



Government of the Republic of Sudan
Ministry of Environment and Physical Development
The Higher Council for Environment and Natural Resources
(HCENR)

**SUDAN'S
FOURTH NATIONAL REPORT
TO THE CONVENTION ON BIOLOGICAL
DIVERSITY**

Khartoum, Sudan
2009

EXECUTIVE SUMMARY

The editors reviewed the relevant literature, analyzed and augmented a number of documents and reports in the different fields of biodiversity management. The review followed the measures and guidelines set out by the CBD.

The Government of Sudan, in accordance with Article 6a of the CBD, undertook a participatory approach in the development of NBSAP. Five regional workshops were held in different parts of the country. The NBSAP project took the initiative of updating the information on biodiversity. The recent nationwide NBSAP biodiversity assessment represented a benchmark and an information base for the different ecosystems, habitats and species.

Biodiversity emerged as a priority issue on the international agendas. The international community was actively involved in biodiversity conservation. The chapters provide a background of biodiversity as a global issue, highlighting the progress and achievements of biodiversity strategies and programmes.

Although Sudan is rich in diverse ecosystems, habitats, species and genetic resources, yet no coordinated or comprehensive surveys and assessments were carried out. Most surveys or studies were fragmented and tailored for academic, research and scientific purposes. The collected data or information were mostly site-specific, local and at institutional levels. The NBSAP assessment was carried out by multi-disciplinary teams.

Cereal crops grown in Sudan include sorghum, pearl millet, wheat, maize, rice, finger millet and barley. The important oil crops grown are sesame and groundnut. The recent years witnessed expansion in the areas allotted for sunflower. Sesame (*Sesamum indicum*) is grown under rain-fed conditions by subsistence, semi-commercial and commercial farmers. Cow pea (*Vigna unguicalata*) is among the important summer legumes. Other summer legumes include pigeon pea (*Cajanus cajan*) and hyacinth bean (*Lablab purpureus*)

A number of vegetables such as okra, onion, tomato, potato, peppers, eggplant, melons, watermelon, pumpkins, squash, sweet potato, radish, jews mallow, purselane, rocket and chard are grown. Several fruit species are grown, some of which date back in ancient history while others were recently introduced. The most widespread are date palm, banana, guava, citrus and mango.

Harrison and Jackson (1958) estimated the tree cover in Sudan at 36-43%. The FAO Forest Resources Assessment 2005 indicated a tree cover of 29%. The decline was explained as a consequence of expansion in agriculture, urban, fuelwood harvesting and grazing. Forests provide protection for a variety of genetic resources. There are some 184 species of trees and shrubs including 33 exotics. Special areas with a wealth of rare species are found in the Red Sea Coast and the tropical rain forests in south Equatorial.

Most of the wildlife is found within the high rainfall Savanna. Recent aerial surveys over 150,000 km² in 2007, covered the most important protected areas and pastures in Southern Sudan. This includes Africa's 9th and 10th largest national parks in Africa, Boma and the Southern National Park.

Surveys indicated that there remain very large numbers of migratory wildlife in Southern Sudan. That makes up the largest mammal migration in the world involving about 1.2 million animals. Comparison between aerial surveys of the 1980's and 2007 indicate considerable downward trend for most species to the levels of 25 years ago. However wildlife populations can recover in many areas.

This information on wildlife, livestock, human activities and habitat contribute in the assessment of threats and in the formulation of specific recommendations for strategic planning of wildlife protected areas and natural resource management in Southern Sudan.

Rangelands are very variable, extending over seven ecological zones from desert, semi-desert to the flood region, high rainfall savanna and mountainous regions. This range supports diverse vegetation and production systems. Rangelands are estimated at 110 million ha with an estimated forage production of about 85.6 millions tons of dry matter. That includes 62.4 million tons of natural pasture and 23.2 million tons of agricultural residue, green fodder, dry fodder and concentrates. About 204 range species were identified. However, no ecological surveys of the rangelands were made since the comprehensive study of Harrison (1958). Pastoralism is integrated with traditional crop production combined with livestock.

Wetlands on the Red Sea Coast, desert oases, dams' reservoirs and in-land lakes are considered important habitats for resident and migratory birds. The River Nile and the Red Sea Coast are part of the fly over for soaring and migratory birds from Eurasia to Africa. The vast wetlands and flood plains of south Sudan such as the Sudd and the Machar Marshes are internationally recognized havens for migratory waterfowl.

The Sudanese Red Sea is still fortunate to have attractive and mostly pristine habitats, particularly its coral reefs. There are Mangrove stands, Sea grass beds, and associated marine fisheries and biodiversity including sharks, dugongs, turtles, and variety of sea birds. Two protected areas are established; Sanganeb and Dongonab-Mukawar Island with good representation of the Red Sea marine ecosystems.

