Conservation and Sustainable Use of Medicinal Plants in Ethiopia

Proceedings of the National Workshop on Biodiversity Conservation and Sustainable Use of Medicinal Plants in Ethiopia

28 April - 01 May 1 1998, Addis Ababa.

Edited by: Medhin Zewdu and Abebe Demissie

Addis Ababa, May 2001

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Front cover: "Kosso tree" (*Hagenia abyssinica*)

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FOREWORD

The Ethiopian region is characterized by a wide range of ecological, edaphic and climatic conditions that account for the wide diversity of its biological resources both in terms of floral and faunal wealth. As a result, Ethiopia is known to be one of the twelve Vavilov centers of origin for domesticated crops and their wild and weedy relatives. As recent studies indicate, there are over 7000 species of flowering plants recorded for Ethiopia of which 12 per cent or more are probably endemic.

Over 85% of the Ethiopian population relies on traditional medicine for the fight against various diseases. Plants are thus the major sources of medicine used by the majority of the population. The indigenous knowledge on the use of many medicinal plants is however undocumented and thus an extensive effort will be required to document and utilize this knowledge. The other concern in this area is that many of the plant species are becoming threatened by several factors, both man made and natural. Therefore, inventorization of the medicinal plants along with their ecosystem will help to know their status and develop proper strategy for their conservation.

In order to have a sustainable development program in the use of medicinal plants, the participation of communities, the traditional practitioners, the private sector and the scientific community at all levels of the activities is essential. Collaboration among these parties will help to identify prior actions for conservation, cultivation, dosage formulation and integration of the traditional health system into the formal health care.

Therefore, medicinal plants should not only be sought as tools for fighting against various ailments but also as export commodities which generate additional income, mainly for the farmers or the private sector engaged in the cultivation and processing of the plants. It is thus within this context that the Biodiversity Institute, along with the collaborating Institutions, organized this workshop where the formal and informal sectors were brought together to strengthen the links between conservation and sustainable utilization of medicinal plants. As a consequence it is expected to come up with appropriate strategies and a plan of action for the conservation and sustainable utilization of medicinal plants.

Editors

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ABBREVIATIONS

CRDA	Christian Relief Development Association
DDR	Department of Drug Research
EARO	Ethiopian Agricultural Research Organization
EHNRI	Ethiopian Health & Nutrition Research Institute
EISC	Ethiopian Islamic Supreme Council
ENA	Ethiopian News Agency
ENDA	Environmental Development Action
EOC	Ethiopian Orthodox Church
EORC	Essential Oils Research Center
EPA	Environmental Protection Authority
EPIA	Ethiopian Private Industries Association
ESTC	Ethiopian Science & Technology Commission
ETV	Ethiopian Television
FVM	Faculty of Veterinary Medicine
IBCR	Institute of Biodiversity Conservation and Research
IPB	Institute of Pathobiology
MEDAC	Ministry of Economic Development and Cooperation
MMM	Medical Missionaries of Mary
MOA	Ministry of Agriculture
MOE	Ministry of Education
MOH	Ministry of Health
MOTI	Ministry of Trade and Industry
NH	National Herbarium
NPC	Natural Products Chemistry
NVI	National Veterinary Institute
OAU	Organization of the African UnionPHC
SOP	School of Pharmacy
THA	Traditional Healers Association
UNIDO	United Nations Industrial Development Organization
UNDP	United Nations Development Program

The Role of Medicinal Plants in Health Care Coverage of Ethiopia: The Possible Benefits of Integration

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Introduction

In the struggle for survival, man had to identify the plants that are not only deleterious to health but also those that which would serve for his well being, i.e., as a source of food as well as drugs that would mitigate pain or symptoms of ill health. Botany, thus, could indeed be considered as the earliest science intimately bound to the field of medicine. (Abebe and Ayehu 1993). It arose through deliberate experimentation or through observation of which plants animals eat when they have symptoms of ill health, or even serendipitously. However, most importantly, a long trial-and-error process must have played the major role in the selection of numerous species for their specific properties. Whatever strategies were employed in distinguishing or establishing the benign and curative plants from the harmful ones, sacrifices, including human lives, had to be made. It is sometimes astounding to consider the degree to which such experience has contributed to the understanding of the properties of the plants and rational use of the biological diversity. For example, local knowledge enabled the identification of six plants containing caffeine (stimulant compound), namely coffee, cola, mate, tea, cocoa and guarana among innumerable species by using particular features that easily distinguish them for their medical properties.

Such knowledge about the curative properties of the plants served all mankind up until early 19th century (Anonymous 1993). This was followed by a period of diminished reliance on medicinal plants up until 1957 when potent substances were isolated from the Madagascar periwinkle for the treatment of leukaemia and Hodgkin's diseases. Ever since, there has been a considerable upsurge of interest in the affluent societies in investigating and using phytomedicine and homeopathy as an alternative to modern or allopathic medicine. The true picture of this revival of interest in medicinal plants can be demonstrated by the annual consumption rate of $12.5 billion that is being spent by people in the developed world on plant-based remedies in the form of extracts, oils, herb teas, capsules, etc. (Ayensu 1983). It is expected that there will be a steep upward trend of demand and trade in medicinal plants. For example, according to a trade forecast of up to the year 1999, there will be an annual growth rate of 20% and 16% in the United States and United Kingdom, respectively. Similar estimates indicate that the global monetary value of plant-based pharmaceuticals in OECD countries will reach $500 billion by the year 2000 (Bannerman *et al.* 1983). Several millions of dollars

are invested by trans-national pharmaceutical firms and research establishments in the west for the screening of bioactive compounds from plants, particularly from those of the tropical countries (Cragg *et al.* 1994). The reason for this interest is because these regions are believed to contain nearly two-thirds of all organisms; and it is also here that the use of plants as a means of therapy has been running for centuries (Good 1977). Therefore, unless we are prepared to spend scarce foreign exchange in re-importing our own plants or the products thereof, we should not be left out of the current international processes and initiatives that are taking place.

The current trend towards the use and/or investigation of medicinal plants stems from a number of factors, including:

- The intractability, emergence or re-emergence of certain diseases.
- The prohibitive costs of manufactured synthetic drugs and some of their limitations (e.g. side effects, issues of drug resistance, etc.).
- Recognition of the limitless potential of plants to synthesize innumerable compounds that are more easily assimilable, biodegradable and environment friendly, etc.
- Recognition of the fact that there is a much better chance of discovering new drugs or substances (such as those that can serve as models for new synthetic chemicals or precursors for elaboration of more complex compounds) from plants of traditional medicine than other sources which are screened randomly.

The observed magnitude of use and interest in medicinal plants in most developing countries may also partly be attributed to these causes. However, as far as Ethiopia is concerned, one may also add the following crucial points:

1) Acceptability: traditional medicine is an integral part of the local culture and therefore, people often resort to it even when there is demonstrably efficient and less costly alternative care.
2) Accessibility: medicinal plants are often within easy reach compared to modern drugs that are dispensed in remotely located health institutions.
3) Biomedical benefits: the use of plant medicine is the result of centuries of accumulated knowledge based on practical observations and therefore there is no doubt that many of the plants employed could have the reputed efficacy. The history of medicine and the contemporary presumptive evidence are supportive of this assumption.

Medicinal plants and the health care situation in Ethiopia

Plant remedies selected over centuries of use still remain the most important and sometimes the only source of therapeutics for nearly 80% of the population in

contemporary Ethiopia, although it is now increasingly difficult to obtain most of the plants in a reasonable radius. A retrospective analysis and the present socio-economic situations and their future trends more or less indicate that the trend of heavy reliance on medicinal plants or traditional medicine as a health care resource will remain for a long time to come. A quick insight into the health and health care service situation in the country can shed light on this fact.

For example, despite incremental increases in the modern health care service in Ethiopia since its introduction in the early 16th century, the health of the majority of the people (according to the various indicators such as morbidity and mortality parameters, crude birth and death rates, etc.) is still among the lowest in the world (Inga 1987; Kleinman 1978). The situation has been compounded by the high rate of population expansion, which is without historical precedent and the associated degradation of the environment leading to, *inter alia*, a decrease in the productivity of the land under cultivation.

The health service situation has particularly been aggravated by the decline of per capita share of public expenditure due to the above and several other reasons (drought, rising debt service payment, etc.). For example, government expenditure for the sector has remained under 2% of the GDP for the last 10 years (Kleinman 1978). Of this meager expenditure, the lion's share (30-40%) goes towards the purchase of modern pharmaceuticals despite the fact that the per capita drug budget is about $0.16-one of the lowest in the world (Lambert *et al.* 1997). It is simply extremely improbable that modern medicine in Ethiopia can unilaterally provide the necessary solution to many of the health problems. The demand for this system of care in this country or in any other 3rd world nation is insatiable and it simply cannot be made available to optimum number of people in the foreseeable future. This may easily be demonstrated by taking the pharmaceutical supply situation as an example.

In 1977, when the global consumption figure of pharmaceuticals was only $47.5 billion, the developing world, with around 74% of the world's population, accounted for less than 20% of the world's consumption, with an average per capita consumption of $3.The developed world, comprising about 25%, enjoyed the benefit of greater than 80% of the $47.5 billion world consumption of drugs, with a per capita average of $34.In the intervening period of up to 1983, the developed nations again accounted for 80% of the global consumption figure of $88 billion. On the basis of the average per capita requirement of the industrialized world, the developing world's estimated requirement would have been $100 billion in terms of the figures for 1977 or $200 billion or more in terms of the 1983 figure. However, the real situation in the developing world indicates that the consumption of pharmaceuticals was only $17.7 billion for 1983 (Wijesekera 1991).

The present health status of the population and the state of the health service, thus, leave much to be desired. Improvement will inevitably require, among other things, the development and mobilization of available human and natural resources, particularly the improvement and streamlining of the remedies that are employed by the majority of the population in bridging the gap between the demand for, and supply of imported pharmaceuticals.

It is important however, to bear in mind that the reliance on plant medicine and the effort being made towards their development should not necessarily be taken as a knee jerk reaction to underdevelopment or as a stopgap measure to overcome the extant deficiencies in modern drugs or quality care. Traditional medicine, also at times referred to as alternative medicine, is a component of the pluralistic health care system observed in most societies. In Ethiopia, this health care system epitomizes the strength of the various ethnic cultures and the marshalling of resources for self-care, a phenomenon that is of major public interest even in wealthy countries. Traditional medicine, or alternative medicine, though outside the main stream of the official health care delivery system, remains the crucial resource for about half of the people of the world, who strive to obtain the most effective treatments from both systems often concurrently or serially for the same illness episode (Mathias and McCorke 1996). Therefore, the continued popularity of traditional medicine or the initiative toward improved and sustainable utilization of medicinal plants is a national as well as a global issue which does not always relate to the simple absence, inadequacy, or high cost of a better health care of the Western-type.

Integration of traditional medicine

The significance of linking the ubiquitous and low-cost indigenous medicine with official care, and thus solving at least some of the primary health care needs of the under served rural masses, is particularly apparent under the Ethiopian context, where there is an an enormous volume of unmet health needs and the cost of meeting them is exorbitant.

There seems to be no village, town or city where traditional healers are not involved in the provision of health care that is culturally acceptable and which more or less deals satisfactorily with certain kinds of local health problems. Integration, therefore, appears a good option. Because integration of traditional and modern medicine will serve not only as a stop-gap measure, but also to help generate and sustain self-reliance and pride in people's cultural heritage, while providing much needed and useful services (Ministry of Health of Ethiopia 1993). Integration is a structural, functional, and legal incorporation of different health delivery systems into the official health care system.

Different countries often opt for various strategies aimed at attaining different levels of such integration. The three broad types are:

1) Relatively "passive" recognition of the existence and activities of traditional medical practitioners (TMPs);
2) Legal recognition with or without requirement for licensure and training
3) More complete legal and structural interaction with definite and enforced requirement for licensure, training and supervision;

For the above reasons and also the persistence of the traditional system, as well as the realization of the fact that it is not economically feasible to replace this system with the western system, consecutive governments in Ethiopia, particularly the Transitional and the Federal governments have shown a great deal of interest in the promotion and eventual integration of both systems (see the various policies).

There are, however, a number of obstacles to the integration of the two systems:

1) The continued popularity of traditional medicine in countries like Ethiopia is often attributed, *inter alia*, to the similarity in belief between traditional healers and lay people. Thus, both the healers and their clients share the belief that the healing power of the remedies depends on maintenance of secrecy and mysticism. Following integration, the practices and remedies will inevitably be publicized and this may erode consumers' faith and confidence in the efficacy. The TMPs may fear the possible loss of potency of their remedies as a result of the violation of the rules of secrecy and therefore this could provide the ground for resistance against integration;
2) Modern health professionals may see integration as reactionary or even dangerous because of traditional medicine's alleged lack of rigorous dosology, imprecise nature of diagnosis of certain diseases, perpetuation of beliefs in witchcraft/sorcery, etc. and hence, its inefficiency and even harmfulness;
3) The use of multiple species in a single medicinal ingredient is often considered by the health professionals and by most researchers as one of the obstacles for integration since it is difficult to designate the possible active ingredient(s).

Several preconditions, therefore, have to be met before integration. Some of these are:

1) The establishment of an association of the healers, through which they could interface with the conventional health care system. At least at the initial stages, this would be the only body, which could assume responsibility for all matters pertaining to ethical and professional issues;
2) Service oriented and problem focused applied research should be given priority, both as a means of making at least a few of the remedies readily available to the suffering humanity, and also as a means of bringing positive

attitudinal change towards this system among all stakeholders, particularly the modern health establishment;

3) It is imperative to study the attitudes of the consumers towards both systems, as well as those of the healers and health professionals toward each other's system, in order to identify the problems hampering integration and to design an appropriate strategy;
4) Oher suggestions made to facilitate the articulation and ultimate integration of the two systems include the training of practitioners in both systems in the philosophies that underpin both systems, i.e., modern and traditional concepts about health and disease;
5) Athough less important, some activities, such as the development of herbal formularies and the preparation of lists of prioritized herbal remedies to be used in different localities are believed to contribute to the rapprochement of both systems;
6) The gap in knowledge regarding the practice and the remedies in this system has to be narrowed down through data collection, identification and validation of the components of the system.

Research into medicinal plants

The prime advantage of medicinal plant remedies is that they are there, an immediate existing source of health care for people where they live. Their wider and systematic application in the official health care delivery system will undoubtedly help to ameliorate the scarcity of some drugs.

The rich experience of countries like China and India indicate that there is no longer any doubt about the value of such incorporation of beneficial traditional medicaments, especially some herbal remedies, into the official health care system (see the various W.H.O. resolutions such as WHA31.33, WHA40.33, WHA41.19, WHA42.43, etc.). These facts were also reflected in the Alma-Ata Declaration of 1978 on primary health care, which recommended, *inter alia*, the accommodation of proven traditional remedies in national drug policies and regulatory provisions. This statement invariably stresses the significance of research leading to evaluating, systematizing, and standardizing empirical medicaments with the aim of producing preparations that are safe and effective for use in the health care system.

However, scientific validation of medicinal plants (whether this is to find new drugs, or to discover lead molecules, or to provide rational for clinical use of moderately improved traditional drugs) has often posed some serious problems. These problems, which have often frustrated the achievement of positive results, are mostly associated with:

1) Too much emphasis on the high resource demanding research approach of isolating active principles and the failure to recognize that extracts are no less valid than isolated active principles. Many extracts, like active principles, can also be standardized and utilized at all levels of the health care delivery system;
2) Failure to follow, as closely as possible, the traditional methods of preparation procedures and the quantities of materials used. Yet these too, seem to influence not only efficacy, but at times even the safety of the preparation. A research attempt made on an effective, traditional, anthelmintic remedy in Thailand illustrates the case in point. Locally, the plant in question is prepared by pounding and mixing it with coconut juice. The attempt by scientists to mass produce the same remedy by using an electric blender and allowing the preparation to stand overnight generated toxins that caused blindness among patients (Mathias and McCorkle, 1996). This, in a nutshell, stresses that the enduring values of medicinal plant lies not only in the pharmacological active components of the herbs, but also in the concepts and methods which underlay them. Local knowledge about the medicinal plant should thus be seriously considered when proposing, preparing and conducting research into herbal remedies;
3) Failure to grasp the principles of synergistic or antagonistic pharmacological effects that may occur when two or more than two plant species are compounded;
4) Lack of interest in taking into account the locality from which the sampled plant material comes from. This, in other words, is to ignore the ecology, altitude and soil type of where the plant grows, which often influences phytochemical balances, and hence pharmacological effect;
5) Failure to record the development stage at which the plants are collected, i.e., young versus mature, in or out of flower, and so on, is often seen to affect the anticipated outcome. This can lead to frustration for the investigator.

With these words of caution in mind, it is possible to obtain useful results from research undertaking into medicinal plants. Furthermore, in view of resource constraints, research itself should have clearly defined programmes, priorities, and goals. In the Ethiopian context, a researcher in the field should aim first to prioritize the disease problems, for which to test the plant remedy. In-depth investigation to ascertain the safety and efficacy of the plant, either through applied research (i.e., based on published data) or through pre-clinical and clinical studies should, as a rule of thumb, take into account the following points in the selection of a candidate plant for evaluation:

- Is it the only drug, or one of the few drugs used in the treatment of a certain health problem?
- Can it be produced more cheaply than alternative drugs?

- Is it less toxic or is it more potent than other existing drugs?

The chances for improvement of traditional plant remedies on a scientific basis, and hence the improvement of the drug supply situation in the country, requires a broader interdisciplinary research approach that is well coordinated, with modern documentation and laboratory facilities at the disposal of the researchers. Pilot-scale facilities should also be availed of, to test the stability of product processing conducted at laboratory level, as well as to forecast the economic feasibility of the product.

The prime objective of all the activities in the field of medicinal plants is to extend/improve the health care coverage by establishing, through scientific research, appropriate and efficient forms of use, i.e., as herbal teas or as standardized extracts or pure compounds. However, unless this is coupled with cultivation, ethno botanical survey and conservation efforts, the chance of achieving the goals will remain minimal. I will briefly touch upon these three points in the next section.

Cultivation

The importance of cultivation lies not only in its contribution in reducing the pressure on wild species collected for use or research, but also to attain one or several of the following aspects:

- under cultivation, the purity profile and quality parameters of the plant material and its chemical characteristics can, by and large, be maintained;
- cultivated plants are grown in accordance with good agricultural practices;
- under cultivation, the yield of the required bioactive compound can be increased using agronomic and breeding techniques;
- species with less varieties or cultivars and chemotypes can be selected under cultivation, thereby ensuring authenticity of the plant in question;
- unlike those in the wild, for species under cultivation large quantities of the raw material can be supplied at a more or less sustainable level.

The major drawback to the cultivation of medicinal plants is that the taxa of this group are mostly wild, and hence their agro-ecological requirements are not well known. Therefore, the appropriate strategy at least for the initial periods would be to initiate the cultivation of established medicinal species in the genera like *Solanum*, *Dioscorea*, *Cassia*, etc. Another useful approach to alleviate the problem would be to assemble data on cultivation methodologies that may be available in the various botanic gardens (Principe 1991).

Ethnobotanical survey

A famous ethnobotanist once said that traditional healers are often accomplished botanists representing probably the oldest professional of Man in the evolution of human culture. What this statement tries to emphasize is that the healers have been instrumental in the continued existence of the traditional healing art to which most of our people still owe their physical and mental well being. Modern medicine too, owes a great deal to indigenous knowledge about the use of medicinal plants. Quinine from *Cinchona* bark, morphine from *Papaver someniferum*, reserpine from *Rauvolfia serpentina,* Curarine and tubocurarine from *Chondodendron*, etc. are some of the examples that attest the case in point.

The question that should be asked is, how do the healers or the communities acquire, preserve/conserve and transfer these and other similar local knowledge about plants from time to time and over geographic distances.

Several of the following possibilities exist:

- Through written record.
- Through application.
- Through non-formal education, i.e., through apprenticeship.
- Through local communication networks.
- Through dreams and alleged contacts with ancestral spirits.

By and large, the largest means of acquiring and transferring traditional knowledge is through non-formal education and local communication networks. However, because of the continued acculturation, indigenous traditional knowledge is confronted with irreversible loss. The numerous languages that mostly lack written scripts, ageing of the healers, displacement of communities, etc, further compound this situation. With the advent of modern medicine whose existence, as far as 80% of the population is concerned, is more of a nominal nature rather than of an actuality, there is a clear indication of reluctance bythe young generation in learning the art of traditional medicine. It is particularly worrying in view of the fact that the knowledge is of mainly an oral nature, and most of it is obviously disappearing fast. Steps, therefore, need to be taken to list the plant remedies and their medical indications and properties i.e., indigenous knowledge.

Therefore, inventorizing the vast and presumably less adulterated knowledge that is still with the healers and the community must be documented, before what is already late becomes too late. This does not have only a long-term advantage of saving the record for posterity, but also an immediate application, at least in terms of preventive health, if not in terms of curative and/or rehabilitative medicine. For

example, it is reported that many plants in Ethiopia are poisonous to both humans and livestock. However, only scanty accounts exist on the subject, thus compromising our ability of realizing the adage "forewarned is forearmed."

Ethnobotanical inquiry is also instrumental in identifying plants that have the same, or similar active constituents to those that are not easily available or harvestable. (for example, plumbagin is found in some of the uncommon or even possibly threatened species like *Drosera* and *Diospyros*. However, the same compound is present in the abundantly distributed taxon, *Plumbago zeylanica*). Extant traditional knowledge about plants is also useful in deciding what type of experiments to conduct to verify the safety and efficacy of the plant in question. For example, if a given plant is used both as source of food and medicine, or used widely for a long period of time, the steps of toxicological testing to which this species is to be subjected would be comparatively fewer. Inventory of this knowledge, thus, not only helps in setting priority species for research or use, but also in determining their population status and designing appropriate conservation strategy. The knowledge of the use of the plant as a medicine also embraces an understanding of the issues relating to the survival of the species, i.e., the habitat, phenology, behavior, etc., all of which are the keys to the secrets of sustainable utilization of the resources.

To accomplish such an endeavor, some major problems, such as the lack of competent taxonomists and access to relevant literature and/or reference herbaria where voucher specimens can easily be checked, will have to be solved.

Political and legal commitments regarding the issue of intellectual property and community rights are pivotal in soliciting the cooperation of the custodians of the knowledge in the process of inventorizing the empirical information. Establishment of trust funds as a potential mechanism for receiving and disbursing proceedings generated from the commercial use of biological resources to the various stakeholders is one of the important steps in winning the confidence of the local people, and hence should facilitate the documentation of the knowledge.

Conservation

There are reasons, albeit many indirect, for conserving species. We do this to maintain the ecosystem, or for their aesthetic value, or on ethical grounds and so on. As important as all these may be, there is more to it when it comes to medicinal plants, i.e., they are of direct benefit to us. This conjecture is supported by the WHO, which estimates that 80% of the population in the developing world relies on traditional medicine (the major component of which constitutes medicinal plants) to satisfy their basic health care needs.

Furthermore, the cases of vincristine, quinine, etc. demonstrate the potential of traditional medicinal plants as a storehouse for innumerable and complex biodynamic compounds still undiscovered, and which are there to be discovered.

Unfortunately, like many other taxa, medicinal species are constantly under threat from the degradation of the environment. This is due to several factors, both anthropogenic and natural causes. What makes a significant difference, as far as medicinal plants are concerned, is that the use (probably unwise use) of these resources has increased considerably, both because they are often the only medicine available in less developed areas and because they are becoming a popular alternative medicine in more developed areas. The case of ginseng root, which costs 250-347 USD/kg, could illustrate not only the popularity of the plant in the industrialized countries but also the vulnerability of the species (Good 1997; Principe 1991).

One of the most important undertakings regarding medicinal plants would be the establishment of proven efficacious, safe and quality products for use at all levels of the health care delivery system. This inevitably leads to commercialization and hence to the depletion of stock in nature, unless sustainability of the species is ensured through the combined application of *in situ* and *ex situ* conservation techniques.

A good starting point for *in situ* conservation of at least hitherto recorded medicinal plants would be to identify:

- Ecosystems with diverse species of medicinal plants and ecosystems with substantial community size of a given medicinal plant species.
- Traditional ways of preserving plants. For example, traditional healers follow a set of regulations, which are primarily for purpose of potency, but also as a means of preventing the destruction of the plant in question. In certain areas of Ethiopia, a part of a plant, for example, is collected from seven individuals or multiples of this thereof. Collection of the plant is at times made at the beginning of the new year or in certain months of the year, or before or after the rainy season.

Not only utilitarian considerations, but also cultural elements seem to influence the acceptability of conservation principles among communities. At times the community as a whole is seen as accepting certain restraints on the use of clusters of plant species in specific areas such as churchyards, or even single species so as not to offend deities. These practices by the indigenous people undoubtedly increase the chances of the plant to continue to thrive, or to assume the population size needed for survival. Such ecologically prudent practices are of a considerable importance in the planning of adaptive conservation strategies.

Systematic documentation of such knowledge and making it accessible in databases will facilitate decision making in the management of the resources and of the proper share of benefits from commercialization. The disadvantage of easily accessible data systems is the possible piracy of the knowledge surrounding some of the biological resources. However, on balance we would be better off monitoring events with such a system, than operating in the total absence of organized information.

Finally, effective conservation of medicinal plants can only be achieved through sustained effort directed in increasing the awareness level of all; particularly the local communities who more or less exclusively rely on these resources to ward off locally common health problems. Awareness issues, i.e., increased involvement of the communities in conservation efforts, can further be reinforced through fair and equitable benefit sharing arising from the development of the medicinal plants, whether this is based on empirical indigenous knowledge or on some other source. Provided that there is equitable cooperation among all stakeholders, the conservation of medicinal plants has a better chance of success than that of other species, because the message "saving life by saving plants" more directly relates to this group of plants, and is thus more appealing to the communities, most of whose health care needs are catered for by these resources.

Furthermore, medicinal plants comprise mostly herbs and shrubs and to a lesser extent trees. Therefore, with modest conservation efforts it would not be a far-fetched idea to assume that most of them could easily, in a relatively short time, assume an optimum population size from existing stock or from re-introduction into their original habitat or even into marginal lands.

Additional strategies such as biological and phytochemical screening of the remedies should be thoroughly and extensively addressed to identify other species (or different parts of the same species) with similar properties, so as to increase the number of choices, and hence reduce the pressure of demand on limited species of traditional medicinal plants.

The role of the private sector in the development of medicinal plants

Research in traditional medicine should have as its goal the transfer of results to the private sector including the TMPs, so as to increase the efficiency and diversity of the health care resources. Assuming that the difficult issue of IPR is properly addressed, the advantages to be gained from the participation of the private sector in the use and commercialization of the medicinal plant industry could be substantial.

The following can be cited as good examples:

- Establishing domestic industry in herbal remedies can provide local or regional income and employment opportunities.
- It can help in fostering the dynamism of valuable local knowledge that might otherwise be lost or stagnate in the face of encroaching westernization.
- Proprietary herbal medicines produced within a country are generally cheaper than the equivalent Western pharmaceuticals.

Another important condition that is of utmost importance to bring the entrepreneur to the general process of sustainable utilization of medicinal plants would be to avail of research methodology pertaining to the production of adequate and good quality raw plant materials. Furthermore, laboratory and pilot-scale extraction and formulation studies should clearly indicate the process technology that would be involved at a commercial level of production to be undertaken by the private sector.

Conclusions

Insufficiency of modern drugs in most urban areas and their virtual absence in the rural hinterland for most of the fiscal year is a widely recognized fact. Regardless of the incremental expansion of modern health facilities and in view of the underlying socio-economic conditions, the problem is likely to persist for decades to come.

On the other hand, phytotherapeutic agents are generally within the economic reach of the majority of the people; they are more accessible and culturally readily acceptable, and better adapted to certain local situations. Therefore, recognizing, validating and developing them on a sustainable basis, and transferring the know-how and technology on phytotherapy can provide more and cheaper options for the wider improvement of the health care delivery service.

Other spin-offs from efforts of this nature include, for example, a renewed respect for indigenous knowledge and technology. Such confidence in the knowledge base could revitalize the art of traditional health care and increase community as well as government interests in exploring, validating, effectively utilizing and conserving the bioresources.

The present lose-lose situation, where only a handful of people appear to unsustainably gain at the expense of the majority should be replaced by a win-win system whereby benefits could be accrued to an optimum number of people and

without compromising the interest of the future generation. Such a system calls for a participatory approach, a greater role for women, incentive, international cooperation, integrated and sustained development efforts, etc.

Recommendations

1) To foster self-reliance in the field of pharmaceuticals and to bring about increased awareness of the comparative merits of plant-derived proven medicaments should be popularized for use at all levels of the national health care delivery system.
2) Indigenous knowledge is essential for the use, identification and cataloging of the biota. Thus, community biodiversity registration should be given priority importance.
3) Efforts need to be made in maximizing the application of existing policy frameworks for the conservation of medicinal plant biodiversity. If there are gaps, these, of course have to identified and filled in. The necessity of this may be particularly evident in the areas of: a) long-term *in situ* conservation measures, b) regulation of wild collection, c) creation of favorable environments for the commercial cultivation of herbs, and d) facilitating sustainable partnerships between the private sector and R & D institutions.
4) Sustainability and progression of long-term goals of development of medicinal plants depends upon utilization of institutional infrastructure. Therefore, strategies have to be devised which would enable the realization of maximum cooperation of existing institutions as well as the involvement of NGOs with a good track record of developmental work among the community;
5) For decision-making, management of resources and equitable benefit sharing, a proper information base needs to be set up; IEC activities with respect to sustainable use, conservation and development have to be supported and promoted.
6) More support should be provided for semi-processing of raw materials as a means of value addition leading to possible higher returns.
7) The application of biotechnology, which could offer possibilities for easing the burden on wild populations, should be explored.
8) Establish well-equipped laboratories both for basic and applied research.
9) Establish a national coordinating body with responsibility for planning, administering and monitoring of conservation and utilization of medicinal plants.

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The Role of Traditional Veterinary Herbal Medicine and its Constraints in the Animal Health Care System in Ethiopia

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Introduction

Livestock production plays an important role in the livelihood and economy of Ethiopia, as in other developing countries, through provision of food and income for the majority of its population. Crop production is almost entirely dependent on traction power provided by animals. In addition, livestock serve as a means of employment, saving and investment. They offer the only way of survival in many harsh environments. Generally, livestock constitute a driving force for food security and sustainable development in developing countries like Ethiopia. However, it is difficult to realize any gain in livestock production and productivity without first ensuring corresponding improvements in animal health.

In Ethiopia conventional veterinary medicine has been playing a paramount role in the control and prevention of livestock diseases in the last 3 decades. It is gradually being improved but cannot yet deliver complete coverage, both in preventive and curative health care approaches. This situation emanates from a number of factors, the major constraints being: inadequate manpower and logistics, scarce and erratic supply of drugs, and high cost of drugs and equipment. Consequently, the majority of rural stock-raisers are far from the site of veterinary stations, and those that have access to veterinary services may not be able to afford to pay for services.

A possible alternative or complementary option which may reduce the reliance on the conventional veterinary health care system could be the exploitation of the great variety of traditional animal health practices which are widely practiced by stock-raisers in this country. The objective of this paper is thus, to review the importance of traditional veterinary medicine, with much emphasis on herbal medicine, in the animal health care systems and to discuss the constraints and the possible actions to be taken.

Ethnoveterinary medicine (traditional veterinary knowledge and practices); an overview

In all parts of the world, traditional medicinal practices formed the basis of health care for both human beings and animals before the advent of modern medicine.

These practices grew up empirically over the centuries and were handed down from generation to generation.

Although traditional animal health care knowledge and practice [recently termed as Ethnoveterinary medicine (EVM)] has been developed and used for centuries, it has a recent history as a recognized area of academic interest. Significant research activities in EVM started in the mid-1970s.

EVM comprises of traditional surgical and manipulative techniques, traditional immunization, magico-religious practices and beliefs, management practices and the use of herbal remedies to prevent and treat a range of disease problems encountered by livestock holders. Many of these practices have been developed and tested over centuries, and accepted widely by stock-raisers for their curative or prophylactic values.

Many of the valuable drugs of today came into use through the study of traditional remedies. Of all modern drugs in use today, at least 50% contain substances of natural origin and most of these substances were first identified and used by local people (McCorcle 1995). Most of these traditional remedies are of plant origin. In India for example, of all traditional drugs recorded in *Material Medica* about 90 % of them are prepared from plants (Lambert *et al.* 1997). Worldwide, a great variety of these plants are still used to treat and prevent livestock health problems.

The pharmacological studies and clinical trials in different parts of the world indicate that a significant percentage of indigenous remedies of plant origin have shown promising biochemical activity and clinical effects (Mathias-Mundyand McCorkle 1989). In Africa, researches reveal that as much as 30% of ethnobotanicals are probably effective against the livestock diseases they are used to treat (McCorkle and Mathias-Mundy 1992). For example, research on 31 plants used in ethnoveterinary medicine among Mauritanian Fulani recommends ten of the plants for treatment of eight livestock diseases (Mathias-Mundy and McCorkle 1989).

Ethnoveterinary medicine in Ethiopia

In Ethiopia people have been using traditional methods to treat both human and animal diseases for generations. Traditional medicine is still widely practiced in rural areas where modern public health and veterinary services are limited. Even in areas where modern medical and veterinary services are available, they are often considered next to traditional treatments. A survey in Central Highlands of Ethiopia where there is relatively better modern veterinary infrastructure and services indicates that a significant proportion (40%) of stock-raisers still relies on

traditional veterinary practices and about 85 % of livestock owners alternatively use both modern and traditional veterinary practices. This figure is obviously high in remote areas of the country. For certain health problems, traditional methods of treatments are even preferable to their conventional counterparts (Wirtu, *et al.* unpublished finding).

Conventional veterinary medicine started late in Ethiopia. Probably the traditional veterinary knowledge and practices have better survived in this country. Secondly, Ethiopia hosts a number of different social groups (which have different traditional practices in animal health care and management) and enjoys a wide range of plant diversity (including medicinal plants), which has resulted from its diversified ecological and climatic conditions. These facts strongly suggest that the country has a rich fund of indigenous knowledge and practices, which can serve to treat and prevent a number of livestock health problems complementarily to the convectional veterinary sector.

Attempts have been made to identify and document medicinal plants of veterinary importance as well as associated traditional practices. A number of plant species have been claimed for their medicinal value against a number of livestock diseases in different parts of the country. However, only a few scientific studies have been conducted to evaluate the medicinal value of these medicinal plants. A Chinese Veterinary team in Ethiopia reported the preparation of 22 kinds of medicaments for different types of animal diseases (unpublished report cited by Mesfin and Obsa 1994).

Recently, different individuals and veterinary institutions have recognized the importance of traditional veterinary practices and shown interest in conducting research in EVM. Some of the institutions involved in the research of traditional practices include: Faculty of veterinary Medicine (FVM), Institution of Agricultural Research (IAR) at Sheno, NGOs such as a EU-Afar Pastoralist Development Project, National Animal Health Research Center (NAHRC) and a number of field veterinary stations.

The currently prepared National Animal Health Research Document also emphasizes the importance of traditional veterinary practices and recommended research undertakings.

Some of the ongoing research activities in EVM include: Study of Ethnoveterinary medicine in East Shewa Zone (FVM), Anthelmintic Effects of some traditionally used herbal remedies (IAR, Sheno), Trail on efficacy of traditional herbal remedy in treatment of mastitis (NAHRC, Sebeta), Study on the effects of selected herbal remedies on ectoparasite (NAHRC, Sebeta).

Traditional veterinary herbal medicine for animal health care

Many disease problems can be diagnosed quickly, treated and prevented satisfactorily using conventional medicine. Standard veterinary practices provide vaccination to prevent outbreaks of economically important infectious diseases. Certain diseases might be treated more successfully with conventional drugs such as antibiotics. Standard drugs are often more effective and convenient to use than traditional remedies. However, the services of conventional veterinary medicine will not be available to the majority of rural stock-raisers because of the previously mentioned reasons.

Traditional remedies, on the other hand, are locally available and usually cheaper than standard treatments. The livestock holder can prepare and use homemade remedies with minimum expense. So, for many livestock holders in rural areas, where there are relatively few veterinarians, and shortage of other facilities traditional remedies are the only choice for many ailments.

Obviously, all traditional herbal remedies are not effective or do not have the standard level of efficacy. However, traditional herbal remedies can be evaluated for their value and those with better efficacy can be improved and used with modern veterinary medicine. Indeed, parallel use of both has been successful and recommended for various reasons (McCorkle 1995): it brings about less dependence on expensive imported drugs and supplies; improves communications and contacts between livestock owners and veterinarians; encourages the use of more natural drugs with less toxic effect.

Traditional herbal remedies can also be used as scientific resources (Mathias-Mundy and McCorkle 1989) to develop new drugs, which are safe, effective, cheap and environmentally sound. Many of today's wonderful drugs were initially discovered through the study of traditional medicine, which were developed and used first by common people (McCorkle 1995). Modern veterinary medicine will benefit from Ethnoveterinary medicine if due attention is given to the research and development of the latter.

Traditional veterinary herbal medicine may also contribute to the maintenance of biological diversity. This can be realized through scientific appreciation of the validity of traditional remedies, which in turn will add impetus to the maintenance of biodiversity via protection and cultivation of the fast disappearing plant resources. Documentation and respect of practices of different social groups would contribute to recognition and preservation of local social cultures.

Constraints/Gaps

Disappearance of Indigenous Knowledge and Practices: Local experiences, which, have been gained through generations to solve indigenous problems, are disappearing from day to day. A number of factors have contributed including: the fact that many traditional remedies remain concealed among traditional healers and are rarely documented; death of elders; migration of people due to drought and other social problems; urbanization; influence of modern veterinary medicine and exotic culture.

Lack of adequate scientific information: Apart from the few attempts made recently, no significant work has been done to validate and propagate the use of medicinal plants and associated indigenous practices. Shortage of manpower well acquainted with traditional veterinary practices, and lack of adequate facilities and finance for research undertakings have been the constraints. There is also no organized responsible body to coordinate research in this area, and to develop the awareness of both professionals of animal science and the community, about traditional knowledge and practices.

Risks to medicinal plants: Plants that are used for preparation of herbal remedies are disappearing gradually. Several medicinal plants have already disappeared from their common habitat and some of them are at risk of extinction. People or traditional healers are forced to travel a long distance to obtain some medicinal plants.

Human population is increasing rapidly. As a result, additional land has to be cultivated to meet the required food production by clearing forest, bush, and grasslands. Simultaneously, livestock population is increasing in size to meet the high demand for livestock products and services. These factors bring more pressure on traditional grazing areas, causing vegetation loss and soil degradation. The recurrent droughts in this country, deforestation, and expansion of desert over the world may also lead to further thinning out and eventual extinction of many important medicinal plants.

Strategies and action plans for the research and development of EVM

- Inter-disciplinary research groups should be established for survey, documentation, and verification of traditional herbal medicine and traditional knowledge and practices.
- Most of the currently proposed studies in traditional veterinary medicine are focused in central parts of the country. The study area should also be extended to remote and pastoral areas, which are perhaps rich in Traditional Veterinary Medicine.

- A number of plants have been claimed as useful in treating livestock diseases. But it has to be verified whether such claims are certain for further economic use of the plants. The findings of effective herbal remedies would also initiate different institutes and researchers to explore traditional herbal medicine.
- Livestock owners must be informed about the activity of validated medicinal plants to be contained in their remedies. This would facilitate further exchange of information, the conservation of plants *in-situ*, and would also help the farmers to use locally available materials to treat their animals.
- Traditional healers should be encouraged through a rewarding mechanism to acknowledge the sharing of their knowledge for verification.
- Protect the intellectual propertyrights of traditional healers.
- Establish collaborative networking among researchers of EVM and Human Traditional medicine.
- Conservation and propagation of useful plants both *in-situ* and *ex-situ* should be undertaken.

Strategies for the conservation of medicinal plants

- Validate the efficacy of certain traditionally used medicinal plants and inform the stockowners to use and propagate them. Such exercises may also convince users to accept conservation programmes of other plant species.
- Promote public education to create awareness that plants can be a source of modern medicine.
- Plantation of medicinal plants in protected areas, such as institutions in different parts of the country; graveyards, churchyards, and reserves.
- Incorporate medicinal plant conservation in other agricultural extension programmes, such as agroforestery, range management, soil and water conservation (hill side enclosure, galley control).
- Control of overgrazing and deforestation.

Conclusion

EVM has a promising role to play in the veterinary services of Ethiopia and other developing countries, alternatively or complementarily with the modern veterinary sector. The prevailing livestock disease problems, and the limited scope of the formal national veterinary sector to deliver adequate animal health services, would justify EVM research and development in Ethiopia.

Traditional herbal medicine is the most essential part of EVM. The plants used in traditional herbal medicine can serve as resource materials in developing reasonably effective, safe, and cheaper drugs, along with their importance in homemade remedies to reduce reliance on expensive import of drugs. But

extensive work needs to be done in identifying, documenting, conserving and evaluating the existing indigenous knowledge and practices, and medicinal plants.

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Basic and Applied Research on Medicinal Plants of Ethiopia

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Introduction

Ethiopia is a country endowed with natural resources and a high degree of cultural diversity. At present it is estimated that 6500 to 7000 species of vascular plants exist in the country. In addition, it has a rich algal, mycological and microbial diversity, although there are no published figures to estimate this rich biodiversity. Ethiopia is a country where most likely the ancestors of modern man evolved, and it is also a country with a long history of human settlement. The majority of the population, as in the past, still depends for its health care on traditional medicine. The rich medicinal resources and the accompanying knowledge have been kept over several generations by the indigenous population. At the moment, there is a global interest in tapping the accumulated knowledge of traditional medicine, and therefore, research is being carried out in many countries with the stated aim of increasing the contributions of traditional medicine to the welfare of the human population. Although this is the stated aim, usually the beneficiaries are multinational companies and the losers are the indigenous people, the providers of the information. In the Ethiopian context, research into traditional medicine has to take into account the fact that the bearers of the indigenous knowledge should get a fair share of the benefits that will be accrued from the development of medicines.

The main purpose of this paper is to address the issues and problems, and suggested solutions of basic and applied research in traditional medicine in Ethiopia.

Basic research is of fundamental importance not only because it reveals new knowledge, but also because it serves as a basis for applied research. The two research types are usually so interconnected, that it is often difficult to see where one starts and the other stops. If one wants to make a distinction between the two, it is of paramount importance that one seriously considers the results of the basic research before launching the applied aspect.

With respect to medicinal plants in Ethiopia, the basic research should include:

1) Gathering information on national and international laws, regulations and conventions regarding medicinal plants;
2) Understanding the concepts and the implications included in the Conservation of Biological Diversity (CBD) on medicinal plants and indigenous knowledge;

3) Compilation of information and building database on indigenous knowledge;
4) Proper scientific identification; documentation of the distribution and conservation status of medicinal plants; and
5) Compilation of other known information.

Traditional medicine is considered by some as unimportant, unscientific, and backward. Such persons consider anything that has not passed a laboratory test as useless. That such negative notions are unfounded and biased is becoming increasingly obvious these days, in particular due to the worldwide resurgence of interest in traditional medicine.

Nothing else refutes this view more than the fact that many outstanding drugs were discovered based on traditional medicine and traditional knowledge. From the well-known Ethiopian plant **Abalo** or **Waginos**, the potent anti-leukemic compound *bruceantin* was isolated.

Massive collections of plants from Ethiopia carried out in the 1960's by the United States Department of Agriculture revealed much biological and chemical information. In many instances the modern bioassay methods corroborated the traditional use of the plants. Owing to the importance of *Maytenus* (Celastraceae) in traditional medicine, the plant was collected and studied by the National Cancer Institute (NCI), USA. Maytansine, an active principle was isolated and its structure was established by Kupchan et al. (1972). After that, many species of *Maytenus* from Ethiopia and Kenya were analyzed, and experimental sites were even developed in Kenya. In 1977 maytansine had undergone pre-clinical toxicological studies and had been selected for clinical trials by the National Cancer Institute. About the same time, a new group of anamycin antibiotics, which are similar in structure to maytansine, were isolated from a fermented broth of *Nocardia*, a microbe (Higashade et al. 1977). What happened then? We do not know. Maybe the companies had developed some medicine under a different name. Until 1977, the research was scientific and the results were published. After that we do not exactly know what happened. Maybe it was a business secret. But we may ask the following questions. What does Ethiopia, from where the first maytansine was isolated, or the indigenous people who provided the knowledge, get? This took place in the past when there were no rules and regulations, nationally or internationally, on the export of plants and plant products. Things have changed now, and laws and regulations are in place to protect the interest of indigenous knowledge. Ethiopia has ratified, in 1992, the international convention: the Convention of Biological Diversity (CBD), which addresses some of the pitfalls shown above. Furthermore, a draft legislation on "Community Rights and on Access to Biological Resources" was prepared and was approved by the Organisation of African Unity Ministerial Meeting in Ouagadougou in June

1998. Thus, a researcher should first of all have a clear understanding of national and international laws, regulations and conventions regarding medicinal plants.

Collection and compilation of the indigenous knowledge should be with the consent of the healers or other bearers of the information, who should be clearly informed about the whole program.

The proper scientific identification of collected plants is sometimes considered unimportant, particularly by some scientists who are working on the applied aspect of the research. It is known that plant names used in folklore are useful, but great care should be taken when establishing the identity in some cases. For example ***Grar*** (Amharigna) or ***Lafto*** (Oromiffa) are used for a number of species of *Acacia*; ***Atat*** (Amharigna, Tigrigna, Guragigna) and ***Kombolcha*** (Oromiffa) are used for almost all species of *Maytenus*. At times, the same vernacular name could be used for different plants in different places. For example people in Eritrea and Tigray use the name ***Beles*** to refer to *Opuntia ficus-indica,* in other parts of the country, to Ficus species. The name ***Qulqual*** in Amharigna is used both for *Opuntia ficus-indica* (L.) Miller and to tree *Euphorbia* species. At times, even botanists who are not familiar with the local flora might end up in making mistakes. In this respect, one may give the familiar example mentioned above, the *Maytenus* story. As it was indicated above, the first plant from which the maytansine was identified was from Ethiopia, and the later one from Kenya; both were identified as *Maytenus ovata* (Wall. ex Wight & Arn.) Loes. But when it was later found that *M. ovata* is restricted to Asia, the Ethiopian plant was named as *M. obscura* (A. Rich.) Cuf., the Kenyan as *M. buchananii* (Loes.) Wilczek. Later, the name of the Ethiopian plant was referred as *M. serrata* (Hochst. ex A. Rich.). When Sebsebe (1985) checked the voucher specimens, the identity of the first plant from which maytansine was isolated is not clear. The specimens cited as *M. obscura and M. serrata* belong to two other different species, *M. addat* (Loes.) Sebsebe and *M. gracilipes* (Welw. Ex Oliv.) Excell *subsp. arguta* (Loes.) Sebsebe

Once the medicinal plants are identified, the distribution of the plants have to be mapped and their conservation status determined; whether the plants are abundant or threatened, etc including their habitat.

I. Building database on traditional medicine

There is enormous amount of information worldwide on traditional medicine; some of this can be accessed through well-established databases such as Abstracts (Biological and Chemical) and NAPRALERT. It is also imperative to develop one's own database that also focuses on indigenous knowledge. This is particularly important for Ethiopia where there is a wealth of information on

traditional medicine in the traditional sector, particularly in churches and mosques.

II. The applied aspect of the research would include:

1) Developing the research capacity;
2) Selection of the plants for the intended purpose;
3) *In-situ* and *ex-situ* conservation of these plants;
4) Chemical analysis;
5) Clinical trials and development of herbal medicines in various forms; and
6) Making sure that the bearers of the indigenous knowledge get a fair share of the benefits that will be accrued fromthe development of the medicine.

