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including those of a socioeconomic, technical, institutional, and policy nature. Unsustainable harvesting of the raw materials from the wild by untrained and poor collectors, mostly using primitive methods, and the lack of awareness of the real value of the resources are other important factors leading to widescale resource depletion. Rural people in developing countries derive a substantial portion of their income, and food and medicinal products for their basic needs from NWFPs gathered from forests.

This article presents conservation-through-use or sustainable conservation as a good practice to integrate biophysical and socioeconomic tools in the management of NWFP to reduce global poverty and enhance biodiversity conservation. The main premise is that NWFP resources are the natural capital of local people and their wise management can improve livelihoods of the rural people in the developing world who in turn will find incentives to conserve the global environment. However, this new approach to NWFP management needs to be properly and systematically monitored and linked to the prevailing national and global market conditions that permit the conversion of these natural resources into sources of gainful employment and the greater well-being of the local community. Mechanisms need to be developed and broadened to formalize the inclusion of market factors and good social and business behavior in the system of NWFP management. Procedures are needed for inspection of proper collection, cultivation, processing, packaging, marketing, maintaining market-demanded quality and schedules. These procedures should be governed by a certification system, which is scientific in operation and global in its acceptance. Central to this approach is the application of a value or commodity market chain method, which can be monitored by both the producers and consumers. Certification of quality product, good management, and fair trade based on the practices of good collection, cultivation, and management can lead to new and economic opportunities such as niche or green markets, price premiums for good social behavior, and a long-term producer-consumer relationship.

Definitions, Good Practices and Certification

M Karki, Medicinal and Aromatic Plants Program in Asia, New Delhi, India

R B S Rawat, National Medicinal Plants Board, New Delhi, India

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Introduction

Non-wood forest products (NWFP) are found abundantly in tropical and temperate forests, range, and shrublands throughout the world. However, due to years of unwise use, the availability of certain NWFPs especially medicinal plants in desired quality, quantity, time, and place has become difficult. This raises serious doubts about their availability to meet both the local demand as healthcare products of local poor communities as well as growing demand of national and global phytomedicine industries. The sustainable production, conservation, and use of NWFPs are influenced by a number of factors,

Definition, Scope, and Potential

Background

Non-wood forest products (NWFPs) are the other forest products apart from wood in its broadest sense. According to the Food and Agriculture Organization of the United Nations (FAO), NWFPs consist of goods of biological origin other than wood as well as services derived from forests and allied land uses. NWFPs are also understood as forest

produce other than timber (construction wood), which can be harvested on a nondestructive basis from nature. More simply put, NWFPs include all goods of biological origin other than wood in all its forms as well as services derived from forests or similar lands. They include a number of goods such as fodder, fibers, flosses, food and food additives, fertilizer (biomass), medicinal plants and herbal potions, phytochemical and aromatic chemicals, fatty oils, latex, gum resin and other exudates, and different kinds of animal products (honey, wax, lac, silk, etc.). They also include services such as grazing, ecotourism, nature trekking, etc. as well as raw materials for different types of rural and cottage industries.

NWFPs are known by different names such as minor, special, nontraditional, and non-timber forest products. Medicinal and aromatic plants (MAPs) are the most prominent NWFP, which have potentialities to safeguard biodiversity, promote sustainable conservation, and help improve the local and national economies. Long-term and equitable economic development of poor NWFP-dependent communities is possible by promoting better protection of indigenous knowledge and providing direct pecuniary benefits to the local people through wise management of NWFPs. International policy documents such as Convention on Biodiversity (CBD), Trade Related Intellectual Property Rights (TRIPS),

and Convention on International Trade in Endangered Species (CITES) provide the international legal platform over which different countries are building up their own system of NWFPs management, development, conservation, and commercialization.

NWFPs and People's Livelihoods

In many developing countries, millions of people residing in and around forests rely on NWFPs for their subsistence. More than half of the employment generated in the forestry sector is through NWFPs. Studies in the Rajasthan state of India have indicated that approximately 5 million indigenous populations sustain themselves through collection, processing, and marketing of NWFPs, which amounts to 50–80% of the total forest revenue in many countries. In the Gujarat state of India, 27% of adults and 72% of children and women collect NTFPs in forest regions, while in the Madhya Pradesh state more than 35% of the forest revenue is from NWFPs. In the NWFP-rich Northeast Himalayas, the contribution of the NWFPs to the local economy is up to 60% (Table 1).

