Non-wood forest products: the way ahead

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FOOD
AND
AGRICULTURE
ORGANIZATION
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FOREWORD

Recently increased attention has been focussed on the potential importance of non-wood forest products (NWFP) toward meeting rural communities' needs for food, fiber and forage, as well as essential sources of cash and better income. The value of such products to forest-dwelling peoples underlines the importance of efforts to conserve and manage natural and planted forests. Such resources provide a range of products and services, and their potential contribution to income generation has too long gone unnoticed by the development community.

This recognition of the possible role of national forestry development strategies has led the FAO Forestry Department to embark upon a series of concerted activities to encourage NWFP development through technical assistance activities in member countries.

Thus the Department has established the post of Forestry Officer (Non-Wood Forest Products) in the Forest Products Division, with responsibilities to oversee the initiation and coordination of programmes and projects in this sector. The Tropical Forestry Action Plans in various stages of preparation in over 80 nations include consideration of NWFP priorities and activities, following a consistent set of guidelines.

The present publication, prepared by Dr. G.E. Wickens of the Royal Botanical Gardens, Kew, England, is intended to serve as a broad guide to issues and potentials regarding NWFP development.

As "The Way Ahead" emphasizes throughout, NWFP development must by necessity comprise a multidisciplinary approach, for which task there must be devised close lines of collaboration both within FAO itself, and between FAO and other organizations, both international and national, governmental and non-governmental. Efforts to strengthen common programmes toward sustained use of NWFP should be encouraged, as one among many approaches for the conservation and wise use of forest resources.

C.H. Murray
Assistant Director-General
FAO Forestry Department

NON-WOOD FOREST PRODUCTS

THE WAY AHEAD

EXECUTIVE SUMMARY

Non-wood forest products (NWFP), as used in this report, refers to market or subsistence goods and services for human or industrial consumption derived from renewable forest resources and biomass, bearing promise for augmenting real rural household incomes and employment. The products include the use of plants for food, forage, fuel, medicine, fibre, biochemicals, as well as animals, birds, reptiles and fishes for food, fur and feathers. Wood used for handicrafts is included, as are services derived from the standing forest that generate such benefits as tourism revenues and preservation of biodiversity.

An extensive bibliographical search revealed that there have been numerous meetings and conferences where the more commercially important NWFP (tannins, cork, turpentine, fungi, etc.) have been the focus of discussion. The more domestic activities, such as food, handicrafts, fuel and fodder derived for subsistence purposes have been increasingly discussed in the realm of the Community Forestry programme.

The division between forestry, agriculture and horticulture is ill-defined, both at national and international levels. Therefore, it is not surprising that there should be some overlap of interests between FAO Departments concerning NWFP. For example, the Agriculture Department has been concerned with the development of wild species of oil producing palms, while the Forestry Department has been concerned with the resource management of vicuna in Peru and the management of captive crocodiles for leather. Inter-and intra-Departmental co-operation can ensure that technical expertise is applied to specific product development problems in response to international need.

The major factors, which have impeded the development of NWFP in the past, include the following:

1. Prejudices against the use of wild resources.

2. A lack of appreciation of the value of non-wood forest products to the national economy

3. A lack of understanding of the role of non-wood forest products in the life of the rural community.

4. Prejudices by both field workers and scientists in favor of products requiring highly specialized technology, rather than natural products, that often require only simple processing.

5. Substitution in industry by synthetics to reduce cost.

6. Lack of information, poor access to literature and lack of adequate training.

The major factors encouraging the development of NWFP are:

1. Deteriorating internal and external economic factors restricting imports and placing increasing reliance on indigenous natural resources.

2. Increasing publicity regarding the benefits to be derived from developing NWFP for national and community economies and environmental conservation.

3. New market opportunities created by the green movement in western countries and new ethnic markets created by the migration of peoples.

4. The ever increasing search for new biochemicals for pharmaceuticals and industry.

Marketing new NWFP requires a niche in the market waiting to be filled by either replacing an existing product with a superior and/or cheaper product, or to supply a demand that has until now been unfilled. Price information and market infrastructure are necessary to ensure adequate returns to the producer. There may be financial problems for the individual supplier when increasing production to meet the demands of new markets. Institutional changes in property rights arrangements may be necessary to avoid over-exploitation and resource exhaustion.

Because of the wide range of products and other contextual conditions affecting development prospects, it is difficult to select any particular ecological zone as a priority for development of NWFP. The humid tropical forests present the greatest range of unexploited NWFP. The arid and semi-arid areas, on the other hand, with their limited natural resources, lack a wide range of options, but a concerted effort to develop any potential product is likely to be beneficial. Food, forage and medicine will always rank high among any community's needs, but product development efforts should give priority to those non-wood sources that promise to improve incomes and employment, while also providing other benefits for local consumption.

The development of NWFP is a multi-disciplinary task requiring close collaboration between specialists within FAO and other international and national organizations. An insufficient effort has been made in the past to strengthen common programmes on sustained use of key NWFP among concerned agencies. Such efforts should now be encouraged, as one among many approaches toward conservation and wise use of forest resources.

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1.1 Definitions

1.1.1 "Wood products"

The distinction between wood and non-wood products is ill-defined. In the present context "wood" refers to round wood, sawn timber, wood-based panels, wood chips and pulp, and usually involving commercial enterprises as well as the domestic use of unfinished poles for construction purposes.

1.1.2 "Forest"

The term "forest", as used here, embraces all the natural ecosystems where trees and shrubs form a significant component. Here "forests" range from evergreen rainforest to desert, although in the latter the trees and shrubs are confined primarily to oases and waterways. In certain areas, plantings of non-wood forest products (NWFP) on farmlands constitute chief supplies available for household consumption or sale (eg., bamboo in Bangladesh; forage species), or have potential as sources of supplemental income (eg., medicinal herbs; mushrooms). In these cases, coordination among NWFP and agroforestry activities is required.

1.1.3 "Non-wood forest products"

Non-wood forest products (NWFP), as used in this report, refers to market or subsistence goods and services for human or industrial consumption derived from renewable forest resources and biomass, bearing promise for augmenting real rural household incomes and employment. The products include the use of plants for food, beverages, forage, fuel and medicine (Table 1.1), animals, birds and fishes for food, fur and feathers, and of their products such as honey, lac, silk, etc. (Table 1.2) and the services of land for conservation and recreation (Table 1.3). These tables may be considered to form a preliminary basis for the classification of NWFP.

Forage, in the sense applied by FAO usage (Ibrahim 1975), includes "all browse and herbaceous food that is available to livestock or game animals". Thus forage includes NWFP that sustain such animal populations.

Fuels derived from wood or NWFP are not considered in this report, although there is an overlap of interests where biofuels have as secondary products tar or chemicals useful to industry. Similarly, handicraft products derived in part from wood are included in this report, as they are insufficiently covered by other FAO branches.

