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REPORT ON FORMULATING A STRATEGY FOR PRODUCTION, VALUE ADDITION AND MARKETING OF PRODUCTS FROM ARID AND SEMI ARID (IGAD) IN SUDAN

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MAINA KARABA

We who knew and worked with you will always cherish the memories

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Abbreviations and Acronyms

ARC	Agricultural Research Corporation
FNC	Forests National Corporation
GAB	Gum Arabic Board (Sudan)
GAPAs	Gum Arabic Producers Associations
FRC	Forestry Research centre
IGAD	IGAD Intergovernmental Authority on Development
RGPMP	Revitalizing the Sudan Gum Arabic Production and Marketing
TSC	Tree Seed Centre
SSMO	Sudanese Standards and Metrology Organization P.O. Box
GAC	Gum Arabic Company
IFAD	International Fund for Agricultural development
NGO	Non-Governmental Organizations
SDG	Sudanese Ginah (Pound)
MAF	Federal Ministry of Agriculture and Forestry
IES	Institute of Environmental Studies
MFT	Ministry of Foreign Trade
MIS	Market Information System
HPS	Hand-picked selected
NWFPs	Non wood forest products
IIED	International Institute for Environment and Development

Disclaimer

This report is prepared for the Inter-Governmental Authority on Development's Programme on Production, Value Addition and Marketing of Non Wood Forest Products from Arid and Semi Arid Lands (ASALs) in the IGAD Region. It was the need, to mainstream NWFPs into the national economy that led IGAD to facilitate the development of "a regional strategy for production, value addition and marketing of non wood forest products from Arid and Semi Arid Lands (ASALs) in the IGAD Region". The overall objective of the programme was to contribute to food security, income generation and alternative livelihoods in the ASALs by exploiting and promoting eco-(bio) enterprises from non timber products existing in the ASALs. The consultancy was commissioned by IGAD, as part of the larger study on strategy development, to i) Undertake review literature to identify underexploited and/or new crop species that exist in wild and/or in limited cultivation in the sub region with a view to promoting and increasing cultivation, multiplication and production; ii) Document, where available, the multiplication and release to research institutions of small quantities of seeds of most promising species cultivars and ecotypes; iii) Explore the present and future research on value addition and market chains (processing and packaging of the new foods and products) in IGAD member states; iv) Undertake preliminary studies on marketing systems for these products and foods to ensure a sustainability of production in IGAD and member states; v) Identify rural cottage industries and community groups for the processing and packaging of the respective foods and vi) Review the possibility of local and international exhibition of these products.

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Date of publication: April 2011

i. Executive Summary

This report highlights the importance of non-wood forests products (NWFPs) with respect to the extent of the resources base and its contribution to food security, income generation and overall livelihoods of the people living in the arid and semi-arid lands of the Sudan. The report provides a comprehensive review of NWFPs and their use emphasizing the over and underutilized or exploited species with a view to describing and characterizing the resources, identifying constraints, opportunities and appropriate intervention to improve production, multiplication, marketing, processing and value addition.

In the Sudan, woodlands in arid and semi-arid environments constitute the most important habitats for the majority of utilized NWFPs. These are mainly natural forests or stands with the exception of some important species such as *Acacia senegal*, which is produced in plantations. The most socially and economically important species are the gum/resin producing trees namely, *Acacia senegal*, *Acacia seyal*, *Acacia polycantha Boswellia papyrifera* and *Sterculia satigera*.

Other important and diverse tree species that are widely utilized by local communities for domestic consumption as food and for other purposes and for sale are: *Balanites aegyptiaca* (Lalob) , *Ziziphes spina christi* (Sidir or Nabag), *Hyphaene thebeica* (Dom), *Adansonia digitata* (Tabaldi), *Tamarindus indica* (Aradieib), *Acacia nilotica* (Sunut), *Borassus aethiopium* (Daleb), *Grewia tenax* (Godeim) and *Vangueria madagascariensis* (Kirkir). In south Kordofan for instance, over 60% of the people in rural areas use Lalob, Gongolez, Godeim, Sidir or Nabag and Aradeb fruits as food and medicines. Some of the species and/or varieties of NWFPs are, however, more utilized than others. These include *Balanites aegyptiaca* (81.2%), *Tamarindus indica* (76.2%), *Ziziphus spina-christi* (76.2%), *Anogeisus leiocarpus* (61.2%), *Sclerocarya birrea* (59.9%*)* and *Diospyrus mespilformis* (56.2%). On the other hand other species and/or varieties are sparingly used including e.g. *Guiera senegalensis* (22.5%), *Boscia angustifolia* (22.5%), *Kigelia africana* (20.0%), *Crateva adansonii* (20.0%) and *Dichrostachys cinerea* (18.0%).

NWFPs are usually collected and harvested by small producers in western Sudan but large scale production of gums is practiced in the eastern Nuba Mountains in South Kordofan and in the Blue Nile, where the tappers tap the gum trees on share-cropping basis. The products are marketed at the village level where merchants buy the products and sell them to middlemen or agents of wholesalers in small town markets who transport the products to big town markets or auction markets. However, more than 40% of Laloub (*Balanites aegyptiaca*) and Aradeib (*Tamarindus indica*) fruits are consumed in Khartoum State, which constitute 18.5% of Sudan's population (39 million) (or 23.3% of the population when the South Sudan become declare independence in June 2011).

Since the 1970s drought years, Sudan's gum arabic production decreased from 45000 tons in the 1960s to 28000 in the 1980's and around 20000 tons in the 1990s and 2000s. Production has since grown marginally to 30000 tons presently. The largest decrease, to less than 12000 tons, was recorded in the drought years of 1984 and 1985. Exports declined from around 50000 Metric tons in 1950s and 1960s to around 350000 MT in 1970s to 30000MT in 1980s – 1990s. Exports increased to 50000 MT in 2000. Exports for the year 2009 and 2010 reached 47000 tons. Generally, the prices fluctuate depending domestic and export market demand and quality. However, in some instances the fall in the price is so high e.g. 65% drop in the price between

2005/06 and the 2009/10 at Gedaref market in Eastern Sudan, that external forces such as cartels are suspected to be in play. On the overall, the total market value of the main NWFPs (fruits and gum Arabic) is estimated at 357.2 million SDG equivalent to 122.85 US Dollar, of which an estimated 70% is accounted for by gum arabic.

The various uses of the different tree species as fruits, bark, gums for food and medicines and the roles played by the different key players in NWFPs production, marketing, processing, exports, research and development are highlighted in this report. In addition the main problems and constraints facing production, marketing and sustainable management of NWFPs are summarized with a list of possible interventions in the areas of processing and enterprise development, research, extension and training. Finally, a selected References' list for further reading is presented.

ii. Introduction

North Sudan encompasses a wide range of ecological zones extending from the desert (<100mm rain), semi-desert (100 - 250mm), arid (250 - 350mm) and semi-arid (350-750) zones on sandy and clay soils to sub-humid environments (>750mm). The River Nile and its main tributaries, the White Nile and Blue Nile rivers, are important features of the country. The 2008 census estimated the total population of North Sudan at 30.95 million, with a population growth rate of 2.5%. Rural population represents 70% of the total population. The average rainfall ranges from around 0.0 - 75mm in the north, to more than 800 mm in the southern part. The rainy season start in May and ends in October.

Forest and wood land areas of the Sudan are estimated at about 32% of the total area of the country before independence of the South and 11.6% at present. The tree vegetation varies from the north to the south depending on soil type and rainfall. The vegetation on sandy soils is composed of *Acacia senegal* as the dominant tree species. *Leptadaenia pyrotechnica, Boscia senegalensis* and *Calotropis procera* are found north of the tree belt. Associated tree species include *Adansonia digitata, Albizzia amara, Faidherbia albida, Balanites aegyptiaca* and *Ziziphus spina-christi*. To the south of this zone, *Acacia senegal*, and the other associates e.g. *Sclerocarya birrea, Commiphora africana*, and *Terminalia laxiflora* constitute the main species. However, the vegetation on the clay plain is typical of the *Acacia seyal-Balanites* and the *Acacia mellifera* thornland vegetation types with *Acacia senegal* as an important variety. In the northern part of the clay plain the vegetation cover is composed of *Acacia mellifera*, *Dalbergia melanoxylon*, *Albbizia amara subspecies sericocephala*, *Guiera senegalensis* and *Acacia senegal.* Gardud soils are dominated by *Acacia mellifera, Acacia nubica* and *Boscia senegalensis.* The high lands between the mountains are covered with *Anogeissus leiocarpus*, *Combretum spp*., *Acacia senegal* and *Acacia polycantha*. *Borassus aethiopium*, *Cordia africana* and *Terminalia laxiflora*, comprising the vegetation of the fertile low lying areas, while along seasonal water courses, *Oxytenanthera abyssinica* and *Diospyrus messpiliformis* occur as economically and socially important species of the water courses' system. This wide diversity of species has resulted in a variety of wood and non-wood products that are used for domestic and commercial purposes. For instance, a number of gum and resin producing species occur naturally and are tapped by the local people for the production of gums. These species include:- *Acacia senegal, Acacia seyal, Acacia polycantha, Boswellia papyrifera* and *Sterculia satigera*.

In general, forest products in the rural areas contribute 21% of the total household income and rank second to agriculture (41.5%). The income level of 50% of the community ranges from SDG 300.00 – 500.00 (US Dollar 112 -186). This income level reflects the local peoples' poverty and justifies their reliance on forests products through traditional management and sometimes irrational cutting of trees for domestic purposes and for sale. However, with increasing demand for forest products and land for agriculture, the rate of deforestation and environmental degradation has increased. Therefore, interventions are needed to rehabilitate and improve degraded farmlands and to compensate the deficits in gum arabic and fuel wood production in order, to reduce soil erosion and desertification and to meet peoples' basic needs from forests products.

There is a high potential for investment in forests products through: the development of small-scale forestry-based enterprises using fruits, gums, resins, honey, medicines, forest-based products, timber, recreation and nature conservation. However, this should be based on sound and sustainable development of the resources, while conserving and managing the environment.

iii. Objectives

The overall objective of this report is to contribute to food security, income generation and explore alternative livelihoods in the ASALs of the Sudan by exploiting and promoting and developing NWFP's enterprises. The specific objectives are:

1. To review and document literature on the NWFPs resource base and to identify the over and underexploited and new crop species that exist in wild and/or in limited cultivation in the country.

2. To explore possible interventions for promoting and increasing cultivation, multiplication, production, value addition and improved marketing of NWFPs.

3. To review the extent of the resources including mapping and access to information.

4. To Identify the key players in the sub-sector and actors and how to involve community participation and needed support.

5. To identify research and training institutions involved in forestry research and training and indicate their programs with respect to improving NWFPs.

6. To determine the potential of multiplication and release to research institutions of small quantities of seeds of most promising species cultivars and ecotypes.

7. To explore the present and future research on value addition and market chains.

8. To advise on sustainability assurance regarding improved production and marketing of NWFPs.

9. To identify rural cottage industries and how to intervene for feasible investment.

10. To determine the possibility for exhibiting NWFPs products in the national, regional and international arena.

11. To identify potential areas of intervention and how public and private sector investment should be encouraged.

12. To prepare a logframe of future activities and interventions to alleviate constraints.

iv An Overview of NWFP in Sudan

a. Ecological aspects

In Sudan, woodlands in arid and semi-arid environments constitute the most important habitats for the majority of utilized NWFPs. These are mainly natural forests or stands. However, a few species such as *Acacia senegal* are produced in plantations. The most socially and economically important species are the gum/resin producing trees namely, *Acacia senegal*, *Acacia seyal*, *Boswellia papyrifera, Acacia polycantha* and *Sterculia satigera*. Other important tree species that are widely utilized by local communities for domestic consumption as food and for other purposes and for sale include: *Balanites aegyptiaca* (Higlig), *Ziziphes spina christi* (Sidir), *Hyphaene thebeica* (Dom), *Adansonia digitata* (Tabaldi), *Tamarindus indica* (Aradeib), *Acacia nilotica* (Sunut) and *Grewia tenax* (Godeim). Plates 1 – 10 (Annex 3) display the different NWFPs. There are also important NWFPs within the sub-humid environment south of the country but those are mostly important for timber production.