Medicinal plants are among the most important NWFPs in poor developing countries. According to the World Health Organization (WHO), 80% of the people in developing countries rely on traditional

Table 1 Contribution of non-wood forest products in the rural economy of the northeast Himalayas (Assam and Meghalaya (ML) case studies)

<i>Product</i>	<i>NC Hills, Assam</i>	<i>Karbianglong, Assam</i>	<i>W.K.Hills, ML</i>	<i>W.G.Hills, ML</i>
Percent household involved in extraction of NWFPs				
Bamboo	50–60	45–50	100	100
Subsistence uses	2–3	3–4	0.5	0.7
Commercial uses				
Cane	10–12	12–15	—	—
Subsistence uses	3–4	5–6	0.15	—
Commercial uses				
Others	—	—	45	—
Subsistence uses	—	—	0.3	1
Commercial uses				
Quantity used/sold				
Bamboo				
Subsistence	0.25 t/yr	0.25 t/yr	0.45 t/yr	0.3 t/yr
Commercial	20–30 t/day	35–40 t/day	3–4 t/day	30–40 t/day
Cane				
Subsistence		10–15 kg	5–10 k/yr	—
Commercial	12–15 kg	215 kg/yr	225 kg/yr	—
Others	120–150 kg			
Subsistence			5 kg/yr	70–75 kg/yr
Commercial				
Contribution to household economy				
Bamboo	25–30%	25–30%	15–20%	50–60%
Canes	25–30%	30–35%	15–20%	—
Others	10–15%	15–20%	55–70%	30–35%

natural medicines and 85% of the traditional medicines involve the use of plant extracts. The ancient Indian Classical Ayurvedic texts, *Charaka Samhita*, *Susruth Samhita*, and *Ashtanga Hardaya Samhita*, mention of a large number of medicinal plants for curing different ailments. Table 2 provides the most commonly used medicinal plants in primary health care. Medicinal plants grow in all kinds of lands throughout the world. A large number of these plants are found in tropical forests and temperate dry slopes, especially in dry and moist deciduous forests and mountainous grasslands. The coastal forests of India, the islands of Borneo and Madagascar, the rainforests of the Amazon and Congo basins, and the entire Hindu Kush, Himalayan and Andean mountain ranges are considered to be the treasure trove of the medicinal plants. Although fewer than 30% of medicinal plants are found in the temperate and dry alpine habitats, they include species of high medicinal value. Figure 1 gives the distribution of medicinal plants by habits in the Indian subcontinent. One-third each of the medicinal plants are trees and shrubs/climbers and the remaining one-third are herbs/grasses (Figure 2). Among the rest of the NWFP species, again more than half are trees. As the demand of several medicinal plants has been increasing at a very fast rate, several species have become threatened or endangered. Threats to wild medicinal plant populations have been classified into seven categories: direct human interference (7.8%), fragmentation (5%), loss of habitat (18.7%), overexploitation (17%), harvest (19.8%), trade (24.6%), and others (7.9%). It may be noted that much of habitat loss and overexploitation are also human-induced.

System of Trade of NWFPs

NWFPs have been traded since the dawn of the exchange and barter system of trade in forest-based goods and services. The intercontinental trade in silk and black pepper dates back several centuries. Today, in most of the developing countries, the national Forest Department leases out the right to collect the NWFPs in designated areas every season or cutting cycle to the highest bidder through a system of auctions or through invitation of bids in a tender system. In this system, basically the state collects rent from the users of the NWFPs. In order to ensure

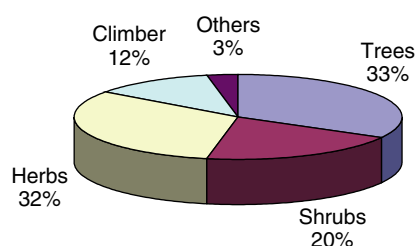


Figure 1 Distribution of medicinal plants by habits, in the Indian subcontinent.

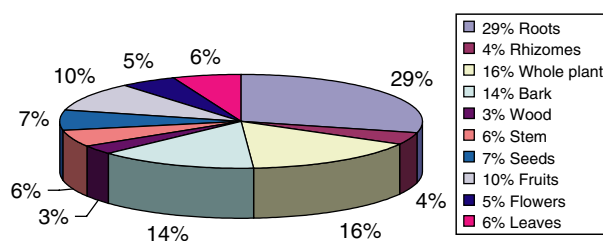


Figure 2 Break down of medicinal plants by their parts utilized, in the Indian subcontinent.