Table 1.1 Non-Wood Plant Products

Food -	wild, domesticated, semi-domesticated plants, useable weeds, fungi, etc. and their edible roots, tubers, bulbs, stems, leaves, shoots, flowers, fruits, seeds, etc. to provide cereals, vegetables, edible fats and oils, spices and flavourings, salt substitutes, sweeteners, rennet substitutes, meat tenderizers, beverages, cordials and infusions, thirst quenchers, etc.
Forage -	food for livestock and wildlife, including birds, fishes, and insects such as bees, silkworms, lac insects, etc.
Pharmaceuticals -	drugs, anaesthetics, salves, ointments, lotions, purgatives, etc. for both human and veterinary use.
Toxins -	for hunting, ordeal poisons, hallucinogens, pesticides, fungicides, etc. Note, some may have a pharmaceutical potential, especially as anaesthetics.
Aromatics -	essential oils for cosmetic and perfume industries (international market highly specialized and vulnerable), unguents, incense, etc.
Biochemicals -	non-edible fats and oils, naval stores, waxes, gums and latex, dyes, tannins, biochemicals for plastics and coatings, paints and varnish industries, etc.
Fibre -	cloth, matting, cordage, basketry, brooms, stuffing for pillows, cork, etc.
Wood -	wood for handicrafts.
Ornamentals -	aesthetically pleasing plants for horticultural and amenity planting, cut- and dried-flower trades, etc.

Table 1.2 Wild Animal Products.[1]

Mammals	meat, hides, skins, furs, wool, hair, horn, bone, pharmaceuticals, etc.
Birds	meat, eggs, feathers, edible nests, guano, etc.
Fishes	food, fish oil, feed protein, etc.
Reptiles	food, skins, shell, toxins, pharmaceuticals.
Invertebrates	edible invertebrates, plant exudates (manna), honey, wax, propolis, silk, lac, etc.

Table 1.3 Service Functions of Forest Lands

Habitat	Grazing, browse, shade and shelter for domestic livestock and wildlife, etc.
Soil improvement and protection	green manure, humus, N-fixation, soil stabilization, shade, shelter, hedges, etc.
Protected Areas	non-consumptive use by such tourism/recreation use as wildlife viewing, photography, bird watching, etc. i.e. eco-tourism carried out in National Parks, Wildlife sanctuaries, etc. consumptive use by such recreational activities as hunting, shooting, fishing, insect and plant collecting, etc. carried out in hunting reserves and similar areas where such activities are permitted/promoted; aesthetic, scenic and historic sites are some of the additional "tourist attractions" which may be present in protected areas and add to their value, rather than a source function of forests.

[1] Note: Some Wildlife Products are Protected under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

1.2 Past involvement

1.2.1 FAO collaboration with external agencies

The Forestry Department has been involved in several relevant conferences, symposia and other meetings in collaboration with other agencies, which have included discussion of NWFP as tannins, cork, furfural, rosin, camphor, turpentine and edible fungi.[2] The emphasis has historically been on the better known, commercial NWFP rather than those of more domestic importance to the local communities, such as food plants and handicrafts. The latter has, however, been increasingly addressed through the programme of the Community Forestry group during the past few years.

The recognition of the need for community involvement has led to a number of projects with SIDA, such as a community study in the Republic of Korea on mushrooms (FAO/SIDA 1982). More recent collaboration includes a useful series of Community Forestry publications where the role of NWFP in the community is discussed and analyzed (FAO/SIDA 1989a-e), as well as the final report on the first FAO/SIDA expert consultation (FAO/SIDA 1989f). In a similar vein, a major FAO/WHO/UNICEF effort is the organization in 1992 of a conference on Human Nutrition, in which NWFP are one of the focuses for their role in food security and nutrition.

Training courses have also been organized in conjunction with DANIDA (FAO/DANIDA 1985) on dune stabilization, a subject which also included forage plants.

Joint studies involving government institutions include a series on forest fruit trees that involved cooperation with the Silvicultural Research Institute, Lushoto, Tanzania (FAO 1983), Forest Research Institute, Laguna, Philippines (FAO 1984) and the Instituto Nacional de Pesquisas da Amazonia, Manaus, Brazil (FAO 1986).

FAO has also provided technical cooperation for a WHO/IUCN/WWF International Consultation on the Conservation of Medicinal Plants held at Chiang Mai in 1988, as well as providing joint sponsorship with UNESCO/MAB for the International Round Table on Prosopis tamarugo Phil. held at Arica, Chile in 1984 (FAO 1985).

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[2] See, for example, FAO/ECA/BTAO (1965), ECE/FAO (976a, b, 1982, 1988), FAO/ECE (1978), FAO, ECE, FINNIDA (1987) and FAO/Instituto Italo-Latino Americano (1980) for relevant conference proceedings.

However, FAO has not been in evidence in other projects or meetings that have taken place to discuss critical NWFP, such as those conducted by UNIDO on the fruit resources of Balanites aegyptiaca or on medicinal plants (UNIDO undated). Neither does FAO appear to have participated in UNSO/ITC's discussions on the marketing, production and management of gum arabic (UNSO/ITC 1983).

Other potential areas for inter-agency cooperation include work with other international organizations concerned with NWFP, such as ILCA and ICRAF on browse species, or with WHO on medicinal plants, and both IBPGR and UNIDO on conservation of genetic material.

1.2.2 Past involvement within FAO

Past involvement in NWFP within FAO crosses departmental lines owing to sometimes arbitrary distinctions that are made between what are considered to be forestry, agricultural and horticultural subjects; similarly vague boundaries also exist among other international organizations as well as within and between national agencies.

Thus, although the growing and felling of trees for timber would appear to be indisputably the responsibility of the forester, and to be logical to expect forest resources and forest management to be his responsibility, yet these assumptions are not always ascertained in practice.

The responsibility for the management of wild tree resources varies from country to country, possibly due partly to the training and interests of the foresters, but probably more to internal politics. Thus, in the Sudan Republic, gum arabic, irrespective as to whether it is obtained from the wild, plantations or fallow, is a forest responsibility. By way of contrast, the Brazil nut, which is almost entirely harvested from the wild, is the responsibility of the agriculturalist. The wild Jessenia and Oenocarpus oil-producing palms of Latin America are similarly regarded as agricultural (FAO 1988). On the other hand, the mandate of some forestry departments even extends to all forms of wildlife, such in Chile, where CONAF's interest even extends to the barren salt flats of the Atacama Desert and the conservation of flamingoes as well as an interest in reptiles.

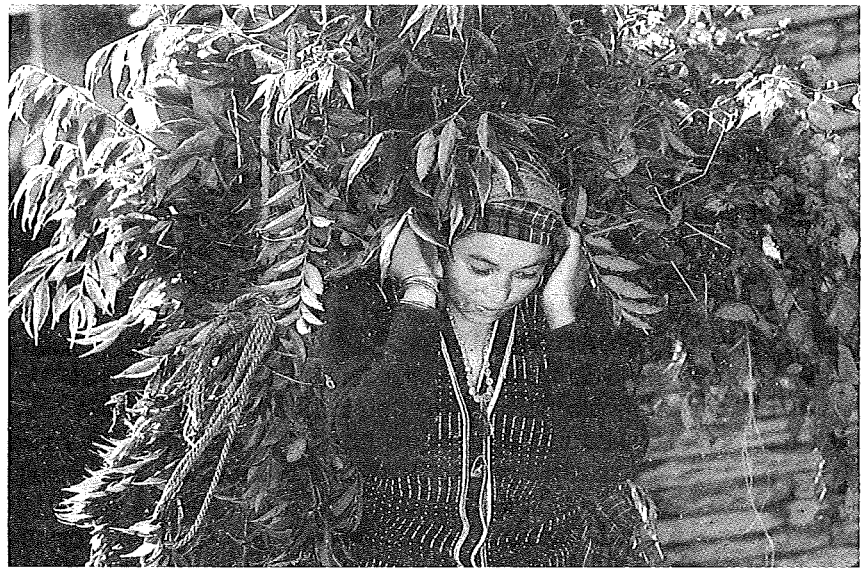
It is no wonder that in an international organization such as FAO there should be grey areas regarding the division of responsibility. Thus, the Forestry Department, as part of its programme for the promotion of appropriate forestry enterprises, has investigated the impact of rural enterprises as vicuna management in Peru (FAO 1985) and the management of captive crocodile for leather (FAO 1989). It

is possible that such studies may have received some input from other Departments, although this is not always apparent.

