

Forest Management for Non-Wood Forest Products and Services in Sub-Saharan Africa

B. Chikamai¹, M. Tchatat², Julius C. Tieguhong³ and Ousseynou Ndoye⁴

¹Kenya Forest Research Institute, P.O. Box 20412, Nairobi, Kenya

²Institut de Recherche Agricole Pour le Développement, P.O. Box 2064, Yaoundé, Cameroon

³Forestry Programme, Faculty of Science and Agriculture, University of Kwazulu-Natal, P. Bag x 01, Scottsville 3209, South Africa. Email: chupezi@yahoo.co.uk, or 204523366@ukzn.ac.za

⁴Food and Agriculture Organization of the United Nations (FAO) c/o FAO Representation in Cameroon, BP 281, Yaounde-Cameroon; Email: ousseynou.ndoye@fao.org or ousseynou.ndoye@yahoo.com; Tel: +237 22202472; Fax: +237 22204811

Abstract

The contribution of Non-Wood Forest Products (NWFPs) and services in livelihood support has been reviewed. Quite a number of NWFPs are also important articles of commerce and contribute significantly to the economies of various African countries. The non-consumptive role of forests has been examined in terms of eco-tourism while the social and economic viability of the production of NWFPs and services have been reviewed from subsistence and commercial perspectives. Conditions that enable long-term viability in the management of forests for NWFPs and services have been reviewed. Need for sound ecological data in relation to resource stock and yield were noted as important in determining ecological sustainability. A number of institutional issues important to SFM were noted, including setting up of strong producer organizations, enabling policies and legislative frameworks, and relevant institutions within the government that provide supportive roles. Multiple use management was noted as an important concept towards sustainable forestry and clearly demonstrates how forests can be managed for both wood and NWFPs. From an analysis of lessons learnt from the above, various recommendations were made.

Key Words: Non-Wood Forest Products, Sustainable Forest Management, Sub-Saharan Africa

Introduction

The terms Non-Wood Forest Products (NWFPs) and Non-Timber Forest Products (NTFPs) are internationally acknowledged and often used interchangeably. However, there is some difference in the scope of the commodities covered by each category which ought to be recognized. FAO has adopted a working definition in which "Non-Wood Forest Products consist of goods of biological origin other than wood, derived from forests, other wooded lands and trees outside forests" (FAO, 1999). This term excludes all wood. NTFPs on the other hand include wood for uses other than timber and hence cover a wider category of products/resources/services. For purpose of this document the term Non-Wood Forest products has been adopted.

NWFPs have been used by man and continue to play an important role in livelihood support. An analysis shows that NWFPs are important to three main groups (FAO, 1995b); rural populations who have traditionally used these items for livelihood and social and cultural purposes, urban consumers, and traders/product processors whose numbers in the NWFPs sector increase as urban markets

grow. NWFPs usually provide essential food and nutrition, medicine, fodder and other related domestic requirements to rural populations as well as urban consumers. Additionally, NWFPs play an important social and cultural role among various African communities in the Diaspora. For example, an estimated 105 tonnes of "bush plums" (*Dacryodes edulis*) and 100 tones of "eru" (*Gnetum africanum* and *G. buchholzianum*) are exported from Central African countries to Africans living in France and Belgium (Tabuna, 1999).

In economic terms, NWFPs contribute substantially to national economic growth and international trade. A study in Southern Africa revealed that wild plant resources contribute an income of US\$ 194–1114 per household per year (Shackleton *et al.*, 2000). Globally, herbal medicines entering the international market were valued at US\$ 14 billion in 1996 (SCBD, 2001). With improved access to information on markets and technology, there are prospects for continued growth of some of the NWFPs.

However, despite the importance of NWFPs, their significance in general, and economic value in particular, is rarely taken into account in land use

planning or in assessing gross domestic product (GDP). This is partly because of the subsistence or local market nature of most of the commodities which often go unrecorded in official national statistics and partly due to the previous tendency where emphasis was on wood/timber and NWFPs were considered only as incidental (FAO, 1995b). These omissions and anomalies need to be corrected since NWFPs can make significant contributions to household incomes of rural poor and, in a number of cases, to the GDP of national governments/economies. In addition, there are generally no systematic efforts to conserve or sustainably manage resources for NWFPs and only a few cases of domestication of NWFPs exist. Where such domestication is carried out, those local people who most depend on the products are often not properly incorporated. Also, despite Africa being a major producer of raw materials and with a wealth of traditional knowledge, her share in processing and value addition remains negligible and hence the actual value of commodities is quite low.