Dungonab Bay and Mukawwar Island MPA is a turtle nesting site of regional and possibly international significance and it is internationally recognized as an Important Bird Area (IBA). The Dugong population in this MPA may be the most important remaining on the coast of Africa. Regional action plans (following regional surveys) were developed for corals, mangroves, turtles and breeding seabirds and are being implemented nationally via national action plans.

Two protocols were signed by Sudan in 2005: 'The Protocol Concerning the Conservation of Biological Diversity and the Establishment of Protected Areas' and the 'Protocol Concerning the Protection of the Marine Environment from Land-Based Activities in the Red Sea and Gulf of Aden'. Both Protocols are additions to the 'Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment' (the Jeddah Convention, 1982).

Survey design guidelines for marine protected areas (MPAs) have been prepared by PERSGA and ecological and socio-economic surveys have been completed at Mukawwar Island and Dungonab Bay MPA. Site-specific master plans, with management guidelines, have been written for Dungonab Bay and Mukawwar Island MPAs with the involvement and participation of local stakeholders.

With regard to Sea-based and land-based sources of pollution two national plans have been prepared: the National Oil Spill Contingency Plan (approved by the Government) and the National Programme of Action for the Protection of the Marine Environment from Land-Based Activities.

The orders *coleoptera* and *Lepidoptera* are the most dominant insect species, while *Siphonoptera*, *Isoptera*, *Ephemeroptera*, *Dermaptera* *Trichoptera* are less spread. Several insect predators and parasites on the crop insect pests were reported. The predators and parasites under favourable conditions of population build- up, check the outbreaks of crops pests. The order *Hymenoptera*, *Diptera*, *Coleoptera*, *Dermaptera*, *Hemiptera* *Neuroptera* include natural insect enemies. These insect groups play a role as pollinators of flowering plants. Several insects such as tree locust (*Anacridium melanorhodon melanorhodon*), Dura antad (*Agonoscelis pubescens*) and the queens of termites are eaten. Insects serve as food for birds and fishes.

Many improved high yielding varieties of different crops are released or introduced at the expense of indigenous landraces and cultivars. The inhabitants migration from rural areas to cities and big towns due to insecurity or economic reasons, abandoning their farms or adopting other jobs, has negatively affected the agrobiodiversity used and conserved by the people.

Pests and diseases on crops have negative impacts on the genetic variability within the crops. A number of pests, fungal, bacterial and viral diseases are known to attack crops. Quarantine measures are not effective enough to restrict the introduction of new pests and diseases. Farmers are used to select the outstanding strains for cultivation, guided by their inherited knowledge on the environment and crops. Such practice leads to the dominance of few genotypes at the expense of others.

The increase in forest dependent populations preempts sustainable forest management and restraint the implementation of forest policies. Decision-makers and the public underestimate the forests values and their role in socio-economic development and environmental protection. The budgets for forest conservation and development reflect the low priority allocate to the forestry sector. Domestic markets and marketing channels for local forest products are inadequate.

Dieback of Sunt (*Acacia nilotica*) is the most serious epidemic affecting many riverain forests. Termites are a serious problem in Eucalyptus plantations. Insect attack on seed has probably more effect on natural regeneration of certain species like *Acacias*, *Balanites aegyptiaca*, *Combretum* spp. etc. The tree locust attacks acacias especially the gum tree *Acacia senegal*. The outbreaks affect gum Arabic production.

Fire is a serious problem in all forest, range and wildlife areas except the semi-desert area where the grass is sparse and the small areas of the moist closed forests in the South.

Baggara traditional nomadic routes and grazing lands were subjected to change due to the horizontal expansion of mechanized rainfed agriculture, drought and increased numbers of livestock. Conflicts often occur over the use of the resource.

The Sudan participates in most conventions related to biodiversity conservation. The country is party to the CBD since 1995 and ITPGRFA since 2002. However, no national legislation has been developed on access to the genetic resources, benefit sharing and farmers' rights. The different institutions, groups and individuals engaged in agrobiodiversity conservation and utilization are characterized by lack of sustained coordinated efforts between them. There are several laws, acts and ordinances dealing with environmental protection and conservation. The current environmental legislations are sector based with the essence of protection and conservation. They generally warrant regulatory powers in resource use and impose penalties on violations. In general, the legislations reflect the mandate of the ministries concerned and their internal structures. The convention on biodiversity enhanced the wildlife conservation by promoting governmental policies and the inclusion of wildlife in the implementation of activities. Pressures on habitats are growing with more areas opened to development and investors.

Information on agrobiodiversity is not widely or easily accessible. Access is hindered by lack of information and database systems at the institutional and national levels. Efforts in the dissemination of knowledge on the importance and values of biodiversity are fragmented, non-sustainable and sometimes poorly displayed through the media. Syllabi on biodiversity conservation are virtually absent in the general education curricula and very little in the higher education.

