

Guidelines on the Conservation of Medicinal Plants

The World Health Organization (WHO)

IUCN -The World Conservation Union

WWF- World Wide Fund for Nature

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Introduction

All cultures from ancient times to the present day have used plants as a source of medicines. Today, according to the World Health Organization (WHO), as many as 80% of the world's people depend on traditional medicine for their primary health care needs. The greater part of traditional therapy involves the use of plant extracts or their active principles.

The preliminary results of a study on behalf of WHO has shown that the number of individuals using medicinal plants is large and on the increase, even among young people.¹ It is not just in developing countries that medicinal plants are important. In the USA, for example, 25% of all prescriptions from community pharmacies between 1959 and 1980 contained materials from higher plants.²

Over the last decade or so, the World Health Assembly has passed a number of resolutions in response to a resurgence of interest in the study and use of traditional medicine in health care, and in recognition of the importance of medicinal plants to the health systems of many developing countries. In answer to WHO's call, health authorities and administrators in developing countries have decided to take traditional forms of medicine more seriously and to explore the possibility of utilizing them in primary health care.

This great surge of public interest in the use of plants as medicines has been based on the assumption that the plants will be available on a continuing basis. However, no concerted effort has been made to ensure this, in the face of the threats posed by increasing demand, a vastly increasing human population and extensive destruction of plant-rich habitats such as the tropical forests, wetlands, Mediterranean ecosystems and parts of the arid zone.

Today many medicinal plants face extinction or severe genetic loss, but detailed information is lacking. For most of the endangered medicinal plant species no conservation action has been taken. For example, there is very little material of them in genebanks. Also, too much emphasis has been put on the potential for discovering new wonder drugs, and too little on the many problems involved in the use of traditional medicines by local populations.

For most countries, there is not even a complete inventory of medicinal plants. Much of the knowledge on their use is held by traditional societies, whose very existence is now under threat. Little of this information has been recorded in a systematic manner. Besides the identification and selection of medicinal plants for use in health services, there is the potential that plants hold as an

1 The study is being carried out by the World Federation of Proprietary Medicine Manufacturers (WFPMM) on behalf of WHO and the results will be published shortly.

2 Farnsworth, N.R. & Soejarto, D.D. (1985). Potential consequence of plant extinction in the United States on the current and future availability of prescription drugs. *Economic Botany* 39: 231-240. The figure quoted did not vary by more than about 1% in any of the 22 years surveyed.

inexhaustible reservoir for the identification and isolation of useful chemical compounds for syndromes such as AIDS, for which there is yet no known cure.³

In the light of this situation, WHO, IUCN, and WWF decided that it would be timely to collaborate in convening an International Consultation on the conservation of medicinal plants, bringing together leading experts in different fields to exchange views on the problems, determine priorities and make recommendations for action. The experts at the meeting included administrators and policy-makers in health and conservation, and covered the disciplines of ethnomedicine, botany, education, pharmacology, nature conservation and economics. For IUCN and WWF, this meeting was an important part of their Plant Conservation Programmes.

The consultation took place in Chiang Mai, Thailand, on 21-27 March 1988, with the Ministry of Public Health of the Royal Thai Government as host. A wide range of topics was covered, which included a review of medicinal plant policies (utilization and conservation) in individual countries; the need for information systems, including databases; and the part that botanic gardens can play in the cultivation and conservation of endangered medicinal species. The papers presented have been published.⁴

A lively and stimulating exchange of views took place between conservationists, scientists and health administrators, who were meeting for the first time in the same forum. The participants prepared and issued "The Chiang Mai Declaration – Saving Lives by Saving Plants" (page 47) – which affirms the importance of medicinal plants and calls on the United Nations, its agencies and Member States, as well as other international organizations, to take action for the conservation of medicinal plants.

The meeting divided for part of its time into several working groups to develop a set of guidelines, primarily for governments, outlining in concise form what needed to be done. These guidelines are presented here and will be disseminated widely to governments and relevant institutions throughout the world for adaptation to local situations. Professor Vernon Heywood, formerly of IUCN, prepared the outline, which was developed by the participants. Hugh Synge coordinated the completion of the guidelines after the Conference taking into consideration inputs from participants, and prepared the final text with Olayiwola Akerele, formerly of WHO, and Vernon Heywood.

The Forty-first World Health Assembly (1988) in its resolution WHA41.19 drew attention to the Chiang Mai Declaration and endorsed the call for international cooperation and coordination to establish a basis for the conservation of medicinal plants, so as to ensure that adequate quantities are available for future generations. This places medicinal plants, their rational and sustainable use, and their conservation, firmly in the arena of public health policy and concern.

3 One such development is the systematic screening of plants for anti-viral properties and activity against opportunistic infections in patients with AIDS.

4 *The Conservation of Medicinal Plants*, Cambridge University Press, edited by Olayiwola Akerele, Vernon Heywood and Hugh Synge, 1991. (In English; Italian version in preparation.)

Referred to in the footnotes below as "Conference Proceedings".

The Chiang Mai meeting covered only plants, but traditional practitioners also use animals and minerals in their remedies. Indeed, the threat to animals by medicinal uses can be even greater than the threat to plants. For example, the use of rhino horn in traditional Chinese medicine has decimated the population of Asian rhino over the last two decades. Any future activity on conservation and medicine should cover not only plants but also animals and minerals.⁵

WHO, IUCN and WWF would like to acknowledge the kind hospitality and cooperation of the Royal Thai Government, especially the late Dr Pricha Desawadi and Mrs Wantana Ngamwat for their help. They thank the Danish aid agency DANIDA, the German aid agency GTZ and the United Nations Environment Programme for financial support. They also thank the participants of the meeting, whose names are listed at the end, as well as Dr Liu Guo-Bin, Dr B.B. Gaitonde and Dr G. Stott from WHO for their help. They are indebted to the following for their help in completing these Guidelines: Mme M. Cestre, WHO; Dr N. Farnsworth, University of Illinois; Dr A. Hamilton, WWF-International; Dr M. Holdgate, IUCN, Mr J.A. McNeely, IUCN; Ms Shimrit Lahav; and Mr C. Rose, formerly Director of Media Natura, UK. The printing of these guidelines was funded by a generous grant from WWF, to whom the other organizations express their gratitude.

OBJECTIVES

The aim of these Guidelines is to provide a framework for the conservation and sustainable use of plants in medicine. To do this, the Guidelines describe the various tasks that should be carried out to ensure that medicinal plants are conserved effectively for the future and that where medicinal plants are taken from the wild, they are taken on a basis that is sustainable.

The Guidelines conform to the principles of *Caring for the Earth*⁶, prepared in partnership by IUCN, UNEP, and WWF. *Caring for the Earth* extends the message and scope of the World Conservation Strategy to an ethic of sustainable living, and explains how to integrate conservation with development. Its message is particularly relevant to the issue of medicinal plants, which in many parts of the world are being seriously depleted due to over-exploitation and loss of habitats, resulting in a lack of essential medicines and so reducing options for the future.

The Guidelines also implement one of the recommendations of the Global Biodiversity Strategy⁷, jointly produced by the World Resources Institute (WRI), IUCN and UNEP, as a set of specific proposals to safeguard the world's biological diversity.

5 This was a policy recommendation of a WHO consultation on AIDS and Traditional Medicine (Francistown, Botswana, 1990).

6 IUCN/UNEP/WWF (1991). *Caring for the Earth: A Strategy for Sustainable Living*. Gland, Switzerland. 228 pp.

7 WRI, IUCN, UNEP (1992). *Global Biodiversity Strategy*. World Resources Institute, Washington, DC.

DEVELOPING A STRATEGY

No single sector, private or public, can undertake the conservation of medicinal plants alone. The job requires a team effort, involving a wide range of disciplines and institutions.

The best way to start and orchestrate such a process is for each country to prepare a national strategy for the conservation and sustainable use of its medicinal plants. The process of preparing a Strategy will help in:

- . • developing a consensus on what needs to be done;
- . • assigning tasks to different institutions;
- . • motivating participants to undertake the tasks; and
- . • monitoring progress.

In such a process, the Guidelines presented here would serve as a checklist of tasks to be done. Those preparing a national strategy should consider all the tasks in the Guidelines, but will undoubtedly wish to give more weight to some tasks than others, depending on local needs and circumstances.

The Guidelines assign each task to a target group (e.g., the task of *ex situ* conservation is proposed to botanic gardens). However, the assignation of tasks to specific government departments, government agencies and non-governmental bodies may vary greatly from one country to another. Preparing a national strategy is the way in which countries can ensure that each task is assigned to the institution best able to carry it out.

