A report prepared for the project

Lessons Learnt on Sustainable Forest Management in Africa

FOREST MANAGEMENT FOR NON-WOOD PRODUCTS AND SERVICES IN AFRICA

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by

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SUMMARY OF FINDINGS AND RECOMMENDATIONS

Summary of findings

The contribution of NWFPs in livelihood support has been underlined. They are particularly important to rural communities in terms of food and nutritional requirements, medicines, fodder for livestock and related domestic requirements. The demand for a number of NWFPs, especially those for food and medicines, is increasing in urban centres and cities as members from respective communities migrate and desire to use these commodities. Gradually, influence spills over to other communities in the cities thereby increasing the markets. The use of *Dacryodes edulis* and *Gnetum spp.* from Central Africa for Africans in Europe and of *Catha edulis* for Somalis in the Diaspora has been mentioned. Quite a number of NWFPs are also important articles of commerce and contribute significantly to economies of various African countries. Examples have been cited of gums and resins as well as indigenous fruits and medicines.

The role of forests in the provision of a wide range of NWFPs and services has been emphasised. *Gum arabic* is an important forestry commodity from the woodlands in the drylands of West and Eastern Africa. Myrrh and frankincense are also from the dry woodlands of the Horn of Eastern Africa. Apart from the above, pine resin for resin and turpentine production and eucalyptus oil (both medicinal and perfumery) are being produced from suitable species of pine and eucalyptus in Southern and Eastern Africa under plantation management. All of the above are important particularly for the export trade.

Indigenous fruits are obtained from two distinct ecosystems; dry savannah and humid forests. Important fruits from the dry savannah include *Vitellaria paradoxa, Parkia biglobosa, Sclerocarya birrea, Tamarindus indica* and *Ziziphus mauritania*. Those from the humid forests are *Irvingia* species, *Garcinia cola, Baillonella toxisperma* and *Coula edulis*. They are important both for the subsistence requirements to supplement nutrition and also sold as a source of income. Among forest vegetables are *Gnetum africanum* and *G. bulccozianum* from the humid zones of West and Central Africa. Additionally, there are some forest plants whose roots are important as spice or condiment. They include *Mondia whytei* from West and Central as well as Eastern Africa.

Medicinal plants are other important NWFPs from forests and woodlands. There are clear regional specificities for West and Central Africa (mostly from the humid forests) and Eastern and Southern Africa (mostly from Savannah woodlands and forests). Forests are also important in beekeeping in providing nectar and pollen for honey and bees wax production. At the same time, bees are important pollinators for some species.

Eco-tourism is one of the sectors with fastest economic growth rates in the world and often depends on forestry resources. Its development can positively contribute to the conservation of forests and their biodiversity as it has low negative impact on the environment. Examples have been cited of the Campfire and Kipepeo projects in Zimbabwe and Kenya respectively.

In terms of services, the role of forests in the regulation of water has been examined. Forests are essential to fresh water management as they are often cover upper watersheds of major rivers. Because of high infiltration rates and protective ground cover, they are important in reducing storm flows while improving re-charge of under-ground aquifers as well as reducing the load of nutrients and pollutants entering water bodies. Forests also play an important role as a sink for carbon dioxide through the process of photosynthesis and hence can be used to mitigate global warming if proper mechanisms are put in place.

Recognising the significance of forests in the provision of NWFPs and services, various countries in Sub-Saharan Africa have put in place some mechanisms that enhance the provision of the products and services. These include the setting aside of areas exclusively for production of NWFPs and services as well as some regulatory measures to prevent over-exploitation.

The social and economic viability of the production of NWFPs and services have been examined. It is observed that most NWFPs provide both social and economic benefits to the livelihoods of rural communities. At the subsistence level, NWFPs normally address livelihood strategies like secure provision of food, health care needs, concerns to reduce risk factors etc. The demand for these types of services from the forest is normally modest and rarely constitutes a threat to the forest.

However, the viability for provision of the NWFPs and services become an issue at two levels when the commodity gets commercialised: supporting rural livelihood (and/or national economies) and threat to the forest resources. The case of Nigeria and *gum arabic* in relation to supporting rural livelihoods as well as affecting the national and international markets has been cited. It was observed that poor institutional structures were beginning to affect the sector in the country until NAGAPPEN was formed. At regional level, the establishment of NGARA is seen as one way of strengthening the gums and resins sector.

Viability of indigenous fruits and related food plants were also analysed. It was observed that the humid forests of West and Central Africa have important fruit and food plants which are popular in the region. The dry savannahs of West, East and Southern Africa also have important fruits typical and important for each region whose markets can be developed to support local economies. However, these markets are limited by variability in quality and inadequate best practices at post harvest handling stage.

Commercialisation of medicinal plants was observed as an aspect which impacts negatively on the availability of forest and woodland resources since most of them are obtained from the wild and vital parts removed (roots and bark) sometimes essential for the survival of the plants. Examples were given of *Prunus africana* and *Pausinystalia jolimbe* from Cameroon and grapple plant in Southern Africa.

Honey and bees wax were noted as commodities which support rural livelihood as alternative income that depend on forests/woodlands and can contribute to sustainable forest management if properly integrated. However, this requires that governments put in place an enabling environment supported by sound policies. The example of Tanzania was used to illustrate the point.

Conditions that enable long-term viability in the management of forests for NWFPs and services have been examined. The negative effects relating to unreliability of supply, variable quality and unstable prices on the economic viability of gums, resins and indigenous fruits have been cited. The setting aside of forests as sacred groves or for use only during adverse conditions were used to demonstrate social viability. 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 organisations, enabling policies and legislative frameworks, and relevant institutions within the government that provide supportive roles. Meanwhile, multiple use management is an important concept towards sustainable forestry and clearly demonstrates how forests can be managed for both wood and NWFPs and services.

From an analysis of lessons learnt from the above, the recommendations below have been prepared.

Recommendations

- Understanding local knowledge on some resources and incorporating this in forest management is essential to sustainable forestry. The case of gum gardens agroforestry technology in the Sudan and management of myrrh/incense resources among the Somalis in the Horn of Africa are good examples. On the basis of this, there is need to empower local communities by increasing their capacity to monitor and manage their resources in a sustainable way.
- Given that a number of indigenous fruits and food plants are generally popular in more than one country within a given region, such markets should be explored and properly developed as a strategy to improving rural livelihood and support to development of sustainable forestry. In other words, efforts should focus on strengthening local, national and regional markets where they exist before moving to international markets.
- There is increasing pressure on NWFPs, but evidence of over-harvesting is rare for most of them. There is therefore need to carry out more biometrically sound inventories.
- Domestication through agroforestry of valuable/important NWFPs is seen as an approach to improving quality and increasing the quantity of the commodity. This is particularly important for indigenous fruits/foods and medicines most of which are either slow growing and/or are quite variable in nature.
- Most NWFPs loose value because of poor post-harvest practices while lack of value addition results in poor market prices, aspects that affect marketing and hence long-term viability. It is recommended that

proper best practices are developed for NWFPs of commerce and initiatives to add value in producer countries explored.

- Examples from gums and resins as well as honey and bees wax have shown the importance of putting in place strong policies/legal framework and institutions for successful development of NWFPs enterprises and sound forestry. This is strongly recommended as a means to sustainable forestry management.
- Joint and/or participatory forest management has been demonstrated as a useful approach to SFM. It is recommended that such opportunities be explored and be fully incorporated in areas where they exist, e.g. through eco-tourism.
- The role of forests in the regulation and/or provision of water should be considered seriously in Sub-Saharan Africa and contribution of beneficiaries to their overall management examined. Lack of adequate information on watershed management has denied foresters an opportunity to convince policy makers on how municipalities and producers of hydro-electric power can contribute to forestry management in watershed areas.
- More studies and/or experiences from elsewhere are needed to justify proper support to forestry development from CDM initiatives.