Research and development capacity in basic and applied research

The research and development capacity required for the above undertakings can be achieved by coordinating the various relevant institutions in the country provided the financial, administrative and other constraints are met.

If there is no local capability to undertake biological, chemical, pharmacological, etc. studies, one is compelled to send samples abroad for analysis, bioassay, etc. With the sending of samples, vital information is also transferred. This over dependence on foreign institutions can be curtailed only through developing national capability both in terms of infrastructure, equipment, and manpower. Existing facilities in all the above areas are far from adequate. The stepwise fulfillment of the needs should be carefully planned and executed.

The institute/institutions that may carry out the various tasks of the basic and applied research are suggested as follows:

The fundamental policy issues, conventions (CBD), regulations, intellectual property rights, protection of indigenous knowledge, etc on medicinal plants may be handled by legal experts in consultations with the Environmental Protection Authority, Biodiversity Institute and the Science and Technology Commission.

The compilation of information on the indigenous knowledge; the proper scientific identification; documentation of the distribution and conservation status of these plants and compilation of other known information could be handled by the Science Faculty (National Herbarium/Biology Dept and the Natural Products Research Unit/Chemistry Department), the Institute of Biodiversity Conservation and Research (IBCR) and the Ethiopian Health and Nutrition Research Institute (EHNR).

In the applied research:

- the selection of the plants for the intended purpose; *in-situ* and *ex-situ* conservation of these plants could be handled by the Science Faculty (National Herbarium/Biology Dept and the Natural Products Research Unit/Chemistry Department), the Biodiversity Institute and the Ethiopian Health and Nutrition Research Institute;
- the chemical analysis by the Science Faculty at Natural Products Research Unit in the Chemistry Department;
- the clinical trials and development of herbal medicines in various forms by the School of Pharmacy and the Ethiopian Health and Nutrition Research Institute and;
- protectors of the rights of the bearers of the indigenous knowledge and guardian of the indigenous community should be identified later.

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Applied Research in Medicinal Plants

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Background

When the concept of primary health care (PHC) was introduced, an international policy emerged to promote the use of traditional medicine in national health care systems. In 1978, WHO officially launched an international programme to promote traditional medical practices, which included the promotion and development of basic and applied research in traditional medicine (WHO, 1978).

The view that modern health care could not cater for the health needs of the entire population of the world and that the available funds were grossly inadequate to provide "*Health for All*" was one of the incentives behind the PHC policy. Traditional medicine is used by a significant number of people throughout the world, and is often the only health resource available. Efforts to reinforce traditional medical practices, emphasizing the use of local resources and the involvement of the community in health care, are very much in line with PHC principles.

Because of all the socio-cultural problems involved in incorporating traditional practitioners into the modern health care system, in 1984 WHO adopted its strategy on the promotion of traditional medicine. Medicinal plants were to be the focus of attention. There was an increase in pharmacological research on medicinal plants and regional offices were established by WHO to coordinate research activities. Databases on medicinal plants (e.g. NAPRALERT) were set up to improve the accessibility and dissemination of information on medicinal plants (Fransworth and Soejarto, 1991a).

Until recently, most of the research activities that have been carried out on medicinal plants deal with scientific investigations that mainly focus on phytochemistry. Research on the use of herbal medicine in the context of PHC has not yet received significant attention. Literature on traditional medicine reveals that there is very little data available on the promotion and use of herbal drugs in PHC, let alone data on its effects on PHC (Wondergem and le Grand, 1986).

Applied research should focus on those medicinal plants that are widely used by the society. As long as herbal drugs are widely used by the society and no acute

toxicity has been claimed (e.g. *Glinus lotoides* for taeniasis), promoting such herbs in PHC should be given priority over promotion of new plants.

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

Some 80 % of the world's inhabitants rely mainly on traditional medicines for their primary health care needs and utilize medicinal plants (Akerele, 1993). A list of 21,000 species of medicinal plants used worldwide has been prepared (Penso, 1993), but others believe that this is a conservative estimate, with the number of species actually used being between 35,000 to 70,000 (Fransworth and Soejarto, 1991b).

In the USA, it was estimated that 42.5 million visits were made to herbalists in 1990, contrasting with the 388 million actual visits made to primary health-care physicians (Eisenberg *et al.*, 1993). Over-the-counter sales of herbal medicines in the USA and Canada during 1990 reached USD 860 million with an annual growth rate of 15 % (Zhang, 1996). In Europe, the sales of herbal products have been referred to as "Europe's growth market" which amounted to USD 1.4 billion during 1992 (Anon, 1992).

Traditional medicines in China are reported to account for 30-50 % of medicines consumed, and the total sales of their herbal medicines amounted to USD 2.5 billion in 1993. In addition, China exported medicinal herbs in 1993 with an estimated value of USD 40 million. Within China, the traditional systems of health care are incorporated into the formal components of national health care (Bodeker, 1994). In India, there are more than 250,000 registered traditional medicine practitioners, the majority having received training in degree granting colleges (Bajaj and Williams, 1995).

The majority of traditional medicines used in developing countries have not been evaluated for quality, safety, and efficacy to the same standards as those in developed countries. Nevertheless, there are some remarkable claims made for their effectiveness and some traditional medicines have been subjected to 'western' scrutiny. The National Institute of Burns in Vietnam is evaluating traditional medicines that are used to treat burns. During the war with the South and the USA, some 60 different plant-based treatments for burns were developed

(Anon, 1992). It is claimed that treatment by these remedies is shorter than by conventional treatment and that they not only inhibit bacterial growth, but also stimulate the formation of scar tissue.

In Ethiopia, modern health coverage is estimated to be 45 %. Drugs are in short supply, and are inaccessible and unaffordable to the vast majority of the population. The provision of essential drugs, their equitable distribution and rational use are still serious problems. As a result, about 80 % of the population, mainly those in the rural areas, rely on traditional medicine for the treatment of both human and veterinary diseases. Despite the wide utilization of medicinal plants in the country, no meaningful research has been conducted to integrate traditional medicine into the formal components of national health care. In view of this prevalent situation, it is deemed necessary that a coordinated national programme on applied research in medicinal plants be launched.

Objectives

- To prioritize applied research in medicinal plants;
- To provide general guidelines on applied research in medicinal plants; and
- To develop herbal drugs into modern dosage forms.

Approaches to applied research in medicinal plants

In developing countries such as Ethiopia where documented data is rare, applied research in medicinal plants could be a difficult task.However, the existence of traditional medicine, mainly of plant origin, for centuries can be regarded as the main source of strength to launch such a programme. In addition, although not well coordinated, there appears to be some research experience in the field.

Prioritization of research

Research programmes in traditional medicine must be very realistic and be based on the PHC needs of the country. Moreover, research objectives should be planned so as to develop safe, effective and quality phytotherapeutic preparations, which can supplement and/or replace modern chemotherapy.

Priority based on prevalence of diseases

According to WHO the following general priority research areas have been recommended (Atisso, 1983).

1) ***Pharmacological groups having first-priority research areas:*** external antiseptics, internal antiseptics, agents for correcting disorders of the digestive system, cardiovascular agents (antihypertensives, vasodilators, cardiac tonics);
2) ***Pharmacological groups having second-priority research areas:*** antidiabetics and hypoglycaemics, cardiovascular agents (haemostatics, antianaemics), diuretics, intestinal anthelmintics, psychotropic agents; and
3) ***Pharmacological groups having third-priority research areas:*** antiparasitic agents (antiamoebics, antimalarials, trypanocides, leishmanicides), antifungals (visceral), antibacterials and antivirals, antitumorigenic agents.

Although the above prioritization may be used as a general guideline, it needs to be modified according to disease prevalence of the country. For example, in Ethiopia, infectious and communicable diseases are wide spread. These include respiratory infections, diarrhoeal diseases, malaria, tuberculosis, sexually transmitted diseases, trypanosomiasis, leishmaniasis, schistosomiasis and other parasitic diseases. Therefore, development of plant drugs that may be used to treat the above diseases should be given the first priority.

Priority based on the therapeutic status of medicinal plants

Medicinal plants can be categorized into three different groups based on the available knowledge of their therapeutic activities:
1) Those with proven and established activities (e.g. *Punica granatum*);
2) Those that are traditionally used medicaments (e.g. *Glinus lotoides*); and
3) Those that are claimed to have medicinal activities.

Group (1) plants are given the first priority in light of the availability of agrobotanical parameters, pharmacological properties, and toxicity data. The development of dosage formulation would be easier for these plants. All that is required is to make selection of the plant and standardization of the extract.

Group (2) plants are given the next priority as they have been used effectively for many years by the society. However, clinical trials should be conducted by using the conventional double blind method. Once their clinical efficacy is established their extracts can be formulated into suitable dosage forms.

Group (3) plants should be given the least priority, as scientific investigations (phytochemical studies, pharmacological testing, pharmcodynamics experiments, toxicological studies, etc.) are required to confirm their claimed activities. Such plants may or may not possess activity. Even if they show activity, the endeavour is not only time consuming but also very expensive.

Coordinated multidiscipilinary research

The implementation of applied research in traditional medicine nationally requires integrated, multidiscipilinary, and coordinated organization. It may not be necessary to set up new institutions for the purpose. What is needed is to create a National Coordinating Committee involving various institutions.

General guidelines

Plant material preparation

Plant drugs can be prepared in various forms ranging from the utilization of fresh plant material to the isolation of pure compounds. By and large, preparation of plant drugs involves various processes including cultivation; collection; drying, sorting and preservation; communition, extraction, standardization and formulation.

Cultivation: Plant material may be obtained from either wild or cultivated plants. If the origin of the drug material is from a cultivated species, there are a number of advantages: seed strains that produce maximum yield and drug potency can be selected; authenticity can be guaranteed; by careful control of conditions production of superior material is possible.

Collection: This involves considerations of season of collection; the maturity/stage of the plant: pre-flowering, flowering, post flowering (e.g. *Datura stramonium* has maximum yield of hyoscyamine if collected just before flowering); time of the day (e.g. generally maximum yield of volatile oils is obtained when the material is collected during the evening); morphological aspects (bark, leaves, etc.)

Drying, sorting and preservation: In general, plant materials are dried before they are processed. The water content is highest in fleshy fruits and decreases through flowers, leaves, fruits, barks and woods to seeds. The method used for removing the water to prevent deterioration depends upon the particular drug. Air drying is the cheapest method. Oven drying is more controllable, but must be used carefully as enzyme activity usually increases rapidly up to 40-50 $^{\circ}$ C. The best method is to introduce the sample into an oven preheated to 55-60°C to inactivate the enzymes as rapidly as possible, while not raising the temperature high enough to cause thermal degradation of the active principles. Drying, however, depends upon the nature of the plant and active constituents. Plants containing volatile oils, for example, lose their valuable components if dried at elevated temperatures. On the other hand, if the active constituents are not present in a free form (e.g. vanillin) and need to be hydrolyzed by enzymes over a certain period of time, quick drying

should be avoided. The dried material is then sorted in which extraneous materials are removed. The resulting material may then be treated with suitable agents to minimize microbial degradation. The resulting material is referred to as a purified vegetable drug and can be used as it is (e.g. herbal tea) or further processed.

Communition: The purified vegetable drug is suitably ground which may involve cutting and/or milling it to the desired size. This unit process facilitates maximum extraction of active constituents. The communited products can be used for preparations of infusion (*in situ* extraction) or for the preparation of standardized drug powders.

Extraction: For most plant materials, communition is followed by the extraction of drugs that are responsible for therapeutic activity. The drugs are extracted with suitable solvents and the product may be an aqueous extract, tincture or fluid extract. Concentration of the extract by evaporation yields a semisolid product, which can be dried to give powdered extract.

Generally, the techniques used to obtain crude plant extracts include infusion (drug kept in hot or cold water for a short a time), decoction (drug boiled with water), maceration (prolonged infusion often in aqueous alcohol), percolation (maceration followed by a slow flow of fresh solvent through the ground material) and continuous hot extraction (repeated infusion with hot solvent).

Processing of extracts

Extracts can be classified as total and purified extracts. Total extracts contain all the extractive matter obtained by treating the drug with a solvent (aqueous or hydroalcholic). Purified extracts are those extracts, which contain the active principles after removal of the unwanted materials (e.g. senna extracts containing 45-60 % content of sennosides).

Vegetable drugs could be either defined extracts (those containing known active ingredients, e.g. alkaloids of *Datura stramonium*) or undefined extracts (those having therapeutic activity but in which the active principles are not defined). Defined extracts can be standardized based on their active principle(s) while with undefined extracts only the amount of extract is declared. In both cases excipients may be added and suitably dried (e.g. spray drying) to provide the finished product.

Standardization of extracts

Standardization is a method by which the active principles of a given extract or formulation is quantified. Biological activity of plants may be standardized by the following methods:

1) standardization of a single active compound (e.g. cineole in eucalyptus oil, citral in lemon grass oil);
2) standardization of a group of compounds (e.g. alkaloids of *Carica papaya,* alkaloids of pomegranate bark, anthraquinone glycosides of senna leaves, saponins of *Glinus lotoides*);
3) standardization of a guide substance or group of guide substances. Guide substances are chemically defined compounds occurring in a vegetable drug, which are used to define the quality of the medicament with respect to identity, purity, content and stability. They are not necessarily related to the pharmacological action of the preparation (e.g. Apigenin-7-glycosides in chamomile); and
4) standardization by the amount of extract (e.g. nettle leaf extract).

Formulation of extracts into dosage forms

In the formulation of phytopharmaceuticals the whole extract containing the active principles should be used. Several examples are cited in literature where the activity of phytopharmaceuticals is attributed not to a single purified compound but to the whole extract. A scientific investigation into the South American "dragon's blood" (sap from the bark of *Croton lechleri*) has concluded that no single wound healing principle is present, and that the sap acts as a natural dressing which forms an occlusive layer with an antimicrobial environment and cell profliferative effects due to several compounds (Chen *et al.*, 1994).

In Ethiopia, most traditional medicinal preparations contain several herbs mixed together. This may have its own advantages and it may not always be logical to look for a single herb that is responsible for the therapeutic activity. This is also supported by a research conducted in UK on a mixture of 10 traditional Chinese medicinal herbs for oral treatment of non-exudative atopic eczema in children (Phillipson, 1994). In a placebo controlled double-blind trial carried out on 47 selected children, the traditional Chinese therapy was found to be effective as judged by western medical criteria (Sheehan and Atherton, 1992). Efficacy was attributed to the combination of the 10 herbs and not to one specific herb.

The formulation of plant extracts into dosage forms is a complex operation. Unlike pure active principles extracts are raw materials that always contain large quantities of extraneous materials, which affect the formulation, processing of the dosage form and the stability of the product.

Practically all types of dosage forms can be prepared, but for plant extracts the most common and suitable forms are liquids (e.g. syrups, tinctures), solids (e.g. capsules and tablets) and semisolids (e.g. ointments and suppositories).

Preparation of liquid dosage forms

Fluids, soft, or dry extracts may be used for preparing liquid dosage forms. Of the dry extracts, purified ones are the most suitable because they contain less extraneous materials. Solubility of the extract and stability of the product are the major problems encountered. The addition of cosolvents or surface-active agents may help. As much as possible pH shifts must be avoided (e.g. in products containing alkaloids) if reconstituting the original extract is necessary. If precipitates have been removed by filtration, it should be checked that the activity of the preparation has not been diminished.

Preparation of solid dosage forms

For the preparation of solid dosage forms mostly dry extracts are used. The processing of plant extracts into soft gelatin capsules does not usually present any particular difficulties, except that the technology is monopolized and expensive. Most extracts, despite being hydrophilic, can easily be converted into pumpable suspensions with lipophilic dispersants when they are finely powdered and then encapsulated.

In contrast, direct filling into hard gelatin capsules is difficult because of the poor flow properties of most dried extracts. Such extracts may also be too bulky to be filled in a normal size capsule for a single dose. The dried extracts must therefore be granulated as in the manufacture of tablets.

In addition to poor flow properties and low bulk density, extracts existing in multicomponent systems are usually highly hygroscopic making tabletting difficult and direct compression usually impossible. Such problems are overcome by the addition of hydrophobic substances such as silicic acid and magnesium stearate.

Procedures applicable to all cases cannot be designed. Measures to be adopted must be established and optimized for each individual case.

Preparation of semisolids

Ointments, creams, liniments and suppositories for local application can be prepared from herbal extracts with the inclusion of suitable excipients.

Excipients

Plant drugs are formulated into dosage forms in combination with one or more non-medicinal agents referred to as pharmaceutical excipients (additives). Most pharmaceutical excipients are of natural origin or semisynthetic. In Ethiopia, climatic conditions are favourable for the growth of a large variety of plants some of which can be used as sources of excipients.

Starch is one of the most popular excipients that can be made available locally. It can be obtained from native plants such as the stem of *Ensete ventricosum,* tubers of *Dioscorea* species and varieties of sweet potato. The applications of these starches as pharmaceutical excipients have been reported (Gebre-Mariam and Schmidt, 1996a, 1996b).

Acacia gum is the other excipient of interest that can be processed locally for pharmaceutical purposes. Acacia trees are widely distributed in Ethiopia and about 60 species have been identified (Thulin, 1983). In Ethiopia, the major sources of acacia gum are *A. senegal, A. seyal and A. drepanolobium.* It has been reported that the local gums have comparable pharmaceutical properties with that of imported acacia gum (Nikolayev and Gebre-Mariam, 1992). Another gum yielding tree, sometimes shrub, of economic value growing in Ethiopia is *Albizzia gummifera.* There are at least eleven indigenous species of *Albizzia* in Ethiopia and most of them yield gum (Thulin, 1983).

Quality, safety, and efficacy

Herbs should be identified by comparison of their macroscopic and microscopic characteristics with authoritative, accurate descriptions or authentic samples. Chemical constituents of herbs may vary from batch to batch because of intra-specific variation, environmental growth factors, time of harvesting, and parts of herb present or storage conditions. Wherever possible, active ingredients should be identified chromatographically and quantitative standardization should be made in order to provide consistency of dosage. Herbs are often contaminated and limits should be set for permitted levels of microbes, soil, other plants or other parts of the same plant, pesticides, fumigants, and toxic metals (Phillipson, 1993).

Some medicinal herbs contain toxic compounds such as pyrrolizidine alkaloids (e.g. species of *Crotalaria, Heliotropium, Senecio, Symphytum*), which may cause liver toxicity and cancer. Other toxic compounds present in some herbal plants include lectins, toxins, lignans, saponins, diterpenes, and cyanogenetic glycosides. Contrary to popular belief, herbs may cause adverse reactions including allergic, cardiac, endocrine, and irritant effects. There is also the possibility that herbal treatment may interact with other medicines e.g. if a herb lowers blood pressure or

increases blood coagulation time or is a sedative, then it may interact with concurrent antihypertensive, anticoagulant or sedative therapy (Newall *et al.*, 1996). All herbal medicines have to be assessed for their efficacy by clinical trials.

Conservation of plants

It is estimated that 25 per cent of higher plant species (ca. 60 000) will have become extinct by the year 2050 (Akerele *et al.*, 1991). Although it is popularly thought that this is due entirely to the removal of large areas of rain forest, it must be acknowledged that the collection of medicinal plants from wild sources plays a considerable role in the loss of plants species. As a result, in 1988, the Chiang Mai Declaration, drafted through the combined efforts of the International Union for the Conservation of Nature (IUCN), the Worldwide Fund for Nature (WWF) and WHO, announced the serious loss of medicinal plants through over-harvesting and habitat destruction (Zhang, 1996).

The demand for medicinal plants is increasing and the international trade in Europe is reportedly mainly in wild-collection species (Cunningham and Schippman, 1995). This is also true in the case of Ethiopia. It is therefore necessary that conservation strategies should be developed for threatened taxa. It is also important that the government understands that the demand for medicinal plants should be met from cultivated species.

Conclusion

Applied research in the development of herbal dosage forms should take the following points into consideration:

- the research should be coordinated, multidicipilinary and integrated;
- medicinal plants with proven and established therapeutic activities should be given the first priority;
- the research should be in line with the PHC system of the country;
- cultivation of medicinal plants should be promoted; and
- conservation strategies must be designed.

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The Ecology and Conservation Status of Medicinal Plants in Ethiopia: What Do We Know?

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Introduction

The basis for health starts with healthy food and the care a woman takes of her family. She is also the first resort for minor ailments: cuts and bruises, headaches and sore throats, skin diseases and upset stomachs. Dr Zemede's study of home gardens in Ethiopia shows that several of the plants include those with both medicinal and culinary uses (paper for the present workshop). Spices and condiments not only add flavour to food, they have recently been found to reduce the hazard of food-borne diseases being spread with food (Nature, April 1998). Home gardens also contain plants only used medicinally.

However, health care has also to deal with major diseases like malaria and other serious health problems like diabetes and cancer. For these, the remedies usually involve plants growing in the wild. Health care and the pharmacopoeia needed to support it thus goes from relatively safe herbs with mild effects to plants known to be highly toxic if handled improperly.

The deteriorating condition of most natural areas is now widely recognized, at least in writing if not in action to curb it. However, comments usually focus first on forests, and then on erosion in agricultural areas. Other major ecosystems, for example, woodland, grassland, do not get much attention. In the past, areas like rangelands were often taken as unused or unusable, and therefore not owned. Such areas could only become valuable if they were converted to some type of agricultural land or enclosed as parks for expatriate tourists to visit. The interests of the local people in these areas were only rarely considered. The fact that this attitude to conservation is totally unsustainable was dramatically demonstrated in Ethiopia during 1991 and 1992 when there was a change in governments. The local people moved in to claim what they saw as their land, and much of the infrastructure was severely damaged or destroyed (Shibru, 1995). The Parks that suffered least were those where dialogue had been started with the local people and some of their interests and concerns had been catered for.

One approach to conservation is to identify items of particular value in an area. These can then be used to justify efforts to conserve the ecosystem and develop sustainable techniques for harvesting the products of interest. There is now strong interest, for example, in identifying secondary forest products, including medicinal plants, which can help provide incentives for better forest conservation

practices. It is now enshrined in the Convention on Biological Diversity (Article 8j) that local communities and indigenous peoples are the most knowledgeable about and the best placed to care for the biological resources around them. They depend on these resources for their existence and know better than any other group the importance of careful management to ensure the sustainable use of these resources.

The thesis of this paper is that most, if not all, ecologies contain some medicinal plants. The value of these in the local economy should be appreciated and used to assist local communities in both rural and urban settings to develop systems for improved conservation and sustainable use of these natural resources.

Material and Methods

At the end of his study, Jansen (1981) gives a "List of Ethiopian spices, condiments and medicinal plants" that contains around 350 names of species that have been taken from 11 published papers. The majority of the plants listed are given as having one or more medicinal use. The list includes the scientific name, family, vernacular names and uses for each species, as well as the literature source.

This list was taken because it is based on a number of studies and covers household as well as stronger medicinal plants.

A form was designed to capture information from the herbarium sheets for these species found in the collection of the National Herbarium of Ethiopia. The forms were filled out by the technical staff of the Herbarium who used the published and unpublished accounts for the Flora of Ethiopia to validate scientific names and family designations. What follows is a preliminary analysis of the findings.

Results

Reliability of identification and affiliation

Scientific name:

It was found that 25 names given in Jansen's list could not be found in the herbarium collections:

- Two of these were for plants described in the Flora of Ethiopia, for which no recent specimens are available; *Melilotus indica* is a weed of cultivation last collected during the Italian occupation. The other is an endemic small tree or

shrub known from only two specimens, which were collected in the nineteenth century from northern Ethiopia.

- Six are names of cultivated plants. Five of these were introduced for research, for example, *Astragalus boeticus*, *Coffea canephora* and *Nicotiana rustica*, the sixth is one of the four species of pumpkin (*Cucurbita* spp.).
- The remaining 17 names are either synonyms or incorrect identifications. For example *Mucuna pruriens* only occurs in Ethiopia as the cultivated variety, which lacks irritating hairs. The wild species in Ethiopia with irritating hairs is *Mucuna melanocarpa*.

Family

The family affiliation of the species was brought in line with the family circumscriptions used in the Flora of Ethiopia, for example *Papilionaceae*, *Mimosaceae* and *Caesalpinaceae* are treated as subfamilies of *Fabaceae,* also called *Leguminosae*, while '*Liliaceae*' is now divided into many families and there are no indigenous members, only introduced ornamentals, of Liliaceae in Ethiopia.

Vernacular name

Jansen's list contains vernacular names, and these were also found with the herbarium specimens. Generally, the more useful or important a plant is, the more likely it is to have a local name. However, vernacular names cannot be used to identify species in the same way as scientific names can. For example, names are often given for groups of species, like ***ERET*** for *Aloe* spp. and *GRAR* for *Acacia* spp., or they are indicative of a use, like ***INJORY*** for the edible fruits of *Rubus*, *Morus* and *Fragaria*.

The only way to get a plant named reliably is to make one or more properly labelled voucher specimens that can then be identified in a herbarium. These can be placed in a permanent collection, like that of the National Herbarium, where they can be found to validate the name at any time now or in the future.

Distribution

The Flora of Ethiopia and Eritrea has established 16 'floristic regions' for the country. These coincide with the administrative regions in use up until 1991; except that the Afar region includes all of what was eastern Tigray, Wello and Shewa below the 1000 m contour.

The following list gives the 14 regions of Ethiopia ranked according to the number of species from Jansen's list recorded in each:

Regions	Percentage
Shewa	73
Harar	66
Tigray	59
Illubabor	58
Sidamo	58
Wello	54
Gojam	52
Bale	52
Keffa	49
Gondar	47
Gamu-Gofa	46
Wellega	33
Arsi	32
Afar	1

This distribution shows that, with the exception of the Afar, all regions of the country have a local pharmacopoeia. This is a reflection of the cultural diversity of Ethiopia and demonstrates the importance of the local flora in the health of local communities.

The number of plants known from the different regions is partly a reflection of their proximity to collecting centres. The highest numbers come from Shewa, which has the National Herbarium of Addis Ababa University, and from Harar where Alemaya University of Agriculture is located. These are also two of the largest regions of the country. However, the proximity of a collecting centre is also found for Eritrea (not shown in the Table). The Italians collected extensively while they were the colonial masters and this is reflected in this region having 67 per cent of the plants in Jansen's list. Apart from Afar, the lowest representation is found in Wellega and Arsi. Wellega is far from Addis Ababa and the uncertain situation in both the last century and this has discouraged collectors going to the region. Arsi is by far the smallest region and many collectors tend to pass through it on their way to Bale.

The virtual absence in the Afar of plants from Jansen's list does not mean that the peoples of this region have no pharmacopoeia. It is more that this hot dry region has not attracted the attention of plant collectors. Eastern Eritrea has been better collected and 24 per cent of the plants from Jansen's list are recorded from this region. Studies started by Dr Tafesse Mesfin and colleagues at the Faculty of Veterinary Medicine are already finding many plants used in traditional animal health practices and these will have their counterparts for human health.

The ecological distribution of medicinal plants

Experience with editing accounts for the Flora of Ethiopia has shown that thirteen broad vegetation types can be recognized. Jansen's list did not include any plant found in desert and very few were recorded as growing in wetlands. The other vegetation types ranked as follows, most to least:

Rank	Vegetation/Habitat
1	Microphyllous woodland
2	Montane grassland
3	Riverine
4	Macrophyllous woodland
5	Cultivated fields
6	Dry montane forest
7	Evergreen bushland
8	Rocky areas
9	Moist montane forest
10	Home gardens
11	Afro-alpine

Microphyllous woodland is also called *Acacia-Commiphora* woodland. It is the most widespread vegetation type found in the drier rangelands of eastern and southeastern Ethiopia. Species of both *Acacia* and *Commiphora* produce gums and resins with medicinal properties. Because there are long dry periods, the vegetation includes plants with well-developed roots and tubers like species of *Cyphostemma* and *Cissus* in the family Vitaceae, several of which are used medicinally.

Acacia-Commiphora woodland is most extensive and rich in species in the southern Borana Zone of Oromia Region and the Somali Region of Ethiopia. An unpublished study of the distribution of the endemic plants of Ethiopia has shown the greatest number in these areas. These are the northern extensions of the Somali-Masai centre of regional endemism identified by Frank White (1983). They also contain one of the endemic bird areas of the world with five endemic bird species including the endangered Prince Ruspoli's Turaco (EWNHS, 1996; Stattersfield, *et al*., 1998).

Macrophyllous woodland is characterized by species of *Combretum* and *Terminalia* -- small trees with large leaves. These woodlands are most extensive in the moist western parts of Ethiopia, particularly Gambella and Benshangul-Gumuz Regions. A recent ethno-botanical study of the vegetation of the Gambella Region has catalogued over 100 species used by the local people for food, water, utensils, and medicines (Tesfaye, 1997).

Both the *Acacia-Commiphora* and the *Combretum-Terminalia* woodland types are being severely depleted through clearing for agricultural schemes, settlement and resettlement, and, most importantly, for wood as fuel and to make charcoal to meet the ever-increasing urban and rural household energy demands. Woodlands have never attracted the attention of conservationists in the same way as forests. Yet for Ethiopia and particularly the pastoralist peoples who inhabit and thus know and use these areas, they are the basis of their survival. An appreciation of the wealth of medicinal plants they contain should help in designing better conservation and development programmes with the local people.

Montane grassland forms a mosaic with the ***dry montane forest***. *Juniperus procera* and *Olea europea* subsp. *cuspidata* characterize the dry montane forests. Aerial photographs have shown that the small areas the dry forests covered some twenty years ago have been drastically reduced and are still disappearing. *Juniper* wood is termite proof and thus in demand for building houses while that of *Olea* has many desirable properties including its use as a fumigant. However, most of the plants used medicinally found in this vegetation type are small trees, shrubs, climbers and herbs which depend on the cover of the larger trees for their survival.

Grasslands are generally regarded as areas only valuable for grazing and/or for turning into arable fields. The high plateau of Ethiopia is covered by mountain chains separated by wide valleys. The soil in many of these valleys is a deep, self-churning, black vertisol which deep-rooted perennial plants cannot survive in. Most of Ethiopia's endemic grasses are found in these grasslands. None of these grasses are recorded as being used medicinally, but they are associated with a diverse flora of other species, for example several species of *Cucumis*, which are used in veterinary medicine. Nearly half of the species in Jansen's list are found in these grasslands. When these species are added to those found in the associated dry montane forest, more than half of the medicinal plants in Jansen's list are found here.

The fact that this vegetation mosaic is also associated with the highly populated and agriculturally productive parts of the country points to the importance of both the dry forests and grasslands in providing the medicinal plants for both human and animal health. However, apart from Menegasha State Forest near Addis, this vegetation mosaic is not included in the officially protected areas system of the country. Its importance in the biodiversity wealth of Ethiopia is seen in both its agrobiodiversity as well as the Central Ethiopian Highlands endemic bird area with one endangered and a second vulnerable endemic species (Stattersfield *et. al.*, 1998). The Important Bird Areas programme of the Ethiopian Wildlife and

Natural History Society has identified several sites where the forest - grassland - wetland complex of the Ethiopian plateau should be considered for conservation activities with the local people (EWNHS, 1996)

Riverine vegetation has been shown, using Jansen's list, to be important in providing local people with their medicinal herbs. But development tends to see the natural vegetation by rivers as a hazard to be removed. Often when woody plants are cleared from cultivated and grazed areas, the only patches left are those in religious groves and beside rivers. It is good to recognize the role of this vegetation in the health care of local communities. The importance of the biodiversity of riverine vegetation is supported through the fact that the Wabi-Shebelli and Genale-Juba rivers in Somali Region are also the sites of the third global endemic bird area in Ethiopia (Stattersfield *et d.*, 1998).

Evergreen bushland is generally regarded as degraded vegetation, derived from the clearing of dry montane forest. The vegetation gets its name from the small evergreen trees or shrubs, particularly *Euclea racemosa* subsp. *racemosa* and *Dodonaea angustifolia*. However, the diversity of the plants in this vegetation can be as high as in the dry montane forest and it provides both medicinal plants and others useful for local communities. It is safe to say that this vegetation has never been studied from the point of view of conservation, only for replacement by plantation forestry with exotic species, particularly *Eucalyptus* and *Cupressus*. Although the trees may provide wood and a cash income, this strategy has a very adverse effect on the diversity of the plant species available to local communities.
Rocky areas are common throughout Ethiopia. It is thus hardly surprising that they have a distinct floristic composition including a number of endemics. For example, one of the important genera associated with these areas is *Aloe*, species of which are renowned in both traditional health care and modern alternative medicine for their medicinal properties. The greatest threat to these areas is plantation with exotic tree species. Particularly devastating for local biodiversity is the Mexican cypress, *Cupressus lusitanicus*. Its dense shade and litter, which does not readily decay, can completely eliminate the local flora including the medicinal plants.

Moist montane forest has been found in this study to supply fewer medicinal plants for the national pharmacopoeia than the other vegetation types. Overall, the moist montane forests of Ethiopia are generally much poorer in species than their equivalents in Kenya, Tanzania, and Uganda. It is generally thought that they are all secondary forests, i.e. at sometime in the past they have been cleared and regrown (Friis, 1992). However, these forests are the homes of some of Ethiopia's minority nationalities, including hunter-gatherer peoples, whose ethnobotanical knowledge has not been well studied. The pharmacopoeia of these forests needs

studying urgently before they are all cut down and/or replaced by plantation crops, particularly coffee and tea.

Cultivated fields and home gardens have been grouped together because several of the plants recorded in Jansen's list can be found in both, although most of the collections come from cultivated fields. The species include cultivated crops with food and medicinal properties like fenugreek, *Trigonella foenum-graecum*, those grown only for their medicinal properties like the shrubby species of *Ocimum*, weeds with medicinal properties like *Bidens pilosa* and *Chenopodium* and *Celosia* spp., and hedging plants with medicinal properties like *Justicia schimperiana* and *Achyranthes aspera*. Unfortunately, many of these plants are among the least well known botanically. The importance of home gardens has been extensively studied by Zemede Asfaw and is reported in another paper from this workshop.

Afro-alpine is any area 3000 m asl and above. It has the smallest coverage of all the vegetation types in Ethiopia. The number of species in Afro-alpine areas is relatively low when compared with all other vegetation types in Ethiopia, except desert. However, the proportion of endemics -- over 20 per cent -- is higher than the country average of 12 per cent (Tewolde Berhan, 1991). Many of these plants are confined to relatively small areas. Thus if any of these plants have medicinal properties they can be considered threatened. Twenty-four of the plants in Jansen's list occur in the Afro-alpine zone. However, they are also found in other vegetation types. Fortunately, some efforts are being made to conserve some of the remaining Afro-alpine areas through the National Parks in Bale and Simen Mountains, but these efforts need reinforcing and the role of local communities in the conservation effort clearly worked out including their traditional rights to the natural resources of these areas.

Status of the plants

An estimate of the threat to medicinal plants can be made from the type of plant and the part used. Harvesting the roots of a tree poses more of a threat than collecting the fruits and seeds, and this can be more threatening than using the leaves. The parts used, as recorded in Jansen's list, have often been confirmed from notes on specimen labels.

The interesting feature in this list is the high proportion of plants where it is the leaves that are used. This indicates that many of the medicinal plants are being used in a sustainable way. It would be pertinent to see if there is a correlation between the type of part used and the seriousness of the disease it is used for. For example, is it mainly leaves and leaf-extracts that are used to treat minor skin problems? Are the medicaments prepared to treat serious complaints mostly prepared from roots and tubers?

The proportion of the plants in the list is as follows:

Part used	Percentage
Ash	1.0
Bark	6.0
Bulb/Tuber	1.7
Flower	2.5
Fruit	13.0
Gum/Resin	2.0
Herb/Stem	26.0
Leaf	43.0
Root	25.0
Sap	10.0
Seed	13.0
Smoke	2.5
Wood	0.5

The number of herbarium sheets for each species was recorded to find out how well we know the plant and/or to get an indication of its rarity.

- About ten per cent of the plants in Jansen's list were represented by ten or fewer herbarium collections. All of the cultivated herbs and spices and nearly all the other plants associated with home gardens were in this category. There is thus very little documented information in the form of specimens on the conditions under which these plants grow and how diverse they are.

- About five per cent of the plants with less than 10 herbarium collections are wild. This list includes species like *Abrus precatorius* notorious for its attractive but highly poisonous red seeds, and *Commiphora* and *Boswellia* species, which are highly exploited for their resins. All these species can be said to be poorly known and need further study to determine the level of threat to their survival. The list is deliberately not being put with this paper in order not to expose these species to the possibility of illegal exploitation.

Conclusion

This study of a list of plants has shown that plants with medicinal properties are found throughout the country with the exception of desert and wetlands. It has also shown that many of the species are exploited through their leaves. However, it has also shown that about a quarter of the plants used are harvested for their roots, tubers or bulbs. These species need special attention to determine their status and what measures should or could be taken to have them conserved.

The study has shown that the woodlands of Ethiopia are the source of most of the medicinal plants followed by the montane grassland/dry montane forest complex of the plateau. Other important vegetation types for medicinal plants are the evergreen bushland and rocky areas.

The importance of cultivated herbs and spices to family health is recognised. It is recommended that every effort be made to get a better understanding of the role of medicinal plants in home gardens and family health.

All studies/lists of plants like the one used here have to be supported by voucher specimens that can be incorporated into the collections of the National Herbarium so that they can be referred to at a future date. This is the recognized and established means of ensuring that the name used for a plant is correct.

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Biodiversity Conservation and Sustainable Use of Medicinal Plants: Problems and Prospects

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Introduction

Plant species of economic importance are not randomly distributed throughout the world. N. I. Vavilov was among the early scientists who conceptualized this phenomenon and recognized eight centers of diversity around the globe. The Ethiopian region has been recognized as an important center of diversity ever since the expedition of Vavilov in the 1920s. The region is largely known as a center of origin and/or diversity for several important economic crop plants *viz.* cereals, pulses coffee, *etc.* and other lesser appreciated but potentially useful crop plants.

In recognition of the existence of valuable biodiversity both by international communities and national institutions, the Biodiversity Institute of Ethiopia (formerly Plant Genetic Resources Center/Ethiopia) was established to undertake collection, conservation, documentation, evaluation, and utilization of plant germplasm. The center ever since its establishment in 1976 has been capturing variations of mainly cultivated, medicinal and other lesser-known but potentially important species.

Vegetation type

Vegetation types in Ethiopia are highly varied ranging from arid lowland to afro-alpine vegetation. It has a large number of plant species. A recent and extensive work is that of Gebre-Egziabher (Gebre-Egziabher 1991) who indicated that the number of higher plants was about 6700 of which ca. 12% are believed to be probably endemic.

Although there have not been many extensive studies made on medicinal plants in Ethiopia Abebe and Hagos (Abebe and Hagos 1991) listed 54 plant species used in traditional medicine and stressed that most of the medicinal plants are endemic species with fairly limited distributions. A detailed account of medicinal plants with important gene pools was presented in Abebe and Ayehu (Abebe and Ayehu 1993) and in this account over 240 species spread over a number of families, mainly trees and shrubs ranging in height from three to 20 meters, were included. The species include both those endemic to the country and those that were not. In a more recent study over 600 species were collected and known to have some medicinal value at one time or the other in some part of the country. In Ethiopia, a

recent estimate indicated that out of 7000 known species, close to 800 species were used in the national system of medicine.

Uses of medicinal plants' genetic resources

The critical importance of genetic resources, both of plants and animals, as crucial components of the health care system has been recognized for millenia. Medicinal plants form the basis for the rural primary care system in Ethiopia. A growing rural population, which depends on limited land size, will have to produce more plants with tolerance to several stress factors to cope with the growing medical demands of the rural population. This requires that herbalists have continuous and dependable access to plant genetic reservoirs especially for medicinal use.

Well over 80% of the population, and possibly more in the rural sector, in the country use alternative medicine, mostly herbal, which is indigenous to the localities. The use of herbal medicines is becoming quite popular due to the mounting prices for modern pharmaceuticals and the inefficiency of modern health care services associated with reduced efficacy of some of the modern drugs.

Collection

Biodiversity Institute (BDI/E) has collected a wide assortment of species (ca.101 species) mainly of the cultivated crop plants. It has a modest collection of root crops, spices, vegetables, and industrial crop plants. The center holds a total of about 56,000 accessions of mainly cereals (over 50 %), pulses, oil crops, spices, medicinal plants, etc. The medicinal plant collection is comparatively limited both in size and scope mainly due to priority reasons and inadequate knowledge of the conservation biology of medicinal plants. For most species the materials collected are seeds, in some cases cuttings and bulbs have been assembled from various geographical regions and agro-ecological zones.

Germplasm sampling

Sampling is a crucial and important aspect of germplasm collecting since a sample must be representative of the polymorphism present in the target population. Random sampling technique is the major collecting strategy adopted to obtain optimum sample size. An optimum sample size per collecting site is the number of plants required to obtain, with 95 per cent certainty, all the alleles that occur 5 per cent frequency or more (Marshal & Brown 1975). Whenever rare types are encountered biased sample technique is recommended and the sample has to be treated as a separate accession. In practical terms, random sampling

complemented by biased sampling technique is recommended. In the case of medicinal plants collecting and conservation, there has been little or no effort to work out an appropriate and scientificallysound sampling procedure.

Sampling from market places and fields has also formed part of the sources of collection. In these situations, after a thorough mix of the material, a reasonable (ca half kg) sample was taken whenever conditions allowed. On the other hand, the sampling of vegetatively propagated material and medicinal plants requires a distinct sampling method since such crops do not occur in large populations but rather in isolated selected genotypes. Proper information on these materials from the local farmers and herbalist is essential before sampling to avoid materials coming from the same plant source.

In ideal situations collecting wild species including medicinal plants occuring in the wild should be preceded with a detailed analysis of the ecological altitude, ecogeographical pattern of distribution and genetic variation in the target species (von Bothmer & Seberg 1995). This will permit efficient sampling in capturing genetic diversity. These authors summarized the approaches to the sampling of material for analysis on diversity. Germplasm of wild species including medicinal plants was sampled at random and sampling was based on the availability of the material and was more of a rescue operation than a well planned collecting activity.

It must be kept in mind that the ultimate objectives of sampling germplasm for conservation are to collect maximum variations and adequate samples that maintain allele frequencies of the collected populations. However, these targets might be difficult to achieve in practice since we collect limited numbers of individuals per population and, consequently genetic drift may be unavoidable (Esquinas-Alcazar 1993).

Genetic erosion

Genetic variation is the foundation of evolution. Evolution is the basis for continuation of all life forms. However, variation is being narrowed as a result of various agents of genetic erosion. Anthropogenic factors are the most important factors threatening biological diversity. Broadly speaking factors of genetic erosion can be grouped into two categories, man-made and natural factors.

Natural factors

Droughts contribute to the genetic erosion of both cultivated and wild species. In recent years recurrent droughts have led to complete failure and subsequently a disappearance of local cultigenes. The reduced availability of medicinal plants in

northern Ethiopia (McGuire 1995) could partly be associated with this particular natural phenomenon, although other factors might also be involved.

Insects, pests, floods and other natural calamities have been cited as possible causes of genetic depletion. Forest fires can also be a major cause of genetic erosion primarily when followed by other stress factors.

Man-made factors

Ethiopia contains immense resources of biological diversity, in both its wild habitats and in the fields. This diversity is eroding under a variety of anthropogenic pressures. Habitat destruction and deforestation by commercial timber interests and encroachment by agriculture and other land uses have resulted in the loss of some thousand hectares of forest which harbour useful medicinal plants annually over the past several decades. In the case of medicinal plants diversity and local materials are being replaced in many areas and genetic depletion is taking place as a result of destructive and over harvesting practices.

The transformation of agriculture from traditional farming systems to modern types has been instrumental in genetic and possibly to the disappearance of rare and endemic species. A massive resettlement program as a result of the recurrent drought, and subsequent government policies have led to the abandonment of old homesteads and back-yard medicinal gardens, which served as field genebanks and sources of primary health care.

The contribution of economic transformation and liberalization in Ethiopia to biodiversity loss are clear in some ways and under-researched in others. In addressing the policy regimes, which assist or inhibit communities to conserve and use biodiversity, it is essential to examine how policy regimes are changing in response to economic transformation and other factors.

Characterization and evaluation

Characterization and evaluation of medicinal plants are of paramount importance in promoting the utilization of these species. Results of preliminary evaluation can assist user communities to select the right materials for plant improvement programs. The work in this aspect concentrates on recording those agro-morphological traits which are highly heritable, can easily be observed by the eye and expressed in all environments.

In addition to the well known cultivated species there are some indigenous species whose cytogenetics are not adequately known or which show dubious

chromosomal counts in the literature. In these situations, the use of cytogenetic techniques becomes a major tool for identification. Chromosomal counting and determinations are, therefore, part of the characterization process for medicinal species.

Evaluation is exceedingly important and forms a prerequisite for the utilization of germplasm. So far activities in this respect have been limited in scope and emphasis, mainly due to the fact that priorities were attached to other activities of the genebank. In-depth studies of the materials with respect to characteristics of adaptations such as drought, frost, cold, heat, and to adverse soil conditions and medicinal properties are essential for further utilization of the accessions.

Basic diversity studies

There appears to be an inadequate information base on the biodiversity of the Ethiopian plant genetic resources. Our knowledge of the structure of genetic variations of the indigenous species is limited both in scope and coverage. Not many species have been considered for major intraspecific studies with the objective of locating sites of concentration of desirable genes and co-adapted gene complexes. Of all the major crop species, the cereals are well studied in compartive terms. There is little or no information on other equally important species. Similar emphasis as on cereals and to some extent pulses should also be placed on medicinal plant species to form a sound base for biodiversity conservation and sustainable utilization.

Conservation of plant genetic resources

The objective of conservation is to conserve maximum diversity within each species to ensure that its genetic potential will be available in the future. Ideally all plants should be conserved as evolving populations in their natural ecosystem. However, this is not practically feasible for all species. Plant genetic resources can be conserved *in situ* or *ex situ*; the two systems are complementary and are being adopted into the conservation strategy in Ethiopia.

***Ex situ* conservation**

Conservation *ex situ*, (botanical gardens and genebanks) has been one of the principal means of preventing the loss of valued plant species. While they have served a variety of purposes, these institutions have thus far done little to safeguard local interests. For example, the genebanks in which farmers' varieties are stored have been designed and managed primarily to supply raw materials to the formal sector plant breeding, not to support the supply of valued medicinal

plants planting material. The conflict between local and outside interests has also been a hallmark of *in situ* conservation, particularly in the case of wild biodiversity. Parks and sanctuaries have protected these resources only by preventing local communities from enjoying their benefits, on which they had in most cases relied for generations.

The seed bank is the major form of conservation strategy. Orthodox seeds are first dried up to 3-7% moisture in a dehumidified drying room operating at 15-20% relative humidity and 18-20^{0}C before they are packed in aluminum foil bags. Seeds meant for immediate use and seed multiplications are stored in the temporary storage at +4^{0}C whereas the long-term material is kept in the base storage facilities operating at -10^{0}C.

Field genebank

Recalcitrant seeds and plant species that do not readily produce seeds are conserved *ex situ* in field genebanks in spatially proximal sites to the research establishments in order to promote the utilization of these materials in national crop improvement programs. Medicinal plants, coffee, root crops and spices are all maintained in field genebanks at the appropriate agro-ecological site. The recently established medicinal plant field genebank at Wendo Genet in collaboration with the traditional healers is an alternative approach especially to medicinal plant conservation and sustainable use in the absence of adquate scientific conservation guidlelines.

Tissue culture technique

The storage behavior of some of the local endemic plants may not be known and the conservation of seed is probably not the appropriate strategy. In addition to seed conservation, alternative techniques such as tissue culture should be sought for species whose storage behaviors are not well known.

In situ conservation

In situ methods of conserving crop genetic diversity are little tried. However, several models that have been suggested appear infeasible in economic terms, and are of dubious acceptability to farming communities.