One way of starting the process would be to hold a regional and/or national workshop, bringing together experts on different aspects of the subject to assess the situation, define objectives, set priorities, and draw up a plan of action. In developing and implementing the strategy, it is essential to work in partnership with those who use medicinal plants – herbalists, plant collectors, health workers and local people, for example. NGOs should also be brought in from the beginning.

An advantage of a national strategy is that it makes it easier for the donor community to identify activities that would match their funding priorities. Already WHO collaborates with and supports Ministries of Health in the development of programmes on utilisation of medicinal plants, IUCN helps many countries prepare National Conservation Strategies, which include the conservation of plants, and WWF funds many projects to conserve plants.

A national strategy is also a good way to secure the involvement and continued participation of the different disciplines involved. One of the remarkable features of the Chiang Mai meeting was the synergy and complementarity of efforts that emerged from the various disciplines present. For example, conservationists learned about how health workers actually used medicinal plants; health policy-makers learned about the efforts of conservationists in maintaining areas of natural vegetation – the ultimate source of their medicinal plants. This synergy was not only very stimulating for the participants, but it also proved very productive and rewarding for the results of the meeting.

Table 1 (overleaf) is a list of the experts whose disciplines can contribute most to the conservation and utilization of medicinal plants. Of course there are many more disciplines that could, and sometimes do, contribute. And of course, not all disciplines, even from those listed, are needed all the time.

Table 1. The experts most needed for a programme of conservation and sustainable utilization of medicinal plants

Agronomists:	To improve techniques for cultivating medicinal plants
Conservation Campaigners:	To persuade the public of the need to conserve medicinal plants
Ecologists:	To understand the ecosystems in which medicinal plants grow
Ethnobotanists:	To identify the use of plants as medicines in traditional societies
Health Policy-makers:	To include conservation and utilization of medicinal plants in their policy and planning
Horticulturists:	To cultivate medicinal plants
Legal Experts:	To develop effective legal mechanisms that ensure that collection of medicinal plants is at levels that are sustainable
Park Managers:	To conserve medicinal plants within their parks and reserves
Park Planners:	To ensure the park and reserve system contains the maximum diversity of medicinal plants
Pharmacognosists:	To study the application of medicinal plants
Plant Breeders:	To breed improved strains of medicinal plants for cultivation
Plant Genetic Resource Specialists:	To assess and map the genetic variation in medicinal plants and maintain seed banks of medicinal plants
Plant Pathologists:	To protect the cultivated medicinal plants from pests and diseases without using dangerous chemicals
Religious Leaders:	To promote a respect for nature
Resource Economists:	To evaluate the patterns of use and the economic values of medicinal plants
Seed Biologists:	To understand the germination and storage requirements of the seed of different medicinal plants
Taxonomists:	To identify the medicinal plants accurately
Traditional Health Practitioners:	To provide information on the uses and availability of medicinal plants

THE ROLE OF INTERNATIONAL ORGANISATIONS

At the Chiang Mai meeting, it was agreed that the main role of international organisations should be to encourage and support the work of individual countries, in particular in designing and implementing their national programmes on the conservation of medicinal plants. International organisations can also help by developing guidelines and monitoring their implementation. In particular, they can promote the exchange of information and expertise and the transfer of technology within and between countries, and so help countries to learn from each other's experience.⁸

⁸ For more details, see Akerele, O., "Proposals for International Collaboration", in the Conference Proceedings.

Since the meeting, WHO has continued to expand its work on medicinal plant utilization, through promotional activities and development of specific guidelines⁹. IUCN has continued to develop its policies for conservation of medicinal plants, both *in situ* and *ex situ*. WWF has continued its joint project with the Ministry of Indigenous Medicine in Sri Lanka as a practical model of medicinal plant conservation (see p. 23), commissioned a report by Conference participant Dr Tony Cunningham on the threats facing medicinal plants in Africa¹⁰, and funded a range of ethnobotanical studies, mainly in rainforest countries. Also since the meeting, Botanic Gardens Conservation International¹¹, set up by IUCN and now an independent organization, has been encouraging botanic gardens to conserve medicinal plants, particularly *ex situ*, a policy supported by recommendations of a number of meetings hosted by WHO.

Participants felt that the range of international organizations involved in the conservation of medicinal plants should be broadened. UNESCO, for example, could contribute through its Man and the Biosphere programme, especially through utilizing the extensive network of biosphere reserves for conservation of medicinal plants. FAO has already been active on this issue and is one of the three sponsors (with the International Society for Horticultural Science – SIHS – and the Research Institute for Medicinal Plants) of a Newsletter of Medicinal and Aromatic Plants.¹² The UN Industrial Development Organization (UNIDO) also has activities on medicinal plants, in particular on transfer of technology for their genetic improvement.¹³

One task that should be done at the international level is the development of a common design for databases on the conservation and sustainable use of medicinal plants. This should involve lead agencies such as WHO, FAO, UNIDO, UNESCO and IUCN.

Within the limits of their financial and other resources, WHO, IUCN and WWF will consider requests from countries for assistance to implement these Guidelines.

9 *Guidelines for the Assessment of Herbal Medicines*. Programme on Traditional Medicines, WHO, Geneva. 1991. (Doc. WHO/TRM/91.4).

10 Cunningham, A. B. (1990). *African Medicinal Plants: Setting priorities at the interface between conservation and primary health care*. Report to WWF-International. 66 pp.

11 Until 1992 it was called *the Botanic Gardens Conservation Secretariat*.

12 An ISHS Working Group on medicinal plants, in conjunction with the International Union of Biological Sciences, met in Berlin at the time of the Chiang Mai meeting, and drew up some conclusions on the conservation of medicinal plants.

13 UNIDO has hosted a series of consultations on the industrial utilization of medicinal plants.

A. BASIC STUDIES

1. TO STUDY TRADITIONAL KNOWLEDGE ON THE USE OF PLANTS IN HEALTH CARE

The natural vegetation of the world is disappearing or being altered at an alarming rate. Many cultures that have lived close to nature, depending on its products for their needs, are suffering rapid cultural, social and economic change. These people had a deep understanding of the properties of their local plants – a knowledge that is itself endangered.

Ethnobotany, the study of how people in traditional societies use plants, has great potential to provide new and useful plant products for the benefit of the world. Many of the plant extracts used in western medicine were discovered through their uses in traditional societies, though not necessarily for the same purpose. Equally important, however, is how ethnobotany can help local communities adapt to changing circumstances.

The practices of ethnobotany are themselves being modified to ensure that the rights of traditional peoples to their knowledge are safeguarded and that these people benefit from any commercial discoveries made from their knowledge.

The great knowledge on plants of traditional people in predominantly wilderness areas, such as of the Yanomani in Brazil, has received much public attention, but the Chiang Mai meeting also drew attention to the herbal knowledge of the urban poor in cities across the developing world. These people brought from their villages to the cities much valuable knowledge on herbal remedies that is rarely studied. Indeed, modern health care can benefit not only from the remarkable knowledge of indigenous peoples but also from the traditional practices found in virtually all cultures around the world.

For many years, WHO has been encouraging countries to re-examine their systems of traditional medicine and practices. Such an examination is much easier in systems of medicine for which the philosophy and educational content are well documented, such as Ayurveda or Unani, than in systems of traditional medicine handed down from one generation to another by word of mouth. In spite of the difficulties, the examination of the latter systems holds great promise for the future benefit of mankind.

1.1 Each country should identify and support one or more institutions to plan, coordinate and implement ethnobotanical surveys.

So far, most ethnobotanical surveys have been carried out by individuals, rather than by institutions. If the useful information of traditional peoples is to be documented before it is too late, ethnobotanical activities must be broadened and accelerated. To do this, the primary responsibility should move from the individual researchers to selected institutions, who can then provide the support, encouragement, coordination and implementation that are needed.

1.2 The selected institution(s) should implement a nationwide programme of surveys on the use of plants for medicinal purposes in traditional societies.

The teams carrying out the surveys should be multi-disciplinary, and should include the traditional practitioners as part of the team, and not treat them as people to be interviewed.

To carry out this guideline, in the case of virtually all countries, training in ethnobotany will be needed to provide the necessary personnel.

It is worth noting that the guideline only covers the use of plants as medicines. Although the term "ethnobotany" is often used in this context, the correct term is "ethnopharmacology", which is the subset of ethnobotany that covers the **medicinal** uses of plants.

A checklist of requirements for an ethnobotanical survey¹⁴

The researcher should:

Collect voucher specimens of the plants used as medicines and get a qualified taxonomist to verify their identity;

Document the **parts** of the plant used in the preparation of the drug and their condition (e.g., whether fresh, dried or processed);

Document the way in which the medicine is prepared and used and by whom;

When describing the illnesses treated with a medicinal plant, document the ethnic group, age, sex and other appropriate historical data on the patient(s) that would aid in defining the state of the disease;

Wherever possible, estimate the relative abundance of the medicinal plants in the areas of collection;

Document when, how and by whom the plant material is collected and how it is traded

1.3 The data on ethnobotany should be catalogued and analysed but only disseminated in such a way that the communities providing the data would receive benefits from any commercial use of the information.

