

*Review*

# Importance of non-timber forest production in sustainable forest management, and its implication on carbon storage and biodiversity conservation in Ethiopia

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**Non-timber forest products (NTFPs) are biological resources of plant and animal origin, harvested from natural forests, manmade plantations, wooded land, farmlands and trees outside forests or domesticated. These products are vital sources of income, nutrition and sustenance for many forest-based communities around the world. This study tries to review available and accessible literatures on role of NTFPs in sustainable forest management including sociological approach, economic approach, ecosystem approach, technological approach and its related services (biodiversity conservation and carbon sequestration). The use of NTFPs has received attention in light of their perceived potential to address both poverty reduction and tropical forest conservation. It was suggested that better management and utilization method has to be set for diversifying products benefit for the local community.**

**Key words:** NTFPs, sustainable, biodiversity, forest management.

## INTRODUCTION

Non timber forest products (NTFPs) are, in broadest sense, any biological resources collected from wild by rural people for direct consumption/income generation on a small scale (Shackleton and Shackleton, 2004). They include wild edible foods, medicinal plants, floral greenery, horticultural stock, fiber of plants, fungi, resins, fuel wood, small diameter wood used for poles, carvings etc. (McLain and Jones, 2005). Interests in NTFPs was

predicated upon a few assumptions these include: commercial exploitation of NTFPs is less ecologically destructive than timber harvesting, and thus has greater potential for sustainable forest management; local forest users exploit forest resources wisely and sustainably and NTFPs will more directly benefit people living near forest compared to timber harvesting (Ruiz Perez and Arnold, 1997).

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There has been increasing recognition of NTFPs contribution to household and national economies and environmental objectives including biodiversity conservation (Arnold and Perez, 2001). For example, a study by MEA (2005) estimated that up to 96% of the values of forest are derived from NTFPs and services. Also, they have been recognized internationally as an important element in sustainable forestry. The UNCED in 1992 identified sustainable forest management as a key element in sustainable economic development, and set out nonbinding guidelines for sustainable forest management with specific inclusion of NTFPs (Jones et al., 2004).

Similarly, Plotkin and Famolare (1992) ascertained it by stating that there was a big concern on how to address the increasing and expanding deforestation of tropical forests. At that time, ecologists tried to answer how to make forest resource economically attractive to local people to reduce deforestation. NTFPs were among options considered best strategies to raise income for local people from forest while addressing conservation objectives (Ruiz Perez and Byron, 1999). Since then, sustainability of NTFPs extraction has been a topic of debate due to the underlying objective of development, and conservation are basically linked. For instance, EARO and IPGRI (2004) argued that contribution of NTFPs to livelihoods of rural communities is likely to persist as long as the resources are exploited on sustainable basis. This has led in a global move towards developing management of natural forest for the benefits of local communities (Hobley, 1996).

Biodiversity is the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part. This comprises diversity within species, between species and of ecosystems (Gillespie, 1997; Huston and Marland, 2002; Koziell, 2001; UNEP, 2007). Particularly NTFPs is one option for slowing the rise of GHGs concentrations in atmosphere which aims to increase the amount of carbon remove and what is stored in forests (Gorte, 2009). CS is defined as an increase in Carbon stocks other than in the atmosphere (Huston and Marland, 2002; Namayanga, 2002).

### **Objective**

1. To know the importance of non-timber forest production in sustainable forest management.
2. To know the importance of non-timber forest product for carbon storage and biodiversity conservation.

## **BASICS OF NTFPS, SUSTAINABLE FOREST MANAGEMENT AND ITS RELATED SERVICES**

### **Non timber forest products (NTFPs)**

NTFPs have many definitions in the literature. Thus, it is

hardly to encounter single definition of NTFPs in the existing literatures (Gary and Kristin, 2005). This is due to the fact that different individuals and/or organizations have modified the definition in different ways to suit their needs (Belcher, 2003; Rajesh, 2006). Accordingly, definition of NTFPs for this study is provided in the introduction section.

### **Sustainable forest management (SFM)**

There is no standard definition of SFM. However, according to Chamberlain et al. (2002), SFM is built on the principle that forest management will meet current societal needs without affecting future generations, or the forests' abilities to rejuvenate. This concept holds three fundamental standards: forest management is socially acceptable and equitable; the impact is ecologically benign and the economic impact to local communities is positive. In similar fashion, it was stated that sustainable forest management is a type of management that maintains and enhances long-term health forest ecosystems, while providing economic, social and cultural opportunities for the benefit of present and future generations (Mulugeta, 2009).