Forest Types, Resources and Stock Condition

The forests resources and variations in condition of the growing stock are discussed in relation to differences in agro-climatic zones:

1. **Semi-desert and Arid**

The vegetation types on sandy soils in the semi-desert (100 -250 mm rainfall) are composed of *Acacia tortilis* and *Maurua crassifolia.* Along seasonal water courses, *Capparis decidua*, *Ziziphus spina-christi, Balanites aegyptiaca* and *Salvadora persica* occur as associates. On the moving sand dunes of the semi-desert grass-land on sand, *Acacia tortilis* subsp. *raddiana*, *Acacia tortilis* subsp. spirocarpa and *commiphora africana* exist. *Leptadaenia pyrotechnica* is dominant on the deep sands. However, *Acacia mellifera* and *Commiphora africana* characterize the vegetation on sandy clay soils in the centre of this zone.

Due to drought, wind erosion, heavy grazing and illicit tree cutting, the condition of the growing stock is generally poor and continuously deteriorating. A number of species such as *Acacia mellifera, Acacia nubica* and *Commiphora africana* have disappeared in some areas e.g. around Gabrat Eskeikh and Um Badir in the northern part of North Kordofan State.

In the southern wetter part of the semi-desert, which constitutes the arid zone (250 -350mm rainfall), *Acacia senegal* constituted the dominant tree species, which also continues south in the semiarid zone on sand and clay soils. This area has been rapidly deteriorating due by drought, desertification and mismanagement resulting in replacement of the tree in vast areas by the relatively less useful *Leptadaenia pyrotechnica, Boscia senegalensis* and *Calotropis procera.*

On the sandy soils on the stabilized dunes *Acacia senegal* occurs in pure stands. The associated tree species such as *Adansonia digitata, Albizzia amara, Faidherbia albida, Balanites aegyptiaca* and *Ziziphus spina-christi* are heavily degraded. To the south of this zone, *Acacia senegal*, and the other associated species e.g. *Sclerocarya birrea, Commiphora africana*, and *Terminalia laxiflora* are much endangered in the *Combretum cordofanum*-Dalbergia -Albizzia zone.

The semiarid vegetation on clay plains (350 -750mm rainfall) to the south of the sandy areas is characterized by high diversity in forest types, species composition and consequently a wide range of wood and non-wood products. The dominant tree species in the northern parts of Eastern Nuba Mountains on the cracking and non-cracking clay soils are: *Acacia mellifera*, *Balanites aegyptiaca*, *Acacia polycantha*, *Tamarindus indica*, *Combretum cordofanum*, *Adansonia digitata*, *Ziziphus spina-christii*, *Caparis decidua*, *Acacia nubica*, *Boscia senegalensis* and *Acacia nilotica*, which occur along seasonal water courses. The forests cover is decreasing due to excessive grazing as the animals are forced to stay in the safer areas for longer than usual due to insecurity in the southern parts of the Sudan. The main vegetation is of the *Combretum-Albizzia sericocephala* type, in association with *Acacia senegal*, *Balanites aegyptiaca, Guiera senegalensis, Boscia senegalensis* and *Adansonia digitata. Piliostigma reticulatum and Acacia nilotica* are found alongside seasonal watercourses. The tree cover in this zone is also deteriorating as a result of illegal felling, intensive grazing and seasonal uncontrolled bush fires. The reserved forests such as Nabag forest are managed by the Forests National Corporation (FNC). However, the rest of the natural forests are regarded as protection against sand movement.

Further to the South, *Boswellia papyrifera*, *Terminalia laxiflora*, *Dalbergia melanoxylon*, *Anogeissus leiocarpus*, *Cordia Africana*, *Terminalia brownii* and Karmadoda (*Nauclea latifolia*) form distinct cover in addition to other species. Generally, the growing stock condition is good despite uncontrolled grazing. In this zone in the hill catenas, the vegetation cover is diverse and differs with elevation. In the natural forests, *Sterculia satigera*, *Boswellia papyrifera*, *Grewia villosa*, Kirkir, *Oxytenenthera abyssinica* and Um Takirna dominate. The reserved forests are composed of *Anogeisus leiocarpus*, *Terminalia laxiflora*, *Acacia seyal, Balanites aegyptiaca, Ziziphus spina-christi*, *Terminalia brownii*, *Terminalia laxiflora*, *Acacia gerardii*, *Acacia senegal and Nauclea latifolia.* Generally, the stock condition of the forests in this area is good. There are vast areas under naturally established *Acacia senegal*, but there are limited Hashab plantations in the area. However, local communities have shown a lot of interest in Hashab plantations for the production of timber, construction wood, fuelwood and environmental protection.

The south western part or the Nuba Mountains is characterized by the *Terminalia-Sclerocarya-Anogeissus-Prosopis* savannah vegetation which is still in good condition except that considerable areas were clear-felled by petroleum companies. On the slopes of the hills and along seasonal streams in this area, *Oxytenenthera abyssinica* (Gana) exists as potentially important species.

With respect to natural forests management, there are attempts by the local administration and the local community to protect and regulate tree cutting in war affected area. The forests serve production, protection of watersheds and grazing functions. The main problems facing these forests are: access resulting from insecurity and illegal tree cutting for construction purposes, especially by those who returned back to their home villages after displacement during war times.

Further to the south, the species diversity and tree stocking increases. Generally, there is a high potential for timber production, gums/resins, fruit production and other minor forests products. Plantation establishment of Borassus aethiopium and Hyphaene thebaica along seasonal water courses and as boundary planting in private horticultural gardens is being carried out by FNC.

2. **Sub-humid**

The sub-humid (> 750mm rainfall) vegetation is restricted to some patches in the south-western part of the clay plain. The most dominant tree species are: Khaya senegalensis (Mahogany), Isoberlinia doka (Vupa) and Combretuim hartmanianum (Habil). The stock condition is good probably as due to insecurity and inaccessibility of some of the areas.

b. NWFP Resource mapping

A part from the gum arabic tree (Acacia senegal), gum olibanum (Boswellia papyrifera), and the tannin producing tree (Acacia nilotica) most of the forests resource's mapping does not specifically target the NWFPs. Therefore, NWFPs are indirectly mapped as components of the overall country's forests resource's mapping. The land cover classes have been developed by FAO Africover project which aims at establishing data base on land cover for Africa. The land cover contains all natural vegetation with a woody component. The land cover classes were developed for Sudan using the FAO/UNDP international standard LCCS classification system (www.africover.org). A map of the gum arabic belt of Africa was given by Brenan (1983) as shown in Figure 1. However, the gum resources were mapped in the early 1950s and updated by IIED and IES (1989). The forests of the Sudan and the gum belt were shown in Figure 2.

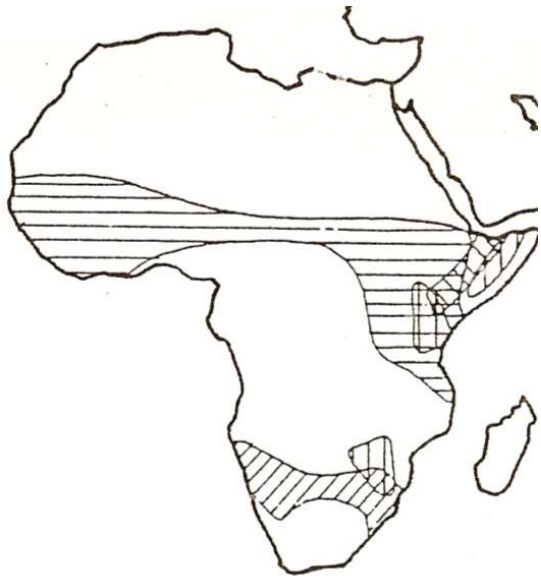

Figure 1: Approximate distribution *Acacia senegal* and its varieties

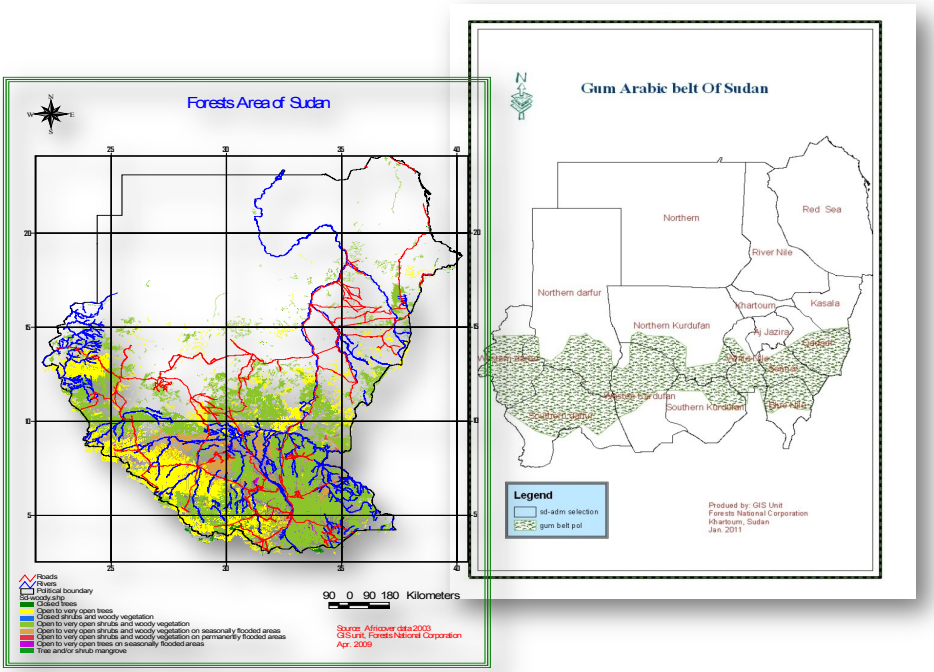

Figure 2. Forests of the Sudan before (32%) and after (11.6%) independence of the south

1. Distribution of Gum Producing Species

The *Acacia senegal* tree occurs naturally in a belt 300 Km wide extending through the southern frontier of the Sahara Desert, from Mauritania to Sudan, Ethiopia, Somalia, also in east Africa and extends southwards to the southern parts of Africa. In Sudan the tree is found naturally between Latitudes 10° and 14° N in western Sudan i.e. in North and South Kordofan and the three States of Darfur; and in the Blue Nile and Gedarif States in central and eastern Sudan. According to Harrison and Jackson (1958) *Acacia senegal* is found in low rainfall woodland savannah on clay and sand, and special areas. The main gum arabic tree (*Acacia senegal*) occurs as component of six plant communities as follows: 1) *Acacia mellifera* thornland on dark cracking clays, and *Acacia mellifera* on hill soil; 2) *Acacia seyal-Balanites* savannah alternating with grass areas; 3) *Acacia senegal* savannah; 4) *Combretum cordofanum-Dalbergia- Albizzia sericocephala* savannah woodland; 5) *Teminalia-Sclerocarya-Anogeissus-Prosopis* savannah zone; and 6) Baggara repeating pattern. Generally, the tree is found naturally in the gum belt which extends between Latitudes 10° and 14° N. The annual rainfall in the tree belt ranges from 280-450mm in sandy soils and 500 - 800mm in clay soils. The mean annual temperature within the species range in Sudan is 14°C and 43°C.

With respect to Frankincense or gum olibanum which is a resin produced by *Boswellia papyrifera*, this tree is also common in many of the east African countries namely; Eritrea, Ethiopia, Kenya, Somalia and Sudan. At least two species of Boswellia exist in each of these countries, except Sudan where *Boswellia papyrifera* is the only one species of genus Boswellia that occurs naturally in the country. This species is found mixed with *Sterculia satigera, Combretum and Terminalia spp*. *Commiphora Africana, Albizia amara, Dalbergia melanoxylon* are found at lower elevations. *Boswellia papyrifera* is mainly found in hilly areas in Blue Nile, South Kordofan and South Darfur states. In the Blue Nile State, the species covers vast areas of the Ingessana hills, Jebel El Gari and on the hills at the border with Ethiopia.