CONTENTS

1.0 INTRODUCTION

The terms Non-Wood Forest Products (NWFPs) and Non-Timber Forest Products (NTFPs) are often encountered while reading documents on forestry. The definitions of the two terms (including their possible harmonisation) and classification of products/services were the subjects of extensive debate in various fora throughout the 1990s (*FAO, 1995; Shiva and Mathur, 1997*). Today both terms are internationally acknowledged and often used inter-changeably. However, there is some difference in the scope of the commodities covered by each which ought to be recognised. 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 done sometime back showed 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 for these products grow.

NWFPs usually provide essential food and nutrition, medicine, fodder and other related domestic requirements to rural populations as well as urban consumers. They are particularly important in relieving hunger periods in the agricultural cycle, can provide employment during slack periods and act as a buffer against risk and house-hold emergencies (*Campbell et al, 1991; FAO, 1995b; Wilson, 1990*). 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*). Significant quantities of khat (*Catha edulis)* are exported from East Africa to Somali communities in Europe and America.

In economic terms, NWFPs contribute substantially to national economic growth and international trade. A study in South Africa showed that 400-500 species are sold in the country and sub-region for traditional medicines (*Williams, 1996* as reported in *SCBD, 2001*). Another study in the same sub-region revealed that wild plant resources contribute an income of US$ 194 -1114 per household per year (*Shackleton et al, 2000*). At a global level, herbal medicines entering the international market were valued at US$ 14 billion in 1996 (*SCBD, 2001*). There is an increasing trade in medicinal plants from Southern Africa to China. With improved access to information on markets and technology, there are prospects for continued growth of some of the NWFPs.

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.

Socio-economic benefits, especially service roles of forests are recognised but have not been properly integrated in forest management for sustainable development. In Africa, many forests are more important for the environmental services they provide, especially in watershed protection and arresting land degradation, than they are for the conventional goods they provide. Intensification in agriculture, which is critical to overcoming food security, requires measures to protect watersheds and arrest land degradation (*FAO, 2003b*). Controlling desertification and land degradation using windbreaks and shelter-belts are

critical issues in Africa, especially the dry Sahel. Yet watershed degradation and clearing woodlands and bushes are taking place unabated in the search for agricultural expansion. It is said that 14 countries in Africa and many urban areas are experiencing water stress largely because of the decrease in the storage capacity of reservoirs caused by heavy siltation (*FAO, 2003b*).

The significance of forests in climate change, especially their role as carbon sinks is gradually being recognised. However, there are still far too many scientific uncertainties associated with carbon sequestration by forests and land use changes compounded by lack of capacity to quantify such changes in most developing countries, Africa included. Additionally, the present diluted form of the Kyoto protocol is unlikely to stimulate sufficient carbon credit trading to attract substantial investment in reforestation and afforestation in Africa, particularly in view of the limited availability of productive land, the uncertainty of land tenure, and political instability (*FAO, 2003*).

With the advent of forest certification, most NWFPs and services will be required to conform to the certification criteria. While the process is practical for some NWFPs, there is a big limitation on quite a number given their wide diversity and low concentrations. Limitations relate to biometrically sound approaches for ensuring statistically reliable data on which to base management (*FAO, 2001*).

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 and Services" has been identified as one of the studies under the project "Lessons Learnt on Sustainable Forest Management in Africa". This is an initiative by the Royal Swedish Academy of Agriculture and Forestry (KSLA) in collaboration with FAO and the African Forest Research Network (AFORNET)/African Academy of Sciences (AAS). The NWFP study is aiming to answer 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 and services, this analysis will provide 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
- Ecotourism and biodiversity conservation
- Forests and water regulation
- Forests and carbon sequestration

The report is divided into five sections. ***Section 1*** (this section) is an introduction and provides a general background on the production of NWFPs (present situation and their importance); some key concerns on the management of forests for NWFPs and Services; and objectives and scope of the study. ***Section 2*** analyses the role of African forests and woodlands in the provision of NWFPs and services. Case studies are provided based on practical experiences on the management of the resources/commodities for sustainable production. Efforts in the past to enhance the provision of NWFPs and services have been mentioned. The economic and social viability of the production of NWFPs and services are examined in ***Section 3***. It examines the production of NWFPs for local consumption and markets, national and global markets, costs and benefits of production from the natural environment and/or through domestication. The role of some services like CO2 sequestration in the management of forests/woodlands is also examined. The issue of long term viability is extended further in ***Section 4*** by examining factors that determine economic viability, social acceptability, economic sustainability as well as issues related to institutional arrangements and feasibility for multiple use management. Again, case studies have been used to illustrate aspects of the viability of the production of NWFPs. ***Section 5*** finally, provides lessons learnt and their implications based on experiences generated from the four sections above.

2.0 PROVISION OF NON-WOOD PRODUCTS AND SERVICES 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*). About 99% of the forests are natural and only 1% classified as plantations. 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 arguer 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 report, 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 and services.

2.1 Plant gums, resins and essential oils

Plant gums are usually water soluble compounds made up of polysaccharides and small quantities of protein and mineral salts (cations). Plant gums from trees are of two types: exudates (ooze from the tree/shrub as a result of injury) and seed gums (isolated from the endosperm portion of some seeds). Exudate gums are the main forms 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, 1998).* The two species are native to the hot and dry regions of Africa. *A. senegal* is found in a belt some 300 km wide immediately south of the Sahara desert from Mauritania and Senegal in the West to the Horn of Africa (*Giffard, 1975*). From the Horn of Africa, it extends southwards through Tanzania to the Southern Africa countries of Angola, Namibia, Zimbabwe, Botswana and South Africa (Natal and Transvaal). *A. seyal* extends from Dakar in Senegal to the Horn of Africa and southwards to Tanzania (*Hall and Mc Allan, 1993*).

Gum arabic is an ancient product that has been obtained from the African drylands for several millennia. It has also remained an important article of commerce to the present day. In terms of production, Sudan is the principal producer accounting for over 50% of the world production. Management of the resources for gum production is well developed and clearly demonstrates how forests can be sustainably managed. Over the years farmers have developed an agroforestry system known as gum gardens in which gum trees are grown on farm plots at an espacement of 4x4 meters. During the first 4-5 years agricultural crops are planted between the lines 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. Meanwhile, animals are allowed to graze under the trees when they have grown big thereby providing fodder. The trees are then harvested for wood fuel and other farm activities, the land left fallow for sometime and the cycle repeated. This system ensures optimum and sustainable use of natural resources since crop production during the initial years and gum production and livestock grazing form 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 oleo-resins. 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 *frankincens*e which, like *gum arabic* are ancient commodities that have remained important articles of trade to the present day. *Myrrh* is an exudate produced from C*ommiphora 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 organised by the "Malmaleys" i.e. *myrrh* (malmal) tappers (*Chikamai and Odera, 2002*), a system that ensures sustainable production from the resources.

Oleo-resin 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, 1995*). 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*. The species *E. globulus, E. citriodora* and *E. camaldulensis* are good sources of both medicinal and perfumery type oils and are commercially utilised 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.

2.2 Indigenous fruits and related forest materials

Forests and woodlands have always been major sources of fruits and medicines for humans. Local communities collect wild fruits from forests to supplement nutrition, particularly during famine or in the event of natural disasters (*Eyog-Matig et al, 2002*). 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. The range of wild fruits in Africa is quite large and diverse and varies according to the prevailing ecological conditions of a given area. Within the humid tropical forests, they form part of the complex biodiversity. Fruit bearing trees for a given species are usually few and scattered within the forest. They are normally collected and consumed at subsistence level with few entering local markets. However, some, like bush mango and bush plums, are articles of commerce in national, regional and even international markets (*Tabuna, 1999b*). In the sub-humid and dryland zones, fruit trees are found in patches, sometimes occurring as diverse stands and some have become articles of commerce in local, national or even regional markets. The current review focuses on some of the key fruits, which present valuable learning points for sustainable management of forests and woodlands.

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

Tamarind is the name commonly given to the fruit produced from *Tamarindus indica.* The origin of the species is still subject of debate, with some authorities tracing the origin to the Indian sub-continent but most evidence placing its origin within Africa, either in Central Africa or Ethiopia (*Gunasena and Hughes, 2000*). The species is found in the drier savannahs from Tanzania, Kenya, Ethiopia and Sudan, westwards through Sub-Saharan Africa to Senegal.