The data should be catalogued, preferably using computer databases¹⁵, to permit comparisons from one study to another, and to ease retrieval of the information.

14 A useful and more detailed account of methods is given in Lipp, F.J. (1989), Methods for ethnopharmacological field work, *Journal of Ethnopharmacology* 25: 139-150.

15 There are a range of regional and other databases on the uses of medicinal plants. One of the largest and most important is NAPRALERT (short for Natural Products Alert), established by Professor Norman Farnsworth and colleagues. NAPRALERT contains records from the world literature on the chemical constituents of plant, microbial and animal (primarily marine)

The communities that provide the information should receive benefits from its commercial exploitation. The ownership of genetic resources – and of information derived from them – is a controversial issue and, since it was not discussed at the Chiang Mai Consultation, no specific recommendations are made on it. Some people regard genetic resources as an important part of a nation's heritage that should only be made available in return for financial compensation¹⁶, while others believe there should be no restrictions on access and that genetic resources should be freely traded. A number of countries have requested WHO and related UN agencies to prepare guidelines on this issue, which is also addressed by the Biodiversity Convention signed at the UN Conference on Environment and Development (Rio de Janeiro, 1992).

It is particularly important to exchange information both within and between countries. National databases (see 2.4) would facilitate this, though data that could be of commercial value could be "hidden" until appropriate patenting was complete. At the international level, the information may be disseminated through the expanding network of the WHO Collaborating Centres for Traditional Medicine.

1.4 The Ministry of Health should incorporate proven traditional remedies into national programmes of Primary Health Care.

This guideline is in accordance with a policy recommendation made at Alma-Ata (1978)¹⁷ that called for, inter alia, the accommodation of proven traditional remedies in national drug policies and regulatory measures.

extracts, and on the chemistry and pharmacology of secondary metabolites of known structure derived from natural sources. For details write to NAPRALERT, College of Pharmacy, University of Illinois, Chicago, Illinois 60612, USA.

16 Proponents of this view have proposed various procedures for publication of ethnobotanical information. At an international botanical meeting in Malawi in 1991, a procedure was recommended under which ethnobotanical findings of potential commercial value would **only** be published after a 3-way agreement had been signed between the community providing the information, an evaluation laboratory and a commercial partner. Under such an agreement, royalties on any commercial sales would be paid to the community concerned.

However, proposals of this kind could prove very difficult to enforce legally, for a number of reasons. These include the question of identifying the community in a legal sense and the difficulty of deciding how to share the revenue when more than one community knows the use of the plant concerned. Changes in law would be needed, since at present, under all or virtually all national jurisdictions, communities do not have **legal** rights to their traditional knowledge.

17 International Conference on Primary Health Care, Alma-Ata. World Health Organization, Geneva, 1978.

The Ministry of Health should be responsible for approving selected plant remedies for use in the health service, as well as banning the use of dangerous plants and products.

1.5 Traditional Health Practitioners (THPs) should constitute themselves into national bodies.

Such national bodies are crucial to the process of introducing traditional practices into national health care. They would facilitate information from the Ministry of Health to reach THPs, and the experiences and problems both of individual and groups of THPs to reach the Ministry. In particular, such a body could provide information from which an "early warning system" could be devised to show which medicinal plants are becoming scarce and so in need of conservation action.

2. TO IDENTIFY THE MEDICINAL PLANTS, OUTLINE THEIR DISTRIBUTIONS AND ASSESS THEIR ABUNDANCE

To use and conserve medicinal plants effectively, it is vital to know precisely which are the species concerned, what are their correct names, and where they grow.

There is no accepted global list of the over 20,000 medicinal plants in use today. In many cases medicinal plants have been mis-identified. For these and other reasons, any country's programme to use and conserve medicinal plants should include a stock-taking to identify its medicinal plants, outline their distributions and assess their scarcity or abundance.

2.1 Each country should have:

- a) an adequate national herbarium¹⁸ with a botanical library, so that plant material can be adequately identified and stored within the country; and
- b) a cadre of well-trained botanists able to identify plants, who can staff the herbarium and other botanical institutes and departments.

Plant identification

Botanists identify plants using herbarium specimens, that is dried, pressed plants in folders or mounted on paper or card. The advantage of herbarium specimens is that they take up little space and that they last for hundreds of years. Using them, a botanist can compare a specimen collected with hundreds of other specimens whose identities have been verified by specialists over many years. Therefore, samples of medicinal plants should be collected and prepared as herbarium specimens. The specimens should include all the organs required for accurate naming, such as flowers, fruits, seeds, roots and normal leaves.

18 Guidelines on how to set up and manage an herbarium are given in *The Herbarium Handbook* by L. Forman et D. Bridson, published by the Royal Botanic Gardens, Kew, Richmond, Surrey TW9 3AB, UK. Kew also runs an annual 8-12 week International Diploma Course in Herbarium Techniques, aimed at herbarium technicians; for details write to the Keeper of the Herbarium at the above address.

Specimens should be adequately labeled. The label should include a unique reference consisting of the collector's name and a sequential number, e.g. Smith 2568. Material from the same collection, such as microscope slides, should always carry the same reference. The label should also include full details of the locality and habitat, as well as those characters of the plant which cannot be seen in the dried specimens, e.g. the height of trees, the colour of flowers.

The specimen should be identified with the scientific (Latin) name of the plant. In practice, there is a high level of mis-identification, both of herbarium specimens and even in the literature. Therefore the determination should be checked by a competent taxonomist; this requires access to a major herbarium and to reference literature. It is estimated that there are around 250,000 species of flowering plants in the world, and many of them need specialists for their identification. Groups of plants for which specialists are most often needed include orchids, palms and grasses.

One problem in naming plants is the occurrence of synonyms – more than one scientific name for the same plant. The correct name is the one that conforms with the International Code for Botanical Nomenclature, but in some cases botanists may disagree over which name is correct, in others well-known names may be overturned for technical reasons and in others botanists may not know which are the correct names without laborious nomenclatural research. More frequently, however, botanists may disagree over the taxonomic position or rank of a plant, so leading to more than one name for it, each equally valid. To ensure consistency of names, especially when plants are mentioned in legal texts, it is recommended that the national herbarium (or equivalent organization) should prepare a list of Standard Names, which would then be followed in legislation and in the literature.

There are even cases, albeit rare, where the same scientific name is used by two different authors for two quite different plants. For this reason, the name of the botanist or botanists (called the "authority (ies)") who coined the name should be added after it (except when a list of a Standard Names is followed).

Vernacular names are useful and important, but are not always easy to correlate with scientific names. One plant species can have many vernacular names, each used in a different part of the plant's range. Conversely, one vernacular name may refer to different plant species in different areas. Nevertheless, vernacular names are often a useful clue to the scientific identity of a plant, and are needed in communicating back to the practitioners who use the plants.

Although the species is the normal unit of plant classification, botanists may further divide species into subspecies (major subdivisions, usually on a geographical basis), varieties (small, local or otherwise distinctive variants) and forms (usually individual genetic variants within populations). These subdivisions are particularly important for medicinal plants, as the medical effect of the plant may vary from one variant to another. Indeed, many species consist of a range of distinct chemical forms, types or races, which cannot be recognized one from another by their visible characters, but have markedly different chemical properties, which may influence their pharmacological content.

2.2 Botanical institutions should make a catalogue of all the plant species used for medicinal purposes in the country.

The following data should be included on each species as far as practicable:

- a) Its scientific (Latin) name, and its vernacular name(s);
- b) Its geographical distribution;
- c) Its scarcity or abundance, population size and conservation status;
- d) Its habitat;
- e) Description of the part of the plant used (e.g. stem or leaf) and how collected;
- f) Its use(s) in medicine, traditional or otherwise;
- g) Its occurrence in protected areas;
- h) Whether cultivated or not, and the availability and location of *ex situ* germplasm.

Where a modern comprehensive Flora of a country or region exists, this should be followed to ensure ease of reference, particularly for legislators.¹⁹

Line drawings or photographs should be included wherever possible.

2.3 The National Herbarium should identify which of the medicinal plants are threatened in the wild so they can be given priority in conservation programmes.

Most developed countries have prepared lists of their threatened plants, often in the form of "Red Data Books". However, most developing countries, especially those with rich tropical floras, have not been able to do so; this is due to a lack of basic field information on the status of the individual plant species, itself caused in part by the very richness of the floras, the lack of trained botanists, and often the speed at which natural vegetation is being lost.