### **Non-timber forest products in Africa**

Although NTFPs play a major role in the rural economy of Africa, information on their overall contribution is patchy and incomplete at best, except for a few species and products of commercial importance (FAO, 2003). The lack of systematic efforts to conserve and manage resources is a major concern, and it is only in few cases that efforts have been made to cultivate species that yield NTFPs. African forests are a source of a variety of NTFPs such as fruits, gums and resins, honey and beeswax, medicinal and aromatic plants, dyeing and tanning materials, bamboo, and bush meat. These products are of critical importance to the livelihoods of rural communities and, in some situations, account for a significant share of household income (FAO, 2003) as a source of food.

Increased demand has not necessarily led to improved management including domestication, and a substantial proportion of products are collected from the wild, hence resource depletion is a major problem (FAO, 2003). Further, Africa has not been able to take advantage of its wealth of raw material and traditional knowledge and investing on processing—undermining opportunities for employment and income generation. Namkoong et al. (1996) concluded that the main effects of harvesting whole individuals would be via genetic drift and indirect selection. In contrast, harvesting only reproductive structures would most likely affect gene flow, the mating system and direct selection.

Throughout Africa, numerous medicinal plant species are becoming increasingly scarce due to a rise in trade to meet the demand from growing urban populations (Marshall, 1998). For example, favored species such as *Dalbergiamelanoxylon* have declined in Kenya and South Africa through harvesting to supply the woodcarving trade (Shackleton, 1993; Cunningham, 2000). Bark extraction has caused serious damage to wild populations of *Prunusafricana*, including trees inside forests of high conservation value (Cunningham et al., 2002). *Warburgiaugandensis* is another tree species threatened by exploitation of its roots, barks and shoots for medicinal purposes in East Africa. *Boswelliapapyrifera* is one of the threatened species in Ethiopia due to over exploitation or improper tapping of its frankincense, and lack of regeneration (Abeje, 2002).

Unless harvesting is controlled, some species will therefore become genetically impoverished or depleted more rapidly than others (Arnold and Perez, 2001). Exploitation of NTFPs from the wild in many respects and depending on the plant part harvested can help for sustainable utilization of the species. However, this requires understanding growth and reproductive characteristics of the plants and the application of harvesting practices that permit adequate reproduction or regeneration of the individual organism (Sunderland et al., 2004). Domestication of the species in question is another alternative in cases where exploitation of NTFPs from the wild cannot be sustainable.

### Important NTFPs in Ethiopia

Due to its varied ecological and climatic conditions, Ethiopia is home to some of the most diverse flora and fauna in Africa. NTFPs in Ethiopia cover a wide range of products, and are most extensively used to supplement diet and house hold income, notably during particular seasons in the year, and to help meet medicinal needs. They are largely important for subsistence and economic buffer in hard times.

These products contribute to the improvement of the livelihoods of rural communities by providing food, medicine, additional income, and employment opportunities and foreign exchange earnings of the country. In addition, by complementing wood-based management, they offer a basis for managing forests in a more sustainable way, thereby supporting biodiversity conservation. Historically, early forestry work tended to ignore this fact; it was mainly focused on managing forests for the continued supply of timber. The significant value and importance of NTFPs is felt more in dry land areas where few alternatives of resources exist for supporting the livelihoods of local communities because of difficult environmental conditions (EARO, Unpublished).

In Ethiopia, non-farm income represents an important

element in the livelihoods of the poor. In several areas, where the population density and depletion of natural resources are high, agriculture cannot possibly remain the only source of income. Observations show that, in many areas, crop production is no longer the main source of income for poor rural households (RESAL, 2000). Therefore, it is essential for rural households to look for non-farm activities like productive exploitation of NTFPs to supplement agricultural production.

The most important NTFPs in Ethiopia include coffee; spices and condiments; honey and wax; bamboo; reeds; natural gums such as gum arabic, frankincense and myrrh; edible plant products like leaves and shoots, fruits, seeds, tubers, mushrooms, edible oil, and fat; fodder; fibers; bark, simple sugar products; essential oils; tannins and dyes; resins; latex; ornamental plants and giant/long grasses (EARO, Unpublished). Spices harvesting is practiced in many forest areas of southern Ethiopia, such as Sheka, Keffa, Bench Maji, South Omo and GamoGofa Zones (Jansen, 1981). Commercial spices such as *Aframomumcorrorima* (Korerima) and *Piper capense* (Timiz) are found as indigenous species in Shekicho-Keficho and Bench Maji forests and woodlands.