Nevertheless, development of enterprises based on NWFPs have been shown as one way of making forest use more sustainable, both because they extend the range of forest benefits and because gathering and processing activities can be managed by communities near the forest resource with a greater proportion of the end-product revenues returning to those who manage the resource (Taylor, 1999). However, there are also examples where increased markets for some NWFPs results in the degradation of forest resources (Ndoye *et al.*, 2001), nor does it necessarily lead to alleviation of poverty (Fisher, 2001) or to economic incentives for the conservation of forests (Wilkie *et al.*, 2001). All these arguments are useful learning points for evaluating the role of NWFPs in SFM.

It is in recognition of the above that "Forest Management for Non-Wood Forest Products" was identified as one of the studies under the project "Lessons Learnt on Sustainable Forest Management in Africa". The study aimed at answering the following questions:

- Is management of forests, woodlands and shrublands for the provision of non-wood products and services a long-term viable option that will help to conserve the forests?
- Are there any successful examples (failures) of such management and under what conditions are they successful (or failures)?
- How does management for non-wood forest products and services compare with management for wood production?
- What are the key issues in the joint management of wood and non-wood products and services? How could the conflicts be resolved?

Because of the wide range of NWFPs, the analysis provided a general overview but with a focus on the role of the following in sustainable management:

gums, resins and essential oils; indigenous fruits and related forest foods; medicinal plants; beekeeping and honey production and ecotourism and biodiversity conservation.

Provision of Non-Wood Forest Products from African Forests and Woodlands

Forests and woodlands cover about 650 million hectares (or 21.8%) of the total land area of the African continent (FAO, 2000). These forests are said to be undergoing the highest levels of deforestation in the world with an estimated annual net loss of 5.3 million hectares (or 0.78%). The above prognosis does not argue well for Africa given the significance of forests/trees in combating desertification, providing basic human necessities, protecting biological diversity, watersheds and moderating climate change (FAO, 2003). In the context of this paper, forests and woodlands have for long been sources of a wide range of NWFPs and services, which are likely to be lost under continued deforestation. An understanding of their role may help mitigate the high destruction being experienced and lead to sustainable management. The discussion below examines this role based on a selected number of resources/commodities.

Plant Gums, Resins and Essential Oils

Exudate gums are the main forms of plant gums produced in Africa. The two most important commodities are *gum Arabic* and *gum karaya*.

Gum arabic is a dried exudate obtained from the stems and branches of *Acacia senegal* or *A. seyal* (FAO, 1999). The two species are native to the hot and dry regions of Africa and occur from Senegal in the west, through the Sahelian countries bordering the Sahara desert to the Eastern Africa and southwards to the South Africa (Natal and Transvaal).

Sudan is the principal producer accounting for over 50% of the world production. Management of the resources for gum production is well developed in the Sudan through an agroforestry system known as gum gardens in which gum trees are grown on farm plots intercropped with agricultural crops during the first four years thereby supplying the farmers with food. The *Acacia* trees are also N-fixing and hence improve soil fertility. Gum production begins at around year four and continues annually until the trees are twenty to twenty five years. This system ensures optimum and sustainable use of natural resources since crop production during the initial years and gum production and livestock grazing form complementary productive components.

Gum karaya is a gum exudate obtained from tapping of *Sterculia setigera*. The species is found in the Sudano-Sahelian zone from Senegal to Sudan.

Commercial production is taking place in Senegal, which is the world-leading exporter (around 1000 MT per year). India was the leading producer and exporter until the mid 1990s and it is believed that large quantities are consumed locally where domestic consumption is about double the volume exported (Coppen, 1995c). Africa has a lot to learn from India with regard to tapping, sorting and grading.

Plant resins are solid or semi-solid materials, which are insoluble in water but soluble in certain organic solvents. The resins found in Africa can be classified into two categories: oleo-gum-resins and oleoresins. The term oleo-gum-resin means that the product contains an essential oil component, a water-soluble gum and alcohol soluble resin. Oleo-gum-resins are represented by *myrrh* and *frankincense*, which, like gum, arabic are ancient commodities that have remained important articles of trade to the present day. *Myrrh* is an exudate produced from *Commiphora myrrha*, a species confined to the Horn of Africa in Ethiopia, Kenya and Somalia (Chikamai and Odera, 2002). Outside Africa, it is found in Arabia. *Frankincense* (incense) is an exudate from species in the genus *Boswellia*. There are eight species of *Boswellia* found on the Horn of Africa (Chikamai, 2002). *B. sacra* and *B. frereana* from Somalia produce the most valued incense in the world. Incense from *B. papyrifera* from Eritrea, Ethiopia and Sudan is the most widely traded while incense from *B. neglecta* is produced in commercial quantities from Ethiopia and Kenya but traded mostly within the sub-region.

