THE STATE OF THE WORLD's FOREST GENETIC RESOURCES

COUNTRY REPORT

SUDAN

This country report is prepared as a contribution to the FAO publication, The Report on the State of the World's Forest Genetic Resources. The content and the structure are in accordance with the recommendations and guidelines given by FAO in the document Guidelines for Preparation of Country Reports for the State of the World's Forest Genetic Resources (2010). These guidelines set out recommendations for the objective, scope and structure of the country reports. Countries were requested to consider the current state of knowledge of forest genetic diversity, including:

- Between and within species diversity
- List of priority species; their roles and values and importance
- List of threatened/endangered species
- Threats, opportunities and challenges for the conservation, use and development of forest genetic resources

These reports were submitted to FAO as official government documents. The report is presented on www. fao.org/documents as supportive and contextual information to be used in conjunction with other documentation on world forest genetic resources.

The State Of

Forest Genetic Resources

In Sudan

By

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September 2012

Gum Arabic Production Process (Acacia Senegal)

Country Report on Forest Genetic Resources

In Sudan

Background:

For many reasons and difficulties the national mechanism for preparing the report is not established.

Instead we gathered all FNC state mangers (17 managers). The meeting discussed F.G.R – assessed status – trends, management, capacities and needs.

The meeting referred to December 2001, country report. In this way we think the report followed guide lines which FAO asked for coming reasons:

- FNC is completely independent National Corporation.
- FNC directly contacts community associations and NGOs.
- FNC supervises advices and runs all activities of forest at different levels.
- FNC fully authorized to sign agreement, contracts and implements projects with national and international agencies.

Forest law and policy permit and help in establishing all types of forest (governmental, communal, privatal or personal).

Introduction

The nature of the large country & different Ecological zones gives very rich and different types of forest genetic resources. It needs great efforts to assess and count the roles and benefits.

The sustainable management and utilization which applied to the riverine forests, Acacia nilotica forests as whole Gum Arabic of **F.G.R** can be easily measured and counted, for Afro cover data which in need of field work in order to update the data, so as to assess natural vegetation range area, and other wooded land.

After Sudan became two countries is very soon the assessment of **F.G.R** in this time is very essential to assess the hazards and estimate the plan needed to overcome.

Objective:

The objective of this report is to assist the country in elaborating a process for reporting on F.G.R assessment as per the guide lines supplied by **FAO** which will enable revealing the Social, Economic and Environmental importance of The **F.G.R**.

On the other hand it is an opportunity for building partnership among all the concerned stakeholder including administration, conservation and research institutions. On the medium run it leads to reinforcing the capacities of the concerned stakeholder in the field of **F.G.R**, conservation, sustainable use, development, information sharing and reporting.

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1. SOCIO-ECONOMIC AND ECOLOGICAL CHARACTERISTICS

1.1. Geographic position of the country

Sudan is large country in Africa, lies entirely within tropical zone. Its area is approximately 1882000 km². Surrounded by the red sea from the east and 8 countries on the other sides. The population was estimated as 33 million, growing at rate of nearly 3% with 14% in capital Khartoum nomads constitute 14% of the population.

South Sudan country a new country separated from Sudan, of an area about 619000 km². of a population about 9.7 million.

Sudan map after separation (with 17 states).

1.2. Socio-economic information

Population density is 11.2 inhabitant/km² with an annual rate of change (1995-2000) of 2.2%

According to FAO (1999). Fig.2 shows the density distribution patterns within the country.

Annual growth of GDP (1990-1995) is 6.8%.

1.3. Ecological information

The physiographic of the country is simple, with climatic and vegetation distribution in belts extending across the country from east to west. Sandy soils constitute about 60% of the country distributed in the northern and North-East and the western parts. The heavy clay soil of the central and eastern part of the country constitutes
about 30%. The remaining 10% are red soils, characteristics of the southern part of the country. Annual rainfall varies between O in the north and 1500 mm in the south.

Variation in annual rainfall and soil type has produced various vegetation types from desert in the northern zone to closed high forest in the most southern part of the country. The country is
consequently divided into seven vegetation zones on the basis of rainfall and soil. Starting

Fig.1: Administrative map of Sudan **Fig. 2:** Population density of Sudan (inhab./km²)