On top of *ex situ* conservation, and in view of the circumstances prevailing in Ethiopia, *in situ* conservation of provenances and populations or even samples of the entire ecosystem may have to be conserved. In principle, *in situ* conservation may well be integrated with the existing system of national parks scattered in

various agro-climatic regions in the country. In addition to limited intra-species diversity the present National Parks incorporate onlya few medicinal plants.

Problems associated with medicinal plant conservation

The problems and difficulties of medicinal plant conservation are literally enormous but there is no reason to be pessimistic. Some medicinal plants differ from cultivated crop plants in that they are far less domesticated. Their sampling strategy and conservation may also differ. An accurate knowledge of the genetic structure of a species is important for capturing the genetic diversity in the species to be conserved. There is practically little or no work carried out on medicinal plants in the country. In conditions where the genetic information is lacking, educated guesses must be based on known ecological characteristics of the species.

While national and international agriculture can benefit from more than 20 years of germplasm collection and conservation of agricultural crops undertaken by BDI/E, a similar task in the field of medicinal plant biodiversity conservation is still in its initial stage. So far, limited species have been collected by various national institutions and the work by BDI/E is limited in scope and size. Only a few tree species such as *Hagnia abyssinica, Calpurnea aurea, Rubia cordifolia* have been collected.

Preliminary study in Welo (McGuire 1995) showed that medicinal plants considered to be at conservation risk due to growth habit, destructive harvest method or suspected overuse are numerous. Though some remedies use leaf-parts, many medicinal preparations use roots, stems and bark, thereby effectively killing the plants in harvest. According to Abebe and Ayehu (Abebe and Ayehu 1993) the most widely sought after part of a medicinal plant in the prepartion of the drug is the root (ca 47%), follwed by the leaf (ca 17%), the bark and the stem - about 11% and 8%, respectively

A recent preliminary work showed that at least two plants that were commonly used in the past, *Hagenia abyssinica* and *Rumex abyssinicus* in Welo, northern Ethiopia are becoming locally scarce for herbal perparations. Furthermore, the survey indicated that medicinal plant species such as *Ficus palmata, Verbena officinalis, Croton macrostachys, Cucumis ficilolus and Calpurnis aurea* were all hard for traditional healers to find in lowland or densily populated areas in the region. According to this unpublished study several plant species are becoming rare and are on the decline. Plant spp. such as *Myrica salicifolia, Plumbago zeylanica* and *Warburgia ugandensis* are very scarce suggesting that these plants are indeed diminishing in parts of northern Ethiopia (McGuire 1995).

According to a recent report by Drug Research Department (Ethiopian Health and Nutrition Research Institute 1997) *Seccuridaca longipedenculata,* a plant well known for its high methyl salicilate constituent,and *Warburgia ugandensi,* whose bark is utilized for various health problems in Dedessa area and in Welega zone are being threatened as a result of over exploitation and destructive harvesting.

Medicinal plants are also harvested for fuelwood and construction purposes, which accelerate the depletion more than single use plant species. This is especially true for the thick stemmed and long statured spp. such as *Hagnia abyssinica.*

Recommendations

1) A priority list of medicinal plants for facilitating focused conservation efforts is needed before undertaking major collecting operations. According to recent work about 1000 indigenous species scattered in 120 genera exist in the country. In the absence of systematic inter- and intra-specific diversity studies, the tentative list of indigenous medicinal plants provided by National Herbarium may form the basis for biodiversity collection, conservation and sustainable utilization.
2) Currently not many botanic gardens and arboreta are in existence in Ethiopia, The few that have been established are mainly of exotic species, which are of less conservation value in terms of the local flora. BDI/E has to take initiatives to encourage local municipalities and government agencies to include local species in the planting programs.
3) There have been little or no systematic studies to determine the storage behaviour of medicinal plants either at national or international level. Basic storage behavior research is a prerequisite to undertake *ex situ* conservation of medicinal plants. In the absence of adequate knowledge on the response of seeds of medicinal plant species to drying and low temprature environment, the conservation of these species in cold storage facilities may be a futile exercise.
4) Both human resources and infrastructural developments are essential to carry out systematic studies and activities in relevant areas, in terms of medicinal plants' conservation and sustainable utilization.
5) The current harvesting method of medicinal plants is basically destructive especially the methods that employ roots and barks. The development of sustainable harvesting techniques as part of the research initiatives should be part of future undertakings.
6) The promotion of *in situ* conservation at appropriate sites is recommended in light of the advantages of the strategy. It is essential to develop models for

conserving valued biodiversity *in situ* by increasing the benefits that are derived from the resource and by ensuring that those benefits accrue first and foremost to local communities. In many instances, communities inhabiting environments of high biodiversity are also marginalized geographically, socially and economically.

7) Promotion of active involvement of local communities with their acquired knowledge and understanding of ecosystem management and further encouragement to develop mutually beneficial partnerships between communities, formal sector organizations and governments which manage the enabling policy regimes.

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The Role of Women in the Use and Conservation of Medicinal Plants

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Introduction

The first person we turn to when we feel sick is a woman: our mother, our wife, our sister or the woman next door. This woman treats us by showing concern, trying to make us feel comfortable and giving medicine that will relieve the pain. In countries where access to health care is inadequate and medicines are neither easily available nor affordable, this medicine is not a tablet, syrup or lozenge. It is a plant grown in the home garden.

Most studies on medicinal plants focus on the ethnobotanical and phytochemical aspects of the plants themselves, or on their use by traditional healers and herbalists. This study considers the use and conservation of medicinal plants from the perspective of the other major users of medicinal plants: the mothers and housewives.

Methodology

The data for this study was collected in two areas: an urban and a rural area. The bulk of the data comes from the rural area and was collected in Wolayta. The survey was conducted by 4 young women, 12th grade completed, who lived at home with their parents some 10 km away from Wolayta Soddo town. A questionnaire was prepared which the girls answered individually before starting the interviews. Questions and answers were further discussed in a group discussion. Visits were made to the 4 girls' yards to see the different plants mentioned during the discussion, and observe where they were found and how they were picked.

Each girl interviewed 10 housewives in different weredas. The girls were specifically told not to look for women known to be specialists in medicinal plants, but rather to interview mothers, grandmothers or elder daughters at home.

The starting point for the interviews and data collection was the common ailments treated at home, rather than the plants and the way they were used. The logic behind this was to start from the local women's practices and knowledge in order to make better use of their expertise.

For comparison purposes, data was also collected in Addis Ababa, through a group interview with 10 young women from different areas in the city. The same

approach was used as in Wolyata, i.e. taking the ailments as a starting point and asking how they were treated at home. The discussion and interview were not as exhaustive as those conducted in Wolayta and therefore some of the data for the city is not complete.

No attempt was made to make a quantitative analysis of the answers given, as the study only aimed at collecting general information and generating an overall picture of the way women treat common diseases and ailments at home, using medicinal plants.

Libraries and the Internet were consulted in an attempt to conduct a bibliographical research on the theme of "women and medicinal plants/herbal medicines". It did not produce any significant result. Gender may be everywhere nowadays, but it is still missing in the documentation on medicinal plants.

The environment in Wolayta

Since the use of medicinal plants by women is very much tied to the latters' immediate environment, it is felt necessary to briefly describe the environment in Wolayta, from where the more detailed part of the information was gathered.

Wolayta is located some 400 km south west of Addis Ababa at an altitude of 1300 (lowlands) to 2100 m (highlands) asl. It is a very densely populated area, with average holdings not exceeding 0.25 ha. Houses are dispersed, and separated from each other by live fences and grassland. A wide variety of crops are produced throughout the year, including different cereals and legumes, enset, different tubers, different vegetables, coffee and fruit trees. Farmers practise mixed farming and different forms of multiple cropping. Livestock raising is part of the farming system, and the cattle manure is used to fertilise the crops. Houses have a front yard and a back yard, with the enset and coffee plantations forming half a circle around the rear of the house. Except for cereals, which are grown at the back of the house behind the enset plantations, all the other crops are grown on the home plots. The plants used for home treatment of ailments grow in-between the different crops found in the garden plots around the house. The Global 2000 Program is very active in the region.

Findings

Commonly treated diseases

In the interviews and group discussions, about 40 different ailments and diseases were mentioned as being treated at home using medicinal plants. Ailments range from skin diseases to respiratory diseases, covering the whole range of common

complaints treated at home but, except for hepatitis and TB, excluding serious diseases. For each disease mentioned, detailed explanation on how the treatments are administered was given.

The most commonly mentioned maladies are listed hereunder for both groups.

Maladies	Wolayta	Addis Ababa
Headache	Y	Y
Common cold	Y	Y
Tonsillitis	Y	Y
Adenoiditis	Y	Y
Earache	Y	Y
Cough	Y	Y
Bronchial Asthma	Y	
TB	Y	
Malaria	Y	Y
Amoebiasis	Y	
Giardiasis	Y	
Ascariasis	Y	Y
Teniasis	Y	Y
Gastro-enteritis	Y	Y
Rheumatism	Y	
Ringworm	Y	Y
Warts		Y
Rash		Y
Scabies	Y	
Furuncles	Y	
Dandruff		Y
Nosebleed		Y
Anemia		Y
Hypertension		Y
Haemorrhoidds	Y	
Hepatitis	Y	
Toothache	Y	Y
Bleeding wounds	Y	

Midwives use plants to treat bleeding during pregnancy, miscarriages and delivery of placenta.

Sometimes the symptoms are treated [e.g. headache, cough, stomach ache, sharp pain *(woogat)*], while at other times it is the specific disease, which is treated (e.g. malaria, skin disorders). Which plant is used to treat a specific symptom is decided according to the type and location of the pain.

In addition to using them for treating diseases, women also use plants as cosmetics. Different plants are used for facial mask, night cream, colouring hand palms, nails and feet, hair care, etc (Earthcare Africa, 1995). This is rarely taken into account when dealing with medicinal plants, yet it provides women with satisfaction and well being and, as such, can be considered as contributing to their good health. It proves that rural women too take the time to, and enjoy the pleasure of taking care of themselves, thus showing a different aspect of women in the rural areas, often depicted as little more than beasts of burden.

Hardly any woman treats sick animals. In Wolayta, it is the men who treat the cattle and know which disease affects their animals. However, housewives prepare a plant and cereal mixture that is fed to the cows to make them give more milk. One common treatment administered by either men or women is a solution prepared with cassava leaves against fever in chickens.

Plants used

In the interviews conducted in Wolayta alone, more than 70 names of plants were mentioned when explaining how common ailments and disorders were treated at home. Apart from weeds, all these plants are also grown as food crops or used as spice.

The number of medicinal plants known by the girls in Addis Ababa was more restricted. There was a marked differentiation between girls from vegetable growing families and those whose parents are traders, artisans or labourers, with the former knowing more plants than the latter (except for the one girl who had been especially taught by her godmother).

In Wolayta, all the plants mentioned by the interviewees are found in the immediate vicinity of the homesteads. This can be the front or back yard, the pasture in front of the homesteads, or the live fence separating homesteads from each other. When a plant is not available close by, it is purchased from the market. Plants are very rarely stored, since they are generally available in the garden plots. In Addis Ababa, plants are not usually stored either. When needed but not available in the home garden, they are purchased in the market.

A plant may not be available in the area, yet be part of the local pharmaccopoeia. One such a plant is *Asparagus* sp. *(dengo* in the local vernacular). It grows in neighbouring Gofa and is used when part of the placenta remains inside a woman's womb after the delivery. When such a problem occurs, somebody is immediately sent to Gofa to buy the plant.

The plants commonly used for home treatment of diseases are those found in the vicinity of the houses. They therefore vary with the environment. Nevertheless, there is a series of plants common to the local pharmacopoeia in both Wolayta and Addis Ababa. These include:

Tosign (Taymus serrulatus)
Demakesse (Ocinum sp.)
Grawa (Vernonia amygdalina)
Kebericho (Echinops sp.*)*
Tenadam (Ruta graveolens)
Papaya
Garlic
Feto (Lepidium sativum)
Bisanna (Croton macrostachys)
Eucalyptus
Vine
Gesho (Rhamnus prinoides)
Pumpkin (Cucurbita sp.)

The use of most of these plants for medicinal purposes is recorded and even documented in several publications, both in Ethiopia and elsewhere (see for instance ENDA TM, S. D., Fortin *et al* 1990; Kloos 1976/77).

Treatment and administration

Most of the time, in the rural area, it is the mother who prepares the medicine. In some cases, the person who is most knowledgeable is the father. In the rare instances where neither the mother nor father has any knowledge of treating with plants, the neighbour is called for help. If she is a relative, she does it for free, otherwise she may ask for payment.

The situation is different in the city. For 6 girls out of 11, it was their neighbours who were said to know most about medicinal plants. In the other cases, it was the mother, grandmother, eldest daughter, or father.

In the countryside, girls learn to recognise and use medicinal plants from being treated themselves when they are sick, from observing what their mothers do and asking questions, from being sent to pick specific plants for treating someone who is sick at home and, eventually, by practising themselves. In the case of one girl in the city, she had learned the skill from her godmother. She definitely knew more than the other girls, mainly as far as more specific plants and diseases were concerned.

Dosage is the trickiest part in the home use of medicinal plants. All the respondents admitted the amount of medicinal mixture to be absorbed is based on estimation. Nevertheless, this is tempered by a number of rules and practices women apply when administering the medicine:

1) Dosages for adults, children, and babies differ. Amounts for children are measured in coffee cups, those for adults in glasses or tumblers. For elder people and weak patients, dosages also vary, according to the patient's state. For throat infections in small babies, mothers take a little of the medicine in their mouth and inject it into their babies' throats.
2) After a first dose of medicine has been given, there is an interval before giving a second dose, during which the patient is observed. If his/her condition is worsening, if shehe vomits or cannot eat or drink, the treatment is discontinued; if, after three days, the patient still does not show signs of improvement, the treatment is also discontinued. Thus, contrary to what is reported for traditional healers (Dawit 1996), in the home treatment of diseases, side effects are not considered to be a sign of the efficiency of the treatment.
3) Plants known to cause harm during pregnancy are only given in very small amount to pregnant women, or not given at all.
4) When different medicinal plants can be used for treating a disease (e.g. malaria), the mildest one is tried first. If it does not generate improvement, a second, stronger mixture is tried, and again a third one if the second one still did not work. The first treatment is usually based on plants from the back yard, while for the last and stronger treatment; the plants used are not available in the immediate neighbourhood and have to be bought from the market.

Conservation

Most of the plants used for home treatment of diseases are grown as food or spice crops. Even if extensively used, the risk of them disappearing is therefore reduced. Nevertheless, there are factors, which contribute to the disappearance (but not extinction) of the plants. According to the women interviewed in Wolayta, major contributing factors are: drought, animals destroying the crops and the requirement to thoroughly weed maize and sweet potato plots so as to ensure maximum crop yield and return for the re-imbursement of loans taken to buy fertilisers.

On the other hand, women have and apply practices and beliefs that contribute to the preservation of their plants. There was a marked difference between the type of conservation practice used (cultivation and beliefs) in the city and in the rural

area. In the city, more restrictions stemming from beliefs apply, whereas in the countryside various cultivation and harvesting methods are used.

Beliefs

Different restrictions exist on the appropriate time for picking medicinal plants. For fear of the plants drying out, losing their effectiveness or totally disappearing from the area, certain plants may not be picked on Wednesdays, Fridays or Sundays, at the time of new moon, or at the time of full moon. Others, on the contrary, must be picked on Sundays or at particular periods in the month. Women apply these restrictions more or less strictly, especially in Addis Ababa. Whether or not some of these restraints on picking time are valid or not, they do act as a conservation method and show there is some concern about the need to preserve the plants in their areas of growth.

Cultivation and harvesting practices

Land holdings in Wolayta being very small, each plant on the land is precious to the Wolyata people, and given intensive care. As for any plant they grow, the Wolayta women are very much aware that plants need to be tended vigilantly so that the useful products they provide will be maintained. They preserve and take care of their plants in different ways:

1) Leaves are picked from the middle part of the plants, never from the top, to make sure the plant will continue to grow.
2) When the part needed for medical use is taken from the plant's root, a little soil is dug around the plant and a small part of the root is taken. The root is then covered again with soil so that it will regenerate and the plant will continue to thrive.
3) When the part needed for medical use is the bark of a tree, only a small strip is taken; if several pieces of bark are needed, large patches of bark are left in between the strips that are removed.
4) Women regularly hoe the plants growing in their gardens. This results in vigorously growing plants.
5) Old plants are replaced by new ones,if necessary. If a plant has disappeared, seed is brought from another place and sown in the yard so new plants may grow again.
6) The plants are grown around the house, intercropped with other crops. They benefit from the manure applied on the other crops and from the humidity of the soil around the house.

The fact that different plants are used in mixtures to treat some diseases could also be seen as a technique that contributes to preserving the plants, as it limits the amount of each plant used in the medication.

Discussion

Seen from the women's perspectives, there are both opportunities for and constraints to the sustainable use and conservation of medicinal plants.

Opportunities

1. Existence of abundant human resource

Most women, whether young or old, know the medicinal value of the plants that grow in their localities. Most regularly use this knowledge in treating minor ailments and disorders of their family members. Assuming 25% of Ethiopia's population is women above the age of 20, this represents some 14 million people with the fundamental knowledge, skills and dedication required to provide basic health care services. This represents an enormous work force providing free service and ensuring that 85% of Ethiopia's population gets minimum health care. This means that, with very little input to value the women's knowledge and skills, and encourage them to still better play their role as health care providers, it is possible to move forward with "affordable health for all" and cope with the increasing population.

2. Knowledge and utilisation of locally available resources

When women use the plants found in and around their yards, they make use of the resources available in their environment. They do not depend on external inputs, thereby keeping expenditures - which would otherwise have to be included in the national budget - low, and helping to save on foreign exchange.

The cost for modern medicines in the pharmacies ranges from 1.00 birr (paracetamol, chloroquine, ORS, etc.) to 15.00 birr (cough syrup). If each household would spend only 5.00 birr per year on purchasing imported modern medicine for the common ailments now treated with plants, this would amount to 60 million birr per year for 12 million households.

3. Transfer of knowledge

Where knowledge about the medicinal use of plants to treat common diseases at home is concerned, there is very little trace of secrecy. The transfer of knowledge from one generation to another is still remarkable, especially in the countryside.

The girls who conducted the interviews in Wolayta showed a vast knowledge of the plants in their environment. The number of plants known by the city girls was more limited, but the trend was the same: their knowledge had been acquired from the family and the neighbours. It must be pointed out that this knowledge is closely related to the environment and it has partly been acquired through observation and practice.

4. Awareness

Women are aware of the value of their plants. They take care of the plants they use for medicinal purpose; they make sure they do not completely disappear from the area. For them, use and conservation go together: a plant they use is a plant they preserve. According to the words of one of them "If we would know more about the effective use of our plants, we would be even more careful to preserve them." The first incentive to promote conservation of the plants is thus to inform the women about the safety and effectiveness of the medicinal plants they use.

5. Cultivation and harvesting practices

As far as women and their families in the rural areas are concerned, there is no need to reinvent the wheel, rather to reinforce and validate some existing practices, which already contribute to the conservation of useful plants. Two major ones need to be promoted and built upon: the home gardens and the live fences.

Various plants used as medicine are intercropped with each other in the home garden. They do not take much space and their growth and status can be observed at any time of the day or year; they are hoed and manured and replanted when getting too old; as only very few plants of a same species are grown, pest problems are minimised. Home gardens are an ideal place for growing the medicinal plants whose use is enabling millions of people to obtain basic health care.

The growth of live fences in between yards is an interesting practice, allowing growth of medicinal plants without taking much land, and requiring no care. They have additional agricultural benefits as well.

Constraints

1) There is a lack of recognition and validation of indigenous knowledge in general, and of the women's knowledge in particular. Despite lip service, indigenous knowledge is considered second best. Only formal schooling and

diplomas are given recognition, thereby eliminating the knowledge and experience of a great number of women. Knowledge is trusted once it is recorded in journals, diskettes or databases. There is little experience in combining the scientific and the indigenous. School education is academic and rarely based on the surrounding environment and the opportunities it offers to solve problems in the area. The fact that most scientists are men while it is the women who dispense the home treatments does not make things easier either.

2) Inadequate awareness of the agents of Ministry of Agriculture about medicinal plants. Anything that has to do with medicinal plants is mostly restricted to the health sector. Medicinal plants are not specifically included in surveys of agricultural or cropping systems. Their place in cropping patterns is not documented and how they are affected by different agricultural techniques is rarely, if at all, investigated. Medicinal plants are examined for pharmaceutical compounds, but the effect of, for instance, fertilisers on their active matter content, or the competition between species is not beingconsidered.

3) Scientific information remains within scientific circles; it is not disseminated to medical personnel, let alone fed-back to grassroots communities. Confidence among women and health agents in the reliability of the commonly used medicinal plants is therefore not encouraged.

4) Changing environments: Knowledge about medicinal plants is closely related to the surrounding environment. Transformation of the environment such as urbanisation affects actual knowledge. With the changing environments, the collective, shared knowledge about these plants also disappears.

Proposals for action

We collect, inventorise, identify, screen, document, compile, and preserve medicinal plants. We may tend to forget that the purpose of researching and conserving these plants is to use them in such a way that Ethiopia's 56 million people have an efficient, affordable, and safe access to health.

But women do not forget this. Their knowledge is not theoretical nor does it get wasted: they make use of the plants in their daily life. They conserve the plants because they know their usefulness for the family's well-being. For a better conservation of the medicinal plants, it is therefore essential to validate and value the use women make of the medicinal plants they find in their area or grow in their gardens. Knowing more about their medicinal plants, feeling confident they use safe dosages, being aware of precautions to be taken, will encourage women to take more care of the plants.

A programme aiming at promoting the sustainable use and conservation of medicinal plants at home level should have the following components:

1) Action-research, whereby it is the local women, especially young educated girls, who carry out the research on the use and cultivation of medicinal plants in their area, under the guidance of a programme co-ordinator.

2) Collecting all the existing information on commonly used medicinal plants in Ethiopia and processing it into material that can be used for training at grassroots level. Wide dissemination of the material is recommended, for both government and non-government actors indiscriminately.

3) Networking between scientists working in the laboratories and university faculties, and different agents working at community level (including women involved in action-research), in order to establish dialogue and interaction between the different parties and learn to combine knowledge.

4) Organisation of workshops in the regions where scientists present their work on medicinal plants to grassroots groups and to health personnel working in the area, and find out how these groups respond to this information.

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The Role of Home Gardens in the Production and Conservation of Medicinal Plants

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Introduction

Home gardens are traditional farming systems wherein indigenous crops of various categories are regularly cultivated and new crops are recruited and domesticated. In the course of embracing different categories of plants for cultivation in home gardens, communities applied diverse intuitive criteria in their decision-making. Criteria for taking a plant into cultivation in home gardens must have included the extent of satisfying basic needs, multiplicity of use, agromorphologic features and safeness of the plant and its products. The plants commonly found in home gardens are those of which the knowledge on their usefulness is open rather than restricted. Traditional medicinal plants are essential components of home gardens in different parts of the world (Christanty 1990, Caballero 1992, Zemede and Ayele 1995). The claim in Ethiopia becomes more founded upon extrapolating information on species found in home gardens and used in traditional medical lore (Mesfin 1986, Gelahun 1989, Mesfin and Sebsebe 1992), than on those of regional and global importance (Boulos 1983). While it is true that some plant species are purposely grown in home gardens for use in traditional medicine, a good number of these are plants grown primarily for non-medicinal purposes. The book on Medicinal Plants of North Africa (Boulos 1983) contains some 50 cultivated medicinal plant species, almost all of them cultivated in Ethiopian home gardens; and about the same number (49 species) of garden crops are included in Gelahun Abate's (1989) book entitled "Etse Debdabe" (Letters/Communication on Plants).

The set of plants used in simple family and neighborhood level therapy and those used by professional traditional healers are not always the same. Ethiopia's traditional medicine, as elsewhere in Africa, is faced with problems of continuity and sustainability primarily due to loss of taxa of medicinal plants, loss of habitats of medicinal and other category of plants (Ensermu *et al.* 1992) and cultures. Whereas the cultivated medicinal plants are traditionally conserved on-farm through community networks, those that continued being used from the wild flora are faced with problems related to unsustainable resource use. There is a growing demand for medicinal plants which when seen together with the rate of destruction of natural habitats calls for enhanced conservation and protection measures. Interventions geared to the conservation of the biodiversity as well as indigenous knowledge and innovations through maintenance of traditional

farming systems (Altieri and Merrick 1987) preferably linked with utilization (Berthaud 1997) are desired. This is the gist of the Convention on Biological Diversity presented under Articles 8 and 9 on *in-situ* and *ex-situ* conservation in general, and paragraph 8(j) on knowledge, innovations and practices of indigenous and local communities in particular (CBD 1994). The home garden farming system with the indigenous plants maintained in it and the associated knowledge, innovations and practices offers a special opportunity for implementing the relevant provisions of the Convention. The timely implementation of these provisions would shield the biodiversity and the indigenous knowledge from undue exploitation. This would also help to circumspect current problems related to intellectual property rights and patent laws that fail to implement mechanisms for equitable sharing of the benefits with the rightful owners of the biodiversity as well as related cultures and knowledge. The home garden is a very strategic and ideal farming system for the conservation, production and enhancement of medicinal plants and the valuable indigenous knowledge on the same is expected to benefit from concerted national, regional and global efforts.

This paper focuses on the role home gardens play in Ethiopia with special regard to traditional medicinal plants and the delivery of traditional medicine. The current contributions of home gardens are examined; gaps and constraints are reviewed and conceivable interventions voiced in light of the potentials and prospects. The protection and increased production of traditional medicinal plants in home gardens is discussed in the context of improving community health, family income, conservation and arbitration on biodiversity, and indigenous knowledge.

Source of information and methods

The present analysis of medicinal plants grown in and around the home garden environment was mainly based on data recovered from previous studies conducted over the past few years, on Ethiopian home gardens (Zemede 1997, Zemede and Ayele 1995, Zemede and Zerihun 1997). In addition to this, fresh information retrieved through a herbarium survey made at the National Herbarium (ETH) about medicinal plants cultivated in home gardens has also been included. Personal experience on how the traditional healing process operates at the rural village level and characteristic plants featuring in the system were also reconstructed. Traditional medicinal plants of Ethiopia reported in monographs and papers/articles (e.g. Jansen 1981, Mesfin 1986, Gelahun 1989, Mesfin and Sebsebe 1992) were screened with the aim of aggregating those that are found in and around home gardens. Plants that grow in Ethiopian home gardens have been cross referenced to screen out the common medicinal plants normally considered

components of the home garden agrosystem, to fully examine the species used as medicine and their share in the traditional healthcare system of communities. Traditional medicinal plants that are common elements of the home garden flora in Ethiopia have thus been reviewed, categorically examined, and analyzed to show the major features and prospects together with other such relevant issues related to the use and conservation of Ethiopian traditional medicinal plants.

Results and Discussion

Medicinal plants in the home garden farming system

In Ethiopia, home gardens range from non-existent, through rudimentary existence to well developed stages (Zemede and Ayele 1995) when their status in individual families/households is considered. The practice is posited to be probably as old as agriculture itself (Zemede and Ayele 1995), the latter being estimated to have taken root about 7000 years ago (Ehret 1979, Brandt, 1984). A study made in southern Ethiopia (Zemede and Zerihun 1997) showed that home gardens are important places for the production of food crops, as revealed by the family nutritional calculus that surfaced out when the various horticultural categories grown together were considered. The importance of food plants in Ethiopian home gardens is also clear from data given in Table 1 where about 74% of the species are food plants.

Though the primary target is human nutrition, considerable medicinal functions are also embodied within the broad functions of the farming system. Out of 30 most frequent crops in 18 randomly selected home gardens, 15 (50%) are used medicinally, showing that crop clusters of home gardens have multiple functions, food and medicine being the most frequent combinations for rural communities. Many garden crops are multipurpose and one of these purposes is medicinal. *Ensete ventricosum* is one of the most frequent indigenous home garden crops, which is valued as food, fodder, fibre, medicine, and as a general utility crop. It is reported that twelve out of forty-two and seventeen out of forty-three clones of this species have medicinal value, in Sidamo and Gurage zones of southern Ethiopia, respectively (Asnaketch 1997).

The agrobiodiversity in tropical Africa is maintained at the highest level near homes (Okigbo 1994), and this is mainly due to the practice of home gardening, which has multiple functions in providing community needs. This feature is best seen in Ethiopian home gardens when one looks at their contributions to the healthcare system. Since home gardens are small-scale traditional farming systems practiced around the house, their primary function is for growing various crops for home consumption. Furthermore, home gardens ensure conservation of these

important crops on-farm and serve as places for experimental planting of new recruits from the wild or other areas (Okigbo 1990, Zemede and Ayele 1995). Staple crops, supplementary food crops, additives, tree crops and non-food plants of various utility classes including medicine are grown in home gardens in tropical and subtropical areas of the world (Christanty 1990, Okigbo 1990, Caballero 1992). This is also the case in Ethiopia as depicted by the results shown in Table 1.

Medicinal plants are found in home gardens at various levels of domestication and intensity, but the species primarily cultivated for their medicinal value, are shown in Table 1 and Table 2 (column one). A survey made on home garden crops covering a large part of Ethiopia (Zemede 1997) showed that the species primarily cultivated for medicinal purposes are few, accounting for about 6% of the total crop species grown in home gardens. These species are used in different formulations alongside many species primarily grown for food and other purposes, as well as wild species from around the homestead and far away. This figure compares well with the proportion of medicinal plants, 8.3%, reported for Maya (Mexico) home gardens (Caballero 1992).

Table 1: Crops cultivated in home gardens in Ethiopia

Crop Category	Number of Species	Percentage
Food crops	127	73.84
Cereals	6	3.49
Pulses	14	8.14
Roots and tubers	13	7.56
Fruits	36	20.93
Vegetables	30	17.44
Spices and herbs*	16	9.30
Oils, nuts and sugars	12	6.98
Non-food crops	45	26.16
Non-food oil crops	3	1.74
Fragrance plants	6	3.49
Stimulants/narcotics	2	1.16
Crafts and implements	9	5.23
Medicinal	10	5.81
Utility	3	1.74
Miscellaneous	12	6.98
Total	**172**	**100.00**

*Some have known medicinal value.

Since medicines are used in small quantities and the crops are meant for home use; few plants maintained close to the house and paths are sufficient for the family, immediate neighbors and relatives. The value of the home garden in

Ethiopia's traditional health care system features well when the volume of medicine obtained from the crops, garden weeds and live-fence plants is added to the plants cultivated primarily for medicinal purposes (Table 2). Some of the well-known traditional medicinal plants of Ethiopia (e.g. *Hagenia abyssinica, Brucea antidysenterica, Embelia schimperi, Bersama abyssinica, Croton macrostachyus and others*) do not feature in Table 2, because healers usually collect them from wild stands.

Table 2: Crops of home gardens primarily cultivated for their medicinal value in Ethiopian traditional medicine

Crops of the Home Garden Cultivated for their medicinal value	**Other Crops of Garden**	
	Widely Used as Medicine	**Given as Medicinal in the Literature***
Anethum graveolens (Apiaceae)	*Allium sativum (Alliaceae)*	*Arachis hypogea (Fabaceae)*
Artemisia absinthium (Asteraceae)	*Lepidium sativum (Brassicaceae)*	*Lens culinaris (Fabaceae)*
Artemisia afra (Asteraceae)	*Rhamnus prinoides (Rhamnaceae)*	*Cicer arietinum (Fabaceae)*
Foeniculum vulgare (Apiaceae)	*Eucalyptus spp. (Myrtaceae)*	*Brassica nigra (Brassicaceae)*
Leonotis sp. (Lamiaceae)	*Ricinus communis (Euphorbiaceae)*	*Sesamum indicum (Pedaliaceae)*
Ocimum lamiifolium (Lamiaceae)	*Catha edulis (Celastraceae)q*	*Carthamus tinctorius (Asteraceae)*
Otostegia integrifolia (Lamiaceae)	*Coffea arabica (Rubiaceae)*	*Avena abyssinica (Poaceae)*
Raphanus sativus (Brassicaceae)	*Ensete ventricosum (Musaceae)*	*Ipomoea batatas (Convolvulaceae)*
Ruta chalepensis (Rutaceae)	*Citrus aurantifolia (Rutaceae)*	*Punica granatum (Punicaceae)*
Salvia leucantha (Lamiaceae)	*Citrus aurantium (Rutaceae)*	*Ocimum basilicum. (Lamiaceae)*
	Capsicum spp.(Solanaceae)	*Zea mays (Poaceae)*
	Cucurbita pepo (Cucurbitaceae)	*Vicia faba (Fabaceae)*
	Linum usitatissimum (Linaceae)	*Dioscorea spp. (Dioscoriaceae)*
	Nigella sativa (Ranunculaceae)	*Citrus medica (Rutaceae)*
	Coriandrum sativum (Apiaceae)	*Guizotia abyssinica (Asteraceae)*
	Carica papaya (Caricaceae)	*Myrtus communis (Myrtaceae)*
	Thymus serulatus (Lamiaceae)	*Daucus carota (Apiaceae)*
	Trigonella foenum-graecum (Fabaceae)	*Prunus persica (Rosaceae*
	Zingiber officinale (Zingiberaceae)	*Vitis vinifera (Vitaceae)*
	Lippia spp. (Verbenaceae)	*Sorghum bicolor (Poaceae)*
	Cymbopogon citratus (Poaceae)	*Ocimum sauve (lamiaceae)*
	Nicotiana tabacum (Solanaceae)	*Plectranthus edulis (Lamiaceae)*
	Vernonia amygdalina (fence) (Asteraceae)	*Eleusine coracana (Poaceae)*
	Phytolacca dodecandra (fence)(Phytolaccaceae)	*Hordeum vulgare (Poaceae)*
	Adhatoda schimperiana (fence) (Acanthaceae)	*Gossypium barbadense (Malvaceae)*
		Arundo donax (Poaceae)
		Phaseolus spp (Fabaceae)

*Mesfin 1986, Gelahun 1989, Mesfin & Sebsebe 1992, q Old plants with hemiparasites of *Loranthus* sp.

Thaman (1990) discussed the role of home gardens in Pacific Islands in the Caribbean area as refuges for medicinal plants including their future prospects. It is shown that Kiribati and Tonga Islands, which are densely populated and have little native vegetation, contain 75% medicinal species cultivated/protected in home gardens; while in Nauru, where the natural vegetation was destroyed by various factors, medicinal plants cultivated in gardens accounted for 85% of the species.

Thus, the ultimate refuges for medicinal plants, when natural habitats and vegetation types recede, are home gardens (see Table 4). It is therefore a natural process that when the species are threatened in nature, the important plants are step by step taken into cultivation in home gardens. When the rate of shrinkage of the natural vegetation is fast, it is necessary to look for enhanced ways of protecting the medicinal plants for posterity; using diverse strategies in response to the growing demand for nature cure (Franz 1993) with the twin objectives of conservation and utilization (Berthaud 1997).

List of medicinal plants indicated as being cultivated in home gardens on the specimin labels at the National Herbarium.

Aframomum corrorima	*Allium cepa*	*Allium sativum*
Aloe sp.	*Artemisia abyssinica*	*Artemisia rehan*
Brassica carinata	*Capsicum annuum*	*Carica papaya*
Citrus sinensis	*Coffea arabica*	*Coriandrum sativus*
Cymbopogon citratus	*Cynara scolymus*	*Jatropha curcas*
Kalanchoe sp.	*Lepidium sativum*	*Lochnera rosea*
Melia azedarach	*Mentha piperita*	*Myrtus communis*
Nerium oliander	*Nicotiana tabacum*	*Nigella sativa*
Ocimum basilicum	*Ocimum canum*	*Ocimum lamiifolium*
Otostegia integrifolia	*Papaver somniferum*	*Prunus persica*
Rhamnus prinoides	*Ricinus communis*	*Rumex abyssinicus*
Ruta chalepensis	*Satureja punctata*	*Senna bicapsularis*
Sesamum indicum	*Trigonella foenum-graecum*	

Comparison of the home garden medicinal flora of Ethiopia with those of the Caribbean shows that the correspondence is very high (see Tables 3 and 4). The common garden crops occurring in both countries are used in traditional medicine in the community and mainly at the family level treatment.

Table 3: Number of medicinal plant species found in and around the home garden recovered and categorized from two publications (Gelahun 1989, Mesfin and Sebsebe 1992)

Medicinal plants	Mesfin and Sebsebe (1992). [347 spp.]		Gelahun (1989) [285 spp.]	
	Number	%	Number	%
Garden crops	30	14.2	49	26.5
Garden live-fences	44		42	
Garden weeds	57		24	
Homestead+cultivated landscape	80		70	
Total in and around home garden	**211**		**185**	

Table 4: Medicinal plants in home gardens of Pacific Island (from Thaman 1990)

Medicinal plants	Number of species in Pacific Islands				Total Number	Total (%)
	Fiji	Tonga	Kiribati	Nauru		
In home gardens	100	56	31	28	215	63.4
Outside home gardens	100	56	31	5		
Cultivated/protected	67	42	27	24		
Wild/weedy	33	14	4	4		
Total	**185**	77	**44**	**33**	339	**100**

Medicinal plants of home gardens in traditional health care

Crop species primarily cultivated for medicinal purposes in home gardens are presented in Tables 2 and 3 to reflect the level of popularity. In addition to about 6% of those primarily maintained for medicinal purposes, traditional medicinal plants are obtained from all crop categories but more so from spices and herbs, fragrances, stimulants, fruits and others. The medicinal value of the following crop species is a common public knowledge in Ethiopia: *Ruta chalepensis, Foeniculum vulgare, Allium sativum, Lepidium sativum, Nigella sativa, Zingiber officinale, Thymus serulatus, Coffea arabica, Linum usitatissimum, Rhamnus prinoides, Citrus aurantifolia, Cucurbita pepo, Ensete ventricosum, Carica papaya.* Most of the medicinal plants of home gardens are meant for instant use. During a recent study in a semi-urban town in southwestern parts of Ethiopia, families affirmed that about 75% of *Ruta chalepensis* and *Coriandrum sativum* they harvest from home gardens were either used or sold for medicinal purposes. Medicinal plants frequently used by rural families are obtained from crops purposely cultivated in home gardens primarily for medicinal uses, and those cultivated primarily for non-medicinal use, but used medicinally when needed. Some medicinal plants grow as weeds and live garden-fences while a large number occur spontaneously in the general area of the homestead.

Medicinal plants and traditional therapy

Hierarchy and ethics in traditional medicine and therapy

There is parallelism in the medical ethics adopted by the traditional and modern delivery and healing systems involving the medicinal plants and the therapeutics. It appears that the toxicity of the plants, the seriousness of the health problem for which medication is sought and the application procedure determine both the hierarchy of medication and the class of plants. Treatment of the health problems of domestic animals follows the first line of therapy. The first line can be seen to be analogous to minor drugs sold openly or to simple first-aid like treatments of modern medicine while the second is analogous to drugs sold and used under strict prescription by doctors or administered under intensive medical care. This is probably one reason, in addition to knowledge monopoly and protection from law, for traditional medicine being secret and myshical in many instances while being more open and transparent at family level. The traditional professional knowledge is not available to all, but only passed over to one of the healer's trustworthy relations through long time training under an apprenticeship system. The medicinal plants of the home garden are, by contrast, well known to many, and their proper prescription is usually sought from mothers who are amateur healers and elderly women with similar abilities.

The delivery system, which is handled by people of different levels of competence, is structured in parallel with that of the modern hospital system. At the initial stage, mothers take care of the simple medication within the family, then a more competent woman/man in the neighborhood and finally a specialist healer take their turns. Some of the plants that healers use may be deadly poisonous and hence careful handling by keeping them secret and prescribing the right amount of doses including through serious medication is practiced. Growing such plants in home gardens may not be advisable for the simple reason that desperate individuals may harm themselves through self or amateur treatment. In rural areas, for example, well-recognized healers are sought to treat a person bitten by a mad dog or one diagnosed to be suffering from jaundice. The plants used, the combinations, the problems attended to and the level of secrecy involved varies with the healing level. A mental reconstruction of this hierarchically structured therapeutic scheme would show the strata of specialization and the differences in gender roles.

The plants of the home garden are often used by the informal, amateur-healing system exercised at the family and neighborhood levels. The medicinally popular home garden plants are frequently used by the family level treatment. They are

items of local trade covering food and medicinal purposes. Women are almost the sole venders of almost all aromatic plants also used as medicine. In traditional lifestyle, the kitchen and the "hospital" looked so close as many of the potherbs and spices are prescribed for some health complaints. The mother is a food maker and the "family doctor", while few elderly women in the village act as "village doctors". The role of traditional medicine is visualized in this hierarchical delivery, which indicates some differences in the plants used and the level of competence. The class of medicinal plants delivered by mothers and semi-specialist women in the village are mostly obtained from the crops of the garden. These are mostly for instant use, usually for external applications and use with food and tea. Such plants usually have one-to-one correspondence with a health problem. Thus mothers prescribe rue, garlic, *Ocimum lamiifolium* and others for specific health complaints, which they apply by including in food, tea, soups or smoke, rub the skin, or smear the affected part as the case may be. The specialist healer usually obtains plants from secluded places and employs elaborate diagnosis; mixing and intensive treatment compared to the non-specialist healing level practiced by mothers and other family member.

Constraints and gaps in traditional medicinal plants sector

Efforts to deal with the conservation and efficient use of traditional medicinal plants in Ethiopia have not been satisfactory. It is therefore imperative that a strategic comprehensive plan is developed and implemented. As it stands now, the available information is limited. The publication of the four volumes of Flora Ethiopia does provide authentic identification of most of the medicinal plants of Ethiopia. However, it needs to be backed by adequate ethnobotanical data, which does not exist. A number of authors have attempted to recover the lists of traditionally used plants and even that is short of the desired ethnobotanical/ethnomedicinal study. Many plants used in traditional medicine are harvested from natural stands. Some of these are becoming more and more restricted in distribution as a result of agricultural expansion and habitat shrinkage (e.g. *Hagenia abyssinica*) and signs of overuse could be felt with regard to some species (e.g. *Taverniera abyssinica, Clausena anisata*). A major current concern, therefore, is to enhance not only conservation but also production of medicinal plants. Medicinal plants that are cultivated for other purposes do not as such face conservation problems. Common weeds in gardens used as medicine are being abandoned because of intensification of the home garden farming system. Plants cultivated primarily for their medicinal value are few and the traditional medical lore depends to a considerable extent on wild grown plants. It is seen that, the role of home gardens for constant domestication of new plants, the medical efficacy of which is acknowledged by the society, has not been encouraging being related to the knowledge system and the healing practice that evolved over generations.

Furthermore, the preeminent function of the home garden is more of food production and some cash generation, and this is compounded by the limited space leaving no room for expansion. The new movement striving for enhancement of crop on-farm conservation will help to optimize the value of home gardening for conservation of the agrobiodiversity including wild and weedy crop relatives.

Improvement needs of the traditional medicinal plants sector

Improvement of the medicinal plants sector in Ethiopia requires motivation of options targeted to production, conservation, processing, and exchange systems. One of these strategies is to enhance the farming system of the home garden to enable more production and effective conservation of medicinal plants either through its direct or indirect influence. Since medicinal plants are many in number and also very diverse in their botany and ecology, other conservation and production methods including those discussed below need to be motivated as appropriate.

Emphasis on traditional medicinal plants in home gardens

Enhancement of cultivation

Home gardens are central targets for *in-situ* and *ex-situ* conservation of traditional medicinal plants. There has to be increased cultivation of medicinal plants that are popular among the community. Other important ones from the wild should be also brought under cultivation and tested step by step.

Attempts towards domestication

Most medicinal plants of Ethiopia are wild and the development of the medicinal plant industry without endangering biological diversity can only come if the important wild medicinal plants are selected and efforts made towards their domestication and adaptation. Three main advantages of this strategy are conservation, large-scale production, and standardization of products through growth manipulations and genetic improvement (Franz 1993). Though domestication of wild species is a tedious and challenging process, ultimately large-scale cultivation of new domesticates of medicinal plants will be a key factor for increasing the share of traditional medicine in Ethiopia's health care system. Efforts in the domestication of wild medicinal plants in home gardens is anticipated to be successful if the followingprocedure is adopted (Franz 1993):

- Study of natural habitats, botany/ethnobotany/ethnomedicine, soil, climate, distribution and propagation methods of important wild-grown medicinal plants

- Collection of specimens, seeds and seedlings of wild growing medicinal plants as well as conducting phytochemical screening
- Plant propagation, vegetative/seed, plantlet cultivation, in-vitro methods
- Genetic improvement, variability, selection, breeding, phytochemical investigations
- Cultivation treatments, growing site, fertilization, crop maintenance and cultivation
- Duration of cultivation, harvest/post-harvest handling, control of produce
- Apply procedure for introduction of new crops blended with farmer methods
- Economic evaluation and calculations

Medicinal plants outside traditional home gardens

Establishment of small-scale special medicinal plant gardens

Some traditional healers have started establishing small compound gardens where they grow most of the medicinal plants they need for their work. Most of the medicinal plants are grown in a plot wherein the pattern of planting is more of a random nature and there is no weeding so that the plot appears like a natural stand wherein weedy medicinal plants get incorporated spontaneously and many of them regenerate naturally. The compound is favourable for many other species growing rather informally; sufficiently increasing the diversity of medicinal plant without having to depend on nature alone, but optimizing the new nature cure drive. Establishing special medicinal plant gardens as currently done by some healers in Addis Ababa would be good for healers and would check the harvesting pressure on wild grown medicinal plants.

Conservation of traditional medicinal plants in nature reserves

Some traditional medicinal plants may have to be conserved *in-situ* in their natural habitats due to difficulty for domestication and management or failure to produce the desired amount and quality of the active principles under cultivation (Franz 1993). A large number of the known medicinal plants would have to be maintained in nature reserves.

Large-scale medicinal plant farms and arboreta

Depending on the level of development of the medicinal plant industry, large-scale private medicinal plant farms and arboreta can be established to produce plant material for formulations and extractions. If the market is available this could be a lucrative business. The feeder to such large-scale cultivation would be plants recruited from home gardens and small-scale medicinal plant gardens.

In-situ conservation of the biodiversity of medicinal plants in special places

Medicinal plants can also be conserved by ensuring and encouraging their growth in special places, as they have been traditionally. Within the cultivated landscape there are different places where these are found: places of worship (churches, mosques, grave yards, etc.), sacred grooves, farm margins, river banks, roadsides, rocky outcrops in fields, trees in fields/villages, live fences of gardens and fields, etc., where native species thrive. It may also be possible to conserve tree and shrub species of medicinal plants by using them in afforestation and hillside plantation programmes or re-vegetating hillsides.

Conservation of medicinal plants by conventional ex-situ methods

Conscious efforts should be made to conserve medicinal plants using appropriate conventional methods in genebanks, botanic gardens and field genebanks so that complementary ex-situ and in-situ conservation of medicinal plant biodiversity is implemented.

The main challenges for the future

There are key issues that efforts undertaken to improve traditional medicine in Ethiopia should take into account. These rotate around enabling the home gardens, concern on conservation of traditional medicinal plants, safeguarding indigenous knowledge and innovations and improving the production and delivery mode of medicinal plants. Equitable sharing of benefits that accrue from medicinal plants industry is also another important dimension that needs to be looked into.

The need to direct a special focus on home gardens

Indigenous and exotic useful plants have been maintained in home gardens for generations. The modern agricultural system has yet not been keen in focusing on this valuable farming system. The ideal thing to do will be to study the system, learn from it and try to positively influence it without pushing for monoculture gardens.