Table 2 Potential NWFP species in the Himalayan Mountains

Local name	Botanical name	Purpose/uses
Jatamansi	<i>Nardostachys grandiflora</i>	Medicine/aromatic oil
Sugandhawal	<i>Valeriana jatamansi</i>	Aromatic oils/medicine
Kutki	<i>Picrorhiza scrophulariflora</i>	Medicine
Chiraito	<i>Swertia chiraita</i>	Medicine/others
Guchichyau	<i>Morchella conica</i>	Food/medicine
Timur	<i>Zanthoxylum armatum</i>	Food/medicine
Dalchini	<i>Cinnamomum tamala</i>	Spice/medicine oil
Hathjadi/Panchaunle	<i>Dactylorhiza hatagirea</i>	Food/medicine
Atis	<i>A. heterophyllum</i>	Medicine
Pipla	<i>Piper longum</i>	Spice/medicine
Padamchal	<i>Rheum australe</i>	Medicine
Shikakai	<i>Acacia rugata</i>	Medicine
Neem	<i>Azadirachta indica</i>	Medicine/biopesticide
Amala	<i>Phyllanthus emblica</i>	Food/medicine/vitamin
Barro	<i>Terminalia bellirica</i>	Medicine
Haro	<i>Terminalia chebula</i>	Medicine
Talispatra	<i>Taxus wallichinana</i>	Anti-cancerous medicine
Satawari	<i>Asparagus racemosus</i>	Food/medicine

adequate and sustained supplies of NWFPs to local healers and village-based enterprises many countries and states have nationalized the trade in NWFPs. The government fixes minimum prices of select products and marketing is also done by the government on behalf of locals. This system is, however, highly inefficient and is on the decline. In many countries, collection, procurement, and marketing of select items of NWFPs especially medicinal plants, whether nationalized or not, is being undertaken through cooperatives of local peoples called community-based organizations.

Exploitative nature of trade The direction of trade in NWFPs is mostly from developing to developed nations, from rural to urban areas. The significant destinations are countries of the European Union (especially Germany), USA, and Japan. The import policies of these major players are increasingly becoming restrictive and are characterized by preference for standardized, organic, and certified produce. Poor nations who are hoping to conserve biodiversity through improved sales of value-added NWFPs are struggling to find stable markets for their NWFPs. However, there are many factors at their end that create market imperfections, price distortion, and sheer exploitation of collectors and small growers by traders and middlemen. In most of the developing as well as developed countries, there is no systematic national level comprehensive database on production, processing, and marketing-related information on NWFPs. In South Asia, countries like India, Nepal, Bhutan, Sri Lanka, and Pakistan are making some efforts in gathering and disseminating information. A number of sample studies have indicated that approximately 150 NWFPs, including 26 essential oils and a large number of botanicals (ranging between 4000 to 6000), enter national and international markets on a regular basis. The size of the global market for botanicals and homeopathic medicines was more than US\$20 billion in 1999 and growing.

Environmental Consequences of NWFP Management

Most of the NWFP species including medicinal plants are used locally and information on supply and demand is often insufficient. It is not known whether the plants are abundant, scarce, or under extinction threat or not; if under cultivation then whether the techniques used are proper or not; what gaps exist in market linkages, and whether the species are endangered or threatened. If they are scarce, what conservation measures would be appropriate is also not clearly known. Undoubtedly, the conservation approach needs considerable policy

support, which in most countries is weak. Generally, product samples are not screened for quality, ineffective marketing methods are applied, packaging is of poor standard, and the products have a very limited shelf-life. The situation calls for effective regulatory frameworks both to control infringements of conservation laws and also to provide incentives to local people to use best practices. These are the reasons why NWFPs certification has a big role to play, as it can promote good sourcing, good field collection, good manufacturing, and good laboratory practices in the management of NWFP species.

NWFP Certification

Increasing global awareness of sustainable forest management and liberalized economic development along with the universal acceptance that market forces and consumer preferences dictate the quality of forestry products including NWFPs is necessitating a shift in the management paradigm that ensures the sustainable use of NWFP resources. There is also a need to ensure consumer acceptance and the creation of social and environmental accountability in the trading of natural forest produce. Certification of forests NWFPs is emerging as a widely accepted and effective instrument for possible solutions to these problems.