In south Kordofan, the tree is dominant in the Nuba Mountains and in the western parts of the state bordering South Darfur. However, in Darfur, the tree occurs in South and West Darfur states mainly at Jebel Marra and along the border with the Republic of Central Africa, and on the hills at Zalingi and El Geneina.

c. Production, processing and marketing of NWFPs

1. Forest Resources and Products

The diversity in forest types and species diversity have resulted in a variety of wood and non-wood products which are used for domestic and commercial purposes. These products include commercial and industrial timber and wood and NWFPs for various purposes e.g. fruits, gums, resins, honey, medicines. The forests also provide other important values such as recreational sites, wildlife refuge, nature conservation and sites of special scientific interests.

2. Domestic and Commercial Use of Forests Products

About 31 % of most of the local communities' income is from forest resources. Forest fruits contribute about 19%, followed by gums (13%) and fencing material. Table 1, shows 10 different forest products, which are important sources of income for the farmers who claimed low productivity of agricultural crops.

Similarly, the local communities depend on wood products for construction and other purposes. Almost all of the local people use wood for building (99%), furniture (100%) and agricultural implements (91%). The forests also contribute to the local communities in the form of rods, thorn, saddles, mortars, oil mills, wooden dishes, smoke wood 'sauna', antiques, medicines (Table 2). However, some of the small scale industries such as the oil mills, wooden dishes and saddles are more destructive to the forests because the whole trunk of the tree is cut. In addition to above, the forests provide sources of material for rods, thorn, saddles, mortars, oil mills, wooden dishes, smoke wood 'sauna' and handcrafts. Some of these small-scale activities such as the oil mills, wooden dishes and saddles are more destructive to the forests because the whole tree is cut. These activities constituted a source of income especially during the dry season and when productivity of agricultural crops is low.

Most of the tree species which are naturally present in the area are used or utilized by the local communities. However, some of the species are heavily used than the others. These include *Balanites aegyptiaca* (81.2%), *Tamarindus indica* (76.2%), *Ziziphus spina-christi* (76.2%), *Anogeisus leiocarpus* (61.2%), *Sclerocarya birrea* (59.9%*)* and *Diospyrus mespilformis* (56.2%). However, some of the species are less used e.g. *Guiera senegalensis* (22.5%), *Boscia angustifolia* (22.5%), *Kigelia africana* (20.0%), *Crateva adansonii* (20.0%) and *Dichrostachys cinerea* (18.0%). Table 3, presents the percentage use of the different species in South Kordofan. This table also shows the wide diversity of the tree species in the area.

Table 1. Contribution of the Different Forests Products to the Total Income from Forests.

Products	Mean (%)
Firewood and charcoal	30.5
Fruits	18.7
Fencing material	12.2
Leaves and bark	7.2
Seeds	7.2
Gums	12.9
Palm leaves 'Saaf'	5.4
Honey	6.1
Oil	2.0
Antiques	5.0

Table 2. Domestic and Commercial Use of some NWFPs compared to wood Products in South Kordofan (based on local peoples' views).

Products	Usage		Source	
	Yes	No	Market	Collected or made
	(%)		(%)	
Medicine	72.5	27.5	62.5	37.5
Tannin	17.5	82.5	87.5	12.5
Dye	82.5	17.5	85.0	15.0
Firewood	97.5	2.5	31.3	68.7
Charcoal	95.0	5.0	60.0	40.0
Building material	98.8	1.2	57.5	42.5
Furniture	100.0	0.0	67.5	32.5
Agricultural implements	91.3	8.7	53.8	46.2
Rods	65.0	35.0	62.5	37.5
Thorn	57.5	42.5	57.5	42.5
Saddles	40.0	60.0	62.5	37.5
Mortar	75.0	25.0	76.3	22.5
Oil mill "Assara"	12.5	87.5	80.0	20.0
Wooden dishes	33.8	66.2	56.3	43.7
Smoke wood	88.8	11.2	61.3	38.7
Antiques	25.0	75.0	56.3	43.7
Fencing material	95.0	5.0	50.0	50.0
Cooking rod	98.8	1.2	65.0	35.0
Ropes	80.0	20.0	60.0	40.0
Nets	22.5	77.5	82.5	17.5
Mats	90.0	10.0	67.5	32.5

Table 3. Tree Species Used for Production of Wood and Wood-Based Products by Local Communities (%) in South Kordofan

Species	**%**
Balanites aegyptiaca	81.2
Tamarindus indica	76.2
Adansonia digitata	40.0
Ziziphus spina-christi	76.2
Anogeisus leiocarpus	61.2
Diospyros mespiliformis	56.2
Vangueria madagascariensis (Kirkir*)*	30.0
Ximenia americana	32.5
Ficus sycomorus	32.5
Sclerocarya birrea	59.9
Grewia mollis	39.9
Combretum hartmannianum	51.1
Albizzia sericocephala	40.0
Dichrostachys cinerea	18.0
Acacia senegal	32.5
Acacia polycantha	34.9
Acacia seyal	51.2
Acacia gerrardii	47.5
Combretum aculeatum	53.7
Acacia nilotica	52.5
Dalbergia melanoxylon	37.5
Prosopis africana	41.2
Commiphora Africana	31.2
Cordia africana	30.0
Boswellia papyrifera	27.5
Terminalia brownie	47.4
Bauhinia rufescens	47.4
Acacia mellifera	35.0
Acacia nubica	27.5
Faidheribia albida	44.9
Hyphaene thebaica	32.4
Borassus aethiopium	30.0
Celtis integrifolia	24.9
Lannea fruiticosa	27.5
Kigelia africana	20.0

Crateva adansonii	20.0
Stereospermum kunthianum	49.9
Grewia tenax	22.5
Oxytenanthera abyssinica	24.9
Acacia tortilis	52.5
Acacia ehrenbergiana	27.5
Guiera senegalensis	22.5
Boscia angustifolia	22.5

3. Production, Processing and Marketing NWFPs

Most of the NWFP are collected from natural forests and forest reserves. Some of the NWFPs such as gum Arabic are also collected from farm gum gardens or natural stands which are owned by producers. Henna (*Lawsonia inermis*) is also a farm product from the Nile and Northern states of the Sudan.

The most important trees that are widely utilized by local communities for domestic consumption and for sale include:- *Balanites aegyptiaca* (Higlig), Ziziphes spina Christi (Sidir), *Hyphaene thebeica* (Dom), *Adansonia digitata* (Tabaldi), *Tamarindus indica* (Aradieib), *Acacia nilotica* (Sunut) and *Grewia tenax* (Godeim).

The quantities of fruits collected from these species vary with the stocking density and the number of households working on forest fruit collection. On the whole, an estimated 2.5% of the total households in rural areas are engaged in collection of forest fruits. In the Blue Nile State the highest percentage (3.4%) households involved in the collection of forests reside at Bao and Wad Abok in the Angasana mountains. In this major producing State, the highest per household production of Garad (*A. nilotica*) was obtained from the area North of Damazin (State's capital). Lalob (*B. aegyptiaca*) is mainly produced (12.1 sack/house hold) in the western and south western part of Damazin area. On the other hand, the area south of Damazin is famous in dom (*H. thibeica*) production (7.6 sack/hh).

4. System of Production

NWFPs are usually collected/harvested as off-farm activities e.g after crop harvest. Fruits and seeds are visually collected starting from January on – wards while Gum Arabic and gum olibanum which are tapped between October and November, depending on prevailing rain fall.

Large scale production of gums is practiced in the eastern Nuba Mountains in South Kordofan and in the Blue Nile, where the tappers tap the gum trees on share-cropping basis.

The wholesalers buy the raw gum or other products and pay according to observed quality judged from own experience. For gum arabic, gum talha, gum olibanum among others the produce is graded according to marked standards e.g Hand-picked selected (HPS), clear, broken nodules "Gassa" , dust among others… Some quality indicators according to Sulieman and Eldoma (1994) are summarized in Table 4.

5. Production of Resin *Boswellia paprifera*

Boswellia paprifera is tapped using a traditional tool known as "Mingaf" which has a blade that is used to remove a 3×3cm, or more, area of the tree bark so as to stimulate oozing of the resin. The process of tapping and collection are traditionally carried out by local producers or by experienced tappers from eastern Sudan, who work on share-cropping basis. The key players in production and marketing of gum olibanum are the producers or tappers, the local traders, forestry and gum arabic research institutions and the Forests National Corporation (FNC), which own the reserved forests. FNC charges the resin traders certain fees or royalties against traded quantities of the produce. Most of the local merchants are agents for exporters who sell the product to importing and processing companies in Europe and the Middle East.

Quality standards for marketable resin are set by local merchants, who hire experienced labor for cleaning the resin from impurities e.g bark, wood among others… and sort the resin nodules into high quality grades for export and other inferior grades for local markets.

There is lack of information regarding the actual production of resin from *Boswellia papyrifera*. However, the total production is estimated at 3000 tons as in previous Table 6. The average price per ton is SDG 3828.0 (US$ 1387).

Table 4. Quality specifications of NWFP based on local standards

Product	Size	Texture	Color	Condition	Taste	Preference by origin locality
Dom (*Hyphaene thibeica*)	Heavy	Smooth	Reddish			El Dubba and Ubu Hamad
Saaf	Long	Soft	White			Kassala
Lalob (*Balanites aegyptiaca*)	Large			Fresh	Sweet	
Nabag (*Ziziphus spina christi*)	Large			Fresh	Sweet	North Kordofan
Gongolez (*Adansonia digitata*)	Fleshy		White	Fresh	Sour	Western Sudan
Godiem (*Grewia tenax*)	Small size		Shiny red	Fresh	sweet	Kordofan/ Darfur
Aradeib (*Tamarindus indica*)					Sour (tasty) then big size	
Garad (*Acacia nilotica*)				Less infested by insects		
Senameca (*Cassia senna*)				Pure		
Henna (*Lawsonia*)						Damar

6. Main NWFPs Producing States

Sulieman and Elduma (1994) estimated the quantities of NWFPs in the Northern part of Sudan excluding the South; their estimate was based on market surveys conducted in 1993/94 season (Table 5). From this table it is clear that Gongolez (fruit of *Adansonia digitata*) and the tannin product (Garad) produced in quite a large number of states. Kordofan and Darfur are famous of Aradeb (fruit of *Tamarindus indica*) and Godiem (*Grewia tenax*). However, senamecca (*Cassia senna*) is only produced in Kordofan, while the River Nile State is a major producer of Henna (*Lawsonia inermis)*.

Table 5. Quantities of NWFPs, and main producing States, Marketed in 1993/94

Product	Total (Ton)	Main producing states/area
Dom	1820	Darfur, Eastern and Northern Sudan
Lalob	8940.24	Dafur, Blue Nile, Kordofan and Eastern Sudan
Loban	1667.644	Kordofan, Blue Nile and Darfur
Garad	244.56	Blue Nile, Kordofan, Eastern and Northern Sudan
Gongolez	9623.25	Dafur and, Kordofan, Blue Nile, Sinnar and Eastern Sudan
Aradeib	19252.17	Darfur and Kordofan
Nabag	7001.82	Kordofan, Darfur and Central Sudan
Gudiem	294.53	Darfur and Kordofan
Senamaca	888.89	Kordofan
Henna	2888.90	River Nile

7. Consumption of NWFPs and Value of products

Total consumption of selected NWFP in the different regions' states as estimated from market demand are presented in Table 6. From this table it is clear that with the exception of Garad (tannin), Khartoum consumes most of the NWFPs. About one third of the NWFPs are usually transported from the production centers in the different states to Umdurman Market in Khartoum State. More than 40% of Laloub and Aradeib fruits are consumed in Khartoum State, which constitute 18.5% of Sudan's population (39 million) or 23.3% after the South independence.