Beekeeping is an ancient tradition in Ethiopia with annual production of about 24,000 tons of honey. This is the third of the total honey production in Africa. The density of hives is estimated to be the highest in Africa. An estimated 4 to 10 million traditional beehives, and some 10 000 modern boxes exist in the country (Vivero, 2001). The main products of the beekeeping industry are honey and wax. Honey is almost exclusively consumed locally, while a considerable proportion of wax is exported.

Ethiopia is one of the few tropical countries well-endowed with diverse plant species that yield economically valuable gum and aromatic resins such as gum acacia, frankincense and myrrh (Wubalem et al., 2003). The commercial use of natural gums is an age-old activity in Ethiopia. Ethiopia has been one of the major producers and exporters of natural gums from different indigenous tree species of the genus *Acacia*, *Boswellia* and *Commiphora*, which are found in different agro-ecological zones of the country (Vollesen, 1989).

Ethiopia has 67% of Africa's bamboo resources which is about 7% of the world total (Kassahun, 2002). It has about 1 million ha (Luso Consult, 1997; Kassahun, 2002) of highland bamboo. *Arundinariaalpina* accounts 150,000 ha, out of which 130,000 ha is natural and 20,000 ha human made bamboo plantations owned by framers. Lowland bamboo is dominant with coverage of 700,000 to 850,000 ha. Bamboo provides food, fodder, furniture and building materials (scaffoldings), industrial inputs, medicinal plants and fuel. Solid bamboo has been tested as a concrete reinforcement to substitute steel and the results have revealed success.

The overall socio-economic and ecological importance

and contribution of NTFPs in Ethiopia is significant, diversified and valuable. The harvesting, commercialization and transformation of certain NTFPs by the rural poor can be a means of shifting efforts away from the unsustainable exploitation of ecologically sensitive forest products. The NTFPs are among the main coping mechanisms that poor households and the nation have. Thus, their importance should not be overlooked or underestimated.

### **The link between NTFPs and forest sustainability and its services**

Forest biodiversity is being lost at an alarming rate. Publications of MEA (2005) indicate that a large and increasing number of forest ecosystems, populations and species are threatened globally or being lost due to the loss and degradation of forest habitats.

The link between NTFPs and forest sustainability and its services (biodiversity conservation & carbon storage) can be understood by taking into consideration of some cases. For example, in the Bio-Carbon fund project of CDM in Niger, *Acacia Senegal* Plantation aimed to reforest over 17,000 ha of degraded land, expected to sequester about 1.8 million tCO<sub>2</sub> in the near future (2017). With strong local social and environmental benefits: income generation through carbon payments, gum production, rehabilitation of degraded land and biodiversity (NTF-PSI, 2008). Likewise, in case of Ethiopia, Humbo Assisted Regeneration Project is aimed to restore 2,728 ha of biodiversity natural forest and expected to sequester about 750,000 tCO<sub>2</sub> in 30 years with benefits of improved community capacity to participate in carbon finance reforestation, and also to improve their livelihoods (NTF-PSI, 2008). Moreover, Mulugeta and Habtemariam (2007) discussed that vegetation of *Acacia*, *Boswellia* and *Commiphora* (ABC) which can be managed to provide many functions (economical and ecological services). This will enable Ethiopia to fulfill international conventions (such as CBC, CCD and CCC) that Ethiopia has ratified. Some of the Potentials of the vegetation, ABC, for biodiversity conservation and carbon sequestration, are presented as follows:

**ABC for biodiversity conservation:** There are two possible states of affairs in that *Acacia*, *Boswellia* and *Commiphora* species can be managed to contribute to biodiversity (Mulugeta and Habtemariam, 2007). (a) Through gum and incense extraction, as NTFPs. Extraction of gum and incense, when appropriately conducted, is non-destructive and hence causes negligible damage to the biodiversity, this is in line with one of the few assumptions of NTFPs. For that reason, via proper gum and incense extraction for economic

benefit, we can conserve the vegetation for their biodiversity value. (b) Through integration of the species into other economic sectors. *Acacia*, *Commiphora* and *Boswellia* species can be integrated with farming systems in different forms of agro forestry. Agro forestry, as one of integrated approaches to biodiversity conservation, is nowadays receiving considerable attention; since many species of *Acacia*, *Boswellia* and *Commiphora* have the necessary qualities to be integrated in agroforestry systems (Mulugeta and Habtemariam, 2007).

