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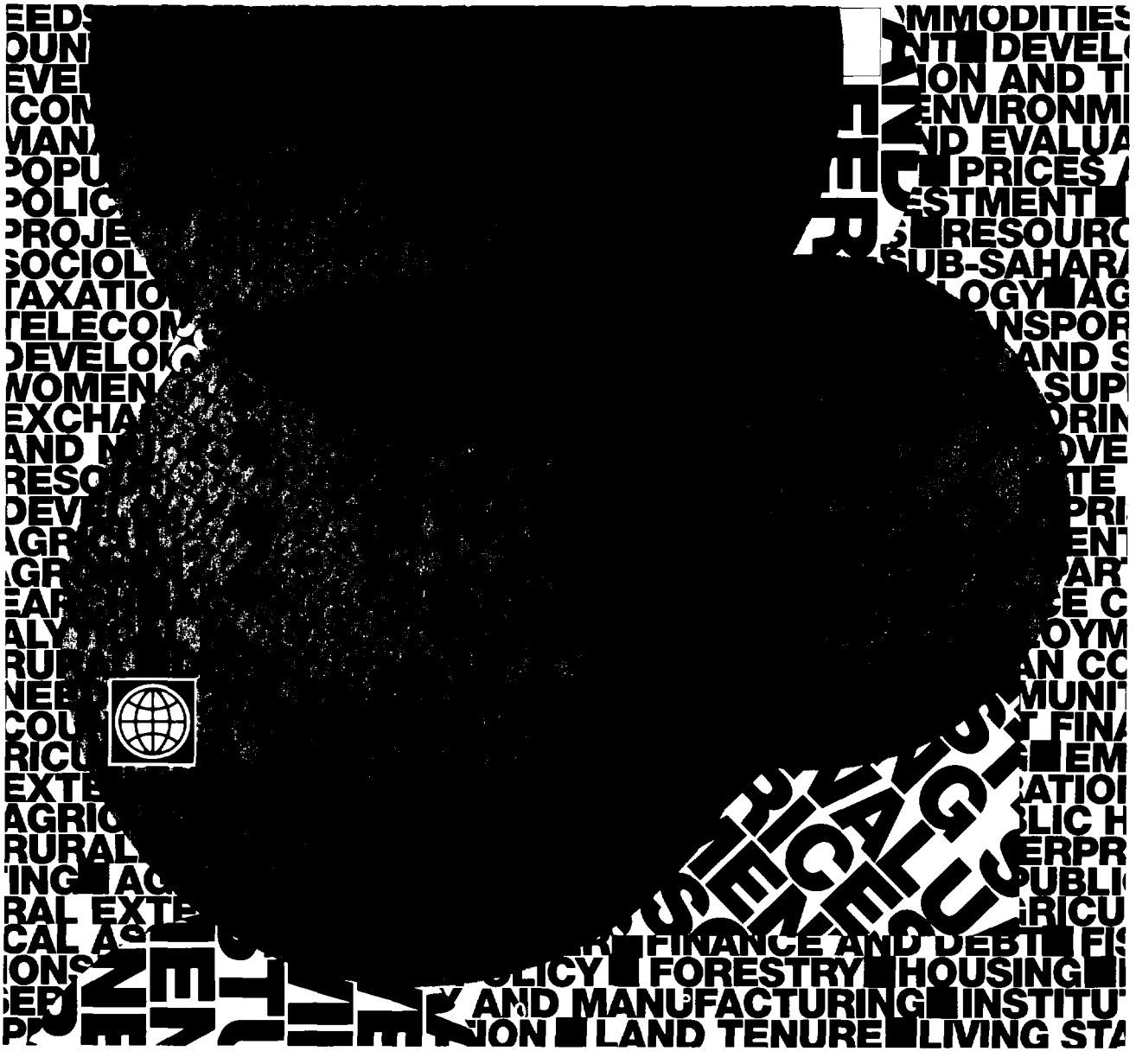
Medicinal Plants

An Expanding Role in Development

Jitendra Srivastava, John Lambert, and Noel Vietmeyer



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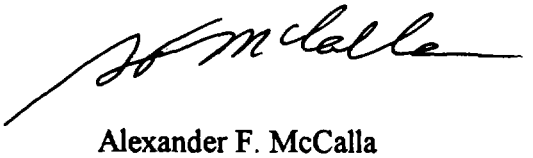
FOREWORD

This short concept paper is intended to serve as a preliminary exploration of the subject of medicinal plants *in their role as biological resources.* Various organizations—among them the World Health Organization and the World Bank's own Human Development Department—are involved with issues surrounding the efficacy, safety and general health merits of healing plants. We concern ourselves only with ways and means of achieving and/or maintaining sustainable production of plant species already accepted for healthcare purposes.

It is a reality of many countries that millions of people employ plants they consider to have healing or preventative properties. Whatever the level of proven efficacy, these plants are economic resources of our times. Yet although millions of dollars are invested in supporting food and other crops, little or nothing is spent on supporting the world's medicinal-plant resource base.

The present paper is a step toward determining if this imbalance in priorities is justified. By concentrating on the agricultural potential, we hope to assist countries and development agencies in better dealing with their natural resource, human development, and general healthcare efforts.

This review has been jointly funded by the Agriculture and Natural Resources Department and the Research Support Budget of the World Bank.