Conservation of medicinal plants and safeguarding indigenous knowledge

The conservation of traditional medicinal plants must be looked at in a holistic manner so that not only *in-situ* but also *ex-situ* options are motivated. Such an approach would automatically serve the objectives envisaged by Article 8(j) of the

Convention on Biological Diversity (CBD 1994). *This article of the Convention calls for respect, maintenance and preservation of knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote wider application with approval and involvement of the holders of such knowledge, innovations and practices and encourage equitable sharing of benefits arising from utilization of such knowledge, innovations and practices.* The article draws attention to the protection of many rights, and instruments to be developed following the scheme of the Convention, which should submit to its basic doctrine. When it comes to application, it would be advisable to cover conservation in toto, *in-situ* and ex-situ, while paying due attention to indigenous innovations and knowledge systems and the social orders that created and maintained the diversity. Article 8(j) does assume, in good faith, that there will be honesty and harmony in regional and global collaborations to preserve and use biological diversity and indigenous innovations in the best interest of collaborating parties. The main issue is protection of biodiversity and associated knowledge systems from individualization of benefits by such legal instruments as intellectual property rights and patent laws (by individuals or companies) that exclude those who generated and maintained the resources and the knowledge through generations.

Increased production and improved delivery of traditional medicine

The production and the mode of delivery of traditional medicines should be improved. The production is best handled through enhanced cultivation in home gardens and other facilities, while the delivery needs to take account of modern extraction and processing options.

Specific recommendations

- Recognize home gardens as facilities for utilization-based *in-situ* and *ex-situ* conservation of medicinal plants, and promote their intensification and enhancement
- Carry out comprehensive botanical/ethnobotanical/ethnomedicinal studies on wild growing medicinal plants with intent for possible cultivation and domestication in home gardens; and compile a compendium of information on taxa of special interest. Organize a rich database system on medicinal plants of special interest.
- Start a two-way awareness raising scheme targeted to the formal and informal sectors
- With the local people, in a genuinely participatory approach, identify wild-growing medicinal plants suitable for home garden agro-culture, considering

botanical, social and ethical factors. Learning from the people about uses, propagation and management methods are important.

- Classify the plants of interest for short, medium and long-term domestication/cultivation in home gardens of the main agroecologic zones
- Activate conservation of medicinal plants in a holistic approach using different options
- Identify families who will be willing to start experimental planting of selected species in their home gardens and step by step initiate actual domestication and cultivation in accordance with the demands, also creating market incentives.
- Develop methods for crude extracts of medicines with keen visions for improvement upto modern pharmaceutical formulations when possible
- Research on traditional medicinal plants must always be linked with the relevant provisions of the Convention on Biological Diversity and instruments and protocols developed to implement the Convention. This will guard the resource base together with the indigenous knowledge system and will help to institute mechanisms fore equitable sharing of benefits.

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The Status and Availability of Written and Oral Knowledge on Traditional Health Care in Ethiopia

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Introduction

Ethiopia, which is virtually as large as France and Spain combined, comprises lands of greatly varying altitudes, and hence considerably different climates. The country therefore has an immense variety of vegetation, including innumerable plants of medicinal value, which in many cases, are to be found within close geographical proximity of each other. Ethiopians thus possesses a particularly wide range of potentially useful medicinal plants, more extensive indeed than available in many other parts of the world.

The Ethiopians, in the course of their long history, in one way or another discovered the medical properties of many such plants, and, having the advantage of possessing a written language, or languages, were able to record much of this information for their own as well as future generations.

Such data can usefully be supplemented by the observations of numerous foreign travelers and others, who, over the centuries, took a keen interest in the country's medical traditions, and recorded much information about them. Both these sources of knowledge, as well as the Ethiopian medical situation more generally, have also been studied in the twentieth century, by a number of scholars of international repute, Ethiopian and foreign, from several distinct disciplines: history, linguistics, social anthropology, botany, and medicine.

Early foreign reports

International interest in Ethiopian traditional medicine, and health practices, dates back to late medireview times, when contacts between Ethiopia and the outside world began to become significant.

Alessandro Zorzi, a scholar in early sixteenth century Venice, learnt from a visiting Ethiopian monk, Brother Ragu'él of Angot, that the latter's compatriots possessed "herbs, roots and excellent gums for curing sickness". The use of other types of treatment was reported, at about the same time, by a visiting Portuguese cleric, Francisco Alvares. Describing his stay in Ethiopia, he declared that the country's inhabitants employed herbs for making curative beverages, applied fire to the skin for certain complaints, and for others, such as headache, made use of cupping, with a knife, with which they drew blood. This type of treatment was, it may be recalled, also current in Europe in this period.

Jesuit travellers, of the early seventeenth century, provided substantially more details on traditional Ethiopian medical practice. The Portuguese missionary Manoel de Almeida reported the existence in the country of "many purgative herbs", as well as not a few other plants known to heal wounds. His compatriot, and fellow missionary, Manoel Barradas specified several Ethiopian medicinal plants by name, among them the **enkoy** (*Ximenia americana*), the **decuma** (*Syzygium guinese*), and the **waginos** (*Brucea antidysenterica*). The use of these, and other plants was also recorded by subsequent observers.

Later in the century, Hiob Ludolf, the German founder of Ethiopian studies in Europe, reverted to the medical use of burning, earlier mentioned by Alvares. Basing himself in part on information obtained from his illustrious Ethiopian informant Abba Gorgoreyos, he declared that one form of treatment was effected "by applying a hot burning iron in the manner of a Semicircle, toward the upper part of the arm", and by "laying a little cotton upon the wound that the humour may issue forth as long as the disease remains".

Considerable interest in traditional Ethiopian cures was likewise displayed by the eighteenth century Scottish "explorer", James Bruce. Falling sick of dysentery, on his return journey from Ethiopia to Sennar, he made use of the above-mentioned anti-dysenteric drug **waginos**, with which he was successfully cured. He also described, for example, the traditional Ethiopian mode of treatment for the Guinea worm.

Such early foreign travellers were followed, in the nineteenth century, by many others, at first mainly British, French, German, and Italian. Their writings constitute a sizable library, which includes many accounts of traditional Ethiopian medicine and surgery. These descriptions, though often only very brief, and in many cases scattered in a seemingly disorganised manner through their memoirs, were of considerable importance. This was the more so in that they tell of at least seven widely employed forms of traditional Ethiopian treatment, which for one reason or another do not figure in the country's traditional medical texts, discussed below. These practices comprised bleeding, cupping, burning, sodorific heating, i.e. sweating, immersion in thermal water, traditional variolation, and more generally, surgery of all kinds.

Ethiopian medicinal texts

The earliest history of Ethiopian medical texts is unfortunately obscure. Such works, which were at first traditionally written in the Ethiopian classical language, Ge'ez, and later in the modern vernacular, Amharic, were regarded by the

Ethiopian Orthodox Church as irreligious, or perhaps even sinful. Ecclesiastical authorities, which were primarily concerned with religious texts, therefore had little interest in preserving them in church or monastic libraries, where they are in fact noticeable by their paucity, or virtually complete absence. Medical practioners, using such texts, were, on the other hand, in no position to preserve them for more than a generation or two, certainly not for posterity. Presumably for these reasons traditional Ethiopian medical texts are extremely rare, and virtually none seem to be extant for the period prior to the late seventeenth or early eighteenth century. There is, however, every reason to suppose that Ethiopian works on medicine were first produced much earlier, perhaps even around the same time as religious texts, the earliest extant copies of which date from around the eleventh or twelfth centuries, though most are considerably later, dating from perhaps the thirteenth or fourteenth centuries. It is moreover probable that medical texts, like other Ethiopian works, were frequently copied, and that the few versions extant reflect earlier texts, which have long since disappeared.

The earliest indigenous medical texts currently known and available for study are no more than four in number. They comprise:

1) Three folios in Amharic, included in a copy of the Ge'ez Psalms of David. This volume, the present whereabouts of which is uncertain, dates from the time of the Gondarine Emperor Iyasu I (reigned 1692-1706), and was produced in the monastic area of Waldebba, in the northwest of the country.

2) Fifteen folios in Ge'ez, dating, it is believed, from the second half of the eighteenth century. This work, which is of unknown provenance, is currently housed in the British Library, in London, where it bears the catalogue designation Additional MS 20,741.

3) Seventy-five folios in Amharic, dating, it seems, from some time in the nineteenth century. This text, also of unknown provenance, is likewise in the British Library, and is known as Oriental MS 829.

4) A much more substantial work, of no less than 420 folios, in Amharic. This compilation, which can be dated with some precision, belonged to Ras, or as he called himself, King, Wassan Sagged of Shawa (reigned 1808-1813), and is also housed in the British Library, as Oriental MS 828.

It may be noted, in passing, that the above works were looted by the British expedition of 1867-8 against Emperor Téwodros, from the latter's fortress at Mäqdäla, and that there is a strong case for their restitution to Ethiopia.

Several other, somewhat later, indigenous works on medicine were subsequently produced, for the most part in Amharic. Several of these, like those cited above, were, as we shall see, studied by modern scholars, a few of whom translated them, for the most part into French, and published them, in critical, annotated editions.

Dr Haddis Gabre Masqal, in London, has in recent years been working on the British Library collection of Ethiopian medical texts, and has published the first, with the title Mäshafa Mädhanit (London, 1980 EC).

International study of traditional Ethiopian medicine and surgery

The international study of traditional Ethiopian medicine and health practices was based on two distinctively different approaches: (1) Investigation of such practices; and (2) Study of traditional Ethiopian medical texts.

The investigation of traditional Ethiopian medical practice was conducted by several early nineteenth century foreign travellers, who described a number of such cures in their writings. One of the first such works in the century, was written by an Englishman, Nathaniel Pearce, whose 'Life and Adventures' appeared in London, in 1831. Another pioneer work was written by two Frenchmen, the Saint Simonian missioaries Edmond Combes and Maurice Tamisier, authors of a 'Voyage en Abyssinie' (Paris, 1838).

These two early works were followed by the coming to Ethiopia of a French Scientific Mission, which travelled widely in the country between 1839 and 1843. The mission was accompanied by two physicians, Dr. Petit and Dr. Quartin-Dillon. They included a detailed scientific report on traditional Ethiopian medical practices, in the mission's multi-volume 'Voyage en Abyssinie' (Paris, 1845-8).

No less important, for its account of traditional Ethiopian surgery, were the memoirs of a British ship's surgeon, Charles Johnston, 'Travels in Southern Ethiopia' (London, 1844).

Favourable mention should also be made of the writings of British consul Walter Plowden, who described Ethiopian thermal baths and other medical matters, in a posthumously published work, 'ravels in Abyssinia' (London, 1868).

Also dating from this period were several studies of the Ethiopian taenicide **kosso** (*Hagenia abyssinica)*, written at a time when it was considered a "wonder drug" deserving adoption in Europe.

The first such work was a clinical study by a French doctor in Constantinople, A Brayer, whose 'Notice sur une nouvelle plante de la famille des rosacées

employée... en Abyssinie'was published in Paris, in 1822. This was followed, a generation or so later, by several other writings discussing then advantages and disadvantages of this traditional Ethiopian medicine. The French adventurer, and sometime envoy to Ethiopia, Rochet d'Héricourt, who was much involved in popularising **kosso**, also published details of a supposed traditional Ethiopian cure for rabies, in his article "Note sur une racine employée dans le Nord de l'Abyssinie (à Dévratabor) contre l'hydrophobie", in the French 'Bulletin de la Société de Géographie', for 1849.

Reference to traditional medical practice continued to appear in foreign travel literature, throughout the nineteenth and early twentieth centuries. Most of these works were, however, written by non-medical authors, and inevitably suffer for this reason. Several notable exceptions, however, deserve be mentioned. They include the work of a number of Italian physicians, whose findings enriched the medical section of Antonio Cecchi's 'Da Zeila alle frontiere del Caffa' (Rome, 1885-7). This was followed, a decade or so later, by a work entitled 'he Source of the Blue Nile' (London, 1905), written by Arthur J. Hayes, a visiting British medical officer from Suez. The following decade witnessed the publication of two works by Italian physicians attached to the Italian Legation in Addis Ababa: Carlo Anneratone's 'In Abissinia' (Rome, 1914), and Lincoln De Castro's 'Nella terra dei negus'(Milan, 1915). Also of no small value was 'Note di patologia etiopica', an account of the medical scene in Wallo and Gondar, drawn up by three Italian medical doctors, D. Brielli, V. Calò, and A. Bevilacqua, and published by the Italian Ministry of the Colonies.

At about the same time a resident Georgian physician in Addis Ababa, Dr Paul Mérab, wrote the first important, though at times unnecessarily gossipy, survey of the then contemporary Ethiopian medical scene. His book, part of a four volume work on the Ethiopia of Emperor Menilek's day, was entitled 'Médecins et médecine en Ethiopie' (Paris, 1912), and in its way cut valuable fresh ground. It can still be read with interest today.

International interest in traditional Ethiopian cures also owed much, in this period, to the pioneer work of the notable French linguist Marcel Cohen, sometime doyen of Ethiopian studies, whose writings, semi-linguistic, semi-anthropological, included an article on "Cérémonies et croyances abyssines", which appeared in the 'Revue de l'Histoire des Religions', in 1912. This was followed, a decade or so later, by Marcel Griaule's no less significant article "Mythes, croyances et coutumes de Bégamder (Abyssinie)", published in the Journal Asiatique, for 1928.

This French anthropological tradition, which included a medical component, was continued in several later studies, on medico-magical matters, by another

Frenchman, Michel Leiris. Among his works are three detailed articles: "Le culte des zars à Gondar (Ethiopie septentrionale)" in 'Aethiopica', 1934, "Un rite médico-magique éthiopien" in 'Aethiopica', 1936, and "La croyance aux génies 'zar' en Ethiopie du Nord", in Journal de Pschologie Normale et Pathologique 1938.

This period also witnessed the publication of a notable work on Ethiopian medical and other botany: E. Chiovenda's 'Etiopia, Osservazioni botaniche, agrarie ed industriali fatta nell'Abissinia nell'anno 1909', published by the Italian Ministry of the Colonies, in Rome, in 1912.

First international scholarship on Ethiopian medical texts

The international study of Ethiopian medical texts, which owed much to the interest of Marcel Cohen, began in the decade prior to the Italian fascist invasion of 1935-6, when the French ethnographer Marcel Griaule was shown an Amharic medical textbook of an Entoto **dabtara**. Griaule, who was assisted by a young Ethiopian student, the future artist Agagnaw Engeda, subsequently published this work, with a French translation, in a scholarly volume entitled 'Le livre de recettes d'un dabtara abyssin' (Paris, 1930).

This pioneer work was followed by the publication of a collection of Ge'ez medico-magical texts by a promising Polish Jewess, who was almost immediately afterwards killed in one of Hitler's gas chambers: Deborah Lifchitz's 'Textes éthiopiens magico-religieux' (Paris, 1940).

Traditional Ethiopian writers, it should be emphasised, never drew a very definite difference between matters medical and magical.

Early research on Ethiopian medicinal plants

Scientific research had begun meanwhile, mainly in Italy, on a number of plants used in traditional Ethiopian medicine, many of which were also found in the then Italian colony of Eritrea.

This research led to the publication of two notable articles which appeared prior to the invasion: Romualdo Ganora's "Flora medica etiopica", in the 'Archivio Italiano di Scienze Mediche Coloniali' in 1929; and Paolo Rovesti's "Medicamenti, aromi e droghe nei mercati indigeni del'Eritrea", in the 'Rivista Italiana delle Essenze. dei Profumi e delle Piante', in 1933.

Further Italian research was carried out during the Italian fascist occupation. This resulted in Giovanni Masucci's "Etnoitria etiopica", which appeared in the 'Rassegna Sociale dell'Africa Italiana', in 1940; R. Cacciapuoti's "Farmacoterapia vegetale indigena in Eritrea ed Etiopia" in the 'Archivio Italiano di Scienze Mediche e di Parassitologia', in 1941; and Martino Mario Moreno's "Ricette mediche abissine", in 'Medicina e Biologia', in 1943.

Early post-war study of Ethiopian texts

The period after World War II witnessed a considerable growth of research on traditional Ethiopian texts. Much of this was carried out by our old friend, the Polish Ethiopisant Stefan Strelcyn. A prolific writer, his first studies began in the Ethiopian magico-medico field with an article "Quelques élements du voculbulaire magique éthiopien (séries verbales)", in the 'Comptes rendus du GLECS' (1948-51), a monograph 'Prières magiques éthiopiennes pour délier les charmes' (maftehe seräy (Warsaw, 1955), and a contribution on "La magie éthiopienne", presented to the first International Conference of Ethiopian Studies, held in Rome in 1961.

These first essays were followed by at least seven articles dealing more specifically with traditional Ethiopian medicine: "Remarques sur la langue des textes médico-magiques éthiopiens, le traitement des verbes amhariques en contexte guèse", in 'Rocznik Orientalistycny', and, "Les traités médicaux éthiopiens", in Cahiers d'Etudes Africaines, both of which appeared in 1961; "Un traité éthiopien d'hygiene et de diétetique", in 'Africana Bulletin', in 1964, "Les écrits médicaux éthiopiens", in the 'Journal of Ethiopian Studies' (1965), "Médecines du Bégamder et du Tchelga (Ethiopie), in 'Africana Bulletin, (1966), "Magie, médecine et possession à Gondar", in 'Journal of Religion in Africa' (1973), and "Emprunt? Parenté? Hybride? Calque? Toponyme? Sur qualques noms de plantes Gallas et Amhariques", a paper delivered at the Secondo Congresso Internazionale di Linguistica Camito-Semitica, in 1978.

These studies were accompanied by the appearance of Strelcyn's major two-volume work 'Médecine et plantes d'Ethiopie'. The first volume, published in Warsaw in 1968, bore the sub-title "Les traités médicaux éthiopiens". It comprised the text, and French translation with commentary, of the four earliest Ge'ez and Amharic medical texts mentioned in a previous paragraph, and a fifth, late nineteenth or early twentieth century Ge'ez work, a photographic copy of which Strelcyn obtained in Asmara, from its owner Abba Yohannes Gabra Egziabher.

The second volume of 'Médecine et plantes d'Ethiopie' was published in Naples, in 1973, after its author's flight from Poland. Sub-titled "Enquête sur les noms et l'emploi des plantes en Ethiopie", it contained a discussion on three hundred, alphabetically arranged, plants mentioned in the texts published in the first volume.

The above texts, edited by Strelcyn, were later supplemented by the appearance of a twentieth century Amharic work written in Gojjam. This was published, with an English translation, and commentary, by an Ethiopian scholar, Tsehai Berhane-Selassie, in her article "An Ethiopian Medical Text-book written by Grazmac Gäbrä-Walde Arägahañ, Däga Damot", in the 'Journal of Ethiopian Studies', 1975.

Botanical identifications

The post-war period also witnessed the beginning of a considerable amount of work on Ethiopian medicinal and other plants by botanists, several of whom were particularly interested in medical ones.

The first of these studies included Georg Cufodintis's "Enumeratio plantarum Aethiopae spermatophyta", which was published in the 'French Bulletin du Jardin Botanique de l'Etat' (1955, with several supplements, 1954-5, and 1965), D. Lemordant's monograph 'Les plantes éthiopiennes' (Addis Ababa, 1960), and Harold F. Mooney's 'A Glossary of Ethiopian Plant Names' (Dublin, 1963).

These works were subsequently largely superseded by the publications of two Ethiopian scholars: Wolde Michael Kelecha's 'A Glossary of Ethiopian Plant Names' (Addis Ababa, 1987), and Dawit Abebe and Ahadu Ayeh's 'Medicinal Plants and Enigmatic Health Practices of Northern Ethiopia' (Addis Ababa, 1993). Reference may also be made to two other useful recent works: 'The Honeybee Flora of Ethiopia', by Reinhard Fichtl and Admasu Adi (Weikersheim, 1994), and 'Indigenous Trees of Ethiopia. Biology, Uses and Propagation Techniques', by Legesse Negash (Addis Ababa, 1995)

The knowledge available in such publications will be vastly enhanced by the gradual publication of the great 'Flora of Ethiopia', the first part of which (Vol. III, edited by Inga Hedberg and Sue Edwards) appeared in 1989.

A number of other studies, more specifically on Ethiopian medicinal plants, and their utilisation, written in this period, deserve mention. They include four studies by a French scholar, Jacques Mercier: "Approche de la médicine des debteras" and "Plantes toxiques d'Ethiopie", both in 'Abbay', in 1979, "A propos des plantes médicales éthiopiennes: quelques aspets de nomenclature guèze et

amharique", in 'Abbay', 1979, and "Le nom des plantes dans la province de Wällo (Ethiopie)', in Abbay', 1980-2.

Three articles by the aforesaid Lemordant: "Contribution à l'ethnobotanique éthiopienne" and "Histoire ethnobotanique du kosso", which appeared in the French 'Journal d'Agriculture Tropicale et de Botanie Appliquée', in 1971 and 1981 respectively, and "Plantes médicinales d'Ethiopie. Le passé-les perspectives d'avenir", in the 'Proceedings of the IXth International Congress of Ethiopian Studies', 1988.

Other studies of traditional Ethiopian medical plants, and health practices, written in these years, include G. Tresca's "Appunti di etnomedica eritrea", in the Italian 'Annali di Medicina Navale', 1965, M. Nagasawa's "Notes on some medicinal plants of Ethiopia", in the Japanese 'Afrika-Kenyu, 1966; Simon Messing and J.S. Prince's "Health practices in Ethiopian pre-urban communities", in the 'American Journal of Health and Human Behavior', 1966, Hermut Kloos's "Preliminary studies of medicinal plants and plant products in markets of southern Ethiopia:", in the German 'Ethnomedezin' 1976-7; Bergit Negussie's "Some indigenous medicines used during childbirth in South West Ethiopia", in the 'Proceedings of the IXth International Congress of Ethiopian Studies', 1978; Belachew Desta's "Ethiopian traditional herbal drugs: potentiality and appropriate utilization", in the 'Proceedings of the Eighth International Conference of Ethiopian Studies', 1988. I might add that many of the present writer's articles in the area of medical and related history have been reprinted in 'An Introduction to the Medical History of Ethiopia' (Trenton, New Jersey, 1990)

The future

Much work on Ethiopian medicine and health, it will be apparent from the above discussion, has been carried out over the last few centuries. The data thus far collected and the research undertaken, has laid a firm, and invaluable, basis for future, more scientific, studies. In this connection it should, however, be emphasised that much of the country has still not been scientifically studied from the medical point of view, and that the traditional medical texts discussed above have not been subjected to systematic investigation from either the botanical or clinical points of view. Identification of many plants mentioned in these texts is in fact in many cases hazy, and their medical re-evaluation is still therefore far from definitive.

Priority should be given to:

1) The collection of traditional Ge'ez, Amharic, and other medical texts.
2) The systematic identification of plants referred to in such texts, and the publication of resultant findings.

3) The recording of traditional, non-written medical cures, remembered only orally, and their systematic publication.
4) The gathering of biographical and other information on traditional medical practitioners, who have up to now scarcely ever been studied, with special reference to their education, as well as their transmission of knowledge from one generation to another.

The study of traditional cures is clearly of major importance. Such treatment is culturally preferred by large sections of the population, and its development, on modern scientific lines, is desirable for the followingreasons:

1) To understand the true character of Ethiopia's medical history;
2) To seek useful cures for Ethiopia, as well as for the world at large, as has resulted from the study of traditional medicine in other countries;
3) To foster national dignity, and self-reliance, by recognizing the value of traditional local and national knowledge;
4) To develop local initiative and industry, thus generating rural wealth, while conserving foreign exchange, which is often spent unnecessarily on the import of foreign drugs;
5) To provide convenient access to medicines more easily available to, and acceptable by, rural communities, which would in many instances be able to find, or manufacture, their own medicaments.

Research on traditional Ethiopian medicine should be regarded as a matter of extreme urgency, for two main reasons.

1) Local indigenous knowledge is fast being lost in consequence of modern development, with the result that traditional medical knowledge, including the identification of plants referred to in traditional texts, is becoming progressively more difficult.

2) Population growth, resulting in intensified cultivation, is leading to the destruction of "virgin land", deforestation, and more generally, the eradication of wild plants, including many of traditionally medical significance.

It is hoped for all these reasons that this gathering will help to generate increased interest in traditional medicine, and encourage intensified, and badly needed research in this field.

The time to establish a Journal of Traditional Ethiopian Medicine has clearly arrived!

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The Status and Availability of Data of Oral and Written Knowledge on Traditional Health Care in Ethiopia: A Base Line Study

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Introduction

Biodiversity, the variety of living organisms on earth, exists at three levels. These are; genetic diversity, species diversity and ecosystem diversity (Cooper *et al.* 1992). It can be perceived as an interacting complex of plants, animals and microorganisms in the natural environment. Biodiversity is the main source of raw materials used in agriculture, medicinal and industrial innovations. It forms the foundation of sustainable development (Dahl and Nabhan 1992).

Ethiopia is endowed with a great diversity of plant, animal and microbial genetic resources. It is estimated that there are about 7000 species of plants in the country. The country has great climatic and ecological variations that largely contribute to the diversity of plants. Ecological diversity, to a significant degree, determines the distribution of bioproductive resources and the nature of economic activities undertaken by local communities in different parts of the country.

Culture is the accumulation of knowledge, rules, standards, skills and mental sets that human utilise in order to survive, *i.e.*to adapt to the environments in which they live. One cannot imagine humans today surviving without culture. In recognising the value of traditional plants, the knowledge has to be seen in its own eco-system, the cultural setting for every society, and one must understand that traditional plants may have different meanings in different societies.

There is much physical evidence to prove the antiquity of traditional medicine in many parts of the world. Ethiopia's traditional medicine lore might have a long story as well (Pankhurst 1976). In Ethiopia the long history of the use of medicinal plants is reflected in the various medico-religious manuscripts produced on parchments and believed to have originated several centuries ago. The practice persists to date for a number of reasons including socio-cultural and economic factors. Its continued popularity, however, seems to be largely due to its biomedical benefits in dealing with many of the local health problems.

According to the World Health Organisation (WHO), as quoted by Yilma *et al.* (Yilma *et al.* 1996), traditional medicine is defined as the sum total of all the knowledge and practices, whether explicable or not, used in diagnosis, prevention and elimination of physical, mental or social imbalance and relying exclusively on practical experience and observation handed down from generation to generation,

whether verbally or in writing. Thus guided by the taste and experience, early societies developed a means of healing by using plants, animal products and minerals that were mostly not in their usual diet.

The term indigenous knowledge is used synonymously with traditional and local knowledge to differentiate the knowledge developed by a given community, from an international knowledge system generated through universities, government research centres and private industry. Indigenous knowledge refers to the knowledge of indigenous people as well as any other defined community. An indigenous knowledge system relates to the ways members of given community define and classify phenomena in the physical/natural, social, and ideational environments. Sustainable development is management of the human use of the biosphere, taking into account ecological relationships as well as social and economic factors, the capabilities of the living and non-living resource base, and long-term advantages and disadvantages of alternative actions, while maintaining the potentials of a given ecosystem to meet the wants and needs of future generations for food, shelter and other aspects of human civilisation (World Wide Fund for Nature 1985; World Commission on Environment and Development 1987:43; Panayotou 1992).

It is apparent that indigenous knowledge covers a broad area dealing with all facets of human life and management of the natural environment. Indigenous knowledge is local knowledge that is unique to a given culture or society. It is the basis for agriculture, health care, food preparation, education, environmental conservation and a host of other activities. Much of such knowledge is passed down from generation to generation, usually verbally and in written form. Thus, it is the knowledge that people have gained through inheritance from their ancestors. It is people's creativity, innovations and skills. The conceptual framework of indigenous knowledge requires analysis at various levels. But, sustainable development requires the application of indigenous knowledge (Indigenous Knowledge and Development Monitor 1993).

Indigenous communication contrasts with the 'exogenous' communication systems and the formal education system. Indigenous channels include traditional performing arts or 'folk media, indigenous organisations, deliberate instruction (e.g. child-rearing, traditional schooling and apprenticeships), unstructured channels such as conversation at market and in the field, written records, memorised records and direct observations.

The knowledge of plant remedies depends on word of mouth, and it passes from one generation to the other with the anathemas not to reveal to any one except to one who is an 'elect'. With the advent of writing and printing materials, however,

medicoreligous manuscripts and traditional pharmacopoeias have developed and become useful source of information.

The greatest advantage of inventorising traditional knowledge of medicinal flora is that it adds to our existing knowledge of herbal medicine confined to a limited community. It is now known that much information about medicinal plants exists in the form of folklore and many useful prescriptions are confined to household remedies. For the last few years, in order to find out about plant resources and their folk usage in Ethiopia, the Biodiversity Institute has made a series of investigations and primary studies in collaboration with the Ethiopian National Traditional Medicine Preparation and Therapy Association. This paper will outline them and make some suggestions.

Different supports to indigenous knowledge (Indigenous Knowledge and Development Monitor, 1993)

Indigenous knowledge is distributed unevenly in communities. All share core knowledge, and only a few hold specialized knowledge. The knowledge structure and social structure are thus intertwined. Information on indigenous knowledge can be useful for development in at least two ways. It can facilitate the design and implementation of appropriate programmes, and be treated and introduced as a technology in surrounding areas or even transferred to other regions.

It is a proven fact that basing projects on an understanding of indigenous knowledge enhances the likelihood of avoiding costly mistakes and promoting appropriate technologies. In addition there are different emerging supports to indigenous knowledge emanating from different sectors and segments of national and international communities, and these supports are summarised as in the following perspective.

The formal sector

Scientific community

Parallel to and intertwined with the rapidly advancing body of international scientific knowledge are bodies of local knowledge derived from empirical trial-and-error of people struggling to survive over centuries. Little of the wisdom has been recorded or validated by the scientific method. The scientist recognises this and wishes to understand and incorporate all knowledge in the scientific corpus. Part of this desire is to validate and use the information in identifying plants that may contain active ingredients for drugs.

Extension/development agent

Many in the development community have come to accept the likelihood of frequent failures in their work if it does not incorporate indigenous needs, concepts and resources. So the development community needs to understand local systems, especially local communication processes. The goal is to identify, verify, and adapt indigenous knowledge and to promote it in areas where conditions are similar.

Conservationist

This stream supports the pursuit of knowledge *per se*, but it also makes normative judgements. It evinces an interest in preserving knowledge, *in-situ*, for its own sake. The isolation of the indigenous system so it will remain unsullied is of value. Thus, there is a potential conflict between intervention to determine knowledge, and isolation to prevent the introduction of change. Rather than the 'neutral' scientific interest in knowledge, the conservationist will add an element of advocacy for retention.

The informal sector

Another underlying stream is the view of indigenous as being a resource that local people can use to further their own development. Such a view sees the role of agricultural extension personnel as facilitating and stimulating farmers' experiments and encouraging the interchange of information among them. This contrasts with the nearly universal (and often unsuccessful) current role of extension agents, which is to try to persuade farmers to adopt technologies developed elsewhere. The role of the agricultural researcher is also transformed into one that responds to and supports the farmers' research agenda, rather than being independent of it.

Associated politicians

The other source of interest in indigenous knowledge derives from North-South conflict and tensions. The South's often expressed frustration with, and feelings of, exploitation by the North are translated into a perception of local people being suppressed by the wealthy developed nations. Political advocates espouse the protection of rights, the end of exploitation, and the exploiters' obligation to pay for past transgressions.

Companies

The capitalist seeks indigenous knowledge as a resource to be tapped by outsiders in pursuit of profit. Examples of this are the 'chemical prospecting' of tropical

plants by western drug companies and germplasm collecting by crop breeding firms. Both may draw on the knowledge of local people to identify promising sites, species, and uses. The key to the capitalist's success is the potential for developing a commodity that can be bought and sold. Some types of knowledge are more readily commodified than others; hybrid seed and drugs are two examples. The capitalist makes a large investment in developing, say, a new drug or crop variety from such germplasm.

Objectives

The central theme of this paper is to investigate the status and availability of data of oral and written knowledge on traditional health care in Ethiopia, from ofcource the point of view of the Biodiversity Institute, and then to analyse the gaps that exist at present.

Materials and method

This base line survey/study was done with the active participation of the Ethiopian National Traditional Medicine Preparation and Therapy Association. This association was established in 1990 and has about 8272 traditional healer members through out the country (see Table 1) of which some of the traditional healers are prominent figures in their respective area of specialisation.

Table 1: Members of the Ethiopian National Traditional Medicine Preparation and Therapy Association by ethnic group and gender

Ethnic Group	Number of the members	Gender	
		Male	Female
Aderie (Hararie)	30	25	5
Afar	200	180	20
Agew	200	180	20
Amhara	2800	2600	200
Gambella	98	90	8
Goomez	56	50	6
Guragie	400	360	40
Konfuel	43	40	3
Oromo	3245	3040	205
Tigrie	800	750	50
Wolayta	400	350	50
Grand Total	**8272**	**7665**	**607**

In April 1994, the Ethiopian National Traditional Medicine Preparation and Therapy Association signed a bilateral agreement with the Biodiversity Institute to work together in the areas of collecting medicinal plants and documenting the associated traditional knowledge and conserving both the genetic material and the

empirical knowledge with the ultimate goal of sustainable use of medicinal plants in Ethiopia. Preserving and safeguarding the medicinal knowledge of farming and indigenous communities are two of the important components of the responsibilities of the Biodiversity Institute.

The Association is housed at the Biodiversity Institute and the activities, *as per* the bilateral agreement, that are jointly served by the Association and the Biodiversity Institute are being co-ordinated by the Community Biodiversity Development and Conservation (CBDC) Division of the Biodiversity Institute.

Inventory of human and domestic animal diseases

Some 400 representative members of the Ethiopian National Traditional Medicine Preparation and Therapy Association across the country, known for their devotion and high calibre knowledge/skill, were asked to send lists of human diseases they knew and found in their respective areas/regions through a memorandum written to them from the Association. All of them responded to the request and sent their lists of human and domestic animal diseases they knew about in their respective areas. The lists were filtered out to avoid repetition and redundancy, and to produce a compendium list of traditionally known human and domestic animal diseases across Ethiopia.

Inventory of plant remedies to human diseases

Representative members

Those members of the Ethiopian National Traditional Medicine Preparation and Therapy Association who were requested to summarise and produce lists of human and domestic animal diseases were also asked to prepare a brief account of the plant remedies they use to heal patients from those diseases. Although this wasa highly protected/guarded secret for themselves, with the emerging confidence in, and with the persistent persuasion of the Association, it was possible to acquire a brief summary of ranges of plant remedies. All this information was kept within the Association under each respondent's name.

Manuscripts and other documents

Different collecting teams of ancient manuscripts and other documents related to the history and knowledge of traditional medical care in Ethiopia were formulated. Members of the teams were comprised of members of the Association and staff from the Biodiversity Institute. The teams have collected several manuscripts/documents with a tremendous wealth of medicinal information from

priority target areas such as the Axumite, Zagwie and Gondar kingdoms; Jima (Aba Jufar Palace); Thana Cherkos; Gojam; Wolo, Zuwaii, North Shewa, and different other sources. The collections were made through the assistance of convents, churches, mosques, elderly respected people, community members and government.

Since most of the documents were written in Ge'ez, they have been translated into Amharic, and the information on plant remedies was listed/summarised. The one collected from Jima was in Arabic. Again all the documents with their Amharic version/translation were kept within the Association.

Results

Traditionally known human and domestic animal diseases found in Ethiopia

A compendium list of traditionally known human diseases found in Ethiopia was compiled and presented below. There are about 84 diseases. Some of them such as cholera and malaria are area specific and very much localised to the extreme lowland/arid areas. Some others such as giardiasis, cancer, rabies, bilhariasis, oesophageal diseases and elephantiasis are mainly found across the lowlands/semi-arid regions of the country. Few others, like internal humeroid and intestinal diseases to the greater extent are found in the medium highland areas. Coughing is largely confined to the highland areas. Others are distributed here and there across the country.

List of common names of traditionally known human diseases found in Ethiopia

1. Amoebiasis
2. Appendicitis
3. Asthma
4. Bilhariasis
5. Bleeding nose
6. Blood poisoning
7. Blood pressure (high)
8. Bone break/rupture
9. Blood clotting problems
10. Blood diseases
11. Blood vessel problems
12. Boils
13. Bronchitis
14. Bubo
15. Cancer (all types)
16. Chancroid
17. Constitipation
18. Cholera
19. Colds
20. Coughing
21. Dandruff
22. Dental diseases
23. Diabetics
24. Diarrhoea
25. Disjoint problems
26. Eclipses
27. Eczema
28. Elephantiasis
29. Eye diseases
30. Food poisoning
31. Gall bladder problems
32. Giardiasis
33. Gonorrhoea
34. Heart problems
35. High fever
36. Headache
37. Haemorrhoid (internal and external)
38. Hyper pigmentation
39. Impotency problems
40. Indigestion problem
41. Intestinal problems
42. Kidney diseases
43. Leprosy
44. Liver diseases
45. Loss of appetite
46. Insomnia
47. Malaria
48. Menstrual problems
49. Mental disorders
50. Nerve diseases
51. Pneumonia
52. Oesophagal problems
53. Oral diseases
54. Paralysis

55. Rabies
56. Rheumatism
57. Scrotal diseases
58. Scull ruptures/breakages
59. Skin diseaes
60. Sleeping sickness
61. Ringworm
62. Seborin
64. Spinal cord problems
65. Spleen diseases
66. Snake bites
67. Small pox
68. Sneezing
69. Stabbing pain
70. Stomach ache
71. Swelling of glands
72. Syphilis
73. Tapeworm
74. Tinia corporis
75. Typhoid
76. Tonsillitis
77. Tuberculosis
78. Ulcers
79. Uric acid
80. Urinary problems
81. Vitiligo
82. Womb diseases
83. Women's breast diseases
84. Wounds

As for the human diseases, a compendium list of traditionally known domestic animal diseases found in Ethiopia was compiled and presented. According to the inventory, there are 36 traditionally known domestic animal diseases, of which **Gurdemos, Aba Megal, Chefin, Mendif, Amenmen, Dereba and Kurtimis** are localised to the highlands, where as others such as **Letim, Kolekol, Gurmit, Nidifit, Aba Senga, Azurit, Adirk and Gendi** are localised to the medium highlands. The rest are distributed in different places, but mainly in the lowlands.

List of common names of traditionally known domestic animal diseases in Ethiopia (local names)

1. Gurdemos
2. Aba Megal
3. Chefin
4. Mendif
5. Amenmen
6. Dereba
7. Kurtimis
8. Letim
9. Kolekol
10. Gurmit
11. Nidifit
12. Aba Senga
13. Azurit
14. Adirk
15. Gendi
16. Chito
17. Birth
18. Entutbiye
19. Shen Temam
20. Atabkign (Muzsiger)
21. Godagod
22. Semerie
23. Dergumut
24. Halafin
25. Ferra
26. Megerem
27. Kuanchefir
28. Ayemaaz
29. Demitoz
30. Efel
31. Alkit
32. Aba Gurba
33. Furro
34. Dedes
35. Armiz
36. Gilaglul

Ethnoveterinary medicine deals with folk beliefs, knowledge, skills methods and practices pertaining to the health care of animals. Research needs on ethnoveterinary research and development include the recording and documentation of the traditional system to provide support for the development of a database, which could also help to produce a checklist of plant remedies.

Ancient manuscripts and other documents collected

A brief summary of the historical background and content of the manuscript(s)/ document(s) in relation to traditional medical care in Ethiopia is presentedas in the following.

Documents from the Axumite Kingdom

Picture 1 shows ancient and very antique manuscript remnant from the Axumite Kingdom, a Kingdom that existed from the 7th to 11th century. It contains several prescriptions of medicines that can be prepared from various plants, animals and minerals targeted against different human diseases. The total number of diseases addressed in the manuscript are 1500, and the plant and animal species, and minerals involved in the remedies are 8000, 90 and 150 respectively.

Picture 1: Photographs of ancient manuscripts and other documents

Documents from the Zagwie Kingdom

In the Ethiopian historical arena, the Zagwie Kingdom succeeded the Axumite Kingdom. This Kingdom lived for about 200 years starting from the 11th to the 13th century. The ancient antique manuscript collected from the ruins of the Zagwie Kingdom stated about 280 human diseases and indicated about 2800 plant species and 150 minerals from which remedial medicines can be extracted and prepared. Nevertheless components of animal remedies are not stated in the manuscript.

The medicinal manuscripts/documents of the era from King Hailemelekot to Emperor Haileslassie (from 1870 to 1973). There were 500 human diseases listed in manuscripts/documents. Likewise there were 700 plant species listed as potential sources of medicine against the mentioned diseases, of course combined with several animal and minerals resources (85 and 90 respectively).

Gap analysis

This gap analysis is meant to provide a good insight to into the problems associated in acquiring information on indigenous/traditional medical care in Ethiopia. It could also serve as a source of inspiration for those who are interested in the potential role of indigenous knowledge in sustainable development and utilisation of medicinal plants in Ethiopia.

Thus, a brief summary of the gap analysis is presented as follows:

- There is no national policy and/or system set to govern collection, storage and utilisation of indigenous knowledge as a whole and on medicinal plants in particular.
- There are no methodologies for recording indigenous knowledge on medicinal plants, identifying and understanding the structure and functions of indigenous organisations that deal with tradtional health care system and describing indigenous approaches to innovations and experimentation.
- A general manual for traditional health care system research, a manual that guides community-based indigenous knowledge research and the production of specific regional and culturally appropriate manuals, is not compiled.
- Methods for archiving indigenous knowledge on medicinal plants and establishing knowledge banking are not developed.
- There is no any organising body to carry out national conferences and workshops to provide opportunities for decision-makers to understand the existing potential value of working with and through knowledge systems for participatory approaches to development.
- Research projects should attempt to establish the scientific validity and economic viability of indigenous technologies, and to evaluate the cost effectivenes of incorporating indigenous knowledge components in developments and sustainable use of medicinal plants.
- Since there is a danger of promoting dangerous practices along with beneficial ones, there must be a testing and validation mechanism of traditional knowledge, and therefore criteria have to be developed to test and validate the traditional system in the health care.
- Training courses on indigenous knowledge and sustainable development

should be developed on the basis of national case studies appropriate for inclusion in the formal education.

- Mechanisms and means should be devised to inventorise and repatriate Ethiopia's ancient manuscripts and documents held in different foreign countries, manuscripts and documents that deal with traditional care system and medicinal plants.

Conclusion

Since the mid 1980s, the 'community first' philosophy has gained widespread attention and support from agencies and institutions around the world, enough to begin challenging the conventional approaches to research. This change in thinking has emphasised the need to listen and learn from the people and to make local people active partners in the research and development process.

Indigenous knowledge on medicinal plants is a technology that can be transferred, with the term 'technology' referring not only to remedies but also to management practices and sustainable utilisation of the dwindling medicinal plant genetic resources. It is a holistic and culturally bound technology from which the culturally appropriate and sustainable aspects can be blended and enriched by the efficiency and productivity of introduced technologies of the formal sector technology for many uses and applications.

The traditional health care system covers many aspects of life and provides a rich resource for suitable development. This is not to romanticize traditional knowledge. It should be viewed critically. Some practices are less efficient than modern technologies. Practices originally benign under conditions of low population and limited contact with the outside may no longer be appropriate. But still, important lessons can be distilled from it even as it changes.

Thus, data of oral and written knowledge on traditional care in Ethiopia should be collected and documented, and a data base system should be designed to primarily serve for access by local peoples and for scientific use. Knowledge collecting and/or indigenous knowledge research on medicinal plants should, however, apply ethnosystem approach, an approach that combines ethnology and historical perspective, which includes analyses of local language, technical skills and medicinal plant resources management. Knowledge banking should always follow ethical guidelines for the use and release of traditional knowledge on health care in Ethiopia, based on principles such as informed consent and right-to know, intellectual property rights, compensation rights, breeders' rights, right to choose, cultural rights and other generally recognised rights.

The most important needs at stake are to work towards filling the gaps indicated above, in order to improve the collection of indigenous knowledge; to salvage valuable knowledge which is at risk of extinction; to improve the capacity of indigenous knowledge research and availability of data on medicinal plants for better use by the local communities and beyond, and to improve the productivity and quality of end products of medicinal plants through blending the traditional knowledge with the technology of the formal sector.

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Some Policy and Legal Considerations Regarding Access to Genetic Resources and Benefit Sharing

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Introduction

Genetic resources are the essential elements of biological diversity, which include all terrestrial and aquatic plants and animals as well as microorganisms. Biological diversity is more than the number and types of genes, species, and ecological systems. It is a lively system where all life forms and ecological processes, human culture and practices merge together. Genetic resources are among the essential elements of biological diversity with which human culture and practices are associated. At times however, these resources are perceived in isolation and as divorced from the customary and custodianship roles, needs and rights of those who closely live with and nurture them. Similarly, the value of genetic resources is reduced to only types or elements that are of an immediate use value. Such reduction of values of resources remains one among the causes of irrecoverable loss of the precious components of biological diversity and associated knowledge.

The rights of states and their communities over genetic resources

The rights of custodianship and customary rights are among the basic elements of human rights. The sovereignty of a nation over the natural resources within its territory embodies also the rights of local communities whose traditional or customary practices contribute to the conservation and sustainable use of biological diversity (CBD-COP 1995). In most of the cases, the effect of violating these rights would amount to the violation of the sovereign right of a nation, which would lead to tensions and continued erosion of biological resources. The best example is the on going tense dialogue on access to genetic resources, and equitable sharing of benefits arising from these resources, which is almost heading towards an impasse.

The main cause of the tension lies in the denial of the custodianship and customary rights of communities and sovereign rights of nations over their genetic resources, which entitles them to an equitable sharing of benefits. With regard to agricultural genetic resources for example, the center of contention remains the lack of full recognition of tenure rights, and the contribution of plant species of industrial and medicinal value. The role the traditional knowledge of the local farming communities has in promoting the use of genetic resources is also overlooked.

Access to genetic resources, until recently, had been thought to be free from restrictions. The underlying explanation was that these resources are the common heritage of humankind. However, although these resources were claimed to be common heritage, responsibilities for managing and nurturing them on the one hand, and benefits accruing from these resources on the other, were not always shared or distributed in a fair manner (Berg 1995). Usually genetic resources and the benefits derived from them flow in just one way. The larger share of the benefits is usually enjoyed by the recipients of the resources only. This is true both at national and international levels, and has contributed to the violation of customary and custodianship rights of communities as well as the principle of the sovereignty of nations.

Exclusion of the major stakeholders from benefits and managerial rights has eventually led to irrecoverable losses of the elements of biological diversity and traditional resource management skills. There are various international commitments made one after another in order to address this problem, but at times without harmony and with no real impacts. The international controversies have significantly slowed down the move towards setting provisions or obligations for establishing functional institutional framework and policy guidelines at intergovernmental level. It has also hampered the adoption of proper policies and accounting methods that promote recognition and support to customary and custodianship rights at national level. As a result, the present efforts to correct those development directions that have aggravated the loss of elements of biological diversity still suffer from a serious gap not yet well appreciated at various levels.

A comprehensive regime that regulates access is still not in place. Nevertheless, some countries are now in the process of developing laws and promoting institutional arrangements that match with the existing international frameworks. Ethiopia is one of these countries that is in the process of developing co-operative arrangements for the conservation and the sustainable use of genetic resources. This includes recognition of the rights of local communities in promoting useful traditional practices of resource management. It is clear, that such arrangements should be consistent with the Convention on Biological Diversity (CBD) and other international instruments relevant to genetic resources.

Access to genetic resources and transfer of technology

Free availability of genetic resources and related technology is the foundation for economic, health and agricultural development and for the improvement of human welfare as a whole. On the contrary, legal monopolies of the use of genetic resources are found harmful to human welfare and to the development of genetic

resources. It is in recognition of the problem that access to genetic materials and related knowledge has recently become an important issue. Serious concerns arose, particularly when intellectual property rights began to be granted for living things that are said to be changed or invented (GRAIN 1996). Formal discussions in relation to these issues started during the preparation to the Convention on Biological Diversity.

