A well can be drilled using the services of local companies. The Resource Coordinator of the local Centre promised his support for drilling a well as well as for the provision of a building and a covered area for the distillation plant.

Essential oils are volatile components of aromatic plants which can be obtained by several techniques depending on the nature of the plant material and also on the requirement of suitable technology. Essential oil extraction techniques are as follows:

a) Water distillation: In this technique, the plant material is boiled in water and the steam and essential oil vapours are condensed on a cold surface and collected in a suitable receiver. Due to differences in density, oil and water separate. Most essential oils being lighter float on water and can be easily recovered.

b) Steam distillation: This technique involves injection of live steam generated elsewhere into a well-packed body of plant material from the bottom. The same principle as above applies and essential oil is recovered.

c) Cold pressing: This applies particularly to the processing of citrus fruits. Freshly peeled outer skin of citrus fruits (i.e. orange, lemon, lime, grapefruit, bergamot, etc.) are pressed using hydrolic or hand presses to obtain the essential oil. However, today this technique is hardly utilized, if any. Citrus technology is well advanced and modern factories extract the fruit juice and the pericarp oil at the same time separately. Citrus oils are not obtained by distillation. Only lime peel oil is distilled but this oil is regarded inferior to the cold pressed oil.

d) Extraction:

(i) with organic solvents: Hexane or petroleum ether are commonly used to extract certain aromatic plant parts such as ginger rhizome, orris rhizome, jasmine flowers, etc. using specially designed solid-liquid extractors. Evaporation of the solvent under reduced pressure yields a solid extract called oleoresin or concrete in which essential oil is mixed with waxes, resins or other extractable plant materials.

(ii) with fats: This technique is only practiced in France for extracting essential oil from delicate flowers. Fresh flowers are spread on a layer of pure, odourless fat coated on glass plates, and replaced after a certain contact period with a new lot of flowers. During this period fat absorbs the essential oil from flowers. Finally the fat is washed with alcohol and evaporation of alcohol gives the oil.

(iii) with liquid gasses: Butane is used under pressure to obtain essential oils called butaflors. This is a patented process. Liquid carbondioxide at supercritical temperature extracts essential oils and other plant substances. This extraction technique does not cause any contamination to the final product since carbondioxide evaporates rapidly once the pressure is released and essential oil is obtained. However, this sophisticated technique require very high initial investment and high running costs.

Lemongrass (*Cymbopogon citratus* Stapf) is an indigenously growing aromatic plant of Sierra Leone. Its essential oil can be obtained by steam distillation of the fresh leaves. The plant is perennial and can easily be propagated vegetatively. Several harvests a year is possible. The main quality criteria of lemongrass oil are the aldehyde (citral) content which should be between 75-90% and the solubility in 70% alcohol. Other significant factors for quality assessment are the appearance and cleanliness. Since wild growing plants may show variation in yield and content of essential oil, some initial research should be undertaken to select the plants having high oil yield with high citral content.

Citronella grass (*Cymbopogon nardus* (L.) Rendle var. *nardus*) is another aromatic plant which can be cultivated. Live materials for planting can be imported. Steam distillation of the fresh leaves gives the oil of Citronella (Ceylon type). The oil should contain alcohols (geraniol) 55-65% and aldehydes (citronellal) 7-15%. The oil of *Cymbopogon winterianus* Jowitt. is called in international markets as Citronella oil-Java type or Java Citronella oil which contain 85% total alcohols (expressed as geraniol) and 35% total aldehydes (expressed as citronellal).

Both the oils are suitable for use in soaps, toiletries, etc. Therefore, considerable domestic market potential exists. On the other hand, if the oils produced comply with international standards export potential is also possible. London spot market price for lemongrass oil was \$13.25 per kg (Indian) and \$9.25 per kg (Guatemalan) in 1992. World production for lemongrass oil in 1991 was 400-500 tonnes and for citronella oil it was 4000-5000 tonnes. Both the oils are produced only in developing countries.