Examples of such cooperation include a major project funded by IBPGR and executed by FAO/FORM, on Genetic Resources of Arid and Semi-Arid Zone Arboreal Species for the improvement of Rural Living (1978-1985), originally involving eight countries. This project, continued since 1985 under the auspices of the FAO regular programme, has expanded to include over 30 nations, having as its focus fuelwood in combination with NWFP.

Other cases include the Fishery Resources and Environment Division's report on the utilization and management of mangrove resources (FAO 1987), written with the collaboration of the Forestry Department. Advising governments regarding suitable management of the mangrove ecosystem for the production of fishery resources and both wood and non-wood products can only be done if there is such collaboration between the two Divisions.

Most of the work involving NWFP is of interest to some other Departments and should not be carried out in isolation; this dictum applies equally within the Forestry Department, where, for example, Community Forestry is especially relevant to our understanding of how people can make more adequate use of the forest's natural resources, and Forest Resources are essential to ensure development and suitable management of this resource base (see Chapter 5).



Fodder is an essential non-wood forest product in Nepal

2 MAJOR FACTORS IMPEDING OR FACILITATING DEVELOPMENT

2.1 Factors impeding development

The development of NWFP has been impeded in the past by a number of factors, some of which appear to be either social or political in origin.

2.1.1 In many cases prejudices among both government functionaries and the population at large within the developing countries favour western style products over indigenous ones. Commodities from wild sources are either socially unacceptable or are considered technologically inferior because they were used by one's less sophisticated forbearers (Sène 1985). Such prejudices can persist even when the western-style product can be clearly seen to be environmentally or otherwise unsuitable. Such changing tastes and preferences are especially true for food products.

An education programme using the mass media could seek to overcome these prejudices and create a national pride in the utilization of natural resources. Competitive pricing and quality control are also important factors in ensuring continued acceptance of natural products.

2.1.2 Government personnel is often unwilling to assume responsibility for efforts to strengthen areas of lesser apparent priority to the national economy. Although individually NWFP often make a minor contribution, collectively they often represent a large proportion of the rural economy, and can add significantly to export revenues. However, when costed individually, they may also appear to require a disproportionate amount of effort to develop and market.

Improvement in valuation of the social and economic benefits to be derived by rural communities and industries following better utilization of NWFP needs to be stressed, as well as strengthening of decentralized rural institutions and enterprises.

2.1.3 Government personnel and urbanized communities may lack sympathetic appreciation regarding the importance of NWFP to the rural population. Development plans and projects that affect such products and resources may be devised without consulting the rural communities involved, leading to possible rejection of measures to be undertaken.

The advantages of NWFP to the rural communities and the need for their involvement and adequate consultation must be emphasized before the start of any project.

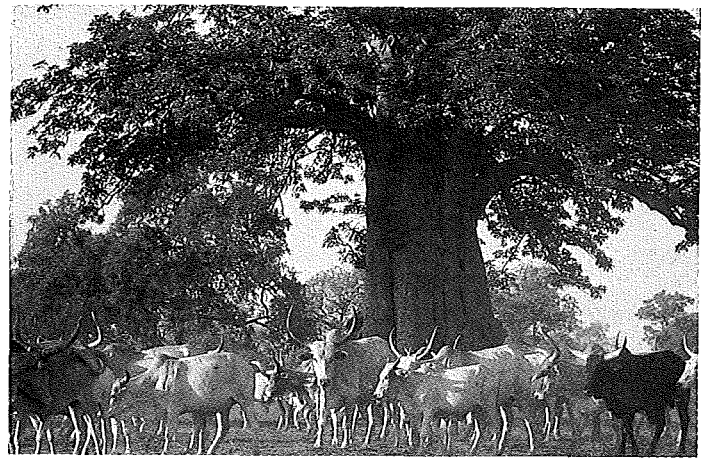
2.1.4 There are prejudices by both field workers and scientists in investigating and developing what may be considered minor natural products requiring unsophisticated analysis. Scientists in developing countries who have received advanced training in the West often find it demeaning to undertake relatively basic research, often based on nothing more than intelligent observation and selection rather than genetic engineering. The major exception to this generalization is the search for new biochemicals, which requires advanced scientific screening, linked with adequate ethnographical observations.

The growing international concern for biodiversity and protection of endangered gene pools may stimulate scientists to have greater pride in their countries' natural resources and to appreciate their value to the community. Such pride should be engendered through forestry training and extension with the help of the mass media.

2.1.5 There is a lack of detailed basic information on resource availability, yield, quality, preparation and utilization for most of NWFP and their relevance to the local rural economy, let alone any consideration of their potential value to the national economy.

The creation of natural resources data banks should be encouraged, attention given to the collection of information for the adequate valuation of their economic contribution, and assistance given on the sustainable development of these resources.

2.1.6 The full potential of a product may not be recognized often because of insufficient exchange of knowledge between countries, for linguistic or political reasons. For example, although the baobab is widely distributed throughout Africa, people in the individual countries where it occurs probably would recognize less than a dozen usages for its products. Yet, when these uses are considered over the entire distribution range of the tree, they number more than fifty.



Baobab trees provide sustenance and shade

There is clearly a need for more and better distributed monographic treatments of potentially useful species; specialists under contract are one means of achieving this, but project outputs may include public information and extension, demonstration and exchange as means of overcoming this constraint.

2.1.7 Few academic institutions provide instruction in NWFP, economic plants or ethnobotany. These are multidisciplinary subjects, a knowledge of which is essential for any development programme involving NWFP.

The training programme within academic institutions and short-term training courses for responsible forestry officials and rural development planners should be considered.

2.1.8 Information sources on NWFP within the developing countries are generally poor. Even where journals are available, there are very few dealing specifically with NWFP.[3] Other articles are to be found scattered through a wide range of publications so that major libraries in the biological sciences need to be consulted when seeking information.[4]

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[3] The major plant journals are Economic Botany, Journal d'Agriculture Traditionelle et Botanique Appliquée, and Travaux d'Ethnobotanique et d'Ethnozoologie; others, such as A Quarterly Journal of Natural Products (formerly known as Lloydia) and the Journal of Ethnopharmacology, deal with medicinal plants.

[4] Further references to the literature on NWFP may be found in Wickens (1990).

The available textbooks are largely concerned with plants that either are or are soon to be commercially exploited. However, important studies at the species or subject level have been published as monographs or reports by FAO, IBPGR, UNIDO, WHO, ILCA, ICRAF, GTZ, US National Academy of Science, etc. Wildlife, with its greater popular appeal, is better documented than plants.