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ABSTRACT

Medicinal plants are commonly used in treating and preventing specific ailments and diseases and are considered to play a beneficial role in health care. Despite their importance, medicinal plants are seldom handled within an organized, regulated sector; most are still exploited with little or no regard to the future. The paper outlines the importance and usage of medicinal plants in health care, national conservation activities in selected countries, and in World Bank development projects. The final section focuses on developing country strategy needs for implementing policies covering medicinal plant conservation, cultivation, processing and marketing. Medicinal plants are viewed as a possible bridge between sustainable economic development, affordable health care and conservation of vital biodiversity.

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EXECUTIVE SUMMARY

In virtually every developing nation, plants are used in medical practice. But now, as a result of rising numbers of people and of an aging populace, many medically important species are becoming scarce; some are facing the prospect of extinction. In India, for instance, providers to the indigenous health care systems have begun recognizing that supplies of raw plant materials cannot be guaranteed. As a precaution, they now require producers to deliver two year's supply in advance. As a further precaution, some are establishing farms specifically to cultivate medicinals.

Such experiences are by no means limited to India, and they serve to raise an alarm. As noted, most developing countries depend on plants for their traditional forms of medicine. Alternative sources of health care are unavailable for many of their peoples. What should be done to assure future supplies?

Despite the potential for disaster, few of the vulnerable medicinal species are today protected by conservation legislation. The new Global Biodiversity Strategy should be a help in protecting such a resource. However, until recently it was focused primarily on protected natural reserves, ignoring agricultural, marginal, and degraded lands, all of which are important sites of threatened medicinal-plant biodiversity.

Although the World Health Organization and other health-oriented institutions have supported medicinal-plant projects, the international development community at large has not addressed the issue of medicinal plants *in the overall framework of natural resources*. As of now, for instance, few developing countries or economic assistance organizations have any policy or strategy that addresses their roles, present or potential, in dealing with medicinal plants.

This neglect could be serious. Many seemingly unrelated projects—those dealing with conventional agriculture, forestry, land reclamation, rainforest protection and infrastructure development, for instance—affect medicinally important wild species. In addition, such high-value botanic resources might have immense value in development projects. In fact, medicinal plants may contribute to the success of future programs dealing with such diverse subjects as agriculture, forestry, biodiversity conservation, health care, and social and economic sustainability.

A successful strategy for medicinal species will involve economic, agricultural, social and environmental inputs. For this reason, the Agriculture and Natural Resources Department of the World Bank is undertaking an evaluation of the present situation and the likely future needs of the medicinal species. The present document is just a small first step. Its purpose is to elicit comment and suggestions for the main paper, yet to come. This second review will focus primarily on three countries, analyzing and drawing lessons from their separate approaches to the regulation and development of medicinally important plants. From that, it is hoped, will come important lessons for all nations.

1. INTRODUCTION

Despite all the progress in synthetic chemistry and biotechnology, plants are still an indispensable source of medicinal preparations, both preventive and curative. Hundreds of species are recognized as having medicinal value, and many of those are commonly used to treat and prevent specific ailments and diseases.

At least four out of every five of those plants are collected from the wild, most from the floras of developing countries. Medicinal properties may be present in one or all of their parts: root, stem, bark, leaf, flower, fruit or seed.

While in industrialized countries health providers have reduced their dependence on the Plant Kingdom, the majority of developing countries still rely on herbal remedies. However, in a complete turn-around, modern science and Western medicine are getting interested in the healing herbs once more (Eisenberg, et.al., 1993; Grunwald, 1994). Indeed, "phytomedicines" are beginning to link traditional (homeopathic) medicine and modern (allopathic) medicine. As a result of the new openness from leading industrialized nations, a wealth of technical information is now coming available, notably from sophisticated laboratories who are analyzing herbal ingredients and their effects with the latest technologies.

Definition

In the past a number of definitions for the term *medicinal plant* have been offered.

and Soejarto (1991) imply that it is only when medicinal properties are proven by Western research should a species be labeled a "medicinal plant." Fellows (1991), on the other hand, suggests that the term indicates merely a species known to beneficially modulate the physiology of sick mammals, and that has been used by mankind.

For present purposes, we are employing the following definition:

> *Medicinal plants are those that are commonly used in treating and preventing specific ailments and diseases, and that are generally considered to play a beneficial role in health care.*

World Trade

Medicinal plants are already important to the global economy. In 1980, for instance, the World Health Organization (WHO) estimated the world trade at US$500 million. Moreover, as above noted, demand is steadily increasing not only in developing countries but also in the industrialized nations. In both Europe and North America, for example, the demand is being fueled by an outburst of consumer interest in products that are "all-natural" as well as by aggressive marketing of herbal remedies (Lewington, 1993).

Box 1: Growth of a Global Industry

Herbal Medicine Sales

Region	Million US$
EU	6,000
Rest of Europe	500
Asia	2,300
Japan	2,100
North America	1,500
Total	12,400

Annual Growth Rates by Region (%)

Region	1985-91	1991-92	1993-98
EU	10	5	8
Rest of Europe	12	8	12
SE Asia	15	12	12
Japan	18	15	15
India/Pakistan	12	15	15

Source: *Grunwald, 1994.*

This rising global interest is now creating burgeoning legitimate and "underground" trades in plant materials, many of which are already being routinely moved around the world. Most samples are collected in developing countries in a completely unregulated manner. In Nepal, for instance, numbers of medicinal plants are being uprooted and sold as raw products to India, where they are graded, packaged and exported (Edwards, 1993).

Usage in Developing Nations

WHO estimates that approximately 80% of the developing world's population meet their primary health care needs through traditional medicine (Bannerman, 1982). Many different systems exist: the Ayurvedic, Unani, and Siddhi in India; the Kampo in Japan, the Jamu in Indonesia; and more.