**9) Benefits to be derived derived form a technical assistance project:**

There are several aspects in the project which are in full accordance with the UNDP and the Government priorities. Overall benefits derived will be the following:

- a) Human resources development
- b) Integrated rural development
- c) Participation of women in development
- d) Utilization of indigenous resources for sustainable development
- e) Development of small scale industries / Private sector development
- f) Increased utilization of locally manufactured products by national industries
- g) Import substitution
- h) Export potential creation
- i) New job opportunities for rural population
- j) Poverty alleviation
- k) Technology transfer
- l) Availability of QC facility in Sierra Leone for essential oil analysis
- m) Increased output in agriculture
- n) Upgraded research capacity and capability
- o) Identification of the potential essential oil resources of the country
- p) Grassroots participatory development
- q) Increased contribution of the industrial sector in the country's GDP.
- r) Environmental protection

It is strongly recommended that a National Research Centre for Medicinal and Aromatic Plants (NRCMAP) should be created at the University which should be directly linked with the vice-chancellor's office, and this Centre should implement the project activities. Such a Centre can also do follow-up activities after the termination of the project. It is expected that after successful completion of the project the Centre could acquire necessary funds to develop into serving as a sub-regional centre for the Mano River Union states.

## 3.1. SUMMARY OF RECOMMENDATIONS

Identification of the problem	Action to be taken	Responsible party
<p>1. Sierra Leone is rich in natural resources and the flora is likewise rich and diverse, comprising many medicinal and aromatic plants. However, these resources are not presently utilized for industrial development or for export purposes.</p>	<p>An inventory of medicinal and aromatic plants of the country should be prepared. This can be facilitated if the flora of the country is well documented. Then, resource estimations should be made to assess their availability to support plant-based industries. Systematic collection of medicinal and aromatic plants from wild sources can be programmed and executed in an organized manner without any damage to the environment.</p>	<p>University</p>
<p>2. Country imports all the essential oils for local industries.</p>	<p>Cultivation of essential oil bearing plants should be initiated as intercropped and on marginal lands, and adequate amount of plant materials should thus be supplied to support industrial operations. Distillation facilities should be set up in rural areas near the cultivation fields. Local industries should be encouraged to buy the oils produced.</p>	<p>Government/Rural voluntary and farmers associations/local industries</p>

<p>3. Although some modest laboratory facilities exist at the Fourah Bay College for research into medicinal and aromatic plants, very little research activity has been carried out so far. There is no quality control laboratory for pharmaceuticals or essential oils, and no independent research centre or institute dealing only with medicinal and aromatic plants of the country.</p>	<p>Research facilities at the Chemistry Department of the Fourah Bay College should be strengthened through the provision of modern equipment to conduct research and quality control analysis of essential oils indigenously produced. Main research activity should constitute the screening of the aromatic flora of the country for the discovery of new potential essential oil sources. To do this, collaboration with and advanced overseas laboratory on essential oils is advisable. It is highly recommended to establish an independent National Research Centre for Medicinal and Aromatic Plants to undertake and coordinate all research activities into medicinal and aromatic plants in Sierra Leone.</p>	<p>Government/University and UNIDO</p>
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4. There is no phytochemical industry in Sierra Leone	A steam distillation facility should be set up in Newton where cultivation of two aromatic plants should be initiated. The essential oils produced should be analysed at the Chemistry Department of the Fourah Bay College in Freetown. The local industries should buy the oils for use in their products. Tax incentives should be provided by the government for local industries to supply field distillation stills to the farmers to produce essential oils for them through buy-back agreements.	Government/University/UNIDO/rural association/ Private industries
5. There is no stainless steel working capacity in the country.	Especially in tropical countries where humidity is very high throughout the year stainless steel distillation plants should be used. The National Workshop in Free-town which has metal working capacity is to be shut down soon. However, even this workshop has no adequate facility to work stainless steel. Stainless steel sheets, valves, pipes, gauges, etc. would have to be imported. It is therefore advisable to import a fully functional stainless steel distillation still. This is also a means of technology transfer into Sierra Leone.	UNIDO



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**PROJECT IN SIERRA LEONE****JOB DESCRIPTION**

**Post Title:** Chemical Technologist/Team Leader

**Duration:** 1.0 m/m

**Date Required:** April/May 1993

**Duty Station:** Sierra Leone

**Purpose of Project:** Fact-finding and preparatory assistance mission to assess the potential for the industrial utilization of medicinal and aromatic plants.