**ABC for carbon sequestration:** Forests involve largest carbon pool of all terrestrial ecosystems (Gibbs et al., 2007; Jandl et al., 2007). This was supported by the study of Von (2006) who stated that tree-based systems and carbon sequestered through process of photosynthesis remains fixed in wood and other organic matter in forests for a long period of time.

In Ethiopia, land use changes such as deforestation and conversion of forests into farm lands are the principal sources of carbon dioxide emission (Mulugeta and Habtemariam, 2007). As a signatory of the convention on climate change, Ethiopia has to work together in the ongoing efforts for carbon sequestration by making use of various sink potentials. In dry lands of Ethiopia, the most viable approach to achieve significant carbon sequestration is by means of productive vegetation management practices. The fact that *Acacia*, *Boswellia* and *Commiphora* can grow under harsh environment, means that there is even a potential to sequester carbon in extreme environmental circumstances. These plants can also act as wind breaks and, thus, reduce loss of soil carbon by wind; and intercept rain drops by their widely spreading canopies, reduce speed of surface run off and thus reduce soil erosion effectively thereby stabilizing soils and protecting soil carbon (Mulugeta and Habtemariam, 2007). As per Table 1, it is clear that the existence and coverage of the vegetation is almost throughout the nation. This indicates that there is a possibility to develop strategy for these vegetation's to provide socio-economic and environmental goods and service, at regional and/or national level based on proper management of the vegetation.

### **NTFPs and community development**

NTFPs were regarded as providing a very good opportunity for sustainable forest management and community development in the last two decades. There has been an increasing recognition of their contribution to household economies and food security, to some national economies and particularly to environmental objectives, including the conservation of biological diversity (Arnold and Perez, 2001). The role of NTFPs to the livelihoods of rural communities is likely to continue as long as the

**Table 1.** Estimated area coverage of vegetations with gum and resin bearing species in Ethiopia by region.

Region	Genus of vegetation	Estimated area (ha)
Afar	<i>Commiphora and Acacia</i>	65,000
Amhara	<i>Boswellia, Commiphora, Acacia and Sterculia</i>	680,000
Benshangul	<i>Boswellia, Acacia and Sterculia</i>	100,000
Gambela	<i>Commiphora, Acacia and Sterculia</i>	420,000
Oromia	<i>Boswellia, Commiphora, Acacia and Sterculia</i>	430,000
SNNP	<i>Boswellia, Acacia and Sterculia</i>	70,000
Somalia	<i>Boswellia, Sterculia, Commiphora and Acacia</i>	150,000-1, 500,000
Tigray	<i>Boswellia, Sterculia, Commiphora and Acacia</i>	940, 000
Total	-	2,855,000-4,355,000

Source:( Fitwi, 2000; Lemenih et al., 2003).

resources are exploited on a sustainable basis. This in itself is not likely to result in tremendous community development since these rural communities have been using these resources for centuries. On the other hand, exploitation of NTFPs for commercial purposes contributes to local economies—hence contributing to community development. The only drawback to this scenario is that commercialization also results in over-exploitation and depletion of the resources. Therefore, a balance has to be stricken between resource sustainability and benefits of exploitation of products, particularly for the export market.

## Management of non-timber forest products

### *Theoretical concepts in NTFPs management*

The process, by which resources are allocated, regenerated, managed and conserved over time and space to meet the needs of humankind has been termed as resource management (Karki, 2001). on the same document, resource management involves an interaction of three major elements. These are:

1. Physical resource base (land, water, forests, wildlife, etc.).
2. Production system (the mix of technologies and productive activities) and
3. Social regulation (laws, rules and principles).

NTFPs management encompasses ecological, technical, social, economic, legal and political aspects (Karki, 2001). As an ecological concept it deals with complex ecosystems that need to be monitored and maintained. Its technical aspect involves choice between different methods, techniques and development of appropriate harvesting and processing technologies. The social aspect of resource management also deals with people,

cultures, belief systems, attitudes and behavior, ethics, aspirations and social values, and its economic aspect aims at maximizing benefits and efficiency from a resource and minimizing input costs.