However, in the case where a country cannot yet produce a list of all its threatened plants, it should be able to determine which medicinal plants are threatened, simply because these plants will be better known in the field and in commerce than other species.

In determining plants as threatened, the criteria of the IUCN categories of threat should be followed. These rank the species in large subjective categories that measure the degree of threat to the species, and hence the likelihood of its local or complete extinction.²⁰

¹⁹ For example, the Member States of the Council of Europe have agreed that the names given in the reference book *Flora Europaea* would be used as Standard Names for European conservation databases and lists, including the species listed in the Bern Convention. For more details see Heywood, V.H. (1991), Needs for stability of nomenclature in conservation, dans *Improving the Stability of Names: needs and options* (D.L. Hawksworth, Ed.), Koeltz Scientific Books, pp. 53-58 and IUCN (1986), The IUCN proposal, in *Threatened Plants Newsletter* 16: 21-22.

²⁰ The categories are Extinct, Endangered, Vulnerable, Rare, Indeterminate and Insufficiently Known. a booklet defining the categories and explaining how to apply them, with examples, is available from Threatened Plants Unit, World Conservation Monitoring Centre, 219c Huntingdon Road, Cambridge CB3 0DL, UK (Fax +44-223-277136).

2.4 Wherever possible, information on medicinal plants should be stored in computerized databases, which should follow international data standards and transfer formats where they exist.

Putting the information into computerized databases has the advantage of enabling retrieval in many different ways yet permitting a constant process of refining and updating. The use of international data standards and agreed transfer formats enables institutes to share and contribute information more easily with each other, and greatly saves in the time and cost of developing database systems.²¹

²¹ Standards for plant databases are set by the International Working Group on Taxonomic Databases for Plant Sciences (TDWG), a consortium of botanical institutes and database projects that is now a Commission of the International Union of Biological Sciences. For a summary of relevant standards, see Heywood and Synge in the Conference Proceedings and for more information write to the TDWG Secretariat, Missouri Botanical Garden, P.O. Box 229, St Louis, Missouri 63166-0299, USA.

B. UTILIZATION

3. WHEREVER POSSIBLE, TO CULTIVATE THE MEDICINAL PLANTS AS THE SOURCE OF SUPPLY

The best way to provide the plant material needed for medicine is to cultivate the plants. This is far better than collecting the plant material from the wild since it does not deplete wild stocks, and in many cases, the declining habitats of native plants can no longer supply the expanding market for medicinal plant products. In the case of rare, endangered or over-exploited plants, cultivation is the only way to provide material without further endangering the survival of those species.

Cultivation also has pharmacological advantages over wild-collecting. Wild-collected plants normally vary in quality and composition, due to environmental and genetic differences. In cultivation, this variation - and the resulting uncertainty of the therapeutic benefit - is much reduced. The plants can be grown in areas of similar climate and soil, they can be irrigated to increase yields and they can be harvested at the right time. Cultivation also greatly reduces the possibility of mis-identification and adulteration.

Many countries have long traditions of cultivating medicinal plants. For example, in some countries, housewives traditionally grow a range of herbs essential for the health care of their families in pots around their houses. Yet in others, most medicinal plants are still collected from the wild; as human populations increase, as forests decline and as areas of remaining wild habitats become locked into parks and reserves, people in some areas can no longer collect the plant materials they need. The need to develop the tradition of cultivating the plants is imperative.

Some mixture of regulations (see section 4) and incentives may be needed to encourage cultivation, especially in parts of the tropics where many medicinal plants are slow-growing trees.

3.1 The Ministries of Agriculture and Health should co-ordinate a programme to establish nurseries where the medicinal plants are cultivated.

The WHO Traditional Medicine Programme has outlined two basic strategies for the production and use of medicinal plants: (a) the agro-industrial production and use of medicinal plants of standardized pharmacologically active constituents; and (b) the distribution of seeds, seedlings and/or saplings to individuals and communities for cultivation in home gardens. For example, plants with proven antimalarial properties could be distributed to communities during the malaria transmission season.

1. *Traditional Medicine and Modern Health Care: Progress report by the Director-General*. Paper presented to the Forty-fourth World Health Assembly, 1991. WHO. Para 20.

The programme should involve horticultural experts, for example from botanic gardens, to provide expertise on how to grow the plants and to train local staff.

Cultivating medicinal plants - an example from Sri Lanka

In 1980, with assistance from WHO and UNDP, the Sri Lankan Government established a Ministry of Indigenous Medicine, which emphasized the values of traditional, Ayurvedic medicine. This was very successful, but as people returned to Ayurveda, particularly for their primary health care, the demand for the drugs, based on plants, rose sharply.

Since 1986, with support from WWF and with technical help from the Royal Botanic Garden, Peradeniya, the Ministry of Indigenous Medicine has been setting up nurseries to cultivate the medicinal plants needed by Ayurveda. The nurseries are in the different climatic zones of the country. At least one is in the grounds of a large hospital, so patients can see the plants that are being used to prepare their treatments.

The Ministry of Indigenous Medicine is also preparing legislation to prevent collectors from over-exploiting medicinal plants in nature and to regulate exports of medicinal plant products. The Ministry plans to declare a series of special nature reserves to protect wild medicinal plants and appoint staff to manage them.

This is a unique example of how a Health Ministry can become involved in the conservation of medicinal plants - and also of nature itself - as part of the development of health care in the country.

3.2 Botanic gardens and horticultural/agricultural institutes should improve the agronomy of cultivated medicinal plants and bring into cultivation those species needed in medicine that have not been cultivated before.

The range, quality and effectiveness of cultivation techniques varies widely and there is a need for much greater application of modern agronomic methods.

There are many ways in which agronomists can improve the ways in which a plant is cultivated. For instance, they can devise better ways of propagation, including novel techniques like tissue culture; they can find the optimum combinations of factors such as light, temperature, mineral and water supply; and they can choose the best time for harvest, so as to maximise the active principle.²

2. For more information, see "Agronomy Applied to Medicinal Plant Conservation", by Dan Palevitch, in the Conference Proceedings, 1991.

Many of the species needed for medicine are not normally cultivated and here the botanic gardens and institutes should undertake the whole process of bringing the plant into cultivation, taking the steps shown below.

Checklist of steps in bringing a species into cultivation³

- Collect propagating material of the most suitable genetic material and improve the stock genetically (see 3.3)
 - Find the best form of propagation
 - Find the optimal cultural conditions (e.g. soil, climate, shading, watering regime)
 - Find ways to protect the plants from pests and diseases
 - Find ways to control weeds
 - Choose the best time of harvest
 - Consider the possibility of mechanization
 - Develop the best system for post-harvest storage
-

3.3 Plant breeders should breed more uniform, higher yielding forms of medicinal plants.

Plant breeding has long been used in agriculture to produce improved forms of the plants (called cultivars), adapted to cultivation. But so far it has only been applied to very few medicinal plants. Plant breeding can not only improve the agronomic traits of a medicinal plant, such as by optimizing the architecture of the plant and improving resistance to pests and diseases, but also improve the phytochemical characteristics of the plant, notably to develop a high and uniform concentration of the active constituents.⁴

Most medicinal plants are at present grown as unimproved wild plants, and so tend to be very variable, even in cultivation. Plant breeding can reduce this variability, and so help standardize the medicinal product. Also, plant breeding can adapt the plants for cultivation in different soils and climates, so that the plants can then be grown under a wide range of conditions.

Effective plant breeding requires a wide range of genetic variation in the plant as starting material. This may either come from wild stocks or from *ex situ* conservation (see sections 6 and 7). Botanic gardens in particular have an important role in maintaining wide gene-pools of medicinal plants for plant breeding.

3.From Palevitch, *loc. cit.*

4.Techniques on how to select and breed medicinal plants are outlined with examples by Palevitch (*loc. cit.*). An outline of the use of biotechnology is given in Schumacher, H.M., "Biotechnology in the Production and Conservation of Medicinal Plants", also in the Conference Proceedings.

However, the costly and laborious techniques of modern plant breeding are only likely to be used in the cases of plants grown for high-volume crops needed for modern medicine. The investment needed is likely to be too high for many of the plants used in traditional systems of medicine. In this case, a national programme for plant breeding should take their needs into consideration.

3.4 Cultivation practices should minimize the use of chemicals.

The use of weed-killers and pesticides may represent a risk to the environment, to those growing the plants and to those treated with the resulting drug. Therefore, the use of chemicals (if used at all) should be reduced to an absolute minimum, and where chemicals are used, necessary regulations should be in place and rigidly followed.