**Duties:** The expert together with the Botanist will work in collaboration with counterparts to accomplish the following:

- 1) Assess the potential of medicinal and aromatic plants indigenous to Sierra Leone for industrial utilization.
- 2) Assess the progress in cultivation and post harvest treatment of medicinal and aromatic plants.
- 3) Assess the progress in the current production of herbal pharmaceuticals and essential oils and the specific needs for improvement of these.
- 4) Assess industrial and institutional infrastructure related to Medicinal and Aromatic Plants in the country, and the development of pharmaceuticals based on traditional preparations and essential oils.
- 5) Assess the current research capabilities and status of equipment, for natural product based drug development.
- 6) Assess the market potential and economic viability of industrial production of plant based products.
- 7) Prepare a priority list of plants for industrial utilization based on raw material availability, market potential and economic viability of their industrial use.
- 8) Prepare a comprehensive report containing the findings, conclusions and recommendations on the basis of the above, and to recommend therein the mechanisms and modalities of a technical assistance project including a draft project document containing the inputs in terms of equipment, training, expertise and other infrastructural requirements for the establishment of a processing plant and a R&D laboratory.

**Qualifications:** A Pharmacist/Chemical Technologist with at least 10 years experience in industrial utilization of medicinal and aromatic plants and with experience in developing countries

**Language:** English

## PROJECT IN SIERRA LEONE

## JOB DESCRIPTION

**Post Title:** Botanist/Plant Biochemist

**Duration:** 1.0 m/m

**Date Required:** April/May 1993

**Duty Station:** Sierra Leone

**Purpose of Project:** Fact-finding and preparatory assistance mission to assess the potential for the industrial utilization of medicinal and aromatic plants.

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- 4) Assess industrial and institutional infrastructure related to Medicinal and Aromatic Plants in the country, and the development of pharmaceuticals based on traditional preparations and essential oils.
- 5) Assess the current research capabilities and status of equipment, for natural product based drug development.
- 6) Assess the market potential and economic viability of industrial production of plant based products.
- 7) Prepare a priority list of plants for industrial utilization based on raw material availability, market potential and economic viability of their industrial use.
- 8) Study the feasibility of establishing small scale production units for essential oils and herbal preparations in rural areas.
- 9) Prepare a comprehensive report containing the findings, conclusions and recommendations on the basis of the above, and to recommend therein the mechanisms and modalities of a technical assistance project including a draft project document containing the inputs in terms of equipment, training, expertise and other infrastructural requirements for the establishment of a processing plant and a R&D laboratory and if feasible small scale production units in rural areas.

**Qualifications:** A Botanist/Plant Biochemist with at least 10 years experience in industrial utilization of medicinal and aromatic plants and with experience in developing countries.

**Language:** English

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THE MAP OF SIERRA LEONE



**PLANT PRODUCTS OF POTENTIAL INTEREST OF SIERRA LEONE FOR  
PHYTOCHEMICAL INDUSTRIES**

(Prepared by C.A.Mac Foy)