Evolution of Certification Concepts and Practices

Certification is a process by which the performance of on-the-ground production and handling operations is assessed against a set of predetermined set of standards and guidelines. Certification is a relatively new concept in marketing, which has been initiated to implement the provisions of WTO and other international agreements. In order to encourage sustainable forest management, the majority of timber-exporting countries have, on their own, initiated certification of their forest products. It has since become not only an important tool for conservation of rich forest flora and fauna, but also a promotional label to market forest products from sustainably managed forests. Developing countries, by using this tool wisely, can find their own niche in global NWFP markets and can thereby ensure a greater flow of benefits to the local communities through production of certified forestry products. Certification can create economic incentives to achieve and maintain high standards of forest and NWFP management worldwide.

Rationale for Certification

The certification process commenced with a strong focus on the goal of improving forest management

standards, and in particular contributing strongly to reducing the rate of deforestation and degradation of the world's forests, with the initial focus heavily oriented to tropical forests. The aim has been to use market forces to encourage and enable improved management of the forests. Those promoting this new tool hope that buyers, especially in Western countries, will show a preference for certified products, which in turn will either encourage producers to improve their forest management in order to tap this demand, or force them to do so under the threat of losing markets if they do not. The focus has, however, changed considerably as the realities of what it might or might not be able to achieve have become recognized. It has also changed to reflect the interests of many different groups that have become involved with this process one way or another – environmentalists, forest managers, governments, industry, traders, retailers, certifying companies, consultants, investment firms, aid agencies, etc. As a market instrument, certification has both strengths and weaknesses, which vary with the specific circumstances of the producing country, the type of ownership of the NWFP resources, the social and institutional environment and, last but certainly not least, the markets served. A point that should be noted is that sustainable forest management is possible without certification, but the reverse is not.

Objectives of NWFP Certification

The basic objective of certification is to provide proof that all quality control criteria and standard specifications set for a particular production and marketing system have been complied with. The aim is to either increase market share, or at least avoid loss due to boycotts or restrictions such as are increasingly common in some parts of Europe and the USA. The idea is to discourage unethical and unsustainable commercialization of forest products, especially in NWFPs, which is rampant in trade with developing countries. The specifications encompass technical (raw materials, manufacturing process, etc.) as well as legal and financial compliance (environment laws, labor laws, taxes, etc.). The objective of NWFP certification should be to provide solutions towards a responsible trade of NWFPs following the principles of sustainable forest management. Its aim should be to fulfill the following objectives and criteria:

- control and ensure sustainable forest resource management techniques
- have a depth of science with a global scope and be carried out by an active and democratic organization

- manage NWFP resources economically and sustainably
- create a transparent and traceable system that addresses public concerns on environmental values
- manage resources holistically and equitably
- balance the need to extract resources from the environment with maintaining integrity of the ecosystem
- improve livelihood opportunities for local communities, especially women and marginalized groups.

Types of Certification

Basically there are three types of certification that are relevant to NWFPs:

1. Management certification as prescribed by organizations such as the Forest Stewardship Council.
2. Organic certification which complies with standards called as a set of 'Basic Standards for Organic Production and Processing' set by the International Federation of Organic Agriculture Movements (IFOAM). These have to be largely adopted with regional and local specifications throughout the world. IFOAM Basic Standards are also now recognized by the International Standards Organizations (ISO) as universal guidelines.
3. Fair Trade certification which ensures that the trade in NWFPs is done ethically and that proper mechanism of benefits flowing to the collectors and growers is in place.

Potential Advantages of NWFP Certification

Certification has an excellent potential to yield a variety of benefits reflected in the economic, environmental, and social spectrum.

Ecological benefits

- Maintenance and enhancement of forest resource productivity
- Improvement in conservation of biodiversity and its associated benefits such as the hydrological cycle of the area, forest ecosystems, soil fertility due to use of organic substances, and, subsequently, an increase in agricultural production
- Maintenance of ecological functions and integrity of forest ecosystems and their resultant benefits as NWFPs comprise a large and diverse floral vegetation.

Economic benefits

- Increased returns to the producers compared to uncertified forest produce, as certified NWFPs often are high-value low-volume products.

- Greater consumer preferences for certified products provide wider and larger market accessibility and competitive advantages.

Social benefits

- Development and improvement of the company's or producer's public image and workers' satisfaction.
- Improvement in the condition of workers, indigenous communities, and local people through participation of stakeholders in the development of NWFP-based forest/farm management standards.

Other advantages

- Increased market share or at least protection from the loss of the existing market share against the substitutes, such as forest and synthetic products.
- Market premium from selling 'green' products and greater market insurance.
- Long-term supply security because of the sustainability of the resource base, especially forests.
- Establish a basis for comparing different management practices and setting common standards, thus improving the image with a range of interest groups.