Cultivation of the tree dates as early as 400 BC in Egypt though it is mentioned to be much earlier in India (*Salim et al, 1998*). Today, tamarind is cultivated in 54 countries with major areas of production found in the Asian and American continents with India, Thailand and Mexico as the major producers (*Gunasena and Hughes, 2000*). Africa does not produce tamarind on a large scale though local people use it widely. The fruit is the major product, which is 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 commercialised species rich in vitamins C, A and B-complex as well as minerals (*Pareek, 2001*). It is cultivated all over the drier parts of the Indian sub-continent. 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 commercialised. 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 1500m, 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 *Vitalaria paradoxa* and *Parkia biglobosa* respectively. Both are found within the Sudano-Sahelian zone with mean rainfall between 600-1000mm. They occur from Senegal and Guinea in the west through southern Mali, Burkina Faso, northern Cote d'Ivôire, 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 commercialisation.

Amarula is the fruit produced by the marula tree (*Sclerocarya birrea*). The species is widely distributed in the semi arid areas from S. Africa, Botswana, Zimbabwe, Namibia, Angola and Mozambique through Eastern Africa and the Sahel countries to Senegal in West Africa. The species has three different subspecies (*Hall et al, 2002*), viz. s*ubsp. caffra* growing from Southern Africa to Central Kenya, while s*ubsp. birrea* is found mainly in West and Central Africa although it extends into Eastern Africa, and s*ubsp. 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 and jelly while commercial prospects for production of jam for export are being explored by the Veld Products Research and Development organisation in Botswana. 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. A major initiative in South Africa since 1980 is the "Marula improvement project" of the University of Pretoria, which has involved the South Africa Council for Scientific and Industrial Research where nursery routines for seedling production and grafting scions of superior material have been established (*Holtzhausen, 2001*). The ideal fruit sought is large (>100 gm), juicy and with high Vitamin C content. Four cultivars have been selected. In Israel, a significant domestication programme, which commenced in 1984, has *S. birrea subsp. caffra* included. Initial work centred on assessing survival, growth, phenology, yields and seedling quality. The second phase of the programme has involved test plots of clonal material (*Mizrahi and Nerd, 1996*, as reported in *Hall et al, 2002*). As in South Africa, cultivar registration is anticipated. Similar programmes are in progress in Botswana for large sweet fruits (*Taylor and Kwerepe, 1995*) and Namibia for kernel (oil production). These initiatives are useful learning points in sustainable forest management.

Other fruit trees, which are becoming important, include *Uapaca kirkiana* and *Azanza garckeana*. The former has a wide distribution in the Miombo woodlands in southern Africa (*Chirwa, et al, 2000*) while *A. garckeana* is widespread in the semi arid areas of Southern and Eastern Africa.

In the humid forest zones of West and Central Africa, people utilise several fruit species of great nutritional and commercial importance. Some are used as spices or condiments and others as snacks or as vegetable oil.

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.* Irvingia is a tree that can reach 40 meters. It is found throughout the forest zones of West and Central Africa (*Vivian and Faune, 1996*). *I. gabonensis* is the most popular one. Irvingia fruit is a drupe with a kernel inside. Fruits are used in two ways. Mostly children consume the fruit pulp. It is juicy and fibrous but perishable after a couple of days. The fruit at this stage has a very low economic value. The almond contained in the kernel is the most important part of the fruit. It has a high nutritional content and is a commercial product in Cameroon, Gabon, Equatorial Guinea, C.A.R. and Nigeria. It is grinded and added into soup as condiment. Removing almonds from kernels is always a hard and very time-consuming job as, currently, everything is done manually.

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. Processing to obtain almonds is usually difficult. Transformed almonds are grinded and added into soup and pepper as condiment or spice.

Baillonella toxisperma (Moabi) is also a widespread species encountered 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. It is usually a very large diameter tree reaching more than 60 meters in height. The pulp of the fruit is smooth and juicy and also consumed mostly by children (*Vivian and Faune, 1996*). The most important product of Moabi is the oil obtained from processing its oleaginous almond. The removal of almonds from kernels and transforming them into oil is also difficult and time-consuming. The whole process is done manually. 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.

Meanwhile, fruits and nuts of many other NWFPs species are used as spices or condiments. The most important ones are *Monodora myristica, Tetrapleura tetraptera, Afrostyrax lepidophyllus, Xylopia aethiopica, X. parviflora, Aframmomum citratum, A. melegueta, Scorodephoeus zenkeri, Piper guineensis.* Others, like *Garcinia kola, Coula edulis, Cola nitida, Cola sp., Dacryodes edulis, D. macrophylla, Anonidium manii and Trycoscypha spp.,* are directly consumed as snacks. The uniqueness of all these species is that they do not need particular transformation (except *Coula edulis* fruit).

Among the vegetables, *Gnetum* leaves (also called Koko or Ekok) from the two species G. *africanum* and *G. bulcchozianum* 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. The sustainable harvesting of leaves is a constraining and time-consuming task. It consists of removing mature leaves from the standing liana. Most of the time, commercial harvesters find this difficult and less profitable. Since the Gnetum plant usually uses trees as support, it climbs up to the canopy. Instead of removing leaf by leaf on the standing climber, harvesters more often prefer to take away the entire climber (with roots) that allows them to remove all leaves. This method of harvesting is the most common and unfortunately unsustainable because it is very destructive. This explains why Gnetum species has almost disappeared from large areas of Nigeria and become rare in many areas in Cameroon, Gabon and Congo Brazzaville (*Tchatat, 1999; Tchatat et al 2002*). It is a popular diet in the region and is found in many restaurants. 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.

Roots of some species are used as spices. This is the case of *Mondia whiteii* and *Dorstenia sp.* Bark of *Afrostyrax lepidophyllus* and *Scorodephoeus 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 guineesis*.

2.3 Forest medicines

Traditional medical practices in Africa, like in many developing countries, are widespread and deep rooted. Most medicines are from plants with a majority coming from forests and allied ecosystems. For example, more than 3.5 billion people in the developing world use plants for their primary health care with more than 35,000 species being used (*Balick and Alan Cox, 1997; Van Seters, 1997*). Approximately 3,000 plants in South Africa are used as medicines out of which 350 are commonly used and traded (*Van Wyk et al, 1997*). The number and diversity of medicinal plant species originating from African forests is large enough to make a topic on its own. In this report, only some examples will be highlighted.

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, Cape aloes (*Aloe ferox*), buchu (*Agathosma betulina)* and devil's claw (*Harpagophytum procumbens*), represent South Africa's contribution to world medicine. *Aloe ferox* is an important commercial laxative medicine. The leaf is the main part harvested from which a bitter yellow juice is extracted. *Agathosma betulina* is part of the cultural heritage of the San and Khoi people. Today, the plant has great reputation for treating kidney and urinary tract diseases as well as minor digestive disturbances. Usually, the leaves are harvested and dried before preparing a concoction and sold. *Harpagophytum procumbens* is commonly used to treat rheumatism, arthritis and as a general health tonic. The thick, fleshy secondary roots are the main plant parts with active ingredients. They are usually harvested, sliced and dried. 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*). Most of these species are also found in the other countries in East Africa. The above constitute the key plants among thirty species identified for conservation due to wide-scale use and hence conservation needs.