Fig.1: Administrative map of Sudan

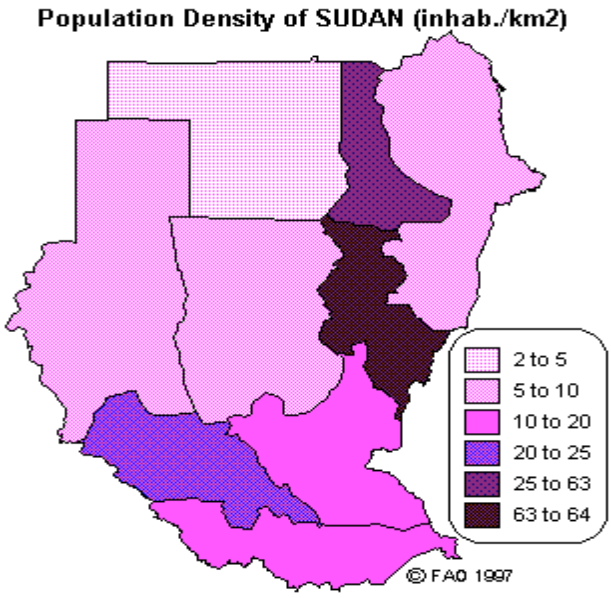

Fig. 2: Population density of Sudan (inhab./km²)

STATE OF FOREST GENETIC RESOURCE IN SUDAN

From the north to the south, these zones are: desert (**zone 1**), semi-desert (**zone 2**)
Rainfall woodland savannah on clay soil (**zone 3**), low rainfall woodland savannah on sand (**zone 4**),
High rainfall woodland savannah (**zone 5**), special forests (**zone 6**) and the montane forests
(**zone 7**).
Topography effect is confined to small areas that are the hilly, mountains and the river Nile
Tributaries (Andrews, 1948). The central part of the country with rainfall confined to rainy season (3-5 month) is dominated by deciduous drought tolerant tree species. Soil effect is
demonstrated by *Acacia senegal* that thrives on annual rainfall of 400 mm in sand while it requires 600 mm in the heavy clay soils. The vegetation zones of the forests have been further
delineated into seed zones by the National Tree Seed Centre (NTSC) according to ecological conditions as described in the NTSC publication n°6.
Approximately half the area of the country (50.5%) is desert and semi-desert. If the term dry land is to denote areas of evapotranspiration in excess of total rainfall, then the whole of Sudan is dry land with the exception of riverine areas, the most southern parts of the country
And some of the mountains.
Forests and woodland range from Savannah woodland, in areas of annual rainfall of about 400 mm to tropical high rainfall forest which are mainly in the southern mountains. The arid parts
carry only scanty vegetation and woody species are confined to few acacias in the seasonally flooded areas. The low rainfall savannah houses the main species currently utilized like
Acacia senegal, the gum arabic producing tree and *Acacia nilotica* of the riverine forests.
Other important species are *Anogeissus leiocarpus*, *Terminalia spp*., *Combretum* spp, *Bowswelia spp*. and some palms mainly *Hyphaene sp.* and *Borassus spp*. The high rainfall
Savannah areas contain the most valuable forests of the country that have largest potential of producing sawn timber.

2. STATE OF FOREST GENETIC RESOURCES

2.1. Phytogeography of the country

The forest ecological zones are similar to those described by Harrison and Jackson (1958).

The desert (zone 1)

This zone embraces vast areas of northern Sudan, approximately 29% of Sudan total area. The annual rainfall is less than 75 mm and with red sandy soil. Woody vegetation is around the Nile banks and seasonal watercourses, mainly *Acacia tortilis*, *Ziziphus spina-christi*, *Boscia senegalensis*, and *Cadaba farinosa.* Towards the southern part of the desert, where increased rainfall permit, woody species like *Indigofera bracteolata* and *Fagonia cretica* are found scattered all over. Along the Nile bank the tree species present are *Acacia nilotica*, *Faidherbia albida* and *Acacia seyal*.

Semi-desert (zone 2)

This zone constitutes about 19.6% of the area of the country. Annual rainfall ranges from 75 mm in the north to 300 mm in the southern fringe. According to soil type, the vegetation is subdivided into:

• Desert scrub: *Acacia tortilis* and *Maerua crassifolia* are dominant species with the following species: *Acacia radiana*, *Caparis decidua*, *Ziziphus spina-christi*, *Balanites aegyptiaca*, and *Salvadora persica*.

• Semi-desert on clay soils: the main species is *Acacia mellifera*.

• Semi-desert on sand soils: the tree vegetation composed mainly of *Acacia radiana, Acacia mellifera, Commiphora africana, Leptadenia pyrotechnica, Cassia acutofolia* and *Calotropis procera*. *Acacia senegal* appear in the wetter parts of the south.

• *Acacia mellifera-Commiphora sp.* desert scrub in the middle part of the greator Kordofan and Darfur.

• *Acacia glaucophylla* and *A. etbaica* in the lower slopes of the southern parts of the red sea hills.