In the case of NTFPs, the social aspect also entails dealing with competing and voracious demands of people invariably place on the shrinking resources. Finally, resource management is a political subject because it involves exercise of power and control over users of resources, and this raises issues of administration and decision making (Karki, 2001).

### *Management approaches of NTFPs*

Non timber forest products management is a process involving harvesting, gathering, utilization and management of resources within a given ecological, economic, social, political, institutional and legal frameworks (Karki, 2001). Further, it was discussed that in past times, focus on forest resource management has been in sector and single purpose user centered, that was solely giving the responsibility of resource management to technical expert such as forester and biological scientists. This scientific approach has neglected, traditional resource management based on local people's knowledge, cultural values and needs. Moreover, the multidisciplinary and integrated nature of resource management in which inter sector a land synergistic linkages has often been ignored (Karki, 2001). With the increasing recognition of the limitations of such centralized approaches in recent years, a need has been felt for more holistic and integrated approaches for sustainable management of NTFPs resources.

### *Sociological approach*

This approach emphasizes on significance of culture, ecological and social ethics, indigenous knowledge, the

role of local people and social institutional arrangements in resource management. The sociological aspect of resource management has been the most neglected area in the resource management strategies of many countries until recently (Karki, 2001). For instance, Chambers (1991) examined that failure of a number of resource management programs was associated to the disregard of local culture and wisdom. This approach involves research methods such as participatory rural appraisal (PRA) and institutional arrangements including administrative structures and procedures, policies and laws and financial management (Karki, 2001).

### ***Economic approach***

This approach is based on the principle that there is a need to rationalize the allocation of natural resources, and optimize their use through competitive market economies to achieve maximum economic efficiency (Karki, 2001). However, this approach is limited as it assumes that firstly, cost and benefits from the use of natural resources must be known and quantifiable and secondly costs and benefits from one resource need to be isolated from those of another. But sometimes it is difficult to price/determine economic value of intangible benefits from natural resources such as ecological uniqueness, biodiversity, etc. Moreover, minimizing production costs and maximizing monetary benefits in order to strive for economic efficiency tends to increase pressure on some resources and neglect other resources for being of little/no significance in terms of economic development.

### ***Ecosystem approach***

This approach considers the whole ecological system, and the relationship among its various components (Karki, 2001; Pawlos, 2010). It recognizes the dynamics of the ecosystem as the basis for resource management. The approach aims at the rational allocation and management of resources based on ecological characteristics, component behavior, change processes and functional relationships among different components within ecosystems (Karki, 2001). The primary concern is to manage resources in a manner that minimizes ecological destruction. This approach involves practices such as; resource inventory, identification of natural processes that affect ecological stability; evaluation of functional significance of different components in an ecosystem and design of alternative management strategies to ensure ecological stability, productivity and sustainable development. Ecosystem approach is based on three perspectives represented as follows:

**1. Technological approach:** This approach comprises comprehensive land use or resource management plans and their implementation for rational allocation and utilization of natural resources based on the land capability classification. It is aimed at monitoring and mitigating environmental change using physical tools and modern technologies like mapping, geographic information system(GIS),remote sensing(RS) etc, environmental impact techniques, biotechnology and other techniques (Karki, 2001). Ecosystem approach is based on three perspectives represented on Figure1.