The impact of petroleum prospecting, drilling and transport on habitats, especially that of produced water on migratory birds is very disturbing. Monitoring of Dinder National Park was made by the Dinder Project. In-situ conservation was improved by the establishment of new-protected areas. The government declarations and the inclusion of biodiversity in the strategies and programmes of the Agricultural Revival Programme, indicate good will. Changes in the status and trends in biodiversity cannot be attributed to the measures taken in the implementation of NBSAP and the convention.

The accomplishment of wildlife surveys in Southern Sudan can be attributed to the CPA and the prevailing peace conditions. The recommendation of NBSAP was taken into consideration in the inclusion of ecosystems not previously included in the protected areas. The development of management plans for Dinder National Park, Sanganeb and Dongoab can be attributed to the implementation of NBSAP, GEF and the African Parks funds.

The report ends up with a number of recommendations directed to the stakeholders, some of which are summarized below:-

- Management systems should adopt recent concepts, criteria and indicators in the approach to sustainable development in the forestry sector.
- More concern should be devoted to the human resources development. Forest management should change from sustained yield to sustainable management, and the application of efficient technologies in resource assessment.
- The capacities of HCENR, as the focal point for Biodiversity need to be strengthened to fulfill its mandate in accordance with the Environment Conservation Act 2001.
- Serious efforts and large resources are needed to upgrade the conservation status of the protected areas in Southern Sudan.

- Increase the coordination between WCGA and WRC.
- Establishment of a biodiversity unit in HCENR

- Control of legal hunting, especially the hunters from rich Gulf countries and their impact on the populations of dorcas gazelles. Training of manpower is urgently needed especially in Southern Sudan. Achievement of wildlife conservation within national land use plans and development strategies.

- Build the capacities of the Wildlife Conservation General Administration and the Wildlife Research Center in Northern Sudan and the establishment of new institutions in Southern Sudan.

- Specific conservation action is required for dugong in Mukkawar Island and Dungonab Bay MPA (Sudan). This should include a ban on fixed fishing nets in areas of the MPA important for dugong.

- National Action Plans for corals, turtles, seabirds, mangroves (that build on the Regional Action Plans) need to be developed as a priority and provided with sufficient funding support to allow them to be implanted.

- Need to reduce camel grazing in mangroves and the felling and cutting of mangrove trees. Efforts to manage camel grazing and wood collecting require alternative sources of food, fuel and construction materials to be provided.

- There is a need to develop community education programmes that highlight the impacts of coastal communities on reef ecology, including degradation, anchor damage, littering, waste disposal and souvenir collection. These could be integrated with programmes of community-based monitoring that involve recreational scuba divers or fishers.

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PREFACE

A.


Sudan has joined the Convention on Biological Diversity since October 1995. It has been active in the implementation of the Convention and in compliance to the reporting requirement of the CBD. Sudan has been able to timely submit the First, Second and Third National Biodiversity Reports in the years 2000, 2003 and 2006, respectively. Sudan has also benefited from the umbrella project that is designed to assist a number of countries in the preparation of their Fourth National Reports on Biodiversity in order to meet their national reporting requirements.

The assistance has helped Sudan very much in achieving the timeliness and quality of reporting as called for under Decision VII/25 of the CBD at its Seventh Conference of Parties.

We are indebted to the Global Environment Facility (GEF) and to the United Nations Development Programme (UNDP) for their assistance and financial support to the Government of Sudan during the Biodiversity Enabling Activities and Add-on Phases. Building functional capacity and infrastructure to support the implementation of biodiversity national strategies and plans is a demanding task. We therefore, will do our best to implement the biodiversity action plans. Nevertheless, we wish that the help and cooperation of GEF and UNDP to continue.

I am grateful to the Secretary General of the Higher Council, the Coordinator of the report and the Taskforce member for their commitment to the report and for the excellent job.

I am very pleased to endorse the Fourth National report in its final version which has been revised after the National Consultation Workshop.


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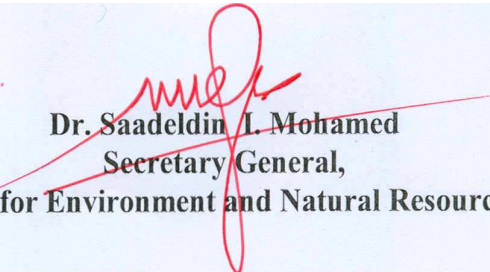


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We are particularly thankful to all the stakeholders, civil society and NGOs representatives who have contributed with ideas and thoughts. Special thanks are extended to Ms. Hanan Mutwakil, UNDP Khartoum office, for her continuous support and contribution to the Report Preparation and to the National Workshop. Thanks are also due to HCENR staff for their role in organizing the workshop. Finally, thanks are due to the media that made good coverage to the workshop deliberations.