Low rainfall woodland savannah (zones 3 and 4)

It covers 27.6 % of the country on clay and sandy soils with annual rainfall between 300 mm and 800 mm. It is subdivided into two zones according to soil type:

• The clayey areas ***(zone 3):*** the main species are *Acacia mellifera, Commiphora africana, Boscia senegalensis, Acacia seyal, Balanites aegyptiaca, Dalbergia melanoxylon, Combretum hartmannianum, Anogeissus leiocarpus, Boswellia papyrifera* and *Sterculi setigera.*

• The sandy areas ***(zone 4)*** the main species are *Acacia raddiana, Faidherbia albida, Adonsonia digitata, Acacia Senegal, Maerua cassifolia, Combretum cordofanum, Dalbergia melanoxylon, Albizia spp, Sclerocarya birrea, Terminalia spp*. and *Tamarindus indica.*

High rainfall woodland savannah (zone 5)

The main species of this zone are: *Khaya senegalensis, Combretum hartmannianum, Parkia africana, Daniellia oliveri, Isoberbinia doka* and *Anogeissus leiocarpus*.

Special forest Types (zone 6)

These forest types lie within the low rainfall savannah or even the semi-desert areas. They are mainly around the rivers and seasonal watercourses. The most important species is *Acacia nilotica, Ziziphus spina-christi, Faidherbia albida, Hyphaene thebaica, Borassus aethiopum,* and *Oxytenanthera abyssinica*.

Montane forests (zone 7)

Four important mountain masses occur in the Sudan, which are the Red sea Hills in the east,

Jebel Marra in the west, and Imatong and Didinga Mountains in the south. They occupy less

Than 1% of the country, with minor and introduced species.

2.2. Utilization patterns of forest species

The forest tree species in Sudan have economical, ecological, and recreational values. The woody products from the forestry sector are sawn timber, round poles, and fuel wood.

Again forests provide 60% of the animal fodder during dry season.

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The Forest Product Consumption Survey (1995) showed that the total annual consumption of wood in Sudan was 15.77 million m3.

Fuel wood share was 87.5%, as the most important direct benefit from the forest. Ecologically forest tree species stabilize sand dunes in the fragile system in the semi-desert region, ameliorate soil through nitrogen fixation, and provide natural ecosystems for wildlife and conservation of biodiversity.

Fuel wood

Fuel wood contributes 78% of the energy balance of Sudan; the rest are 8% oil, 8% generated Electricity and 6% agricultural residues. However, the 8% of the oil balance consume all the export returns of the Sudan. Rural inhabitants use most of the tree species in the low rainfall savannah for fuelwood (wood and charcoal). Removal of dead trees and branches is permitted for people living around forests. Forest authorities direct the commercial logging of mostly

Acacia nilotica and *Acacia seyal* for firewood and charcoal for supply to the cities.. This is mostly from thinning and branches of *Acacia nilotica* in the reserved riverine forests, and

Clearing of *Acacia seyal* and other acacias from areas allocated for agriculture.

Saw timber

The main wood products are building poles, sawn timber in the form of railway sleepers construction and joinery elements. The study showed that the household sector uses 89.4% of

the total wood produced while industrial, commercial and service use amount for 10.6%. Sawn timber is mainly from *Acacia nilotica* and other species of the high rainfall savannah

woodland zone like: *Isoberlinia doka*, *Khaya grandifoliola*, *Milicia excelsa*, *Khaya*

senegalensis, *Olea hochstetteri, Afzelia africana*, *Daniellia oliveri*, *Sclerocarya birrea*,

Podocarpus milanjianus and *Acacia nilotica*.

Non-woody products

Non-woody products contribute significantly to Sudan exports (19.35% of the total exports).

Other forest products of importance to rural communities are honey, fruit, fibers, food, fodder, medicinal materials, dyes and as tannin material. Gum arabic from *Acacia senegal* and other acacias generate income for farmers.

And contribute significantly to Sudan exports. Badi (1993) provides an exhaustive list of about 100 species bearing non-woody products used as food, oil, fodder, gum, fibre, medicine, and tannin agents. Policies are now towards reducing the consumption of wood as an energy source and increase their use as sawn timber for furniture. Research is encouraged to identify uses of woody and non-woody products for high commercial values.

2.3. Threats

The Sudan forest tree vegetation cover was estimated as 40% in 1901 of the total area, 34- 36% in 1958 (Harrison and Jackson 1958), and decreased to 19% in 1990 as estimated by the FAO. It decreased further to 13.7% according to the recent surveys (Abdelnour and Abelmagid, 1997).

Man has been the most powerful and persistent factor that caused the deforestation and disturbance of Sudan natural ecosystems.

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The main human activities that are threatening the tree species and endangering some of them are unregulated cutting for timber and fuel wood, clearing of forestland for agriculture, overgrazing of livestock, burning and civil wars.

About 80 per cent of Sudan's population derives its living from crop farming or grazing.

Approximately 5 percent of the country's land area is used for arable cultivation; large are used for seasonal grazing. The chief food crops include sorghum (*durra*), millet, wheat, rice, sesame, cassava, potatoes, beans, bananas, sugar cane, and groundnuts (peanuts).