Table 6. Consumption (Tons) and trade value of selected NWFPs in the Sudan

Product	Khartoum State (Ton)	Other States (Ton)	Total (Ton)	% Khartoum State	Price/ton	Trade value million SDG	Us Dollar million
Dom	650.0	1170.0	1764.0	36.8	384.6	0.68	0.23
Laloub	4000.0	4880.0	8880.0	45.0	625	5.55	1.90
Loban	2000.0	1000.0	3000.0	66.7	2125	6.38	2.20
Garad	60.0	184.8	244.8	24.5	1666.7	0.41	0.14
Gongolez	3500.0	6125.0	9625.0	36.4	2714.3	26.13	9.00
Aradeib	7875.0	1365.2	19240.2	40.9	1587.3	30.54	10.53
Nabag	2753.0	4246.2	6999.3	39.3	873	6.11	2.11
Godiem	46.2	150.5	196.7	23.5	8333.3	1.64	0.57

Gum Arabic	47000.0	5287.5	249.51	85.70
Cassia senna	888.9	4785	4.25	1.47
Henna	2889.0		26.00	9.00
		Total	**357.2**	**122.85**

Note: *Gum Arabic, Cassia senna* and Henna are mainly for export
1Dollar = 2.9 SDG

d. Economic Contribution of NWFP

1. Types of Markets

The markets of gum ababic are classified as central or city markets such as El Obeid Auction market in North Kordofan State, Gedarif market (Eastern Sudan), Sennar, Nyala (Darfur) and Damazin (Blue Nile); urban markets found in small towns and rural markets, which are situated in rural areas.

Elobeid Crops Market, established in 1905 for all agricultural crops, is the biggest market for gum Arabic in Sudan with an auction hall since 1930. The market is technically administered by the Ministry of Finance and Economy, North Kordofan State whereas, the market assets and manpower structure is managed by executive officers from Sheikan Locality. The stakeholders in the market include merchants and their agents, producers, Gum Arabic Company (GAC), processing companies and executive authority related to market daily work.

This market and the other urban and rural markets are managed according to state regulations and laws. At the level of the main markets at each locality, the commissioner is the head of the market board and the market director in addition to membership of merchants and producers' representatives, a member from Sudanese corporation of quality control and standards, economic security and the executive administration of the market.

2. Markets Infrastructures and services

Elobeid crops market is situated in the centre of the city in an area of 18324 m^2. It consists of different specialized sections, an information office, main auction hall, executive authority offices, electronic and conventional balances, and a nursery. Besides, other offices are allotted for representatives of *Zakat*, taxes and duties, corporation for standards and quality control, merchants and producers agents. Basic services of water and power are available in addition to security elements to protect crops and assets inside the market.

8. Gum Arabic Quantities and price trends

Since the 1970s drought years, Sudan's gum arabic production has decreased from 45000 tons in the 1960s through 28000 in the 1980's to 30000 tons presently. In 1984 and 1985, when drought struck the region production fell to an all time low of less than 12000. of The average

production was less than 20000 tons in the 1990s and 2000s. The trends of quantities of gum arabic were presented for the main centres of production viz. ElObeid, South Kordofan and Gedarif (Table 7 - 10). The average prices of the commodities were also shown. The trend of gum arabic quantities received at Elobeid Crops Market showed a fluctuating and declining trend. The highest production (>10000 tons) were obtained in 1995, 2006 and 2007. The lowest record was in 2008. A similar trend but with lower production levels was observed at El Gedarif were the year 1995 gave higher production level. The years 2006 and 2007, gave higher levels (>1000 tons) after a sharp drop to less than 500 tons for a number of years.

In South Kordofan, productive natural stands of Hashab occur on clay, gardud and sandy soils in the State. Gum production in North-west Dilling and Kadogli was high in 2005 where vast stands exist. However, in south of Kadogli towards upper Nile, despite the high stocking of Hashab (*Acacia senegal*), the production is variable depending on soil drainage as water logging is detrimental to production. In Rashad and Abu Gibaiha localities, there are extensive stands of Hashab and other gum producing species such as *Acacia polycantha* and *Acacia seyal*. Forty percent of the farmers were found to own Hashab (*Acacia senegal*) gardens. There are also some plantations established by FNC and local communities.

Women participate in collection of gum arabic besides their assistance in Hashab tree planting. The total supply (in 2007) at Abu karshola, Moreib and Al Faid in South Kordofan was 62.2, 14.2 and 10.0 tons as in Table 9, respectively. The production of Frankensence (*Boswellia papyrifera*) was more than 200 tons at Abu karshola. Kakamut gum (*Acacia polycantha*) production at Al faid was about 36 tons. However, Tartar or karaya gum (*Sterculia satigera*) supplies at Moreib and Al Faid were approximately 39 and 11 tons, respectively. These gums fetch an estimated SDG 675.00 – 1350.0 per ton.

In the case of Blue Nile, the production of gum Arabic (*Acacia senegal*) was over 3000 tons and similarly for gum 'talga' from *Acacia seyal.* The production of gum olibanum (*Boswellia papyrifera*) and kakamot (*Acacia polycantha*) were 624 and 543 tons, respectively (Table 10).

Table 7. Gum Arabic supplies: El Gadarif Crop Market

Years	Quantity	
	Kintar	Ton
78/79	74639	3317.3
79/80	61528	2734.6
83/84	82191	3652.9
84/85	31857	1415.9
85/86	28746	1277.6
86/87	26254	1166.8
87/88	20371	905.4
88/89	78946	3508.7
89/90	60725	2698.9
90/91	28450	1264.4
91/92	6804	302.4

92/93	23076	1025.6
93/94	46781	2079.2
94/95	89997	3999.9
95/96	84123	3738.8
96/97	46416	2062.9
97/98	28208	1253.7
1999	28208	1253.7
00/01	9544	424.2
01/02	10466	465.2
02/03	9182	408.1
03/04	9593	426.4
04/05	12270	545.3
05/06	23353	1037.9
06/07	24651	1095.6
07/08	2178	96.8
08/09	10670	474.2

1 Kintar = 44.4 kg

Table 8. Gum Arabic supplies: El Obeid Crop Market

Years	Quantity	
	Kintar	Ton
94/95	46021	2045.4
95/96	230733	10254.8
96/97	71271	3167.6
97/98	33785	1501.6
98/99	28334	1259.3
2000	23730	1054.7
2001	142906	6351.4
2002	159605	7093.6
2003	133074	5914.4
2004	184693	8208.6
2005	27687	1230.5
2006	340087	15115.0
2007	259398	11528.8
2008	17824	792.2
2009	188009	8356.0
2010 till April	1898	84.4

1 Kintar = 44.4 kg

Table 9. Gums (tons) supplies in selected markets in South Kordofan in 2007 season.

Gum/Resin	Market			Unit Price (SDG/ton)
	Abu Karshola	Moreib	AL Faid	
Gum Arabic	62.2	14.2	10.0	1350.00
Gum Olibanum*	213.3	1.8	35.6	1125.00
Kakamut (*Acacia polycantha*)	-	-	35.6	675.00
Tartar (*Sterculia satigera*)	-	39.1	10.7	1350.00

***** Or frankincense from *Boswellia papyrifera*.

- Not available

Table 10. Market supplies and prices of NWFPs at the Blue Nile States' capital market (Damazin) for 2010.

Product	Quantity (Ton)	Average Price (SDG/ton)	Total Value (SDG)
Dom (*H. thibeica*)	7.215	18.75	135.3
Gongolez (*A. digitata*)	230.08	180	41414.4
Aradeib (*T. indica*)	5.796	90	521.6
Gum Arabic (*A. senegal*)	3332.32	162.5	541502
Gum Talha (*A. seyal*)	3652.32	130	474801.6
Kakamut Gum (*A. polycantha*)	543.36	127.5	69278.4
Loban (*B. papyrifera*)	624.08	135	84250.8
Total			**1211904.1**

The production and export trends of gum arabic are shown in figures 3 and 4, respectively. Gum Arabic supplies at El Obeid crop market are given in figure 5.

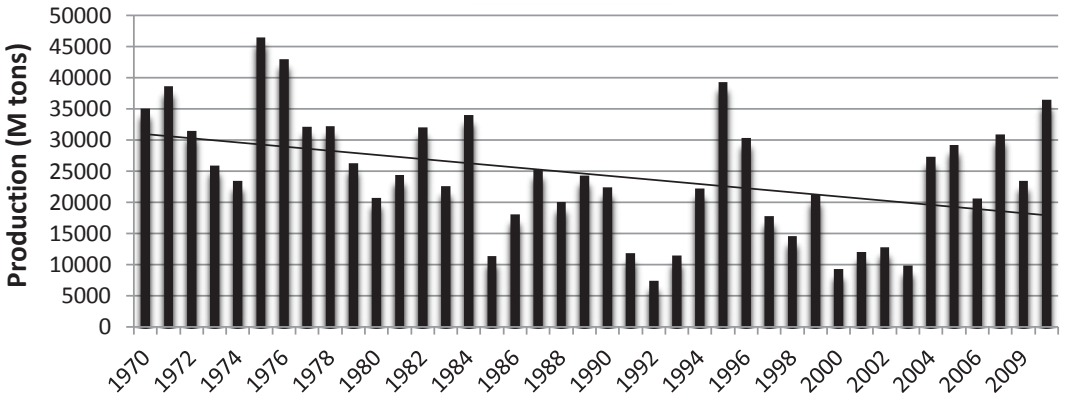

Figure 3. Gum Arabic production trend 1970-2010

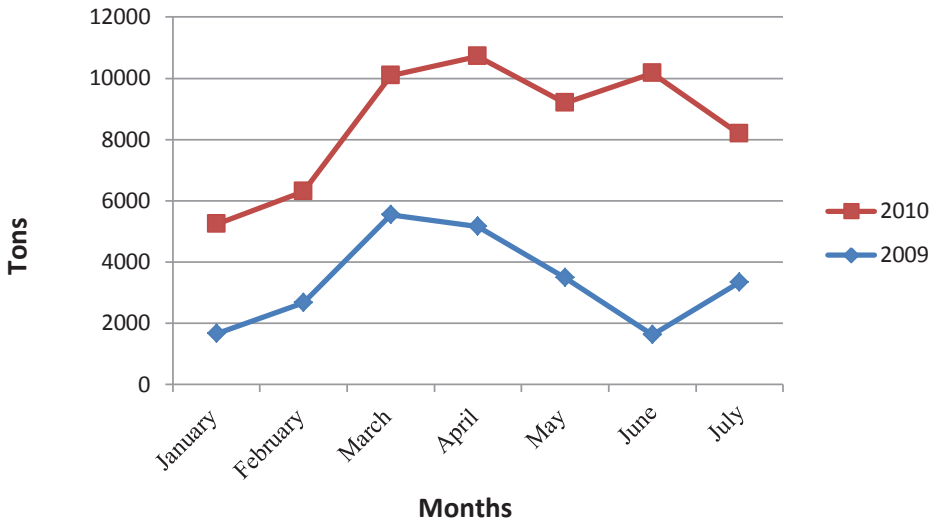

Figure 4. Gum export for the years 2009 and 2010

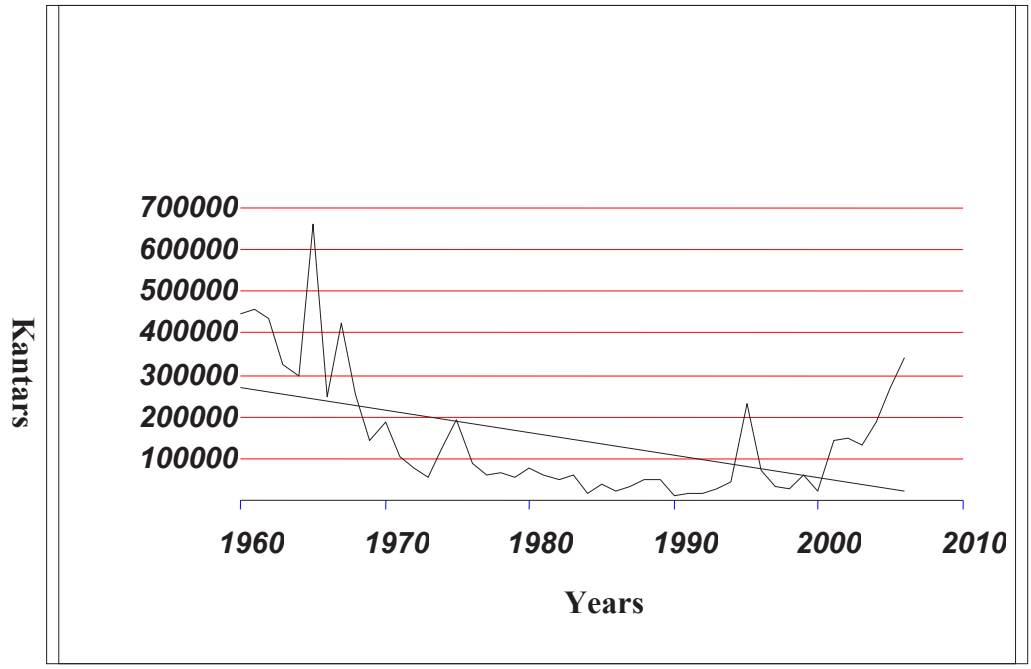

Figure 5 . Gum arabic received at Elobeid crop market (1960-2006)

The Sudan's gum exports declined from around 50000 Metric tons in 1950s and 1960s to around 350000 MT in 1970s to 30000MT in 1980s – 1990s. Exports increased to 50000 MT in 2000.