The importance of NWFPs as medicines in the West and Central Africa can be clearly measured from several studies carried out. Ethno-botanical studies highlight the richness of natural flora as sources of medicines. Among these studies are *Bouquet (1969, 1972 and 1992), Fournet (1979)* and *Adjanahoun et al. (1993)* in Congo Brazzaville. In CAR, the most important references are *Vergat (1970)* and *Ake Assi et al. (1985)*. In Equatorial Guinea we have *Gomez Marin and Merino Cristobal (1989);* in Cameroon *Binet (1974)*, *Zipey-Saivet et al. (1976)* and *Tedongmouo (1996)*. For Gabon and DRC, basic references are *Raponda-Walker and Sillans (1961)* as well as *Adjanahoun et al. (1986), Wildeman (1953)* and *Delaude et al. (1971)*. In Mali we have *Adjanahoun et al. (1979)* and in Niger *Adjanahoun et al. (1980)*. Recent studies in the humid region of West and Central Africa reveal that species like *G. lucida, P. johimbe and P. africana* whose bark is the major component in herbal medicine or *Gnetum* species whose leaves are both vegetable and medicinal have been heavily over-exploited in their natural ranges. To ensure sustainable management, various initiatives covering domestication and educating local communities on the management of the resources in the wild will require to be put in place *(Nkuinkeu, 1999; Tchoundjeu et al, 1999)*.

2.4 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. Beekeepers have a highly developed sense of time and orientation with respect to seasonal beekeeping floral calendar. Their aim is to make optimum use of available flowering trees and they will consider introducing supplementary species where required to bridge flowering gaps in the calendar. Many lists have been published of valuable melliferous trees, some with multiple uses (*Svensson, 1991*).

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. Tools are fitted with wooden handles obtained from trees and shrubs. Particular plants also supply materials for lighting smokers. Other plants provide the scented leaves used for rubbing on the inside of empty hives in order to bait swarming colonies. Trees also provide much needed shade for keeping hives cool under hot tropical climatic conditions (*Svensson, 1991*). 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. Beekeepers need recognition as major stakeholders in forest conservation and should be involved more deliberately in sustainable forest management.

Bees are responsible for the pollination of many flowering plants and are therefore important in sustaining biodiversity (*Hertz, 2002*). The economic importance of the pollination to agriculture and forestry is very high.

2.5 Eco-tourism and biodiversity conservation

In well designed eco-tourism undertakings local residents can receive a substantial economic benefit at the same time as it enhances incentives for nature conservation (*Wunder, 1999*). 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, the Kipepeo project in Kenya, Gorilla watching in Bwindi forest (in Uganda, Rwanda and the Democratic Republic Congo) and the USAID/Ghana tourism led economic growth promotion programme in Ghana, 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. By 1999, the programme had 185 local communities representing 200,000 households in wildlife producing wards in 36 of 57 districts of Zimbabwe. The success of the programme is attributed to benefits from wildlife which accrue to local communities, an aspect that has generated increased local support thereby enabling the programme to embrace other communal resources such as grazing, water and woodland (*Dubois and Lowore, 2000*, as reported in *FAO, 2003b*). However, the programme has had its share of problems related to unclear institutional frameworks and responsibilities, disparities in income accruing to households between sparsely and densely populated areas and financial abuse by some individual community leaders.

The Ghana tourism growth promotion programme is based on the rich forest resources in the Central region of the country as one of the main tourism attractions). The project concept involved, among others, the creation of a new national park from the two adjacent forest reserves (including canopy walkways), aspects that have led to increased tourist visits.

2.6 Forests and water regulation

The role of forests in the provision or regulation of water is obviously important but has still been disregarded resulting in destruction of forests for other products or uses and loss of this service. Most rivers originate from mountains or hills that are covered by forests, which play an important regulatory role in hydrological processes. Mountain forests capture and store rainfall and moisture, maintain water quality, regulate river flow, reduce erosion and protect against landslides, among others (*FAO, 2003*). Tropical montane cloud forests (TMCF), for example, have the unusual ability of adding water to the natural rainfall by stripping moisture from clouds in the condensation zones (*Palmer, 2001*). As head waters of major rivers, forested watersheds are essential to fresh water management and hence relationships between forests and water need to be better understood.

Because of the high infiltration rates, protective ground cover and high tensile strength of roots, forests reduce storm flow and decrease levels of sediment better than any other vegetation type (*FAO, 2003*). Increased infiltration recharges underground aquifers and storage. Reduced sedimentation coupled with uptake of soil water by forest plants has various added advantages that include reduced load of nutrients and pollutants entering water bodies and being exported down-stream. Water originating from forested areas is therefore normally of good quality for consumption and other uses. For this reason, cities, municipalities and urban centres prefer sourcing water from forested watersheds.

Sound management of forested watersheds may not only benefit downstream users but also governments, e.g. through hydro-electric generation, which is the main source of industrial energy in most of the developing world. In Kenya, for example, over 90% of the electricity generated in the country is hydro with 90% of this coming from river Tana whose water sources are the Aberdare and Mt. Kenya forests. Other power plants are being built on the rivers originating from the Mau forests. Loss of forest cover and conversion to other land uses is adversely affecting both fresh water supplies and the capacity of the hydro-electric power stations to function efficiently. Unfortunately, management of forests in the country has been wanting. For example, some 6.3% of the 1.40 million hectares of indigenous closed forests have been lost recently through excisions (*Njuguna et al., 1999*). Most remaining forests have suffered abuse in the form of illegal logging, overgrazing, encroachment and/or poaching of forest products, charcoal burning, human/wildlife conflict and insecurity, among others. Overgrazing is extremely serious in some forests where cattle grazing pressure was estimated to exceed carrying capacity by 6-7 times thereby degrading the forest and destroying regeneration.

2.7 Forests and carbon sequestration

Plants use atmospheric CO2 through the process of photosynthesis to manufacture their food requirements. The significance of photosynthesis has become more acknowledged with the advent of concerns about possible global warming. The latter is considered to be partly brought about through human actions of generating green house gases (GHG) in the atmosphere (*IPCC, 1990*). Evidence of global warming is well established (*Hulme, 1996*) and Africa is believed to be contributing up to 7% of the green houses gases (*Silveira, 1994*).

In an effort to contain the effects of global warming, a United Nations Framework Convention on Climate Change (UNFCCC) was developed and ratified in 1992. The convention aims at stabilising green house gases in the atmosphere at a level that would slow down climate changes. To make the convention work, a protocol was outlined in Kyoto in 1997, which legally commits 39 developed countries to reduce their GHG emissions by an average of 5.2% relative to 1990 levels. Under the Clean Development Mechanism (CDM) of the Kyoto Protocol, industrialised countries will be able to meet a part of their carbon emission reduction commitments for 2008-2012 (up to a maximum of 1% of their 1990 emissions times five) by carrying out specified afforestation and reforestation activities in developing countries (*UNFCCC, 2001*). Other activities, such as averted deforestation and forest management, may be considered. These types of activities are considered particularly relevant since deforestation and other land use changes account for at least 20% of total annual carbon emission.

However, the above activities related to carbon sequestration need a lot of funding that African countries do not have. To solve this problem, the international community put at the disposal of developing countries in 1991 an instrument called the Global Environment Fund (GEF). The functioning of this fund is based on the principle according to which industrialised or polluter countries should help developing or less polluter countries to implement projects aimed at mitigating climatic change. Since its establishment, GEF has contributed well over a billion US$ from its climate change, forest and desertification prevention (*Karsenty et al., 2002*).

GEF finances three types of programmes that can support implementation of projects in Africa. They include: operation programmes dealing with biodiversity, capacity building activities that allow GEF to support countries to meet their communication obligations related to the Climatic Convention.

2.8 Systematic efforts in the past to enhance the provision of Non-Wood Forest Products and Services and their effectiveness

2.8.1 Different niches for NWFPs and services

In most SSA countries, there exist various niches where NWFPs are found, including:

- *Undisturbed forest*

There are still some areas, particularly in the Central African Republic (CAR), where no exploitation for timber or conversion of forest land to cultivation occurs. Such areas are rich in NWFPs. Most often these ecosystems belong to the State (in the case of protected forest or permanent production forests) or are included in non-protected zones. In such areas, forest resources including NWFPs are protected according to forest regulations. However, within non-protected forest zones strict observance of management plans is required for those engaged in the exploitation of timber or non-wood forest products.

- *Protected areas*

Protected areas are often permanent forests or woodlands established by Governments and designed for conservation and sustainable management of biodiversity for present and future generations. The opportunity here is that it is more than a reservoir of NWFPs. Among various objectives are biodiversity conservation, water regulation, watershed protection and eco-tourism. Management of protected areas for biodiversity production or conservation is multipurpose by nature and is based on a management plan.