3.5 Botanic gardens and horticultural institutes should provide effective horticultural training and information.

Provision for training and information is vital. Training may be the best approach for those working in medicinal plant nurseries. Information leaflets and other forms of extension may be more suitable to help members of the public grow their basic home pharmacies themselves.

4.TO ENSURE THAT ANY COLLECTING FROM THE WILD IS SUSTAINABLE

Sustainability should be the guiding principle for the ways in which people use nature and natural products. True development can only be sustainable development. If collecting a medicinal plant reduces the wild population, continuing to do so will inevitably impair the rights of future generations.⁵

In the past, many societies had complex systems of rules, often unwritten, to control the exploitation of the natural world. As these traditions have broken down, a legal framework is needed to replace them. The basis for that framework, much simplified, is presented below.⁶

5.Guidance on how to achieve sustainable development in general is given in *Caring for the Earth* by IUCN, WWF and UNEP (1991).

6. For more details see de Klemm, C., "Medicinal Plants and the Law", in the Conference Proceedings, and his book *Wild Plant Conservation and the Law* (IUCN Environmental Policy and Law Paper No. 24, IUCN, 1990, 215 pp). The latter critically analyses all the laws that protect plants in the world and provides detailed guidelines to law-makers on how plant conservation laws should be drafted. Anybody considering new or revised laws on plants is strongly recommended to read this book. If further help is then needed, contact the IUCN Environmental Law Centre, Adenauerallee 214, D-5300 Bonn 1, Germany, who offer an advisory service to governments on environmental law. Section 4 of these Guidelines is principally taken from these works.

So far relatively few countries have laws to protect plants, and those that do are mostly in developed regions like Europe and North America. Yet a legal framework is particularly needed for plants, which are at a legal disadvantage over animals. As private property, plants can be destroyed by the owners of the land on which they grow; yet as free produce of nature, in many countries plants can be collected by anyone almost anywhere.

4.1 The Government should regulate the collection of medicinal plants from the wild.

The ideal system is one where permits are required for any commercial collection of any plant. Otherwise, if a new use is discovered for a plant or if there is a sudden demand for a well-known plant, wild populations may be decimated before the Government can bring in specific controls on collecting it.

If this is not practical, regulations can require permits for the commercial collection of certain named plants that are believed to be in danger of depletion. For example, India bans the collection of *Rauwolfia* species, except under a permit.

The advantage of the permit system, as opposed to blanket bans, is that it gives great flexibility to the issuing authority. If a plant is in steep decline in one area, permits can be suspended there for a year or so, but if a plant is on the increase, the volume of material licensed for collection can be increased. This way, the issuing authority can effectively manage the wild populations.

The regulations should take account of the part of the plant used, and of the capacity of the plant to regenerate afterwards. Collecting fruits, flowers and leaves generally has little impact, but collecting bark, roots and even whole plants can be much more harmful. Regulations should also take into consideration harvesting practices.

The regulations should also respect the ethical, legal and social interests of all those concerned, in particular those living in the area where the plants are native. Regulations can be boosted by public information campaigns, to convince traders and users of the need to conserve wild stocks (see Section 8).

Wherever possible, any collecting should be done by trained people, adopting good management and a rotation system, and suitably supervised.

4.2 The Government should prohibit the collection from the wild of threatened medicinal plants except for propagation purposes.

The only exceptions should be to allow the collection of small amounts of the plant as propagating material. This should be done by qualified staff, under permit, and should not further endanger the wild plants.

The legislation should ban not only the collection but also the possession and trade of those plants if collected from the wild. This is necessary for enforcement, as it is very hard to catch an offender in the act of collecting a protected plant, but much easier to catch him or her afterwards in possession of the plant. The legislation should include a prohibition over land-owners collecting material of the plants concerned on their land.

When the collection of a plant used by traditional practitioners is banned, measures should be taken to provide them with alternative species that contain products of similar effect. The practitioners should also be involved in the process of conserving the threatened plants concerned.

4.3 The Government should control trade in medicinal plants and their products.

Trade in medicinal plants should be fully controlled, but in most countries it may only be practical to control trade in and out of the country, making use of customs facilities.

Long-established phytosanitary regulations affect the movement of all plants across international frontiers. The Convention on International Trade in Endangered Species (CITES), now with 115 member nations, controls the movement of a large number of plants listed on Appendices, mainly of species threatened by trade and relatives that are difficult to distinguish from them.

If a government wishes to regulate trade in a species not on CITES, the best means may be by requiring export permits.

By cultivating the medicinal plants they need, governments may be able to replace imports of medicinal plants with home-grown stocks, and so save foreign exchange, ensure quality and guarantee continuity of supply.

5. TO IMPROVE TECHNIQUES FOR HARVESTING, STORAGE AND PRODUCTION

The wide array of medicinal plants requires many different techniques for harvesting, storage and production, yet rarely are these researched and documented. For example, the season at which the drug is collected and the age of the plant may affect the amount and nature of the active constituents.

The processes involved include selection (of wild plants), harvesting (or collection from the wild), cleaning, extraction of the drug, processing and storage.

5.1 Ministries of Agriculture, Health and Trade should develop and co-ordinate a programme to improve the techniques for harvesting and storing medicinal plants and preparing their products.

This may best be done as a collaborative effort, involving pharmacological institutes, horticultural organizations and representatives of the users. It should be remembered, too, that local people often have very good knowledge on how to harvest, store and process medicinal plants.

Some Practical Considerations on Harvesting

- The crop should not be harvested when wet or in conditions of high humidity;
- If mechanical cutters are used, then all parts in contact with the crops should be kept clean and free from accumulated material;
- Harvested material should be collected in sacks or baskets;
- Composting and mechanical damage to the harvested material should be avoided.

5.2 Safety should be the over-riding criterion for use of medicinal plants.

To ensure safety, the Ministry of Health should regulate the preparation of drugs and other remedies from medicinal plants used in their country.

Standard reference material of medicinal plants and drugs derived from them is required. In addition to the need for descriptive monographs on plant materials, there is also occasionally a need for reference substances. Until they can be made available from a central point, WHO is assisting in identifying national laboratories which could supply samples of natural substances to be used for reference purposes.

As part of WHO's efforts to establish the safety of medicinal plants, two WHO/DANIDA inter-regional workshops were held on appropriate methodologies for the selection and use of traditional remedies in national primary health care programmes (Bangkok, 1985; Kadoma, Zimbabwe, 1989). These workshops addressed the problems of safety and efficacy involved in the use of traditional remedies, including related issues of standards, stability and dosage formulation.⁷

WHO have prepared Guidelines for the assessment of herbal medicines, setting out the procedures for assessment of quality, safety, and efficacy and intended use.⁸

7. *Traditional Medicine and Modern Health Care: Progress report by the Director-General*. Paper presented to the Forty-fourth World Health Assembly, 1991. WHO. Para 37.

8. *Guidelines for the Assessment of Herbal Medicines*. Programme on Traditional Medicines, WHO, Geneva, 1991. 4 pp. WHO/TRM/91.31. Available from WHO.

5.3 Appropriate governmental and non-governmental agencies should disseminate information on how to harvest, process and store medicinal plants.

Information is needed for the lay public, who may grow a domestic pharmacy of common herbs around the home, for the commercial grower, and for the health practitioners who use plant products.

C. CONSERVATION

6. TO CONSERVE POPULATIONS OF MEDICINAL PLANT SPECIES IN NATURAL HABITATS

The vegetation of the world is being changed or destroyed at an alarming rate. The tropical moist forests, home to about half of the world's plants, are in particular danger, declining at an estimated 16.8 million ha/annum according to UNEP/FAO. Combined with exploitation, this is putting many medicinal plants in grave risk of genetic erosion and even extinction.

The best means of conservation is to ensure that the populations of species of plants and animals continue to grow and evolve in the wild - in their natural habitats.

Such *in situ* conservation is achieved both by setting aside areas as nature reserves and national parks (collectively termed "Protected Areas") and by ensuring that as many wild species as possible can continue to survive in managed habitats, such as farms and plantation forests.

Managing large areas of natural vegetation is a complex process and goes far beyond simply removing external threats. The experience of protected area managers over many years has shown that the most important step is the preparation of a management plan, which should define the objectives of the area and outline how they can be met.

6.1 The Parks Department² should prepare a policy at national level on the conservation and utilization of medicinal plants in protected areas.

The policy should include:

- Identifying which of the protected areas are most important for medicinal plants;
- Targets and techniques for recording and monitoring medicinal plants in protected areas;
- Techniques and procedures for collection of medicinal plants within protected areas; -A legal mechanism to ensure that benefits reach local people (see 6.3);

1.IUCN's Commission on National Parks and Protected Areas (CNPPA) links together over 300 senior protected area professionals from over 100 countries. It holds regular meetings, publishes a wide range of books and papers on protected areas, and its staff and members provide advice on request about protected area planning and management. For details write to CNPPA, IUCN f The World Conservation Union, Rue Mauverney 28, CH-1196 Gland, Switzerland.