The price trends are not steady and there was a 65% drop in the price between 2005/06 and the 2009/10 at Gedaref market in Eastern Sudan (figure 6). The prices (US$ equivalent) at El Obeid crop market were also fluctuating, the highest prices obtained during the 1980s (Figure 7). The marketing channels for gum arabic from the production to exportation are shown in Figure 8.

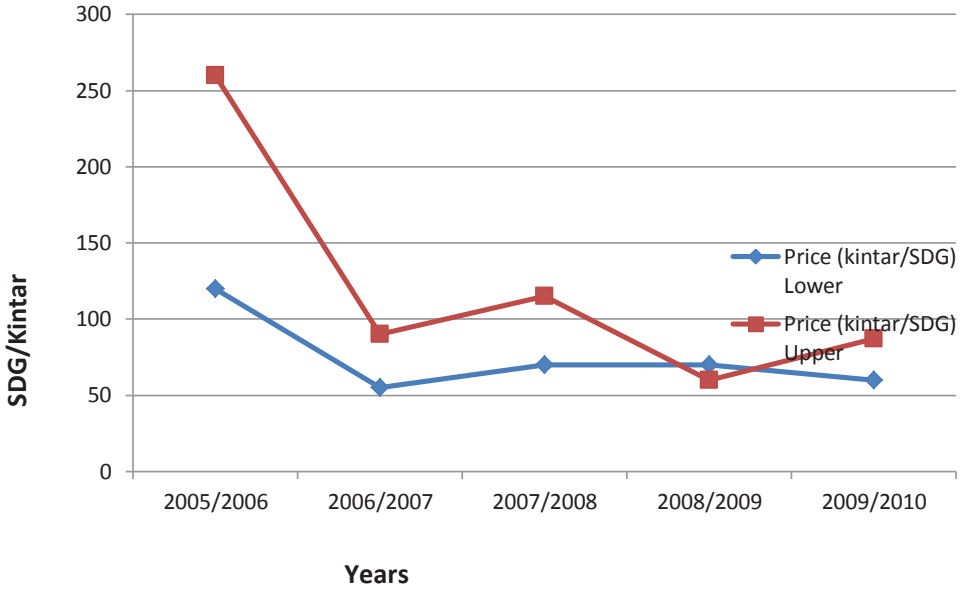

Figure 6 . Gum arabic price trend at Gadarif market (Eastern Sudan)

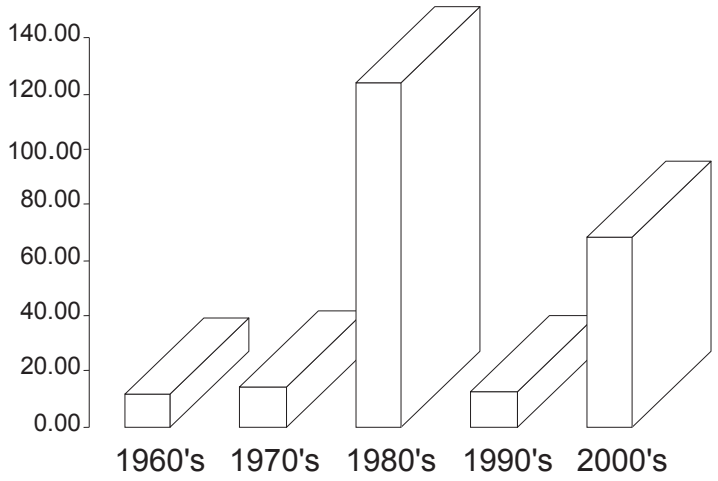

Figure 7 . Equivalent gum arabic prices in US$ per *kintar* (1960-2006).
1 *kintar* = 44.4 kg

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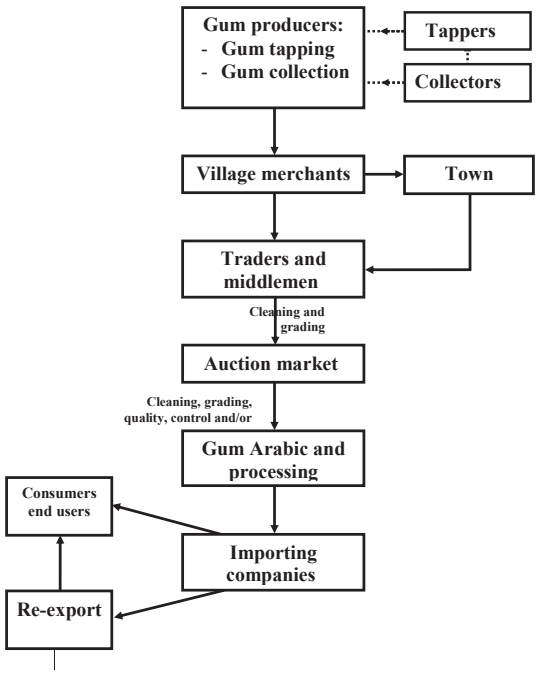

Figure 8. Gum Arabic marketing channels[35]

9. Pricing mechanisms and taxes

The price mechanism for gum arabic was dependent on a minimum floor price set by the government based on the estimated export prices to protect producers. However, recently the minimum floor price was abolished due to liberalization policies. The market's fees against provided services have been imposed by the state authority to compensate for the taxes and fees on agricultural products abolished by the federal government. In addition to taxes and fees of federal nature, there are other taxes on the level of state and localities which constitute duplication of taxes on the same crop. Moreover, there are additional fees imposed by the ministry of foreign trade on export crops.

10. NWFPs Markets

Market surveys showed that there were no separate markets that are specialized in forest products. However, there is always a special display of non- wood products within each of the crop markets at Abu Hamad and ElDubba (Northeren State). There are two types of markets. There namely town and village markets. The important town markets are Roseiris, Damazin and Bot, in the Blue Nile, El Obeid (North Kordofan), Kadogli, Abu Gibeiha, Moreb and Rashad (South Kordofan), Nayala, El Fashir (Darfur), Gedarif and Hawata (Eastern Sudan). These markets are made of mud or brick buildings and have some storage facilities.

In contrast, the village markets are weekly markets that are built with local materials. However in both types of markets, the forest products are displayed on the ground.

Due to the barely passable roads and the difficult landscape, the transport of products from the production centers to the market is mainly by donkeys. On the other hand, the transport of products to town markets and to Khartoum State is by trucks through rough roads. Many authors have has emphasized the scarcity of reliable quantitative data and information regarding production and marketing of non-wood forest products. This is in spite of their well known and acknowledged role in improving the livelihoods of local communities. In addition to their food, fodder, medicinal and cosmetic values, these products contribute significantly to the income of producers, merchants and traders in production and consumption centers.

11. NWFPs Marketing Channels

NWFPs are harvested from the natural forests by so-called collectors or producers in small quantities packed in jute or plastic bags. Some of the producers (male and female) carry their produce to the village market manually by hand and some use donkeys, camel or cart driven by donkeys or horses. Village merchants or middlemen buy the products from the producers after inspection and repacking if necessary, before they transport the NWFPs to wholesalers in big towns e.g El Obeid (North Kordofan), Kadugli (South Kordofan), Damazin (Blue Nile), Gedaref and Kassala (Eastern Sudan), Nyala (Darfur) and El Damur (Northern States). The village or small town's buyers are mostly agents for the big towns' traders. The products are then distributed to retailers and some of the export products are exported by the traders or companies to foreign markets. The marketing chain is presented in Figure 9.

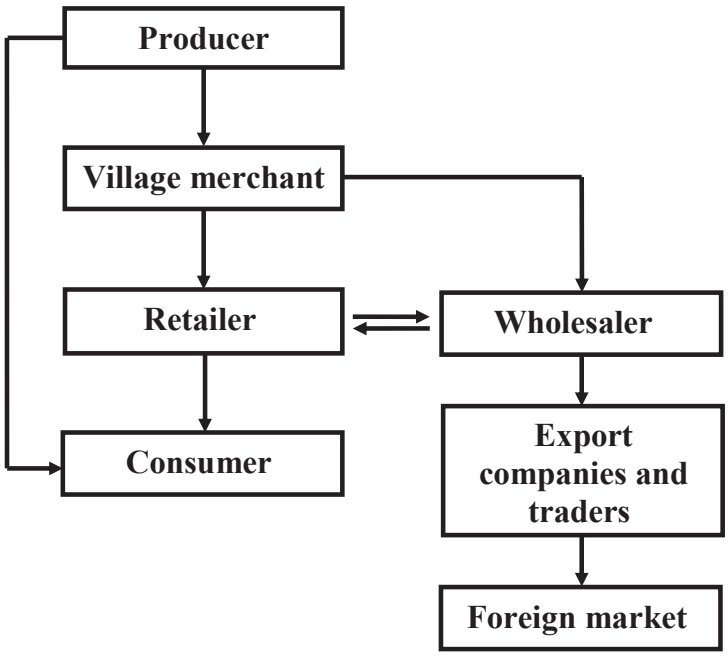

Figure 9. Marketing channels of NWFPs other than gum arabic (adapted from Sulieman and Eldoma, 1994)

12. Forest Fruits

There is a wide diversity of forests fruits which are used for various purposes. These include: Lalob (*Balanites aegyptiaca*), Gongolez (*Adansonia digitata*), Godeim (*Grewia tenax*), Nabag (*Ziziphus spina-christi*), Dom (*Hyphaene thebeica*), Aradeb (*Tamarindus indica*), Kirkir, Daleb (*Borassus aethiopium*) and various minor fruits. In south Kordofan, e.g over 60% of the people utilize Lalob, Gongolez, Godeim, Nabag and Aradeb fruit (Table 11). Other important minor fruits such as Dalib (*Borassus aethiopium*), Dom (*Hyphaene thebaica*), Om togolgol, Medeika (*Ximenia americana*), Kirkir, oil and medicinal fruits are also used as food or medicine. These products are found in varying amounts (0.4 -3.7 sacks) in every house. However, the majority of people in rural areas collect forest fruits from nearby forests (Table 12).

The various uses of the different tree species as fruits, bark, gums, forage and antiques are presented in table 13. From this table it is clear that more than 70% of the local people use the fruits of *Balanites aegyptiaca* (78.7%), *Tamarindus indica* (78.8%), *Adansonia digitata* (72.5%), *Ziziphus spina-christi* (80.0%), *Diospyrus mespilformis* (75.0%), *Ximenia Americana* (76.2%), *Ficus sycomorus* (72.5%), *Sclerocarya birrea* (73.7%), *Grewia tenax* (76.2%) and *Acacia tortilis* (90.0%). The amount and percentage consumption by the local producers is shown in table 14, which shows that between 5 – 18% of the amount collected in consumed. The food value i.e. carbohydrates, proteins and oil were given by Abdelmoti (2006) as shown in Annex 2. Further information was documented by Talaat (2001).

The bark of *Tamarindus indica, Adansonia digitata* and *Ziziphus spina-christi* is mostly used for making ropes or as medicine. In South Kordofan there are also different gums producing tree species. However, only few of them, namely *Acacia senegal, Acacia seyal*, and *Acacia polycantha* are well known to the farmers.

Table 11. Percentage use of non-wood forest products from main trees in South Kordofan (based on local peoples' views).