Ethiopia, Somalia and Kenya are the three leading producers and exporters of *myrrh* and *frankincense*. Virtually all the resources are natural stands except in a few cases in northern Ethiopia where the *Boswellia* species are being used in the rehabilitation of degraded sites. In areas where commercial production is well established, there exist a form of natural resource management based on indigenous knowledge. Although land is owned communally, clans within the Somali community have responsibility of managing resources within their areas of jurisdiction, which is well respected (Chikamai and Kagombe, 2002). *Myrrh* or incense trees are protected from felling by local rules and regulations. Only the dead and/or dry are cut. *Myrrh* production through tapping is also well organized by the "Malmaleys" i.e. *myrrh* (malmal) tappers (Chikamai and Odera, 2002), a system that ensures sustainable production from the resources.

Oleoresin or resin from pine plantations is being produced from four countries in Africa: South Africa, Kenya, Zimbabwe and Uganda. Production is fairly recent having started in Zimbabwe in 1976, Kenya/South Africa in 1986 and Uganda in 1994 (Coppen and Hone, 1995). The principal producing species are *Pinus elliottii* in Zimbabwe and *P. elliottii* and *P. caribaea* in Kenya and South Africa. *P. radiata* is also tapped for pine resin in Kenya. In Uganda, *P. caribaea*

is the main species. There exist good prospects and potential for commercial production in Malawi from *P. elliottii* and *P. kesiya*; Zambia from *P. merkusii* and *P. kesiya* and Tanzania from *P. elliottii* and *P. caribaea* (Coppen, 1995a). Management of the pine species for pine resin in addition to timber has a definite added economic advantage both at community (provides employment) and national (import substitution or foreign exchange) levels and an incentive to SFM based on the principle of multiple use.

Meanwhile, there is a wide range of essential oil sources from Africa but the major ones on a commercial scale are from *Eucalyptus* species. Southern Africa is the major producing region, mostly from South Africa and Swaziland (Coppen, 1995b). Principal species are *Eucalyptus smithii* and *E. radiata*, which produce medicinal oils because of the high content of *cineole*. *E. globulus*, *E. citriodora* and *E. camaldulensis* are good sources of both medicinal and perfumery type oils and are commercially utilized from other regions but have not been exploited for their potential in Africa. Like pines, the *Eucalyptus* species are grown for poles/posts, timber or pulp and eucalyptus oil from the leaf biomass represents an added source of income.

Indigenous fruits and related forest materials

Forests and woodlands have always been major sources of fruits and medicines for humans. Wild fruits contain vital nutrients (carbohydrates, protein, and minerals) and essential vitamins which are important, especially for growing children, who are prone to malnutrition and related diseases.

Among indigenous or naturalized fruits with commercial potential in Africa are: *Tamarindus indica* (tamarind), *Ziziphus mauritiana* (ber), *Adansonia digitata* (baobab), *Vitellaria paradoxa* (karite), *Parkia biglobosa* (nere), *Sclerocarya birrea* (marula), *Uapaca kirkiana* (uapaca) and *Azania garckeana* (azania) for savannah and dryland zones and *Irvingia* spp. (Andock), *Baillonella toxisperma* (Moabi), *Ricinodendron heudelotii* (Njansan), *Coula edulis* (Ewome), *Monodora myristica* (Nding), *Garcinia cola* and some *Xylopi* species for forest zones.

Tamarind is the name commonly given to the fruit produced from *Tamarindus indica*. In Africa, the species is found in the dry savannah from Tanzania, Kenya, Ethiopia and Sudan, westwards through Sub-Saharan Africa to Senegal. The fruit is the major product used for culinary purposes, making juices, sauces, etc, while the seed is the main component used in industrial applications. Although it is found growing in the wild in Africa, propagation is not a problem for increased production.