In China, plant-based medicine is the backbone of the health care for perhaps a billion people; botanicals are used for the primary health care needs of 40% of China's urban patients and over 90% of its rural patients. In the traditional decoctions as well as in the officially decreed medicines, huge quantities of plant materials are used. Indeed, the annual demand has been reported to exceed 700,000 tons (Xiao-Pei-gen, 1991). The economic value is also huge. In 1987, for instance, China's traditional plant remedies were valued at US$571 million, and its country-wide sale of crude plant drugs was put at $1.4 billion (Li Chaojin, 1987).

In South Asia the situation is similar. There, some 800 million people (out of a total population of over one billion) rely on herbal medicines. In India, for instance, traditional health systems run

parallel to the modern health-care sector. Officially recognized and fully sanctioned by the government, these traditional systems (such as Ayurveda, Unani, Siddha and Tibetan) are

Box 2: The Mongoose Knows

Before a mongoose attacks a snake, reported the botanist Rumphius in the 1700s, it fortifies itself by eating the leaves of the serpent-root plant. And if a mongoose gets bitten, it seeks out the serpent root, eats the leaves, rolls around three or four times, rests a little as if drugged; then, regaining strength, rushes back to the attack.

Maybe there is nothing to this story from the great naturalist who lived his life in what is now Indonesia, but since 1949 the serpent root's magical powers has certainly excited the world's medical establishment. That year the British Heart Journal reported that the plant is "clinically effective for treating high blood pressure." Three years later, Swiss researchers discovered that a chemical in the root, is an antihypertensive and sedative. Called reserpine, it became the world's first tranquilizer, thereby opening up a vast new field of therapy, previously unsuspected.

Reserpine extracted from the roots of various species of *Rauvolfia* is now known to not only calm the central nervous system but to lower blood-pressure and control heart-beat arrhythmia. Most of it comes from India, where the powdered root has been in use for at least 2000 years, notably for treating mental illness. Not until 1952, when reserpine was isolated from the raw plant extract, did its use in Western medicine begin to take off. Nowadays, the drug is mainly used to control high blood pressure but it is still one of the most effective tranquilizers, and makes the lives of millions of schizophrenics far more bearable.

In the 35 years since the serpent root gave the world its first tranquilizer, this wild Asian plant and its botanical relatives in Africa have risen to become of major economic and medical importance. Already by 1961, the consumer market for prescription drugs from serpent-root species exceeded US$100 million in the United States alone. These days, more than 22 million prescriptions for reserpine and 5 million for serpent-root extracts are dispensed annually in the U.S. In addition, 2 million prescriptions for combinations of serpent root and other drugs are filled each year.

All this goes to show that the mongoose probably knew what it was doing. Rumphius's story offered a provocative lead to a breakthrough in medicine, but it took us 200 years to realize it. And hundreds of other provocative leads and a lot of healing power remains in plants still to be explored. Hopefully, people will get to investigate them soon, or it may be too late; the plants just may not be around anymore.

comparable to the modern one in their degree of organization and research. Indian records estimate that the traditional health sector encompasses 55,000 licensed pharmacies, 13,770

dispensaries, 7,000 licensed manufacturing units, 16,990 hospitals, 98 Ayurvedic colleges, and 400,000 registered practitioners (versus 332,000 registered physicians). India's traditional health sector actually accounts for an estimated 35 million persondays of employment annually and therefore is an important income generator.

Usage in Industrialized Nations

Different levels of medicinal-plant usage are found in different industrialized countries, but all the levels are surprisingly high. For example, the German herbal-product market in 1989 was estimated at US$1.7 billion. And of the 500 million prescriptions written each year in the United States one in four is reported to involve a pharmaceutical derived from a leafy plant, an amount estimated in 1990 to be worth US$11 billion a year. Furthermore, almost all countries have a second outlet for plant-derived pharmaceuticals: non-prescription drugs. Many laxatives, cough and cold preparations, and over-the-counter sleep remedies come from plants.

The natural products in these prescriptions and over-the-counter preparations include:

1 quinidine, suppresser of out-of-sequence heartbeats from the bark of *Cinchona* sp.;
2 quinine, antimalarial from *Cinchona* sp.;
3 pilocarpine, glaucoma treatment from Brazilian *Pilocarpus* sp.;
4 picrotoxin, used worldwide as a nervous system stimulant from *Anamirta* sp.;
5 L-Dopa, treating Parkinson's disease form *Mucuna* sp.;
6 bromelain, anti-inflammatory from pineapple *Ananas* sp.;
7 scopolamine, sedative from *Datura* sp.;
8 digitalin and digoxin, heart drugs from foxglove *Digitalis* sp.;
9 atropine, powerful pupil-dilator from belladonna *Atropa* sp.;
10 curare, muscle relaxant (notably used in surgery) from *Chondrodendron* sp.;
11 ephedrine, decongestant from Chinese *Ephedra* sp.;
12 ipecac, emetic and dysentery cure from Central American *Cephaelis* spp.; and
13 sennosides, laxative from *Senna* spp.

Some of these therapeutic compounds are now easier or cheaper to synthesize in industrial facilities. However, in the above list, numbers 1-7 are extracted from plant sources while those listed in numbers 8-13 can be produced synthetically but in developing countries at least still come mainly from the plant sources (Farnsworth and Soejarto, 1991).

When the overall benefits to society are taken into account, the value of plant-derived pharmaceuticals is even more surprising. Principe (1991) estimates the total economic value to the United States to be at the very least $68 billion annually. In other words, when the improvements in people's health and capacities are factored in, the country reaps a financial dividend about six times the already large market value of the plant products themselves.