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ABBREVIATIONS AND ACRONYMS

| | |
|------------|---|
| ABS | Access to Genetic Resources and Benefit Sharing |
| APAI | African Protected Area Initiative |
| ARC | Agricultural Research Corporation |
| ARRC | Animal Resources Research Corporation |
| ASARECA | Agricultural Research in Central Association for Strengthening and Eastern Africa |
| BI | Biodiversity International |
| CBD | Convention on Biological Diversity |
| CBO | Community Based Organization |
| CITES | Convention on International Trade in Endangered Species of Wild Flora and Fauna |
| CPA | Comprehensive Peace Agreement |
| COP | Conference of the Parties |
| DANIDA | Danish International Development Agency |
| DNP | Dinder National Park |
| EAPGREN | Eastern Africa Plant Genetic Resources Network |
| EARO | Eastern Africa Regional Office |
| FNC | Forests National Corporation |
| FAO | Food and Agriculture Organization of the United Nations |
| GAB | Gum Arabic Belt |
| GDP | Gross Domestic Products |
| GEF | Global Environment Facility |
| GIS | Geographical Information System |
| GOSS | Government of Southern Sudan |
| HCENR | Higher Council for Environment and Natural Resources |
| IBA | Important Bird Area |
| ICZM | Integrated Coastal Zone Management |
| IFAD | International Fund for Agricultural Development |
| ITPGRFA | International Treaty on Plant Genetic Resources for Food and Agriculture |
| IUCN | World Conservation Union |
| MPA | Marine Protected Area |
| NBSAP | National Biodiversity Strategy and Action Plan |
| NCR | National Center for Research |
| NGO | Non Governmental Organization |
| NTEAP | Nile Transboundary Environmental Action Project |
| NWFPS | Non Wood Forest Products |
| PERSGA | Regional Organization for the Conservation of the Environment of the Red Sea and the Gulf of Aden |
| PGRU | Plant Genetic Resources Unit |
| PGRFA | Plant Genetic Resources for Food and Agriculture |
| RPA | Range and Pasture Administration |
| SECS | Sudanese Environment Conservation Society |
| SIDA | Swedish International Development Agency |
| TOE | Tone of Oil Equivalent |
| UNDP | United Nations Development Programme |
| UNEP | United Nations Environment Programme |
| UNESCO-MAP | United Nations Education, Scientific and Cultural Organization Man and Biosphere |
| UNFCCC | United Nations Framework on Climate Change |
| USAID | United States Agency for International Development |
| VDCs | Village Development Committees |
| WCGA | Wildlife Conservation General Administration |
| WCS | Wildlife Conservation Society |
| WRC | Wildlife Research Center |

Chapter 1

1. Overview of Biodiversity in Sudan: Status, Trends and Threats

1.1 Introduction

The Sudan is a vast country extending gradually from the desert in the north, with hot dry climate and almost no vegetative cover, to the African sahel zone in the center, with light and dense Savanna, and to the sub-tropical region in the south with heavier rains and dense tree cover. This endows the country with various environments and different agricultural systems.

The Sudan is an Afro-Arab country well-placed geographically, median among the Arab countries in North Africa, the Arab countries across the Red Sea and the countries of east, central and west Africa. In this respect, the country serves not only as a bridge facilitating trade and human movement, but also as a melting pot of African and Arab cultures. The country by size and diversity is Africa in miniature with complex cultural, ethnic and religious entities. With 2.5 million square kilometers (sq. km.) in area, Sudan is the largest Arab and African country. It enjoys extensive arable land, estimated at some 85 million hectares (ha) (1ha= 2.38 feddans), that can mostly be rain cultivated with rain-fall varying from about 50 millimeters (mm) in the extreme north to more than 1500 mm in the extreme south. Thanks to the extensive rains, most of central and all southern Sudan are largely covered with forests and grasslands, estimated at some 66 million ha. The Nile River with its various tributaries crosses the country from the south to the north with an annual flow of some 84 milliard cubic meters (md.c.m.), Sudan's share of which is 18.5 md.c.m. at Aswan. The country is also well endowed with underground water, which has hardly been tapped, in addition to numerous seasonal rivers outside the Nile Valley, which need to be controlled and regulated to maximize their utilization. These natural resources have allowed the build-up of a national herd of livestock, estimated at some 116 million head of cattle, sheep, goats and camels, as well as several million wild animals. The Nile Valley and the Red Sea are also rich in fish and aquatic life constituting a tourist attraction in addition to their role in food security.