Possible disadvantages

- Initial high cost, both financial and managerial, due to initial investment.
- Reduced (short-term) revenue due to reduced output volumes.
- Loss of some control to other groups (e.g., to those developing the certification standards; those less close to the resource).
- Lack of consumer awareness making it hard to achieve an accelerated market penetration.

Components of Certification

Certification of either forest management or organic farms or fairly trading business comprises several activities, each of which has its own rules and guidelines: The main components are:

- certification
- standardization
- accreditation
- logo use (labeling).

Certification Certification is a potential market instrument that can contribute towards improving forest management and at the same time provide an assurance that a product or service is in conformity with certain specified standards. There are two main

components of certification: (1) certifying the standards of NWFP-based forest management, and (2) certifying the products from these forests. The first involves an investigation of all the aspects relating to NWFP management including social, economic, and environmental conditions and assessment of how the management of these is being addressed. The process may then include the second component, that of product certification and the associated labeling.

Currently, a wide range of actions is under way concerning certification of NWFPs worldwide. The shift of emphasis from timber and timber products to NWFPs is a recent development. However, attention has mostly included pulp and paper and tea products. First, since a large number of NWFP species collected and transported are straight from the forests, it has been extremely difficult to trace the source of origin of the produce. It is still harder to find out whether or not the harvesting was done in an environmentally sound manner and that the produce available is not responsible for any damage done at the social, economic, or environmental levels. These gaps indicate that there is an urgent need for developing a certification process specifically targeted to the needs of NWFPs. Second, the present trend in management and trade does not lay any emphasis on the process of harvesting of NWFPs either from forested or agricultural lands. The primary forest produce gatherers go to the forests and harvest forest produce without giving much consideration to sustainable harvesting levels and techniques. They have little regard and information regarding the regeneration and health of the forests. Thus, there is a need to check the process of harvesting as well as building capacity of the forest produce collectors and farmers, at the same time as developing the framework for promoting certification of NWFPs including medicinal plants. Recently, several organizations especially the US-based Rainforest Alliance have started certifying NWFPs such as Brazil nuts, maple syrup, and chicle. However, there is considerable variation in what is being certified and some misunderstanding as to what certification of a NWFP actually means. A common assumption is that certification of a NWFP is a guarantee that it has been collected and/or produced in a sustainable way. This may not, in fact, be the case. There are three different certification approaches for NWFPs.

Certificate of origin This is used for a variety of products, including food and medicinal items. It guarantees only that a given product comes from a certain region or area – not necessarily that it has a certain standard of quality. An example is the Denomination of Controlled Origin (DOC) label

used for wines, cheeses, and other products by many countries. Certain high-value edible NWFPs, such as truffles and morel mushrooms, are increasingly being certified through such documentation of origin systems.

Product quality standards Organic certification is being used for an increasing number of products, from food to textiles. It certifies that the full production sequence of a product (from the farm up to processing) has respected the criteria set by the competent authority for organic production and chain-of-custody protocols. The quality parameters are set by buyers or their organizations and may differ from market to market.

Social certification This involves documentation of certain social aspects of production, assuring that the labor conditions for production are acceptable, for example, or that the benefits are equitably distributed to those involved in production. Social-based certification schemes have existed for a long time for agricultural and manufacturing products (e.g., for soccer balls certified to have been produced without child labor).

Need for Generic Guidelines for NWFP Certification

As social and cultural issues are important in NWFP certification, there is a need to develop guidelines specifically covering this aspect. The solutions suggested need to be field-tested to determine the relative strengths and weaknesses during the implementation period in the following areas: (1) wider applications, (2) adequacy of plant indicators and verifiers, and (3) suitable species-specific indicators and verifiers. Field tests should be carried out at multiple locations to gather enough data to adequately assess and monitor sustainable NWFP management. In developing specific guidelines, there is a need to interact with a wide range of groups working on sustainable forest management and certification of products including workers engaged in fair trade and organic production and certification as well as the broader community practicing ecologically sustainable forest management. NWFPs do not appear to be adequately covered by any existing certification program, but most programs can make significant contributions to the process by which standards are developed and tested in the field. The work requires wider consultation and multi-stakeholder collaborations at all times. Certifiable NWFP management processes need to ensure long-term ecological viability of NWFP populations.

NWFP harvesting and management can have lower impacts on forest ecosystems than timber harvesting, but care must be taken that species are not over-harvested, and appropriate protection must be provided for vulnerable species in residual stands. Assessments of the field conditions need to be completed prior to the commencement of production and collection activities based on the scale, type, and intensity of management operations.