2. THE RESOURCE BASE

The number of plants that are used medicinally is very large. The Natural Products Alert (NAPRALERT) database at the University of Illinois has documented the ethnomedicinal uses for more than 9,000 species, including monocotyledons, dicotyledons, gymnosperms, pteridophytes, bryophytes and lichens (Farnsworth and Soejarto, 1991). The number officially sanctioned due to proven efficacy is less, but still impressive. India, for example, formally recognizes just over 2,500 species as having true medicinal value (Jain and DeFilipps, 1991). In the Third World as a whole, it is estimated that over 6,000 plants are authorized in traditional medicine (Huxley, 1984). This is perhaps an underestimate because Chinese traditional medicine alone employs an estimated 5,000 officially sanctioned plants (Farnsworth and Soejarto 1991).

The number of plant-derived compounds known to be pharmacologically active is also large. Worldwide, at least 121 chemical substances of known structure are extracted and purified for medicinal purposes (Anon, 1982). A much larger number of "raw" extracts are used in traditional medical practices. Although these are not purified into separate compounds, many are believed to exert therapeutic effects good enough to be proven effective by modern analysis.

Uncontrolled Exploitation

Despite all their importance, medicinal plants are, for the moment at least, seldom handled within an organized, regulated sector; most are still exploited with little or no regard to the future. As noted, escalating consumer demand is already resulting in the indiscriminate harvest of wild plants. This is damaging both ecosystems and their precious biodiversity. The damage is especially serious when bark, roots, seeds and flowers—all essential for the species' survival—are removed.

Concern is growing that many medicinal plants (not to mention the knowledge about their use) are on the verge of extinction. The need to protect rare medicinal plants seems to be urgent. Samples collected today may in the future be found to combat dreaded diseases, but there is no guarantee that the plant will then still exist. This could be unfortunate not only for the patients but for the countries that could develop lucrative industries out of the budding resource.

China's situation gives some sense of the scope of this problem. There, more than 80% of the 700,000 tons of plant material harvested each year comes from wild sources. The destruction of forests, overgrazing of meadows, expansion of industry, and increasing urbanization, as well as the excessive collection of wild plants all mean that the natural sources of medicinals for a billion people are being rapidly reduced.

In country after country, reducing exploitation rates is clearly necessary if vulnerable wild populations are to survive, let alone to recover. A look at the legislation regarding harvesting and trading indicates that it is ineffective as it now stands. New policies and rigid enforcement are needed.

Although it is obvious that the economic value of medicinal plants is enormous, the true size of the sector is undetermined. Data are scarce or non-existent; detailed information on medicinal

plants is seldom collected (and in some cases deliberately so). As a result of the uncertainty, no conservation action has been taken for most of the threatened species.

National Conservation Activities

Despite the fact that not much is being done to conserve medicinal plants, a few governments are trying to protect some local species. Their efforts include improving the methods of collection as well as the deliberate cultivation of the plants. The goal is normally to ensure proper quality control and to regulate commerce for the protection of both producer and consumer. These few governments are also involved in educating their populations and in creating greater awareness of the importance of medicinal plants as a whole. Examples follow.

China

- Some 35,000 items of ethno-pharmacological data have been entered into data bases.
- The Institute of Medicinal Plant Development, a WHO Collaborating Centre of Traditional Medicine, in Beijing specializes in the research of medicinal plants.
- The Center of Traditional Medicine—which includes a genebank and a botanical garden in Beijing, with branches in Yunnan and Hainan Island—undertakes R&D in medicinal plants. (These programs all operate under the auspices of the Chinese Academy of Medical Sciences.)

Thailand

- Thailand's Primary Health Care Program recognizes and even promotes herbal and traditional medicine.
- A National Committee on Medicinal Plants has been established and charged with developing a nationwide policy. This policy will include support for ethnomedical and botanical surveys, an information system and data base, the manufacture and export of traditional medicines based on plants, and the conservation and cultivation of medicinal plants on a national basis.

Indonesia

- A medicinal-plant garden (Hortus Medicus Tawangmanguensis) has been established at the Center for Research and Development of Industrial Plants.
- The Department of Health operates a country-wide program called "the living pharmacy" to take the benefits of medicinal plants to the various and widely scattered rural areas throughout the archipelago.

India

- The Central Council for Research in Ayurvedic, Unani and Siddhi medicine and homeopathy undertakes R&D into botanicals.
- The Indian Pharmacopoeial Laboratory analyzes traditional healing-plant materials.
- The Indian Forestry Service and the Forestry Research Institute both have programs on the planting and encouragement of medicinal herbs in the forest understory.
- The Botanical Survey of India includes medicinals in its assessments of the Subcontinent's plant resources.
- The State Department of Tribal Welfare promotes herbal medicines because the tribal peoples tend to rely on these even more than most Indians.
- The Arya Vaidya Sala, an important center of Ayurveda medicine at Kattakkol in the state of Kerala, operates a college, hospital, factory, and research laboratory for medicinal plants. It also operated a herbal garden and two farms that cultivate medicinals.
- The Tropical Forest Research Institute at Jabalpur in the state of Madhya Pradesh emphases medicinal plants that can be grown among the trees. It cultivates and distributes plant materials to pharmaceutical enterprises.

Bangladesh

- The newly established Research Institute on Herbal Medicines has recently been preparing a "formulae" of traditional medicines. This formal document—being constructed with inputs from government, universities and private organizations—will establish protocols for evaluating traditional remedies, as well as the processing, production, licensing and marketing of medicinal plants.