Encouragement should be given to preparing regional and/or national textbooks. Developing country professionals should be informed of the availability of abstracting services solely for the benefit of the developing countries that may facilitate access to ephemeral ("grey") literature on NWFP, such as ILEIA, ODI Social Forestry Network, etc.

2.1.9 The utilization of NWFP was largely predetermined by earlier colonial exploitation patterns when many tropical countries were governed by Europe. Under the various colonial systems only a few key species were selected for export and thereby determined cultivation and research policies. In some cases the market advantages that such crops obtained were due to the disproportionate amount of research that they received compared to less-exploited crops of similar or possibly better potential.

Shifting research resources toward those neglected products that have promising potential may provide significant economic dividends, but may require a long-term commitment.

2.1.10 The relative prosperity of the early 1960s meant that many traditional NWFP, e.g. plant-based pesticides, were discarded in favour of western-style products (see 2.1.1 above). The elder generation that knew of their usages may die without first handing down their knowledge. Furthermore, much of the relevant information that was recorded during the colonial period is no longer readily accessible within the country concerned, although often still available within the former colonial power.

Information retained by the colonial metropolis needs to be extracted and made available to the countries concerned. Attempts should also be made to record and document the traditional usages known to older generations before their knowledge is lost forever.

2.1.11 Potential uses of NWFP may have been discarded, either because the appropriate technology was not available or the economic climate was not propitious. In other cases, where the species has been introduced, the appropriate source material (provenance) was not selected.

Unfortunately such failures tend to discourage further ventures due to discredit.

Discarded usages need to be revised in the light of present-day technical and economic viability.

2.1.12 Utilization of NWFP may, in some countries, be either hindered or prevented by restrictive forestry legislation, sometimes even to the extent of forbidding the harvesting of dead wood, wild fruits, etc.

Such restrictive legislation requires amendment. Customary laws and taboos should be assessed regarding potential conflicts with formal legislation.

2.1.13 World market forces have encouraged increasing concentration on a limited range of raw materials in the belief that uniformity is more efficient than diversity. This puts increasing pressure on developing countries to concentrate on staple products.

Fortunately there is a growing awareness of the inherent dangers in using restricted germplasm and monoculture. Nevertheless, there is still a need to increase this awareness further through education and the mass media.

2.1.14 It is not generally appreciated that NWFP demand a multi-disciplinary approach by biological and social scientists.[5] Even palaeo-scientists and historians can contribute. For example, the rediscovery of the use of penicillin by Flemming earlier this century could possibly have been made much sooner if greater attention had been paid to the writings of Pharaonic Egypt where the use of a penicillin-type mould is recorded.

Training programmes need to be strengthened and a greater interchange between the social and biological scientists encouraged. Furthermore, acces by industrialists and entrepreneurs to information on market potential for new forest products should be improved.

2.2. Factors encouraging development

The development of NWFP in developing countries has mainly received encouragement from deteriorating internal

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[5] See Appendix A for the function and interaction of some of the disciplines that might be involved in developing plant products.

and external economic factors, and from efforts to conserve tropical forests and biodiversity.

2.2.1 Worsening domestic economic condition and balance of payments crises have meant that many developing countries can no longer afford certain imports and have been forced to consider a greater use of their own natural resources. Synthetic pesticides are an example of costly imported products that now need to be replaced by local plant pesticides (see 2.1.10 above).

Training programmes for national forestry officials in opportunities for product development should be encouraged. For example, Zambia's Forest Department has, after training at the Royal Botanic Gardens, Kew, created a data bank on NWFP in order to advance their utilization.

2.2.2 There is a growing realization by some governmental administrations that a segment of local communities is dependent on non-wood forest resources for their well-being and that the use of such resources can provide a steady improvement in their living standards.

Publicity should be given to success stories to encourage further development.

2.2.3 There are new market opportunities being created by the green movement in the western countries, especially in their demand for herbal instead of synthetic pharmaceuticals. Recent efforts to link forest product sales with rainforest conservation have stimulated demand and improved prices for some goods. Profits are being reinvested in community development projects by groups such as Cultural Survival, the Body Shop, Conservation International, etc. (May 1990).

These opportunities need to be identified and developed.

2.2.4 New ethnic markets are sometimes created by the migration of peoples, such as the Jewish community from Morocco to Israel; their preference for argun oil from the wild Moroccan endemic, Argania spinosa, has stimulated its introduction for domestication in Israel.

Such demands need to be identified and met.

2.2.5 The ever continuing search for new biochemicals for pharmaceuticals and industry has been stimulated by the urgent need for a cure for AIDS. Drugs for treating cancer and the necessity for strategic alternatives for rubber and

sperm whale oil are part of ongoing research programmes underway for decades.

Strengthening the national institutions in the developing countries is recommended so that they too can become involved in the search for new biochemicals and pharmaceuticals and benefit from their development. Such participation should ensure intellectual and provenance property rights and standards for payment of royalties to the country of origin of genetic resources.

2.2.6 It is increasingly being realized that the world has become dependent on fewer and fewer staple resources, especially for food, and that there is an urgent need to diversify in order to avoid the possible consequences of panendemics.

As mentioned in 2.1.13, even greater awareness must be encouraged through education and the mass media.

2.2.7 The ever increasing global population and the occupation of the more hospitable land have created a need for the better utilization of less hospitable areas. New NWFP, adapted to such environments, are often necessary as a basis for regional resource development. This is particularly true for the arid, semi-arid and saline regions of the world, but also for the humid tropics.

Strengthening of national institutions is required to encourage greater research and development in the utilization of NWFP in these less hospitable regions.

2.3 Problems of marketing

Although complex, the problems involved in NWFP development from identification through manufacturing are relatively simple compared to those of marketing at the local, national or international level (Wickens *et al.* 1989).

2.3.1 There must be a niche in the market waiting to be filled, either by replacing an existing commodity by something that is superior and/or cheaper, or supply a demand that has until now been unfilled.

The price structure for a product must be such that the provider, merchant and buyer are all reasonably satisfied, without the middleman making an excessive profit at the expense of the provider.

2.3.2 Expanding production to enter new markets can cause problems for the producer. The unprofitable time lag

during which stocks have to be increased, so as to meet the quantity demanded by the new market, can be beyond the financial resources of the individual supplier. In general, the more expensive the processing required, the greater the volume of throughput needed to keep costs at a reasonable level. Although increased production by the community will create an increased demand for labour, this will be offset by any increased efficiency in processing technology needed to maintain competitiveness.

2.3.3 Monopsony (few buyers) should be avoided, to ensure that competitive market conditions prevail. At the outset in product development, however, it may be necessary to protect domestic producers by restricting imports of substitute products, provision of export financing, and technical assistance.

2.3.4 Trade restrictions between nations may prevent exports, or internal politics may prevent the introduction of a new product if the producers of an alternative product are disadvantaged. Lobbying by the pro-animal life lobby may also reduce the market for wildlife products. The Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) protects a number of species, although continued existence of clandestine markets continue to threaten extinction.

2.3.5 All these marketing factors need to be considered together. For example, conservation pressure groups seek the substitution of sperm whale oil by jojoba oil, or similar plant substitutes. At present the production of jojoba is too small and the price too high for sperm whale oil to be entirely supplanted in industrial uses. An increasing number of more efficient large-scale plantations will undoubtedly reduce the price but, as a corollary, almost certainly will also imply that small-scale producers will be unable to compete. Many developing countries will then find jojoba uneconomic as an export crop and must seek alternative internal markets with their cosmetic industries. They then will be faced with the decision whether to restrict imports of substitutes to bolster national jojoba producers. Such protection can have a perhaps unwanted side-effect of stimulating domestic entrepreneurs to invest in more efficient production practices, also marginalizing small producers.