1.1.2. Ecological Zones

Harrison and Jackson (1958) classified the vegetation of the Sudan ecologically into five major divisions, as follows (Table 1)

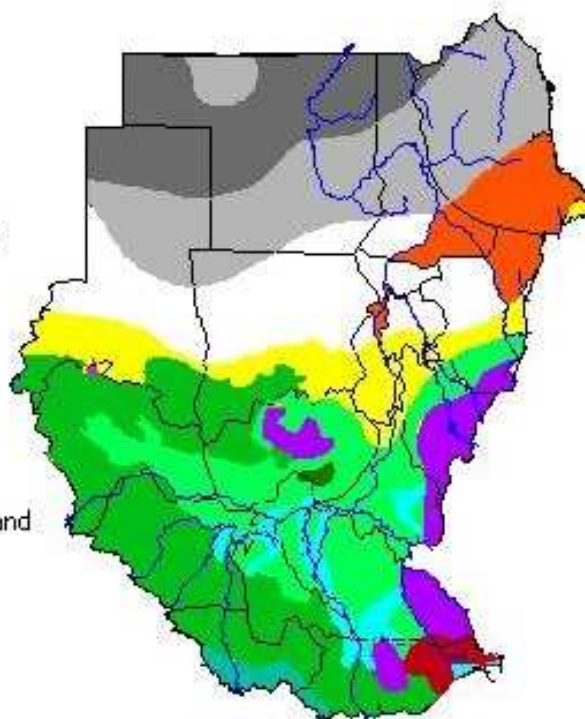
Table (1): Ecological zones of Sudan.

| Major division | Sub-division | App. Area square km. |
|-----------------------|--|----------------------|
| I- Desert | - | 726000 |
| II- Semi-desert | <i>Acacia tortillis</i> – <i>Maerua crassifolia</i> desert scrub | 187000 |
| | Semi-desert grassland on clay | 104000 |
| | Semi-desert grassland on sand | 86000 |
| | <i>Acacia mellifera</i> - <i>Commiphora</i> desert scrub | 86000 |
| | <i>Acacia glaucophylla</i> - <i>Acacia etbaica</i> scrub | 31000 |
| III- Woodland Savanna | low rainfall on clay soils | 96000 |
| | <i>Acacia mellifera</i> thornland | |
| | On dark cracking clays | 52000 |
| | On soils formed in situ with | |

| | | |
|-----------------------|---|--|
| | <i>Commiphora</i> and <i>Bascia</i> <i>Acacia seyal</i> – <i>Balanites</i> savanna woodland <i>anogeissus</i> – <i>Combretum</i> savanna woodland | 119000 49000 |
| | On sand <i>Acacia seyal</i> savanna woodland <i>Combretum cordofanum</i> - <i>Albizzia</i> <i>Terminalia</i> - <i>Sclerocarya</i> - <i>Anogeissus</i> - <i>Prosopis</i> Special areas Toposa area Hill catenas Baggara catena Ragaba catena High rainfall <i>Anogeissus</i> - <i>Khaya</i> - <i>Isobertia</i> savanna woodland Woodland savanna recently derived from rain forest | 65000 86000 65000 36000 70000 18000 34000 311000 36000 |
| IV. Flood region | <i>Cyperus papyrus</i> swamps of the “sudd” and “toich” area with <i>Hyphaene thebaica</i> , <i>Borassus aethiopum</i> , <i>Acacia seyal</i> , <i>A. siberiana</i> and <i>Balanites aegyptiaca</i> among the tree species. | 25000 |
| V. Montane vegetation | The montane areas include the Dongotona and Didinga Hills, the Immatong Mountains, the Red Sea Hills and Jebel Marra. | 6500 |

SUDAN: vegetation cover

- Absolute desert
- Desert dunes without perennial
- Semi-desert grassland and shrubland
- Acacia wooded grassland and bushland
- Woodland
- Edaphic grassland mosaics with trees
- Transition woodland to bushland
- Grassland with semi-aquatic vegetation
- Mosaic of lowland rainforest and grassland
- Deciduous bushland and thicket
- Sahelmontane vegetation



Source: FAO

1.1.3. Population

The total population of Sudan is estimated at 39 millions (2008). The annual rate of the increase in population is one of the highest in the Arab Region (about 3.9%), but the geographic density is one of the lightest 24 persons per square kilometer, on average, varying from one state to another. The demographic constitution of the population is leaning towards the younger generations from 10 to 40 offering adequate labor force.

There are some 42 universities and higher education institutions, most of which have been established after 1990. Currently, only 20% of the students are enrolled for technical education. Plans, however, are underway to increase this ratio up to 60% to match the demand triggered by the enormous investments in industry, mining, communications and modern technology.