Another pertinent concern was that if genetic resources should remain the common heritage of mankind, the costs of maintaining them should be based on reciprocity, and benefits extracted from them distributed in a fair and equitable manner. Refusing a share of benefits to the local people who have always been the custodians and actual managers of genetic resources is a flagrant violation of the principle of "common heritage". Refusal to share benefits while claiming legal protection over products from genetic resources on the one hand, and insisting on having an unrestricted access to the same resources on the other, is unworthy. Similarly, restrictions on the transfer and use of technology are strongly enforced by the developed world. It is due to such an attempt that the imbalance in reciprocity is created, and the free flow of genetic resources among nations is discouraged.

One of the rationales for restricting technology transfer for example is the need to encourage creativity by way of rewarding inventors. In other words, the restriction serves as a means to protect formal innovators intellectual property from being pirated or illegally exploited. Unfortunately, piracy of genetic resources and knowledge of local communities by the formal innovators and companies is never considered as being illegal or immoral (GRAIN 1996). It is the property and slightly modified innovations of local communities that are at times put under the property protection rules of companies.

There are many cases around the world where patents have been obtained on community owned genetic resources and on information derived from the knowledge of local communities. These are clear cases of piracy but sanctioned by law in many of the developed countries.

On many occasions people with the opportunity to enjoy Intellectual Property Rights (IPR) protection are free to obtain patents over communities' properties (Leskin and Flitner 1997). The implications of such rules and its trans boundary effects have always been the bottom-line for the on-going North-South dialogue. To resolve these conflicts and to ensure commonality of resources, there should be a principle of equity by which the property rights of communities over the use of their genetic resources are recognized and equally protected.

The international efforts

At a certain stage, the growing alarm over bio-piracy and the monopoly of genetic resources provoked FAO to make an attempt to qualify the unrestricted access principle by adopting an *agreed Interpretation* of the IUPGR (Resolution 4/89). The adoption of the Interpretation was an attempt to reconcile IPR with the principle of unrestricted access to plant genetic resources. According to the Agreed Interpretation, plant genetic resources should freely be available as *"a heritage of humankind"*; while at the same time *free-access* does not mean free of charge (FAO 1996).

In a way, this was intended to put a measure of balance between the simultaneous recognition of Farmers' Rights and the Plant Breeders Rights or IPR system. However, the enforced IPR system and patents on the components of plants or the entire plant do not comply with the objectives and needs of Farmers' Rights and with the provisions of other international instruments that are relevant to genetic resources. One of the impacts of the provisions of the enforced system of IPR for example, is the imposition of patent rule on traditional agricultural practices and their products, and on other community innovations that are common to the large majority of small-scale farmers and local communities (Leskin and Flitner 1997).

Access to community owned genetic resources have never depended on intellectual property protection (Tewolde 1996). For example, farmers' varieties and community developed medicinal plants are openly available in the fields and on the market. Usually, both public and company researchers have free access to genetic resources that communities preserve but without their consent. In most of the cases, materials accessed in such a manner enter into exchange agreements based on the principle of reciprocity between researchers or officials of public and private organizations or companies. The real owners of the materials, or the customary and custodianship rights of the local farmers and communities never come into the minds of all parties (Walter and Jeroen 1995).

On the other hand, breeding lines or propagating materials originating from freely accessed genetic materials, for example, are usually kept under restricted access or can only be accessed with the consent of those who made slight modifications to the original material. This is how national or international research institutes including genebanks have been operating up until now. Such disparity is one of the reasons why the principle that germplasm should freely be available for a scientific and breeding purpose remains still unresolved at the international level. Simultaneously however, it is recognized that the exclusion of the major stakeholders will eventually lead to increased erosion or loss of elements of biological diversity and related knowledge and management practices.

Consistent with the emerging recognition of protection of property and sovereign rights of a nation over genetic resources, some countries at present are in the process of developing rules about the rights and obligations of the parties involved in genetic resources transfer and use. In the process of developing such rules, it is essential that the objectives and provisions of the CBD, which are built on the principle that states have sovereign rights over their own biological resources, be strictly considered. CBD generally aims at the conservation of biological diversity, sustainable use of its components, and at the fair and equitable sharing of the benefits arising from the use of genetic resources. There are also certain loose provisions of the CBD that need adoption and implementation according to the national interest, but without violating the objectives of the Convention. For example, the stipulation made as to the objectives of formal IPR in the Convention Article 16(5) is not made for the sake of promoting the objectives of the collective rights of communities and to the empowering of the local communities with rights to conserve and benefit from conservation.

Obviously, there is room for improvement while implementing the Convention's provisions at national level. At the moment, there is an effort going on to create a strong complementarity of the CBD and other international instruments. As a follow-up to resolution 3 of the Nairobi final Act, negotiations are underway on the issues of *ex situ* collections not covered by the CBD and on the harmonization of the International Undertaking on Plant Genetic resources (IUPGR) with the CBD. There is also an ongoing effort to elaborate the provision of Article 8j of the Convention, which is a bit shy in addressing Farmers' and Community Rights explicitly (Regassa 1996).

Towards resolution

Opting for approaches that may keep reciprocities in balance and neutralize polarization of genetic resources related politics is indispensable. One of the optional approaches is sharing of responsibilities of custodianship, which may be effected through contributions to the process of genetic resources management tasks by rural communities that nurture the resources, and through compulsory support to improve their wellbeing.

Development systems and policies that do not consider the relationship between ecological systems, genetic diversity, and human culture may cause losses of resources and breakdown of functions of both ecological and social systems. Inequity in sharing costs and benefits of resource management may also result in the loss of traditional resource management practices and skills. Currently, it is

recognized that different components of biological diversity are threatened as a result of, *inter alia,* poor resource management, and environmental degradation. Appropriate government policy and regulation remain an important priority area of national action towards proper access and benefit sharing on plant genetic resources.

In accordance with the commitments made in Agenda 21 and the Convention on Biological Diversity, ensuring conservation of biological diversity and providing adequate rewards to those who contribute to the development and management of these resources rests with the national governments. However, many countries still do not have proper policy guidelines to promote and co-ordinate genetic resources conservation and development in conjunction with policies and development strategies in other sectors. Ownership rights and benefit sharing mechanisms and regulations for the movement of genetic resources into and out of these countries are still not in place. This has exposed the genetic resources of these countries to illegal access and has encouraged the introduction of unverified genetic materials, diseases, pests and weeds.

Reward or royalty payment systems such as patent and intellectual property rights regime, operating in highly commercialized and industrialized countries may not be applied under the conditions in most of the developing countries (Tewolde 1996), But still, innovations and technology development including the enhancement of diversity should be promoted and strengthened through mechanisms that are proper and applicable under the conditions of these countries. Under the conditions of the developing countries, it should also be recognized that formalized practices and knowledge in agriculture and health care system for example have their roots in informal practices, prior arts and knowledge. Practices and knowledge at the informal level always serve as basis for modifications and improvements. Under most of the developing countries' conditions for example, farmers' varieties offer multiple options, and still remain important sources of adapted genetic characters and diversity for formal breeding in the development of agricultural crops. Overlooking the interdependence of both formal and informal efforts in these countries may result in unnecessary and harmful gaps in the process of agricultural development.

In most of the developing countries, the farming communities play a major role in domesticating and developing varieties, and much of the existing diversity is still in their hands (Worede 1993). Traditionally, they select seeds for various traits and purposes and exchange seeds through traditionally established seed networking systems, and maintain genetic diversity as an essential component of socio-economic developments in their system. Their system also operates in a continuous process of managing, maintaining and developing genetic diversity as

part of community-based agricultural practices and knowledge system. The expansion of formal seeds in such farming systems is usually restricted due to diverse agro-ecological requirements that are marginal to the formal seeds. Thus large number of local communities still continue to depend on the traditional skills and products of their innovations such as varieties of their own and agronomic practices. In the health care system the larger portion of the population depends on traditional medicinal preparations and skills. Under such circumstances, threats to medicinal plant species and community know-how would therefore be equivalent to a threat posed onto the larger portion of the population that still depends on traditional medicine and knowledge.

Under the circumstances where agriculture and health care systems are still based on genetic diversity and traditional knowledge and skills, the objective of right protection regimes should base itself on approaches that strengthen life support systems. It should also meet the need to increase production, which is based on diverse and wide options. Introduction of IPR systems as stereo-copied from monoculture based agriculture to diversity-based agricultural production system may invite changes in the basic principles of countries' agricultural development by indirectly and directly enforcing monoculture production system. It may also be accompanied by IPR legislation that is normally backed by the combination of seed laws and additional policies that are usually set to promote farmers shift-over from their own diverse varieties to the monoculture varieties (Leskin and Flitner 1997).

Such IPR can only be applicable in the commercialized agriculture as a mechanism that usually contributes to the generations of new plant varieties for a specific group of farmers who can operate under more favorable conditions. This mechanism is not designed to support the breeding of varieties for resource-poor farmers or for production of varieties that are useful in the preservation and further generation of genetic diversity. Eventually, the incidence of stereo-copied IPR would be such that when farmers start to use protected varieties, their customary right of seed saving becomes a legal provision or even less a privilege. More over, such a legal provision may be subject to political decision-making and may also possibly be prone to restrictions as is already happening in some developing countries.

It is necessary that effective provisions appropriate to the conditions of a given country be in place to protect the role and interests of local communities, farmers and non-commercial researchers in their effort of maintaining, improving and promoting sustainable development and use of resources in the country. The basis for the provision should be such that resource use rights and accountability of all parties involved are equivocally addressed, and the overall national interest

is protected. The provisions should also have rooms to accommodate fair benefit sharing by all concerned, and should also be able to keep concerns in balance. There should also be effective legislative coverage and rewards for innovations and intellectual property of both formal and informal groups. In line with this, it is already a commitment that countries signatory to the CBD avoid restriction over practices of typical or customary uses of genetic resources that are part of the culture of local communities. In other words, the scope of IPR should be limited when it comes to the practices of local communities as part of their traditional or cultural heritage. This should include, for instance, the right to freely choose seeds and planting materials of their interest and also the freedom of using all harvested products for further production and sale.

To treat community intellectual rights and the IPR of the formal system on an equal footing, it is necessary to develop a kind of *sui generis* system that may depend to a large extent, on the country's economic situation, on its agricultural and industrial policy as well as on its over-all development strategy. Factors of significant effect on *sui generis* system may include the importance of agricultural exports, the state of the art in domestic plant breeding and health care system, the role of public and private research, the objectives and special needs of priority to the local communities. It is quite important for a developing country like Ethiopia whose economy is based on agriculture to consider the development of *sui generis* system outside the trade oriented IPR legislation. Such *sui generis* should include community intellectual rights that reflect the cultural and socio-economic values of community systems, and should also be supportive of custodianship and customary rights over resources and local innovations.

The *sui generis* system should also contain provisions to protect free exchange of resources and knowledge among communities, and obligations to pay a royalty by any other person or organization that commercially utilizes community resources and innovations. It should also avoid interference with established or emerging principles of traditional resource rights, and local community needs and priorities. Inclusion of elements such as benefit sharing into the system should be considered as one of the strategies to promote agricultural development and community health care system, including environment friendly practices of development in all sectors. Such an approach should also serve as a tool or trigger to facilitate a system of incentives for informal innovators.

Recognition of resource ownership and use rights as well as royalties for the works done should serve as mechanisms for incentives to support the increased input of groups or individuals towards the promotion of agricultural productivity and the health care system on the one hand, and as a mechanism to regulate bio-piracy on the other. The principle of benefit sharing should include facilitation of

the management and maintenance of traditional resources such as genetic diversity in farmers' varieties (The crucible group 1994). The provision of rewards should consider the past, present and future collective and individual contribution and cultural practices in the conservation and development of biological diversity.

The rationales for regulatory mechanisms

Local communities have always lived with diversity and with intimate connections to custodial and management responsibilities for land and species diversity. Such traditional practices and outlooks persist in many parts of the world. Despite the poor recognition of their knowledge, local communities through their cultures maintain a strong interest in the wellbeing of land and natural systems. If they are to continue to do so, they should be rewarded and supported for their contributions.

Complementarity of formal and informal efforts in the management of biodiversity and in the enhancement of its components is essential. Recognition of those who are involved in the process is necessary for promoting the development of new elements and options. In the context of countries such as Ethiopia, resolution of access to genetic resources under patent and other existingsimilar intellectual property right mechanisms may disrupt the existing genetic resources development systems. This may happen due to lack of fairness of these right systems during their practical application. Similarly, it may not be possible to provide economic, social and cultural benefits and incentives for local communities in order to continue conservation of biological resources. It may also hamper the generation of new traditional knowledge and skills.

Farmers' varieties have multiple values and are the basis for the formal crop improvement efforts. Thus there is no grounds that Breeders' and Farmers' Rights can stand in controversy in the context of agricultural systems of countries such as Ethiopia. Instead, the Breeders Rights should contain provisions for rewarding the innovations and contributions of farming communities for conserving and maintaining diversity on-farm and in their gardens. Protection of varieties should be used not as a mechanism to restrict the flow of the varieties of farmers and breeders' in either way. The system of the rights at national level should also ensure the retention of the breeders and other researchers talent through an appropriate reward mechanism.

There should be sound measures for monitoring, controlling and facilitating movement and exchange of genetic resources and related information and technologies. Mechanisms for controlling excessive exploitation of the

components of biological diversity and for penalizing unauthorized collection of germplasm by individuals, groups and organizations/institutions (national or international) should be in place. The measures developed should also be consistent with environmental requirements, prior informed consent and local community needs and culture. The use of traditional knowledge in scientific, commercial and public domains should be effected through prior informed consent, with the will and co-operation of the communities. Mechanisms should also be in place for the development, use and safeguarding of traditional knowledge particularly, with regard to commercial products resulting from the use of traditional knowledge.

Access to genetic resources should be governed by a mechanism that reaffirms the sovereignty of the countries' over their genetic resources and the rights of farming and local communities. The mechanism should also ensure equitable sharing of benefits arising from the utilization of such resources with a view to promote conservation and sustainable utilization of biological diversity in accordance with the objectives of the Convention on Biological Diversity.

Unlike most of the existing IPR systems, which because of their nature of interest can not serve as instruments to facilitate conservation of biological diversity, or to promote sustainable use of its components, the *sui generis* system to be developed should enable effective resource management and exploitation. The system should consider the potential impacts of its interdependent elements on resource management and the sustainable use of it. It should also address the protection of collective and individual rights, as well as the over all development of the process of sovereign interest. In addition, the process of implementation of *sui generis* rights should be such that it is open ended for improvements, in order to counterbalance the unforeseen negative side effects through modification of the scope of the effect of the system of rights or by adding other supportive measures.

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Intellectual Property Protection and Technology Transfer: Emerging Issues

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Introduction

The concept of intellectual property and technology transfer is very broad and complex. The issues of intellectual property and technology transfer related to bio-diversity are also diverse and difficult. It will thus be impossible to deal with the concept in depth, and raise the various issues in this short paper. Attempts will only be made to briefly define or describe the concepts and to give a bird's eye view on some of the issues that the writer considers basic.

Intellectual property rights protection and biological resources.

Intellectual property refers to legal rights over the creation of the human mind. It consists of three major elements, namely, copy rights, industrial property rights and plant breeder's rights. In this paper, we will only focus on patents and plant breeder's rights and their implications for biological resources and developing countries.

Patent protection

A patent is defined, in a document prepared by the World Intellectual Property Organization, as a legally enforceable right granted by law to a person, to exclude others from certain acts related to a described new invention for a limited period of time.

For an invention to be patented, it must meet the criteria of patentability, *viz*, novelty, inventive steps and industrial applicability. These criteria, which are found in almost all patent laws, are incorporated in article 3 of the Ethiopian patent law (TGE, 1995). An invention is considered new if it does not form part of the state of the art, which is the sum total of knowledge made available to the public in any form in any part of the world, before the filing date of the patent application. An invention is deemed to involve an inventive step where having regard to the prior state of the art, it is not obvious to a person having an ordinary skill in the art. That is, the invention must bring in a technological advance over the prior knowledge. The industrial applicability requirement refers to the fact that the invention must be more than an abstract theory and that it can be put into practice.

The fact that the three criteria of patentability are met is not enough for granting a patent. The invention should not also fall into the category of excluded subject matters. An example is what is provided in article 4 of the Ethiopian patent law (TGE, 1995).

Patent laws list what should or should not be considered patentable subject matters. The exclusion might be based on the nature of the subject matter itself or public policy considerations. Examples of excluded subject matters are plants or animal varieties. To date most patent laws, known to the writer, exclude plant and animals or plant and animal varieties from patentable subject matters. However, there are some countries, which recognize patentablity of life forms. These countries include USA and Japan. In these countries anything under the sun will be patentable so long as it is the creation of mankind. In USA, for instance, microorganisms such as a genetically engineered bacteria strain, plants such as a corn plant containing an increased level of a particular amino acid, and animals such as a mouse carrying a human cancer gene were patented in 1980, 1985 and 1988 respectively. In Diamond V. Charkabarty, where the US Supreme Court decided that a genetically engineered bacteria is patentable, the courtstated that the basis of patentability is not whether an invention involves a living matter but whether it involves human made inventions.

The European Union, after long and intense debate, also approved a directive in 1998 that recognized the patentability of life forms (European Union, 1998).

These countries are free to recognize the patentablity of life forms with in their jurisdiction. What is amazing, however, is that the countries have been striving hard to ensure the patentablity of life forms worldwide. The linkage of intellectual property to international trade during the 1986 Uruguay Round was a reflection of such an effort (G.Tansey, 1988)

The patentability of life forms will, if recognized, have serious implications in particular to developing countries. This may be elucidated by looking at the following two examples:

1) Developing countries will be required to obtain a license and apay royalty fee to acquire a technology developed using their own genetic resources. Moreover, the patented bio-technological products often require the use of specific input thereby worsening the financial burden of developing countries. For example, Funk Seed international, a subsidiary of Ciba-Geigy, accessed freely a sorghum variety from Sudan and developed a new sorghum seed covered by a patented protective capsule called '' safner''. The purpose of the

capsule was to make the seed respond ony to a herbicide developed by Ciba-Geigy (Johnston and Sasson, 1986). Sudan will thus have to pay for the use of the improved sorghum developed using its own resource. Furthermore, the cost will be high, for the use of the seed requires the use of a specific herbicide.

2) Patent protection is given not only to processes but also products. The patentee has the right to claim not only the originally patented materials but also the derivatives and characteristics of the original plant. As a result farmers may not use or sell plants containing patented genes and have to pay additional royalty fees for seeds that they themselves have harvested (Choplin, 1989). Tansey explained that small farmers will lose control of their seeds and reap no rewards for the breeding work they have done over generations, and that seed production will be dominated by seed companies using varieties containing patented genes and they will have to pay royalties for reusing seed crops grown by themselves (G. Tansey, 1988).

Plant breeders' rights

Plant breeders' rights protection is a form of protection tailored to protect new plant varieties. A variety is defined, under article 1 of the 1991 international convention for the protection of new varieties of plants, as a plant grouping within a single botanical taxon of the lowest known rank, of which the grouping can be;

- identified by the expression of the characteristics resulting from a given genotype or combination of genotypes;
- distinguished from any other plant grouping by the expression of at least one of the said characteristics; and
- considered as a unit with regard to its suitability for being propagated unchanged.

In order for a plant variety to be protected, it is required to be new, distinct, uniform and stable (UPOV, 1991). The plant variety must be:

1) New, in that the variety must not be previously commercialized. The availability to the public of mere information or of a description of the variety will not defeat its novelty.
2) Distinct, in the sense that it must be clearly distinguishable by one or more important characteristics from any other variety known at the time of application for protection.
3) Uniform, in that it must be homogenous having regard to the particular features of its sexual reproduction or vegetative propagation. The degree of

uniformity is determined taking into account the particular features of the variety's propagation, and
4) Stable, in the sense that it must be reproducible unchanged in its essential characteristics.

When a variety fulfills these requirements, a plant breeder's right will be granted to the breeder.

The scope of the right of the breeder, defined by plant variety protection acts modeled after the 1978 UPOV convention, is limited to the commercialization of the reproductive material of the variety. Unlike patent protection, the right does not extend to the farmer's use of a seed from previous harvest. This was known as "farmers' privilege". Furthermore, the right does not deprive free use of the variety as a plant genetic resource for the purpose of breeding other varieties, which was known as "plant breeders privilege or exemption". However, the plant variety protection based on the 1978 UPOV convention was criticized as weak.

In order to strengthen protection, the convention was amended in 1991. The revised convention, amongst others, has:

1) Broadened the scope of protection to all plant genera and species.
2) Extended the scope of the right from controlling the marketing of the reproductive material and production of such material for marketing to all production and reproduction of the variety. It, however, recognizes that member states may provide as an exemption traditional forms of saving on the farm. This restricts what had been known as "farmers privileges". Farmers may only use the seed they harvested from their own holdings. The exemption excludes exchange of seeds. Such restrictions are not in line with the needs of farmers, especially in developing countries, who traditionally rely on free and regular exchange of seeds (Dan Leskien *et al.*, 1997).
3) Extended protection to harvested material when there is no reward from the exploitation of a protected variety.
4) Provision that varieties, which are "essentially derived" from a protected variety should not be exploited without the authorization of the breeder of the prior protected variety. This will deny breeders the privilege they enjoyed under the 1978 convention. Under this convention, a protected variety can be slightly modified and exploited without requiring the authorization of the earlier breeder so long as the modified variety is distinct from the protected variety.

The table below summarizes the differences between the 1978 and 1991 conventions. (IDRC, 1994).

Provisions	UPOV 1978	UPOV 1991
Protection coverage	Plant varieties of nationally defined species	Plant varieties of all general species
Requirements for protection	• Distinctness • Uniformity • Stability	• Novelty • Distinctness • Uniformity • Stability
Term of protection	Minimum 15 years	Minimum 20 years
Scope of protection	Commercial use of reproductive material of the variety	Commercial use of all material of the variety
Breeders' exemption	Yes	Not for essentially derived varieties
Farmers' privilege	Yes	No. Up to national law
Prohibition of double protection	Any species eligible for PBR protection can not be patented	--------

It may be concluded that the revised convention has strengthened plant variety protection and made it patentable.

Both the plant variety protection and the patent protection, which evolved and developed in the North, helped to protect the rights of breeders and inventors over improved varieties. However, they failed to recognize any rights with respect to source plant materials such as land races and varieties, as well as the accompanying knowledge, skill and innovation of farmers and local communities of the south.

International intellectual property protection agreements

There are various international treaties and conventions concluded by states to govern intellectual property protection. In this paper, attempts will be made to discuss only two conventions:- the agreement on Trade Related Aspects of Intellectual Property Rights and The Convention on Bio-Diversity, which the writer deemed to be relevant for the subject at hand.

The agreement of trade related aspects of intellectual property (TRIPS Agreement)

The TRIPS agreement, which forms part of the world trade agreement was signed on 15 April, 1994 in Marakashi and came into effect on 1 January 1995 (For details, see M. Blankeny, 1996).

The agreement, *interalia,* tries to:

1) harmonize intellectual property rights protection by providing with the minimum standards that should be adopted by member states, and
2) enhance and broaden the scope of protection of intellectual property rights. The agreement broadened the scope of patent protection, under article 27, by providing that protection should be made available for any invention, whether products or processes, in all fields of technology (WTO, 1994).

It tries to strengthen intellectual property protection such as a patent by:

1) reducing the impact of the various restrictions and safeguards which were used to be incorporated by national laws to protect the public interest and control abuse of a right by the patentee;
2) expanding the duration for patent protection to 20 years,and
3) prohibiting the imposition of the obligation to work inventions and permitting exploitation of inventions through importation etc..

These can be deduced by looking at articles such as articles 31 and 33 of the TRIPs agreement (WTO, 1994).

The provisions of the agreement, when implemented, will have adverse impacts on developing countries as well as on the conservation and sustainable use of biological resources.

This may be elucidated by looking at article 27(3)(b). This provision states "... members shall provide for the protection of plant varieties either by patents or by an effective *sui-generis* system or by any combination thereof". As per this provision, member states will have the obligation to:

1) patent plant variety, or
2) protect plant variety by suigeneris system (an independent system or a system of its own), or
3) protect plant variety both by patent and an effective *sui-generis* system.

An "effective *sui- generis* system" is not defined in the agreement but some writers (Grain, eds. 1997, Dan Leskien, *et al.,* 1997) have explained the concept.

However, one thing is clear. Members have a duty to provide for some form of intellectual property rights protection for new plant varieties.

Before TRIPS, countries were free to protect and recognize, or not to protect and recognize, intellectual property rights. Moreover, they were free to exclude some from protection and to design their intellectual property rights system in the way they wanted. This right and freedom has been denied by TRIPs. There is a duty to adopt the minimum standards that are lopsided in favour of the right holder. The agreement will reduce developing countries to protectors of the lucrative intellectual property rights of a few multinational companies and citizens of the north. The south, with their meager resources will suffer the negative consequences of intellectual property right protection.

The Convention on Biodiversity

The Convention on Biological Diversity (CBD) is a legally binding agreement signed at the Rio Earth Summit of 1992. More than 176 countries including Ethiopia are party to the Convention.

The objectives of CBD are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising from the use of the resources.

The Convention provides that Intellectual Property Rights (IPRs) will be recognized and observed by the contracting parties.

However, Article 16(5) requires parties to cooperate to ensure that intellectual property rights do not run counter to the objectives of the convention. IPRs in their current form, which are granted to new inventions and plant varieties, have a tendency to lead to uniformity and loss of diversity contrary to the underlying purpose of the convention.

The exercise of IPR may also defeat the objectives of the convention, namely conservation and sustainable use of biological diversity and equitable sharing of benefits. The existing IPRs which disregard the contributions made by local people, misappropriate their knowledge etc. are in equitable. Since this provision can be invoked so as not to recognize intellectual property rights in certain circumstances, there is a fear in the advanced countries that this would weaken intellectual property protection.

It is therefore proposed by the US unofficial interpretative statement that the article should be read as not altering the obligation of contracting parties to ensure

the use of terms that recognize and are consistent with the adequate and effective protection of intellectual propertyrights (United states, 1993).

This interpretation disregards the fact that the exercise of intellectual property rights may in some cases defeat the objectives of the convention, namely, conservation and sustainable use of bio-diversity and equitable sharing of benefits.

Moreover, the intellectual property rights in their current form, which are granted to new inventions and varieties, have a tendency to lead to uniformity and loss of diversity contrary to the underlying purpose of the convention.

There is a conflict between the obligations of states in TRIPs and CBD. Developing countries may make use of this conflict and seek the deletion of the provision of Article 27(3) (b) which imposes the obligation to protect plant varieties during the review of the article.

Technology transfer

Technology may be defined as "the skill, knowledge and procedure for making, using and doing useful things" (F. Stewart, 1977). The introduction or use of the technology from the place where it originated to another place or purpose is known as transfer of technology (F. Stewart, 1979).

In this paper, the concept of technology transfer will be limited to the transfer of technology across national boundaries and further confined to that which takes place between the North and the South.

In technology transfer between the North and the South, the North is often considered as the sole source and provider of technology and the south as recipient of technology and provider of raw materials. Furthermore, intellectual property protection is usually considered as a prerequisite for the transfer of technology from the North. In this paper we will set aside the various issues involved in technology transfer and concentrate with two issues; namely - Intellectual property protection and the erroneous perceptions of technology transfer and technology.

In the unofficial interpretation of the convention on bio-diversity by the USA, it has been said that:

Conservation and sustainable use of bio-diversity cannot effectively occur without transfer of technology to developing countries. Participation by the private sector

is essential. However, the private sector will not transfer proprietary technology or invest in developing countries without a favorable investment climate. This includes the adequate and effective protection of intellectual property (United states, 1993).

Technology transfer is always used as grounds to justify intellectual property protection. The statement and the justification, however, seem to be based on a number of wrong assumptions. They assume that:

1) there is a direct linkage between intellectual property right protection and technology transfer;
2) technology owners will part with their technology if their rights are protected, and that
3) there is technological capability to adopt and assimilate the transferred technology in the technology receiving country, etc.

Studies revealed that there is no direct linkage between the transfer of technology and intellectual property protection. Owners of technology often seek protection in countries that have lucrative market or have the capacity to imitate and copy the technology. Where either of the two are absent, technology owners will not seek protection even when there is intellectual property rights protection. Technology owners commonly resort to transfer their technology to countries that promise generation of profit even when there may not be adequate and effective protection for their intellectual property rights. Pharmaceutical technologies, for instance, were transferred to India when Indian patent law excluded pharmaceutical products from patent protection.

In addition some studies revealed that the technology owners and suppliers are reluctant to part with scientific principles and core knowledge to the recipient, for fear of creating a potential competitor. Instead they strive to create and strengthen dependent relationship so as to ensure their profit making and maximization objectives.

The effective transfer of technology requires indigenous capability to assimilate, adapt and improve the acquired technology (Mytelka, 1985). This capability is weak in developing countries and recognition of intellectual property will not help to improve this capability.

The other basic problem that we often encounter in technology transfer relates to the erroneous perception that the North is the sole source and provider of technology and the non-recognition of local knowledge and skill of the South as technology.

Bio-technological inventions, which the North is proud of and seeking for protection, are based on the biological resources that have been kept for generations and developed by local knowledge and innovations of the South. Nevertheless, these are not considered as technologies, and their acquisition as not involving the transfer of technology but raw materials and the access as access to resources. These erroneous perceptions might be caused as a result of lack of a scheme that enables the recognition and protection of local community achievements.

In the opinion of the writer, transfer of technology should be considered a two-way phenomenon and the terms and conditions should likewise be the same. Moreover, the South, instead of wasting its resources on protecting the lucrative intellectual property rights of the north in the pretext of facilitating technology transfer, should concentrate on the building up of indigenous technological capability and improving the bio-technology it already has. Efforts should also be made to design a scheme to ensure the recognition and protection of local knowledge and to use it as a bargaining chip in seeking similar terms and conditions in the exchange of technology.

Conclusion

The issues of technology transfer and intellectual property are complicated. There is thus a strong need to undertake a comprehensive and detailed study and come up with well developed and reasoned out proposals. Moreover, it is essential to develop an alternative to the existing intellectual property rights protection over life forms and establish a mechanism that will minimize the adverse effects thereof.

It is high time there was a scheme for the recognition and protection of local communities over their knowledge, innovations and achievements. Concerted efforts should also be made to promote South-South cooperation. Such cooperation will help to secure and rectify the erroneous perception of technology transfer and the recognition of the knowledge, innovation and practices of the communities of the south.

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Study on Traditional Medicine, the Case of Endod and others: Cultivation, Application and Health Improvement

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Introducation

The molluscicidal property of Endod was discovered in 1964 by Aklilu Lemma. Since 1965 much interest has been generated in Endod by the scientific community, both nationally and internationally.

Schistosomiasis affects an estimated 200 million people in the tropics and subtropics. It is spreading as a consequence of increased development of Wetlands and irrigated lands for agriculture. In Ethiopia, the disease appears to spread also as a result of replacement of the traditional Endod soap by synthetic soap partly in response to the disappearance of many Endod bushes that were growing wild following deforestation and expansion of agricultural land. Many Endod bushes were chopped down and/or dried out during the droughts in 1973/74 and 1984/85.

It is therefore important to preserve the genetic variation that is still available, and launch a breeding/conserving program in the hope of achieving cultivar characterized by high berry and saponin yields, pest resistance and that is more adapted to Ethiopian lowland growth conditions, where schistosomiasis is endemic.

The genetic variation of Endod is presently under investigation using molecular techniques and may provide useful information for Endod conservation and breeding programs. This goes also for those endangered medicinal plant-species. For example, the *H. abyssinica* species was once abundant in the semi-humid mountain woodlands of Ethiopia with an altitudinal range of between 2,450 and 3,250 m.a.s.l.

Presently, the species is sparsely distributed in parts of Bale, Sidammo, Kaffa Harrarghe, Arssi, Gojjam, Wello, Gonder, Tigray, Shewa and Wellega (Legesse 1995). In traditional Ethiopia, the female flower of *H.abyssinica* (Kosso) is used for treating tapeworm (Lamordant 1972). According to *Berhanu Abegaz* and *Ermias Dagne (*Berhanu and Ermias 1978*) Kosins* (Kosso) exhibit comparable potency with the marketed drugs *Dichlorophane* and *Niclosamid* (Edemariam *et al.* 1978).

Due to the great demand for its timber, regeneration of the tree has become almost impossible as a result of widespread human interference and probably also as a result of climatic changes of the natural habitat. Therefore, active intervention measures including propagation endeavors have to be taken to put the tree back in those regions where it used to grow well.

Since the early 1930s, several plant species have been tested for molluscicidal activity (Daliziel 1936, Harlan 1969, Humbert 1971, Hutchinson & Daliziel 1929, and Kloos and McCullough 1987). Few, however, have proven to have the characteristics necessary for widespread use: low toxicity, water soluble, common, easy to cultivate, and consistently high molluscicidal potency (Legesse and Kloos 1989).

If other uses could be found for these few species their value would increase (Adams 1986; Legesse Wolde-Yohannes et al. 1986; Kloos and McCullough 1987; Legesse Wolde-Yohannes and Kloos 1989).

For several reasons, including; high toxicity for non-target organisms; the active principle being present in a non-regenerating part of the plant; slow growth etc; only a few are considered promising today. However, in 1986 at a special WHO expert meeting on plant molluscicides, where the potentials of over 1000 different species of plants were assessed by an independent group, Endod was found to be the most promising and most extensively studied of all plant molluscicides known up to then. Endod, a natural molluscicide, is biodegradable; its active principle decomposes rapidly, breaking down to inert and non-harmful material within a few days (Legesse 1970, Lambert *et.al.* 1991, Lamordant 1972, Legesse & Kloos 1989, UNFSSTD/IDRC 1986).

Commercially available chemical molluscicides are expensive in view of the large quantities required for control programs on a regular basis and currency constraints faced by developing countries (Lambert *et al.* 1985). Compounds, such as copper sulphate and sodium pentachlorphinate, have been used as molluscicides for many decades in Egypt, the Sudan, and other parts of the world to control schistosomiasis.

Recently, however, the niclosamide (bayluscid), has been found to be more effective and is currently the only synthetic molluscicide recommended by the World Health Organization (WHO) for global use. Mainly because of its high cost (26 000 USD/t in 1974), most developing countries, especially those in Africa, are not using it to control schistosomiasis. There is also an effective

chemotherapy for the victims of schistosomiasis, but the cost of treatment is beyond reach in many cases. Meanwhile, many well-intentioned agricultural development and water conservation schemes are providing more sites for snails to breed, and schistosomiasis is spreading rapidly (Lambert *et.al* 1985, Legesse & Kloos 1989, UNFSSTD/IDRC 1986).

In 1964 while making an ecological study on the distribution of the aquatic snails which transmit the disease schistosomiasis in the Northern Ethiopian town of Adwa, Aklilu Lemma observed more dead snails down stream from areas where people were washing with Endod than in any other stretch of water, including areas where commercial soap was being used (Lemma 1965, Lemma & Wolde Yohannes 1989).

This simple observation led to over 30 years of extensive scientific work conducted on Endod; mainly in the Institute of Pathobiology, on its chemistry, its agrobotany, its molluscicidal and other properties, which has now led to numerous international assessments and conclusions of its potential uses for the control of schistosomiasis on a community self-help-basis (Right Livelihood Award Press Release 1989). The cost of producing an Endod molluscicide, which could be safely handled by local people in communities at risk, has been estimated in the range of US # 0.25 per person per year (Lemma & Wolde Yohannes 1989, Legesse 1989).

Germplasm collection

Between 1972 and 1976 more than 500 samples of Endod germplasm in the form of hardwood cuttings and/or berries were collected at various agroecological zones in Ethiopia and screened on the basis of growth characteristics and molluscicidal effects by the Institute of Pathobiology, Addis Ababa University (Lugt 1981; Legesse *et.al* 1986; Legesse and Kloos 1989; Lemma 1970; Lemma & Yau 1974; Makhubu *et.al* 1986; Matsumura 1975; Lemma *et.al.* 1979). All of these were from altitudes ranging between 1600 and 3000 meters above sea level. Among an initial selection of 65 ecotypes, three strains labeled type 3, 17, and 44, were selected for better growth performance and molluscicidal potency, berry yield and resistance to pests and drought than the other ecotypes. The three types are morphologically characterized by: Type 3 - leaf base ovate, wide leaves, somewhat viney habit, small amount of pubescence on leaves; Type 17 - leaf base acute, lanceolate leaves, somewhat viney habit, no pubescence on leaves; Type 44 - leaf base cordate, wide leaves, shrubby habit, very pubescent leaves. Among these three, type 44 has been found the best in terms of growth habit, berry and

saponin yields; hence it is selected as the standard type for agronomic molluscicidal, toxicological and field application studies (Legesse & Kloos 1989, Legesse 1970).

Propagation

Endod can be propagated either by seeds or cuttings. Propagation by seeds will result in an equal chance of producing male (non-bearer) and female (bearer) plants. The sex of individual plants can be distinguished only during flowering time after about two years. (Research is in progress to find sex-linked molecular markers for early identification of the sex of individual plants). In addition, the germination of seeds obtained from wild type is limited due to a dormancy problem although it may be improved by surface scarification of the seeds (Legesse & Kloos 1989, Demeke *et.al.* 1992, Demeke & Hughes 1990). Storage of berries up to 1 year did not affect germination rates of the seeds but rates declined by 14% after 4 years of storage (Legesse, 1983 Legesse and Kloos 1989, Ndamba, 1993). Plants derived from both seeds and cuttings are being propagated in Ethiopia, Zambia, Swaziland and Zimbabwe.

The first report on tissue culture of P.dodecandra was by Adams and Balandrin (Adams 1986, Legesse 1983) and a procedure for routine micropropagation of Endod by shoot-tip and nodal culture was described by Demeke and Hughes (Demeke and Hughes 1990, Demeke *et.al.* 1992). A few type 44 plants that have been derived from tissue culture by Adams and Balandrin were planted in our experimental plot in Addis Ababa. These plants took more than two years for first fruiting but the berry yield and molluscicidal potency of berries of such plants are comparable to the mother plants from which the tissue cultures were initiated. Demeke and Hughes (Demeke and Hughes 1990), however, reported that staminate clones regenerated by shoot-tip and nodal cultures flowered six months after transplantation in greenhouse conditions. Currently, production and molluscicidal studies are based on plant materials that are clonal propagated by cuttings. Good percentage of rooted cuttings can be obtained from hardwood cuttings obtained either from apical or medial region of the bush with or without treatment by plant growth regulators. Unlike propgation by seeds which results in heterogenous individuals that reach flowering in about 2 years time, genetically uniform plants that will flower within about 6 months can be obtained by cuttings. In cases where there is a need to use plant growth regulator (PGRs), vigrous stem cuttings that contained 2-3 internode can be treated with either powder or solution of indole-3-acetic acid (AA). Indole-3-butyric acid (IBA) or naphthalin acetic acid (NAA) and planted in a mixture of peat and soil. Results indicated that the percentage and number or roots per cuttings increased as the concentration of PGRs increase (Demeke *et al.* 1992).

Field cultivation

Rooted cuttings are usually transplanted after 6 weeks at the beginning of the rainy season (June-July). The proportion of male and female rooted cuttings during transplantation is 1:10, respectively. Survival of transplants depends on:

1) the ease availability of ground water in dry season;
2) control of pests such as insect larvae and nematodes, and
3) tolerance to sun burn and salt.

Better survival and growth performance is obtained when transplantation is done close to relatively wet areas rather than very dry areas because the roots of those transplanted close to wet areas will be more likely to reach ground water before the end of the rain than those transplanted to very dry areas. Although old Endod plants can be found on dry hills, the establishment of rooted cuttings is only sucessful on such sites if the plants are irrigated the first one-year. We assume that old plants found on dry sites may have been established during a pastecological period prior to deforestation. If irrigation facilities are available transplantation can be done at any time of the year (Legesse & Kloos 1989). However, Ndamba (Nmbada 1993) reported lower saponin concentration of berries harvested from irrigated plants than from non-irrigated Endod plants cultivated in Zimbabwe. To our knowledge, saponin concentration for both irrigated and unirrigated plants will not be different as far as it is estimated from dry berries rather than from fresh berries (Wolde-Yohannes & Kloos 1989) Endod plants are often attacked by pests. The larvae of *Gitona* spp. is a stem-borer that has been found to several attack both stems and racemes. The main symptom of infestation by this larva is the wilting or drying of young shoots and the abortion of berry set. When raceme buds are attacked they will simply dry before flowering but when the raceme is attacked at or after flowering, false berry like swollen mass will be produced which, in some cases, may significantly reduce berry yield. Attack of racemes and stems by such larvae might be minimized by spraying 0.1-0.2% Lebycide emulsion whenever there is a sign of infestation (Legesse & Kloos 1989).

Endod plants have very soft shoots and are unable to tolerate direct exposure to strong sunlight. Infact the plant growth is best when it gets partial shade fromother bushes/trees than when it is transplanted directlyin an exposed field. This is one of the limitations in cultivating Endod plants at lower elevations where schistosomiasis is endemic. However, cultivation under more shade may substantially lower berry yield and saponin concentration compared to full sunlight (Ndamba 1993).

Economic considerations with respect to future production possibilities require the berry yield factor to be studied. Factors that have limiting effects on berry yield include spacing, bush size, additional nutrients requirements and the type of mother plant. Endod plants have a bushy and trailing growth habit. This necessitates consideration of spacing and training. Spacing is related to the volume of berry yield per unit area of land and ease of cultivation activities such as weeding, pruning, harvesting, and potentially intercropping, especially if peasant farmers are involved in the production. A spacing of 2 meters between plants (equivalent to 5000 plants per hectare) has been found to give satisfactory results for small bushes. (Legesse 1983, Legesse *et.al.* 1988, Takie and Legesse 1979).

Intercropping is the growing of two or more crops simultaneously on the same field. If intercropping is going to be practiced spacing transplantation will be made at least 3 meters between rows.

The advantages of intercropping Endod with annual crops, especially legumes and vegetables, are:

1) increased productivity;
2) better use of available resources such as land, water and nutrients; and
3) reduction in damage caused by pests.

Preliminary results indicate that horse beans, potatoes, carrots and head cabbages grow between the rows without substantial yield reduction of both Endod and the intercrops. The ability of Endod plants to develop a few number of deep tap roots within a short period of time encourages annual intercrops to get all accessible nutrients from the surface of the soil more easily. The development of deep tap-roots should not be restricted by hardpans in the soil. Furthermore, the attack of *Gitona* larvae was observed to decrease when Endod was intercropped with horse bean than planted alone as a sole crop. It is generally believed that such a practice is indispensable especially for peasant farmers with limited land holdings (Legesse & Kloos 1989, Legesse 1983).

Berry harvest

Harvesting of berries is a labor intensive process which does not lend itself ammenable to harvesting by machines. (Mechele 1992). The berries on a plant mature at different times. Mature green Endod berries can be harvested by hand every 2 weeks between November and March until all berries have been collected.

They should be air-dried before being stored. Ripe berries have not only lower potency but are also more difficult to harvest and are eaten by birds. The total annual yield of berries of the three tested types of Endod increased over a 4 year period, especially between the first and third harvest, reflecting the growth and maturation of bushes. The dry berry yield recorded four years after establishment was 1850,1047 and 2750kg/ha E3, E17 and E44, respectively, with saponin yield of approximately 25% (Legesse & Kloos 1989, Legesse *et.al.*1992). Berry yield starting 6 months after planting two months old rooted cuttings increased from about 240 to 600 g/plant equivalent to 1200 to 3000 kg/ha. The berry yield of Endod type 44 appears to be superior in all the regions observed. Yield figures for type 44 in Ethiopia are apparently much higher than those reported from Swaziland, Zimbabwe and Zambia (Legesse & Kloos 1989).

Results of the first longitudinal studies on the cultivation, yield and molluscicidal potency of Endod types 3, 17 and 44 indicate that they can be cultivated successfully and that type 44 is the most suitable for schistosomiasis control and detergent production (Legesse & Kloos 1989).

Molluscicidal saponin and field efficacy testing

The molluscicidal property of Endod has been studied over the last 30 years at the Institute of Pathobiology, Addis Ababa University, the Tropical Products Institute in London, the Stanford Research Institute in California, the G.W. Hooper Foundation at the University of California, the Harvard School of Public Health in Boston, the Public Health Service Laboratory and Field Station in Puerto Rico, the US Naval Medical Research Unit in Cairo, Carleton University in Ottawa Canada, and in other laboratories in different parts of the world, (Kloos and McCullough 1987, Kloos *et.al.* 1987, Kloos 1974, Lambert *et.al.* 1985, Legesse *et.al.*1992, Strelcyn 1973).

More than 100 scientific papers have been published directly or indirectly on the subject of the relationship between Endod and schistosomiasis. Books on Endod, workshop proceedings and a handbook were published. Chemical studies to isolate and identify the active principle in Endod berries led to the discovery of a new compound, oleanolic acid glucoside, which Stanford Research Institute's chemists have named Lemmatoxin (Parkhurst *et al.* 1974). Mature green berries contain the highest concentration of molluscicidal saponins (Table 1). Newly harvested and air dried type 44 berries in powder form kill 100% of *Biomphalaria pfeifferi* snails exposed to cold-water extracted concentration of 5 ppm for 24 hours at room temperature.

Table 1: Concentration of dried berry material added to water to give 100% mortality rate using *Biomphalaria pfeifferi* as a test organism

Harvesting Stage	Concentration (mg/l)
Flower buds	50
Flower	25
Early green Berries	10
Late green	5
Ripe berries	50
Over Ripe berries	75

Molluscicidal tests indicated that type 44 is most active, achieving 100% kill of *B.pfeifferi* at 5 ppm for newly harvested berries and 4-year old berry powder gave 100% mortality at 7.5 ppm (Table 2). Concentrations of 10 ppm were required for Type 3 and 17 to kill all snails. Since the dry-weight molluscicidal saponin portion is about 25%, 750 kg of saponin may be harvested annually from type 44. This is sufficient to treat 275,000 m^3 of water at 10 ppm in one application or the water used in a 20,000 ha irrigation scheme twice a year.

Table 2: Molluscicidal potency of Endod berries (fresh and after 1 and 4 years of storage) from three genotypes (T3, 17 and 44).

	Percent potency*								
Concentration	Fresh			1 Year			4 Years		
(ppm)	T3	17	44	T3	17	44	T3	17	44
10.0	100	100	100	100	100	100	100	100	100
7.5	60	20	100	60	60	100	0	0	10
5.0	0	0	100	0	0	60	0	0	0
4.0	0	0	30	0	0	20	0	0	0
CONTROL	0	0	0	0	0	0	0	0	0

*dead snails

This means that to treat the water needed for 1 hectare of irrigated sugar cane, only 4 m^2 of Endod plantation would be required (Legesse & Kloos 1989; Lugt 1981).

The non-molluscicidal bidesmosidic saponins are confined to the pericarp. But it is converted to nighly molluscicidal monodesmosidic saponins only after hydrolysis by an enzyme released from the seed (Legesse *et.al* 1992, Parkhurst et al. 1974). Such conversion of the inactive form to active form is enhanced by using ground seeds. The natural ratio of pericarp/seeds for E44 is 62% (Legesse *et.al.* 1992) further increasing the molluscicide yield of the Endod type (Legesse 1983, Legesse *et.al.* 1992) is possible through preparation of pericarp to seed 3:1 ratio (Legesse *et.al.* 1992).

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Prospects of Medicinal Plant Cultivation in Ethiopia

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Introduction

Medicinal plants, the major ingredients of traditional medicine, contribute considerably to the development of modern medicine in a number of ways. They can be used either as major components, or as supplementary starting material for the manufacturing of modern medicine. The progress in synthetic chemistry and biotechnology has not decreased the importance of medicinal plants. In some cases it has even increased the importance, due to the danger of side effects of synthetic products. As to the current market assessment of the $100 billion of plant-derived chemicals, pharmaceutical products take the major share (OECD 1992). The developed Nations have been estimated to spend about $12.5 billions on plant-based remedies (Cathy 1995). In the United States of America about half of all prescriptions dispensed contain substances of natural origin. Of over 50% of these medicines were found to contain materials of plant origin. In 1984, more than 40% of the medicines produced in Germany were of biogenic origin. It was also reported by UNCTAD that in the early 1970's, plant derived drugs accounted for 33% of the total drug production in the industrialized countries.