3 NEEDS FOR ASSISTANCE

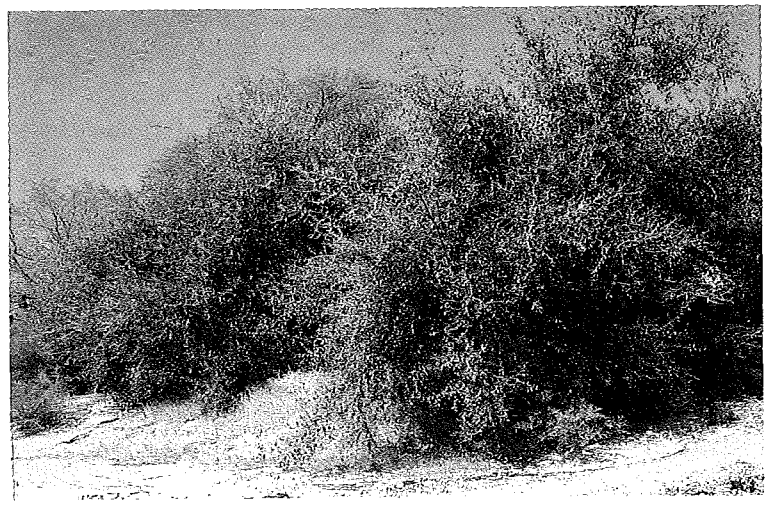
There is a tremendous range of products, as well as local economic and social conditions affecting potential for development of NWFP. Therefore, it is difficult to select any particular ecological zone for priority development. Some factors involved as well as the relative merits of a programmatic focus on the arid and semi-arid, sub-humid and humid zones, are discussed below.

3.1 In recommending priority regions for assistance, consideration has to be given as to whether local needs are consistent with government policy. One factor to be considered is the origin of demand for assistance in forest product development, whether generated by a need perceived by administrators, by local communities, both, or neither (i.e., other interests have stimulated such demand). The administrators should also consult potential beneficiary communities and intermediary organizations to identify priorities.

The administrator may also have to consider other national or commercial economic considerations regarding a particular development. Product development assistance should aim to produce a significant increase in prosperity of local communities through increased employment and improved income and living conditions. Even where sustainable harvesting of NWFP is viable and attainable, the potential for channelling significant benefits to land users may be uncertain (Flint 1990).

3.2 Within FAO units consulted, the consensus of opinion is that the arid and semi-arid regions, including the higher altitudes should be treated as a priority for improvement in subsistence production systems. Because natural resources and potentials are limited in these areas, almost any development is bound to be beneficial, especially for provision of basic necessities as food, forage, fuel and medicines.

However, although based on this criterion, sub-Saharan Africa has been singled out as the region most in need of assistance, it is doubtful whether development of NWFP would be financially feasible in most of the Sahelian region. However, there is some scope in the Sudanian region, immediately to the south of the Sahel, as well as in the Kalahari and the Horn of Africa. The improvement of Ziziphus fruits (see section 4.2), Vitellaria paradoxa and Parkia spp. for food production should be considered as possible product priorities.



Ziziphus in Niger

The caatinga of Brazil and the puna belt of the Andes are other arid areas with a high potential for non-wood forest product development, especially for forage and medicinal plants. FAO field projects in these areas are focussed on rural development through promotion of use by farmers of multipurpose woody species. National institutes in Peru are engaged, with FAO support, in programmes for the conservation of multipurpose woody species and their rational use in the high Andes.

3.3 The tropical rainforests have the greatest range of unexploited NWFP, with some communities entirely dependent upon them. Many wild fruits marketed in Brazilian regional capitals are unknown in Europe and North America, and may have potential for export. Such potential is already being explored by local NGOs linked with international environmental and human rights movements and progressive entrepreneurs (May 1990), and have recently received FAO assistance to prioritize NWFP for development through the Institute for Amazon Studies.

3.4 Land tenure security is an important factor promoting conservation and sustainability in land use systems. The sub-humid zone, lying between the arid regions and the tropical rainforest, forming the principal locus of settled agriculture, is an area of insecure tenure. Development of NWFP in this zone should focus on efforts to allay the process of desertification, but must go hand-in-hand with better definition of property rights over trees and land.

4 NON-WOOD FOREST RESOURCE MANAGEMENT AND IMPROVEMENT

Generally, food, forage and medicine rank high in community needs, both for subsistence and commerce. However, as suggested in the preceding section, their degree of priority can be subject to other factors, both local and national.

Priority should be given to the further development of NWFP that are already providing socio-economic benefits at the local level. Locally important NWFP that have the potential to generate export revenues or to enter broader national market circuits should receive higher priority.

A selection of specific NWFP is described below in general terms; their development will be subject, among other things, to the variables discussed in previous chapters.

4.1 Bamboos and rattans

Assistance could be provided in harvesting and transport of rattan and bamboos to increase the productivity and improve the working conditions (safety) in the forest. Although major NWFP, they are not discussed here in more depth as such as they are already viable industries, backstopped by UNIDO whenever necessary. More assistance should be provided to the producing countries to maintain and develop these resources.

FAO's Forest Resource and Management Branch has a programme activity in the management of rattan and bamboo, and several field projects are focussing not only on the harvesting/utilization but also on resource development.

4.2 Food plants

Food plants from non-domesticated species help to supplement existing staples, maintain balanced nutrition throughout the year and provide food in times of scarcity. Sometimes, wild food plants provide marketable products for local, national or international consumption.

For most of wild food sources there have been no or little nutritional analyses. The few analyses that have been carried out have often been incomplete and/or based on a single sample. Little information is available regarding seasonal availability and yields.

Local nutritional laboratories and university departments should be encouraged to carry out additional analyses. Local schools can be involved in efforts to

collecting data on phenology, yields, use, preparation and period of use. If necessary, local nutritional laboratories may have to be strengthened.

Multipurpose trees and shrubs are to be preferred to single-purpose food sources. Apart from use as snack foods, the harvesting and preparation for storage/market of species selected for development, should not interfere with the labour requirements for staple food production. For local consumption, harvesting spread over a period of time is preferable to a short season. However, the latter may be preferred for commercial marketing and processing.

It may be desirable to focus attention on potential for genetic improvement or selection for locally important food plants. For example, selection of elite fruit trees and grafting wild populations have been successful in the case of Irvingia gabonensis in Nigeria. Similar increases in productivity could be obtained for Sahelian conditions with wild Ziziphus varieties already sold in local markets in the semi-arid zone, using recognized cultivars from the Indian subcontinent.

The ye'eb, Cordeauxia edulis, an endangered species whose nut has been a staple food of the Somali and Ogaden nomads, is most definitely worthy of development. Its fruit has potential as a valuable food source in other arid regions as well as a dessert nut for export markets. Very limited germplasm is available from a few trees of this species cultivated in Kenya.

Another example is in Brazil where numerous fruit juices and ice creams are prepared using pulp from local wild species, many of which could well have an export potential. Selection for quality and yield, propagation and processing for export could usefully be investigated (see FAO 1986).