2.The authority responsible for protected areas varies from country to country. For simplicity, the term "Parks Department" is used here for that authority, though it is understood that the authority referred to would be responsible for other types of protected areas as well, such as nature reserves and protected landscapes.

- Training of park managers about medicinal plants, including their uses;
- Public education about medicinal plants in protected areas (see Section 8).

Protected areas that are important sites for wild medicinal plants are good sites for continuing research programmes on genetic improvement of medicinal plants. Linkage with local universities and botanic gardens can often be extremely useful.

The policy should be at national level, but should be implemented by individual park managers. It should be prepared in consultation with conservation and development groups, and other relevant sectors, in particular the Ministry of Health.

In general, the objective of conserving medicinal plants may be compatible with the other objectives of protected areas, such as watershed protection and saving biodiversity. But this will not always be so: in some cases, a management objective, such as promoting tourism or encouraging climax vegetation, may conflict with the need to conserve a medicinal plant. In such cases, certain areas would need to be zoned and conflicting uses controlled.

6.2 The Parks Department should assess the extent to which the protected areas system covers the medicinal plants of the country. It should then create new protected areas and extend existing ones to ensure that all the medicinal plants of the country are conserved.

The starting point for this process is an up-to-date map of the vegetation cover of the country. Images from satellites provide a way to keep this information up-to-date.

Also needed are the data on individual species, gathered under 2.2. These data will most likely be held by national herbaria and botany departments, but ideally should be brought together in one place and entered in a centralized database, to support planning efforts at the national level.

Once the habitat of a species has been identified, botanists can predict where that species might occur, in addition to those places where it has already been found. This enables maps to be prepared highlighting the key areas for medicinal plants.

Species which **only** occur in areas of natural vegetation - as opposed to species in disturbed habitats (such as *Catharanthus roseus*, Rosy Periwinkle, which, outside its natural habitat, is a roadside weed) - should be given priority. Of these species, the endemics - plants confined to the country should receive particular attention.

Park planners can then superimpose maps of:

- a) species distributions;
- b) surviving vegetation; and
- c) existing protected areas.

This will show the extent to which the protected area system covers the medicinal plants of the country, and where the principal gaps in the system occur. Although this can be done manually, using maps drawn on transparent plastic, it is better done nowadays on computers,

using the technology of Geographical Information Systems (GIS).³

6.3 The Parks Department should devise economic and social incentives for maintaining natural habitats and wild species.⁴

Modern conservation planners try to reduce the loss of living resources by showing how conserving biodiversity helps to safeguard the benefits that people derive from wild species. Medicinal plants are only one of these benefits and should be treated together with other benefits, such as protecting relatives of food crops and maintaining supplies of fresh water.

Park managers should ensure that the some of the benefits of conserving medicinal plants accrue to local people. In the past, protected areas tended to exclude local people, in some cases even from their traditional lands and practices, but this is now seen as a mistake. Large protected areas will only survive if they have the support of the people who live nearby. Thus conservation planners try to ensure not only that local people do not lose out from the the establishment of a protected area but also that they actually benefit⁵ .

6.4 Park managers should ensure that the conservation and exploitation of medicinal plants are incorporated into site management plans.

In some areas, it may be appropriate to allow local people to collect limited amounts of medicinal plants in protected areas for their own

3.The following organizations offer help in setting up national conservation databases and in GIS technology: World Conservation Monitoring Centre (219c Huntingdon Road, Cambridge CB3 0DL, UK); The Nature Conservancy (1815 N Lynn Street, Arlington, VA 22209, USA); and Conservation International (1015 18th Street NW, Suite 1000, Washington, DC 20036, USA).

4.Useful suggestions on how to do this, with examples, are given in McNeely, J.A., *Economics and Biological Diversity: Developing and Using Economic Incentives to Conserve Biological Resources*, IUCN, 1988, 236 pp.

5.A wide range of techniques to maximize local benefits from protected areas are outlined in MacKinnon, J. & K., Child, G., Thorsell, J. (1986), *Managing Protected Areas in the Tropics*, IUCN, Switzerland. Many protected areas are now managed to provide benefits to local people - from providing Thatch Grass in Chitwan National Park, Nepal, to water in Canaima National Park, Venezuela, to animals in several of Zimbabwe's protected areas. These benefits should wherever possible be extended to include medicinal plants.

use. This can improve public relations for the park, and may help to discourage illegal and damaging activities. But it should only be permitted to levels that are sustainable, and a percentage of the profits earned from the medicinal plants should be returned to improving management of the protected areas. Where a commercial company makes use of plants from the protected area, arrangements should be made to ensure that the industry contributes to local needs - of both park and people.⁶

In other areas, a policy of absolute protection, except for removal of small amounts of propagating material, may be appropriate. The pharmacologically active ingredients in medicinal plants may vary within the same species, depending on factors such as soil chemistry, type of vegetation, and presence of insect predators. For this reason, to conserve the full genetic diversity of the species, a range of wild populations of each medicinal plant should be maintained, even when the main source of supply is cultivation.

Park departments can also help encourage the process of cultivating the medicinal plants. They can provide seeds and saplings for local people, and can even set up small medicinal plant nurseries in suitable areas.

6.5 Species that are heavily depleted by over-collection should be re-introduced into areas where they once grew wild.

In appropriate cases, species which have become extinct in nature may be re-introduced either to their original localities or if that no longer exists into a similar habitat. Guidelines for such re-introductions are being prepared by Botanic Gardens Conservation International and IUCN's Species Survival Commission.

7. TO CONSERVE POPULATIONS OF MEDICINAL PLANT SPECIES EX SITU

Ideally all medicinal plant species should be conserved as evolving populations in nature. However, these species should also be conserved *ex situ* (i.e. outside their habitat) as well. The primary purpose of this is as an insurance policy. But it also has the advantage that it is usually easier to supply plant material for propagation, for re-introduction, for agronomic improvement, for research and for education purposes from *ex situ* collections than from *in situ* reserves.

The disadvantages of *ex situ* conservation are that the sample of the species conserved *ex situ* may represent a narrower range of genetic variation than that which occurs in the wild. Species conserved *ex situ* can also suffer genetic erosion and depend on continued human care. For this reason, *ex situ* conservation must not replace, but should complement, *in situ* conservation. Most important

6. Various ways of preventing over-exploitation of medicinal plants in protected areas are suggested in McNeely, J.A. and Thorsell, J.W. (1991), "Enhancing the Role of Protected Areas in Conserving Medicinal Plants", in the Conference Proceedings.

of all, *ex situ* conservation should not be used as a reason for failing to safeguard representative samples of the medicinal plants and their habitats in nature.

Priority for *ex situ* conservation should be given to species whose habitats may have been destroyed or cannot be safeguarded. It should also be used to bulk up populations of depleted or even locally extinct plants for restocking in nature (see 6.6, above). In some countries it may be appropriate to conserve **all** medicinal plants *ex situ*, in others, where for example some medicinal plants are common

weedy species, this may not be necessary.

With medicinal plants, it is particularly important to conserve a broad genetic base, to permit improvement in the cultivated material as outlined in Section 3.

When collecting the plant material for *ex situ* conservation, care should be taken **notto** put the survival of the wild population at risk.⁷

7.1 Each country should have at least one functioning botanic gardens

In most countries, botanic gardens are the organizations best suited to carrying out the *ex situ* conservation of medicinal plants. The origins of botanic gardens, in Europe in the 16th Century, were as training centres on medicinal plants, and today many botanic gardens, especially in Asia, have important living collections of medicinal plants. Botanic gardens are also important centres for

7. As a general rule, no more than 20% of the available seed of a population should be taken. The forthcoming guidelines on *Ex Situ* Conservation of Germplasm in Botanic Gardens, being prepared by BGCI (see footnote 9, below) will amplify many of the concepts and practices in this section.

8. The Botanic Gardens Conservation Strategy (see footnote 9, below) gives ten criteria for what constitutes a botanic garden. The most important of these are an underlying scientific research programme and documentation of the plants grown, especially of their origins in nature. Although the botanic garden should be open to the public and its plants should be labelled, most town parks do not qualify because they do not have an associated research programme into the plants they grow.

research and monitoring of wild plant populations, and have a vital educational role as the shop window of botany to the outside world.⁹

7.2 Botanic garden(s)¹⁰ should set up seed banks for the medicinal plants native and cultivated in the country.

Seed banks¹¹ are the best form of *ex situ* conservation for plants. In a seed bank very large numbers of species and individuals can be stored in a small space, but seed banks are vulnerable to loss of electricity supplies, require careful monitoring and do need time-consuming regeneration.