<b>Plant species</b>	<b>Plant part used</b>	<b>Product of economic value</b>	<b>Therapeutic or other use</b>
<i>Acacia senegalensis</i>	Gum exudate	Gum	Arabic gum used in pharmaceutical and other industries
<i>Azadirachta indica</i>	Leaf, fruit, bark, gum	Azadirachtin, oil	insecticide
<i>Capsicum annum</i>	Fruit	Oleoresin, capsaicin	rubefacient, spice
<i>Datura metel</i> and <i>D.stramonium</i>	Leaf and fruit	Alkaloids: Atropine, hyoscyamine, e'c.	Anticholinergic
<i>Dioscorea</i> sp.	Tuber	Diosgenin	Steroid manufacturing
<i>Eucalyptus</i> sp.	Leaf	Essential oil	Bronchitis
<i>Cymbopogon citratus</i>	Leaf	Essential oil	Cosmetic, toiletries
<i>Zingiber officinale</i>	Rhizome	Oleoresin, ess. oil	Spice
<i>Cinchona</i> sp.	Bark	Alkaloids: Quinine, quinidine	Antimalarial, antiarrhythmia
<i>Rauwolfia</i> sp.	Root	Alkaloids: Reserpine	Antihypertensive, sedative
<i>Cassia</i> sp.	Leaf and pod	Sennosides	Laxative
<i>Mucuna pruriens</i>	Beans	L-Dopa	Antiparkinson
<i>Arachis hypogea</i>	Seed	Fixed oil	Emulsion base, food
<i>Catharanthus roseus</i>	Herb	Alkaloids: Vincristine, vinblastin	Anticancer
<i>Tamarindus indica</i>	Fruit pulp	Pulp or juice	Laxative, astringent
<i>Ocimum gratissimum</i>	Leaf	Essential oil	Cough suppressant, insect repellent
<i>Ricinus communis</i>	Seed	Fixed oil	Purgative
<i>Hyptis</i> sp.	Leaf	Essential oil	Colds
<i>Xylopia</i> sp.	Fruit	Oleoresin, essential oil	Spice, bronchitis, cough,
<i>Garcinia cola</i>	Seed		Stimulant
<i>Cola nitida</i>	Seed		Stimulant

<i>Cinnamomum</i> sp.	Bark	Essential oil	Flavouring, cosmetics
<i>Aloe</i> sp.	Leaf	Exudate	Purgative, cosmetics
<i>Citrus</i> sp.	Fruit peel	Essential oil	Flavours, fragrances
<i>Aframomum</i> sp.	Seed	Essential oil	Flavour, cough
<i>Agave</i> sp.	Leaf	Hecogenin	Steroid manufacturing



SIERRA LEONEAN PLANTS OF EXPORT POTENTIAL  
AS DEMANDED BY AN OVERSEAS DEALER

Plant name and part

- Aframomum melegueta* seeds  
*Alchornea cordifolia* leaves  
Annato seeds  
Arabic gum (*Acacia senegal*)  
*Brackenridgea* leaves  
Calabar beans (*Physostigma venenosum*)  
Castor oil seeds (*Ricinus communis*)  
*Catharanthus roseus* roots  
*Ceiba pentandra* leaves  
Chillies dried (*Capsicum frutescence*)  
*Cinchona* bark  
Ginger rhizome (*Zingiber officinale*)  
*Gloriosa superba* seeds  
*Griffonia simplicifolia* seeds  
*Helinus integrifolius*  
*Mitragyna ciliata* barks  
*Pseudocinchona* barks  
Pygeum barks (*Prunus africana*)  
*Pycnanthus angolensis* beans  
*Rauvolfia vomitoria* rootbarks  
*Schinus terebinthifolius* seeds  
Senna pods and leaves (*Cassia* sp.)

Sesame seeds (*Sesamum indicum*)

*Strophanthus gratus* and *S. kombe* seeds

*Terminalia sericea* rootbarks

*Voacanga africana* seeds

*Xylopia africana* seeds

*Pentadesma*

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**Backstopping Officer's Technical Comments  
based on the work of K.H.C. Baser and C.A. Mac Foy**

The report contains the findings of the two experts with an assessment of the current situation with regard to industrial utilization of medicinal and aromatic plants and recommendations for initiation of industrial activities. The consultants have identified the type of industrial activity to be initiated which could result in development of small scale industries in rural areas of the country. The initial investment for the proposed project is not high and could serve as a model project for rural industrial development and sustainable use of natural resources. Consultants have recommended the requirements for such a project and identified the counterpart institutions. Backstopping Officer agrees with the proposal made and hopes that the government would consider funding this model project through the small scale industries development programme. The establishment of a separate institute for R & D should be considered as a long term objective once small scale industries are established and the private sector's interest is secured as such an institute has to generate funds through services to industries.