Cotton is Sudan's leading cash crop; it is produced in large amounts in the Gezira region between the Blue and White Niles. The livestock population in 1995 included about 35 million chickens, 23 million sheep, 22 million cattle, 16.5 million goats, and 2.9 million camels. Livestock Production is carried out mainly through nomadic pastoralism using traditional practices (Libanis, 1998). During the 1970s large-scale mechanized production of sorghum was

introduced in eastern Sudan, in the area between the Blue Nile and Atbara rivers. Production increased hugely, particularly in 1994, enabling Sudan for a while to become an exporter of the grain,

but at the cost of soil erosion, and increased desertification (Libanis, 1998).

The demand for wood, mainly for fuel wood, is high in the north beyond the allowable cut.

The situation in the north is becoming more critical due to extensive clearing for large scale mechanized farming operation, and overgrazing. If current rate of clearing for wood and agriculture continues, there will be no forest in the low savannah regions shortly.

The civil war in the south is posing a serious threat to forest resources. Apart from that the non-human factors threatening the forest tree species and consequently the genetic resources are drought, natural tires, and insects. In addition, the drought of the 1980's affected tree spp Seriously in the low rainfall savannah areas and arid zones.

3. MANAGEMENT OF FGR

3.1. *In situ* conservation activities

Protected areas

The forest resources are unevenly distributed between the north and south, between the states and between provinces within states. Only, 32% of the forests exist in the north while 68% are in the South.

However, the population distribution is opposite to that of forest with 72% of the population lives in the north and 28% in the south. This resulted in high pressure on the forest resources in the northern parts of

the country. The forest reserves are generally those areas where the cutting of trees is concentrated and replanting made immediately after felling. The constituted and gazetted forest reserves covered 1.278.000 ha by 1979, distributed as: 167,000 ha in the semi desert, 547,000 in the low rainfall woodland savannah and 564,000 in the high rainfall woodland savannah.

The reserved area was increased substantially after 1993 (following the *Rio declaration*) to reach 8 million ha (2.8% of the country area) distributed in the different vegetation replanting zones.

Due to the control of cuttings of trees and replanting using bulk seeds from natural stands, the genetic resources are reasonably conserved.

Forests legislation also controls tree cutting outside forest reserves with the objective of forest reserves.

This measure of concentrating felling within the reserves reduces the pressure on natural stands and consequently helps in conserving genetic resources.

Bio-reserves, exclusively for wildlife, are distributed in the different vegetation zones. Eight national parks were established with a total area of 8.5 million ha. The parks are administered by the Department of Wildlife, whose ordinance established in 1953, prohibits the felling of trees. The national parks therefore contribute significantly to the conservation of genetic resources especially in the low savannah woodlands in the north, which had been degraded as a result of over cutting.

Forest enrichment or plantation

Reforestation and afforestation programs run by the Forests National Corporation (FNC) is one of the activities that result in conservation of resources. Except in few cases, seeds are from the natural stands collected as bulk by inhabitants for the FNC. The National Tree Seed Centre (NTSC), under the FRC, has identified and described 79 sources in an area of about6,000 ha. The NTSC also collects seeds for the FNC from natural stands.

3.2. *Ex situ* conservation activities

An *ex situ* conservation program based on tree seed storage has recently been established. This program also entails a long-term strategy consisting of establishment of seed sources to ensure good quality seeds in the long run.

A National Tree Seed Centre (NTSC) was established in 1990 under the FRC with the objectives of providing of seeds for the FNC afforestation and reforestation programs and resource conservation. The consumption of forest tree seed was estimated as 135 tons per year and expected to reach 600 tons, shortly. *A. senegal* accounts for almost 65% of the present seed use, followed by *A. nilotica*, *A. seyal*, and *A. mellifera*.

The exotic species account for less than 10% of the present use.

3.3. Selection and genetic improvement

Beside the introduction of exotic species, mainly *Eucalyptus spp.* that started in 1915 little effort has been made in tree improvement.

The few attempts include:

• Identification of high-gum- yielding trees of *Acacia senegal* in 1967 from the gum belt areas and planting their progenies in a progeny test in western Sudan which was not followed properly.

• Establishment of irrigated schemes: *Eucalyptus camaldulensis* seed orchard for irrigated schemes.

Provenance trials and studies are concentrated on *Acacia senegal, Acacia seyal, Acacia nilotica* and *Faidherbia albida.*

Genetic studies, tree improvement activities and germplasm conservation efforts are minimal and limited to *Acacia senegal*, *Acacia nilotica*, *Faidherbia albida* and *Eucalyptus camaldulensis*.

3.4. National priority species

The most important species according to their products and values are: *Acacia senegal, Acacia nilotica, Acacia seyal, Acacia mellifera, Eucalyptus spp* and *Khaya senegalensis.*

Prosopis chilensis, an introduced species, was once considered as a priority species because of its drought tolerance and fuel wood supply. Due to its invasion to agricultural land, measures are taken to eradicate it from the country.