It has been stated that about 4000 plant drugs have been widely used. In Western Europe about 400 plant drugs are widely traded (TRUMAP 1995). Most societies in developing countries view traditional medicine practices as an integral part of social culture (Lambert 1997). The majority of the people in these countries still rely on herbal remedies. The renewed interest in traditional medicines has made the importance more significant than ever. In Africa, due to the availability of medicinal plant materials the percentage of plant-derived drugs produced could be higher than 33% (UNECA 1989).

With regard to the problems associated with the existing medicinal plants various opinions were expressed. According to the Washington convention of 1973, efforts to protect plants against extinction are necessary. This would mean collecting and domesticating a large number of medicinal and aromatic plants dispersed in the wild, whereby special attention wouls be given to the outstanding but diminishing flora.

An International Consultation on the Conservation of Medicinal Plants organized by WHO, IUCN and WWF in Chiang Mai Thailand in 1976 have released a declaration entitled "Saving Lives by Saving Plants". On this occasion grave

concern was expressed that many of the plants that provide traditional and modern medicinal drugs are threatened, and therefore the urgent need exists to establish conservation progress for medicinal plants, to ensure that adequate gene materials are available for future generations (Franz 1992). In Ethiopia the situation is even worse due to successive droughts, deforestation, bad agricultural practices etc. Therefore, conservation, domestication and cultivation of medicinal plants deserve due attention.

Currently the pharmaceutical industries in Ethiopia are the Ethiopian Pharmaceutical Manufacturing Enterprise (EPHARM) and the newly established pharmaceutical production plant in Adigrat. They are formulating medicine mainly based on imported drugs, which are not adequate for the health coverage of the population. Therefore, the pharmaceutical sector is not well developed and access to modern pharmaceuticals is very limited. Thus, the public will continue to depend on traditional medicines and technologies.

Ethiopia is a country with a wide range of climatic conditions. It has areas ranging from below sea level up to over 4620 m. a .s. l. The wide range of climatic conditions enables the country to posses an enormous diversity in plant genetic resources making it one of the Vavilove centers.

The diversity in the ecological conditions enables it also to grow different types of plants, even those, which are not indigenous to the country. Different Eucalyptus species, which are found in different parts of the country, are among the few examples.

In Ethiopia, Government expenditure for health sector has remained under 2% of the GDP for the last 10 years (MOH 1995). Considering the health service situation of the country, there is a need to utilize the existing knowledge and natural resources.

Domestication of wild plants

Considering the important but diminishing flora leads to the conclusion that the use of spontaneous and wildly collected plants must be limited as far as possible and replaced step by step by their cultivation. The domestication of new species is historically a tedious process, and there exists no valid scheme for the introduction of new crops.

Firstly, a rough strategy for their introduction is concerned with the evaluation of potential new crops. Thereafter follows the actual domestication, e.g. in accordance with the plant, which has been proved to be successful in practice for many years.

Strategy of introduction (Van Soest, 1987):

PHASE I:
1. Rational selection of new crop
2. Introduction of limited gene pool
3. Phase I evaluation
4. Establishment of collection (gene-bank)
5. Selection of promising crops

PHASE II:
1. Broadening the gene pool
2. Phase II evaluation
3. Establishment of collections (contd.)
4. Selection of a few crops, considering marketing and utilization

Further research by specialized Institutes (breeding, agronomy, processing, marketing, development, and utilization) is vital for successful introduction and production.

Possible procedures of domestication and some arising problems will be discussed in the following examples.

Domestication strategy for plants of the spontaneous flora

1) Studies at the natural site: botany, soil, climate, growing, natural propagation etc.
2) Collection of plants and seeds of the wildly grown plants, phytochemical investigation of the materials.
3) Plant propagation / by seeds or vegetative, plantlet cultivation
4) Cultivation treatments, growing site, variation, direct sowing, transplanting, fertilization, inter-cultivation.
5) Phytosanitary problems: pests, diseases, weeds.
6) Duration of the culture, harvest, harvesting time, phyto-chemical investigation of the produced raw material.

7) Economy:
   a) Labour requirements, machinery, agrochemical, yield and processing
   b) Contracts

The importance of cultivation

Cultivation of medicinal plants has a number of advantages. Herbs grown under cultivation can give a higher yield, and allow the production of plants with more consistent properties than plants growing wild. Cultivation assists crop husbandry, facilitates weeding, controls insects and pests and permits mechanization - especially planned harvesting, quick transport to the drying shade and correct preparation, drying and storage of the herb.

To maintain the supply of medicinal plants at today's level, cultivation is the main hope (Lambert 1997). Besides, there is a large demand for certain products and so the necessity to cultivate them on a large scale has become even greater. This has necessitated domesticating and propagating the valuable medicinal plants economically.

The following conditions favour cultivation of medicinal plants:

- Too few of the plants grow wild.
- The wild source is sparsely distributed.
- The wild plants are inaccessible e.g. mountainous plants or very tall trees from which leaves are to be collected.
- There is a need to improve the yield of active principles produced by the plants growing wild.
- There is governmental control over the plants such as cannabis or plants yielding dangerous drugs.
- Only a desired species or variety of a particular plant is to be used because of its higher yield of active constituents.
- Cultivation can be employed to produce better plant growth by introducing good agricultural practices to have better quality control.
- Cultivation allows for better and quicker fast-harvest treatments of the plant drug such as drying and packaging before exportation.
- The supply from the wild source is fluctuating
- Botanical identification from the wild source is difficult.

However, there are controversies as to which is the best method, since one can argue that herbs collected in their natural habitat have more flavour or more active ingredient than those cultivated, and some are uneconomical to cultivate.

Factors favouring production of medicinal plants in Ethiopia

Limited access to modern medicine

The Ethiopian Pharmaceutical Manufacturing Enterprise (EPHARM) and the pharmaceutical production plant in Adigrat are formulating medicine mainly based on imported drugs, which are not adequate for the health coverage of the population. Therefore, the pharmaceutical sector is not well developed; and hence access to modern pharmaceuticals is very limited. Thus the public will continue to depend on traditional medicines and technologies.

Favourable agro-climatic conditions

It is an often quoted and said fact that, Ethiopia, with its highly contrasting topography and diverse climatic conditions is rich in a wide variety of flora which are indigenous to the locality and expected to possess high potential medicinal value. There are a large number of plants well known and widely used by many practitioners of traditional medicine and consumed by the majority of the Ethiopian people.

Inherited knowledge and Traditional Healers Association

Indigenous health technologies have been widely used in Ethiopia. It is important to look into these technologies in order to up-grade those, which are useful, accessible and applicable. Moreover, the traditional healers are now organized with their own association in order to contribute their herited (indigenous) knowledge and have shown keen interest in collaborating with the formal sector.

Past experience and research so far conducted

There is a considerable amount of information and expertise concerning medicinal plant scattered throughout the country in the public and private sectors. A number of activities that are being done in various institutions need to be organized and be in harmony. Ethno pharmacological survey has shown that there are about 600

medicinal plant species used against various types of disease (Database of the Traditional Medicine Research Center). Endod, for instance, developed by the Institute of Pathobiology, has proved to be an effective prevention of schistosomiasis. The Chemistry Department of Addis Ababa University analyzing chemical constitutes of medicinal plants; the Biology Department /National Herbarium, with a collection of about 500 medicinal plants; the School of Pharmacy and Medicinal Faculty, having carried out a number of biological and pharmacological studies; and the Essential Oils Research Center collecting and growing various plant species, including medicinal plants and having pilot plants for bench sample preparation are some of the organizations engaged in the research and development activities. At Wondo Genet more than 34 species of medicinal plants have been collected. These are most commonly used by the traditional healers for various diseases. These collections are used for field gene bank conservation. On some of them, research and development activities such as adaptation, agronomic and processing trials are being conducted at the Essential Oils Research Center.

Government policy

Ethiopia has formulated a health and science technology policy based on the firm commitment to improve the health status of the country's population (National Health Science and Technology Policy 1994). The policy encourages the promotion and incorporation of traditional medicine in the health care delivery system of the country. The policy directives support studies on traditional medicine to ensure safety and efficacy, and to devise effective mechanisms for the promotion of wider use of its beneficial aspect. Government policy towards development of private companies involved in the processing of biological resources, including spice extracts, essential oils and extracts of medicinal plants appears to be among one of the most encouraging.

Interest of international bodies

Realizing the importance of traditional medicine in the health care system of developing countries, a number of resolutions and recommendations have been forwarded by regional and international organizations for its promotion and development. The resolution, recommendation and initiations made by WHO, UNIDO, UNESCO, OAU etc. indicate that the development of traditional herbal drugs for immediate application in the health care system of developing countries have been believed to be an objective worthy of active support (Tchcknavrian *et al.* 1982).

The World Health Organization, who have also compiled and published an inventory of medicinal plants with a list of the world's most widely used plants, has similar interests. This short list is a good beginning for all research work aimed towards different objectives (Tchcknavrian *et al.* 1982).

UNIDO's main thrust has been, and understandably will continue to be, in the direction of industrial utilization of medicinal and aromatic plants. Hence the UNIDO programs have fallen into one or more of the following categories (Tchcknavrian *et al.* 1982):

- Survey of the potential of the flora for its utilization as a source of plant derived pharmaceuticals and/or economic natural products.
- Transfer of technologies for systematic cultivation of selected medicinal and economic plant species for industrial processing
- Training, exchange of expertise and institution strengthening.

Cultivation and post harvest handling of medicinal plants

Many species of medicinal plants grow wild. In their natural occurrence the plants are scattered and it is difficult to economically collect, cultivate and process them. There are problems to be tackled in order to obtain an economic yield of good quality in respect of every product.

In the process of cultivation there are difficulties in distinctiveness, uniformity and stability due to the absence of true varieties (Hay 1993). Most named varieties are results of simple selection and they can display spectacular degree of variability in morphology, physiology and in particular in the chemistry of the required component, even the taxonomy of some of the cultivated species is yet unknown. Biomass yield per unit area and content of the required active ingredients must be checked.

Climate

Agro-climatic and ecological conditions must be suitable for the successful cultivation of these crops. Different crops require different climatic pattern and the growers who propose to cultivate a particular crop should seriously take into cognisance the normal and abnormal climate likely in the area. The availability of the needed optimum rainfall and temperature for the crop in the area generally poses a big problem. Apart from that, sudden natural calamities such as flood, drought, snow, hail, and wind are usual features in hilly areas where these plants

could grow. In short, preventive measures have to be taken to guard the crops against these natural calamities.

Secondary metabolites, which are potential sources of drugs and essential oils, are strongly affected by environmental influences. As a result there can be fluctuations in concentrations and quantities of the secondary metabolites such as alkaloids, glycosides, volatile oils and steroids. The most important environmental factor is water. Water stress due to shortage of water usually results in a positive effect to the accumulation of secondary metabolites (Yaniv and Palevitch 1982).

Soil and fertilizer

To begin with, one has to study the soil conditions, and these include the kind of soil and depth, its capacity to retain moisture by virtue of its physical properties and above all its pH status of macro and micro nutrients. The study of response to different fertilizers needs patience. The economics of fertilizer use is also of utmost importance, and the recommendations for fertilizer application should include what fertilizers are absolutely needed and how much, the time and method of application for the particular crop and soil, etc. Organic fertilizers gaining more preference in the cultivation of medicinal plants, their availability (type and quantity) and utilization is worth considering

Planting material

It is to be recognized that the yield is determined by the potentiality of the species and variety of the crop. Botanically there are many varieties under the same species. Without identifying the correct variety, sometimes large-scale plantations are raised with heavy monetary input and ultimately when the production stage comes, the error is noticed. The cultivator has to get over this difficulty and get the right type of planting material from a recognized trusted source.

Propagation

Different crops need different methods of propagation such as propagation by seed or cuttings from different parts of the plant. The seed physiology must be clearly understood, since low or irregular germination can result from inappropriate seed harvesting, drying or storage procedures. Besides seed dormancy of the plant can affect the germination. Some of the plants, such as mint do not even produce viable seeds. Their propagation is by stem cuttings and rhizomes. The available growing season can be more fully exploited by establishing the crop using transplants raised under controlled conditions. The

appropriate method of propagation should be followed, looking into cost involved, convenience of plantings and establishment of plants.

Cultivator's package of practices

The cultural practices adopted in different localities vary to a great extent, with the result that the outputs are not the same. Packages of practices and economics for each crop should be worked out for different regions. There is thus a need to standardize and bring up-to-date the agronomic practices for the cultivation of various medicinal and aromatic plants under different agro-climatic conditions.

Pests and diseases

Almost every crop is subjected to attack by one or other type of insect pest and disease. The incidence may be sporadic or heavy. The crop suffers in the nursery stage and in the field. Many fungicides and pesticides are available in the market, but the problem is not fully solved. The use of fungicides and pesticides requires very high precautions.

Harvesting

The climax of the plant growing comes when one collects the part of each plant that one wants to use, and gather the seeds that can be sown to produce next season's plants. If it is harvested correctly, the plant will preserve useful properties. This means gathering the herbs at the right moment during the day and at the right point in the growing season.

It is best to:

- Gather the leaves and aerial parts when the flowers are in bud and before any have opened. Cutting leaves for drying should be done early in the day, as soon as the dew has evaporated from the plant.
- Take flowers at the same time of the day as leaves and as soon as possible after they are fully open. After removing each flower, shake off any tiny insects in the head.
- Harvest roots and underground organs at the end of the growing season, when aerial parts begin to wither and die. This is when the maximum nutrients are stored in the roots for the winter. The roots and the underground parts should not be damaged when lifting them. Damaged parts should be discarded. The harvested parts have to be washed in cold water to remove all soil and dirt before drying, but do not soak them for any length of time.

- Harvest seeds when they reach the stage of maturity. Loss of seeds due to shattering should be avoided.

Storage

Storage facility should be provided to hold excess plant materials. Well ventilated places such as kitchens or sheds with doors and windows left open are essential. Dried herbs can be adversely affected by light, heat and air. To keep them at their best, it is better to store them immediately after drying and rubbing them down. This helps to prevent the herbs from picking up moisture from the air.

Constraints of medicinal plants production

- Ethiopia is rich in medical lore, while much of this is indigenous; it is not properly identified, documented and maintained.
- As a result of deforestation, natural calamity, mal agricultural practices, habitat distraction and unsustainable exploitation, valuable medicinal plant sources are being lost.
- Research results so far conducted are not released and popularized to the public.
- Co-ordination of traditional healers, botanists and agronomists is not adequate.
- Packages for cultivation and production of medicinal plant are not available.
- Out grower schemes are unknown and extension services are not well co-ordinated and developed as a system.

Gap analysis

- Despite the large potential of medicinal plants in Ethiopia and favourable agro-climatic conditions to grow various plant species, none are cultivated in a large scale. The small numbers of projects on medicinal plants, which have been undertaken by a number of institutes, are not well co-ordinated and so far, not fruitful in terms of development.
- Cultivation will be a vital complement and alternative to collecting plants from wild. Such cultivation will require a true partnership between outgrowers, farmers and processors and will permit improved reliability of supply and uniform quality of raw materials whose properties can be standardized, and from which crude phyto-medicines can be obtained.
- Those species, which the traditional system relies on, are becoming rare and

limited in distribution. They are threatened by several factors, both man-made and natural. Environmental degradation, agricultural expansion and over harvesting appear to be the principal threats to medicinal plants in the country.

- Collection of spontaneous plants for utilization is extremely problematic if the reproductive organs (flowers, fruits and seed) or the permanent organs (root, rhizome) are used. In such cases the species is much more endangered than the species from which only the herbs or the leaves have been collected.
- There are a number of plants grown in home gardens by individuals for various uses including as spices and condiments, and by some traditional healers for the purpose of preparing medicine. The cultivation practices, the varieties they are using, yield improvement techniques and the way they are preparing medicine is not assisted by scientific approach. As a result, the use of these home garden medicinal plants with out scientific evaluation for treatment has considerable side effects. This calls for making a bridge between traditional medicine practitioners and modern science through research. It has, however, a positive contribution in that the rural societies are using their own land race varieties that could be used as a source of germplasm conservation and for crop improvement through agronomic practices and breeding. Moreover, the practices that they are using now can be easily enhanced for better development through extension services and outgrower schemes in the current farming system, for sustainable supply, conservation and utilization.

Strategies

- Research to identify sustainable cultivation methodologies (package) of medicinal plants along with agricultural intensification and production system is one of the areas to be considered, since very little is known in how to incorporate medicinal plants into the present farming systems. Agronomic and cultural practice studies for various medicinal plants have to be established prior to large scale production.
- An objective approach is required for selecting a realistic number of species among the many hundreds potentially available for cultivation trials. The scale of cultivation (small, pilot and large) has to be developed step by step, taking into account technological accessibility and the local capability and needs.
- In the short term, efforts have to be focused on assessing the possibility of cultivating and utilizing those commonly used traditional medicinal plants and those already in use in modern medicine.
- Adequate extension services regarding agronomic and technological needs should exist, and methods by which such extension services are made to reach

farmers and outgrowers for sustainable cultivation practices. These make medicinal plants compatible with existing food cropping systems.

- Creation of agencies and practices to ensure the development of medicinal plants industries as an income generating operation for the rural population (outgrowers) is of utmost importance. An organized system of central collection and primary assessment of produce, would enable farmers to promptly dispose of their produce and promote the production of raw material.
- There is a need to create incentives such as capital support, pricing and marketing guarantees and means of transportation of products from remote field areas.
- Means and ways must be proposed for the expected role of, and assistance from international organizations which are active in the field of traditional medicine and medicinal plants, for example WHO, UNIDO, UNESCO, OAU, etc. to help in cultivation and utilization.
- The possibility for technological transfer and experience exchange, bilateral agreements with countries such as China, India, Egypt, etc. should exist. And also multilateral agreements with concerned organization such as UNIDO, WHO, UNESCO, etc. are necessary.

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Promotion of Medicinal Plants through Involvement of Private Sector

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Introduction

The Ethiopian economy predominantly being agricultural, most of the population lives in rural areas. This part of the population is known to have no, or very limited, access to modern medicine and relies highly on traditional medicine and its practitioners to meet its primary health care needs. Traditional drugs have been and are still used in their crude and unmodified form.

Even where modern medical care is available and affordable, people still go to the traditional practitioners. Though the medicinal plants used in traditional treatments are not systematically studied, they have gained acceptance and appreciation by the population for they possess healing properties. Moreover, because of magic associated beliefs, these medicinal plants have a high physiological impact on the patients.

In the past, governments in developing countries largely ignored the importance of medicinal plants. However, the advantages of traditional health care systems are now being reconsidered for the following reasons.

Effectiveness and practicality

Due to the accumulated experience of using these medicinal plants, the effectiveness of using them is well established. Because of this established effectiveness, they are widely used by the society. Moreover, the source of these traditional drugs being the forests close-by, they create little inconvenience or scarcity. This encourages wide practical use of the drugs.

Affordability

Medicinal plants grow wild in the forests or as common weeds near rural settlements. This makes them easily available for the practitioners and thereby accessible to the patient at an affordable price.

Import substitution

The volume of plant-derived medicines produced in developing countries is high. Their potential as a substitute and supplement of some of the imported modern medicines is high.

Resource management (use)

Ethiopia is endowed with vast resources of medicinal plants, which have been used in health care for centuries. Apart from traditional ways of using these plants, they can be exported to industrial countries as raw materials for modern medicines or processed locally.

International demand

Medicinal plants, major ingredients of traditional medicine contribute considerably to the modern medicine. Hence, these medicinal plants have great demand in the developed countries to be processed into modern medicine.

Solving socio-economic problems and bringing about attitudinal change

Ethiopia cannot afford to buy all the modern drugs it needs to improve the health of its people. One possible way of improving the health of the people, is allowing rational use of traditional drugs in the health care systems of the country. This can ease the foreign exchange constraints, which the country faces in the import of modern drugs. The health care system can complement the effect of modern drugs in the improvement of the health of the people, which has certainly a strong impact on the socio-economic development of the country.

Foreign currency generation and trade balance

Over and above, the export of medicinal plants to developed countries helps the country earn foreign exchange. As a result it can bring about improvement in the control and balance of trade.

Ethiopian economy

The structure of the Ethiopian economy can be seen in three sections as: Agriculture, Industry and Service. The agricultural section, which is the largest portion of the economy, constitutes the GDP, the industrial sector 12%, and Service 33%, respectively. The participation of the private sector in industrial activity is quite insignificant.

	ETHIOPIA	KENYA
Population	56.4million	26.7million
Average Annual Growth Rate	1.9%	
Surface Area	1,097,000 sq.km	580,000 sq.km
GNP per capita	100	280
GNP per capita Av. Annual Growth	-0.3	0.1
Poverty per % people		
Living on less than birr 7 per day	38%	58%
Life Expectancy	50.2	49
Labour Force Agriculture (1990)	80%	
Industry (1990)	2%	
Access to health	55%	
Total Fertility Rate (1995)	7	
Land use (crop land) (1994)	11%	
Forest Area		142,000 Sq. Mt.
Structure of the economy (GDP)		
Agriculture	57%	
Industry	12%	
Service	33%	

Source: World Development Report

Ownership by major industrial group 1989/90 (Percentage of each industry's value of production)

Industry Group	Public	%	Private	%
Food	630,195	95.80	27,641	4.20
Beverage	425,549	97.99	8,730	2.01
Tobacco	182,037	100.00	-	-
Textile	446,266	98.85	5,659	1.25
Leather and Foot wear	226,821	93.58	15,549	6.42
Wood and Furniture	37,973	77.88	10,786	22.12
Paper	37,173	97.35	1,013	2.65
Printing	58,167	92.15	4,953	7.85
Chemical	143,148	96.00	5,960	4.00
Non-Metallic Mineral Products	69,913	96.16	2,793	3.84
Metal and Electrical	140,826	96.60	4,950	3.40
Total	**2,398,068**	**96.46**	**88,034**	**3.54**

Source: Results of the Survey of Manufacturing and Electricity Industries (1982 E.C.) (Addis Ababa Central Statistical Authority, April 1993), pp. 46-47. (Figures for enterprises with more than 10 employees)

The share and role played by the private industrial sector is an important factor for the development of a country's economy. During the past, the private sectors have been denied the appropriate consideration and support to take part in the industrial activity.

Challenges faced

Globalization

Although developing countries are richly endowed with many natural resources, these on their own, can not and will not solve the continent's stagnated economic growth. As the world's economic pattern changes, Globalization is becoming the rule of the day. This has exerted a serious economic pressure on developing countries, as it calls for more competitiveness and free access of markets. Developing countries could very easily be victims unless they strengthen their position by taking comparative advantage of their potentials. By virtue of the vast bio-diversity in our country, medicinal plants can assist considerably in resisting the challenge of Globalization.

Investment environment

Difficulty in getting land for industrial use and the high cost of land has inhibited the expansion of industrial activity and has acted as a barrier for the entry of new entrepreneurs.

Lack of infrastructure facilities

There are serious problems associated with the administration and supply of infrastructure facilities such as electricity, water, communication, transportation etc.

Access to finance

Financial facilities and funds received from various sources for support for industrial activities are not fairly allocated and the rural areas are not the usual beneficiaries of such funds.

Promoting traditional medicines

Ethiopia, like any of the third world countries, spends a large amount of money on the purchase of imported medicines and medical supplies. The high cost of imported medicines puts modern health care services out of the reach of developing countries, especially in rural areas. Instead they use traditional medicines for their health care needs. Although medicinal plants and plant products are of little monetary value they occupy a key position in Ethiopian medicine and public health. As traditional drugs are still used in their crude form, their harmful effects have not been much realized. So medicinal plants should be

examined and studied and should be granted the necessary recognition by the government and research organizations, by which they can be integrated into modern medical systems.

Research

This is one way to promote awareness of the advantages and income generating potentials of medicinal plants. Undertaking research and development projects for medicinal plants requires a large amount of resources, and the private sector cannot sustainably go with it. So the National Goverment should play the major role in facilitating research and development programs by providing adequate funds and support.

Marketing

The study of distribution of medicinal plants among markets and the frequency with which they are sold needs major involvement of the government along with better participation of the private sector.

Production

The production of medicinal plants can easily be over taken and facilitated by the private sector with less involvement of the government.

Production of medicinal plants for local and export Use

Crude drugs:

The plants could be used to some extent without any further treatment. This is broadly practiced in most parts of country.

Crude extracts:

This is to use the plant to produce extracts for both local use and export. The extracts that are proved to be safe can be used directly without further processing.

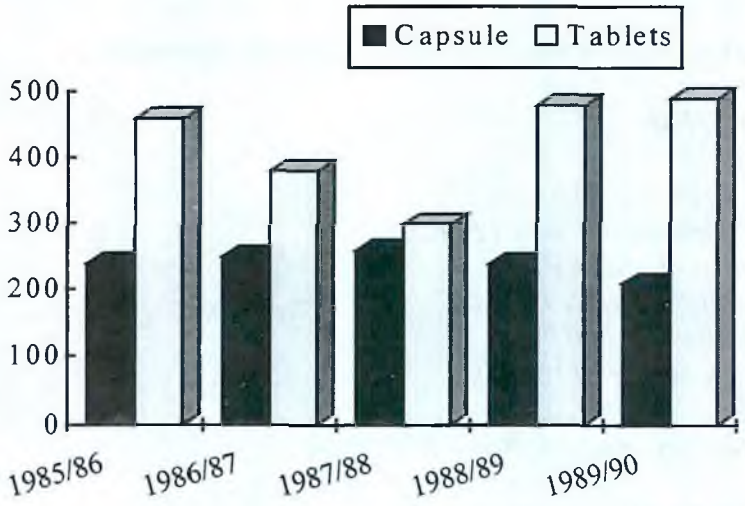
Separation:

The separation of active ingredients from the extracts is an even better processing of the medicinal plants.

Dosage form production:

This involves quite sophisticated technology and resource.

Capsules and Tablets, (Millions Units)



Source: Results of the Survey of Manufacturing and Electricity Industries (1982 E.C.) (Addis Ababa Central Statistical Authority, April 1993), pp. 46-47. (Figures for enterprises with more than 10 employees)

Priorities that should be considered to implement production of medicinal plants

- Crude drugs/Crude extracts
- Usage of multi-purpose processing equipment.

This involves designing a processing plant that will enable to carry out similar processes and operation within the same unit.

- Identifying plants already in use with minimum processing.
- Gathering information from internal organization and other countries is important.
- It is also important to provide the required support and consideration for local innovations.

The investment cost for the production of medical plants is relatively small and its profitability is promising. Moreover, the promotion of medicinal plants could very easily be handled if project ideas and profiles could be prepared by government-sponsored organizations. The availability of such useful information will assist to convince the potential. A sample estimation of investment and profit is given below.

Estimation of investment and profit for ginger essential oil

PLANTATION

1 sq. ft. 2 plants =100 gm
Annual requirement =69,120 Kg.
Area required =65 hectares
Equipment = Birr 840,000.00
Land = Birr 273,000.00
Plantation = Birr 113,750.00

Total Req. Investment = Birr 1,226,750.00

PRODUCTION OF GINGER OIL

Yield = 3ml/100 gm
Density = 0.8 24 gm oil/1kg.
120 Kg./batch = 2 batch /day
Annual Raw Material = 69,120 Kg.
Daily yield = 5.76 Kg. Annual Yield 1,658. 9 Kg.
Price of Oil = 1,155 birr (1985)
Value of Annual Production = birr 1,916,005

INDICATION OF VALIDITY

Raw Material = birr 109,200
Other Production Costs = birr 105.000
(energy, water, maintenance.....)
Total production Cost = birr 214,200
Value of Production /Year = 1,916,005
Cost of Production = 214,200
Profit/year for the 1st year = 1,701,805

Payment Period $\frac{\text{Investment Cost}}{} = \frac{1,226,750}{} = 0.72$ *years*

In Ethiopia, medicinal plants are not well exploited. Thus, the benefit from the processing of these medicinal plants with low investment cost is enormous. Towards this end, the following recommendations are suggested for the promotion of integrating medicinal plants.

Recommendations

- Investment related policies should be flexible and attractive tothe private sector.
- Government should be strongly involved in carrying out research and marketing activities
- Resource Management: Plantation of medicinal plants and extraction of plants should be facilitated. This includes the proper care of forests.
- Social Entrepreneurship (entrepreneurs' concern for the advantage of the society as a whole) should be developed.
- Preparation of project profiles and feasibility studies on the production of medicinal plants and traditional drugs should be highly facilitated.
- Incentives should be provided to draw in the private sector: such as land, long term loans, etc.
- Highest priority should be given to the development of infrastructure including access to road, telecommunication, water, electricity, and other facilities.
- Information centers should be made available for entrepreneurs.
- Traditional practitioners should be rendered the appropriate attention and encouragement.

A Preliminary Eonomic Valuation of Medicinal Plants in Ethiopia: Trade, Volume and Price

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Introduction

Ethiopia, due to its variety of topography and climate, has a high diversity of plant and animal species. Indeed no country in Africa possesses as great a diversification of geology, landforms, soils, and climate as Ethiopia. There are more than forty vegetation types where forest, savanna, woodlands, steppes and grasslands comprise 75% of the vegetation cover (Amare 1986). Ethiopia has been using these natural resources since time immemorial, some as a source of food, others for medicine to cure disease and heal wounds and for other purposes.

In traditional medicine of plants and animals, Ethiopia has been known to use herbal remedies from the very earliest time. This knowledge of traditional medicine has passed by word of mouth or oral communication from generation to generation by priests, witchdoctors, expert herbalists, bonesetters, professional debteras and traditional birth attendants to their offspring. This would be done only as they approached death. In medicine the first-born son is entrusted to pass on the skill.

Today, together with the alarming rate of population growth and decline in living standard, the tendency of people to use traditional medicine is increasing from day to day because.

1) The supply of pharmaceutical products is relatively limited.
2) Limited and uneven distribution of health stations throughout the country makes people use herbs from nearby vicinities.

Economic use of medicinal plants in Ethiopia

Medicinal plants are exploited for domestic use rather than for export. In the remotest areas of Ethiopia, especially in those parts where clinics and hospitals are very rare, the economic use of medicinal plants is highly significant. Even though the availability of modern drugs in larger towns seems to have reduced the consumption of traditional medicine, people in urban areas still experience the use of herbal drugs (Kloos 1976/77). And indeed most people prefer herbal drugs to modern drugs for their efficiency in treating diseases such as liver disease, asthma, scrofula, vitiglio, diabetes, heart condition, hypertension, infectious

hepatitis, epilepsy and evil sprits. Because of this, the demand and supply are high on the local market and in the herbal clinics. Nowadays many herbal clinics are established in Addis Ababa and a few in other regions from which people also buy medicines. The price of traditional medicine is not as cheap as people think, but it depends on the providers. For example medicine, such as medicine for sores (Ye-michmedhanit), wounds (qusil) scabies (Ekek) tapeworm (kosso), provided by the mother or father in a given family for the household (a free source) may be considered to be cheap. For some other diseases that cannot be treated by mothers/ fathers, medicines will be bought from known individuals (expert herbalists) in the rural areas and herbal clinics. Though this is an informal market it provides basic health care needs to the people. And since it is informal and no studies have been carried out to document the total quantity of plants purchased by the people, and the volume sold by the herbalist is difficult to evaluate volumes and economic values of medicinal plants in Ethiopia.

Objectives

The general objective of the survey was to compile information on the economic value of traditional medicine and its trade, volume and price.

Specific objectives

1) To collect and document economic use of medicinal plants used by traditional people of Ethiopia.
2) To list the names of the important medicinal plants used by the local community including their scientific names, local names, uses, parts used, volume used and price.
3) To provide baseline information on gaps and constraints on the economic use of medicinal plants.

Methodology

The survey was carried out in February 1998. It was carried out in Jimma, Bonga, Iluababor (Gambella) and Addis Ababa. The main methods that were used to collect data included:

1) Direct field observation, plant specimen collection and identification.
2) Species-specific information on plants in trade. Interviews were conducted using semi-structured questionnaires (see Annex) prepared for Traditional Medical Practitioner (TMPs) and vendors. Information was collected for species found to be in trade i.e. sold in the market or administered by TMPs. Specific information to be gathered through questionnaire led interviews

included: identity of traded species, volume in which species were traded, what the species were used for, trade patterns and price.

3) Information on the trade structure: Location of the main medicinal markets; whether the markets were wholesale or retail; when the markets were open for business.
4) Interviewing different people on the spot while they were selling their medicines and in their clinics.
5) Observing the market places, to see and to identify the medicines on sale as they were displayed in the market.

Results and Discussion

Medicinal plant trade

Local trade

Little was known about the patterns of local medicinal trade in Ethiopia. However the present survey indicates that medicinal plant trade in Ethiopia involves traditional medicinal practitioners, street vendors and collectors. To identify the pattern of trade the survey was undertaken for 22 days from February 9 - 30, 1998 in Jimma, Bonga and Iluababor (Gambella) and around Addis Ababa. Markets of these villages and towns were observed 2-3 times per week to record the exact number of market days/week, possible number of vendors selling their medicine and the number of plant species sold.

Markets in Addis Ababa were observed many times even after number of market days were known, since the number of vendors varied due to their irregular movement from market to market. There were nine market areas surveyed during the study. Among these, six markets were in Addis Ababa and one each was in Jimma, Kaffa (Bonga), and Illuababor (Gambella).

During this study 78 vendors and 10 healers were recorded as shown in the table below. And a total of 88 people were recorded while they were selling their plant medicine. From these 36 were women and 52 were males; 64 were in Addis Ababa, 12 in Jimma, 6 in Kaffa (Bonga) and 5 were in Illuababor (Gambella). There were only three women with medicine stalls displayed in the market, one each in Addis Ababa, Jimma and Bonga. However almost all other women were selling their medicine (Kebericho, Gizawa, Weira, Woggart Ye-hitanzaf (*Boswellia papyferia*), etc.) in addition to other goods which were agricultural products. These included *Trachyspermum copticum* (Nech azmud), *Nigella sativa* (Tikur azmud) *Cinnoamiomum zeylanicum* (Kerefa), *Mentha piperita* (Kunde berbere), *Curcuma longa* (Ird), *Zinziber officnalis* (Zinjible), *Coriandrum sativum* (Dimbilal), *Trigonella foenum-graecum* (Abish) *Aframomum karorima* (kororima).

Table 1: The number of vendors in the market and practitioners in their clinics selling plant medicine.

Market place	Number of vendors		Market days/week	Number of healers		Address
	Male	Female		Male	Female	
Merkato	13	5	7			Addis Ababa
Shiromeda	4	6	2			Addis Ababa
Cherkos	2	-	1			Addis Ababa
Sholla-gebeya	7	8	6			Addis Ababa
Saris	5	-	1			Addis Ababa
Aware		7				Addis Ababa
Gulit-gebeya	7	3	6			Jimma
Kaffa (Bonga)	1	5	2			Bonga
Gambella	4	1	5			Gambella
				7	-	Addis Ababa
				2	-	Jimma
				-	1	Gambella

Table 2: Medicinal plants recorded in Practitioners' Clinics

Scientific Name	Vernacular name	Disease treated	Part used	Availablity	Price/ Treatment
Matricaria chamomilla		Headache	Leaf	Little	150
Rosmarinus officinal	Qora (Or.)	Nerve manipulation with paralysis	Whole plant	Little	300
Datura stramomum	Ate'faris (Am.)	Chronic cough, asthma	Seed	Abundant	150
Taraxcum sp, Lactuca sp, Marubium sp, Cynara sp		Hepatitis	Leaf	Abundant	250
Verbascum	Qetetina yeahiya-joro (Am.)	Haemorrhoid eye disease	Leaf, flower	Abundant	250
Coriandrum sativum, Ocimum lamifolium	Dimbilal (Am.), Damakasse (Am.)	Hepatitis	Fruit, leaf, leaf	Abundant	250
Ricinus sp, Datura sp and Solanum gigantum	Gullo (Am.), Ate'faris (Am.) and Tikur embaye	Skin disease	Leaf, seed and fruit	Abundant	100
Marubium sp		Chronic cough	Leaf, bark	Little	150

Am. = Amharic, Or. = Oromifa

The markets were conspicuous retail outlets where the price was affordable to local people. Retailers sat either on the ground with their folk medicine, as in the merkato around the Moslem mosque, or on elevated platforms as in the markets of Shiromeda, Sholla-gebeya, Aware, Saris, Chirkos, Gulit gebeya near the bus station in Jimma, along the road to the market in Gambella and in the market in Bonga. Medicines were carefully spread out around vendors seated on fibre mats and waiting for customers. The medicines were dispensed using measuring cups, spoonfuls, handfuls and can-fulls. Even though the market price was expensive, it was cheaper than herbal clinics. Most vendors reportedly collected medicines by themselves travelling to the original place while others relied on local suppliers. According to vendors, those who collect plants by themselves instead of buying from the gatherers believe that collecting traditional medicine has its own principles and nobody else could collect it the wayhe needs it. In an attempt to retain and increase the effectiveness of medicine; they are commonly gathered, processed and administered in ways described in medicinal recipes of herbalists (Kloos 1976/77)

Table 3: The most commonly medicinal plants sold by vendors

Scientific name	Vernacular name	Medicinal use	Parts used	Availability	Unit	Price (birr)
Hagenia abyssinica	Kosso (Am.)	Tapeworm	Root, Flower	Abundant	Single dose tied up, Kg	1 30
Embelia schimperi	Enqoqo (Am.) Hanqu (Or.)	Tapeworm	Fruit	Abundant	Cupful	5
Ximenia americana	Enkoyi (Am.) Hudha (Or.)	Stomach-ache, folk medicine	Whole plant	Abundant	Cupful	10
Glinus lotoides	Metere (Am.)	Tapeworm	Fruit	Little	Cupful Kg	4 25
Croton macrostachy	Bissana (Am.) Bakanissa (Or.)	TapewormSyphilis, Asthma, Scrofula	Bark, Leaf, Root	Abundant	Soup spoon	15
Senna arrereh	Senemaki (Arabic)	Stomach-ache, Purgative	Fruit	Abundant	Kg	45
Aloe sp.	Eret (Am.)	Fever, Cold, Malaria	Leaf	Abundant	Tea spoon Kg	15 40
Jatropha curcas	Habetelmuluk (Arabic)	Anthelementic, purgative	Fruit	Little	Tea spoon, Kg	15 45
Unidentified mineral	Dechmerchi (Arabic)	Gastrit, Boils, Haemorrhoid	Fruit, Bark	Little	Tea spoon, Kg	4 20
Euphorbia sp	Kulqual (Am.) Hadami (Or.)	Haemorrhoid	Milky part	Abundant	Tablet	50
Tamarindus indica	Roqa (Or.)	Malaria	Fruit	Little	Kg	30
Corindrium sativum	Dimbilal (Am.)	Ascaries	Fruit	Abundant	Kg	10
	Odeselem (Arabic)	Haemorrhoid	Root	Abundant	Single root	10
Ricinus communis	Qobo (Or.) Gullo (Am.)	Purgative	Fruit	Little	Kg	15

Am. = Amharic, Or. Oromifa

Table continued

Scientific name	Vernacular name	Medicinal use	Parts used	Availability	Unit	Price (birr)
Unidentified plant	Azembel (Am.)	Lung TB	Whole plant	Abundant	Soup spoon	50
Lupinus albus	Gibto (Am.)	Blood pressure	Seed	Little	Soup spoon	15
	Oumer, Arabic	Amoeba	Seed	Abundant	Kg	7
Calpurnia aurea	Digita (Am.) Cheeka (Or.)	Amoeba	Fruit, Leaf	Little	Soup spoon	15
Rumex abyssinicus	Meqmeqo	Blood pressure	Root	Abundant	Soup spoon	5
Rumex nervosus	Imbach'o (Am.) Dhangago (Or.)	Scabies	Bark, Leaf, Root	Little	Soup spoon	30
Adathoda schimperiana	Sensel (Am.) Dhumuga (Or.)	Hepatitis	Root, Leaf	Abundant	Soup spoon	50
Asparagus africana	Serit/Haranga ma (Or.) Ye-set kest (Am.)	Syphilis	Bark	Little	Tea spoon	25
Bersama abyssinica	Azamir (Am.) Lolchissa (Or.)	Antidote, ascaries	Root	Little	Soup spoon	50
Kalenchoe petitiana	Indahula (Am.) Bosok'e (Or.)	Boils, Haemorrhoid	Whole plant	Little	Soup spoon	10
Olea europea ssp cuspidata	Weira (Am.) Hejerssa (Or.)	Stomach haemorroide	Oil from leaf	Little	Soup spoon	80
Dovyalis abyssinica	Koshim (Am.) Koshmo (Or.)	Scrofula	Whole plant	Little	Soup spoon	5

Am. = Amharic, Or. Oromifa

The traditional medicine of plants sold by vendors in the central markets of the Merkato and other markets in Addis Ababa most probably came from Bale, Arsi, Jimma and around Addis Ababa to retail at a reasonable price. Vendors who relied on local suppliers bought medicines from them in Kg and retailed them. Vendors in turn sold their medicinesto practitioners in Kg. Almost all vendors sitting with their folk medicine in the Merkato were Moslems. They spoke Oromigna, Amharic and Arabic. Most of them were males and only one woman was encountered with her folk medicine with out any additional agricultural products. Some plant species most commonly sold by vendors and TMPS during market visits were recorded. Even though some of them hesitated to divulge the plant name and the price people paid for the medicine at the beginning of the study, enough information was obtained after making a close relationship with retailers. Each vendor was selling more than ten different species of plants though their stalls contained more or less the same set of plants. In contrast to Traditional Medical Practitioners vendors used a large number of plant species in their medicaments.

Vendors sometimes acted as if they were practitioners because they gave many prescriptions to the patients and they insisted on seeing them again after they fully recovered. There were many consumers asking for medicines in the market and

most of them were seen buying anthelementic medicine, medicines for colds, syphilis and hepatitis.

Nearly all the vendors selling their folk medicine, sitting in the market, along the road, around the Mosque in the merkato and in other markets of Addis Ababa, Jimma, Illuababor and Bonga had no other profession on which their livelihood depended. They rely on selling their medicine. These people, when they displayed their medicine beside each other, usually had the habit of exchanging ideas and experiences among themselves. The medicinal plants most frequently sold by them were **Odeselem, Habetelmuluk, Senemaki, Barjel, Enkoy** and **Temenai,** and these were brought from the lowland parts of Bale and Arsi. Even if these plants were found in the highlands, vendors thought that medicines collected from lowland areas had more effect on disease than medicines collected from highland areas. There were groups of religious people called Garibas who brought plants from lowland areas and provided vendors in Addis Ababa with medicine. Garibas were Moslem and they were found everywhere in the country. They met in Bale coming from different regions for regular worship. When they travelled to and from Bale they collected plants on the way and stopped enroute whenever possible to visit periodic markets to sell their medicine to vendors and traditional Medical practitioners. Garibas living around Addis Ababa also moved in a regular weekly pattern with their folk medicine among the markets of Addis Ababa to dispense to retailers.

Most medicines sold by vendors were powdered, pounded and in extracted form, which was difficult to identify because of the absence of leaves and flowers. There were also plants sold as a single dose tied up with a string as in the case of roots of *Taverniera abyssinica*, *Securidaca longipedanculata*, *Echinops kebericho*, *Haginia abyssinica*, bark of *Stereospurmum kuntianum* and wood of *Withania sommenifera.* And some vendors displayed their medicine in small piles, each one constituting a single dose, but most of them measured and then mixed the medicine after the patients explained the type of the disease they needed treatment for. A single dose tied up like **Kosso** and **Dingetegna** cost Eth. $ 1. But the cost of other plant products prepared in the form of powdered, concoction, infusion and decoction were different from vendor to vendor. The cost difference also depended on the site of application. For example, medicine reqiured for external use, such as a wound on the leg, scabies, or eye ointment was less expensive than medicine applied for diseases located deep inside the body such as liver disease, haemorrhoid, Stomach disorders etc. Plants brought from the remotest areas were more expensive than plants gathered around homes, in the fields and along the wayside in the vicinities of settlements. And the price of the same plant species, which was used to treat the same disease, depended on the distance of the market from the source. *Tamaridus indica* which is collected in

riverine forest and woodland areas of Ethiopia cost Eth. $ 30/kg in Addis Ababa and Eth. $ 10/kg in Jimma. The application of the same plant species was different from place to place; for example the root of **Temenai**, which was used as a medicine for hepatitis and many internal diseases in Jimma, Addis Ababa and Illuababor was used as a soap to wash clothes in western Ethiopia.

International trade

Ethiopia is not legally known in exporting and importing medicinal plants. However, as research (Traffic East/Southern Africa Medicinals Ethiopian Component sponsored by IUCN undertaken by Dessalegn Desissa et al. 1996) reported Ethiopia legally exports some agricultural products such as coffee, cottonseed, Niger seed, lin seed, castor seed, chat and etc. These are not exported for the purpose of medicinal value but as means of getting foreign currency to boost income for the country. The only medicinal plant export from Ethiopia is that of *Catha edulis*, which is traded primarily for its properties as a stimulant. Export figures appearing in Ethiopian customs Statistics reveal that in 1992 a total of 937425 kg were exported, of which approximately 96% went to Djibouti. In 1993, a total of 2711165kg were exported, nearly all of which also went to Djibouti. Other reported destinations include the Netherlands, Italy, UK, USA, Thailand, Saudi Arabia and Poland (N. Marshall, 1998)

Contribution of medicinal plants to Ethiopian economy

In 1975 the Ministry of Health set up an office for traditional medicine, with the aim of conducting chemical screening of medicinal plants, coordinating activities regarding traditional medicine, carrying out a census of TMPs and evaluating traditional medicine. However, little progress was made and interest in traditional medicine declined (N.T. Marshal, 1998). This was probably due to the absence of a harmonious relationship between traditional medicine and modern medicine. TMPs, vendors and collectors in Ethiopia are using medicinal plants for their daily livelihood. This has no significance to the economy of the country.

Conservation of medicinal plants

Whether or not collectors, TMPs or vendors have any idea about conservation; they do not know how to collect without destroying the plants. They collect by wandering about wherever the plant is available. If they can not get some species around their vicinities, they will move to faraway places, whether it is on the hillside, along the river or at the top of a mountain, they will get it and bring to the vendors and healers. Most collectors say that some plants are difficult to get, and when they collect these plants they will sell them at a high price to the traditional

practitioners and vendors and in turn vendors and practitioners will charge patients high prices.

Research by Traffic East/Southern Africa, Ethiopian component undertaken in 1996 shows which plants are in high demand, scarce and difficult to acquire due to this over use of plants by people. For instance, plants in high demand are: *Croton macrostacy*, *Cyphostema junceum*, *Haginia abyssinica*, *Calpurnia aurea*, *Ruta chalepensis*, *Silene macrosolen*, *Echinops kebericho*, *Aloe sp.*, *Rumex abyssinicus*, *Withania sommenifera*, *Embelia schimperi*, *Ocimum lamiifolium.*, Plants that are scarce: *Securdica longipedunculata*, *Cineraria abyssinica*, *Plumbago zeylanica*, *Satureja biflora*, *Ceropagia vigmalaiana*, *Ceropagia abyssinicus*. Difficult to acquire: *Biophtum abyssinicus*, *Dracaena steudnen*, *Coccinia sp*, *Senna sp*, *Glinus lotoides*.

According to the healers the same species of plant may be used to treat different diseases by mixing it with another plant product or by using it by itself. There are plants as shown in the above tables 2 and 3 that are used alone to treat different or one type of disease. Due to this use of a single plant for different diseases, over exploitation of the species is increased and many of them are destroyed. Today the number of people using medicinal plant products is increasing and the number of vendors and practitioners have also increased as compared to the 1996 report.