Running a seed bank is a specialized and full-time job, requiring meticulous record-keeping, seed-testing and "growing-out"¹². Little is known of the seed biology of most medicinal plants; in many cases research will be needed to adapt standard techniques to the needs of individual species, and therefore, most important of all, seed banks should include a research facility to study seed biology and population genetics.

One problem is that with existing techniques the seeds of an estimated 50,000 plant species - 20% of the world's total - cannot be stored

9. IUCN created an organization to promote and encourage the work of botanic gardens in conservation. This is now an independent charity, called Botanic Gardens Conservation International (BGCI) and with about 300 gardens as members. Participating gardens receive newsletters and other services. BGCI, with IUCN and WWF, has prepared a *Botanic Gardens Conservation Strategy* (1989), which outlines the tasks that botanic gardens should undertake for the conservation of plants. For membership details and for copies of the Strategy, write to BGCI at 199 Kew Road, Kew, Richmond, Surrey, UK.

10. In some countries, other organizations, such as national and regional crop gene banks, have seed banks that include medicinal plants.

11. In a seed bank, seeds are stored at low temperature, ideally at -20°C ., after they have been cleaned and dried. This delays the loss of their viability; work done on species of food crops suggests that if properly stored, seed may retain its viability for 100 years or more.

The techniques of seed banking have been developed by the International Board for Plant Genetic Resources and the Crop Genetic Resource Centres over the last 20 years, applying them to the major food crops. Botanic gardens, aided by BGCI, are now adapting the techniques to the needs of other wild plant species.

12. The most vital task is to test the viability of the seeds at regular intervals. As soon as the viability drops to a certain level, the staff should either collect a new sample from nature, or "grow out" the remaining seeds from the seed bank and harvest a new crop of seeds, which are themselves then banked.

without loss of viability. These species are termed recalcitrant and for them other techniques are needed. Some other species may not produce seed at all.

7.3 Botanic gardens should set up alternative means of *ex situ* conservation for those species which cannot be stored in seed banks.

For plants where seed banking is not possible, if they are long-lived species like trees and shrubs, the best means of *ex situ* conservation is the Field Genebank. This is simply a plot of land in which the plants are grown in rows and carefully labelled. The disadvantages are that Field Genebanks take up a lot of space, cannot conserve as much variation as in seed banks, and are vulnerable to disease epidemics.

In fact many samples of medicinal plants are already grown in botanic gardens. In some cases, these collections are in the public area of the garden, but in many cases the material is in cold frames and greenhouses. This provides a good temporary measure of *ex situ* conservation as well as providing material for various purposes. Conventional cultivation in flower beds is ideal for demonstrating the interest and importance of medicinal plants to the public, but is of little value for genetic conservation because of the few specimens of each species usually held.

Effective techniques of *ex situ* conservation other than seed banks or Field Genebanks are still in their infancy and need further research before they can be recommended for general use. The main approach under study is cryopreservation - that is the storage of tissue and cell culture at low temperatures, in some cases as low as -196°C .

D. COMMUNICATION AND COOPERATION

8. TO BUILD PUBLIC SUPPORT FOR THE CONSERVATION OF MEDICINAL PLANTS THROUGH COMMUNICATION AND COOPERATION

Building public support for the conservation of medicinal plants is essential and worthwhile for several reasons. To create such support first requires public understanding.

In part due to encouragement from WHO, an increasing number of governments and other agencies are fully aware of the importance of medicinal plants in providing primary health care to their people. Many experts and practitioners now have an in-depth understanding of the issues involved. But without a solid foundation of understanding by the public, essential research and management programmes may not be fully secure at times of political change or financial stringency.

Unless the public, who are the ultimate beneficiaries of medicinal plant resources, fully appreciate the work that needs to go into the conservation of those resources, vital political backing may prove to be fragile. To this end, ministries, agencies and others will find it worthwhile to conduct well-targetted public information and education programmes.

The various tasks involved are summarized below:

8.1 Establish a Communication Strategy.

Wherever possible, scientific experts and administrators should obtain the assistance of communication professionals in drawing up a strategy for communicating the importance of the conservation of medicinal plants.

The strategy should cover communication to the public and to health practitioners at a local level - in effect external communication. It should also be targetted to the relevant policy-makers, administrators and scientists both inside and outside government - in effect internal communication. Many well drawn up communication strategies fail because the organization itself is not seen to "practice what it preaches" and this is often the result of a failure of internal communication.

8.2 Decide who should be involved, both from inside and outside the organization.

Within ministries and agencies, professional staff such as press or information officers will normally be on hand, but their time is frequently taken up with the day-to-day priorities of the organization, and there is a risk that if no distinct, self-contained and comprehensive strategy is drawn up on medicinal plants, the issue and message may get swamped or diluted by other messages, which are justifiably seen as important. Indeed, given the difficulties of delivering effective health care in any country, there is a tendency for communicators in an organization having to deal with the urgent at the expense of the important.

For these reasons it is important to draw up a written communication strategy and to identify the means of implementing it, rather than simply rely on the usual channels to deliver the right message

automatically.

In-house communications staff must be involved in outlining the process, and are essential in implementing it. But there is often a good case for bringing in additional help from outside the organization. Not only would such advisers bring a fresh eye to the problem, but they may be able to devise a strategy that functions well across several agencies or institutions. They will also be able to devote their time to the task in a single-minded way that in-house staff can rarely do. In-house staff should still be involved at each stage, for example by drawing up the brief, selecting the relevant experts, providing them with information, and helping organize the "selling-in" of their work to as many staff as possible within the organization.

Given the support of conservation groups for this "good cause", local advertising agencies or other communication companies may second staff or undertake work free or at a reduced rate. Even if this is not so, asking companies for assistance is a good way to make the communication community aware that medicinal plant conservation is a subject of importance.

There is no single blueprint for a communications strategy but a few principles can be identified:

- Effect desired Identify what the audience is expected to do as a result of receiving the message.
- Core message Define the message in terms which will persuade the particular audience to take the action desired. Deliver only one principal message in each piece of communication.
- Targetting Draw up separate communication activities and materials for different target audiences.
- Planning Produce a written plan for communication activities identifying who will undertake which actions in which weeks and months.
- Research and Monitoring If possible assess the existing perceptions and levels of awareness of the subject among people in the target groups before the campaign starts, and repeat after the campaign. In this way it is possible to measure the results of the work with some objectivity.

8.3 Decide who should be the target audience.

To be effective, communication strategies are most effective when they are targetted at specific groups. In the case of conservation of medicinal plants, there are many groups involved. First and foremost are the users - health professionals, including traditional health practitioners. Then there are the relevant professions, including agronomists, horticulturists, pharmacologists, park managers and plant breeders. In Government, they include policy-makers and legislators. In industry, they include business leaders, in particular from food and pharmaceutical companies. In the media, they include newspaper editors, health and environment correspondents, and TV producers. They also include community and religious leaders as well as staff in conservation organizations.

8.4 Decide what the target audience is requested to do.

Communication strategies work best when the aim is for the target audience to take a particular action as a result of the message.

To do this, the first step is to raise the awareness of the group concerned on the conservation of

medicinal plants as an issue. Awareness itself rarely achieves practical results - it is not, for example, a sufficient condition to cause a desired result - but it is an essential **precursor** to achieving practical results.

Some possible changes that the campaign might seek are listed below:

Improved training in the professions. In this case, as with any dealings with professionals, it is best to use people **from** that profession in selling ideas or information **to** that profession.

Improved practices in the professions. In general the professional associations are helpful in selling-in new ideas if they can be persuaded of the merits of the case. The editors of professional magazines are also often particularly helpful. Information targetted at a profession from outside, however, may be resented.

Incorporation of material into the formal education curricula. It is normally advisable to use existing machinery through established channels, as most educational systems are planned on the longer term. This also presents an opportunity to seek leverage by using existing educational media and budgets to carry the message, and to persuade educational publishers, broadcasters, etc., to do so, rather than to produce new materials. Mass production of formal educational materials is not usually cost-effective in countries with a reasonable educational infrastructure.

Incorporation of information into informal education and outreach. This is an enormous area of potential activity and will vary according to national and local circumstances. In general, however, it is worthwhile for ministries and agencies to work in partnership with nongovernmental organizations, particularly when these have at least some professional staff and a capacity to manage projects. Funding projects such as an education officer on medicinal plants will often unlock large amounts of *pro bono* voluntary resources otherwise unavailable to government.