4. POLICY, PLANNING AND INSTITUTIONAL MECHANISM

4.1. National forest policy

Laws of conservational nature were enacted in 1901, 1908 and 1917. They placed the full custody of the forests on the government to avoid the misuse of the genetic resources. Wood harvesting was limited to species that are sure to regenerate naturally like *Acacia nilotica*.

Creation of forest reserves was started in 1923 and tree harvesting for commercial use was confined these reserves.

The Governor of Sudan issued the first forest policy statement. This defined the role and relationship between the states and the central government. It called for the reservation of 15% of the area of the country as forest. It also emphasized importance of conservation of the forest germplasm.

The policies and laws evolved and changed with the country political changes but mainly remained with conservational nature. The latest policy revision was issued in 1986 with a prime objective of reserving and developing the forest resources. The policy raised the goal of forest reserves to 20% of the country area. Accordingly, new forest laws were enacted in 1989 to enforce the new policies.

Item 17 of the law gave the Minister of Agriculture and Forestry the right to ban the cutting of any tree spp. that is endangered or requiring some special attention.

Several directives were issued to protect the following tree species and banning their cutting: *Acacia senegal* (if density is more than 50%), *Balanites aegyptiaca*, *Commiphora africana*, *Dablergia melanoxylon*, *Hyphaene thebaica*; *Salvadora persica* (roots), Sclerocarya *birrea* and *Sterculia* setigera.

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A new policy was formulated in 1997 due to national changes and the international Agreements especially the Rio declaration in 1992. The policy calls for:

• To assign 25% of the country to natural resources mainly forestry,
• To limit felling and use of trees for domestic products to areas where regeneration is assured.
• Replanting according to sustainable use.
• To limit local people rights and privileges from the reserved forests and
• To promote private, communal and rural forest.

4.2. Laws and others rules

Sudan attended UNCED in Rio in 1992 and signed the conventions on biological control and agreement on climate. In 1994 it also signed the convention to combat desertification.

The country is committed to abide by those conventions.

4.3. Institutions involved in FGR

The ministry of Agriculture and Forestry: Forest National Corporation (FNC)

Still there the relation between ministry of Agriculture and FNC but administratively FNC became a part of ministry of Environment, Forest and physical Development since last 2009.

Conservation of the forestry resources and consequently that of the forest genetic resources as carried by the Forest National Corporation (FNC) as part of the ministry. The FNC is the custodian of the country forest resources by law and it evolved through the past years.

In 1901 the Woods and Forests Department was created as a pioneer governmental institution. Its major objective was to supply fuel wood for the steamers and first forest laws were then enacted.

Then it developed into a Forest Department that observed conservational measures.

Tree planting was effected using indigenous and exotic species. Important species introduced included *Tectona grandis*, *Eucalyptus spp.*, and *Azadirachta indica* between 1919 and 1934.

Reservation of forests started in 1923.

The Forest Department evolved into the Forests National Corporation (FNC), which is a Parastatal body in 1989. The FNC is technically responsible for all forests in the Sudan and is responsible for the protection of forest areas adjacent to the desert, watercourses and streams and watersheds. It shares the forestry administrative responsibilities of other forests with the 17 State governments. The FNC provide technical assistance to local communities managing village and communal forests and to companies, organizations and individuals running private forests. Also, the FNC is responsible for the forest in the national parks, which are managed by the Wildlife Department.

The Native or Tribal Administration aided the Forest authorities in conservation of forests.

The Native Administration backed by the laws and using its own local wisdom has been very instrumental in tree conservation.

4.4 forest situation And Plan After Sudan Separation

a) Comparison Of plant Covered Area Between Sudan And South Sudan

Country	Area in million Km2	percentage	Area Covered By Plant Million Feddan	Percentage to The Sudan Country
Sudan	187.8	73.4	51.96	32%
South Sudan	68.2	26.6	109.62	68%
(S.s+N.s)	256	100	161.58	

***FNC annual report 2011**

b) Effect Of Separation ON Forests Changes

Changes	From	To	Observations
Forest cover%	29.4	11.6	As the result Sudan became one of low forest cover
Annual Deforestation 90%	0.74%	2.46	The country became of high Deforestation rate in the world
Annual increment in million m3	11.0	10.0	The reduction due to the high rate of the Deforestation which lower trees density
Average Of Permitted Deforestation in million m3	11.0 million m3	10>3 Million m3	Deforestation rate can be increased after increasing in the annual increment
			According to increased planted area or improving in natural forest management which improve forest density
Green Area /Inhabitant Per Feddan	5.89	1.68	According in increasing Deforestation &increasing population
Forest density	400-700	200-500	Elicit cutting lowers the density can be used proper management

***FNC annual report 2011**

c) Forest Comparison between Sudan and South Sudan

Compared	Sudan forests	S.Sudan forests
Forests type	80%	Productive forest includes hill forest, water shed forests
Average density per feddan	20.0-5.0 150-300 trees	40.0 -70.0 m3 300-500 areas
Annual increment	10 million m3	15 million m3
Forests No	3225	63
Total area	25.13	4.66
Percentage of ….. area to the Sudan country	4.13	0.77