1.1.4. Water Resources

1.1.4.1. Rainfall

Summer is the main rainy season, extending from May to October, with precipitation ranging between less than 50 mm in the extreme north to more than 1500 mm in the extreme south. The rainfall, however, is characterized by significant variations in distribution as well as in timing and location thereby magnifying the risks of localized crop failure. To avert this risk, mechanized rainfed production schemes have been spread all over central Sudan. Apart from agriculture, the rains replenish the underground reserve and provide the scattered wadis and water points with annual quantities to support the enormous wealth of livestock and wildlife.

1.1.4.2. Nile water

Sudan is a meeting point of river tributaries that emanate from the Ethiopian plateau and the region of the Great Lakes. The Blue Nile with its tributaries, Dinder and Rahad, flows from the east annually providing some 54 md.c.m. The Atbara tributary adds another 12 md.c.m. On the other hand Bahr El Jebel commences from Lake Victoria with permanent rains, but the greater part of the runoff is lost in the *Sudd* area inside the Sudan, bringing only about 15 md.c.m. at Malakal. The Sobat River, which joins the White Nile at Malakal, flows from the Ethiopian plateau and is fed from tributaries inside and outside the Sudan. About 8 md.c.m. of its runoff (estimated at 13 md.c.m.) are lost in the *Sudd* area of Sobat and Mashar. Almost all the water flow of Bahr El Ghazal River (estimated at 14 md.c.m.) is lost in the *Sudd* area of Bahr El Ghazal basin, leaving only half a md.c.m. to join the White Nile at Lake No.

The big variation in the Blue Nile and River Atbara flow between the high river during the flood season and the low river during the months from March to May has necessitated the construction of dams to store water for irrigation and for the generation of hydroelectric power. At present, there are three dams: Sennar (1 md.c.m.), Roseires (3.4 md.c.m.) and Khashm El Girba (1.3 md.c.m.). However, the accumulated silt in the dam lakes has reduced the storage capacity by 25% in Roseires dam and by 40% in both Sennar and Khashm El Girba dams. Thus, heightening the Roseires dam to increase the storage capacity to 7.3 md.c.m. and constructing Siteit Dam across upper Atbara River to install additional storage capacity for irrigation projects are being seriously considered by the Sudan Government.

Sudan is now utilizing about 14.6 md.c.m. of its share of the Nile water for irrigation, of which 9.5 md.c.m. are from the Blue Nile, 1.7 md.c.m. from River Atbara, 1.8 md.c.m. from the White Nile and 1.6 md.c.m. from the River Nile. The heightening of Roseires Dam and the construction of the new dams will enable the country to fully utilize its share of the Nile water, which stands currently at 20.5 md.c.m. at Sennar (18.5 md.c.m. at Aswan) according to the Nile Water Agreement of 1959. During the early eighties, Sudan and Egypt launched a joint project to excavate the Jongli canal and bypass part of the *Sudd* region, thereby sparing

some 4 md.c.m. to be divided equally between the two countries. However, the project was hampered by the civil strife, which started in 1983.

1.1.4.3. Seasonal surface non-Nile waters

These include El Gash seasonal river which has an annual runoff of 600 million cubic meters (m.c.m.) and Khor Baraka with 500 m.c.m., in addition to about 40 smaller riverlets or wadis scattered all over the central plain, providing about 6.7 md.c.m., which are so far not utilized with the exception of about 0.16 md.c.m. used for domestic purposes. This has been made possible by constructing 63 barrages across the wadis to store 130 m.c.m. and by digging 840 hafirs to store about 26 m.c.m.

1.1.4.4. Underground water

The water bearing rock strata comprise the Nubian Sandstone, the Um Rwaba Series and the basement complex which cover, respectively, 28.1%, 20.5% and 9.1% of the total area of the Sudan. The preliminary surveys of the underground reserve quote the figure of nine md.c.m. However, there is need for more research to ascertain the actual figures for the reserve and the replenishment rate. At present, only about 1.3 md.c.m. underground reserves are utilized, of which about 0.45 md.c.m. are used for domestic purposes, while about 0.85 md.c.m. are used to irrigate about 67,200 ha.

1.1.5. Infrastructure

The development of the infrastructure is highly important for the Sudan because of its extensive area and diverse environment and agricultural systems. Thus, the railway lines draw their importance as lifelines connecting south, west and north Sudan to the main port on the Red Sea coast. The railway in the Sudan is the oldest on the continent and the longest, extending for 4570 kilometers (km) and together with the branch lines constitute some 5500 km.

The total length of the permanent roads in the country is estimated at 50000 km, of which 1700 km are tarmacked and work is underway on a number of intra-state highways.

Sudan Sea Line, which is government-owned, has a number of vessels for the transport of commodities and passengers around the world. Apart from Port Sudan; the main port, other ports are being rehabilitated and developed such as Suakin, Ausif and Bashair from which petroleum products are exported. The communication sector has developed significantly thanks to the introduction of modern technology.