Species	Fruits and seeds	Bark	Gum	Forage	Antiques
	%				
Balanites aegyptiaca	78.7	47.5	0.0	67.0	60.0
Tamarindus indica	78.8	67.5	0.0	65.0	65.0
Adansonia digitata	72.5	72.5	0.0	65.0	62.5
Ziziphus spina-christi	80.0	60.0	0.0	62.5	67.5
Diospyrus mespilformis	75.0	45.0	0.0	62.5	65.0
Vangueria madagascariensis (Kirkir)	73.7	37.5	0.0	60.0	60.0
Ximenia americana	76.2	40.0	0.0	55.0	60.0
Ficus sycomorus	72.5	40.0	0.0	55.0	60.0
Sclerocarya birrea	73.7	40.0	0.0	60.0	57.5
Grewia mollis	32.5	37.5	0.0	62.5	60.0
Combretum hartmannianum	15.0	46.2	0.0	0.0	65.0
Albizzia sericocephala	17.5	40.0	0.0	37.5	62.5
Dichrostachys cinerea	15.0	42.5	30.0	62.5	62.5
Acacia senegal	17.5	47.5	77.5	62.5	52.5
Acacia polycantha	15.0	47.5	55.0	47.5	60.0
Acacia seyal	15.0	47.5	62.5	52.5	62.5
Commiphora africana	41.2	35.0	0.0	52.5	70.0
Acacia gerrardii	17.5	35.0	0.0	50.0	57.5
Combretum aculeatum	10.0	38.0	47.0	50.0	62.5
Acacia nilotica	16.2	42.5	0.0	57.5	62.5
Dalbergia melanoxylon	0.0	20.0	0.0	47.5	66.2
Prosopis africana	0.0	0.0	0.0	45.0	55.0
Cordia africana	10.0	0.0	0.0	42.5	85.0
Faidheribia albida	10.0	35.0	35.0	48.5	57.5
Hyphaene thebaica	37.5	0.0	0.0	48.5	57.5
Borassus aethiopium	40.0	0.0	0.0	45.0	60.0
Celtis integrifolia	20.0	0.0	0.0	42.5	55.0
Grewia tenax	76.2	.37.5	0.0	40.0	55.0
Acacia tortilis	90.0	37.5	0.0	47.5	62.5

Table 12. Domestic Use of Forest Fruits by local Communities (%) in South Kordofan

Fruit/species	Usage % Collected	Source %	
		Market	
Nabag (*Ziziphus spina-christi*)	70.0	72.5	27.5
Lalob (*Balanites aegyptiaca*)	70.0	77.5	22.5
Gongolais (*Adansonia digitata*)	62.5	80.0	20.0
Aradeb (*Tamarindus indica*)	67.5	47.5	52.5
Um togolgol	42.5	80.0	20.0
Midaika (*Ximenia americana*)	47.5	82.5	17.5
Godeim (*Grewia tenax*)	40.0	80.0	20.0
Daleib (*Borassus aethiopium*)	32.5	85.0	15.0
Dom (*Hyphaene thebaica*)	42.5	75.0	25.0
Oil fruits	32.5	81.2	18.8
Medicinal fruits	32.5	56.3	42.5

Table 13. Part (s) of tree (s) used as food and/or medicine (Percentages based on views of local people) in South Kordofan.

Species	Part (s) used				Type of use (%)			
	Leaves	Fruit	Bark	More than one part	Food	Beverage	Medicine	Multiple uses
Adaonsonia digitata	✓	✓	✓	✓	20	12.5	7.5	60.0
Tamarindus indica	✓	✓	✓	✓	7.5	12.5	2.5	77.5
Balanites aegyptiaca	✓	✓	✓	✓	10.0	5.0	17.5	67.5
Guiera senegalensis	✓	✓		✓	2.5	5.0	20.0	72.5
Acacia senegal	----				5.0	12.5	16.3	76.3
Acacia seyal	✓	✓	✓	✓	7.5	18.8	18.8	55.0
Ziziphus spina-christi	✓	✓	✓	✓	50.0	22.5	12.5	10.0
Acacia nilotica	✓	✓			0.0	0.0	100.0	0.0

* Scientific name not known

Table 14. Domestic use of selected non-wood products in relation to amount collected – totals production of 12 villages in Blue Nile State

Type of product	Total collected (kg)	Amount consumed	% Consumption
Gongolez	64442.0	3500	5.431240495
Aradeib	138045.6	6930	5.020080321
Lalob	456848	69200	15.14726999
Dom	236658.5	29575	12.4969101
Nabag	199993.5	37170	18.58560403
Godem	531657	82740	15.5626654
Garad	35168.4	3516	9.997611492

13. Bee products (Honey)

Honey is widely produced by local people in Kordofan, Darfur, Blue Nile and Eastern Sudan. In south Kordofan, the bulk of the product is produced at Al Faid area (Kaloba, Kloro, Al Faid, Abu Odam, Hallofa), Habila area, Moreib, Kadogli, Talodi, Kalogi, Leeri and many other areas. For instance, the supply to Al Fiad and Moreib in one market day during the season is about 55-60 and 90–180 pounds, respectively. The production is very traditional with little or no safety precautions and/or hygiene. The use of fire to repel the bees is very destructive to forest fauna and flora, and insects. It is therefore of paramount importance to improve honey production as one of the economic activities in South Kordofan and other producing areas in the Sudan.

14. Medicinal Uses of Trees

Leaves, gums, fruits and bark of many tree species e.g. *Adaonsonia digitata, Tamarindus indica, Balanites aegyptiaca, Guiera senegalensis, Acacia senegal, Acacia seyal, Ziziphus spina-christi, Albizzia anthelminthica and Acacia nilotica* are commonly used as medicines to cure a variety of human and animal diseases. The tree species, the part used or the method of use sometimes differs with national grouping (tribe). However, since the use of trees in treating diseases is a source of income to some people, it is difficult to get truthful and accurate figures on this aspect. The different parts of tree species used as medicine were presented earlier in Table 13. Some of the important NWFP that are used for various purposes including medicines for treating some common diseases such as malaria, stomach disorders, rheumatism, toxicity and poisoning, hypertension, heart burn and kidney problems among others are presented in Table 15.

It is important that a biochemical/pharmacological research project be initiated to study the pharmacodynamics of these and other medicinal plants.

Table 15. Multipurpose NWFP of Sudan

Product	Food	Beverage	Fodder	Medicine	Oil	Cosmetic	Perfume	Tannin	Tooth brush	Against evil spirits
Nabag	√	√		√**W**						
Dom	√		√	√**U,D, BP**						
Daleib	√			√**W,G,M,BP,L**	√					
Lalob	√									
Gimbil	√		√							
Jughjagh	√									
Gum Olibanum	√						√			√
Abu liela	√									
Henna						√				
Um dika	√									
Arak									√	
Godiem		√		√**A**						
Gongolez	√	√		**M,S,Da**						
Aradeib	√	√		√**L**						
Garad	√			√**C,T**						
Senameca				√**L**						

W: worms; G: Gardiasis; M: Malaria; C: Cold; T: Tonsillitis; L: Laxative; S: Stomach pain; U: Urinary tract infection; Da: Diarrhea; A: Anemia; D: Diabetic; BP: Blood Pressure

15. Recreational Uses of Trees

There are a number of forests that have a high potential value for recreation because of their outstanding natural beauty as a result of their biodiversity in tree/plant species, wildlife, birds, insects among others… Some of these areas can also serve other function such as scientific, research and teaching some of the special characteristics and features of the proposed sites and their conservation as given in Table 16.

With respect to soil and water management, the farmers in the Nuba Mountains in South Kordofan State have realized the negative impact of the clearing vegetation from the steep slopes on accelerating water runoff and transporting the fertile soil down the slopes. Consequently, the local farmers have established series of terraces with the objective slowing down water run-off to improve crop production. In addition the farmers retain trees establishment from the seeds washed from higher elevations along the terraces.

Table 16. Areas or Sites Suggested for Recreation and Conservation Purposes in South Kordofan.

Suggested area or site	Location	Special features
Abu Habil View at Dilling	Dilling	View of up stream water shed with diverse tree cover.
Migrih	Rashad	Superb landscape.
Kolloro Mountains	between Rashad and Al Faid	Superb landscape
Miri Gowa (Migrih and Goghob)	Kadogli	Wonderful landscape, wildlife refuge.
Lake Kailak	South west Kadogli	Water reservoir
Khor Addaleib (Doshol area)	Between Dilling and Kadogli	Beautiful landscape, various wildlife species.

Katsha	S. Kadogli	Beautiful landscape; Diverse Overstory /understory and wildlife.
Sallara	Dilling	Landscape, folklore.
Um Dowal	Talodi	Water reservoir.
Korondi Reserved Forest	Talodi	Diverse plants, lots of wildlife species, birds, insect, honey bees among others…
Alleeri (Gharb and sharg)	Talodi	Diverse plants, wildlife, birds, insect, honey bees.

16. Role of Trees and NWFP in Social Beliefs

Various tree species in different areas in Sudan constitute an important component in social beliefs. Some of the trees are believed to bring good luck while others are believed to bring bad luck. However, it is important to note that the local people are reluctant to mention the species, which have some magic effects because they believe that there are some evil effects associated with those tree species. Accordingly, the percentages of those who openly acknowledge or confess that they believe on magic effects or supernatural powers of trees is very low.

17. Forests Reserves

The national forests policy 1986 emphasized the importance of easing the process of reservation and registration of forests. The policy aimed at setting 20% of the countries' total area as reserved forests to serve protective and productive functions in view of erosion, drought and desertification, which are among the major problems facing the Sudan. In addition to this policy, the overall national strategic plan 1992 -2002 stated that 25% of the countries' area should be reserved under natural resources, of which the forests constitute the backbone. According to Table 17 the area of forest reserves in the country is approximating 25.3 million feddans (10.63 million ha).

Table 17. Total forest reserves in the Sudan

Status	**Number**	**Area**	
		Million Fadden	**Million Hectare**
Reserved forests	3225	25.13	10.63
Proposed reserves/year	-	6.5	2.73

FNC records 2011

18. New Products

i. **The Tea Tree (*Feretia apodanthera* Del.) in Eastern Nuba Mountains**

The natural tea tree occurs along seasonal water courses at 550-900 Alt. between latitudes 11° 27′ 19″ - 12° 09′ 48″ N and longitudes 31° 02′ 14″ – 31° 28′ 19″ E., in the eastern Nuba mountains. The tree covers vast areas at Rashad and Abu Gibaiha localities. The local people at Balola and

Al Biteira have identified and used this tree for the production of tea since 1947. However, commercial production was started in 1990 and stopped by local government authorities with the objective of testing its safety for human consumption. In 2004 a study was conducted by a multidisciplinary team to identify the tree, its geographic location, the safety of the tea produced and the economics of its production. The study described the tree, its ecology, possible domestication and the chemistry of the tea produced. It was found that there are vast natural stands of the tree that needed to be managed and improved. Biochemical analysis revealed that the leaves contain caffeine (1.6 - 2%), which is within the same range as tea (1-5%). However, recommending use of this tree for production of tea for human consumption requires that the volatile oils be determined using stem distillation immediately after picking the leaves. Further research is needed to explain other values of this tree as is believed to prevent malaria.

e. Roles of Some Key Players

Key players in NWFPs production, marketing, processing, exports, research and development among others…are listed in Annex 3. However, some of the roles played by some of them were highlighted below:

1. Roles of the Forests National Corporation (FNC)

The main activities of Forest management for NWFP by FNC is listed below, while some of the activities are further detailed;

1. Protection of natural forests.
2. Seed procurement, distribution to beneficiaries and storage.
3. Establishment of nurseries.
4. Afforestation (formal and community approaches).
5. Silvicultural operations.
6. Production of firewood, round wood and sawn timber.
7. Inventory of gum producing species.
8. Extension to raise environmental awareness and to conserve the environment.
9. Training local communities on sustainable management of gum producing species.
10. Rehabilitation of areas clear-felled by petroleum companies.
11. Activate and control collection of fees on forest products.
12. Execute the order number 345 stating that 10% of mechanized agricultural schemes should be under tree belts.
13. Increase number and area of forest reserves.
14. Supervision of gum producers' cooperatives.