*****Sudan map

***FNC annual report 2011**

d) Explain Traditional land use in Sudan after Separation

Type of land use	Area in million feddan	Area type percent from total Sudan
Land covered by forests	51.96	11.60%
Agricultural land	67.24	13.70%
Pasture land	117.95	26.40%
Follow land	214.2	47.90%
Water area	0.762	0.17%
Total	452.112	100%

***FNC annual report 2011**

4.5. Years strategy goal (2012-2016)

- To reach sustainable management through rehabilitation programs, conservation of forest ecosystem, well developed forests industry system, so as to increase different benefits, raising environmental awareness, services of the community needs, contribution on food security & poverty achieved & needs of FNC goals after 2016.
- Existing forest potentialities for possibility to provide community needs in term of forest products and services.
- Observation of forest hazards and changes in natural habitats.
- Increase reserved forest to reach 20% of total country area and manage it properly for sustainable production in a develop and rehabilitation way.
- Give chance of natural regeneration of reserved forests, community forest, corporations forest, and encourage private sector to deal with forest products to organize their markets to meet forests needed products.
- Plant 5% and 10% from the total areas of the crops irrigated projects in the country.
- To a achieve capability of sustainable forest products.
  Conservation of
  conservation of forests from biological hazards, fires, miss use and over grazing.
- Efforts coordination for keeping more conservation to encourage private sector to invest in forest field of activities.
- Improving non wood forest products especial trees fruits and others.
- To raise gums production to reach annually production about zoo thousands tons.
- Raising community participation especially in rural areas as a successful tool in forest management and safe environment.
- Get use of country indigenous knowledge and wisdom in keeping proper forest management.
- Enforce and encourage technical scientific research, improving making furniture, pulp & paper Gum trading, food and production process in keeping good quality and standards.

Raising skill and field training continue on field level

Discussion group of Gum Arabic producers association is going on

5. TRAINING AND RESEARCH CAPACITY BUILDING AND REINFORCEMENT

5.1. Research on FGR

The Forest Research Centre (FRC) was transferred in 1975 from the Forest Department to become a component of the Agricultural Research Corporation under the Ministry of Agriculture and Forestry to conduct forestry research. Also the National Research Centre under the Ministry of Higher education is conducting research in forest related issues

5.2.Training

Academic institutions offer B.Sc. and postgraduates programs and undertake research in forestry and genetic resources conservation:

• University of Khartoum offers B.Sc. (Honours) in Forestry after five years academic program emphasizing management, and conservation with courses in forest genetics.

Postgraduate programs in M.Sc and Ph.D. have also been established.

• University of Sudan offers B.Sc. and M.Sc. degrees in forestry,

• Other universities, including Juba University, offer B.Sc. (Honours) and M.Sc. in natural resources and environmental.

6. REGIONAL AND INTERNATIONAL COLLABORATION

Following the directive in the nonbinding Forestry Principles issued by the conference of the UNCED in Rio in 1992, Sudan received assistance from UN Global Environmental Facility (GEF) to sensitize the local communities on the importance of conserving genetic resources, combating desertification and observing the environmental balance. The Sudan is also an active member of the IGAD, African Environmental Ministerial Council and Arab Environmental Ministerial council.

7. SELECTED REFERENCES

Abdelnour, H.O., Abdelmagid, T.D. 1997. *The Human activities in the Sudan during the 20th century and its effect on the forests of the Sudan.*

Andrews, F.W. 1948. *The vegetation of the Sudan*. Agriculture in the Sudan 1948.

Badi, K.H. 1993. *Study on consumption of forest products: an exhaustive list of forest species bearing non-wood forest products*
GCP/SUD/049/NET, Khartoum, Sudan.

Forest National Corporation (FNC). *Reports 1990-1998.* Khartoum, Sudan

Harrison, M.N. and Jackson, J.K. 1958. *Ecological classification of the vegetation of the Sudan*.
Sudan Government, Khartoum, Sudan.

Libanis. 1998. *Sudan country guide.*
http://libanis.net/c/sd/guide/economy.shtml

Smith, J. 1949. *The distribution of Tree species in relation to rainfall and soil texture*. Sudan
government, Khartoum, Sudan.