- *Secondary forest*

Secondary forests most often result from one or several interventions by man. Such interventions may consist of timber exploitation and/or slash and burn agriculture that is followed by fallow. Logging in West and Central Africa is usually selective. Only a few valuable species are removed (about 1 to 2 trees per hectare). Usually, the post harvest operation is more destructive than the harvesting itself. In spite of the fact that NWFPs species may suffer during timber exploitation, there normally always remains enough in terms of diversity and species richness after logging for the NWFPs to recover.

- *Food crop and perennial cash crop fields*

Perennial cash crop or food crop fields can also be considered as reservoirs of NWFPs. These land use systems are often derived from natural or secondary forests. In fact, during clearing operation, farmers usually only remove weeds and useless trees but preserve all useful forest food tree and medicinal species on their land. In West and Central Africa, cocoa and coffee plantations are rich and diversified in NWFPs. Contrary to secondary forests the owner who manages them sustainably controls these resources.

- *Home gardens*

Home gardens are agroforestry systems usually found near the house. They can also be considered as reservoir of NWFPs. In fact, during the establishment of the house, a farmer clears a portion of secondary forest. When clearing, useful NWFP is also preserved as in the case above. Home gardens in the humid forest zone are usually well managed where ashes and kitchen wastes are used to improve fertility. Thus, home garden soils are 2 to 5 times richer in organic matter, Ca, K and P than those of secondary forests, cocoa or food crop systems. pH is much higher than the acidity usually characteristic of humid forest soils in Central Africa. NWFPs take advantage of these soil properties to perform very well (*Tchatat, 1996*).

2.8.2 Regulatory measures to prevent over-exploitation of certain products and their effectiveness

In all countries of West and Central Africa, French and Belgian colonial administrations put in place laws according to which all forest lands belonged to the government. It enabled the administrations to take any measure related to forest exploitation, creating protected sites, etc. In colonial times the emphasis was mostly on timber production and NWFPs were normally neglected. This situation remained for many years after independence.

After independence in the 1960's, the majority of francophone countries of West and Central Africa wrote new land and forest laws. All these were modelled on the law used during the colonial era and basically reconfirmed the right of the State to all natural resources including lands and forest resources. This approach of using the regulation by States to appropriate all forests has never been accepted by the rural dwellers that, up to now, have the feeling that they are excluded from the management of their forest.

However, forestry laws have evolved and each country has adapted them depending on its own policy and socio-economic situation. In the C.A.R., the law authorises forest dwellers to harvest forest products for domestic use from permanent forests. This means that dwellers can continue to benefit from their common rights of use in the permanent protected forest. According to this law dwellers can harvest forest foods,

medicines and any other important forest products from national parks, recreation forests, forest reserves, etc., although the exploitation of wood for house construction, tools and canoe fashioning is restricted.

However, in Congo Brazzaville, access and the common right of use is free only in non-protected forests. They are authorised to harvest, even for market purpose, valuable NWFPs such as *Gnetum* leaves, rattan, etc from such forests.

In Gabon, the law describes some regulations as far as forest exploitation is concerned. Free access is actually authorised, as in Congo Brazzaville, only for protected forests. This law was later complemented by another law regulating the common right of forest use. Contrary to Congo and C.A.R, access of dwellers to non-permanent forest is only authorised within the framework of common right of use designed exclusively to fulfil the subsistence needs. Commercial harvesting of NWFPs requires payment of taxes.

In Cameroon, common right of forest resources use by the dwellers is also designed for fulfilling subsistence needs. It mainly concerns non-permanent forests. Collection of NWFPs is authorised only for domestic consumption. These new laws give opportunity to each community to request a portion of forest not exceeding 5000 hectares from the Forest Department. This so-called "community forest" belongs to non-permanent forest zones but can indefinitely be allocated to the community if the forest administration finds that the community is managing the forest well. These community forests fall under strict forest regulation and are devoted as well to the production of wood and NWFPs.

Meanwhile, in many countries in Southern Africa there exist varied traditions where most NWFPs are protected. A good example relates to *Sclerocarya birrea*, which is treated as sacred and community elders use their influence to regulate the harvesting of fruits to prevent over-harvesting (*Hall et al, 2002*). Traditional protection (bans on felling) of this and other important species is widespread throughout the region. There also exist national legislations and by-laws. For example, the forest acts of 1968 in both Botswana and Namibia protect *S. birrea* as an indigenous fruit tree in gazetted forests and only allow local communities to collect fruits for subsistence consumption. However, male trees can be pollarded/lopped for fodder and fuel-wood. National legislations and by-laws are complemented by relevant administrative regulations through traditional authorities act (Namibia) or the district councils act (Zimbabwe).

2.8.3 Effectiveness of the measures

After having examined the forest regulations prevailing in the region, we can now discuss the effectiveness of their application in the field in order to prevent the over exploitation of NWFPs. It is clear that the laws exist, but they are not as explicit for NWFPs as they are for timber. In many countries, apart from Cameroon, NWFPs are not protected from commercial harvesting in non-permanent forests. In protected forests, their commercial exploitation is restricted in many countries. However, governments in the region do not allocate enough financial, human and material means to prevent over exploitation of NWFPs. More often, even portions of protected areas are occupied and cultivated by people. In some countries, such as Nigeria, some resources such as *Gnetum* and *Irvingia* have become scarce because of extensive export of them.

Nevertheless, in some land use systems, such as home gardens, old fallows, food crop and perennial cash crop (coffee and cocoa plantations) systems, access to NWFPs is more often restricted to the close family members to whom the land belongs. In some natural and secondary forests near villages, communities regulate exploitation of some selected valuable NWFPs by preventing access to the forest for strangers, or regulate the quantity of NWFPs harvested by members. This situation, for example, occurs around the Takamanda Forest Reserve area in Cameroon.

Whatever the land use production system existing in the region, the type of informal regulation to prevent over-exploitation of the resources varies according to various criteria such as the commercial value and the use of the product, its location in the ecosystem, the individual or the group of people that plant or discover the product in the forest (*Le Roy et al., 1996; Karsenty et al., 1997*). For example, in many regions of Cameroon, Equatorial Guinea and Gabon wherever there is *Baillonella toxisperma* (Moabi) species, also called the humid karite forest (a high commercial valuable oil and timber species), it belongs to an individual, or a family. Even logging companies no longer cut them due to violent conflicts with dwellers (*Tchatat, 1999*).

3.0 SOCIAL AND ECONOMIC 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. Meanwhile, various services from forests and allied ecosystems provide many social benefits to rural people, and some also provide economic benefits.

Gums and resins are among the commodities that provide both social and economic benefits to rural populations at the subsistence level. The social benefits are reflected in the many local uses they offer to the communities: the use of *gum arabic* as a food by children or herdsmen in the bush; myrrh as ink in some schools or burnt in houses to repel snakes or dangerous insects; chewing of frankincense as a gum; or burning as incense among local populations is well documented (*Chikamai and Odera, 2002*).

Indigenous fruits are important components in food security strategies of many rural populations, especially in times of famine or disasters. Sometimes, they are used to supplement normal diet like the staple starchy foods that form the bulk of people's food in the tropics. Some examples include the use of tamarind pulp as a flavouring agent in porridge made from sorghum or maize flour in Eastern Africa, or using a bitter infusion of tamarind pods in Ghana to detoxify poisonous yams while cooking (*Gunasena and Hughes, 2000*). *Ber* has even wider applications in Southern Africa where the fruit is either consumed fresh when in season (June-September) or the powder is used for baking, to make jam or a traditional loaf (*Maposa and Chisuro, 1998; Kadzere, 1998*). The baobab fruit contains a kind of flour that makes a very nice drink by local communities from Sudan to Senegal while its seeds are rich in fat and locally used for making fat. The *karite* fruit has edible flesh and a kernel rich in fat from which Shea butter is produced while fruits of *nere* trees are used in the sauce for the staple porridge (*Fries, 1996*).