Sri Lanka

- The Ministry of Indigenous Medicine has established (with WHO assistance) medicinal-plant nurseries. It has also declared a number of natural areas to be "Medicinal Plant Reservations."
- The Bandaranaika Memorial Ayurvedic Research Institute undertakes research into medicinal plants as well as into the formulation of products from them.
- The Royal Botanical Gardens in Peradeniya and several private gardens maintain living medicinal plant collections.
- Botanical surveys that include therapeutic plants are being carried out by the Wildlife Conservation and Forest Departments.

Ethiopia

- The Biodiversity Institute (formerly Plant Genetic Resources Center) plays a leading role in getting medicinal plants into cultivation. It has a well established program of conserving plant genetic resources and is complementing its gene banks by establishing on-farm conservation. It recently established a collaborative program with regional traditional health practitioners, providing among other things land for growing medicinal plants.

International Conservation Activities

Although the situation is hardly clear, one can say with confidence that globally speaking little has been done to conserve medicinal plants in any organized fashion. In spite of the rising trade in medicinals, few policies at the national and international level encourage cultivation programs or protect the resource base. Moreover, since the 1988 Chiang Mai Declaration *Saving Lives by Saving Plants* (WHO/IUCN/WWF, 1993), few genetic conservation efforts now incorporate species used in traditional medicine. Many countries have "gene banks" of course, but these repositories are mainly dedicated to food-crop germplasm, not many contain any medicinal plants.

The Consultative Group on International Agricultural Research (CGIAR)—with its network of 17 international agricultural research centers and programs in natural resource management, germplasm conservation, institution building, and networking—would seem to be well placed to play a role in medicinal plant conservation and cultivation. However, its primary focus is food crops, and a review of past CGIAR Annual Reports fails to reveal attention to any medicinal-plant activities.

Privately funded international agencies seem to be the current leaders in conserving medicinal-plant biodiversity, or at least in highlighting the need. These organizations include the World Conservation Monitoring Center (WCMC), the World Wildlife Fund for Nature (WWF), the Nature Conservancy, the International Union for the Conservation of Nature (IUCN), and several botanic gardens (notably, Kew, Edinburgh, New York, and Missouri Botanical Gardens). One notable endeavor is the joint collaboration between IUCN, WWF and the International Plant Genetics Resources Institute (IPGRI), which has drawn up guidelines for establishing a network of wild-species seedbanks in botanic gardens.

Many non-government organizations (NGO's) are collaborating with local interest groups to strengthen the traditional healthcare systems. A few are also assisting in programs to conserve and cultivate medicinals.

3. MEDICINAL PLANTS IN WORLD BANK PROJECTS

At present medicinal plants are hardly a priority in the World Bank's financial, analytical and/or advisory services. A preliminary review of abstracts listed in the Lending Operations Database and the Report Bibliography Service turned up only six references to the words "medicinal plant" and "traditional medicine" in the period covering FY 79 to the present. These six were the following:

- Projects in both Pakistan and Indonesia seeking to overcome constraints to incorporating traditional-health practices into government healthcare efforts.
- A general review of traditional medicine in Sub-Saharan Africa, which had found that traditional medicine was an important source of healthcare for educated, as well as less privileged, people. (It also concluded that traditional healers were important human resources.)
- Projects in Turkey, India and Madagascar that were establishing programs to conserve and cultivate a range of genetic resources, including some medicinal plants. Each project was oriented particularly toward strengthening institutional capabilities, and dealt with the plants only secondarily.

A search of Operational Directives, Operation Policies, Bank Procedures, and Good Practices, revealed only one reference to medicinal plants. This (found under Good Practices) covered a sectorwide strategy for forestry development. In one section the strategy emphasized the economic importance, particularly to the poor, of non-timber forest products (notably, nuts, fruits *and medicinal plants*). It noted that information on these products is rarely available or analyzed.

Three recent World Bank publications, two: *Investing in Health*, 1993; and *Better Health in Africa*, 1994, clearly recognized the role traditional healers can play in helping the informal health sector and modern healthcare systems, but neither provided any detail. The third publication, *Traditional Knowledge and Sustainable Development* (Davis and Ebbe,1995) discussed the contribution and importance of plants in traditional medicine to the health and well-being of the world's population.

Country reports dealing with China, India, Indonesia, Philippines, and Pakistan identify medicines, crude drugs, and/or pharmaceuticals in production and export trade tables (see, for example, *China: Foreign Trade Reform*, 1994, pp262, 263, 303).

The country reports from China also identify medicinal-plant components in three projects:

- **Jiangya Dam sub-project**. An important component of this activity in Hunan Province is the resettlement of 14,000 people. These are mainly farm families skilled at growing rice, wheat, maize and soybean, with some rapeseed and tobacco as cash crops. Most are to be resettled at higher elevations in the river valley where they will have to develop new farm lands and new crops. They are expected to switch to predominantly cash-crop production that will include medicinal plants, tea, and fruit trees.

- **Southwest Poverty Reduction Project**. Livelihoods in the project area in Guizhou, Guangxi, and Yunan provinces are mostly based on subsistence farming; the families have very limited resources and access to only small amounts of cash. The objective of the Bank-supported component is to increase agricultural incomes. In this regard, approximately 10,000 ha will be planted to medicinal plants (*Eucommia ulmoides, Illicium verum, Lonicera confusa,* and *Ficus* spp.). Farmers have been assured they will receive use rights for a term not less than 50 years for the lands they plant to these perennial crops.
- **Sonliao Plain Agricultural Development Project**. This integrated agricultural development project in Liaoning Province has the primary objective of increasing agricultural production, farm income, and rural employment. A small component of the project is the cultivation of eight species of medicinal plants (names not provided) on 1,333 ha in Kuzuo County.