4.3 Forage

Forage for both domestic and feral livestock raise similar problems to those noted above for food plants regarding the paucity of information. In addition, forages also present attendant management problems, such as overgrazing and bush encroachment. Efforts to improve productivity of existing forages and introduce new species will make an important contribution to these problems.

Forage production from Prosopis in Niger

Livestock production is the largest and most important industry in the arid and semi-arid regions of the world and its prosperity is very much dependant upon the ability of the animals to survive the long dry season with the minimum loss in condition. Dry season browse is, therefore, the key to their survival.

Phenological observations will provide the necessary information regarding forage species availability (but not quantity) and the range of browse species required to ensure maximum productivity through the dry season, providing, of course, that stocking rates are adjusted to carrying capacity.

Local schools should be encouraged to provide phenological observation and animal preferences for forage species, and universities to carry out seasonal nutritional analyses; information regarding yields of forage species is also required.

The rich leguminous flora of the semi-arid caatinga of Brazil is worth investigating for potential browse species that could be introduced into other low rainfall regions of the world.

Among the more unusual forage requirements are those of some fishes of the Amazonian rainforest, which enter seasonally inundated areas to feed on large quantities of seeds and fruits, surviving for the remainder of the year on their stored fat. The mangrove ecosystem also plays a vital role in the food chain for many marine fishes, crustaceans, etc. Deforestation of such areas can eliminate the fishes, an important non-wood forest product!

4.4 Handicrafts

Wood use is here limited to handicrafts. These have somewhat limited possibilities for development as local industries since they cater to a limited local tourist market. Such products need to be of high quality and have a unique appeal if they are to attract the overseas ethnic markets.

Baskets made from palm fibers in a local market

4.5 Medicinal plants

Medicinal plants include those used for the treatment of both humans and animals, the latter uses being poorly documented. Herbal medicines, especially local herbal remedies, have always attracted a great deal of interest to the layman; if all the claims for folk medicine remedies were true then the world would certainly be a much healthier place.

Generally, similar specific claims for the same species, made by several, preferably widely separated communities, are worth investigating; claims regarding multi-cure species are generally of dubious veracity.

Unfortunately the medicinal attributes claimed of folk remedies are seldom supported by clinical evidence that a cure had been effected, that no placebo effect or autosuggestion was involved, i.e., proof that the herbal treatment by itself was effective. Possible side-effects involving either the active principles or, if present, secondary metabolites, and/or the presence of toxic or carcinogenic compounds, also need to be considered, especially if the effects are cumulative.

Medicinal plants are generally seasonal in their availability; their efficacy throughout the year may be subject to such variables as stage of growth, season, method of preparation and storage, etc. It is this variability in the concentrations of the active principles that pharmaceutical companies wish to eliminate, either by rigorous harvesting control or by developing synthetic substitutes.

Research into medicinal properties is best conducted on a plant systematic basis, paying particular attention to taxonomic relationships, rather than attempting to scan the whole range of a herbalist's medicine chest. Analyses need to be carried out not only at regular intervals throughout the year but also over a range of dietary habits. There is always the possibility that mineral uptake from other foods, for example, may affect the medicinal properties.

It is evident from the above discussion that, apart from the initial collecting of information on use and application, distribution and availability, study of medicinal plants represents a specialized field requiring both clinical and pharmacological expertise, their ultimate exploitation being dependent upon whether they are to become official or remain as traditional remedies.

4.5.1 Official medicinal plants

Medicinal plants accepted as official in the pharmacopoeias have been subjected to rigorous and extremely costly investigations; even the preliminary tests merely to prove that a new drug is safe for clinical trials can cost the pharmaceutical company more than over 2.5 million dollars. Only the most promising of species are likely to get beyond the first screening.

Purity, uniform quality, adequate and regular quantities are prerequisites for pharmaceutical companies. If their demands cannot be met from natural sources, then synthesis is inevitable. Presently, there are still several pharmaceuticals plants that cannot yet be synthesized.

There is also a growing market in the western world for the use of some specific official herbal material in preference to synthetic pharmaceuticals. The supply of such plants can be undertaken by rural communities, but such enterprise demands rigorous standards for quality, packaging, storage, and in particular, no fluctuations in annual supply.

4.5.2 Traditional medicines

Traditional herbal medicines are not usually subjected to control within the country of origin. As far as the western world is concerned, their use when exported, subject to a preliminary screening by the importing country for undesirable metabolites, is generally on the understanding that no claims are made regarding their alleged medical/pharmaceutical properties.

China, the Indian subcontinent and Latin America are particularly rich sources of herbal medicines, many of which are already being exported to the western world.

Any development of herbal medicines needs to ensure management for sustainable yields. Where underground organs, such as tuber roots and bulbs, are involved, sustainable use may imply the need to bringing the plant into cultivation so as to prevent over-exploitation. Some such species, for example, the South African grapple plant, Harpagophyton procumbens, still defy cultivation, making this option impossible until limiting factors are identified. Alternative harvesting techniques may be necessary, such as using secateurs to prune leaves instead of collecting small shrubs by pulling them up by the roots.

Close communication with the forest/rural population is needed to obtain local knowledge on the use and preparation of herbal remedies. Properly prepared, packaged and marketed, herbal medicines can serve as the basis for profitable local industries.

4.6 Toxins

Toxins used in ordeal poisons and for stunning game and fish may be considered as potential pharmaceuticals; some have already been discovered to possess anaesthetic properties. Other toxins may have a potential as pesticides or antifeedants and can consequently be of interest to local farming communities as well as possibly having commercial potential. Their management within the community would be similar to that for herbal medicines; their use against specific insect or other pests would almost certainly be based on empirical experience handed down by practitioners.

Consequently, exploration into toxic plant sources requires close communication with the local population to obtain information on the toxins themselves and their role in local society.

4.7 Aromatics

Aromatics are a specialized field, with the international markets for essential oil concentrate (concrete) controlled by the cosmetic industry. There is usually a demand for such products within a country to supply the local cosmetic and soap industries. The international markets require both high quality and a regular supply.

There are possibilities for increasing production and, in particular, the quality of many essential oils, incenses, myrrh and other unguents gathered or tapped from wild sources. The cultivation of aromatic herbs and shrubs for market during the early stages of reafforestation can considerably reduce the costs of activities and provide additional local employment.

For many aromatics, maximum concentration within the plant is to be found in plants growing in the drier regions, which suggests another rationale and focus for NWFP development in the semi-arid zones.

4.8 Biochemicals

Production of biochemicals from wild plant sources represents a specialized field where the initial identifications and their potential applications are largely the responsibilities of the biochemists and industrial chemists (see Appendix A). Like aromatics, maximum concentrations are generally found in the drier regions. Here too there is room for improvement in harvesting techniques and in quality, especially in standards of cleanliness.

Often, improvements in yields are dependent upon first understanding the plant's physiology; only then can there be a sound scientific basis for selecting higher-yielding strains - selection for gum arabic production based on apparently high-yielding mother trees has conspicuously failed to provide a new generation of higher yielding trees. The mother trees are not consistently productive, and the productivity enhancing features are apparently not genetically transmitted.