ANNEXES

Annex 1: Values and use of target, important species

Name of species Value Present, future or potential use

Name of species	Value code	Present, future or potential use											
		ti	**po**	**wo**	**nw**	**pu**	**Fo**	**fd**	**sh**	**ag**	**co**	**am**	**xx**
Acacia mellifera	1		x	x				x			x		
Acacia nilotica	1		x	x	x			x	x	x		X	
Acacia senegal	1	x		x	x		X	x		x	x		
Acacia seyal	1		x	x	x			x			x	X	x
A. tortillis raddiana	2		x	x				x			x		
Adansonia digitata	1				x		X		x		x		xr
Ailanthus excelsa	2	x						x	x				
Albizzia amara	2			x									
Albizzia aylmeri	1	X											
Anogeissus leiocarpus	2		x	x									
Azadirachta indica	1	x	x	x	x				x			X	xp
Balanites aegyptiaca	1	x		x	x			x	x	x	x		
Borassus aethiopum	1	x	x	x			X						
Boswellia papyrifera	1		x		x						x		
Callitris gluca	1	x											
Conocarpus lancifolius	1	x	x	x									
Cordia africana	1	x	x			x							
Cupressus lucitanica	1	x	x										
Dalbergia melanoxylon	1	x	x					x					
Dalbergia sissoo	1	x	x										
Diospyros mespiliformis	2	x											
Eucalyptus camaldulensi	1		x	x	x				x				
Eucalyptus microtheca	1		x	x	x				x				
Faidherbia albida	1	x	x	x	x				x				
Hyphaene thebaica	1								x	x	x		
Khaya senegalensis	1	x	x		x				x				xf
Lannea fruticosa	2	x	x										
Parkinsonia aculeata	2		x	x									
Pseudocedrela kotchii	1	x	x	x	x								
Sclerocarya birrea	1	x							x				
Sterculia setigera	2				x								
Tamarindus indica	2			x			x				x		
Terminalia brownii	2		x	x					x				
Terminalia laxiflora	2	x	x	x									
Ziziphus spina-christi	1	x	x	x			x	x					

Key

Value:

1. Species of current socio economic importance

2. Species with clear potential or future value

3. Species of unknown value given present knowledge and technology

Utilization:

ti timber production;

po posts, poles, round wood;

pu pulp and paper
wo fuelwood, charcoal;
nw non-wood products (gums, resins, oils, tannins, medicines, dyes...)
Fo food;
fd fodder;
sh shade, shelter;
ag agroforestry systems;
co soil and water conservation;
am amenity, aesthetic, ethical values;
xx other (specify).

Annex 2: Management and location of forest genetic resources, by natural site and species

Species/ecological zones	Reserve, natural park	Stands in situ, ex situ	Protected natural stands	Protected planted stands	Villages fields, homesteads	Experimental Trials
Acacia mellifera						
Zone 3	>10000		>10000			
Acacia nilotica						
Zone 6	>10000	>100	>10000	>10000		
Acacia senegal						
Zone 3			>10000	>10000	>10000	>10000
Zone 4			>10000	>10000	>10000	>10000
Acacia seyal						
Zone 3	>10000		>10000	>10000		
Zone 6			>10000			
Acacia tortilis						
Zone 2			>500			
Adansonia digitata						
Zone 3			>1000			
Zone 4			>1000			
Ailanthus exclesa						
Zone 6				>10000		
Albizia amara						
Zone 3			>10000			
Zone 4			>10000			
Albizia aylmeri						
Zone 3			>500			
Anogeissus leiocarpus						
Zone 3	>500		>10000			
Azadirachta indica						
Zone 2				>1000		
Zone 3				>1000		
Zone 4				>1000		
Zone 6				>1000		
Balanites aegyptiaca						
Zone 3	>1000		>10000			
Zone 4			>10000			
Borassus aethiopum						
Zone 6			>10000			

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Boswellia papyrifera						
Zone 7			>10000			
Callitris gluca						
Zone 7				>10000		
Conocarpus lancifolius						
Zone 3				>1000		
Cordia africana						
Zone 3			>500	>500		
Cupressus lucitanica						
Zone 7				>10000		
Dalbergia melanoxylon						
Zone 3	>500		>1000			
Zone 4						
Dalbergia sisso						
Zone 6				>10000		
Diospyros mespiliformis						
Zone 3			>500			
Eucalyptus camaldulensis						
Zone 2				>10000	>1000	>1000
Zone 3				>10000	>1000	>1000
Zone 6				>10000		>1000
Zone 7				>10000		>1000
Eucalyptus microtheca						
Zone 3				>10000	>1000	>1000
Zone 6				>10000		>1000
Faidherbia albida			>100			
Zone 3	<100		>1000			
Zone 4			>1000			
Zone 6			>1000			
Hyphaene thebaica						
Zone 6	>10000		>10000			
Khaya senegalensis						
Zone 5			>10000			
Zone 6				>10000		
Zone 7			<100			

Lannea fruticosa	>100					
Zone 3			>10000			
Zone 4			>1000			
Parkinsonia aculeata						
Zone 6			>1000			
Pseudocedrela kotchyi						
Zone 3	<100		>500			
Sclerocarya birrea						
Zone 3			>10000			
Sterculia setigera						
Zone 7			>10000			
Tamarindus indica						
Zone 3	<100		>1000			
Terminalia brownii						
Zone 3			>10000			
Terminalia laxiflora						
Zone 3			>10000			
Ziziphus spina-christi			<100			
Zone 3			>10000			
Zone 4			>10000			
Zone 6	>1000		>10000			

Number of individual trees in each category per zone was estimated for all the species.