Performance Indicators and Verifiers

NWFP species, in general, are no more or less susceptible to exploitation than trees. However, parameters to determine (1) the impact of harvest intensity and frequency, (2) the differential response to disturbances including invasion, (3) different regeneration and growth characteristics of different species, and (4) the degree to which the plant depends on animals for pollination and dispersal may need to be defined. Geographic and climatic variations, such as elevation, aspects, and moisture, may also influence production and desirable levels of harvest. Therefore there is a need to divide the broad category of NWFPs into classes, which are based upon the product or plant part harvested, in order to define the performance indicators and verifiers. The following classes of NWFPs has been suggested by the Rainforest Alliance:

- exudates
- vegetative structures: apical bud, bark, root, leaves
- reproductive propagules, fruit, seed.

The purpose is to achieve more effective field assessments by providing information necessary to define sustainability. Species-specific performance indicators, verifiers, and other guidance documents will be required for globally traded NWFPs. These indicators and verifiers can be based upon the general principle that the management plan, implementation activities, and monitoring need to ensure sustainable yield, ecological balance, and good soil/watershed health. Training, capacity building, and empowerment of the stakeholders, accompanied by the provision of information dissemination, are highly desirable activities to provide appropriate benefits to the various stakeholders involved in this sector.

Good Collection, Sourcing, and Manufacturing Practices

WHO has recognized the need to protect medicinal plants by promoting their sustainable use through a system of nondestructive harvesting and cultivation. In order to achieve this through the member countries, a series of good practices such as good

agricultural and field collection practices (GAFCP) and good manufacturing practices (GMP) has been proposed. The purpose of GAFCP and GMP is to provide guidelines and set standards regarding the general strategies, basic methods, and simple rules of the game for both small- and large-scale field collections, harvesting, and postharvest handling of fresh NWFPs such as medicinal plant materials. Under these good practices rules, collection practices should ensure the long-term survival of wild populations and their associated habitats. Management plans for field collection should 'provide a rationale for setting harvest levels and describe the implementation of harvest practices that are suitable to each medicinal plant species and plant part used (root, leaves, fruits, etc.). Field collection of medicinal plants raises a number of complex environmental, technical, and social issues that vary widely from region to region and species to species. In many parts of the world, collection of medicinal plants is a cultural practice dating back many centuries, and which has been well recognized and documented as having a strong scientific basis as the practices were refined through years of trials and testing. It is acknowledged that these issues (some of which are outlined below) cannot be fully covered by the guidelines for good practices alone.

- The population density and geographic distribution of species must be identified and a harmony created between level of extraction and resource base to be maintained.
- Essential biological, social, and commercial information must be obtained and targets disseminated to the collectors, growers, processors, and local traders.
- Research on the morphology and variability of the plant must be undertaken in order to develop a 'search image' for the species and maintain authenticity of the plants.
- Training of personnel should be conducted on site or prior to departure so as to ensure quality maintenance across the chain of operations.
- Collection practices should ensure the long-term survival of wild populations and their associated habitats based on the biophysical requirement of each ecosystem and species.
- Medicinal plant parts should be collected during the appropriate season or time period to ensure both sustained yield and species survival.
- Mechanical instruments must be clean and kept in proper condition and operated correctly to ensure quality of the processed products.
- During collection, the crew should be trained to detect and remove nonmedicinal parts, foreign matter, and damaged/decomposed medicinal plants from the lot.
- The collected raw medicinal plant materials should not come into direct contact with soil, and in case of roots, the attached soil should be washed off properly.
- After collecting and harvesting, the raw medicinal plant parts may be subjected to appropriate preliminary processing. The collected raw medicinal plant material should be protected from pests, rodents, and other animals and stored in proper sanitary conditions.
- Species that are designated as rare or scarce should not be collected from the wild. Collection of the oldest and youngest members of the population should be avoided to maintain ecological balance.
- Medicinal plants should not be collected in areas where pesticides or other possible contaminants are used or found.
- Only ecologically sound and nondestructive means of collection should be employed and collectors must be trained in such methods.
- Different plant species or plant materials should be packed and transferred in separate containers. Cross-contamination should be avoided at all times.
- Cultivation, collection, and harvesting of medicinal plants must be carried out respecting the laws of the land. The provision of national and international conventions such as the Convention on Biological Diversity (CBD) must be respected.
- Agreements on the return of immediate and/or long-term benefits and compensation for the use of sourced medicinal plant materials must be discussed and agreed to in writing prior to collection or cultivation.
- Medicinal plants that are protected by national and international laws such as Control of International Trade in Endangered Species (CITES) must not be collected illegally, and legal procedures must be followed.
- When medicinal plant materials are used from threatened/endangered/protected medicinal plant species through cultivation, the medical plant materials obtained should be given appropriate documentation to certify the source of origin according to national and international legislation, to demonstrate that no plants were collected from the wild population.