Table 4: Number of vendors and practitioners in Addis Ababa

Year	Number of Vendors	Number of Practitioners
1996	65	5
1998	78	10

The plants listed above did not represent all the market medicines of the areas investigated, and they were only a small part of the plants found in the market. There were also minerals and animal materials sold in addition to plants by vendors and practitioners. They included: minerals such as dign and animal parts such as hyena skin, crushed worms, rabbit meat, and python skin. However, during the survey the concentration was on plants, therefore forty-five plant species were recorded. The amount of plant material in the market depended on the availability of the plants near the area, and the demand and conditions of use. **Bissana, kosso, dingetegna, kebericho, dimbilal, dumuga, meqmeqo atefaris** and **qetetina** were found in large quantities because they were easily available in the vicinity, and **metere, habatelmuluk, dechmerchi, roqa** and **botoro** were in small amounts in the market since they were not easily collected in the surrounding area. There were also plants found in small amounts in the market though they were grown in nearby areas (**damakasse, imbacho, seriti, digita azamir, indahula, koshim** and **abalo**), because they were used in fresh form, vendors collected them only when customers requested them. There was a large

quantity of some plants in the market, such as **kosso, dingetegna, kebericho, bissana, meqmeqo, odeselm, senemaki, ret, azambil, kulqual** and **enkoy** since they were in most demand. Some plants were prepared in decoction, concoction and infusion form. Due to this they had short life time/ expiry date, therefore they were collected weekly or monthly whenever needed. Due to this over exploitation, plants face many problems if they are not protected. Excessive harvesting of rare species in the wild, destruction of forest for settlement, expansion of farmland and overgrazing, are all contributing to the reduction of diversity of these plants.

Conclusions and recommendation

Traditional medicines are used by a large segment of the population in Ethiopia. They are the most important way of making a livelihood for those people who have no another means of income. It is also the most important way of getting relief from diseases like lung TB, gonorrhoea, haemorrhoids, coughs, cold etc. in the local community. But since it is informal it is difficult to evaluate the trade volume and price of it. Therefore, it should be made formal. This can be formalised if the traditional healers work under the government institution.

The use of traditional medicine is increasing and it puts pressure on wild species. This uncontrolled use of plants has brought a scarcity of certain species. For instance collectors can easily destroy plants when their roots and the whole parts are used as medicine. Therefore, teaching the community is the primary solution, the key for conservation. Conservation will become effective, if and only if, there is participation and good will from the population.

Most medicines sold in the market are roots and bark in pounded form, which brings identification problems. There are still many unidentified plant products in the market because of the absence of flowering part and leaves. This will be solved in future studies by collecting the whole plant. And the plant records included in these papers (Table 2 and 3) do not include all the plants found in the market and used by practitioners, but they are the only plants which have been identified and of which their price is known.

Recommendations

- Studies on the economic aspects of medicinal plant should be encouraged.
- Encouragement and funds for researchers should be required to document and analyse trade volume and price of medicinal plants.
- Establishment of a database on the economic value of medicinal plant is very important.

- Conduct research to increase the understanding of medicinal plant markets and trade patterns, supply and demand.
- Ascertain the identity of the commonly traded plant species and review the impact of trade for medicinal purposes.
- Investigate market information systems to ascertain how to promote sustainable harvested medicinal products.

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Annex

Ethnomedicine market information collection format

1) Location of interview: _____
2) Name of Information collector: _____
3) Name of Traditional Healer: _____
4) Address: _____
5) Gender: _____
6) Estimated age: _____
7) Area of specialization (fore example Hemorrhoid): _____
8) Years in business: _____
9) Areas where the healers/ vendors conduct business: _____
10) How many different medicines do you administer? _____
11) Which do you administer the most of (which ones are used in the highest volumes)? _____
12) Which medicines are most frequently requested by customers (which are most in demand)? _____
13) Has the pattern of trade changed in recent years (different species available, different customers, change in demand etc)? _____
14) Have prices of medicines changed in recent years? How? _____
15) Are any medicines scarce or difficult to acquire? _____
16) What is the name of the plants you use? Local name _____
Scientific name _____
17) Part used _____. Preparation _____
18) Application _____. Dosage _____
19) Price /dose _____.

The Role of Educational Institutions and Health Professionals in the better use of Medicinal Plants

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Introduction

Most developing countries are endowed with vast resources of medicinal plants, which have been used over the millennia for the promotion of both human and animal health. Even today, a large proportion of people in developing countries still depend on plants for their health problems, mainly because they are precluded from the luxury of access to modern medicines due to economic and cultural reasons.

In some countries, even where modern drugs are readily available, people still prefer to use herbal medicines, several of which have proved to be very effective.

Modern pharmacopoeia still contains at least 25 percent of drugs derived from plants. Several others are synthetic analogues built from prototype compounds isolated from plants (Tuley de Silva 1997). Today, in a constant effort to improve the efficacy of modern medicine, researchers are increasingly turning their attention to folk medicine for new drugs.

According to *World Pharmaceutical Review* of 1995, the estimated value of plant based drugs in 1994 ranged between USD 32 and 43 billion. In addition to this, home remedies, herbal teas and decoctions have an average sale value of about USD 5 billion and this figure is growing annually at the rate of 12-15 percent (Grumwald 1994).

Traditional medicine and herbal drugs may not be substitutes for modern therapeutic drugs but the fact remains that they are the only ones available to the vast majority of the rural people in developing countries. The vital complementary role played by traditional medicine in the health care delivery system has been clearly demonstrated by the Chinese. It is, therefore, relevant and vital that medicinal plants be considered as possible useful alternative sources of drugs for people in desperate need of essential drugs in developing countries.

Africa, where the menace of endemic diseases is greatly felt, has not yet followed the examples of China and India. These two countries have standardized their indigenous medicine and pharmacopoeia through teaching and scientific research.

In most developing countries the syllabuses in medicine and pharmacy include neither traditional medicine nor traditional pharmacopoeia. In schools or faculties of pharmacy the tropical medicinal plants brought to the attention of the students are limited to the small number of those plants that have been studied by the industrialized countries. It is universally acknowledged that the tropics are a rich source of plants with medicinal properties. Paradoxically, however, as will be explained later, the study and knowledge of these properties remain largely in the hands of industrialized countries.

The large numbers of plants that have not yet been studied represent a potential rich source for the developing world to explore. This is where modern technology can play a useful role.

The application of modern scientific methods in the cultivation, selection, formulation and clinical trials of herbal medicines will speed up the process of transforming traditional medicine into a modern industrial practice. Educators, researchers, health professionals and traditional healers should join hands to fully exploit the potential and promote the development of medicinal plants in the best interest of the great majority of people in developing countries.

The role of educational institutions

Educational institutions, at all levels, starting from elementary schools through the universities have important roles to play in the promotion and advancement of medicinal plants. Below an attempt will be made to discuss possible contributions of the various levels of educational institutions in the better use of medicinal plants.

Elementary and secondary schools

One important contribution of primary and secondary schools would be to bring awareness to the pupils/students that the use of traditional medicine and medicinal plants is no more considered to be primitive and fake. The students need to be informed that:

1) although only a very small fraction of the plant kingdom has been scientifically investigated, several important modern drugs have already been derived from plant sources; and

2) as technology advances several more drugs are expected to be discovered from these sources.

Ministries of education should seek innovative approaches to teaching natural sciences to primary and secondary schools for promoting knowledge of traditional values. The use of local medicinal plants and their demonstrable contribution to the advancement of modern medicine can be suitably incorporated in the school curriculum. The inclusion of a list of the most important modern medicines derived from plants including the names of the plants and the most widely used local medicinal plants would be a good start.

Colleges and universities

The major responsibilities of higher education institutions are teaching and research and their roles in the promotion and advancement of medicinal plants will therefore be discussed under these two headings.

Teaching

Higher education institutions would be responsible for training the following target groups in the basic principles of the use of medicinal plants.

a) Medical and paramedical professionals

Modern doctors in training as well as other paramedicals should be introduced to some features of traditional medicine that will enhance their understanding of the subject. The Association of Medical Schools in Africa (AMSA) has decided that the training programmes of modern doctors in Africa should include an exposure to traditional medical practice (Sofowora 1982).

University medical and paramedical curricula should, therefore, be appropriately revised to incorporate an introduction to traditional medicine. This approach has already been implemented in Somalia where 50 percent of the modern doctors have had some exposure to the knowledge of traditional plants (Emile 1980).

Already two countries (China and India) have successfully designed systems of training and practising traditional medicine alongside modern medicine and it would be of advantage to developing countries to follow the examples of these two pioneers.

In China, for instance, both modern and traditional medical practices are officially recognized health care services and health professionals are trained in both systems of medicine.

In India, on the other hand, the two systems are developed in parallel and the practitioners are independently trained, at all levels of officially recognized institutions. A close and detailed study of these two systems by health professionals in other developing countries would be most appropriate

b) Pharmacists and Druggists

As mentioned earlier, in most developing countries the syllabus in pharmacy neither includes traditional medicine nor traditional pharmacopoeia. In Schools and Faculties of Pharmacy, the topics in medicinal plants brought to the attention of the students in courses like Pharmacognosy, are limited to the small number of those plants that have been studied by industrialized countries. Developing countries, however, need not and should not be restricted to these few plants, but rather should enrich the courses by including several medicinal plants that are widely and effectively used in many developing countries.

In addition to this, an introductory course to traditional medicine should be incorporated in the syllabus. Such a course may include such topics as:

1) contributions of traditional medicine to the advancement of modern medicine;
2) the resurgence of traditional herbal drugs;
3) recognition of the importance of traditional medicine by WHO and reasons for it;
4) review of the most common medicinal plants used by developing countries;
5) the proper identification, collection and storage procedures of medicinal plants;
6) problems involved in dosage formulation of medicinal plants;
7) the importance of standardization and dangers of lack of it.

c) Traditional practitioners

On basic techniques

Educational institutions should make a provision for traditional medical practitioners to be trained in some simple hygienic and basic techniques that will improve their ability and performance.

On identification, collection and storage of medicinal plants

Traditional medical practitioners can make serious or even fatal mistakes in the identification of medicinal plants. Appropriate professionals should therefore prepare simple guidelines and manuals not only for the proper identification of medicinal plants but also for their proper collection, storage and processing.

On sustainable use of medicinal plants

In tropical countries practically all-medicinal plants are collected from the wild except for few practitioners who grow selected plants in their backyard garden. Serious concern is being shown over the rapid destruction of natural vegetation, particularly in the tropical countries containing the greatest diversity of plants, often in limited amounts. The impact of people on the environment has considerably changed since the beginning of the 20th century as a result of industrialization, rising consumption of plant resources and increasing populations. The collecting of wild growing medicinal plants has had its own significant role. As a consequence, biodiversity has begun to be lost as the utilization of plant resources is no longer sustainable. Due attention should be given to the matter and relevant professionals from higher education institutions should therefore alert traditional practitioners and the public at large to the imminent danger and educate them on sustainable utilization of medicinal plants.

d) The general public

Special educational programmes should be conducted to publicize the proper use of herbal medicine by providing educational materials on valid traditional health practices.

Research

The other major responsibility of higher education institutions is research. Countries wishing to make full use of their heritage of traditional medicine should undertake systematic scientific investigations and ethnopharmaceutical studies by bringing together botanists, phytochemists, pharmacologists, agronomists, clinicians and traditional medical practitioners for the purpose of assessing and realizing the potential of development of traditional medicine.

It is unfortunate that although it is acknowledged that the tropics are a rich source of plants with medicinal properties, the study and knowledge of these properties still remain largely in the hands of industrialized countries. For instance, the US National Institute of Health (NIH) collected 4,500 higher plant specimens per year during the years 1991 -1995 from African, South American and Southern Asian tropical countries. Moreover, the collection of these plants is not random but is a deliberate attempt to use local knowledge of traditional medicine to focus on those plants that are, or have been, used for their medicinal properties (WHO 1990). Researchers in developing countries not only have much better access to these plants than those from industrialized countries but sharing the same languages, cultures and traditions with the traditional practitioners is also a big advantage over foreign researchers. With these clear advantages, researchers in developing countries are expected to establish close and genuine relationships with traditional practitioners and undertake systematic studies in the following areas:

a) Ethnopharmacy

Today the major danger to the development of traditional medicine is that with the gradual decline in the importance of traditional healers valuable information on medicinal plants will be irretrievably lost. Ethnopharmaceutical studies should therefore be undertaken as a matter of urgency.

These studies would include making a review and inventory on a national basis of the utilization of medicinal plants and medicaments derived from them. A description of the geographical and climatic distribution of the plants, their sources (wild or cultivated), an indication of their natural abundance and scarcity would be recorded. Taking an inventory of medicinal plants is essential for the identification of endangered species for setting priorities and for monitoring the situation before it is too late.

b) Phytochemical, pharmacological and formulation studies

It has now been universally accepted by the scientific community that nature is still the greatest chemist and many compounds that remain undiscovered in plants are beyond the imagination of even our best chemists. As a result, on the basis of the findings of the ethnopharmaceutical studies and the inventory of medicinal plants, phytochemical studies should be carried out with the view to isolating new therapeutic agents. This should be complemented with pharmacological studies of the isolated compounds not only to distinguish between those that are effective

and not effective, but also to find out whether there are any with hazards of toxicity.

One of the major criticisms against traditional herbal practitioners is that their preparations are not usually dispensed to patients in specified doses. Pharmacy technologists should therefore work on refining and standardizing the collection, processing and storage of medicinal plants as well as on the formulation of herbal medicines.

c) Agronomic studies

With the exception of China and India, almost all traditional medical practitioners in developing countries rely on medicinal plants that grow wild for their practices. The obvious disadvantages of this method of plant collection are; a) the yield of the bioactive constituents may not be optimum; and, b) sustainable utilization of medicinal plants is not practised. Agronomists can play an important role by way of:

- introducing varieties with higher yields of bioactive constituents obtained as a result of agronomic studies;
- improving and perfecting cultivation practices and giving appropriate advice to traditional practitioners and farmers;
- undertaking seed research to determine the best conditions for germination and providing traditional practitioners and farmers with good seeds;
- explaining to the traditional healers that collecting medicinal plants from the wild can have not only a serious destructive impact on the environment but medicinal plants will be depleted and they will eventually be forced to move farther afield to collect the herbs theyuse for their practices;
- encouraging traditional practitioners/farmers to cultivate medicinal plants and advising them on sustainable utilization of their plant resources. Sustainable management of medicinal plants is important to ensure that while the benefits of the present generation are satisfied, the potential to meet the needs and aspirations of the future generations is not jeopardized.

It is evident from the above that the type of research to be undertaken should be multidisciplinary. What is needed is, therefore, to take a comprehensive approach and bring together the main disciplines and interest groups such as health, agriculture, research institutes, universities and traditional medical practitioners under some form of a coordinating mechanism.

The role of health professionals

In most countries including the majority of African countries, official recognition is given to modern medicine. Traditional medical practitioners, however, are at best merely tolerated and their failures are blown up out of all proportion. They are unjustifiably looked down upon by health professionals, particularly by medical doctors, as irrelevant, superstitious and medical hazards. In spite of all this, the traditional healer, especially in developing countries, is playing a bigger and bigger role in today's health care services, with or without a licence to practice.

To bring about rapprochement between modern and traditional medical practitioners, a genuine change of attitude is expected from health professionals and concepts like, "the African mind", "the native mind" and "the primitive mind" as well as the feeling of superiority usually manifested by health professionals will have to be abandoned.

A study carried out in Mali among traditional healers and the various medical and paramedical staff in the hospitals showed that the socio-cultural background of the modern practitioners and the paramedical personnel as well as their individual level of education are factors which affected their disposition to recognition or integration of traditional medicine into the modern health care system (Imperato 1977).

Modern health professionals are often opposed to recognition of traditional medical practitioners on the grounds that providing medical care is too important, too complex and too dangerous to be left in the hands of less trained or differently trained personnel (WHO 1975). However, while health care is a matter not to be treated lightly, the role already played by traditional healers should be taken into consideration. At the same time, however, the need to evaluate traditional healing practices cannot be overemphasized with the view to noting procedures that need to be eliminated or modified in order that the contribution of traditional healers is maximised.

It has already been said that the impact of traditional healers no longer requires to be proved but they need to be linked up in some way to the official system based on modern medicine in order to obtain equitable and wider health coverage (WHO 1983).

Modern health professionals will have to do away with their bias against the traditional healers and approach them with open minds, negotiate with them to reach some common understanding. They need to understand their strengths and

limitations in the practice ofmedicine and also to know more about the input of traditional healers.

The traditional practitioner, too, needs to know and accept that the modern healer has technological expertise, which will put him at an advantage. It is true that the traditional practitioner, for obvious reasons, is dubious about the intentions of the modern practitioner. There is always doubt and mistrust, but once a healthy and genuine rapport is established between the two groups, and the traditional healer is satisfied that they are consulted as equals in their own right with the negotiators, mistrust is dispelled.

In China, for instance, traditional medicinal plants are an integral part of the formal health care system, on equal footing with modern medicine and are used in 40 percent of the cases at the primary health care level.

In Malawi, an attempt to promote traditional medicine alongside modern medicine has been made and this attempt has resulted in the formation Herbalists' Association of Malawi (HAM). HAM closely works with the Malawian Ministry of Health and the University of Malawi, which it provides with plant specimens for phytochemical and pharmacological studies (Sterner 1986).

This acceptance of traditional healers in the modern health delivery system in Malawi means that the confidence of the traditional healers is considerably easier to obtain. They are less suspicious of officials investigating their remedies and more and more willing to provide exact details of the plants theyuse.

Tanzania has opened Traditional Medical Clinics in various rural areas where traditional practitioners are allowed to work in some wards. Ghana, Mali and Madagascar are reported to have taken similar steps (WHO 1978).

The integration of the two systems is not going to be an easy exercise and there will certainly be opposition to it. However, with genuine efforts from both parties, the current mutual rejection will develop gradually through coldness towards each other, followed by strained acceptance of each other. This may lead, hopefully, to peaceful co-existence and finally to active cooperation on either side. As has been aptly said:

> "*an integration of the two systems without compromise of principle, yet with full understanding on both sides, should enable the under-privileged populations of the Third World to benefit from one of the fundamental human rights - the right to health*" (Meyers 1982).

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Global Perspectives of Medicinal Plants

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Introduction

Global utilization of medicinal plants has increased enormously over the last two decades. The untapped wealth of the plant kingdom has become a target for new drugs and lead compounds by multinational drug companies and research institutes. Investigation of traditional remedies, largely of botanical origin, on which a worldwide majority of the population (80%) still relies for its source of medicine has become prominent (Akerele, 1993). It is estimated that 35,000 to 70,000 species of medicinal plants are used worldwide (Farnsworth and Soejarto, 1991).

In the developing countries traditional medicine has remained the major means of treatment due to shortage of pharmaceutical products and their unaffordable prices. Governments of the developing countries, unable to sustain a complete coverage with modern drugs, have encouraged the rational development of traditional treatments. At present the WHO is taking an official interest in such developments in order to facilitate its aim of making health care available for all.

The society in the developed countries has become increasingly interested in "natural" products and the sales of traditional remedies are increasing. An average of 25 % of modern dosage forms contain one or more active principles obtained from plants.

Of the 250,000 species of higher plants on earth the majority have not been examined in any detailed way for their pharmacological properties. One of the largest investigations of recent years into potential new drugs from plants has been undertaken by the National Cancer Institute in the USA. Between 1960 and 1982 some 35,000 samples of higher plant were collected and provided 114,000 extracts which were screened for anticancer activities (Cragg *et al.*, 1993).

The herbal medicine tradition in some European countries remains strong, with quoted figures for herbalists being 16,000 for Germany and 4000 for Denmark

(Evans, 1996). Among the most popular extracts used in Europe are garlic (*Allium sativum*, antimicrobial, blood cholesterol lowering), ginkgo (*Ginkgo bilboa*, circulatory insufficiency), saw palmetto (*Serenoa repens*, diuretic, reduction of enlarged prostrate), milk thistle (*Silybum marianum*, treatment of liver disorders), bilberry (*Vaccininum myrtillus*, inflammation of mucous membranes and diarrhoea), and grape seeds (*Vitis vinifera*, antioxidant and cardiovascular disease treatment).

Commercially, the European market for herbal remedies is growing constantly. In 1990, There was a growth rate of 13% average overall, and a value of USD 2.3 billion (McAlpine, 1992). One Italian Company (Indeana of Milan) specializes in the preparation of medicinal extracts and utilizes some 12,000 metric tons of dried plant material annually (Bombardelii, 1996). The company prepares some 1139 plant extracts for medicinal use together with 202 pure compounds, which are isolated directly from plant material and used as such or as semisynthetic derivatives. The main markets for these products are Europe, USA, Japan and South Korea. In the USA and Canada over-the-counter (OTC) sales of herbal medicines during 1990 reached USD 860 million with an annual growth rate of 15 % (Zhang, 1996).

Germany is one of the largest importers of medicinal plants. It is the leading nation in integrating traditional medicine with the modern drug delivery system. More than 80% of German physicians regularly prescribe or use herbal products. OTC phytomedicine retail sales of Germany is more than USD 1 billion (Grundwald, 1994). In France, as a result of legislation enacted in 1941, the marketing of herbal products is very much under the control of pharmacists, 65% of total sales being through pharmacies. Many physicians in Europe are now reportedly prescribing an increasing number of medicines based on plant sources, as distinct from synthetic ones. In Britain it has been estimated that 6000-7000 tons of herbs are extracted annually for use as ingredients of herbal remedies (Phillipson, 1981); and for the health food market in 1983 it was estimated that the sale of herbal, homeopathic and other remedies amounted to USD 24 million (Anderson, 1986). A survey made in central London on herbal teas, found that more than 100 varieties were on sale from pharmacies and involved 117 different herbs, which were mainly available as tea-bags containing either single or multiherb components.

In China the use of medicinal plants for the health care of the society extends back 4000 years. Medicinal plants still account for an average of 40 % of the medicine market in China. In rural areas drugs obtained from plants constitute up to 90 % of the total drug consumption. China is one of the most successful countries in

linking traditional medicine with modern medicine. It is estimated that more than 6000 plant-based drugs are processed in China. Reports indicate that currently there are more than 2000 hospitals; about 850 manufacturers and some 250,000 doctors specializing in traditional medicine (Kuipers, 1996). Traditional medicines in China are reported to account for 30-50 % of medicines consumed and the total sales of their herbal medicines amounted to USD 2.5 billion in 1993. In addition, China exported medicinal herbs in 1993 with an estimated value of USD 40 million. The most commonly used plant species include ginseng, eucommia and seabucktorn. Within China, the traditional systems of health care are incorporated into the formal components of national health care (Bodeker, 1994).

The use of Chinese herbs has continued in the traditional manner with physicians and pharmacists serving Chinese communities around the world. In many major western cities the Chinatown districts support many herbal shops and practices with remedies imported directly from Asia, and practitioners trained by the old system of long apprenticeship. Much of this activity has remained closed to westerners, although this has changed in recent years as the remedies have become better known and demand for treatment has increased. Among western practitioners Chinese herbal medicine is among the most rapidly growing in popularity as a complementary therapy in the English-speaking western world. It is particularly applied as a second tier of treatment by western acupuncturists who, having pursued the highest profile Chinese therapy, discover how closely herbs and acupuncture are integrated into clinical practice in China itself.

India, because of its diversified climate and its long experience in traditional medicine, is one of the few countries that is capable of producing medicinal plants for both local use and export. Europe, USA and Japan are the major importers of Indian medicinal plants. India's export value of crude drugs amounted to USD 53.2 million between 1994-1995 of which psyllium, ginseng, senna and periwinkle were the major ones (CHEMEXCIL 1996). This value is very much under estimated since a large volume of medicinal plants is traded illegally. The importance of medicinal plants in the health care system of India can be seen from the number of health institutions and traditional medicine practitioners that are solely devoted to practices of traditional medicine. There are over 200 hospitals and 14,000 dispensaries, and about half a million registered traditional medicine practitioners in the country (Bajaj & Williams, 1995).

The majority of the African population rely on traditional medicine for treatment of both human and animal diseases. The vast area of Africa, coupled with wide variations in altitude and climate has resulted in the diversification of medicinal

plants. Although Africa has not taken significant advantage of its medicinal plant resources, reports indicate that some African countries have made considerable progress in the export of medicinal plants. For example, Cameroon is the major source for the world market of *Prunus africana* bark. Over a 6-year period (1986-1991), 11,537 metric tons of the bark (reaching an average of 700 tons) were processed by Plantecam Medicam, a French-owned company based in south-west Cameroon. *P. africana* bark represents 86% of the medicinal plants exported by this company between 1985 and 1991 (Cunningham & Mbenkum, 1993). The seed of *Voacanga africana* is another major plant material exported by Cameroon. Cameroon exported USD 40 million worth of *V. africana* in 1993 alone. It also exports *Tabernanthe iboga* and *Myrianthus arboreus*, but in small quantities (Cunningham & Mbenkum, 1993). Capsules containing the extract of *P. africana* bark are marketed in Europe where the market value of this trade is estimated at USD 150 million per year. Other African countries which export this bark include, Kenya (1923 tons/year), Uganda (193 tons/year), Zaire (300 tons/year) and Madagascar (78-800 tons/year) (Cunningham & Mbenkum, 1993).

The Republic of South Africa exports Rooibos tea (*Aspllathusa linearis*), Marula (*Sclerocarya birrea*) and *Aloe ferox*. Besides, about 500 million South African Rands per annum are spent on traditional remedies in the Republic of South Africa. Namibia exports 200 tons of *Harpagophytum procumbens* and *H. zeyheri* tubers annually to South Africa, and Europe (Cunningham *et al.*, 1992). *Catharanthus roseus* and other medicinal plants represent the major export items in Madagascar. The roots of *Swartzia madagascariensis* and *Entada africana* are traded in West Africa. Ghana exports about 80 tons of *Griffonia simplicifolia* seeds to Germany each year (Cunningham 1993a, Cunningham 1993b). Large quantities of various medicinal plants are also exported to France by Senegal. It has been reported that the demand for many African medicinal plants exceeds the supply (Cunningham 1993a, Cunningham 1993b).

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Experiences in Integrating Traditional and "Western" Health Systems and the Role of NGOs in the Promotion of Medicinal Plants

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Introduction

The following paper draws mostly on the experience of the author on work carried out in Uganda and Ethiopia when working with CONCERN, an Irish NGO. The paper outlines in detail, work, which is ongoing in Booranaland, Southern Ethiopia. This work is attempting to promote the work of traditional healers in a semi-pastoralist community in Dhaddiim, near Yaaballoo and to link their work with a local clinic run by the Catholic Church under the direction of the Ministry of Health.

A project set up in 1991 in Rakai district of Uganda is also examined in detail. This project was a joint effort between local women and a researcher/taxonomist where knowledge on various medicinal plants was shared and a first aid box of local herbs for some of the main symptoms of AIDS was established. Another project in Uganda is also examined. This was a joint effort between NGOs and traditional healers to evaluate the effectiveness of treatments used by healers on three symptoms of AIDS. Reference is also made to a couple of other initiatives in other countries, which are known to the author. In conclusion some suggestions based on the experience of the author are made.

Integrating the traditional and 'conventional' approaches; Ongoing work in Booranaland

In 1997 I began research on the traditional health system in a community around Dhaddiim near Yaaballoo, in Booranaland. The aim of the research was to find out what kind of traditional health system exists in the area and to see if there was any possibility of building links between the traditional system and the 'conventional' system.

Apart from a local research assistant I formed a group of elders who acted as guides and advisers to the study. Having explained to the elders the purpose of the study they quickly put me in touch with all the healers in the community and arranged a meeting with them. The elders also arranged for two of their representatives to attend so as to give it their stamp of approval.

Following discussions it quickly emerged that there is a very formal traditional system in Dhaddiim community. Knowledge is formally passed on from elder to junior - mostly from father to son or mother to daughter. If the son or daughter is not interested the healer will pass knowledge to either a relative or some other person interested in the community like a fellow clan member. Once the healer has passed all his/her knowledge to their junior, the junior brings a gift of coffee and tobacco - a traditional gift to the healer. The healer spits on the gift and in the process of spitting passes on their knowledge to their junior. The junior then becomes a fully-fledged healer. The community believes that medicine will not be effective unless the healer has knowledge formally passed on. Until recently traditional community leaders ensured that all practising healers had knowledge formally passed on.

I only worked with healers who had knowledge passed on in this manner. They were eleven healers in the project. This group formed the basis of the research. In explaining the purpose of the research I emphasised that I would not be asking them about their treatments but I would look at the possibility of integrating their work with the local clinic run by the Catholic Mission under the direction of the local woreda Ministry of Health. The healers said very clearly that if I were going to ask them about their herbs they would not have co-operated in the research.

Most of the healers were generalists rather than specialists. Two were bonesetters only and one woman dealt mostly with gynaecological problems. There were Traditional Birth Attendants (TBAs) in the area but they were not involved in this study. There were also spirit healers but none were present in the study area. The community was reluctant to speak about spirit healers, as it is quite a recent phenomenon among the Boorana. It was only through observation that I came to know that some members of the community frequented these healers. It appeared in the study area that people who had psychological problems or depressive symptoms attended 'spirit' healers.

The healers said that they had to be secretive about their herbs, as the herbs would lose their power to heal. They also said that if everyone in the community knew the herbs there would soon be no herbs left as everyone would go and use them. In fact when healers go to collect herbs they bring coffee and tobacco to the plant from which they wish to collect material from. They put the coffee and tobacco at the base of the tree and then collect material from a neighbouring plant of the same species.

In discussions it became clear that one had to take account of the world-view of the community in relation to the causes of illness. The healers and the community saw health and wholeness in a different light to people coming from a different orientation. For the community in Dhaddiim to maintain harmony with the community and with nature it is important that they respect and follow their customs at all times. Another guiding principle is peace - to live in peace and harmony with each other at all times. If these principles are not adhered to it will lead to bad luck and unspecified ill health. Other causes of ill-health are God - the ultimate cause. For an illness which had no other explanation,God was the cause. Humans for sexually transmitted diseases, insects for malaria, water for certain skin diseases and air for colds and coughs were other stated causes.

Another issue, which emerged in the discussions, was the importance of a common understanding of language used to describe illnesses. For example falxaaxaa means measles to the healers and is caused by drinking dirty water while it is syphilis for the Ministry of Health. This lack of clarity can cause confusion in the community. Other examples are robbi - for the healers it is leprosy and for the MoH it is ringworm. There are local diseases for which MoH personnel did not have a 'western' equivalent. One is xiraa, which healers say is a dry cough and is sexually transmitted. MoH personnel believe that this disease may be TB.

There are a number of diseases where the community prefer to use the healer in preference to the clinic. They include snakebite, evil eye, dawwaroo - a particular type of Boorana headache and associated with the moon, xiraa - already mentioned and bone breakage. It was also found that the further people were from the clinic the more likely they were to use the traditional system. Gonorrhoea is a good example where those closer to the clinic use the clinic and those further away use the healers. It was a disease where the community felt that 'conventional' medicine acted faster but local medicine was more comprehensive in its effectiveness. As the healers would not reveal their treatments for gonorrhoea it was not possible to carry out research to find out if this folk belief is true. According to government policy it is not possible to carry out research on humans using unknown substances.

As a result of the research a training programme was devised in consultation with the healers and clinic staff and the head of the MoH in the woreda. The head of MoH in the zone also participated in a meeting with the healers, elders and local MoH staff. He was fully supportive of the work and offered some good suggestions.

It was very important to keep the clinic staff involved as initially they felt threatened and negative about the healers. They said that healers were killing people by overdosing although they were unable to give many concrete examples. They also pointed out that healers were practising uvulectomy and circumcisions, which were causing hardship. Often the patient ended up in the clinic with heavy bleeding.

Following the design of a basic training programme it was decided that the training would be interactive and facilitated either by the woreda MoH or the clinic staff. Shortly after the training started the head of the MoH in the woreda was transferred. This was a big blow as he was both helpful and interested in the initiative. He had built up a good relationship with the healers. His replacement participated in the training but has still to gain the trust of the healers.

This initial training ended in March. It has led to increased co-operation between the clinic and healers. This was stated by both the healers and the clinic staff. There has been a severe outbreak of malaria in the area in March. The healers said that they are now referring immediately any patient who comes to them with a fever in case it is malaria. They learned this from the training, they said.

One of the issues discussed in the training was the harmful traditional practices which some of the healers have been involved in. One of the healers carries out uvulectomy in the community and is well known for this work. The fact that this issue could be discussed in a non-threatening way is proof of the trust and co-operation, which is slowly building up between the clinic staff and the healers. Another issue discussed was the practice of blood sucking practised by some of the healers. Healers were frightened to learn that one could pick up AIDS through this practice.

It has been decided to hold more comprehensive training with the healers. Discussions are ongoing to decide on the content of further training. Discussions were also held with the healers, Ministry of Health and clinic on the possible long-term direction of the programme. It was felt that an ideal scenario would be for the healers to be the first line of treatment in the community. The clinic would then become the first place of referral. There are a number of problems though with the implementation of this scenario. It is not in line with current Government policy especially if healers are using unknown substances. While people are free to go to healers, one cannot encourage people to go to healers due to their use of unknown substances. The feeling was that these are issues out of control of the

local health ministries but it is useful to continue to build on the good will that exists at the moment. Training is one approach to maintain this confidence and good will.

The healers were looking for tablets for pain especially when bone setting. Following a lot of discussion it was felt that healers should only use their own herbal medicine and if 'conventional' drug treatment was required the healers would refer the patients to the clinic. The clinic has appointed one of the health assistants to be a liaison person between the healers and the clinic. The person is a native of the community.

Lessons to be learnt

- One needs to find out what traditional system exists in the community where one is working.

- One needs to recognise that different communities have different ways of looking at health problems and their view of the world may be substantially different to the view promoted by western, scientific medicine.

- One needs to recognise that words used for an illness by the traditional system may have different meanings than those used by the 'western' system and may have implications e.g. if healers believe and tell people that an illness is caused by drinking dirty water whereas the illness is contagious then the disease may spread rapidly in the community.

- Healers are willing to participate in attempts to integrate their system with the 'formal, western' system. A lot of sensitivity is required and one has to work to build up trust. It is important not to start with the treatments being used by the healers - otherwise they will feel threatened that there is another agenda i.e. to steal their medicines.

- Once trust is built one can talk about some of the harmful practices being used by the healers in a non-threatening manner.

- It is important to keep the practitioners of 'conventional' medicine on-side in such an initiative as it is not an 'either or' situation. One is trying to build good will and co-operation with a view to integrating both systems.

The use of a First Aid Box of traditional medicines in Kirumba sub-county, Rakai district, Uganda.

Rakai district in Southern Uganda was, and still is, severely affected by HIV/AIDS, which is profoundly affecting the lives of some households and communities (Barnett & Blaike 1994). Kirumba sub-county is located in Rakai district. It has thirty-five villages, comprised of 4,802 households and a population of 22, 840 (Apio 1993).

Although there are eight health facilities including two clinics and some drug stores, herbal remedies still provide the main source of health protection for the people in the area (Apio 1993). In the course of working in the area community members, especially those who were sick, asked CONCERN for medicine to help them cope with their sickness. When CONCERN personnel spoke with donors the response they received was that you don't invest money in someone who is going to die. You will not get any return on that investment. When this was discussed with the community especially the women, as they are the ones who mostly care for the sick, the women asked that CONCERN teach them about their own herbs and they would share with each other what knowledge they had.

There was a well-known traditional healer in the area and he agreed to come out one day and share some knowledge with the women who were caring for the sick. He told the women the herbs he used for some of the major symptoms of AIDS such as diarrhoea, fever, skin rashes, itching, headache and so on. He encouraged the women to set up first aid boxes with their plants in them so that they could be like the 'conventional' medical practitioners who usually go around with a first aid kit!! This idea caught the imagination of the women and they duly made their boxes.

A subsequent meeting was held with the women. They found that many of the sick were not interested in local medicines and were unwilling to take them. They also found some confusion among themselves in relation to the exact plant to be used to treat a particular symptom. They said that they also had some knowledge on herbs and would be willing to share the information due to the chronic nature of the illness in the area.

As CONCERN wanted to keep any activity with traditional medicine within the ambit of the Government of Uganda, contact was eventually made with the Natural Chemotherapeutics Research Laboratory (NCRL), which is under the

Ministry of Health. This laboratory is the official point of contact for healers with the government. They advise healers in issues related to government policy and provide testing facilities regarding herbs being used by healers.

One staff member of the NCRL happened to be particularly interested in the project and she had quite a bit of knowledge on medicinal plants. With her assistance two groups of women were formed in the sub-county in order to discuss and share information. One group had thirty-eight members and the second group had thirty-five members. At the first meeting the women discussed the major symptoms of AIDS, which were presenting among the sick in the community. The idea was to find out which symptoms should be discussed with a view to looking for local treatments. Ten symptoms were identified. The women agreed to bring along the plants they know of and use to treat any or all of the identified symptoms.

At the subsequent meeting women discussed in groups of five which plants they knew were effective in their eyes to relieve any of the identified symptoms. Local names were always used. The idea was to identify three plants for each of the major symptoms. In the end fifty-eight plants were identified in total for various illnesses mostly but not exclusively linked to AIDS.

While there was general agreement on two major plants there was often disagreement on the third plant. It was felt by the women that to avoid confusion it would be better to bring along samples of plants so that everyone was clear on the plant being recommended. It took three meetings for the taxonomist to discuss with the women and identify the various plants. In most cases the genus of the identified plant would be the same but in many cases the species would be different. Discussions with the women were in the form of individual interviews, as the women did not want to publicly declare all their knowledge both in relation to diseases treated and method of treatment. They had no problem declaring their knowledge privately, knowing that this knowledge would then become available to all for later use. "It is for the general good of the community" they used to say.

The whole exercise took about nine months. At the end of the exercise a list of effective plants in the eyes of the women was devised. Effectiveness was the main criteria used in prioritising the plants. The taxonomist also checked to ensure that the proposed plants had minimal or no poisonous short-term or long-term effects. Herbarium samples were collected and processed for storage for future reference.

The community, especially the sick, began to accept the project. Word got around that the women had discovered some very good herbs for skin rash, shingles and diarrhoea and were not charging for the herbs. In a couple of instances the village leader fell sick and was treated with the herbs. When he was cured he began to extol the benefits of local medicine. Those caring for the sick soon realised that they were making significant savings by using local medicine instead of going to the hospital every time.

At a later stage another experienced healer began to take interest in the project. He came and had some discussions with the women and taught them how to make cocktails of some of the herbs.

On a recent visit to the area I found that there was extensive use of herbal remedies. I documented many case studies of savings made by the community by using local medicine. I found in a couple of villages that women had begun to package their herbs and had set up stalls to sell them. Village leaders told me stories of their own experiences of using herbs and now encourage others to use them. Six people who were ill were also visited. All except one spoke in a positive way about the usefulness of the local medicine. The one who did not appreciate local medicine was well off and could easily afford 'conventional' medicine. Two of the women have now become village chairpersons and two more are vice-chairpersons. Other women have assumed other posts in the village councils. One woman also received training in reflexology and is now quite a famous woman in Southeast Uganda. She has helped three well known people who had stokes to walk again. People now believe that she can 'make the lame walk'.

As a result of the effectiveness of this project the local district medical officer has recently carried out an assessment of the project with a view to incorporating it into future district health policy.

Lessons to be learnt

- One needs great trust in and with the community to develop such an approach. It had taken twelve months working with and visiting the sick before the women came up with the ideas.

- Women have a crucial role to play in traditional health care, as they are the people who traditionally provide health care in the family.

- Many people in the community particularly women have a lot of knowledge on local herbs although they are not formally considered healers. By using group methods where there is a good level of trust, community members are willing to share knowledge for what they perceive is the common good.

- Local health officials are willingto take on board approaches and practices, which they perceive are beneficial to the community.

- From the outset of the project, the issue of staff involvement in the project and the possibility of them commercialising the knowledge, which they gained, was discussed. Staff were asked not to commercialise any knowledge they gained and signed an agreement to that effect. The community took this commitment on trust and to this day seven years later all the staff have honoured this commitment. This has greatly cemented trust among staff and the women who are involved in the project.

Research project with traditional healers in Uganda

Traditional and Modern Health Practitioners Together against AIDS (THETA) is a local NGO founded out of a joint effort between MSF - Switzerland, The AIDS Support Organisation (TASO) in Uganda. The long term goal is to promote and support collaboration between indigenous traditional healers and conventional health practitioners in order to re-inforce both sectors at the community level and eventually achieve better disease prevention and health promotion.

A study was carried out with 8 traditional healers in Kampala in order to investigate the potential effectiveness of traditional herbal treatments for AIDS related chronic diarrhoea, chronic wasting and Herpes Zoster infection (shingles). In phase II a confirmatory study focused on Herpes Zoster and chronic diarrhoea.

Criteria were set up to guide the healers who participated in the study.

- healers would not mix synthetic and herbal drugs;
- healers would maintain the same treatment for a given patient throughout the follow-up;
- healers would not coerce patients into joining the study but explain to them its objectives and constraints and let them choose freely;
- healers or doctors would not divulge results or make claims before completion of the study;

- only patients presenting with at least one of the symptoms under study would be enrolled;
- doctors would respect healers' rights of ownership over their preparations.

Methods used in the study

- Patients were selected, enrolled and followed up by a doctor, nurse and/or healer at a consultation set up in Mulago Hospital. Healers came once or twice a week to the hospital on a fixed day. They saw, treated and talked to patients together with the project's Medical Assistant and nurses in the clinical room. Healers brought their herbal preparations with them to the consultation each time. Nurses took patients' data. Control patients were recruited and followed up by a TASO doctor and nurse at the TASO clinic in Mulago hospital.
- Herbal preparations were coded by each healer and administered according to the healer's dosage and regimen.
- Controls received the best medical treatment available at TASO clinic.
- Enrolment criteria included; informed consent; diagnosis of the illness under study e.g. WHO definition of chronic diarrhoea; patient not under another treatment at the time of enrolment.
- A pattern of follow-ups was agreed depending on the illness being treated. Patients were followed up over a six month period.

Chronic diarrhoea

Two end points were considered to measure effectiveness of treatments used for chronic diarrhoea:

- the proportion of patients whose diarrhoea responded to the treatment;
- the number of days it took for the diarrhoea to stop;

Response to treatment was defined as the absence of diarrhoea episodes over at least 2 consecutive follow up visits. Improvement was defined as a lesser daily frequency of diarrhoea episodes, while worsening related to a greater daily frequency of episodes.

The study found both in phase I and phase II that the proportion of chronic diarrhoea patients who responded to treatment were significantly greater at healers than among controls ($p<0.005$).

Herpes Zoster

End points considered measuring effectiveness of treatments used for *herpes zoster:*

- the number of days it took for the postules to heal;
- the number of days it took for scabs to heal;
- the number of days it took for post-herpetic neuralgia to heal.

The study found that:

- the average number of days it took for postules and/or scabs to heal were very similar;
- the average number of days it took for post-herpetic neuralgia to heal was significantly shorter among healer patients;
- the proportion of patients whose post-herpetic neuralgia subsided over follow up was significantly higher among healer patients than among controls.

The purpose of the study was to evaluate the clinical effectiveness of herbal preparations for AIDS symptoms. It was felt that the results answer the question sufficiently to justify promoting the use of such preparations as valid and viable local alternatives for the treatment of the conditions studied.

Lessons to be learnt

- Herbal treatments could be valid alternative treatments for chronic diarrhoea and Herpes Zoster in HIV infected people.
- Healers participated eagerly in the study. They were able to accept and understand the constraints of research. This should encourage both biomedical professionals and traditional healers to collaborate with each other in a serious and systematic way to further explore other local alternatives.
- Trust was established and maintained with the healers through the study. Both sides honoured their commitments. The researchers did not ask the healers for their treatments. Codes were used throughout the study so the healers did not have to revel which treatments they were using.

Some other attempts to link both systems

There is one project in Madagascar where traditional healers work side by side with 'western' practitioners. They are all based in one health centre. Diagnosis is carried out in the conventional way. Once the illness is diagnosed the patient is treated either with 'western' medicine or local medicine or a combination of both.

For example if someone has a skin disease they may be referred to the traditional healer. If some one is diagnosed with malaria the fever is treated with traditional medicine and the malaria is treated with 'western' medicine. Other diseases are treated using 'conventional' medicine only.

Another approach used is to have healers and 'conventional' practitioners work side by side in the one clinic. When patients come for treatment they can choose either system. Diagnosis, prescription, treatment and follow up is done according to the norms and practice of each system. Both systems co-exist under the same roof but each system works according to it's own norms.

Concluding comments

1) There are attempts at linking and integrating both systems of health care as outlined above. There are I believe some points to keep in mind when considering linking both systems.

2) One needs to work to build up trust between the healers and the Ministry of Health. Healers feel under threat and are suspicious of an external intervention. Their worldview is different and this needs to be recognised. It is a worldview shared by many in the community.

3) To work with the community it is important not to begin by asking healers about their treatments. It is a sure and quick way to alienate them. In my experience as trust grows healers will begin to share information anyway, in their own time and in their own way.

4) One has to consider carefully issues related to intellectual property rights already enunciated by Ato Regassa and Ato Worku. There is a lot of suspicion grounded on experience, when major international institutions including the World Bank become involved with traditional health systems. This has to be recognised and handled carefully.

5) Although not referred to directly in the case studies there is need for all interested parties to ensure that plants traditionally used for medicinal and other purposes are preserved. Involving healers in conservation issues is vitally important as they have a vested interest in preserving valuable medicinal plants.

6) Harvesting and packaging medicinal plants can offer possibilities for income generating activities for rural communities provided environmental and intellectual property issues are dealt with.

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Biodiversity Conservation and Sustainable Use of Plant Genetic Resources in General and Medicinal Plants in Particular in Ethiopia: Review of Existing Laws and Polices

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Introduction

The 1955 revised constitution of Ethiopia under article 130 stipulates the following:

1) The natural resources of, and in the subsoil of the empire, including those beneath its waters, are state domain.
2) The natural resources in the waters, forests, land, air lakes, rivers and parts of the empire are sacred trust for the benefit of present and succeeding generations of the Ethiopian people. The conservation of the said resources is essential for the preservation of the empire. The imperial Ethiopian Government shall, accordingly, take all such measures as may be necessary and proper, in conformity with the constitution, for the conservation of said resources.
3) None of the said resources shall be exploited by any person, natural or juridical, in violation of the principles of conservation established by imperial law.

Having read this article one may ask why such strong legal intervention in the use of natural resources is needed? If we consider the case of biotic wealth alone- because of human intervention in the earth's natural process, the earth's biotic resource, a resource of unlimited potential to be tapped to satisfy the ever growing human need, is severely threatened. The threat has never been so great as it is today; and no part of the globe is an exception. From the tropical to the temperate forest, from the fresh water to the marine ecosystem both the components and varieties of the earth's biotic wealth are exposed to a threat continuing at an alarming rate (UNEP 1992). Should this not be stopped, the future of human society will be dark.

It was in an attempt to give a legal response to this crucial threat to existence that the 1955 Revised Constitution of Ethiopia, forty-eight years ago, provided such a concise and impressive stipulation on the conservation and utilization of natural resources. This constitution constituted a milestone in the development of the law of natural resource conservation and utilization in the country. It for the first time established the legal basis for the conservation and utilization of natural resources, determined the issue of ownership over natural resources and the general direction

of national policy on natural resource conservation and utilization. This paper aims to review and assess the situation of the existing laws and policies put in place to ensure conservation and direct sustainable utilization of plant genetic resourses in general, and medicinal plants in particular, half a century after the first concise legal regulations were put in place.

Policy on plant biodiversity conservation and sustainable utilization

Biodiversity conservation and sustainable utilization first became an object of national policy in Ethiopia in the 1955 revised constitution. The constitution defined in a very general expression the policy to be followed by the government, pertaining to the conservation and utilization of natural resources of which plant biodiversity is a component (Revised Constitution of Ethiopia 1955). The policy so stipulated, states that the government shall take all such measures as may be necessary and proper for the conservation of natural resources. To put in place detailed policies on the conservation of the various forms of natural resources is one of the measures that needs to be taken for the conservation of the said resources (Revised Constitution of Ethiopia 1955).