Ber or Indian jujube, is the name of the fruit from *Ziziphus mauritiana*, the most commercialized species rich in vitamins C, A and B-complex as well as minerals (Pareek, 2001). In Africa, it has been

cultivated in the drier parts of Zimbabwe, Zambia, Malawi, Uganda, Tanzania, Kenya, Ethiopia and Burkina Faso. There exist other indigenous species in Africa (*Z. abyssinica* and *Z. mucronata*), which, however, have not been commercialized. The fruit is the major commodity and, at present, nearly 90% of its production is consumed as fresh fruit. The species can easily be planted in agroforestry systems as live fences around agricultural fields.

Baobab is the common name for *Adansonia digitata*, an imposing large tree (Owen, 1999). It is a common species in thorny savannah woodlands across most of sub-Saharan Africa at altitudes below 1500 m, annual rainfall of 200–1500 mm and extended dry periods. The tree has many uses and its fruit is one of them. The fruit has a pulp, which is eaten when fresh and makes a refreshing and cooling juice from a kind of flour when dry (El Khalifa and El Kamali, 2000; Fries, 1996). The tree is usually left standing when land is cleared for cultivation.

Karite and *nerè* are common names given to the species *Vitellaria paradoxa* and *Parkia biglobosa*, respectively. Both are found within the Sudano-Sahelian zone with mean rainfall between 600–1000 mm. They occur from Senegal and Guinea in the west through southern Mali, Burkina Faso, northern Cote d'Ivoire, Ghana, Togo, Benin, Nigeria, Cameroon, southern Chad, Central Africa Republic, Sudan, northern Uganda and south-western Ethiopia. The species form part of the very common agroforestry parklands systems in the regions where they occur (Tekleheimanot, 2003). The fruit of *karite* provides a high quality oil or butter used in cooking, and as a cosmetic and medicinal ointment. *Nerè* fruits provide a pungent nutritious spice or condiment, which is added to soups and stews. Fruits of both species are traded at local, national and regional levels with a potential for full-scale commercialization.

Amarula is the fruit produced by the marula tree (*Sclerocarya birrea*). The species is widely distributed in the semi arid areas from S. Africa through Eastern Africa and the Sahel countries to Senegal in West Africa. The species has three different subspecies (Hall *et al.*, 2002), viz. *subsp. caffra* growing from Southern Africa to Central Kenya, while *subsp. birrea* is found mainly in West and Central Africa although it extends into Eastern Africa, and *subsp. Multifoliolata* that is endemic to Tanzania. *Amarula* is used as a source of food during famines and drought (Phofuetsile and O'Brien, 2002). Ripe *amarula* fruit is eaten raw by removing the cover and the cream fruit pulp is sucked. The fruit is very rich in vitamin C and the kernel contains oil rich liquid (+50%) with very high stability. At commercial level, the pulp of fresh fruits is processed into sun dried fruit, cooked jams and preserves. A number of cottage industries in South Africa are producing jam. In addition, alcoholic beverages (liqueur and cider) are well-established articles with the South African 'Amarula' cream liqueur being the most familiar

product. Another product that is entering commerce is the *amarula* oil, which is often described as similar to olive oil. Efforts to market the oil are carried out in Southern Africa by SAFIRE (Gondo, 2004). There are initiatives to domesticate *S. birrea* in Southern Africa and Israel (Mizrahi and Nerd, 1996, as reported in Hall *et al.*, 2002). These initiatives are useful learning points in sustainable forest management.

In the humid forest zones of West and Central Africa, people utilize several fruit species of great nutritional and commercial importance. *Irvingia* spp. is one of the most common species used in West and Central Africa. This genus is made up of several useful species such as *I. gabonensis*, *I. wombolu*, *I. grandifolia*, and *I. robur*. *I. gabonensis* is the most popular one. *Irvingia* fruit is a drupe with a kernel inside. The fruit pulp is consumed fresh. The kernel is the most important part and commercial product in Cameroon, Gabon, Equatorial Guinea, C.A.R. and Nigeria. It is grinded and added into soup as condiment.

Ricinodendron heudelotii (Njanssan) is a very large tree common from Cameroon to Ivory Coast. It is mostly found in secondary forests, cocoa and coffee plantations and in home gardens. The fruits are drupes with a fibrous pulp containing one to three kernels (Vivian and Faune, 1996). Almonds are the useful part of the fruits and are intimately enclosed in these very hard kernels. *Baillonella toxisperma* (Moabi) is also a widespread species in the humid forest zones. It is often called forest *karité*. It belongs to the same botanic family as the *karité* tree found in savannah zones. The pulp of the fruit is smooth and juicy (Vivian and Faune, 1996). The most important product of Moabi is the oil obtained from processing its oleaginous almond. Unlike *Irvingia* and *Ricinodendron*, Moabi wood is one of the best timbers found in the region. Due to this, its logging is a source of conflict in many countries of the region between dwellers and logging companies and concrete measures are required as elaborated in the section called Multiple Use Management.