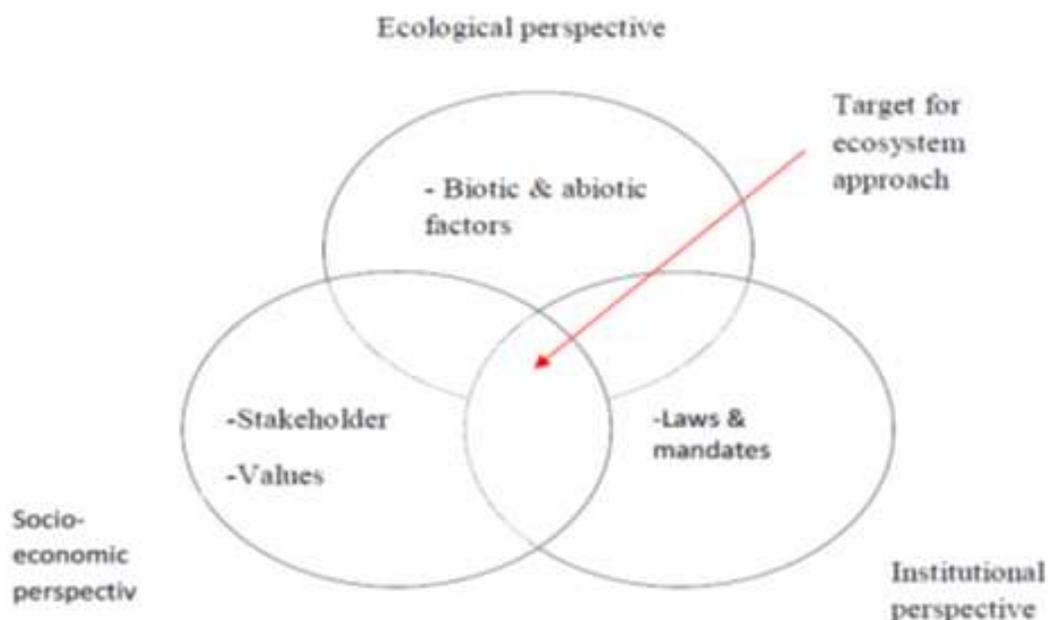
**2. The contribution of NTFPs extraction to forest conservation:** Some NTFPs enter into international market, even though most of them are locally used as food, medicine etc (Ros-Tonen, 2000). Among the NTFPs that enter the international markets are: honey, palm heart, plant and animal input to the pharmaceutical industry, bamboo, essential oils and gum arabic. In relation to this commercial extraction of NTFPs through adding value to the forest product it may provide an incentive to conservation and sustainable forest management. Similarly, Andel (2006) stated that commercial NTFP extraction may contribute to forest conservation because collectors often protect useful trees from being logged.

3. Moreover, if people can earn a living by selling NTFPs, they will not need to involve in other environmentally more destructive activities. Increased income from trade of NTFPs is thought to provide stimulus for local communities to protect their forest and manage sustainably (Ros-Tonen, 2000). Many NTFPs can be harvested without significantly changing the forest, hence maintaining the forest environmental services and biological diversity (Ros-Tonen, 2000). On the other hand, any harvesting of NTFPs have ecological impacts including, gradual reduction of vigor of harvested plant species, decreasing rate of seedling establishment (Peters, 1996). However, comparing to that of logging and conversion of land to other land that use these ecological impact were viewed as minimal. Ros-Tonen (2000) stated that it is incorrect to suggest that NTFPs are harvested indefinitely without proper management practice to sustain their yield.

### **Factors that hamper sustainable management of ntfps**

#### ***Ecological factors***

Ecological issues, if not addressed, could result in long-term and perhaps permanent decline in biological diversity (Chamberlain et al., 2002). The same document revealed that current scientific knowledge cannot adequately determine sustainable harvest levels of



Source: Adapted from Pawlos (2010)

Figure 1. Ecosystem approach on different perspectives.

biological resource from which NTFPs is collected; research is needed to examine and determine effects of harvesting on plant populations, as well as the impact on associated forest ecosystems, and concluded that sustainable forest management will remain elusive until knowledge concerning NTFPs is developed. Neumann and Hirsch (2000) supported this idea by stating efforts to measure the direct ecological impacts in actual NTFPs harvesting systems is not easy since most real world situations are complex that other underlying factors are hard to filter out.

Nevertheless, many studies have tried to deal with it. For example, seventy studies have quantified ecological effects of harvesting NTFPs from plant species perspective, with aims of assessing current state of knowledge, and illustrated that NTFPs harvest can affect ecological processes at many levels, from individual to ecosystem (Ticktin, 2004). In this case, it was evidenced that intensive annual harvesting of a valuable market fruit or oil seed can gradually eliminate a species from a forest ecosystem (Ruiz and Arnold, 1997). Ecological impacts of NTFPs harvest is not only observed in plants but also in animals. For instance, Fitzgibbon et al. (1995) stated that bush meat harvesting has the potential to alter ecosystem structure and functioning where one/more important animal species are depleted.

### ***Change in socio-economic and institutional aspects***

It is clear that transport systems are reaching further into remote areas, catalyzing forest and woodland clearing for different purposes, and this result in the loss of supplies of wild harvested species as habitat declines. For this reasons, Wilkie et al. (2000) underlined the need, through co-ordinated land-use and infrastructure planning, to plan roads in a way that maximizes local and national economic benefits while minimizing the negative effects road construction has on biodiversity. Since the 1960's, growing demand from urban areas has catalyzed NTFPs trade, drawing resources from rural areas to towns and cities, for fuel wood, building materials, medicinal or edible wild fruit species (SCBD, 2001). Consequently, urbanisation has tended to increase rather than reduce the demand for wild plant resources that stimulates overexploitation.