4.9 Fibres

Fibres are in local demand for cordage, which may be required for a range of purposes, from musical instruments to bindings for house construction. Both animal and vegetal fibres are required for weaving and matting; both have possibilities for local industries and, if of good quality, reaching the international ethnic markets.

For plant fibres there may be room for improvement in the retting operation, while for both animal and vegetal fibres improvements can generally be made in the standard of cleanliness throughout the harvesting and manufacturing processes.

4.10 Environmental plants

Environmental plants are basically those that are necessary to maintain a stable and healthy environment for man, his livestock and all forms of wildlife, by providing shade, shelter, hedges, nitrogen, green manure, soil stabilization, etc. The number of plants that can be used for such purposes is unknown and many can be initially selected merely through observation, e.g., by finding plants that assist dune stabilization or grow naturally in saline soils.

4.11 Ornamental plants

Ornamental plants for horticulture can provide quite a lucrative activity. Growing orchids, cacti and other succulents, crocuses, for sale to the specialist collector can be particularly profitable where the import of wild material is prohibited under CITES, but not the import of cultivated material.

However, the conservation regulations within the exporting country must be respected. For example, the collecting of wild cacti for growing and multiplication in a nursery may be forbidden; the collection of seed is usually, but not always, permitted.

The product may then be marketed through national or international horticultural firms or through the specialist societies to be found in many western countries, interested in cacti, succulent plants, orchids, etc.

Many horticultural firms employ their own seed collectors, and undertake their own processing, packaging and marketing. However, the vegetative propagation of bulbs, succulents, etc. is often preferably carried out in the country of origin, provided the importing country's plant health regulations permit import of the living

material. Such multiplication work can provide employment for community members.

The use of attractive, locally produced containers, climbing frames, etc. will enhance the value of the plants as well as providing additional employment.

4.12 Forestry Services

Forestry services are derived from a wide range of sources, including trees in rangeland (grazing, browse shade and shelter for cattle and wildlife etc.), establishment of parks and reserves for conservation, rearing of valuable wildlife species such as crocodiles and pythons, tourism recreation and aesthetic, scenic or historic sites.

Crocodile rearing in India

5 INSTITUTIONAL RESPONSIBILITY FOR NON-WOOD FOREST PRODUCTS

The priority given by the Forestry Department to a specific NWFP must be subject to such products coverage elsewhere within FAO or by other organizations. In cases where referrals are made regarding specific products covered better elsewhere, mechanisms for coordination between FAO and other institutions in this area should be formalized.

5.1 Products covered within FAO

5.1.1 Products covered by the Forestry Department

Within the Forestry Department, the former Mechanical Wood Products Branch (FOIM) of the Forest Industries Division (FOI), was responsible for all departmental activities concerning harvesting, transportation, processing and marketing of forest products, including woodfuels. In 1987 FOIM initiated a number of activities focussed on NWFP. Among these activities, regional studies were conducted for Asia and the Pacific Region, the Mediterranean Basin and the Latin American countries.

These studies assessed the principal NWFP in the regions considered and identified areas for possible intervention. Particularly in the Asia/Pacific region, the study draws on nearly a decade of research on rattan, bamboos, mushrooms, sticklac and other NWFP sponsored by RAPA. Other regional and country-specific documentation is emerging from the Tropical Forest Action Planning exercise, whose products deal in some cases in considerable detail with NWFP.

Meanwhile, discussions were initiated in the Department with different technical units and joint activities involving FOI, FOR and JEUR (Joint ECE/FAO Agriculture and Timber Division) were undertaken for the organization of a Seminar on Products from Mediterranean Forests, held in Florence, Italy, 20-24 September 1988 (ECE/FAO 1988a).

Within the Forestry Department, the Forestry Planning and Institutions Service is responsible for Community Forestry. Their work is largely concerned with social factors relating to the use of forest and the organization of work within the community. This provides good background material, essential for the development of NWFP, and the response of the community to that development. Community Forestry and NWFP should collaborate closely over the selection and development of projects, as well as complementary research and institution building efforts.

The Forest Resources Division has an interest in sand-dune stabilization, an area for liaison regarding the selection of species, bearing in mind that for conservation reasons unpalatable species may be preferred. Also within the Division, the Forest Resources Development Branch is involved in sustainable management of the resources (including genetic conservation aspects), species selection, research on little-known local multipurpose species (biology and variation patterns etc.). This work is of great significance for NWFP, and greater collaboration should be encouraged.

The Wildlife and National Parks Officer of the Forest & Wildlands Conservation Branch is responsible for wildlife conservation through national parks and reserves, for the national training of wildlife personnel, and wildlife products. Technical aspects of processing, distribution and marketing of wildlife products should be considered a responsibility to be undertaken jointly with FOPN.

5.1.2 Products covered by other FAO Departments

Related subjects that are among the interests of other Departments within FAO are shown in Table 5.1. These may be of major importance, such as the Plant Production and Protection Division's (AGP) understandable interest in browse species. The economic aspects of charcoal, gum, essential oils, etc. when advocating bush control for grazing (Little 1971) may be of secondary interest to AGAP. They are of great interest to FOPN, which must develop good working relationships with other Departments to ensure attention to these vital interrelationships.

Meetings with the Commodities and Trade Division (ESC), Crop and Grassland Service (AGPC) and Food and Agricultural Industries Service (AGSI) were carried out, beginning in 1987, to discuss possible areas of cooperation. Such discussions should be continued, extended to other Divisions, and lead to formal mechanisms for cooperation.

Table 5.1 Non-wood Forest Products of Interest to other Departments within FAO

Department & Division	Subject
Agriculture	
AGAP	Forage and livestock management in plantations
AGLW	Water resources, watershed management
AGLS	Soil conservation
AGPC	Forage, range management, Industrial crops, Horticultural crops, including bees
AGSI	Agricultural industries; production and marketing
Food Policy & Nutrition	
ESNP	Community nutrition
Fisheries	
FIRM	Marine environment; mangrove management
FIRI	Freshwater environment

5.2 Products covered by other international agencies

The mandates of the various international agencies which may appear to have some interest in NWFP are shown in Appendix A.

Relevant NWFP being covered by other international organizations are shown in Table 5.2 hereafter. As with other FAO departments, efforts should be made to identify overlap with particular species and subject matter interests with other international organizations.

Table 5.2 Non-wood Forest Products Covered by Various International Agencies

Organization	Subject	Liaison by FAO
ACSAD[a]	Range management and browse species, soil conservation and dune stabilization. development on non-wood products	Collaborate in selection and propagation.
IBPGR[b]	Conservation of plant genetic resources	Choice of dry zone species and genetic resources in conjonction with FORM.
ICRAF	Agroforestry practices and species.	Collaborate in selection and propagation of agroforestry species.
ILO	Handicrafts	Collaborate where appropriate.
UNESCO	MAB Programmes - much basic environmental information on both flora and fauna.	Consult.
UNIDO	Extraction and processing of fruit of Balanites aegyptiaca for edible oils and diosgenin.	Selection and propagation of high-yielding trees.
	Transfer of technology for the genetic improvement of medicinal plants and their processing.	Investigate.
WHO	Medicinal plants, plant molluscicides, etc.	Collaborate in selection and propagation of species.

[a] Activities restricted to Arab countries.

[b] Still technically part of FAO.