Nonetheless, apart from what is provided in the Environment Policy of Ethiopia, no specific policy on plant biodiversity conservation has been enacted as yet, let alone on medicinal plants in particular. The Environment Policy has a section, composed of eleven provisions under a heading "Genetic, species and Ecosystem Biodiversity", dealing with biodiversity conservation and sustainable utilization in general. This section deals with the whole range of the biotic wealth in very general terms. In effect it is limited to laying the basis for the development of detailed specific policies on the various aspects of the biotic wealth. As the provisions of this policy are few in number and self-explanatory it is preferable to present the full script of the provisions rather than a treatise there-of.

The policies (Environment Policy, 1997) are:

1) To promote *in-situ* systems (i.e., conservation in a nature reserve, farmers' fields, etc.) as the primary target for conserving both wild and domesticated biological diversity; but also to promote *ex-situ* systems (i.e., conservation outside the original or natural habitat) in gene banks, farms, botanical gardens, ranches and zoos as supplementary to *in-situ* conservation.
2) To promote *in-situ* conservation of crop and domestic animal biological diversity as well as other human made and managed ecosystems through the conscious conservation of samples of such ecosystems, even when change as a whole is taking place.

3) To ensure that the importation, exportation and exchange of genetic and species resources is subject to legislation, e.g., to ensure the safeguarding of community and national interests, the fulfilling of international obligations, quarantine, etc. Above all, biological materials, which are self-regenerative and impossible to control once allowed to get out of control may result in the most insidious and damaging form of pollution which is biological pollution, thus the importation and use of biological material, including those genetically engineered, should be under stringent regulations.
4) To ensure that factors such as the level of vulnerability, uniqueness, importance and economic and environmental potential of the genome be taken into account in determining priorities in conservation.
5) To ensure that the conservation of genetic resources *in-situ* maintains a dynamic system of genetic variability in an environment of constant selection pressure that is normally present in the natural or human made ecosystem as the case may be.
6) To promote the involvement of local communities inside and outside protected areas in the planning and management of such areas.
7) To ensure that the conservation of biological diversity outside the protected area system be integrated with strategic land use plans, local level plans and sustainable agricultural and pastoral production strategies.
8) To include in protected areas as wide a range of ecosystems and habitats as possible and where appropriate to link them by corridors of suitable habitats along which species can migrate.
9) To ensure that pricing polices and instruments support conservation of biological diversity.
10) To ensure that park, forest and wildlife conservation and management programmes that conserve biological diversity on behalf of the country allow for a major part of any economic benefits deriving there from to be channelled to local communities affected by such programmes.
11) To recognize that certain animal and plant species are vermin or pests or may be a reservoir of disease to humans, crops and livestock, and to control them.

The development of plant biodiversity laws in Ethiopia

With the promulgation and coming into force of the 1955 revised constitution, the law of natural resource conservation and utilization as a definite legal regime came into existence. The constitution under article 130 determined in general terms the ownership over natural resources and the principles of their utilization.

Like many other constitutional provisions, art. 130 of the 1955 revised constitution is only a general provision for the implementation of which the enactment of detailed enabling laws specifically to regulate the conservation and utilization of the different forms of natural resource is a must. For this reason and on the basis of the constitution, the state forest proclamation (Proclamation no. 225 of 1965), the private forest conservation proclamation (Proclamation no. 226 of 1965) and the protective forests proclamation (Proclamation no. 227 of 1965) and the corresponding regulations to determine the conservation and sustainable utilization of forest resource were consecutively enacted. These proclamations gave the Ministry of Agriculture the power to arrange for and control, in accordance with modern scientific principles, the conservation, management and utilization of state, protective and private forests. Pursuant to these laws no forest is exploited from these forestlands without having an exploitation permit from the Ministry of Agriculture. And whosoever contravenes these laws is punishable under the penal law.

The scope of application of the state forest proclamation and the private forest conservation proclamation is, however, limited to forest trees - woody plants, including bamboo, which normally attain the height of ten meters. The scope of application of the protective forest is wider than this and covers trees, shrubs and other plants (Proclamation no. 227 of 1965) However, the objective behind the protective forest proclamation is the creation and maintenance of permanent vegetative cover for the purpose of protection of soil, water regime, and control of flood (Proclamation no. 227 of 1965), not plant biodiversity conservation.

Neither of these proclamations has provisions to deal with medical plants specifically, nor there is another law to specifically deal with medicinal plants. The relevance these proclamations have to medicinal plants conservation and utilization is that both medical plants that qualify as forest trees as defined in the state forest proclamation and private forest proclamation, and those found in the protective forest get the legal protection provided therein.

Plant biodiversity conservation and sustainable utilization is also an international concern that requires a coordinated action at global level. This led to nations of the world negotiating and adopting the Convention on Biological Diversity in December 1994. The adoption of this convention represents a dramatic step forward in the conservation and sustainable utilization of biological diversity and its components. Determined to conserve and sustainably use its biological resource, Ethiopia joined the world community to approve the convention and made it part and parcel of its national laws. The convention strengthened and

widened the legal basis for the conservation and sustainable utilization of the plant genetic resource of the country.

Shortly after the ratification of the convention, the Forestry Conservation, Development and Utilization Proclamation (Proclamation No. 94/1994) was enacted, with the view to consolidating the various laws on the subject and providing for the inclusion therein of provisions that better further the conservation, development and utilization of forest resource. This proclamation is a turning point in the development of laws of plant biodiversity conservation and utilization. It introduced, for the first time, the concept of plant biodiversity conservation and utilization into the national laws Until the enactment of this proclamation, plant biodiversity conservation had never been a distinct national legislative objective. It has to be borne in mind that even at this stage, the conservation of plants from the perspective of their medicinal utility is non-existent.

The existing laws on plant biodiversity conservation and sustainable utilization

The Constitution of the Federal Democratic Republic of Ethiopia, the Convention on Biological Diversity, the Forestry Conservation, Development and Utilization Proclamation, the Plant Quarantine Regulation and the Regulation to establish the Ethiopian Health and Nutrition Research Institute are the laws that constitute the existing legal framework of plant biodiversity conservation and sustainable utilization in Ethiopia.

Article 40 and 92 of the Constitution of the Federal Democratic Republic of Ethiopia lay the base of the legal framework. They regulate only the most basic issues: ownership and the principle of conservation on the basis of which detailed enabling laws are to be enacted. The convention, though it contains forty-two provisions and two annexes, is mainly limited to providing the legal and policy direction to be followed leaving the regulation of specific matters to the national laws to be enacted based on the existing national reality.

The only specific law of such kind we have at present is the Forestry Conservation, Development and Utilization Proclamation of 1994. The scope of application of this proclamation is not limited to only forest resources even though the title thereof seems to indicate so. It has incidental provisions applicable also to the conservation and utilization of plant genetic resource in general These incidental provisions provide for the establishment of protected forests wherein, *inter alia*, plant biodiversity in general is conserved.

The pertinence of this proclamation to the conservation and sustainable utilization of medicinal plants is to the extent of its scope of application. It applies to the conservation and sustainable utilization of those medicinal plants that qualify as forest trees (any woody plant including bamboo, reeds and palms and other plants to be designated as tree by the Ministry of Agriculture) or those found within protected forest areas.

The only legal stipulation that talks specifically of medicinal plants is art. 5(11) of No.4/1996 regulation, the regulation to establish the Ethiopian Health and Nutrition Research Institute. It stipulates that the Institute has the obligation to cooperate with the concerned organizations and make all efforts for the conservation and protection of plants that serve as traditional drugs. But nowhere in that law or in other laws, are specified the concerned organizations to conserve medicinal plants or the measures of conservation to be taken. Bearing in mind what has been said above of medical plants, we shall now see how ownership, development, conservation and sustainable utilization of plant biodiversity in general and forest genetic resource in particular are regulated.

Ownership of forest and plant genetic resources

The 1995 Constitution of the Federal Democratic Republic of Ethiopia provides for joint ownership of the natural resources in the country. Article 40 (3) stipulates that the ownership over the natural resource of the nation is vested in the state and the people. The Forestry Conservation, Development and Utilization proclamation of the 1994 determines the issue of ownership as it specifically concerns forest resources. Article 3 of this proclamation provides that there are three types of ownership over forest resources: Federal, Regional and private forest ownership.

The Federal State owns those forests designated by the federal government itself as state forest and state protected forest (Forestry Proclamation, 1994) A state forest is a forest developed by a programme covering more than one region for purpose of protecting the genetic resource or the ecosystem and designated as state forest by a regulation to be issued by the council of Minsters (Forestry Proclamation, 1994). A state protected forest is a forest or forest land so demarcated by the Ministry of Agriculture in order to make it free from human or animal interference for the purpose of protecting, *inter alia*, rare or endemic plants and plant genetic resource in general (Forestry Proclamation, 1994). The Regional States own those forests designated as regional forests and regional

protected forest by the regional states themselves in a manner and for purposes similar to that of state forest and state protected forest (Forestry proclamation, 1994). A forest developed by any private person, peasant association or association organized by private individuals is a private forest. It is owned and administered by the person that developed it (Forestry proclamation, 1994).

Development of forest and plant genetic resources

Article 7 of the Forestry Proclamation allows forest to be developed by the state, the regions and private persons. In addition to forests, the State and the Regions may develop plant biodiversity in general in the protected forest area (Forestry proclamation, 1994).

Forest development in the country is directed by the overall forest policy to be enacted by the central government. And the Ministry of Agriculture shall encourage and render the necessary technical assistance towards the development of forest (Forestry Proclamation, 1994). With regard to State and Regional Forest development, the Ministry of Agriculture or the appropriate regional body, as appropriate, prepares a forest development program and monitors its implementation (Forestry proclamation, 1994).

Private individuals and organizations are allowed by law to develop forest in a sound manner and benefit there from (Forestry proclamation, 1994). The Ministry of Agriculture or each Region shall, without prejudice to the overall policy of the central government, facilitate conditions and provide technical assistance towards the development of private forest (Forestry proclamation, 1994).

Conservation of forest and plant genetic resources

The forestry proclamation provides for some conservation measures to be taken by the government and private persons. The following are the main ones: -

Plant pest and disease control

Plant pests and diseases cause great damage to the plant resource. Taking measures to stop them contributes to the conservation of the plant resource. That is why the forest proclamation imposes obligations on the government and private forest owners with regard to plant pests and disease control. The Ministry of

Agriculture and the appropriate Regional body, as regards state and regional forests respectively, shall take the appropriate preventive measure to ensure that the forest is free from forest pests and disease. The state and the regions are also responsible for doing the same with respect to the protected forest (wherein plant biodiversity in general is protected) (Forestry proclamation, 1994). As concerns private forests, the owners thereof have the obligation to take the necessary measures on their own to ensure that the forest is free from pests and disease and to notify the Ministry or the appropriate Regional body any occurrence of forest pests and disease (Forest proclamation, 1994).

Quarantine control is another important measure to be taken to control plant pests and disease. All imported plants and other articles (Quarantine regulation, 1992), which are liable to be infested or infected with plant pests, are subject to plant quarantine. Quarantine control is not limited to forest plants; it is applicable to all plant varieties. The Ministry of Agriculture is responsible for ensuring the conducting of quarantine control (Quarantine regulation, 1992).

Controlling human settlement and grazing in forests

Unsound human settlement and overgrazing in forests affect the forest resources. Human settlement and grazing in forests thus need to be regulated to conserveresources. Article 13 (2) of the Forestry Conservation, Development and Utilization Proclamation takes the same stand and prohibits human settlement and grazing in the state and regional forests unless in possession of a permit to do so from the concerned body. The requirement of a permit enables the authorities to control that settlement and ensure that grazing in forests is not causing damage. Apart from settlement and grazing, no other minor activity is allowed in protected forests (Forestry proclamation, 1994).

Control of forest fire and other disasters

Article 5(2) (d) of the Forestry Conservation, Development and Utilization Proclamation provides that the Ministry of Agriculture and the concerned Regional body have the duty to ensure that state and regional forests are protected from fire and other disasters. Preventive and reactive measures are provided for in the proclamation to control forest fire. The preventive measures are those related to taking the necessary precautions not to start forest fires, and the reactive measures are those related to stopping the spread once it has occurred. As a preventive measure individuals who inhabit and work in a forest are obliged to take all the necessary precautions, prior to starting a fire, by removing all inflammable materials from their surroundings, so as not to cause forest fires.

The concerned regional body also has the responsibility of taking the necessary measures to extinguish forest fires by coordinating and mobilizing any private or public organization and the community. Any individual who is aware of the occurrence of forest fire has a legal duty to immediately report the same to the Ministry of Agriculture or the appropriate regional body; and cooperate in the effort to extinguish the fire (Forestry proclamation 1994). Private forest owners are also under obligation to do everything possible to avoid or stop forest fires.

Regulating utilization

The forestry proclamation provides for a regulated utilization as a means of conservation. A regulating utilization may be by limiting the size of exploitation or totally excluding some plant species (usually endangered ones) from exploitation (Forest Proclamation, 1994). Article 13(1) (a) of the Forestry Conservation, Development and Utilization Proclamation of 1994 excludes from exploitation *Hagenia abyssinica, Codia africana, Podo carpus gracillior* and *Juniperus procera* in state or regional forest whereas article 13(2) (a) limits size of exploitation through attaching utilization to the requirement of a permit whereby it is convenient to control the size of exploitation.

Rehabilitation of endangered species

The Forestry Conservation, Development and Utilization Proclamation of 1994 provides for rehabilitation of endangered species as one mechanism of conservation. Article 5(2) (g) of the proclamation stipulates that the Ministry of Agriculture and the concerned Regional body have the obligation to rehabilitate endangered indigenous forest species. Private forest owners are made responsible by law to observe the directives to be issued by the Ministry of Agriculture on the conservation of endangered tree species (Forestry Proclamation, 1994).

Replacing forest trees made use of

Replacing the forest trees made use of, helps maintain the forest population. This mechanism is employed in the conservation of private forest (Forestry Proclamation, 1994). Article 6 (2) (a) imposes an obligation on private forest owners to replace the forest trees they made use of in different ways.

Conservation of plant genetic resources

The Forestry Conservation, Development and Utilization Proclamation of 1994 contains provisions dealing with plant genetic resource conservation. Article 7 of

this proclamation provides for the system of establishing protected forest wherein, any tree species, bush and other plant is developed and protected with the objective of, *inter alia*, protecting rare and endangered endemic plants and plant genetic resources in general. Plant varieties in protected forests are kept free from any human or animal interference. No person is allowed to cuttrees, utilize the products thereof, or perform other activities in protected forests (Forestry Proclamation 1994). The conservation measures provided for the other forest types are also applicable to protected forests.

Utilization of forest and plant genetic resources

The utilization of forest resources is regulated by law. The forestry proclamation establishes the principle of forest resource utilization (Forest Proclamation, 1994). The principle of utilization for state and regional forest, and private forest is different. State and regional forest is utilized in accordance with the forest management plan to be approved by the Ministry or the appropriate regional body. The management plan is believed to be based on utilization research and ensure the sustainable utilization of the forest resource. Some endangered forest tree species are excluded from utilization so that they can be reinstated. *Hagenia abyssinica, cordia africana, podo carpus gracillior* and *Juniperus procera* are excluded from being utilized.

The principle of utilization followed with regard to private forest is maintaining the equilibrium between utilization and replacement (Forestry Proclamation, 1994). Accordingly, the proclamation imposes an obligation on private forest owners to replace the forest trees they made use of. Private forest utilization is also subject to a utilization permit.

The utilization of plant genetic resource found in the protected forest is subject to permission from the Ministry of Agriculture or the appropriate Regional body and is limited to harvesting forest products, grass and fruits and keeping of beehives (Forestry Proclamation, 1994). One cannot cut any tree from a protected forest whatsoever.

Mechanisms of ensuring the enforcement of the forestry proclamation

Various mechanisms are provided for to ensure the enforcement of the conservation and utilization measures and obligations stipulated in the law. The institutions of forest guards and inspectors are established and empowered to ensure the observance of the forestry proclamation (Forestry Proclamation, 1994).

Imposing a legal obligation on citizens to cooperate with the government in the implementation of the proclamation, and the regulation and directives issued thereunder is the other mechanism employed by the proclamation. The last mechanism employed is imposing penal liability. Any person who violates the provisions of the proclamation is subject to penal punishment.

Observations and recommendations

Plant biodiversity conservation seems a point better taken in policy than in law. The existing policy, though is very general, is wide enough in scope to be applicable to the whole range of plant biodiversity. What is missing is the enactment of a detailed and specific policy that takes into account the special needs of conservation and sustainable utilization of the various sections of the plant genetic resources. And there is no specific policy of such kind on medicinal plants. Hence, a detailed and specific policy on the conservation and sustainable utilization of the plant genetic resource in general, and medicinal plants in particular, must be framed and put in place.

The major objectives behind the existing laws concerning plant genetic resource are to prevent soil erosion and desertification, and maintain the containing of forest products and the ecological balance. In these laws plant biodiversity conservation is an incidental objective. This is observable from the fact that plant varieties, apart from forest trees and those outside the protected forest area, are not covered by these laws. This is true with medicinal plants. Even those medicinal plants that fall within the ambit of the existing laws are not treated from the angle of their medicinal utility. Hence, the special needs of conservation and sustainable utilization of medicinal plants need to be identified and established by law.

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GROUP DISCUSSIONS

Group I. Conservation and Cultivation of Medicinal Plants

A. Conservation of Medicinal Plants

I. Problems/Constraints

1. Undetermined rate of erosion of medicinal plant germplasm due to:
   - Increased rate of habitat/biota loss as a result of population growth and the associated need for expansion of farmlands and grazing lands.
   - Climatic change / droughts.
   - Excessive collection (over-harvesting) of medicinal plants.
   - Unsustainable harvesting techniques as a result of lack of acceptable regulations. Governing the management and sustainable collection of M.P. from natural ecosystems.
   - Replacement of natural vegetation by exotic species.
2. Continuing problem of rural poverty, which is a root cause for unsustainable use of natural resources.
3. Lack of ex-situ conservation sites (Botanical Gardens, Medicinal Plants Gardens).
4. Lack of supportive education programs: written, video, radio, TV.
5. Lack of communication and co-operation between Government resource managers, Traditional Health Practitioners and Communities.
6. Lack of awareness/appreciation by MoA/MoH of indigenous knowledge of M.P. (No attention accorded by the MoA extension system to the value of M.P. and their sustainable utilisation).
7. Insufficient institutional linkages.
8. Insecurity / Secrecy of THP regarding plants used and potential endangerment.
9. Knowledge gap between M.P. distribution, volumes annually collected, and threat to future management, availability and use.
10. Inadequate land tenure security.
11. Limited information on M.P.'s used in animal health care by pastoralists and threat to survival.

II. Strategy and Components

1. Establishment of databases on M.P.s and traditional knowledge concerning their use.
2. In-situ conservation/conservation of natural ecosystems
3. *Ex-situ* conservation
4. Capacity building/Logistics
5. Awareness creation/education/communication/networking

III. Major Activities by components

1. Database establishment

1.1 Develop formats for databases and establish mechanisms for the release of information to the various stakeholders
1.2 Carry out surveys on MPs in their natural environments.
1.3 Collect and enter all-important information on MPs in the database (e.g. scientific and vernacular names, distribution, agro-ecology, conservation status and physiology).
1.4 Explore and document traditional knowledge on uses and conservation of M.P.s from relevant sources (e.g. communities / women, THP, Orthodox Church, EISC).
1.5 Update and maintain databases.

2. *In-situ* conservation

2.1 Identify ecosystems that are important as habitats for M.P.s, but not covered in Ethiopia's Protected Areas System (gap, analysis).
2.2 Carry out surveys on existing conservation practices.
2.3 Prioritise MPs for conservation measures according to an established set of criteria (degree of endangered nature, e.g. medicinal, cultural and economic values).
2.4 Identify appropriate modes (e.g. appropriate legal status, incentive system for communities) and sites for in-situ conservation in different agro-ecological zones.

3. *Ex-situ* conservation

3.1 Identify priority species for ex-situ conservation.
3.2 Identify appropriate sites and technologies for ex-situ conservation for the different species.
3.3 Collect germplasm/specimen of MPs.

4. Capacity building/logistics

4.1 Identify training needs and design and implement training programs for all levels.
4.2 Establish required infrastructure and procure equipment.

5. Awareness creation/education/communication/networking

5.1 Promote the incorporation of conservation science in school curricula, with particular reference to M.P. issues.
5.2 Promote the understanding/appreciation of traditional knowledge on MPs and their applications as an important part of Ethiopia's cultural heritage.
5.3 Popularise scientific research results on M.P.
5.4 Promote networking of institutions and all relevant stakeholders at various levels.

B. Cultivation

1. Gaps/problems

1.1 There are no proven cultivation methodologies for Ethiopian MPs.
1.2 Retention of quality and efficiency in cultivation must be determined.
1.3 How would farmers be selected?
1.4 Limiting factors for cultivation are not determined.
1.5 What MPs should be selected for cultivation are not identified.
1.6 Will EARO collaborate? (So far no institute has embarked on medicinal plants.

2. Strategies

2.1 Identify MP species, which need to be considered for cultivation.
- Identify status of MPs commonly used by TH.
- Prioritise MPs for cultivation.

2.2 Characterise MPs suitable for different agro-ecological conditions and identify appropriate agro-ecological conditions for MPs.
- Plant and characterise different collected materials in the agro-ecological environment from where they originate.
- Plant and characterise different collected materials in different agro-ecological environments.
- Work in collaboration with different institutions, BDI, EARO, HLI, RARCO.

2.3 Identify and develop appropriate technology for production of MPs.
- Identify appropriate cultural practices: agronomic (including fast propagation methods, crop protection, post-harvest handling, economic components).

2.4 Develop out-growers schemes along with the participation of the private sector (production and processing).
- Popularise and promote the economic value and use of MPs.
- Provide technological packages for producers through production manuals, seminars, workshops, etc.
- Organise central system of collection.

2.5 Promote growing MPs in home gardens
- Document existing cultivation practices in different ecosystems and farming systems with particular emphasis on home gardens.
- Conduct scientific evaluation of techniques used.
- Involve women in the research.
- Promote intensive, affordable techniques, which do not require much land.

2.6 Support institutions to generate technologies
- training
- facilities

2.7 Develop source of planting material for sustainable production
- maintenance of planting material in suitable agro-ecologies
- production of planting materials in appropriate agro-ecologies

2.8 Take gender issues into consideration when developing and promoting MPs cultivation schemes
- identify role of gender in maintenance and cultivation of MPs
- identify role of gender in resource allocation in cultivation of MPs and sharing benefits thereof.

Group II. Policy and Economics

1. Gaps/Problems

1.1 Absence of detailed national laws and policies on conservation and utilisation of medicinal plants.
1.2 There is no law to protect the rights and define the duties of traditional healers.
1.3 There are negative attitudes and misconceptions about traditional healers.
1.4 Unfavourable conditions to organise traditional healers.
1.5 Absence of co-ordination between traditional and modern medical delivery systems.

1.6 Absence of law to recognise community rights. (exclusion of communities from decision-making on matters affecting their resources)

1.7 Absence of a system to collect, organise, conserve and protect as well as develop and promote traditional knowledge (written and oral).

1.8 Absence of the necessary forum to popularise traditional medicine/practice.

1.9 Absence of incentives or award system.

1.10 Absence of opportunity for traditional healers to enrich their knowledge/gain from experiences in other countries.

1.11 Absence of a transparent relationship between government institutions and traditional healers.

1.12 Absence of traditional medicine from the curriculum of the formal education system and a mechanism to promote the transfer of this knowledge to the coming generations.

2. Economy

2.1 The monetary value and contribution of traditional medication to the national economy is not known.

3. Possible solutions

3.1 Develop the necessary policies with the objectives of.

- identifying, conserving and developing medicinal plants;
- recognising, protecting and developing traditional medical knowledge;
- developing, co-ordinating and promoting a partnership and working relationship among the private, government, higher education and R&D institutions;
- maximising benefit for the country, and ensuring health for all.

3.2 Develop strategies, which include:

- Establishing a broad-based institutional mechanism to cater for the concerns of all stakeholders/interested parties.
- Creating and strengthening awareness about and foster a positive attitude among the public about the traditional health system which includes acknowledging the usefulness and need for conservation of the plants on which the traditional system depends.
- Establishing a system that recognises and promotes the rights and knowledge of traditional healers/practitioners.
- Creating conducive conditions for the development of the skills and knowledge of traditional practitioners through the exchange of experiences and knowledge both among themselves and with equivalent organisations outside the country.

- Establishing a system of incentives and awards to recognise outstanding achievement in health care and development, whether by an individual or by a group.
- Organising and strengthening the traditional healers association at local community, regional and countrywide level.
- Ensuring that the policy, which sets priorities and programs for research, includes the conservation, domestication and cultivation of medicinal plants.
- Establishing legal mechanisms that recognise the rights of communities over the medicinal plants in their care/area.
- Incorporating information from traditional knowledge systems into school curricula and actively encourage efforts to pass on knowledge.
- Establishing a system to collect, organise, conserve and protect medicinal plants.

3.3 Laws and regulations

- Enact laws on the conservation and sustainable use of medicinal plants
- Issue laws and regulations defining the rights and duties of traditional practitioners, herbalists, communities and other stakeholders.
- Put in place the relevant laws to regulate traditional medical and herbal practices.

4. Methodologies

4.1 Involve the stakeholders in the development of laws and policies.

4.2 Ensure that the laws and policies to be developed are consistent with existing national laws and policies as well as relevant international conventions.

5. Specific proposals

5.1 On economy: Set up a study to quantify, in economic terms, the contribution of the traditional medicine to the health care system of the country.

5.2 On Research: evaluate the results acquired from research on medicinal plants.

5.3 On Project formulation and administration: All the stakeholders must be involved in the formulation as well as in determining the apportioning of responsibilities and activities in the Project.

Group III. Research, Technology Transfer and Health

1. Problems

Research Problems:

1. Problems in communication, co-operation and understanding
2. Scarcity of research centres in the regions.
3. Lack of policy to support research regarding medicinal plants.
4. Problems in Management.
5. Unable to access original scripts, as they are not translated.
6. Lack of concurrence between the knowledge of healers who use medicinal plants, and that of spiritual healers.
7. Lack of basic records and documents on medicinal plants.
8. Lack of co-ordination among the different types / places research being undertaken.
9. Implementation and/or the sequence of research activities are often incorrect, and priorities are not clearly given.
10. Lack of funding in particular and capacity building in general.
11. Lack of linkage and co-ordination between the modem and traditional medical systems.
12. Lack of support from government bodies to initiate and provide incentives for research.
13. Traditional health care of livestock is mostly ignored.
14. There is no law/body to protect the IPRs of traditional health practitioners, and thus the information they have is not freely disseminated.
15. Lack of economic rewards and returns also prevents information being shared.
16. Presence of wrong and bad attitudes to traditional health practitioners.
17. Lack of willingness to undertake research and work together on both sides traditional health practitioners and modem scientists.

Technology Transfer has problems in:

1. Finding out how technology should be transferred.
2. Determining the role of IPRs in technology transfer.
3. Tracing the source / origins / mechanisms for unrecorded technology transfers that have taken place.
4. Determining the transferability (i.e. acceptability, attitudes, abilities) of a technology
5. Lack of a body to certify technology transfer.
6. Lack of guidelines for traditional medicines.
7. Lack of standards in traditional medicines

8. Lack of a body to validate traditional medicines.
9. Getting technologies from research (prototypes) into production and popularised - most technologies remain un-implemented.
10. Lack of financial support for technology transfer.
11. Lack of linkage

Health

1. Lack of clear guidelines from the Ministry of Health on the role / place of traditional health practitioners.
2. Lack of standards in handling traditional medicines and a means to validate traditional practices.
3. Lack of a mechanism for registering and granting permits to traditional health practitioners.
4. Lack of training in basic modern skills (like hygiene) for traditional health practitioners.
5. Lack of education centers for traditional practitioners.
6. Secrecy and mysticism, which surrounds traditional practices.

Recommendations on Research

1 & 2 For cooperation, communication and understanding, the government should support and initiate a NATIONAL COORDINATION COMMITTEE involving all the stakeholders. This committee should work through consensus. The aim will be to strengthen the Traditional Healers Association, not to replace it.

Stakeholders identified by the group include:

Ethiopian Science & Technology Commission
Environmental Protection Authority
Higher Education Institutions (Universities, Colleges)
Islamic Supreme Council
Ministry of Health
Ministry of Mines and Energy
Ministry of Agriculture
Ministry of Education
NGOs (local and international) concerned with environment and health development issues with CRDA as the umbrella organization
Orthodox Church
Professional Associations (medical doctors, pharmacists, veterinarians, etc.)
The Biodiversity Institute
The Private Sector
Traditional Healers Association

3. Means should be found to strengthen institutions with equipment/capacity for research, wherever they are found.
4. Some form of IPRs should be granted to traditional healers and their knowledge, but the plants should belong to the nation.
5. Wherever possible, conservation should be in the care of goveniment bodies.
6. Outside the official protected areas, home gardens for medicinal plants should be promoted, and an inventory of medicinal plants should be taken.
7. All scripts/books etc should be translated
8. People that are able to recommend medicines through spiritual means should only be consulted as a source of information.
9. Research should be multi-disciplinary and under control of a coordinating body. The BDI should take responsibility for coordination until the national committee recommended earlier has been set up.
10. Funding has been promised by the World Bank. However, in the meantime, the committee should seek other sources of funds, including local.
11. Means should be found to coordinate traditional health practitioners and the Ministry of Health.
12. Research should consider indigenous knowledge.
13. Incentives for activities of the project should be given.
14. Traditional livestock medication should be included as part of the project.
15. IPRs should be protected by laws and regulations so that the owners of the knowledge will be the beneficiaries.
16. The Traditional Healers Association should be supported both materially and financially.
17. Grounds for the free exchange of information should be made.
18. A means of patenting should be found to overcome the problem of secrecy and mysticism.

Recommendations for Technology Transfer

1. Preparation of guidelines on the use of standards in traditional medicine is urgently required.
2. Environments to check the standards and validity are required.
3. Ground should be prepared for the free exchange of information.

Regarding Health

1. A system of registration and granting of permits for traditional health practitioners should be devised.
2. The criteria for granting permits should be drawn up by the Ministry of Health and the traditional healers.

3. Knowledge about traditional treatments should be brought into the education system.
4. It is recommended that an international level exhibition on traditional health practices should be arranged which would help lead to an attitudinal change to traditional health practices.

The Technical Committee, based on the recommendations made by the three groups, compiled the common points of recommendations and reported to the workshop. After thorough discussion on the commonalties the workshop approved the recommendations; these are the following

Common Recommendations from all Groups

The unanimous recommendations were:

1. Incorporating validated medicinal plants and practices into the health care system of the country, particularly at the primary health care level, will maximize the benefits from this resource for the country and achieve "Health for All".
2. For cooperation, communication, and understanding, the government should establish and support a NATIONAL COORDINATION COMMITTEE involving all stakeholders. The committee should work through consensus.
3. Recognition and appreciation of traditional knowledge on medicinal plants and their applications as an important part of Ethiopia's cultural heritage.
4. Create and strengthen awareness of the value of traditional health practices, particularly the role played by women in home self-administrated home health care.
5. Development of a common database on medicinal plants and traditional knowledge used in human and livestock health care.
6. The Traditional Healers Association should be strengthened from local to federal level.
7. Build and strengthen capacity (human resources and infrastructure) for conservation, cultivation, management, policy, research and technology transfer in medicinal plants.
8. Promote the incorporation of conservation science into school curricula, with particular reference to traditional knowledge on medicinal plants and other natural resources.
9. That medicinal plant in-situ and ex-situ conservation initiatives be identified for inclusion under the UNDP/GEF projects in Bale Mountains, and specifically in Tigray under the Dynamic Farmer-based Approach to the Conservation of African Plant Genetic Resources, and that an additional site be identified in the Wello Region.

Annex 1

Introductory Session

Welcome note and briefing on objectives, by Dr. Abebe Demissie, Acting Director General, BDI

His Excellency Dr. Seyfu Ketema, Minister, Ministry of Agriculture Distinguished Research Scientists, Workshop participants, Invited Guests, Ladies and Gentlemen

On behalf of the entire staff of the Biodiversity Institute, the host institute, the Technical committee and myself, it is indeed my pleasure to welcome you all to this national workshop on Medicinal Plants Conservation and Sustainable Utilization in Ethiopia this brilliant morning.

This workshop is a preparatory workshop towards a formulation of project concept document on medicinal plant conservation, management, and sustainable utilization. The preparation of the workshop has passed through various stages. A Technical Committee drawn from a number of Institutions including the Ethiopian Health and Nutrition Research Institute (EHNRI), Pathobiology Institute, AAU, the National Herbarium, AAU, the Ethiopian Orthodox Church, the Islamic Supreme Council, and Ministry of Trade and Industry has been established to organize the workshop. It has had several biweekly meetings towards the identification of workshop topics, paper presenters and the details of the workshop.

The overall objective of the workshop is to identify a strategy and plan of action to support the conservation, management, and sustainable utilization of medicinal plants for human and animal health in this country. It will address relevant issues that are related to conservation and primary health care system in the country.

The workshop is designed to bring all representatives from relevant and pertinent partner institutions (governmental and NGOs), international agencies and individuals together and to provide a forum through which intensive exchange of relevant information, diversified views of conceptual matters, and to consider contemporary issues on biodiversity as related to the medicinal plants conservation and sustainable utilization in Ethiopia.

We fully understand that it is important for a country like ours to have the public and private sectors work together and exchange information in order to provide new insight and deepen mutual understanding of the subject of medicinal plants

conservation and utilization. We hope that the workshop will achieve this through the papers that will be presented and active discussions by the participants, and that further cooperation between institutions will be developed in the field of phytomedicine and related fields.

Furthermore, the meeting is devised to provide a forum through which intensive exchange of information is made and to consider contemporary issues as related to conservation and sustainable utilization of medicinal plants. I must stress that the breadth of the subject matter and complexities of the associated factors are far from simple.

I hope, through the questions that will be raised, the discussion points to be covered, and the interactions that will follow, we shall be in a position to work out appropriate strategies and a plan of action that will assist our country in the implementation of its activities in the field of medicinal plants conservation, cultivation and development of standardized pharmacopoeia. It is my firm belief that we will gain a great deal. I would also like to thank the paper presenters, workshop participants and to those who have shown keen interest in participating and sharing their experiences with us in forging an appropriate strategy and action plan. May I finally take this opportunity to express my gratitude to the funding agencies especially the World Bank and Global Environmental Facility.

Appreciation is also due to Dr. Shiv Singh, Senior Agriculturist, World Bank and Dr. John Lambert, Medicinal Plant Consultant, the World Bank, for their support and unreserved cooperation provided to the Technical committee all the way from the initial stage to the organization of this workshop. Special thanks goes to Dr. Oey Astra Meesook, Country Director for Ethiopia and Ato Berhane Manna for expediting the process from this end. Appreciating is also extended to the Dr. Tadesse Gebre Medhin, General Manager AIR, for providing us this spacious conference room and the facilities needed for the workshop.

I thank you all.

Annex 2

Inauguration by H.E. Dr. Seifu Ketema, Minister, Ministry of Agriculture

Distinguished Scholars, Workshop Participants, Ladies and gentlemen

It gives me great pleasure to be with you at the official opening of this national workshop on Biodiversity Conservation and Sustainable Use of Medicinal Plants in Ethiopia. The workshop is important because it brings together, scientists, researchers, agriculturalists, botanists, policy makers, traditional healers, NGOs, private sector from all relevant national Institutions and UN systems to discuss the various ways to protect, conserve and sustainably utilize medicinal plants in Ethiopia.

Ethiopia is endowed with an immense diversity of plants. According to recent studies there are over 7000 plants species out of which 12% are probably endemic. As you all know, it is one of the Vavilovian Centers of diversity. Numerous crop plants have first been brought to domestication in the Ethiopian region. Wild and weedy relatives of the cultivated plants, as well as lesser known but potentially useful plants occur in the region. Their economic contribution to agricultural growth, national primary health care and pharmaceutical development, industrial expansion, and environmental concern both at national and international levels is great.

However, these plant resources are being constantly threatened, mainly because of factors that are associated with the environmental degradation of natural ecosystems and habitats because of urbanization, technological changes, fire and the growth in human population. Many species are being lost every day, to the extent that by the beginning of the next century, one million species could have been lost unless some measures are taken now. Medicinal plants are vulnerable for many reasons mainly due to the unsustainable use of harvesting practices and utilization in spite of the fact that 80% of the Ethiopian population is dependent on herbal medicine as primary health care system. The country has a long history of traditional health care based principally on a rich though unstandardized pharmacopoeia drawn from plants to some extent animals and minerals.

Here in Ethiopia there is a great diversity of plant germplasm, which is the result of several factors, including the geographical position of the country and the wide variation in climate, edaphic and topographical factors. Ethiopia is long committed to the conservation of her biological resources. The Biodiversity Institute, which collects, conserves and enhances the utilization of plant germplasm has been operating sine the mid seventies. The Institute has assembled

over 56000 accessions of primarily cultivated crops from various agroecological zones in the country. Recently the Institute is promoted to Institution, which caters not only to plant genetic resources but also to animal and microbial genetic resources. The conservation and sustainable utilization plant germplasm will remain high in Ethiopia's list of priorities and medicinal plants deserve more attention than has been the case in the past.

This workshop marks a new approach in the realization of the potential of medicinal plants in this country. We hope that the cooperation, and courage that has prevailed so far will be maintained and strengthened to marshal the resources required to implement the recommendations and initiate the project emerging from the workshop. The Ethiopian government is committed to the conservation of its biological resources as has been demonstrated in signing and endorsing the Convention on Biological Diversity (CBD). A practical demonstration of its commitment is the recent approval of the policy document and the proclamation to provide for the establishment of Biodiversity Conservation and Research Institute with much expanded responsibility.

We are gathered here because we recognize that medicinal plants are vital for sustainable utilization of plants for human and livestock health in Ethiopia. In the field of health care, which is an area relevant to your workshop, our objectives are not only in improving and expanding health care services, but also at making them efficient and available to all people. I am glad to state that as a result of the effort of the government health care institutions have increased significantly over the years. It is against this background that I feel confident the network of the rural health centers, which is being promoted, may prove extremely useful in the application of medicinal plants as remedy at community level.

In light of the situations in the country, I would like to highlight some of the challenging issues, which I hope the workshop will address. The workshop should:

- determine the medicinal species which are threatened both by natural and man-made factors;
- determine potential medicinal plants which require attention because of their possible role as source of remedy;
- discuss and develop a strategy and plan of action for survey, documentation, evaluation cultivation and sustainable utilization of medicinal plants;
- encourage a collaborative approach through the involvement of relevant stakeholders so as to foster national institutional collaboration;

- discuss ways of training for people working in pertinent areas to conservation, health; etc.
- encourage traditional healers by recognizing their contribution and by rewarding them to their knowledge and contribution.

I feel if the above issues are considered seriously, the workshop will have achieved its objectives of enhancing the conservation and sustainable utilization of medicinal pants in Ethiopia. I sincerely hope that the present workshop will be successful and useful for further promoting activities on biodiversity particularly medicinal plants in this country. I also hope that the cooperation will be further strengthened through our joint effort in reaching this common target of immense importance.

The overall objective of this workshop is to identify a strategy and action plan to support the conservation, management, and sustainable utilization of medicinal plants for human and livestock health in this country. I hope that four days of serious thought and evaluation on the potential of medicinal plants in the national health system, on the potential of our country to grow these plants and on the possibilities of small scale manufacturing products and or any other uses your evaluation may prove feasible.

Finally on behalf of the Ethiopian Government, I wish to thank the World Bank and the Global Environmental Facility, an interim financial mechanism of the Convention on Biological Diversity for providing the financial assistance to organize the workshop.

I now have the pleasure in declaring this national workshop on Biodiversity Conservation and Sustainable Utilization of Medicinal Plants open.

Annex 3

Closing remark, Ato Asrat Bulbula, Commissioner, Ethiopian Science & Technology Commission

Mr. Chairman
Dear Participants
Ladies and Gentlemen

May I first be permitted to thank the organizers of this workshop for having dealt with a timely and important subject matter.

As you have repeatedly heard of Ethiopia's Biodiversity resource, as a matter of fact, Ethiopia is one of the few nations endowed with wide biodiversity. Specially so in medicinal plants, traditionally exploited for hundreds of years. Even at this day and age, traditional medicine plays a major intervention role in the Ethiopian health services sector, even to the tune of greater than 60%. Support to practitioners should be strengthened; both morally and materially. Their services should be institutionalised at the grassroots level together with modem health services. The traditional knowledge needs due recognition and protection. The Ethiopian Science and Technology Commission will see to it to facilitate the realization of this.

The commission will also work for a strengthened regulatory mechanism for materials exchange with due benefits of Ethiopia protected.

It is my hope that all concerned will work together harmoniously to bring about a meaningful and synergistic result to our nation.

Thank you

Annex 4

List of Project Preparation Technical Committee Members

A Project Preparation Technical Committee (PPTC) drawn from relevant institutions *viz.* governmental, non-governmental and religious institutions was formed to assist the preparation of the Conservation and Sustainable Use of Medicinal Plants Project. The PPTC members actively participated in organizing the national workshop on Biodiversity Conservation and Sustainable Use of Medicinal Plants in Ethiopia held in April 28, 1998. On the basis of the workshop recommendation, IBCR with full support of the PPTC members developed the initial project document. The PPTC members have assisted the project document preparation process all the way upto appraisal of the document by the Ethiopian government and the World Bank. IBCR is very much thankful to all PPTC members for their unreserved support.

PPTC members:

1	Dr. Abebe Demissie	Biodiversity Institute	Chairman
2	Dr. Asfaw Zeleke	EARO	Member
3	Ato Belete Abera	EWCO	Member
4	Ms. Camille De Stoop	ENDA Ethiopia	Member
5	Dr. Dawit Abebe/Kelbessa	Urgaa EHNRI/DDR	Member
6	M/s Dagnachew Kassahun	EOC	Member
7	Ato Delil Redi Nur	EISC	Member
8	Dr. Girma Adugna	FVM	Member
9	Dr. Kaleab Asres	SOP	Member
10	Dr. Legesse W/Yohannes	IPB	Member
11	Dr. Mulualem Tarekegn	MOA	Member
12	Ato Mulugeta Chane/Dr. Tadele Worku	EORC	Member
13	Ato Siraj Bekele	OADB	Member
14	Ms. Sue Edwards	NH	Member
15	Dr. Workineh Negatu	IDR	Member
16	Ato Wubet Abay	THA	Member
17	Dr. Medhin Zewdu	Biodiversity Institute	Secretary

Annex 5

List of Workshop Participants

1.	Abebe Demissie (Dr.)	BDI
2.	Abera Debelo (Dr.)	EARO
3.	Abonesh H/Mariam (Dr.)	WHO
4.	Andrew Danino	IFC/World Bank
5.	Anne Ouma	UNDP
6.	Asrat Bulbula	ESTC
7.	Balcha Abera	Jimma Agricultural College
8.	Bekele Dinke	National Fertilizer Industry Agency
9.	Berhane G/Mariam	BDI
10.	Berhane Manna	World Bank
11.	Berhene Mewa	EPIA
12.	Bekele Nigatu	Oromiya Regional Government
13.	Birzaf Tekle	BDI
14.	Bogale Sinda	Gambella Regional Government
15.	Camille de Stoop	ENDA Ethiopia
16.	Dagnachew Kassahun (M/S)	EOC
17.	Dawit Abebe (Dr.)	DDR/EHNRI
18.	Dawit Dikasso	Community Health Dept., MOH
19.	Dawit Dikasso Dilbato	Ethiopian Health Professionals Association
20.	Delil Redi Nur	EISC
21.	Derebew Below	Jimma Agricultural College
22.	Dereje Tefera	BDI
23.	Desalegn Dessisa	NH/AAU
24.	Desit Ibrahim	Harai Regional Government
25.	Eamonn Brehony	MMM
26.	Eleni Tegegn	ICIPE/PPI
27.	Ermias Dagne	NPC/AAU
28.	Eshetu Debabu	Women Affairs Dept., MOA
29.	Fassil Kebebew (Dr.)	BDI
30.	Fikreab Kebede (Dr.)	CDRA
31.	Fisseha H/Meskel (Dr.)	ECO-Consult
32.	Fiiseha Kassa	THA
33.	Getachew Mengistu	ESTC
34.	Getahun Mulat	BDI
35.	Gezu Bekele (Dr.)	FARM Africa
36.	Guenther Haase	GTZ
37.	Gutema Sultessa	NVI

38.	Hakim Arega Alemu	THA
39.	H.Selassie Yibrah (Dr.)	BDI
40.	Hana Abate	Prime Minister Office
41.	John Lambert (Dr.)	World Bank
42.	Kaleab Asres (Dr.)	SOP/AAU
43.	Kidanewold Birku	THA
44.	Legesse W/Yohannes (Dr.)	IPB
45.	Lemlem Sisay (Dr.)	BDI
46.	Mamo	THA
47.	Matiyos Meleso	EPA
48.	Medhin Zewdu (Dr.)	Biodiversity Institute
49.	Media	ETV, ENA, Radio
50.	Mekonnen Lemma (Dr.)	Faculty of Veterinary Medicine
51.	Melaku Worede (Dr.)	Private, Scientist
52.	Mekonen Hagos (Dr.)	MEDCO PLC.
53.	Mekonnen Masresha (Dr.)	EOC
54.	Mengesha Workenhe	LEM Ethiopia
55.	Merigeta Alemu Tefera	Traditional Healer, ICIPE/PPI
56.	Mesfin Bayu	BDI
57.	Moges Tilahun	Amhara Regional Government
58.	Mohammed Hagi Umer	Somali Regional Government
59.	Mohammed Negi Umer	Afar Regional Government
60.	Mulatu Djoti (Dr.)	SOP/AAU
61.	Mulualem Tarekegn	Extension Dept., MOA
62.	Mulugeta Chane	EORC
63.	Regassa Feyissa	BDI
64.	Richard Pankhurst (Prof.)	Ethiopian Studies
65.	Ruth Kahurananga	UNDP
66.	Seblework Belayneh	BDI
67.	Sebsibe Demissew (Dr.)	NH/AAU
68.	Seifu Ketema (Dr.)	MOA
69.	Shibiru Tedla (Prof.)	ECO-Consult
70.	Shiv Singh	World Bank
71.	Shumu Tefera	ESTC
72.	Sue Edwards	NH/AAU
73.	Tadele Worku (Dr.)	EORC
74.	Tadesse Arega	BDI
75.	Tadesse G.Medhin (Dr.)	IAR
76.	Tafesse Mesfin (Dr.)	MOA
77.	Tefera Abula (Dr.)	Gondar Health College
78.	Teferi Gedef	ESTC
79.	Tekalign Tsegaw	Alemaya University

80.	Tesfaye Gebru	Tigray Regional Government
81.	Tesfa Mebrahtu	THA
82.	Tibebu Shiferaw	EOC
83.	Tilahun Bekele	MOTI
84.	Tsige G/Mariam (Dr.)	SOP/AAU
85.	Umer Haji Ushra Sali	Benishangul Regional Government
86.	Wondoson Mwambazi (Dr.)	WHO
87.	Worku Damena	EPA
88.	Wubet Abay	THA
89.	Yeronmesh Ayele	MOE
90.	Yewebdar Ayalew	UNDP
91.	Yodit Tewolde	ISD
92.	Zemede Asfaw (Dr.)	NH/AAU
93.	Zemene Sime	MEDAC
94.	Representative from Southern People Regional Government	

Members of the Project Preparation Technical Committee

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