Major ecological zones:

Zone 1 : Desert
Zone 2 : Semi-desert
Zone 3 : Low rainfall savannah (LRS) on clay
Zone 4 : Low rainfall savannah (LRS) on sand
Zone 5 : High rainfall savannah (HRS)
Zone 6 : Special areas
Zone 7 : Montane forests

Annex 3. Species and populations degree of management and security

Species/ecological zones		Managed for			Unmanaged but		Threatened by (causes)					Degree of security
	Protected in parks	Soil water protection	Wood, non wood production	Animal grazing	Used and harvested	Used and grazed	Environment	Clearing	Overgrazing	By infrastructure	By other factors	
Acacia mellifera												
Zone 3	>1000/1				>10000/3			>10000/4				
Acacia nilotica												
Zone 6	>10000/1		>10000/1		>10000/3							
Acacia senegal												
Zone 3			>10000/1		>10000/3							
Zone 4			>10000/1		>10000/3							
Acacia seyal												
Zone 3	>10000/1		>10000/2		>10000/4			>10000/5				
Zone 6	>10000/1				>10000/4			>10000/5				
Acacia tortilis												
Zone 2					>10000/4			>10000/4				
Adansonia digitata												
Zone 3					>1000/3							>1000/5
Zone 4					>1000/3							>1000/5
Ailanthus exclesa												
Zone 6			>10000/1									
Albizia amara												
Zone 3					>1000/3			>10000/4				
Zone 4					>1000/3			>10000/4				
Albizia aylmeri												
Zone 3					>500/4		>500/5					
Anogeissus leiocarpus												
Zone 3	>500/1				>10000/3			>10000/4				
Azadirachta indica												
Zone 2			>1000/2									
Zone 3			>1000/2									
Zone 4			>1000/2									
Zone 6			>1000/2									
Balanites aegyptiaca												
Zone 3	>1000/1		>1000/2		>10000/3							
Zone 4						>10000			>10000			
Borassus aethiopum												
Zone 6			>1000/2		>10000/4			>10000/5				

Boswellia papyrifera												
Zone 6			>10000/2		>10000/4			>10000/5				
Callitris gluca												
Zone 7		>10000/1			>10000/2							
Conocarpus lancifolius			>1000/1									
Zone 3												
Cordia africana												
Zone 3			>500/2		500/5			>500/5				
Cupressus lucitanica												
Zone 7			>10000/1									
Dalbergia melanoxylon												
Zone 3	>500/1				>10000/4			>10000/5				
Zone 4					>10000/4			>10000/5				
Dalbergia sisso												
Zone 6			>10000/2									
Diospyros mespiliformis												
Zone 3					>500/4			>500/5				
Eucalyptus amaldulensis												
Zone 2			>10000/1									
Zone 3			>10000/1									
Zone 6			>10000/1									
Zone 7			>10000/1									
Eucalyptus microtheca												
Zone 3			>10000/1									
Zone 6			>10000/1									
Faidherbia albida												
Zone 3	100/1				>1000/3				>1000/4			
Zone 6					>1000/3				>1000/4			
Hyphaene thebaica												
Zone 6	>10000/1				>10000/4			>10000/5				
Khaya senegalensis												
Zone 5			>10000/1									
Zone 6			>10000/1									
Zone 7					>1000			>1000				

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Lannea fruticosa												
Zone 3					>10000/4			10000/4				
Zone 4					>10000/4			10000/4				
Parkinsonia aculeata												
Zone 6					>1000/3			1000/4				
Pseudocedrela kotchyi												
Zone 3	>100/1				>500/5			500/5				
Sclerocarya birrea												
Zone 3					>10000/4			1000/5				
Sterculia setigera												
Zone 7					>10000/2							
Tamarindus indica												
Zone 3	<100				>1000/3							
Terminalia brownii												
Zone 3					>10000/2							
Terminalia laxiflora												
Zone 3					>10000/4			10000/5				
Ziziphus spina-christi												
Zone 3					>10000/3							
Zone 4					>10000/3							
Zone 6	>1000				>100000/3							

Number of individual trees in each category per zone was estimated.
Number after slash refer to level of protection and security

Major ecological zones:

Zone 1: Desert
Zone 2: Semi-desert
Zone 3 : Low rainfall savannah (LRS) on clay
Zone 4 : Low rainfall savannah (LRS) on sand
Zone 5 : High rainfall savannah (HRS)
Zone 6 : Special areas
Zone 7 : Montane forests

Degree of security

1: Low risk of genetic erosion
2,3,4: intermediate risk of genetic erosion
5: High risk of genetic erosion