6 APPROACH TO DEVELOPMENT OF NON-WOOD FOREST PRODUCTS

6.1 Multi-disciplinary collaboration

The development of NWFP must be a multi-disciplinary approach carried out in collaboration with appropriate specialists within FAO and other international and national organizations. Within the Forestry Department close collaboration with specialists in the Forest Resources Division and with Community Forestry will be essential. Appropriate initial interactions with other FAO Departments and other agencies are elucidated in Tables 5.1 and 5.2, respectively.

6.2 Geographical and product priorities

The advantage in selecting a humid region for development is that there is a wide range of suitable plant and animal products that can be developed. Apart from the Sahel, where the struggle is for rehabilitation and survival rather than improvement, the arid regions offer opportunities for development but, where these do occur, they could be highly beneficial. Urgent consideration should be given to establishing non-wood product projects in the subhumid Sudanian zone, immediately to the south of the Sahel, to help prevent the advance of desertification.

The selection of priority products for development, irrespective of geographical regions, is determined by three major necessities for life, namely food and beverage, forage and medicine. As a general rule, these should receive priority over the other products listed in Tables 1.1-3, since the advantages from their development would be expected to benefit a wider range of people. Products that promise to increase rural incomes and employment as well as provide for these basic needs should receive highest priority. A description of product areas for priority development is mentioned in Chapter 4.

6.3 Stages in product development

The various stages in the development of a product, from its initial discovery to eventual marketing are shown in Appendix A. FAO's NWFP programme may in certain cases initiate and co-ordinate these stages at the project level. New NWFP product development activities are more likely to be identified from within a larger project than to come as a direct request by the country concerned.

Collaboration with other Departments within FAO, and when required, consultative panels may be formed to guide

this process. Such panels would likely include representatives from FAO, national institutions within one or more project areas, with international specialists in a particular field.

Before taking any such action a dossier should be drawn up showing the present state of knowledge regarding a particular product, bringing together information not only throughout the entire distribution range of the plant or animal involved, but also related to the sustainable management of the resources. This is most effectively carried out by a short-term consultant conversant with the product at issue. Efforts should be made to amplify the available consultant and institutional pool to support efforts in this area.

6.4 Education, training and research

In Chapter 2 there are several references for the need to educate the people in the developing countries to be more appreciative of the value of their own natural resources, as well as the need to strengthen some training and research facilities.

When necessary, training should be organized in any new skills required and back-up support should be given to appropriate research institutions. Appropriate demonstrations could be arranged for visiting public and officials. Publicity should be given at both local and national level to sustainable utilization of NWFP. These aspects require the collaboration of the Forest Research, Education and Training Branch.

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Appendix A: Possible Action Chain for the Stages in the Development of Non-wood Products

Specialist	Function	Action by Specialist
Ethnobotanist, Anthropologist, Sociologist, Ecologist Eremologist,* Thamnologist* Palaeobotanist	Recognition in the field of plant usage and possible potential for development, and Communication.	Collect herbarium specimens, field notes, information through scientific publications, verbal communication, interaction among fieldworkers, etc.
Taxonomist	Identification	Name and provide synonyms (including possible misidentifications in the literature), description, distribution, phenology, etc.
Ecologist	Environment	Liaise with taxonomist to characterize environmental factors (e.g., climate and soils) affecting plant management throughout distribution range
Biochemist (non-food products), Industrial Chemist	Analysis	Identification of biochemicals and their possible industrial application.
Biochemist (human food), Nutritionist	Analysis	Nutritional analysis, toxins, etc.
Biochemist (animal food), Animal Specialist	Analysis	Nutritional analysis, toxins, etc.
Biochemist (medicinal plants), Pharmacologist, etc.	Analysis	Identification of active principles, secondary metabolites; assay and clinical trials, etc.
Processing Technologist	Appropriate Technology	Feasibility studies for processing using appropriate technology, etc.

* Eremologist: Desert science
Thamnologist: Shrubs and bushes science.

Economist	Costs	Cost analysis of raw materials, harvesting, transport, processing, marketing, etc.
Marketing Specialist	Marketing	Identification of market opportunities and marketing
Industrialist	Industry	Establishment and operation of industrial activities
Processing Technologist	Processing	Processing and conditioning according to market requirements.
Conservationist (manager of the resource)	Conservation	Ensure germplasm supply for future generations
Breeder	Improvement	Genetic manipulation for improved product.
Agronomist, Silviculturalist	Propagation	Develop appropriate multiplication and propagation techniques, investigate possible pathological problems, etc.
Forester, Agriculturalist, Horticulturalist, Livestock/wildlife Specialist	Husbandry	Cultivation operations from sowing to harvesting, and/or management of livestock and wildlife for sustained production.
Storage Technologist	Storage	Post-harvest operations before processing (storage and transport, etc.)
Civil Servant	Participation	Allocation of land, labour, communications,etc., community relations, etc. for the well-being and economic growth of the local community.

Appendix B: Acronyms and Abbreviations

ACSAD	Arab Centre for the Studies of Arid Zones and Dry Lands
BTAO	Bureau of Technical Administrative Operations (UNO)
CGIAR	Consultative Group on International Agricultural Research
CILSS	Permanent Interstate Committee for Drought Control in the Sahel
CONAF	Corporacion Nacional Forestal (Chile)
DANIDA	Danish International Development Agency
ECA	Economic Commission for Africa
ECE	Economic Commission for Europe
FINNIDA	Finnish International Development Agency
GEMS	Global Environment Monitoring System
GTZ	Deutsche Gezellschaft Technische Zusammenarbeit
IBPGR	International Board for Plant Genetic Resources
ICARDA	International Center for Agricultural Research in Dry Areas
ICRAF	International Centre for Agroforestry
IFAD	International Fund for Agricultural Development
IGADD	Inter-governmental Authority on Drought and Development (Djibouti, Ethiopia, Somalia, Sudan Kenya and Uganda)
ILCA	International Livestock Centre for Africa
ILO	International Labour Organization
ITC	International Trade Centre
IUCN	International Union for the Conservation of Nature
IUFRO	International Union of Forestry Research Organizations
JEUR	Joint ECE/FAO Agriculture and Timber Division
MAB	Man and the Biosphere Programme
SIDA	Swedish International Development Authority
UNCHS	United Nations Centre for Human Settlements (Habitat)
UNCTAD	United Nations Conference on Trade and Industry
UNDP	United Nations Development Programme
UNDRO	United Nations Disaster Relief Organization
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIDO	United Nations Industrial Development Organization
UNSO	United National Sudano-Sahelian Office
WHO	World Health Organization
WWF	World Wildlife Fund

FAO

AGAP	Animal Production Service
AGLS	Soil Resources, Management and Conservation Service
AGLW	Water Resources Development and Management Service
AGP	Plant Production and Protection Division
AGPC	Crop and Grassland Service
AGSI	Food and Agricultural Industries Service
ESC	Commodities and Trade Division
ESNP	Nutrition Programmes Service
FIRI	Inland Water Resources and Aquaculture Service
FIRM	Marine Resources Service
FOI	Forest Industries Division, now called Forest Products Division
FOIM	Mechanical Wood Products Branch
FOP	Forest Products Division
FOPN	Non-Wood Products and Energy Branch
FOR	Forest Resources Division
FORM	Forest Resources Development Branch
NWFP	Non-Wood Forest Products
RAPA	FAO Regional Office for Asia and the Pacific, Thailand

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