Global Environmental Facility Activities

Under the GEF only one listed project includes medicinal-plant protection and conservation: the Sri Lanka National Planning and Conservation of Biodiversity Project. This specifically notes that medicinal plants are an important component in the country's rich biodiversity, that they contribute to the healthcare delivery system, and that they are of economic importance in the daily lives of local people. Under the project there are three sub-components relating specifically to medicinal plants:

- Programs for the in-situ conservation of selected medicinally important species,
- Expansion of the ex-situ conservation programs; and
- Research and demonstration on the feasibility of medicinal plant propagation and subsequent promotion of community-based efforts aimed at cultivation and marketing promising species.

4. TOWARD A STRATEGY

It seems unlikely that medicinal plants will decrease in importance anytime soon. For one thing, the number of people demanding greater access to herbal remedies in the industrialized countries seems likely to go on increasing. For another, the healing plants will continue as the primary means of preventive and curative healthcare in the developing countries. Indeed, rising population growth and falling economic levels will probably make these plants more important than today.

Even now supplies of certain species cannot be guaranteed, and the future will see the situation worsen. Many seemingly unrelated natural and man-made activities—among them, the construction of roads and dams, the expansion of cities, deforestation, desertification, and land degradation—will profoundly affect the medicinal-plant supply and costs. The present time therefore offers a unique opportunity to work with developing countries in implementing policies to regulate medicinal plant conservation, cultivation, processing, and marketing.

At this pioneering stage, in which norms and standards for the healthcare of billions of people in the developing nations are going to be rapidly set, a strategy for the future should be developed. This will be far from easy, the medicinal-plant business is fluid, undocumented, and largely unregulated. Much about it is unclear, and will remain that way for some time. But, regardless of the difficulties, a beginning must be made to address this important but neglected area. Elements for such a strategy could include the following.

Policy and Regulations

Any nation's strategy for medicinal plant development needs to consider both current and potential policies and regulations. Among points each nation needs address are:

- Is the use of medicinal plants encouraged in healthcare programs?
- Are there policies for conserving medicinal plants and incentives to encourage local community participation?
- Is there a policy for restoring plants harvested in the wild?
- Are there incentives for collectors and farmers to keep the production of medicinal plants sustainable?
- Does the government support research into these plants?
- What are the policies regarding the export of medicinal plants?
- Are only raw materials exported?
- Is "in-country" processing (which may further help the trade in medicinal plants) being promoted.

Markets and Prices

Any future strategy should be based on good knowledge of the economics and commercial operations surrounding medicinal plants. A preliminary review of available data on markets and prices indicates that at present no complete data for even a single medicinal species is available.

Despite the fact that herbal products are being exported in large quantities, few plant of medicinal importance are subject to international regulations, and little is known about the volume of such trade. There is not even a clearcut understanding about the factors affecting the trade. For instance, almost no data on actual production, employment, pricing, and financial flows between countries is available. The market prices for medicinal plants and materials derived from them provide only limited insight into the workings of the markets and their profits.

All of these uncertainties need to be taken into account in developing strategies and policies for future decision-making purposes.

Conservation

As a matter of priority, any strategy must address the plight of the increasing number of wild medicinal plants threatened with extinction. Some Western countries have adopted protective legislation to control collection and limit the demand of their own species by imposing export restrictions. (This has occurred with ginseng in the forests of United States, for example.) In the developing countries, similar legislation is desperately needed, at least for certain species.

It seems likely that some nature reserves and protected areas can provide a sustainable supply of plant materials for sustaining health. Local people will cooperate in conserving a habitat if their own self-interest is enhanced. Allowing them to gather herbs in the forests, as they have done traditionally, could be an incentive to protecting the whole ecosystem, such as a rainforest. These plants are not like field crops; many can be profitably harvested on small scale and with little disruption to the natural environment. American families, for instance, have for centuries scavenged forests from North Carolina. to Wisconsin in search of ginseng. Protected areas containing reservoirs of medicinal plants might similarly be exploited on a sustainable basis. Not only may this reduce the damage from illegal harvesting, it might perhaps even provide financial resources to build up the native resource.

Acceptance

There is a need to create a greater awareness of the medicinal and economic value of medicinal plants. This is especially important among government officials, farmers, and scientists. Only with their support can the heritage be wisely used, and exploited and conserved at the same time.

Tradition is especially important in the case of medicinal plants. Any strategy to preserve such species will have to take people's needs and perceptions into account. Local users often have a good understanding of how sustainable harvesting should be practiced (Cunningham, 1991).

At present there is little support for strengthening conservation of medicinal plants. How to bring this about should be part of the strategy evolved. Approaches might include participation of:

- *The Public*. It seems obvious that to promote conservation and the sustainable economic use of medicinal plants demands a better dialogue with the recipients of traditional healthcare.
- *Industry*. People who collect medicinal plants in the field are generally unaware that they are destroying the resources that sustain them. Local industries and exporters who pay them, however, are aware that supplies are declining and threatening their livelihood. They should therefore be coopted. It is in their self-interest to participate supportively.
- *Women*. Women play a vital role in collecting and cultivating medicinal plants as well as in dispensing medicines to the family. Their knowledge and input into the decision-making process should be sought from the beginning. Various NGOs and local groups involving women might well spearhead the conservation and use of medicinal plants.
- *Farmers*. The idea of cultivating medicinal plants is not entirely new. Many traditional health practitioners even now maintain their own sources of healing plants. Families commonly plant medicinal species in their home gardens and some encourage the plants to grow in nearby common lands. Local pharmaceutical enterprises also maintain herbal suppliers who sometimes operate farms.