Among the vegetables, *Gnetum* leaves (also called Koko or Ekok) from the two species *G. africanum* and *G. bulchozianum* are mostly used in the region. *Gnetum* is a liana found all over the humid zone of West and Central Africa, from Angola to Ivory Coast. It is one of the most important regionally traded commodities and is also exported to Europe. Traders often dry leaves in the sun for conservation (Tchatat, 1999; Tchatat *et al.*, 2002).

Roots of some species are used as spices. This is the case of *Mondia whiteii* and *Dorstenia* sp. Bark of *Afrostryax lepidophyllus* and *Scorodaphneus zenkeri* are used as spices in many countries. The ones of *Garcinia lucida* and *Garcinia kola* are added to palm wine in Cameroon, Gabon, Equatorial Guinea and C.A.R. The exploitation of the bark is intensive for commercial purpose. The harvesting method generally consists of removing most or all of the and

in many cases the trees die after a couple of months (Guedje, 1998; Van Dijk, 1999). It can be said that in general, bark of high commercial value are harvested unsustainably.

Some palm trees in the region produce a sweet sap called "palm wine". This palm wine is very appreciated by people. Some, particularly adults, do not appreciate sweet palm wine, and therefore bark of some other species such as *Khaya* sp., *Garcinia lucida*, *G. kola*, etc are added to give the wine a bitter taste. The most popular species producing palm wine are *Raphia* sp. and *Elaeis guineensis*.

Forest medicines

Traditional medical practices in Africa are widespread and deep rooted. Most medicines are from plants with a majority coming from forests and allied ecosystems. Important high value medicinal plant species include *Garcinia lucida*, *Prunus africana*, and *Pausinystalia johimbe* from Central Africa (Van Dijk, 1999; Laird, 1999; Nkefor *et al.*, 1999). In southern Africa, *Erythrophleum lasianthium*, *Cassine transvaalensis*, *Alepidea amatymbica*, *Warbugia salutaris* (Cunningham, 1997) and *Harpagophytum procumbens* (Grapple plant), are used. Three species, i.e. Cape aloes (*Aloe ferox*), buchu (*Agathosma betulina*) and devil's claw (*Harpagophytum procumbens*), represent South Africa's contribution to world medicine. In Eastern Africa, key medicinal plants include *Albizia anthelmintica*, *Myrsine africana*, *Prunus africana*, *Strychnos henningsii*, *Warbugia salutaris*, *W. ugandensis* and *Zanthoxylum chalybeum* (Stella *et al.*, 1996).

Bee keeping and honey production

Honey and beeswax are two important NWFPs that have a strong relationship with plants. Honeybees derive the nectar and pollen they need from a wide range of vegetation types. In the natural environment forests, woodlands and bushlands are major sources of nectar and pollen, which has made traditional beekeepers acquire a profound knowledge of trees and other plants that bees depend on. Forests are also important sources of materials used by beekeepers. Most modern hives are made of sawn timber while those used in the traditional set up are assembled out of bark, logs or other locally available types of plants or soils. Trees also provide much needed shade for keeping hives cool under hot tropical climatic conditions. The relationship between the beekeeper and trees thus acquires such importance at times that trees come to be regarded as personal property. Insensitive and wanton exploitation of forests thus poses a serious threat to beekeeping.

Eco-tourism and biodiversity conservation

Eco-tourism is one of the sectors with fastest economic growth rates in the world and one that has

generally low negative impact on the environment in comparison with other productive sectors. It is a form of non-consumptive use of the forest and hence a well suited element for conservation of the forest and its biodiversity. Unlike conventional tourism, eco-tourism has also an educational potential for the participant who may be enlightened and encouraged by the visit to support nature conservation.

Forest and related woodland ecosystems are an important focus for eco-tourism development. There are many examples of forests being important in eco-tourism, including the internationally acclaimed campfire project in Zimbabwe and the *Kipepeo* project in Kenya, among others.

The Commercial Areas Management Programme for Indigenous Resources (CAMPFIRE) is a community based wildlife management programme developed in Zimbabwe where management of wildlife and other resources is undertaken jointly with the involvement of local communities. The programme has initiated income-generating activities from wildlife (funds from concession leasing for hunting, safari and tourism, trophies and bed night fees in communal lands), which has made it self-sustaining (Hasler, 2003). Management of wildlife and other resources is eventually devolved to local communities.