Constraints and Issues in Implementing Good Practices

There are a host of issues and constraints that need to be resolved to successfully implement good practices

and certification of good practices, quality products, and fair trade. Among them policy and institutional issues are the most important.

NWFP policy issues Critical review of the existing NWFP policies, legal framework, and institutional environment accompanied by justified revisions considering the above-mentioned issues are the most urgent tasks for achieving sustainable management of NWFP resources in developing countries. The policy and regulatory constraints are mainly of four types.

Regulatory policy issues The regulatory policies are related to harvesting/collection, transport, and processing of NWFPs. Unsustainable harvesting of NWFPs from the wild is a serious issue which is also related to the principles and mechanism of appraising, monitoring, enforcing, and sanctioning rule-breakers in the sustainable management and harvesting of NWFPs. Various types of permits have been designed to implement regulatory policies, although no systematic and detailed inventory of NWFPs has so far been undertaken. The transaction cost of these instruments such as issuing permits, monitoring sustainable harvesting, enforcement of rules, etc. is a serious financial and economic issue. Moreover, the provision of these permits has encouraged rent-seeking behavior among various stakeholders.

Fiscal policy Fiscal policies are related to the imposition of various types of taxes and subsidies that affect various agents involved in the collection, processing, and export of NWFPs. Revenue collection mechanisms such as royalties, and export and other informal taxes are included in this category. Some of the community forestry projects are now providing materials such as seeds and seedlings, and some block grants to promote the cultivation of NWFPs. Major fiscal policy constraints in the development of NWFP subsector are: (1) the system of royalty fixation and collection is irrational and (2) different forms of informal taxes are levied by various organizations which create various forms of disincentives.

Institutional and policy issues The instruments and organizations using the rules and regulations to regulate NWFP trade and use comprise the institutions and organizations relevant to the NWFP policies. The revenue collection mechanisms used by the government are fundamental for the sustainable NWFP management, local addition, and generation of employment for the poor. Coordination

and cooperation among the NWFP stakeholders are the major policy issues having impacts on the conservation and sustainable use of the NWFP resources. The major institutional constraints in the development of the NWFP subsector remain the lack of coordination among different stakeholders for policy coordination and project implementation.

Marketing and trade issues Many agents and institutions are involved in the collection, trade processing, and marketing of NWFPs. Marketing information on, and knowledge of, NWFPs is very weak among collectors, traders, and government officials. Similarly, the capital market is imperfect in rural areas. This has led to high interest rates being paid by NWFP collectors in the remote areas of the Himalayas. Input and output markets need to be made more effective and efficient for the growth of NWFPs.

A major issue in the marketing and trade of NWFPs is the lack of a system of transparent and accessible information collection, dissemination, and use by the collectors and growers so as to increase their bargaining power in negotiating the price of the NWFP. The nationalization or ban of collection and sales of many NWFP species has restricted the free and assured supply to the market resulting in a limited number of buyers who operate in monopolistic/monopolistic conditions.

General Opportunities in Implementing Good Management Practices

A large number of MAP species that are currently harvested from the wild are also possible to be regenerated *in situ* and cultivated *ex situ* by training and organizing traditional collectors and farmers. Different types of micro-enterprises, producer companies, and services agencies can be set up to produce quality raw materials, to insure that rural livelihoods are supported. Relevant factors for this type of development include:

- Existence of a high level of market demand, accessibility, and scope for reaching international, regional, national, and local markets with organic and certified products.
- Possibilities for augmenting raw material supplies through domestication, *ex situ* cultivation, and sustainable harvesting (many countries have large areas under forests, shrublands, and rangelands).
- Access to postharvest and processing technology, availability of skilled labor, infrastructure, and capital (e.g., the savings-to-loan ratio is quite low in South Asia and government budgets are not spent properly).