Medicinal plants represent one of the major groups of NWFPs with wide applications at subsistence level of most rural populations. The generally low incomes of most people in both rural and urban areas and concomitant high costs charged for conventional drugs contribute to this. As a result, traditional medicine is becoming a mainstay of the health system in most African countries. In addition, the belief that herbal medicines are able to treat ailments which conventional drugs are not able to treat also contribute to the popularity of traditional herbal medicines.

Thus, production of NWFPs for local consumption and/or markets is carried out as parts 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 at the beginning of this chapter. 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. For example, *gum arabic* accounts for about 10% of the approximately 500,000 MT hydrocolloid trade on the international market (*Dondain, 2001*). With improved production, post harvest handling and aggressive marketing, the traded volume is bound to increase from the current 55,000 – 60,000 MT to 100,000 MT by 2010. 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.

An example from Nigeria illustrates the initiatives being undertaken to ensure long-term viability of the *gum arabic* sub-sector. In the mid 1990s, Nigeria was the second largest producer and exporter of *gum*

arabic after Sudan. However, in spite of the fact that the country has the best type of *gum arabic* (from *A. senegal* var. *Senegal,* like the Sudan), the quality of the commodity entering the international market was poor to the extent that reputable importers avoided buying from the country. During a review by FAO of the production, market and quality of *gum arabic* in Africa (*FAO, 1996*), it was found that production was highly fragmented, with a plethora of producers and traders all competing to do business and no coordinating body to ensure consistency of production methodologies or product quality. Quality was variable with consignments always being mixed. There was no extension advice to collectors and, although the Nigerian Gum Arabic Association existed, it didn't go beyond that of simply acting as a forum for discussion and airing of grievances. This happened against a backdrop of unreliable supply, high (though unstable) prices and variable quality of *gum arabic* entering the international market. This was hurting the *gum arabic* trade giving leverage to competitors, mostly of synthetic substitutes. The FAO mission strongly recommended improved production and quality control.

The FAO recommendations were taken up seriously by relevant authorities in Nigeria, led by the private sector. In 1996, the national gum association was reorganised to form the National Association of Gum Arabic Producers, Processors and Exporters of Nigeria (NAGAPPEN). The latter is devoted to enhancing Nigeria's share of the international *gum arabic* market through active discussions of marketing strategies and best practices (*USAID/NAGAPPEN, 2002*). Since the formation of the association, the sub-sector has undergone vital reorganisation by establishing and strengthening *gum arabic* producers and exporters associations in the country. Through the USAID/Nigeria Gum Arabic programme, the Association has prepared a workbook and organised a series of workshops, which are held throughout northern Nigeria designed to help Nigerian producers and small traders of grade 1 *gum arabic* strengthen their share of the international market. Recent inquiries show that a lot has changed for the better and Nigeria is now firmly placed in position three among *gum arabic* exporters, after Sudan and Chad (*Okoro, pers. comm*.). The association has a programme with a target of generating foreign exchange earnings of US $ 6 billion in the next four years.

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. The fruit is produced by *Irvingi*a species, namely *I. gabonensis* and *I. wombulu* (*Ladipo, 1999*). The fruit is quite nutritious and eaten by local people while the cotyledons (kernels) produce a thickening agent popular for making stews. It is widely marketed throughout the region (*Ndoye, 1995*) and the market value is estimated to be US $ 50 million (*Ladipo, 1999*). 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. There also exist general logistical and organisational limitations to expanded markets for the fruits. *Tabuna (1999b)* has identified seven such factors that limit sound development in producer countries. A good understanding of market requirements in importing countries is also vital.

The distribution and uses of *karite* have been described previously. Recent studies show that total production in Africa in 2000 was 650,000 MT (*Statz, 2003*). Better qualities of Shea are exported to Europe, which consumes between 50,000-60,000 MT in a year. There is a form of triangular trade of Shea between Africa/India/Europe. Most Shea is exported to Europe via India where oil is extracted on a contract basis for companies in Europe. Two types of oils are extracted: stearene and oleine. The former is

exported to Europe for use in the confectionery industries, while oleine is sold within India. In Africa, Burkina Faso is the leading producer and exported 7,600 MT of Shea nut in 1999 (stable export since 1995) and 30 MT of Shea butter.

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.

Beginning with pharmaceuticals, it is estimated that about 25% of prescription drugs in the United States contain plant extractions (*Farnsworth, 1988*). The range of health products has increased a lot also within Africa where South Africa is leading. More people in the developing world use traditional medicines where it is estimated that 80% of the population use traditional medicines for their primary healthcare needs (*Kuipers, 1997*). The actual volume traded is not known since the trade codes used are not exclusively for medicinal plants. Nevertheless, large volumes of medicinal plants are traded on the international market and imports to Germany alone from Africa in 1994 were more than 7,300 MT (*Lange, 1996* as reported by *Kuipers, 1997*). Sudan, Egypt and DRC were the main exporters. Cameroon exports large volumes of *Prunus africana* bark to France and *Pausinystalia johimbe* to Europe with about 65% going to Holland (*Cunningham, 1996*). Within Africa, there is a fairly good informal cross border trade involving species like *Warbugia salutaris* and *Sphonochilus aethiopius* in Southern African countries. Regional trade within countries is also flourishing.

Commercialisation 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. In Africa, Eastern and Southern Africa are major producing areas. Ethiopia exported 3000 MT of honey and 270 MT of beeswax annually between 1984 and 1994 (*FAO, 2000*). Annual production of honey is estimated at 24 000 MT (about one third of total production in Africa). About 20% of the production is consumed in rural areas and up to 60% in the production of a local beverage known as *tege* (*Thomas, 2002*). Tanzania's annual production of 4860 MT of honey is worth US $7 million and 324 MT of beeswax around US $925,000 which is only 3.5% of the existing potential (*Mpuya, 2003*). In Kenya, exports of honey and bees wax are under 3000 tons and 100 tons respectively though potential production can reach 100,000 MT (*Mbae, 2000*).

Long term viability in the production of honey and bees wax 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 bee keeping policy that became operational in March 1998. To implement the policy, a national bee keeping programme was established in November 2001 which provides strategies for sustainable existence of honey bees, diversity of bee forage and ensured supply of improved quality and quantity of bee

products. A beekeeping act was put in place in April 2002 as a legislative and regulatory mechanism to harness and sustainably use bee resources in the country.

Tanzania also has a research centre that has conducted studies on sustainable bee keeping covering aspects of hive design and diversification of hive products. However, the research will need to be more demand driven by strengthening links with users such as beekeepers, processors of bee products, manufacturers of bee equipment and traders. The country also has a training college at Olmotonyi in Arusha that offers both long-term courses (at certificate and diploma levels) and short courses on skill improvement in honey and beeswax production as well as quality of honey and general knowledge on bee keeping (*Kwaslema, 2003*). 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 project 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 among the top 25-biodiversity hotspots on earth. It is home to six globally threatened bird species and an additional five bird species that are coastal endemics. A further eight bird species are regionally threatened. The forest also has an exceptionally diverse amphibian fauna, three near-endemic mammals and a small population of around 100 elephants. In addition, the forest has six taxa of butterflies that are endemic to the Coast including one that is confined to the forest.

The Arabuko-Sokoke forest is surrounded on all sides by agricultural communities. There are 51 villages with a population of about 110,000 people. Average population density in the district was 47-60 people per km^2 in 1997. Subsistence agriculture, especially farming is the main occupation of the surrounding population as tsetse flies and lack of grazing area constrain cattle keeping (though most households own goats). Forest usage includes collection of water, fuel-wood, poles and herbs, butterfly farming and hunting wildlife for bush meat. Building poles are the single most important wood product from the forest. 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. 133 households from forest adjacent communities were identified through interviews to participate in the project. They were trained on how to rear butterflies. 25 volunteers from the group were recruited and trained in butterfly breeding techniques. Information on forest butterflies had come from a nine month inventory and monitoring project that had shown which species were most abundant, where and when.