Viability of the Production of Non-Wood Forest Products and Services

Many NWFPs have both social and economic benefits to rural communities. Some of these commodities also play an economic role to the national and international economies.

Production of NWFPs for local consumption and/or markets is carried out as part of livelihood strategies at household level, e.g. to secure provision of food and other essential subsistence goods and social security (Arnold, 1995), health care needs, concerns to reduce risk factors and local social cultural and spiritual considerations. The pressure on forests resources to meet these subsistence demand is generally modest and in accord with availability of the commodity in terms of abundance or seasonality. Local communities have a good understanding of the availability of different commodities and adjust accordingly. There are no serious threats to forest resources and prices are mostly within their means. Even with some destructive practices, e.g. uprooting and/or debarking to provide medicinal products, the extent of the practice is rarely severe enough to degrade the forest ecosystem.

Many NWFPs are articles of commerce and have indeed contributed to the economic development of some local communities and national economies, as pointed out earlier. Gums (especially *gum arabic*) and resins (frankincense and myrrh) are good examples.

They are ancient commodities that have remained important articles of commerce on the international market to the present day. Sudan, Chad and Nigeria, which account for the bulk of exported volume, are putting in place aggressive programmes at the level of production and post harvest handling to improve quality and value of the traded commodity. However, the long-term viability of the gum and resins sector is still constrained in some dozen other countries. There is no information available to producers on best practices concerning production and quality control and limited access to knowledge on national and global markets. To overcome some of these constraints, a coordinated strategy has been initiated among producer countries and partners to enable them to have a better control of international trade and share experiences in the area of production, processing, quality and marketing. This initiative includes the establishment of the Network for Natural Gums and Resins in Africa (NGARA), which is initially supported by FAO.

Indigenous fruits represent a second category of NWFPs that are traded at national and regional levels with a few having entered the international market. Two examples will be used to illustrate the issues affecting the long-term viability of marketing indigenous fruits:

- Bush Mango is a popular fruit from the tropical forests of West and Central Africa. However, the fruit exhibits great variation in quality, taste and size, as does the size of the kernel, timing of fruit production and in the maturation process (Tchondjeu *et al.*, 1999). Important kernel quality factors have been identified (Ladipo, 1994). For eating and cooking, consumers consider the following factors important: *appearance*, including kernel size, colour and shape; *absence of defects*, *oil content*, *flavour* and *level of adulteration*. Improvements in quality can therefore be achieved at two levels: through a tree improvement programme at domestication stage and through improved practices at the post harvest handling stage, covering aspects of harvesting of fruits, extraction, drying and sorting of kernels, storage and packaging.
- The distribution and uses of *karite* have been described previously. A number of issues influence the long-term viability of Shea trade. One relates to the quality of the Shea across the ecological range. Studies carried out on the fat quality in 42 populations in 11 countries revealed high variability in the quality of the fat both within and between populations (Maranz *et al.*, 2003). Kernel fat content varies between 20–50%. Fatty acid composition is dominated by stearic (25–50%) and oleic (37–62%) acids thereby producing major differences in butter consistency across the species distribution range, aspects that influence use in the chocolate

and cosmetic industries. Meanwhile, improved appropriate processing technologies for higher olein Shea of Eastern and Central Africa has resulted in better quality Shea oil for the local market and increased opportunities for export (Masters, 2003). Not only processing technology determines product quality, but also cultivation and management practices.

Medicinal plants represent a third category of NWFPs whose volume in the local, national and international trade has been increasing in the recent past. The volume of medicinal plants entering the international market has been mentioned previously. They are used either directly as herbal remedies in Africa and as food supplements or to extract active compounds in the developed world.

Commercialization of medicinal plants may have far reaching implications on the survival of some of the plants. Firstly, most of the material comes from wild harvests. Information on primary production, demography and growth characteristics is usually too limited to ascertain sustainable off-take levels and increased extraction tends to put pressure on the available stocks thereby threatening the species through over-harvesting (Cunningham, 1997). A second aspect relates to what part of the plant is harvested. Most of the popular medicinal plants contain active ingredients either in the roots or bark. A good example is *P. africana* in Cameroon whose bark is sought after in the treatment of prostate cancer (Nkuinkeu, 1999). The demand for the bark, in the 1980s and early 1990s, almost threatened the remaining natural populations to extinction.