2. Seed Collection and Nursery Activities

Some of the tree seed collection is carried out by Forests National Corporation (FNC) with very limited support from the local communities. The bulk of forest seeds are collected, processed and certified by the Tree Seed Centre under the Forestry Research Centre. The most commonly collected seeds are those of *Acacia senegal*, *Acacia mellifera*, *Acacia polycantha*, *Balanites aegyptiaca*, *Khaya senegalensis*, *Adansonia digitata*, *Terminalia laxiflora* and *Oxytenanthera abyssinica*. However, seed collection by local communities focused on *Acacia senegal*, *Hyphaene thebeca* and *Borasus aethiopium* for sowing on their fields is widely practiced. Seedlings are

mainly produced in central nurseries in big towns such as Diling, kadogli and Abu Gibaiha to supply small or flying nurseries in small towns and villages. There are extension nurseries for the production of fruit, shade and ornamental trees needed by local communities. Surveys proved that most farmers and local people have expressed their willingness to establish nurseries for production of *Acacia senegal* seedlings.

3. Formal Afforestation Activities

Most of the afforestation work is carried out by Forests National Corporation (FNC) with some participation by the local and urban communities. *Acacia senegal* constitutes the main focus of this activity, especially on the sandy soils in north. In the last years, a participatory approach was used whereby the farmers were authorized to intercrop groundnut and sesame with *Acacia senegal* inside some of the forest preserve e.g South Kordofan. Similarly, in the eastern Nuba Mountains in Rashad and Abu Gibaiha, Acacia *senegal* is also the target species for afforestation. However, in the South-western parts (Lagawa and Assalam localities) *Acacia senegal, Oxytenanthera abyssinica;* and *Acacia senegal* and *Acacia nilotica* were the target species at the two localities, respectively (Table 18).

4. Extension Activities

The extension activities carried out by FNC focus on distribution of seedlings to local communities with silvicultural management packages; establishment of community forests; social afforestation; afforestation of public and community institutions; distribution of gas cylinders to save wood energy; television and radio-broadcast extension programs; conferences; workshops and field visits, in addition to various annual extension programs during the National and States' Tree Festivals.

5. Role of Local Communities in Establishment, Management and Protection of Forests

Community-owned-registered and managed forests are rare. Only about 10% of the rural populations seem to possess community forests in their respective villages/areas. However, the role of local communities in tree planting is depicted in collection of tree seeds and planting them inside their houses.

Traditional practices, rule, legislation and/or directives supportive of forests protection have been practiced by the local communities. For instance, those who break the laws e.g. illegal tree cutting are punished or penalized according to local people's regulations and traditions. The enforcement of the law is largely dependent on the authority of the local administration or the degree of respect they get from members of the community. However, only about 2.5% of the communities construct fire breaks. It is now formally acknowledged that communities have a important role to play in the establishment and maintenance of forests.

Table 18. Average Annual Seedlings Raised in Nurseries for Afforestation by FNC (e.g. South Kordofan State).

Forest circle	Nursery	Number of seedlings	Species
Dilling	Nabag	88000	Mainly *Acacia senegal*, shade trees and ornamentals e.g. *Azadirachta indica, Delonix rigia,*
Lagawa	Kailak	64453	Mainly *Acacia senegal* and *Oxytenanthera abyssinica*.
Talodi	Talodi	5652	Mainly *Acacia senegal,Tectona grandis,Oxytenanthera abysinica, Khaya senegalensis* and ornamentals.
Abu Gibaiha	Abu Gibaiha	5120	*Mainly Acacia senegal Ficus spp., Cassia siamia, Albizzia lebbek, Azadirachta indica, Khaya senegalensis and Grewia tenax.*
Abyai	Almoglad	4634	Various species and *Acacia senegal*.
Kadogli	Kadogli -Al Dandor	69135	*Cordia africana, Tectona grandis, Khaya senegalensis* and *Eucalyptus spp*.
Rashad	Rashad	220735	Mainly *Acacia senegal* and *Acacia seyal* (Um Fakarin Forest); *Khaa senegalensis* and *Eucalyptus spp*. (Um Abdalla Foreststst).
Assalam	Tibun, Babanoosa and Fula.	51495	*Acacia senegal* (Tibun Forest) and *Acacia nilotica* (Kaddam Forest).
Total		509224	

Source: Adapted from FNC reports.

h. Research and development

The Forestry Research Centre and the Gum Arabic Research Program both belong to the Agricultural Research Corporation under the Ministry of Agriculture. The general theme of research on forest products and gum arabic focus on the following:

- Assessment of the non wood products for appropriate utilization and their improved utilization to increase national income.
- Improved utilization and processing of non wood products for improving the livelihood of the rural communities.
- Sustainable provision of quality seeds (genetically and physiologically) for forest trees including conservation of biodiversity and forest genetic resources (ex-situ and in-situ).

- Development of practical and feasible propagation technologies and improved packages for afforestation programs.
- Development of management technologies for the degraded dry lands.

  In case of gum/resin, the research focus on ensuring stable and sustainable production of good quality gum arabic while enhancing the environment and promoting other gum/resin producing species and upgrading producers' management skills through research on silvicultural management, tree Improvement, agroforestry, anatomy and research on other gums.

i. Main Problems and Constraints to Sustainable Management of NWFPs

1. General

- Illicit tree cutting for fuelwood and construction.
- Vast clearance of forests for mechanized farming (mainly mono-cropping).
- Dry-seasons' fire.
- Overgrazing.
- Pests and diseases.
- Conflicts over resources' use.
- Insecurity.
- Poor harvest and post-harvest of forests fruits.
- High taxes on forests products.
- Poor marketing infrastructure.
- Lack of improved small scale forest enterprises.
- Lack of /or limited extension.
- Lack of training.
- Loss of traditional knowledge in management of forests and use of their products by young generations.

2. Loss of Biodiversity

Surveys showed that some of the very important tree species such as *Dalbergia melanoxylon, Borassus aethiopium* and *Bombax malbaricum* have disappeared completely from from some of the areas. There are also some important species, which are highly endangered and about to disappear such as: "Fidaila" (97.5%), *Terminalia brownii* (97.5%), *Anogeisus leiocarpus* (95.0%), *Terminalia laxifora* (95.0%). A number of other species are also endangered as can be seen in Table 19. These percentages are based on local peoples' views. It was also found that some species namely *Collatropis procera* and *Boscia senegalensis*, which are indicative of drought and eroded soils, have appeared and colonized vast areas in the sandy areas as due to ecological disturbances. The loss of biodiversity is due to a number of factors: natural and manmade fires; illegal cutting of trees to meet local and market needs; agricultural expansion, grazing by domestic and wild animals, war and tree cutting associated with reconstruction after resettlement after peace in South Kordofan. In this respect, people have mentioned mis-management, fire, agricultural expansion, and war, felling of trees and intensive grazing as the major causes of the disappearance of those species.

Generally, the deterioration of natural forests and the decline in their productivity is due to a number of factors, of which natural and manmade fire and the illegal cutting of trees to meet local and market needs are considered the major causes. The contribution of tree cutting to the deterioration of natural forests ranges from 30 – 60% in some of the villages.

Table 19. Endangered Tree Species (based on farmers'/producer's views).

Endangered species	**%**
Dalbergia melanoxylon	100.0
Vepris nobilis (Fidaila)	97.5
Terminalia brownie	97.5
Anogeisus leiocarpus	95.0
Terminalia laxifora	95.0
Diospyrus mespiliformis	90.0
Borassus aethiopium	100.0
Prosopis africana	85.0
Cordia africana	85.0
Nauclea latifolia "karmadoda"	90.0
Bombax malbaricum	100.0
Pseudocedrela kotshyi	90.0
Ximenia americana	85.0
Sclerocarya birrea	80.0

3. Specific to Gums and Resins

The main constraints to increase production and productivity include:

- Desertification.
- Illicit clearance of Hashab stands.
- Excessive grazing.
- The resource is still wild and untended as was the case in Nuba Mountains.
- Lack of information on sound management of the resources.
- Lack of organized set up for harvesting and NWFP marketing.
- Unreliable market both at the national and international levels.
- Poor market infrastructure e.g. roads in the eastern mountains.
- Low prices for the NWFP product at local markets.
- Lack of acceptable credit conditions for gum production operations.
- Low quality produce.
- The long distances traveled in tapping and collection of gum resins and collection of funds.
- Water shortages and lack of labor.
- Tree cutting in settlement areas, e.g. Miri, after peace agreement.
- Water erosion at Al Faid in the eastern Nuba mountains;

g. Policy and Legal Framework

The forests resources' management, utilization and protection is controlled and organized according to the Sudan's forest policy 1932, which was revised and amended in 1986. A new policy was initiated in 2003 through support from FAO and the final draft was prepared in 2006 but still awaiting approval from the National People's Assembly. The Forests National Corporation (FNC) is governed by the Forests and Renewable Natural Resources Law 2002. The most important national policy and legislation that directly relate to forests resources and products is the liberalization of gum arabic trade and new structure of the Gum Arabic Board and the establishment of a Commodity Council for Forest Products in 2009. In 2009, the Nation People's Assembly approved the Desertification Control Law and the establishment of a National Council for Desertification Control and a National Fund for Desertification Control.

h. Proposed Interventions

Investment Opportunities

1. Small-scale forestry-based enterprises.

A special program should be initiated by the government through FNC to encourage and support investment by the private sector in the following areas:

- Improved collection and processing of forest fruits such as Lalob, Nabag, Aradeb, Gongoleis, Dom, Daleib, Godem among others...
- Improved production of gums and resins.
- Improved honey production e.g. Al Faid, Rashad , Lrrei, Talodi among others…(provision of bee keeping facilities and training).
- Wood-based handicrafts.
- Saaf (Palm leaves) based products.

This requires Introduction of intermediate technology to improve skills in fruit collection and post harvest operations and processing, handcrafts, local furniture, honey collection and purification.

2. Gums and Resins

Improvement of marketing of gums and resins requires:

- Training producers in gum/resin tapping; selection of trees, timing and intensity of tapping; collection e.g. containers, handpicked selection, hygiene; cleaning, grading and quality control.
- Strengthening producers' associations; encouragement of governments and private sector investments; enhancement of value-added processing of gums and resins; to establish market information database on prices, production trends, and international demand.

3. Recreation and Nature Conservation Sites

Establishment of recreational and nature conservation sites at Dilling (Abu Habil View); Rashad (e.g. Migrih); Miri Gowa (e.g Goghob); Kloro Mountains (between Rashad and Al Faid); Lake Kilak among others…(as in previous table). This requires infrastructure e.g. roads, hotels and cottages, and advertisement.

4. Sustainable Development of the Resources: Protection of stands

The sustainable development of the resource requires:

- Training local communities on how to construct fire breaks.
- Control grazing.
- Development of plans for locusts control and IPM strategies and techniques in pest control e.g. use of Neem (*Azadirachta indica*) for control of insect pests at the nursery and field stages.

5. Environmental Conservation and Management

- Conservation of biodiversity and releasing the heavy pressure on some of the tree species; developing an action plan to conserve these species; and to seek ways and means of utilizing the lesser used species.
- Develop watershed management and techniques for soil and water conservation; agroforestry, and alternatives to wood energy.
- Initiate afforestation programs to rehabilitate degraded areas with a special attention to the endangered species and those disappearing from mainly area in the country.
- Establishment and registration of community forests, and encouraging more involvement of the local people in the management and protection of the forests resources based on clear legal rights.

6. Research

- Research is needed in all aspects of silvicultural management of forests.
- Use of a wide range of species in medicines.
- Conservation and utilization of biodiversity.
- Biochemical studies on the natural "tea" tree (*Feretia apodanthera*), its propagation and domestication.

7. Extension and Training

Extension and training programs are important to:

- Train local people on nursery practice, tree establishment and management.
- Promotion of use of alternatives to wood energy for domestic purposes.

A summary of some of the constraint and opportunities for better production and utilization of NWFP are shown in table 20.

Table 20. Constraints, opportunities and possible intervention

Constraints	Opportunities	Possible Interventions
Most of Tree stands of NWFP are wild and unmanaged	Value of NWFP is increasing; Vegetative propagation by cuttings and micro propagation is possible for many species;	Research is needed to improve propagation and management of the tree; research to enhance natural regeneration.