- Potential for decentralized production, processing, and marketing, and thereby downstreaming of the benefits to the local people as the supply chain of the quality MAP products link rural to urban areas.
- Economic viability of raw material collection, cultivation, primary processing, and marketing as the investment is low and returns are assured or have less risk.
- Availability of reliable markets for quality products, e.g., a buy-back guarantee to the collectors within the country and region.
- Possibility for creating MAP-based small and micro enterprises as well as organizing a viable enterprise support service, in the private sector, in order to provide credits, extension services, technical advice, plant management training, and market information on reliable terms and conditions.

Discussion

Sustainable and equitable commercialization of NWFPs holds a great promise in promoting economic growth and social equity in poverty-stricken but biodiversity-rich developing countries. The existing system of extraction and trade is exploitative, inequitable, and unsustainable. A certifiable system backed by implementation of good production, processing, and marketing practices using the commodity chain model is felt to be an answer, that can lead to better market access, product assessment, product development, and certification. Lessons learned from different parts of the world can provide us with in-depth knowledge of the diversity, complexity, and potentials of NWFPs in improving livelihoods and conserving biodiversity.

However, this article further suggests an approach of improved management practices and regulatory frameworks to contain NWFP resource misuse and environmental degradation. Training and capacity-building of local people are necessary prerequisites for implementing good management practices that can lead to income generation and local biodiversity conservation. When communities are provided with technical, financial, managerial, marketing, and training support, they will have better incentives to conserve the NWFP diversity of their forests. As community groups move from being only suppliers of raw materials to being processors and market players of those raw materials, they become aware of the greater values of the resources that can be realized by them, and thereby promote the conservation of those resources to assure a sustainable supply for their commercial operation. This in essence is the foundation for the institutionalization of good

practices and of acquiring national and international certification.

See also: **Medicinal, Food and Aromatic Plants:** Edible Products from the Forest; Forest Biodiversity Prospecting; Medicinal and Aromatic Plants: Ethnobotany and Conservation Status; Medicinal Plants and Human Health; Tribal Medicine and Medicinal Plants. **Non-wood Products:** Resins, Latex and Palm Oil; Rubber Trees; Seasonal Greenery. **Silviculture:** Bamboos and their Role in Ecosystem Rehabilitation; Managing for Tropical Non-timber Forest Products.

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Causes of Deforestation and Forest Fragmentation

J Ghazoul and J Evans, Imperial College London, Ascot, UK

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Introduction

At the close of the twentieth century there remained an estimated 1700 million ha of tropical forests and 1600 million ha of temperate forests worldwide. These figures represent about 60% of the original forest cover that is estimated to have existed some 8000 years ago. Much of this loss can be directly attributed to human impacts over the last three millennia, with increased clearance in recent centuries, and even more recently in tropical regions.

Forests provide important resources and a multitude of natural services and their recent rapid destruction is causing increasing concern due to environmental, social, and economic problems across the globe. However, developing solutions is proving to be a highly complex task due to the variety of causes of deforestation and conflicting stakeholder interests.

Deforestation is the complete or almost complete removal of tree cover and conversion of the land to other uses. Technically, deforestation may be defined as the semipermanent depletion of tree crown cover to less than 10%. In this respect a distinction needs to be made between deforestation and forest degradation, which is the significant damage to forest ecosystems but without the total elimination of forest cover.

This article begins by describing current deforestation trends. The present causes of deforestation in recent years are discussed, followed by the consequences of deforestation for a variety of environmental parameters. Solutions to the deforestation problem are presented, and potential future trends are described with a brief discussion of the impact of projected climate change.

Historical Deforestation and Land Clearance

At the advent of agriculture some 8000 years ago forests are thought to have covered approximately 40% of the world's land area, or about 6000 million ha. Up to 1500 AD the spread of agriculture across the globe resulted in the clearance of many forests, particularly those on the most accessible and fertile land. However, in the last 200 years deforestation rates have increased greatly. Between 1850 and 1980, 15% of the world's forests and woodlands were cleared. The world forest area has now shrunk to 3500 million ha as a consequence of human exploitation, most of which occurred in the latter half of the twentieth century.

Contemporary Deforestation

Deforestation and land clearance in the twentieth century increased greatly, with the highest rates of clearance occurring since 1960. Most current deforestation occurs in the tropical regions, while in temperate countries there has been a net increase of forest cover by 0.1% due to reforestation and regeneration policies. In Canada the area of land under tree cover increased by 1.4 million hectares to 417.6 million ha in the late 1980s. The Food and Agriculture Organization (FAO) has estimated annual rates of forest clearance in developing countries at 15.5 million ha for the period 1980–1990, and 12.3 million ha for 1990–2000. Thus, the total area