Honey and beeswax are also important articles of commerce at both national and international levels. Long-term viability in the production of honey and beeswax requires that a wide range of measures are put in place both by national governments and organisations involved in the sector at local level. Tanzania provides an example of a good case at the national level (Mpuya, 2003). The country has formulated a national beekeeping policy (1998) a beekeeping programme (2001) and a beekeeping act (2002) to harness and sustainably use bee resources in the country. The enabling environment in the country has made it possible for a number of NGOs and CBOs to support various honey and beeswax production activities.

Eco-tourism is an attractive conservation strategy because of the high revenues it can generate from the non-consumptive use of natural resources (Brown, 1998). If properly implemented, it is an alternative source of income that can divert local populations away from actions that can negatively impact natural resources in buffer zones around protected sites. Various examples abound in Africa and the *Kipepeo* project in Kenya provides a good case (Gordon and Ayiemba, 2003). This is a community-

based butterfly-farming project on the margins of Arabuko-Sokoke forest on the north coast of Kenya. This forest (42,000 ha) is a globally important forest for biodiversity conservation and is among the top 25-biodiversity hotspots on earth. Agricultural communities surround the Arabuko-Sokoke forest on all sides. The community is generally poor and given that their operations in the forest were considered illegal by the government (Forest Department and Kenya Wildlife Service), they had little concern with the forest, which was instead seen as a source of many of their problems. In fact, 59% of the forest adjacent communities wanted the forest cleared for settlement in the early 1990s and the forest was invaded by farmers on several occasions.

The *Kipepeo* project was set up in 1993 to change community attitudes to the forest by giving them a stake in forest conservation. Some members from forest adjacent communities were identified through interviews to participate in the project. They were trained on how to rear butterflies. Eight months after commencement of the project 10,000 pupae (belonging to 14 species) raised by farmers had been exported amounting to a revenue of around US \$ 16,000. By the end of 2001, the cumulative export earnings had surpassed US \$ 400,000 more than eight times the initial grant (US \$ 50,000) that set up the project and annual income had grown six fold since 1994. The project has been self-sustaining since 1999. The number of butterfly farmers has increased from 133 in 1994 to 700 in 2002, and they now completely surround the forest.

An analysis of the impact of the project to the forest and community showed that:

- *Kipepeo* has added value to the forest where butterfly sales for the period 1996-2001 accounted for 80% of all recorded revenue from the forest, with 15% coming from the forest department (fines and royalties for timber products), 3% from tourism and 2% from beekeeping.
- *Kipepeo* has had an effect on both attitudes and livelihoods. The proportion of farmers wanting forest cleared and settled had fallen from 59% to 16% in 1997 and that butterfly earnings contributed some 73% of farmers' cash income. Attempts to degazette part of the forests have recorded strong protests from the communities,
- Other benefits have been in awareness raising and education. More than 10,000 visitors to the project have learned about the forest and its adjacent communities. *Kipepeo* farmers and their families have also learned about the forest and its global significance and about butterflies and their food plants,
- Butterfly monitoring indicates that there are no adverse effects on wild butterfly populations.

Conditions that Enable the Long-Term Viability of Management of African Forests for the Provision of NWFPs

Among conditions that enable the long-term viability of management of African forests for the provision of NWFPs are economic viability, ecological sustainability and institutional arrangements, including resolution of conflicts. This paper will focus on the last two since the others are covered in a separate paper.

Factors in ecological sustainability

Sound ecological information is a major factor in the sustainable production of NWFPs. At the very basic level, sustainable use requires information (Peters, 1999) on: density and size-class structure of the plant population producing the NWFPs (i.e. resource stock) and how much of the desired resource this population is able to produce in a given period of time (i.e. yield). An overall strategy for collecting this information in ensuring optimal production has been developed (Peters, 1994). The six steps process involves species selection, forest inventory, yield studies, regeneration surveys, harvest assessments and harvest adjustments. The basic concept is to provide a constant flow of diagnostic information about ecological response of the species to varying degrees of exploitation. Sustainability is achieved through a continual process of reciprocal feedback where the demographic reaction of the target species must result in a corresponding adjustment in harvest levels. However, the above-recommended measurements are expensive and time consuming, and very few species have been studied from this perspective.

Nevertheless, they provide a rational approach to sustainable management and hence conservation of biological diversity.