1.1.6. Economy

The livelihood of the population and the source of internal and external trade is based on primary commodities. Over 80% of Sudan's employment takes place in the agricultural sub-sector of the economy and the contribution of this sub-sector has been the highest for the last four decades, at least. Again, 97% of Sudan export trade is in the form of low value primary commodities or agro-based industrial production. Sudan's principal exports are cotton lint, groundnuts, sesame seed, gum Arabic, sorghum grain, livestock, hides and skins together with cotton seed cake and meat.

Agro-based industrial production includes such goods as flour, sugar, biscuits & sweets, tomato paste, animal feed concentrates, vegetable oil, starch & glucose, spinning & weaving and leather work.

Forest products go directly to the household and to small enterprises. The household gets its energy requirements and building materials. The small enterprises receive energy in the form of wood for brick making and furniture timber. The non-wood forestry products are numerous and have mainly food and handicraft values. The most important non-wood product is the gum Arabic, which has an export value and fetches a handsome income of foreign currency.

Livestock export has accelerated in recent years as a result of demand in the Arab region. Its contribution to the GDP is increasing. It has reached about 23% in 1998.

From the above description it is evident that biodiversity is the source of Sudan's present wealth and the driving force of its economic activity. Although Sudan has started producing and exporting petroleum, it will continue to depend on commodity production for some time to come.

This situation means that Sudan has to very carefully conserve the sources of its present wealth in plants and animals. At the same time, and while developing and exporting its oil wealth, Sudan has to avoid and control the pollution hazards associated with the industry both in the hinterland where production takes place and the Red Sea coast where the export terminals are located.

1.1.7. Social Setup

In many of the inhabited parts of Sudan it appears that population has approached the carrying capacity of the environment under the prevailing agricultural and animal production technology. The recurrent conflict between cultivators and herders, particularly in the arid zone, is an indicator of both degradation of resources as well as the growth of the human and livestock populations.

At the present the population of Sudan lives off land resources and their biodiversity. This takes the form of rainfed and irrigated agriculture, wood and non-wood forest products and livestock production. The agricultural sector contribution to GDP is about 40%, which is high compared to other developing countries. This is clear indication of the role of biodiversity in the livelihood of the population. There is growing sense of commitment to the conservation of resources at various levels of the society. The experiences of drought and desertification and displacement have taught the ordinary citizen that his livelihood is vulnerable if he continues to adopt his present survival strategies, which are becoming environmentally unfriendly. Changes have been made in the management of rural resources in order to cope with the new situation.

1.1.8. Legal and Institutional Aspects

There are several laws, acts or ordinances that deal with the environment, either for protection or conservation. What characterizes the current environmental legislation in Sudan is that it is sector based. Thus we have environmental legislation dealing with land tenure, health, forestry, wildlife, fisheries, agriculture, livestock, public health, etc. The sectoral legislation is closely connected to the structure of the government ministries, departments and parastatal corporations.

The legislation has mainly regulatory powers of harvesting some resources and powers of penalty for violation. The essence is both protection and conservation. The sector legislation is in some respects a reflection of the terms of reference of the different ministries and their internal structures.

It may be said that sector-based environmental legislation has been satisfactory for a long time, perhaps up to the early 1980s. The widely observed environment degradation, which arises from the use of resources, has given grave concern and raised the question of the necessity of integrating the work or programs of the different ministries to achieve much needed conservation through integration of planning and development activities in the fields of agriculture, range, forestry, rural water development and veterinary services.

The Higher Council for Environment and National Resources (HCENR) came into existence in 1990. The establishment of the council was in response to the country's internal environmental challenges and in fulfillment of Sudan's international post UNCED commitments.

The council's main role is coordination between the different ministries, which have protection roles of Sudan's resources, the manner of their development and their sustainable use. The council is under the minister of Environment and Tourism. The creation of the ministry is the response of Sudan Government to commitments arising from the UNCED.

The present need in terms of legislation is to advance the protection of resources phase into a phase of conservation and sustainable use. An initial step has been made in this regard by the promulgation in March 2000 of the Environmental Policy Act. The new act is now in force. The new law empowers the council with additional coordinating roles, requires that environmental impact assessment be part of the planning of big development projects and stipulates that environmental awareness becomes incorporated into the general and higher education curricula.

There is still room for further improvements in the institutional structures of the federal system of government. The most urgently needed is the clarification of the roles of the different levels of the government system with respect to responsibilities for planning of development. These levels are the central or federal, state government, provinces and local government units. Precise roles for these levels are yet to be developed and implemented.