Encouraging villagers to grow the medicinal plants they need rather than uproot them from nature. This may also be a worthwhile task for schools, youth groups, religious groups, universities and businesses. It can be stimulated by government and other authorities giving them seeds, saplings and other propagating material free of charge.

Examples of approaches that could be taken

-Medicinal Plant Gardens. A collection of medicinal plants within a public parks or botanic gardens, or even in the grounds of hospitals, clinics, forestry stations, hotels or local authorities, can form an intriguing, accessible and popular feature. The garden can be laid out by reference to parts of the body showing the ailments the plants may be used to treat.

-Guided visits and open-days at research facilities and botanic institutes. These events are equally popular with the public and with professionals, although events for these audiences should probably be separated. When, for example, health professionals make such visits, it is

important to have their "peers" on hand to discuss technical matters with them. The public may be most interested in events where they can get "hands-on" experience of the therapeutic use of medicinal plants, especially for self-medication.

-Lectures and formal courses. Lectures and talks may be arranged at the place of work for particular target groups (for example, civil servants in a ministry or doctors in a hospital). In this way, a useful question-and-answer session may develop, which is not possible with even very expensive materials such as exhibitions. Also, a public institution may arrange a series of lectures to the public, and publicise it accordingly.

-Educational Campaigns. The attention of the press and public may often be best aroused by a time-limited "campaign" of public awareness, rather than essential but routine work. While ministries and agencies can play a direct role in such campaigns, it is often better to fund a non-governmental organization to undertake the main activities. For example, the annual tree-planting day could be used to promote the cultivation of medicinal plants in home gardens.

-Protected areas. Many national parks are under-used and few people realise that the plants used in popular remedies can actually be seen in their wild habitat. Efforts should therefore be made to attract people to such areas and to see the plants growing in their natural environment. Where the plants are sustainably harvested, information materials should explain that this does not harm the plant population or the purposes for which the park was established.

Annex 1

THE CHIANG MAI DECLARATION

Saving Lives by Saving Plants

We, the health professionals and the plant conservation specialists who have come together for the first time at the WHO/IUCN/WWF International Consultation on Conservation of Medicinal Plants, held in Chiang Mai, 21-26 March 1988, do hereby reaffirm our commitment to the collective goal of "Health for All by the Year 2000" through the primary health care approach and to the principles of conservation and sustainable development outlined in the World Conservation Strategy.

We:

- Recognise that medicinal plants are essential in primary health care, both in self-medication and in national health services;
- Are alarmed at the consequences of loss of plant diversity around the world;
- View with grave concern the fact that many of the plants that provide traditional and modern drugs are threatened;
- Draw the attention of the United Nations, its agencies and Member States, other international agencies and their members and non-governmental organisations to:
 - The vital importance of medicinal plants in health care;
 - The increasing and unacceptable loss of these medicinal plants due to habitat destruction and unsustainable harvesting practices;
 - The fact that plant resources in one country are often of critical importance to other countries;
 - The significant economic value of the medicinal plants used today and the great potential of the plant kingdom to provide new drugs;
 - The continuing disruption and loss of indigenous cultures, which often hold the key to finding new medicinal plants that may benefit the global community;
 - The urgent need for international cooperation and coordination to establish programmes for conservation of medicinal plants to ensure that adequate quantities are available for future generations.

We, the members of the Chiang Mai International Consultation, hereby call on all people to commit themselves to Save the Plants that Save Lives.

Chiang Mai, Thailand
26 March 1988

Annex 2

List of Participants at the WHO/IUCN/WWF International Consultation on the Conservation of Medicinal Plants (Chiang Mai, Thailand, 1988)

Dr O Akerele, World Health Organization, Geneva, Switzerland

Mr S K Alok, Ministry of Health and Family Welfare, New Delhi, India

Mr L de Alwis, Sri Lanka

Dr A Bonati, Inverni della Beffa, Milan, Italy

Dr A B Cunningham, University of Namibia, Tsumeb, Namibia.

Dr Pricha Desawadi, Department of Medicinal Sciences, Ministry of Public Health, Royal Thai Government, Bangkok, Thailand

Professor N Farnsworth, College of Pharmacy, University of Illinois at Chicago, USA

Professor O Hamann, Botanical Gardens, University of Copenhagen, Denmark

Professor He Shan-an, Nanjing Botanical Gardens, Jiangsu, People's Republic of China

Professor V H Heywood, IUCN (until 1992) and Botanic Gardens Conservation International, Kew, UK

Dr A Husain, Central Institute of Medicinal and Aromatic Plants, Lucknow, India

Dr A S Islam, University of Dhaka, Bangladesh

Dr K Kartawinata, Unesco Regional Office for Science and Technology for Southeast Asia, Jakarta, Indonesia

Mr C de Klemm, Paris¹

Dr J O Kokwaro, Department of Botany, University of Nairobi, Kenya Hon.

W J M Lokubandara, Minister of Education, Cultural Affairs and Information, Colombo, Sri Lanka

Professor D Palevitch, Agricultural Research Organization, The Volcani Center, Israel

Dr M J Plotkin, Conservation International, Washington, DC, USA

Dr P P Principe, US Environmental Protection Agency, Washington, DC, USA

Dr H M Schumacher, Deutsche Sammlung von Mikroorganismen und Zellkulturen GmbH,
Braunschweig, Germany

Mr H Synge, WWF International (until 1989), Gland, Switzerland

Mr J Thorsell, IUCN, Gland, Switzerland Mr P Wachtel, WWF International, Gland, Switzerland

Dr Xiao Pei-gen, Institute of Medicinal Plant Development, Chinese Academy of Medicinal Sciences,
Beijing, People's Republic of China

1. Mr de Klemm was unable to attend the meeting but contributed a paper.

THE WORLD HEALTH ORGANIZATION (WHO)

The World Health Organization is a specialized agency of the United Nations with primary responsibility for international health matters and public health. Through this organization which was created in 1948, the health professions of some 180 countries exchange their knowledge and experience with the aim of making possible the attainment by all citizens of the world by the year 2000 of a level of health that will permit them to lead a socially and economically productive life.

By means of direct technical cooperation with its Member States, and by stimulating such cooperation among them, WHO promotes the development of comprehensive health services, the prevention and control of diseases, the improvement of environmental conditions, the development of human resources for health, the coordination and development of biomedical and health services research, and the planning and implementation of health programmes.

These broad fields of endeavour encompass a wide variety of activities, such as developing systems of primary health care that reach the whole population of Member countries; promoting the health of mothers and children; combating malnutrition; controlling malaria and other communicable diseases, including tuberculosis and leprosy; coordinating the global strategy for the prevention and control of AIDS; having achieved the eradication of smallpox, promoting mass immunization against a number of other preventable diseases; improving mental health; providing safe water supplies; and training health personnel of all categories.

Progress towards better health throughout the world also demands international cooperation in such matters as establishing international standards for biological substances, pesticides, and pharmaceuticals; formulating environmental health criteria; recommending international nonproprietary names for drugs; administering the International Health Regulations; revising the International Statistical Classification of Diseases and Related Health Problems, and collecting and disseminating health statistical information.

Reflecting the concerns and priorities of the Organization and its Member States, WHO publications provide authoritative information and guidance aimed at promoting and protecting health and preventing and controlling disease.

IUCN F THE WORLD CONSERVATION UNION

Founded in 1948, IUCN f The World Conservation Union brings together States, government agencies and a diverse range of non-governmental organizations in a unique world partnership: some 650 members in all, spread across 120 countries.

As a union, IUCN exists to serve its members - to represent their views on the world stage and to provide them with the concepts, strategies and technical support they need to achieve their goals. Through its six Commissions, IUCN draws together over 5,000 expert volunteers in project teams and action groups. A central secretariat coordinates the IUCN Programme and leads initiatives on the conservation and sustainable use of the world's biological diversity and the management of habitats and natural resources, as well as providing a range of services. The Union has helped many countries to prepare National Conservation Strategies, and demonstrates the application of its knowledge through the field projects it supervises. Operations are increasingly decentralized and are carried forward by an expanding network of regional and country offices, located principally in developing

countries.

IUCN *f* The World Conservation Union seeks above all to work with its members to achieve development that is sustainable and that provides a lasting improvement to the quality of life of people all over the world.

WWF *f* WORLD WIDE FUND FOR NATURE

WWF *f* World Wide Fund for Nature is the world's largest private international conservation organisation with 28 Affiliate and Associate National Organisations around the world and over 4.7 million regular supporters. WWF aims to conserve nature and ecological processes by preserving genetic, species and ecosystem diversity; by ensuring that the use of renewable natural resources is sustainable both now and in the longer term; and by promoting actions to reduce pollution and wasteful consumption. WWF continues to be known as World Wildlife Fund in Canada and the United States of America.