Eight months after commencement of the project (i.e. by the end of 1994) 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. Limits on the number of butterfly farmers are set by the market rather than by resource scarcity.

An analysis of the impact of the project to the forest and community shows the following:

- 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 bee keeping.

- Kipepeo has had an effect on both attitudes and livelihoods. A socio-economic survey in 1997 revealed that the proportion of farmers wanting forest cleared and settled had fallen from 59% to16% 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.

In the context of possible global warming, forest projects can help lower net greenhouse gas emissions in a number of ways (*CIFOR, undated*). First, by preventing carbon stored in standing forests from being released to the atmosphere by reducing deforestation and forest fires or improving management practices that reduce damage to the surrounding vegetation. Second, by increasing carbon stocks (carbon sequestration) through tree planting, improved soil management or by enhanced natural regeneration of degraded forestlands. Findings from studies (*Kotto-Same et al., 2000*) carried in Cameroon show that the carbon stocks of the above ground vegetation and litter of logged forests averaged about 228 t C/ha. The maximum value of C stock in various crop-fallow systems was 167 t C/ha for the traditional long fallow. A mature jungle agroforestry cocoa stand contains from 54 to 131 t C/ha, about 43 % of the C of the forest. The estimates of C sequestration before and after 20 years of nutrient recapitalisation and agroforestry in the East African highlands are respectively 70 and 136 t /ha (*Woomer et al., 1997*). Third, to reduce the combustion of fossil fuel by increasing use of bio-fuels.

Of the above approaches, carbon sequestration projects that promote agroforestry, small scale plantations, natural forest regeneration, forest gardens and improved forest fallows can improve the livelihoods of small scale farmers, communities and indigenous peoples (*CIFOR, 2002*). A majority of these people are found in the developing countries and especially in the tropics. Carbon forest projects can therefore give local people greater influence over local management decisions and strengthen local businesses and social organization. These projects also have positive environmental benefits, including conservation of locally important biodiversity, improved water quality and supply, and control of soil erosion and sedimentation.

Under the CDM of the **"**Kyoto protocol", industrialised countries can meet the cost of afforestation and/or reforestation in developing countries to compensate for continued release of CO2 from industries. Based on this understanding, a number of industrialised countries have initiated carbon-forestry projects in developing countries. A good example is represented by Norwegian projects in Uganda and Tanzania (*WRM, 2002; Stave and Eraker, 2000*). The Norwegian Company "Tree Farms", through its subsidiary company "Busoga Forestry Company Ltd", is carrying out afforestation in Bukaleba Forest Reserve in Uganda (*Stave and Eraker, 2000*). The project intends to set up between 80,000 and 100,000 ha of plantations of *Pinus* and *Eucalyptus* species (*WRM, 2002*). So far, it has financed afforestation of about 600 ha. Tree Farms is also setting up afforestation in the Kilombero and Mafinga Districts in Tanzania where about 1,900 ha have been planted. Although some people question these arrangements, it seems to work for now in the framework of CDM.

However, there is debate as to whether the example given above for Tree Farms is indeed clean development or a form of "CO_2-colonialism". Issues about land value in view of the exclusive ownership rights of private forestry operations and long term lease contracts for the land on which trees are planted, displacement of local populations to create areas for planting are causing concern. Given the current uncertainties surrounding the Kyoto protocol and very limited lessons to draw from in Africa, it is probably safest to say that it is too early to draw any conclusions on this subject.

4.0 CONDITIONS THAT ENABLE THE LONG TERM VIABILITY OF MANAGEMENT OF AFRICAN FORESTS FOR THE PROVISION OF NWFPS

4.1 Factors that determine economic viability

Consideration will be given to goods of commerce at national, regional and international levels, which have a potential impact on resource status. Beginning with international trade, reliability of supply and quality are among the key factors that determine the long-term viability of a given product. Importers engage in business enterprises that guarantee regular (reliable) supply and consistent quality. Irregular supply and variable quality have detrimental effects on the market of a given commodity.

Trade and marketing of *gum arabic* can illustrate the negative effects unreliability of supply and variable quality can have on long-term viability. During the 1960s international trade volume in *gum arabic* was around 70,000 MT (with Sudan accounting for 85%). However, events in the 1970s and 80s led to fluctuations in both the supply and price and, as a consequence, to changes in demand (*FAO, 1996*). The severe Sahelian drought in 1973/74 and again in 1982/84 resulted in a world shortage (exports fell to 20,000 MT) and high prices, which had a big impact on the food (soft drink and confectionary) and pharmaceutical industries in Europe and USA. A similar shortfall, though not as long, occurred in 1993/94. In addition, the quality of *gum arabic* that entered the international trade was noted as being quite variable arising from differences in the botanical sources. To overcome negative effects of low supplies, most manufacturers sought substitutes as replacements where modified starches as well as other natural gums were introduced. When supplies recovered following the end of the drought, international trade volumes never rose above 40,000 MT. *Gum arabic* therefore lost its market share by about 43% during the period 1972-1995. A constrained market affects production and eventually the care given to the management of the resources by producers.

At regional level, issues of reliability and prices are also important. An illustration will be made based on a study in Central Africa (*Ndoye et al., 1999*). Four commodities: *Irvingia spp* (bush Mango), *Cola acuminata* (Kola nut), *Garcinia lucida (*essock) and *G. kola* (onnie) are important articles traded across the borders between Cameroon, Central African Republic (CAR), Equatorial Guinea and Gabon. For all of them the quantities and value traded between 1995 and 1996 varied significantly. For example, the quantity of *Irvingia spp* marketed within the region in 1996 declined by 5% while the value of sales increased by 11% for the 1996 production because production of one of the fruits (*I. wombolu*) was less important in 1996 than in 1995 affecting the quantities traded. This is a characteristic of "thin markets" where a small change in production has a large effect on the quantity and value marketed as it changes the role of markets in assembly and distribution of the commodity from year to year. The same observation was made for *G. lucida* bark whose quantity declined by 8% while actual value of sales increased by 31% because of a drastic decrease in the amount of bark traded as a result of high pressure on the resource in the supply areas.

Various reasons have been advanced to explain the relationship between quantities marketed and prices (*Ndoye et al., 1999*). Nevertheless, they conformed to the well-known scenario of price elasticity of supply. Prices increased as quantities marketed declined and the greater the reduction in quantity marketed the higher the increase in price. Various suggestions were advanced for the decline in the production between two years, which included drought, excessive pressure on the resource, and changes in the weather patterns affecting the period of flowering and fruiting. To overcome the thinness effect, several conditions must be met. The most important is to increase aggregate production either through conservation or domestication. The former can be achieved by determining the rate of harvesting that will preserve the resource (i.e. bark) and educating producers on suitable methods of harvesting. Domestication and cultivation reduces the length of production while preserving the characteristics that are important to consumers.

The above example also illustrates two aspects regarding economic viability of regional trade in terms of shared cultural or ecological features. The sale of forest fruits and bark is viable largely because of a shared culture of the people in the region in the use of the various products. Additionally, the region shares some ecological characteristics that guarantee availability on a sustainable basis.

Meanwhile, some commodities have purely national markets determined by the customs and traditions of the people in that country (*Lintu, 1995*). They include some fruits, nuts, spices, flavours and fragrances, herbal medicines, among others. An increase in the numbers and income levels of urban dwellers makes markets for these commodities expand as people moving to urban areas will maintain their cultural habits. Long term viability of national markets and development of NWFPs will depend very much on reliable, up-to date marketing information. Information on quality, standards, packaging and elaborate promotion aspects regarding application are important.

4.2 Factors that determine social acceptability

Peoples' history, culture or religions have played important roles in the preservation and survival of some forest areas, even under conditions of increasing population (*Arnold, 1995*). In several communities in Africa, particular forest areas are often maintained as sacred groves in which harvesting of produce is banned or closely controlled. A good example is the Khaya forests at the Kenyan coast among the Mijikenda community. Among the Turkana in Kenya, Ekwar forests are strictly managed by elders and only used when other options have been exhausted. In West and Central Africa, there are many sacred groves around some villages or close to some traditional kingdom palaces. The peculiarity of these groves is that they have been protected over years by the King, under traditional forest regulations with clear rules about activities that can be undertaken in the forest. This is the case of Binka and Tabenken sacred forests located in the North-west provinces of Cameroon (*Tchatat, 1998* and *1991*). Although the strength and extent of these cultural considerations are diminishing due, in part, to western cultural influence (education, religion), they remain potent factors and learning points in the sustainable management of NWFPs and services.