Cultivation

At present, the farming of medicinal plants is small, scattered, and largely informal. Given the increasing global population and consequent rise in demand for medicinal plants, one strategy option is to regard medicinally important species as underutilized crops. Farming these species is not only an alternative to collecting plants from nature, it could help conserve the wild types by relieving some of the pressure on them. Cultivation also permits production of uniform material from which standardized products can be consistently obtained.

Cultivation should be a major part of any strategy. An increasing number of developing countries are already showing an interest in farming medicinal plants—trees, shrubs, lianas and herbs, annuals as well as perennials. In principle at least it seems possible that the cultivation of medicinal plants could be appropriately included in many agricultural and rural development projects. It will demand social acceptance, the incorporation of indigenous knowledge, and farmer and community participation, but it can be done.

Box 3: Market Forces Threaten Healing Ingredients

Rapid urbanization in South Africa is bringing thousands of country people to Cape Town each month. The new arrivals bring with them the tradition of visiting "sangomas" who prescribe herbal medicines.

Gathering herbs from the wild has become a boom industry, and there are fears that some plants, especially those dug up for their roots or bulbs, may become extinct. Attempts by the police to stop people collecting plants have failed. On one occasion six sangomas were arrested while collecting bark in a forest on Table Mountain. Fiona Archer, an ethnobotanist at the University of Cape Town, interceded on their behalf, pointing out to the magistrate that if these collectors were locked up, others would simply take their place. Archer explained, it was an opportunity to cooperate with the healers in finding more sustainable sources for healing plants

The sangomas were released, and the Western Cape Traditional Plant Use Committee was set up. This committee has now discussed with the sangomas plans for cultivating traditional herbs. The healers are enthusiastic about the idea because it will save them a lot of traveling, and ensure them a steady supply of plants. The committee, chaired by Cape Town City Council's director of parks and forests, Peter Rist, has applied to the South African Nature Foundation for funding for a full-time worker and cash to start a nursery.

Wouter van Varmelo, spokesman for the committee, agreed that the authorities would need to be careful about which species were cultivated, and they were still discussing how much control there would be over the nurseries. The crops will be valuable not only to sangomas, who can sell them in the same way the now sell wild plants. They will also form a reservoir of potential pharmaceuticals. Research is needed to find the basis of most of the traditional remedies before the sangomas' knowledge disappears.

Kate de Selincourt, **New Scientist**, 4 January, 1992

The cultivation of medicinal plants provides opportunities for genetic improvement. For one thing, selection and vegetative propagation could produce cultivars that are rich in active ingredients and also have desirable agronomic traits such as good yields, pest and disease resistance, and environmental tolerance.

A well managed cultivation program presents an opportunity for local and national authorities as well as communities to exercise a beneficial influence over commerce in medicinal plants and their derivatives—a process that could guarantee both safety and efficacy and also ensure fair prices to collectors and cultivators. Both in-situ and ex-situ cultivation programs could be promoted especially to protect those rare, endangered and vulnerable species most threatened in their natural habitats.

Box 4: Helping Restore Healing Herbs

India possesses a long unbroken medical heritage. The Foundation for the Revitalization of Local Health Traditions (FRLHT) seeks to rejuvenate that legacy for use by the people of India.

The FRLHT is a non-governmental foundation which has links with the traditional medicine community, modern physicians, community health organizations, scientists, industry and government. Current projects include:

- In-situ and ex-situ conservation of the plants used in traditional medicine.
- Eco-development projects to benefit local communities living around medicinal plant conservation areas.
- Field nurseries to provide planting material for rural households for their primary health needs
- Training in conservation biology.
- Creating public awareness of conservation efforts along with a sense of public accountability.
- Computerized multi-disciplinary databases on medicinal plants.
- International cooperation in traditional medicine.

FRLHT, Bangalore, India. 1994

Quality Control

There is increasing concern regarding the quality of medicinal plant material being delivered to local pharmaceutical industries and the length of storage prior to processing. The storage time is of particular concern because of loss of efficacy. Any future strategy should encourage better handling and prompt deliveries.

Therapeutic products from plants differ crucially in one particular aspect from those from a laboratory: they are subject to the vagaries of nature. A compound from a chemical reactor inside a factory is identical batch after batch, but the amount of product in living plants can change with such factors as the weather, the time of harvest, and the way the crop is harvested and handled.

Any strategy must address this variability. Investigations should be made into the stability of each herbal product, taking into account such practices as the effects of sunlight, temperature, humidity, plant husbandry, and packaging.

Box 5: The 200-year Treatment

One of the great complaints in the late 1700s, was dropsy. People in later life came down with sodden, flesh, fluid-filled chests and grossly swollen bellies. Physicians of that era spent much of their efforts attempting to rid patients of the burden of excess fluid. All seemed in vain until, in 1775 William Withering visited an old Shropshire woman suffering from dropsy. She was seemingly far gone but a few weeks later, the good doctor, who spent much of his time treating the poor, found her much improved. He discovered she had taken a local folk-remedy that included more than 20 different herbs. Upon consideration, Withering decided that the active herb was the European wild flower known as foxglove.

He then used foxglove extracts on his own patients with dramatic effect, achieving a high proportion of cures. One man, for instance, shed 40 pints (about 10 liters) of fluid in two weeks. Withering, quite logically, thought the drug worked through the kidneys. He spent 10 years looking into that potential but only after his death was the real story recognized: foxglove acts not on the kidneys but on the heart. Its components improve the circulation of the blood, which in turn flushes out the accumulation of excess fluids.