Institutional arrangements including resolution of conflicts

There are a number of institutional aspects that can be taken into account to ensure sustainable resource management. Amongst these are:

- Clear organization of producers and their organizations into producer groups whose capacity can be improved through training in sound methods of harvesting and post harvest handling. The groups can be trained in good management of resources, including aspects of marketing;
- Setting up specific policies and legislative framework that promote and regulate management of NWFPs. This will entail review and harmonisation of policies that support

development of the sector reinforced by relevant legislation;

- Establishment of relevant institutions within the government that provide supportive roles, e.g. extension to producers and/or merchants and research that address specific issues of resource development, management and use.

Multiple use management

Multiple use management is a concept towards sustainable forestry. It entails managing forestry resources for more than one use and fits in quite well with the management of forests for both wood and non-wood products and services. Good examples can be drawn from managing suitable pine forests for timber and pine resin or eucalypts for pulp/pole and eucalyptus oil.

Meanwhile, most trees in natural forests have more uses than both timber and NWFP, an aspect that requires a better strategy on multiple use management to prevent conflict. In planning for multiple use management, managers are advised to analyze inventory information to determine complementary harvest strategies and uncover potential conflicts between wood and non-wood harvest (FAO, 1995a). In areas where forests are important in the provision of services, e.g. water or sensitive biodiversity sites, these roles should be properly factored in management. They can take the form of forest protection with zoning as a component of comprehensive and multi-faceted water management programmes. The whole forest can also be allocated to specified land uses, including (FAO, 2003):

- Protected areas for conservation, tourism and non-consumptive use;
- Protection forest, e.g. for watershed management;
- Production forestry management principles for timber and other forest products;
- Planted forest for intensive production of specific commodities.

Lessons Learnt and Their Implications

Various lessons can be drawn from an analysis of the contribution of NWFPs in forest management in Africa.

Quite a number of examples abound at the level of resource management. The gum gardens in the Sudan are a good example and learning point on how forestry resources can be managed sustainably for the provision of a wide range of goods and services. The gum garden is an old agroforestry practice that permits multiple use of the land resource for agriculture, livestock and *gum arabic*. The ability of the acacia trees to fix nitrogen ensures

that land productivity is at least maintained. Increase in population in the areas where the technology is practiced presents challenges on the length of the fallow period. However, with advancements in agroforestry technologies, the practice can be modified by building on the wealth of indigenous knowledge that is already known. It is a suitable technology that holds the future to sustainable NWFPs management in the dry Sahel.

The *karite* and *neré* parkland agroforestry system practiced by communities in dry areas of West Africa has preserved valuable fruit trees within a farming landscape. These parklands are a rational land use system developed by farmers in Africa over many generations to diversify production for subsistence and for income generation, as well as to minimize environmental risks related to the high climatic variability prevalent in the dry Savannah regions of Sub-Saharan Africa.

Examples from eco-tourism clearly demonstrate the benefits of involving local people in joint forest management. This gives them a sense of ownership and responsibility in the protection of the resource. Improvements in the management of the resources through eco-tourism are becoming a valuable strategy in sustainable forestry.

Valuable examples have also emerged with regard to the management of commodities. The production of indigenous fruits and vegetables from the humid forests of West and Central Africa and medicinal plants in Southern Africa have demonstrated the importance of the availability of ready markets across borders within a region which share the same ecological and cultural heritage. The markets are not only limited to the region but have international dimensions among members from the communities living in the Diaspora. The spin-off effects are when other communities in the newly settled areas take to the use of the commodities thereby expanding the markets.

However, two limitations need addressing to ensure long-term sustainability of expanded markets at regional and international levels. One relates to the regularity of supply which cannot always be guaranteed with increased demand. This has been demonstrated from studies made in Central Africa on some fruit and food plants with "thin markets" and can only be resolved by putting in place effective conservation strategies where off-take levels are properly understood and producers are trained on sound harvesting procedures and post harvest technologies. An alternative and more effective approach is to undertake domestication programmes which has several advantages. A second limitation relates to variation in the quality from a given botanical source as has again been shown from the different fruit plants of commerce. Domestication is seen as a major approach also in resolving this constraint.

Among the NWFPs most threatened by expansion of commercial markets from the wild are medicinal plants. The situation is particularly constraining when the part of the plant harvested is root or bark. However, there is scope for expanded markets supporting rural livelihoods and sustainable forestry management if proper programmes of domestication are put in place.

The need for sound policy and institutional framework in sustainable forestry was demonstrated by Tanzania in the management of bees for bee products.

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