According to Chamberlain et al. (2002) three major institutional weaknesses were important to have impact on sustainable forest management efforts. First, staff levels and expertise were inadequate to deal with non-timber forest products. Second, institutional impediment to sustainable management of NTFPs was that the biological materials from which these products originate are not recognized nor treated as other natural resources

(such as timber and minerals) and third, lack of funding to support sustainable forest management activities.

### **Some suggested points concerning sustainable managements of NTFPs**

Ticktin (2004) suggested that, so as to manage and conserve NTFPs populations effectively, at least three ecological questions must be addressed in addition to socio-economic issues; these were: what are the ecological impacts of NTFPs harvest? What are the mechanisms underlying these impacts? And what kinds of management practices mitigate negative impacts and promote positive impacts?

It was also recommended that, feasible strategies and continuous action plan should be developed for conservation and sustainable utilization of respective source of NTFPs species and their habitat (EARO and IPGRI, 2004). Similarly, Arnold and Perez (2001) recommended that approaches to conserve plant species that are source of NTFPs, need to be adapted to individual species and their habitat. Suggestion provided by SCBD (2001) also support the same idea, that if policy on sustainable management of NTFPs is to be implemented successfully, then policies and their implementation practice have to be tailored to local ecological, economic and socio-political circumstances.

Source of NTFPs populations managed by knowledgeable harvesters may show high growth rates under high harvest pressure, whereas populations of the same species managed by less knowledgeable harvesters may decline under much lower levels of harvest (Ticktin and Johns 2002). It seems for this reason, EARO and IPGRI (2004) recommended that, public awareness needs to be created about the contribution of NTFPs at local and national level to promote sustainable utilization of products for economic and environmental benefits. On the other hand, Chamberlain et al. (2002) suggested a helpful thought that, many collectors can trace their heritage and relationship with NTFPs back to several generations, and this traditional ecological knowledge is critical in understanding the fundamentals of NTFPs management.

Thus, sustainable management strategies will require understanding and respecting people views and uses of the NTFPs resource. Biodiversity of tropical forests with its millions of species, which have not yet been scientifically described, might hold many NTFPs for future uses in different sectors, thus conserving this biodiversity is critical. Good forest governance and incorporation of NTFPs in relevant national strategies and action plans are important steps for conservation and sustainable use of NTFPs resources (SCBD, 2009). Furthermore, it was suggested that, it is indispensable to continue research on possibilities for NTFPs to contribute to sustainable forest management since NTFPs play important role in

local forest use (Ros-Tonen, 2000).

### **CONCLUSION**

Forest management is primarily for ameliorating climate, checking soil erosion and flood, protect biodiversity etc. Dry land forest management and silviculture incorporate a set of practices that can facilitate the expansion, regeneration, growth and functional utility of forests, and the human activities essential to the conservation and sustainable development of forest and woodland resources in drylands, helping these resources to become ecological and environmental buffers that tone down the often harsh climatic conditions and their impacts.

NTFPs have been increasingly recognized for their contribution to economic development and sustainable forestry management. The link between NTFPs and forest sustainability could be understood by taking some cases into consideration (for example, properly managed vegetation for gum and resin can store carbon and conserve biodiversity). This can lead to sustainable forest resource management; since extraction of NTFPs can be conducted without significantly changing forest stands. However, sustainability in NTFPs resources management is questionable without giving considerable attention to ecological, social, and economic aspects. On the other hand, there are some obstacles that restrain sustainable management of NTFPs related to ecological change, socio-economic change and institutional factors.

Eventually, some suggestions regarding sustainable management of NTFPs were provided. These were linked to impact of NTFPs extraction on species and ecology; management approaches; knowledge of collectors, integration of NTFPs in national strategies and need of continuous research on NTFPs for forest sustainably.

Thus, based on the review, management approaches and practices of NTFPs in sustainable forest managements need to be adapted to local ecological, economic and social political circumstances. Responsibility of NTFPs management for forest sustainability should not be given only to an expert (forester) but also inclusion of traditional knowledge through involvement of stakeholders in management of forest resource is vital. Finally, further research on possibilities of NTFPs management for forest sustainability and its related services is needed.

### **Conflict of interest**

The author has not declared any conflict of interest.

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