Low yields per unit area from fruits, gums and resins	Improved yields from gums/resins were achieved by trained and skilled producers compared to traditional production systems.	Technology transfer and training of local gum/resin producers is important; strengthening research on forest fruits is important.
Discouraging prices and low producers' share from NWFP's trade.	High demand for certain NWFP e.g. gums/resin; adoption of free market policy.	Strengthening producer capacities e.g technical knowhow, establish marketing groups or association; Provision of credit for gum/resin tapping and collection; encourage , through incentives, value addition e.g. (quality produce) of NWFPs .
Inaccessible and insecure sites	Plantation establishment and domestication of certain NWFP species is possible; comprehensive peace agreement.	Conduct research to domesticate the species and improve production and conservation.
Poor harvest and post-harvest of forests fruits.	There is a growing market demand for NWFP	FNC, FRC and private sector investment on research and development is needed.
High taxes and fees on forests products.	Some taxes waved e.g. case of gum Arabic.	
Poor infrastructure (stores and transport)	There is a notion to improve overall agriculture and forests production in Sudan	The State government should set up a certain % of gum revenue to construct roads and stores
Loss of traditional knowledge in management of forests and use of their products by young generations.	New projects and private sector investment attracted some young generations; Improved technologies are being developed.	Strengthening government institutions (FNC and others) and NGOs to reach all producers and provide incentives for young generations to work on production of NWFPs.
Lack of market information; poor promotion and advertisement.	Policy reform is going on e.g. FNC; GAB; RGPM project; There are a number of producers' associations; exporting private companies; projects such as RGPM	Relevant institutions responsible should establish data base and market information system.
Unclear land tenure and land use.	FNC policy support private ownership of forests (community or individual).	Formulation of policy for land registration; Establish investment maps.

Poor infrastructure (roads, stores, transport facilities among others..); water shortages; poor health and education services.	Roads should be linked to markets and production site and stores set at central areas for gum storage	Part of revenue from NWFPs should be directed to services.
Poverty and lack of funding to small scale NWFP producers.	Some support to income generating activities is provided by local institutions and donors e.g. IFAD, FAO, and World bank among others…	Policy to encourage banks and local and foreign bodies to provide loans; credit or grants.
Illegal cutting of trees for cropping and unauthorized grazing.	Integrating of trees in farming systems; and demarcation of grazing land and livestock corridors and camping areas being implemented.	Authorities should enforce land use policies and laws; and encouragement of tree planting.
Lack of investments in small industries and limited processing.	There are a number of investing private companies (see list of key players).	Government authorities should pave the way for investments in NWFPs and small forest-based enterprises and industries

Selected References

Abdel Bari, E. 1977. Changes in the vegetation of the Sudan with special references to the Savannah zone. Sudan Silva, 3 (22). Sudan Forestry Society and the National Council for Research, Khartoum.

Abdelmoti O. M. S. 2006. Wild plants as food for human (In Arabic). Conference on Wild plants in the Arab World. Ministry of Science and technology.

Abdel Magid, T., and Badi, K. 2002. Forest related traditional knowledge (in Arabic). Unpublished paper.

Abdelmuti, O. M. S. 1991. Biochemical and nutritional evaluation of famine foods of the Sudan. Doctoral dissertation in Biochemistry and Nutrition. Faculty of Agriculture. Khartoum, Sudan: University of Khartoum.

Abdelmuti, O. M. S. 2006. Wild plants for human nutrition (In Arabic). Conference on Wild plants in the Arab World. Ministry of Science and technology.

Abnaof M. O. M. 2002. Economics of non-wood forest products in Blue Nile State. PhD thesis (In Arabic), Sudan University of Science and Technology.

Ahmed, E.A. 1986. Some aspects of dry land afforestation in the Sudan with special reference to *Acacia tortilis* (Forks.) Hayne, *A. senegal* Willd. and *Prosopis chilensis* (Molina) stuntz. Forest Ecology and Management, 16: 209-221.

Ali, A. H. 2005. Yield of gum olibanum (*Boswellia papyrifera*) (Del.) Hochst.) in relation to methods of tapping in South Kordofan. MSc. thesis, university of Kordofan, Sudan.

Awdoua, E.H.M. 1973. Social and economic problems of the gum arabic industry. A thesis submitted for the Degree of Bachelor of Letters, Oxford University.

Badi, K.H.M., Ahmed, A.E. and Bayoumi, M.S. 1989. The Forests of the Sudan, Khartoum.

Ballal, M.E. 1991. *Acacia senegal*: a multi-purpose tree species for arid and semi-arid tropics. M.Sc. University of Wales, UK.

Ballal, M.E. 2006. Traditional knowledge in forest management and use of forest products. Sudanese Social forestry Society, Forests National corporation, Sudan.

Ballal M. E., Talaat, A. and Hamid,A. A. 2008. Forest-related traditional knowledge with emphasis on *Acacia senegal* bush-fallow systems in the Sudan. Special issue on the occasion of: The Joint Meeting of the African Forestry and Wildlife Commission (AFWC) and the Near East Forestry Commission (NEFC). Sudan Silva Vol.X1 (1): 67 –77.

Barbier, E.B. 1990. The economics of controlling degradation: Rehabilitation gum arabic systems in Sudan. London Environmental Centre, International Institute for Environment and Development. London

Bayomi, A.M.S. 1996. General protection of forests – in Arabic version, KhartoumUniversity Press, Sudan.

Catterson, T.M., Gulick, F.A. and Resh, T. 1987. Rethinking forestry strategy in Africa: experience drawn from USAID activities, Desertification Control Bulletin No. 14, UNEP, Nairobi.

Chikamai, B.N. and Kagorrbe, J. 2003. Review and synthesis of on the state of knowledge of *Boswellia* species and commercialization of frannkinscense in the dry land of Eastern Africa. Country report of Kenya. Edited by Ben Nadi Chikamai. Nairobi,

Kenya.
DANIDA 1989. Environmental profile: the Sudan. DANIDA, Department of International Development Cooperation.
Deans, J.D., Diagne, O., Lindley, D.K., Dione, M., and Parkinson, J.A. 1999. Nutrient and organic matter accumulation in Acacia senegal fallows over 18 years. Forest Ecology and Management 124: 153-167.
El-Dukheri, I.A.1997. Past changes and future prospects of traditional rainfed farming in North Kordofan, Sudan. Ph.D. thesis, University of Munchen, Germany.
El Siddig 2001. Community based natural resources management in Sudan. Draft report submitted to the regional IGAD workshop on CBNRM, Kenya.
FAO 1978. Forestry for local community development. Forestry paper No. 7. Rome.
FAO 1995. Non-wood forest products for rural income and sustainable forestry. Non-wood forest products 7. FAO, Rome.
FAO (2001).Non-wood forest products in Africa: A regional and national overview.
Ganry, F., and Dommergues, Y.R.1995. Nitrogen fixing trees: a research area. Agriculture et Development, No. 7, 38-55.
Hammer, T. 1982. Reforestation and community development in the Sudan. Development Research and Action Programme (DERAP) publication No. 150.
Harrison, M.N. and Jackson, J.K. 1958. Ecological classification of the vegetation of the Sudan. Forests Bulletin No. 2 (new series). Agricultural Publications Committee, Khartoum.

IIED and IES 1989. Gum arabic rehabilitation in the Republic of the Sudan: Stage 1 report, International Institute for Environment and Development (IIED) and Institute of Environmental Studies (IES). IIED, London.
Khamis, M. A. 2001. Management of *Boswellia papyrifera* stands for resin production in Jebel Marra area. Western Sudan. Present situation and future prospects. M.Sc. thesis, Institute of International forestry, Dresden, Germany.
MFE 2007. Marketing of argicultural products in in North Kordofan State: Current situation and future prospects. Minstry of Finance and Economy, North Kordofan State.
Mukhtar, M. E., and Warrag, E. I. 1994. Indigenous knowledge for sustainable development in the Sudan, edited by Ahmed, M. M. M. Institute of African and Asian studies, Sudan Library Series (20).
NAS 1979. Tropical legumes: Resources for the future National Academy Sciences (NAS), Washington, D.C.
Ndoye, I., Gueye, M., Danso, S.K.A. and Dreyfus, B. 1995. Nitrogen fixation in Faidherbia albida, *Acacia raddiana*, Acacia senegal and *Acacia seyal* estimated using 15 N isotope dilution technique. Plant and Soil, 172: 2, 175-180.
Obeid, M. and Seif El Din, A. 1970. Ecological studies of the vegetation of the Sudan. *Acacia senegal* (L.) Willd. and its natural regeneration. Journal of Applied Ecology, 7: 507-518.
Pearce, D.W. 1988. Natural resource management in the Western Sudan, Government of Sudan and the World Bank, Washington, D.C.
Philip, M.S. 1975. Gum arabic and Acacia senegal. Nigerian Forestry Information Bulletin (New Series) No. 29. Federal Department of Forestry. Ibadan, Nigeria.
Sanginga, N., Vanlauwe, B. and Deans, S.K.A. 1995. Management of biological nitrogen fixation for the development of more productive and sustainable agricultural

systems. Plant and Soil. 174:1-2, 119-141.
Seif El Din, A. 1984. Agroforestry practices in the dry regions. At-Tasahur, Vol. 2, 8-9.
Seif El Din, A. and Obeid, M. 1971. Ecological studies of the vegetation of the Sudan. The germination of seeds and establishment of seedlings of *Acacia senegal* (L.) Willd. under controlled conditions in the Sudan. Journal of Applied Ecology, 8: 191-201.
Sharawi, H.A. 1986. *Acacia senegal* in the gum belt of Western Sudan: A cost benefit analysis. Unpublished M.Sc. thesis, University College of North Wales, Bangor, UK.
Sudanese Social forestry Society 2006. Manual on use of Traditional knowledge in forest management and use of forest products, Forests National corporation, Sudan.
Sulieman, M. S., and El Doma, A. M. A (1994). Studies on consumption of forest products in the Sudan: use and marketing of non-wood forest products (excluding the Gum Arabic). Forestry Development in the Sudan. GCP/SUD/047/NET.
Talaat, D. A. 2001. Forests biodiversity and its effects on the anniversary of non-wood forests products (In Arabic). Published by Forests national Corporation on the event of the 100 years forests anniversary day, Solo printing and Publishing.
Walter, H. 1971. Vegetation of subtropical arid regions. In: Ecology of tropical and subtropical vegetation. Oliver and Boyd. Edinburgh, UK.

Annex 1

Plate 1. Basket Maker (Sudan)

Plate 2. *Acacia senegal* Agroforestry (Sudan)

Plate 3. Forests Fruits (Sudan)

Plate 4. Forests fruits (Sudan)

Plate 5. HPS Gum arabic (Sudan)

Plate 6. Hand crafts (Sudan)

Plate 7. Abu Karshola Crop and Forests products market (Sudan)

Plate 8. Natural stand of *Boswellia papyrifera* (Sudan)

Plate 9. Gum arabic and talha gum for export (Warm seas factory) -Sudan

Plate 10. Fire in the open Savannah -Sudan

Annex 2

Chemical composition of some forests fruits.

Product	Protein %	Starch	Soluble sugar	Oil %	Fiber %	Ash %	
Lalob		5.1	30.1	70.5	0.4	2.8	21.2
Nabag		5.6	21.8	84.5	0.6	4.1	5.2
Dalib		2.8	20.8	76.4	0.5	16.8	3.5
Dom		3.2	22.3	74.3	0.5	15.0	7.0
Aradeib		4.8	12.7	84.4	0.4	6.6	3.8
Gongolez		3.1	15.3	80.9	0.5	9.2	5.8
Godmim		6.3	15.1	80.7	0.4	8.1	4.5
Gghan		3.0	6.1	75.1	0.9	16.5	4.5
Greigdan		6.0	24.3	84.6	0.1	6.3	3.0

Source: Abdelmoti (2006)

Annex 3

List of key players in NWFPs in Sudan

Ministry of Agriculture
Khartoum- Sudan
http://www.sudagric.net

Agricultural Revival program?

Ministry of Foreign Trade
Khartoum, Sudan
http://www.moftrade.org/index.htm

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Locality Unions, the State Unions (in gum producing States)
The Gum Arabic Producers' Union in Khartoum
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