4.3 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 rational approach to sustainable management and hence conservation of biological diversity.

4.4 Institutional arrangements including resolution of conflicts

Institutional issues are quite important in the sustainable management of NWFPs but often tend to be left out. Perhaps the informal nature in which most of these commodities are handled in producing countries results in their not being well captured in national statistics, while traditional technologies of production make standardisation difficult. Nevertheless, there are a number of institutional aspects that can be taken into account to ensure sustainable resource management. Amongst these are:

- Clear identification of producers and their organisation 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. Good examples are the Gum Arabic and Resins Association (GARA) in Kenya and the National Association of Gum Arabic Producers, Processors and Exporters of Nigeria (NAGAPPEN), which have associations of producers and merchants that have resulted in improvements in the quality of *gum arabic*. The same associations

are playing a crucial role in conflict resolution with respect to removing suspicion between producers and merchants on prices.

- 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. This will also reduce or alleviate corruption or bribery that occurs when some important NWFPs such as Gnetum (*Awono et al., 2002*) is transported from forest to the market.
- Establishment of relevant institutions within the government that will provide supportive roles, e.g. extension to producers and/or merchants and research that will address specific issues of resource development, management and use.

4.5 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. A recent study in the forests of the Congo basin (*Ndoye and Tieguhong, 2003*) has made the following recommendations as a step towards sustainable forest management and reduction of conflicts;

- Management plans need to be drawn to which timber companies must abide.
- There is a need to exclude timber species/size classes and sacred groves that are important to local communities from timber harvesting.
- Compensations have to be made to timber companies for leaving behind useful trees in their concessions for NWFP values. This can be done by reducing the taxes timber companies pay for specific concessions with specifications in the 'Cahier des Charges'.
- Rural communities need to be involved in monitoring the activities of timber companies (respect of minimum diameter, allowable cuts etc…).
- Community forests that are allocated to local communities need to consider both timber and NWFPs for revenue generation.

In planning for multiple use management, managers are advised to analyse inventory information to determine complementary harvest strategies and uncover potential conflicts between wood and non-wood harvest (*FAO, 1995*).

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 forests management principles for timber and other forest products;
- Planted forest for intensive production of specific commodities.

5.0 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 management of myrrh and incense resources among the Somali communities on the Horn of Africa provides good examples of how natural woodlands can be sustainably managed. Although the resources are under communal tenure rights, there exist resource allocation and management among respective clans. This is particularly true for some ecosystems and/or for valuable resources like myrrh and incense. For such resources, there are strict management practices that are well respected by the clans, e.g. trees are protected from being cut down. During gum season, harvesting is systematically carried out and a tree is tapped again only after it has fully recovered. Commercialisation of myrrh and incense has the danger of putting pressure on available resources, especially when new players come on board but this can be addressed through development of sound production procedures for the communities. Once again, successful management of natural resources by local people is a useful learning point of how sustainability can be achieved.

Some fruit trees like ber (*Z. mauritania*) are adapted to ecologically poor, drought prone areas, which encounter crop failures. Given the ease with which the shrub can be planted in agroforestry systems as live fence at low cost, multiple benefits both as a fruit for humans and nutritious leaf fodder for livestock, it emerges as a suitable candidate species for degraded lands in the marginal dry savannah and Sahel areas of Sub-Saharan Africa. The fruit is economically important in the dry areas of Zimbabwe and Zambia where a mature tree provides an income of about US$25 per tree. Development could initially focus on meeting demand for local, national and regional markets while at the same time promoting it as a candidate species in the rehabilitation of poor/degraded sites.

The *karite* and *nere* 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 minimise environmental risks related to the high climatic variability prevalent in the dry Savannah regions of Sub-Saharan Africa. However, increase in population in these areas is putting pressure on remaining trees which are being cut down to give room for crops. In addition, fallow periods are getting shorter which also affects tree regeneration. The consequence of cutting trees or shortened fallow periods is parkland degradation. However, adding value to the fruits through improved management and marketing should increase demand for them and lead to preservation of the trees in the parklands and/or domestication.

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. This has been demonstrated by the CAMPFIRE project where poaching of wildlife has decreased sharply within project sites. Also, there have been improvements in the management of other resources such as water and woodlands, thereby contributing to the conservation of biodiversity. The example of the Kipepeo project in Kenya illustrates how communities' attitudes can change towards a natural resource once benefits have been demonstrated. Communities involved are contributing to the policing of the forest and are at the forefront in the fight against degazettment, a complete reverse of the situation ten years ago. Improvements in the management of the resources through eco-tourism are becoming a valuable strategy in sustainable forestry. Indeed, eco-tourism is emerging as a useful tool in the conservation of biodiversity and alleviation of poverty through environmentally sound income generating activities. As a new approach, there are, however, still some areas related to institutional organisation that will require streamlining as observed with the CAMPFIRE programme.

Valuable examples have also emerged with regard to the management of commodities. A case in mind is the *gum arabic* industry in Nigeria. The reorganisation that took place with the formation of NAGAPPEN clearly demonstrates the importance of strengthening institutions in both the private and public sectors. A once vibrant sector in the country was collapsing due to poor institutional structures until NAGAPPEN

came on board as a private sector driven initiative, which is good for *gum arabic* which, like most NWFPs, falls largely within the private sector. A similar lesson is being learned in Kenya where the Gum Arabic and Resin Association (GARA), a private led organisation, has taken a leading role in the development of the sector in the country. Like NAGAPPEN, GARA is lobbying the government for enabling policies while putting in place mechanisms for improving quality and marketing of the gum, aspects that are important for long term viability. At the regional level, NGARA is putting in place a coordinated strategy among producer countries and partners to enable them to have better control of the international trade and to share experiences in the areas of production, processing, quality and marketing.

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. The degradation of *Prunus africana* resources in Cameroon and grapple plant in South Africa are clear examples of the dangers of expanded markets in the absence of adequate information on the resources and best practices. However, there is scope for expanded markets supporting rural livelihoods and sustainable forestry management if proper programmes of domestication are put in place. Efforts in this direction by ICRAF in Central Africa are commendable.

Bees have been shown as friends of man in their provision of honey and bees wax and forests are important in the provision of nectar and pollen for this. Many forest trees and plants require bees for pollination and they are important for sustaining bio-diversity and, if properly integrated, will contribute both to improved rural livelihood and sustainable forestry. However, to be meaningful, an enabling environment is needed. This is an aspect that has not been given adequate attention in most of the African producing countries. It is only in Tanzania among the producing countries that there exist some valuable experiences. The country has not only put in place policy frameworks but has also enacted legislation and institutional structures in support of the policy. Indeed, these have spurred the private sector and NGOs/CBOs to get fully involved in the industry and contribute to improved rural livelihoods.

The analysis has also identified bad experiences and their negative impact on sustainable forestry and other resources that depend on the forests. One such experience relates to the role of forests in the provision of water on the one hand and the unabated destruction that is taking place in most water catchment areas for other uses in Sub-Saharan Africa. In Kenya, for example, large areas of catchment forests have been destroyed for a number of reasons, and have had negative consequences for down stream users, including farmers, municipalities and hydro-electric power stations. A close examination as to why this destruction proceeds despite the known role of forests in the regulation of water flow reveals a lack of clear understanding among policy makers on these relations. This is partly because lack of quantitative data and partly because of the long time frames involved for these effects to become obvious. There is urgent need for hydrological data to be generated that clearly demonstrate the contribution of forests to provision and/or regulation of water. This will contribute in part to the development of enabling policies which will also spell out how beneficiaries downstream can contribute to the management of forests in watershed areas.

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