Today, the common foxglove provides the world's major heart medicines, digitoxin and digoxin. These have so far resisted attempts at commercial synthesis; it is still necessary to use plant material for every dose administered. Each year American doctors write more than 16 million prescriptions for these compounds as well as 2.5 million prescriptions for the undifferentiated extract of foxglove leaves. All are still derived from the dried leaves, sometimes from the British foxglove *Digitalis pupurea* but mostly from the European *Digitalis lanata.*

Millions of-heart sufferers owe their lives to this. Digoxin and digitoxin, strengthen and regulate their heartbeat. This success and the consequent relief of human misery is thanks to the inquisitive and insightful country doctor, who established beyond doubt the great value of various foxglove samples the poor folk of Shropshire were employing two centuries ago. We have now benefited from William Withering's wisdom for two centuries.

Environmental Issues

Any forthcoming strategy should address the ecological soundness of the conservation, management, and cultivation initiatives. Farming medicinal plants can in principle be an environmental benefit. For example, in marginal, remote, and/or degraded areas it may increase income and land values, which in turn may promote better soil conservation and more environmentally friendly land-management practices.

But cultivation may also exacerbate environmental problems. Pesticides and fertilizers, for instance, represent a risk if indiscriminately used. In the United Kingdom there is even now a proposal to produce 20,000 tons of daffodil bulbs annually, for galanthamine, a product thought to slow the progress of Alzheimer's disease (*The Independent*, May 23, 1995). Such large scale production implies monocropping, perhaps with accompanying pest problems and a possible need for pesticides.

Institutional Capacities

At present few developing countries have the resources or institutional capability to advise on policy and regulatory mechanisms and to provide the level of research required to guarantee a production of medicinal plants to sustain local pharmaceutical industries and provide for healthcare needs. The subject tends to fall into two government ministries that normally don't deal directly with each other: agriculture and health. They would have to coordinate programs if medicinal plants are to be cultivated.

International Actions

Countries facing the problems of declining medicinal-plant resources probably have a lot to learn from each other. Collaboration between countries such as China, India, Ethiopia, Indonesia where cultivation programs are being developed is one approach. Another is to get those countries to cooperate with the others who have not yet begun to take stock of their medicinal-plants or whose resources are just too limited for the task.

The international research institutions can possibly play a major role in providing expertise in developing local capacities and assisting governments in framing appropriate laws to ensure protection of medicinal plants and to control their exploitation. As already noted, international agencies such as WHO, WWF, IUCN, and IPGRI also have experience to offer. They are presently playing a limited, but increasing role in medicinal plant conservation and cultivation. The recently established Botanic Gardens Conservation International (BGCI), linking more than 450 botanic gardens, is potentially a major resource for the conservation and development of medicinal species.

The Ultimate Outcome

Any strategy should maintain the long-term view. In principle at least, medicinal plants could contribute substantially to the overall management of natural resources. Indeed, if given research and policy support, they could potentially become high-value components of many agriculture and rural development programs, perhaps providing upscale alternatives to low-value food crops.

They have an especial promise for the fragile habitats, where conventional farming is fraught with hazard.

All in all, it seems clear that a greater awareness and appreciation for this subject of the healing herbs could be important to development efforts in general. For many countries medicinal plants are a possible "bridge" between sustainable economic development, affordable healthcare and the conservation of vital biodiversity.

The more detailed assessment that is to follow will examine many of the issues raised above. It will also document the use, abuse and development potential of medicinal plants. In particular, it will focus on China, India, and Ethiopia. From all this, it is hoped to derive lessons and, where appropriate, to propose new best practices. Further in-depth studies are needed to shed light on the issues raised in this paper. More specific information is required in areas indicated in Appendix 1. This will necessitate a series of desk reviews and in-country research.

APPENDIX 1

Topics that require in-depth studies

1. **CURRENT STATUS OF MEDICINAL PLANTS**
   - Trade and Economics
   - Status of medicinal plants
   - Links to modern medicine
   - Links to biodiversity
   - Links to agriculture (good, bad, and misrepresented)
   - Links to forestry
   - Medically useful wild plants
   - Chemical Synthesis and its relation to medicinal plants
2. **FUTURE NEEDS FOR MEDICINAL PLANTS**
   - Genes to maintain productivity
   - Potential for dramatic advances
   - Changing opportunities (new markets, new nutritional or health findings, etc.)
3. **THREATS TO MEDICINAL-PLANT BIODIVERSITY**
   - Current losses of genetic diversity in medicinal plants
   - Threatened wild varieties
4. **PROTECTING MEDICINAL-PLANT BIODIVERSITY**
   - Preserving wild genes
   - In-situ conservation
   - Preserving by utilizing
   - Ex-situ cultivation, conservation
5. **OPERATIONAL ISSUES**
   - Economic issues
   - Policy issues
   - Regulatory issues
6. **SOCIAL ISSUES**
   - Medicinal plants in traditional systems
   - Developing medicinal crops without losing their biodiversity and traditions
   - Encouraging use (and preservation) of traditional medicines, practices, and knowledge
   - Women's and children's issues
   - Enhancing social capital
   - Trust embodied in the traditional healers their herbal cures
   - Income generation
   - Values and constraints not well understood
   - What are required policies, incentives, regulatory framework, research support, market support, market information
7. **LESSONS LEARNED AND IMPLICATIONS FOR THE FUTURE**

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