1.2. The Status and Trends of Biodiversity in Sudan

Even though Sudan is rich in its diversity of ecosystems, habitats, species and genetic resources, no coordinated, comprehensive surveys or assessments have been carried out. Most surveys and studies on biodiversity components were fragmented and were tailored for limited academic or research and scientific purposes. Data collected or information gathered have most of the time been site-specific, local and at the particular institutional levels. The BSAP assessment was carried out by multi-disciplinary teams. The BSAP project has taken the initiative of updating the information on biodiversity.

The recent biodiversity countrywide assessment undertaken by NBSAP project even though not very comprehensive, it constituted a benchmark and a base of information for the different ecosystems, habitats and species. The effort made was to update the information on the different biodiversity components but future monitoring and filling in of the gaps in knowledge is imperative.

1.2.1. Status and Trends of Agriculture

Cereals

Cereal crops grown in Sudan include sorghum, pearl millet, wheat, maize, rice, finger millet and barley. Important local genetic resources exist from crops such as sorghum, pearl millet, and rice. The Sudan's flora includes the three wild sorghums believed to be the progenitors of cultivated sorghum (viz *S. aethiopicum*, *S. verticilliflorum*, and *S. arundiaceum*). Through centuries Sudanese farmers have developed and conserved diversified varieties of sorghum well adapted to the conditions where they evolved. At present such variability is still observable in different regions of the country. Recent collection mission in South Kordofan state resulted in collection of sorghum landraces with more than 150 local cultivar names, which is an indication of the extent of sorghum diversity that still exists in the country. Pearl millet (*Pennisetum glaucum*) is another important cereal food crop in Sudan especially in the western parts of the country. About 18 wild species of *Pennisetum* are found in the country. Genetic resources of this crop in Sudan consist of a variety of landraces grown by farmers mainly in Darfur and Kordofan regions. Eighteen names for different farmer's varieties were recorded when collecting pearl millet germplasm from North and South Kordofan between 2003 and 2004.

Rice (*Oryza sativa*), although grown on a limited scale in southern Darfur and White Nile regions, it is one of the food crops used in Sudan. Wild types of rice are known to be found in the water-logged swampy areas mostly in the Sudd region of southern Sudan. It is well known that the wild red seeded rice *O. punctata* is found in Radum area in Darfur region of western Sudan, where it is still collected and consumed by the people there. Maize (*Zea mays*) is another cereal crop introduced to Sudan and produced in different regions on a limited scale for local consumption. The grown cultivars of this crop are mainly variable local landraces as it is the situation in the northern, central, western and southern parts of the country. Old cultivars of maize still cultivated in Sudan, and recent collection missions to South Kordofan and Blue Nile states in 2004 and 2005 showed remarkable variation in cob size, and seed colour. Old landraces of wheat (*Triticum aestivum*) in the northern region seems to be completely eroded as not a single wheat accession was collected by a multi-species collection mission carried out in the Northern state in 2005 and only two accessions were collected from the River Nile state in 2008. Another traditional area of wheat production in Sudan is Jabel Marra area in Darfur region, where old traditional cultivars are expected to be found if not lost due to the civil war there. Barley (*Hordeum vulgare*) is not cultivated in considerable areas in Sudan except for some few pockets in Northern and Darfur regions. Only two accessions were collected from the Northern state in 2005. Finger millet (*Eleusine corocana*) is cultivated mainly in western Equatoria of southern Sudan. Due to its cultivation there for long time many adapted local cultivars have evolved. Some wild species are also known in Sudan such as *E. indica* and *E. flagellitera*. The former is believed to be the progenitor of the cultivated types.

Oil crops

The most important oil crops grown in Sudan are sesame and groundnut. In the recent past years the country witnessed expansion in production areas allotted for growing sunflower. Sesame (*Sesamum indicum*) is grown in Sudan under rain-fed conditions by subsistence, semi-commercial and commercial farmers. It is a crop that contributes with a considerable portion in the export trade of Sudan. Selection by subsistence farmers resulted in many landraces adapted to different ecological areas. Three wild relatives of sesame were recognized in Sudan viz. *S. alatum*, *S. latifolium* and *S. angustifolium*. The existing wide variability in the cultivated landraces and the wide spread of the wild types make Sudan an important area of sesame genetic diversity. Collection efforts between 1999 and 2008 have resulted in the collection of more than 300 accessions from areas in eastern, western and central Sudan including both cultivated and wild material with different characters especially on seed colour.

Groundnut (*Arachis hypogea*) is another important oil crop grown in central, eastern and western regions of Sudan. It is mainly produced for its seed oil, which is important cooking oil in Sudan. It is believed to be introduced to western Sudan by West African immigrants about two to three hundred years ago. Farmers' varieties previously grown in that area were of the runner type locally known as "Abu Hibailat", which is a type believed to be available at present only in some remote and isolated areas, with a high risk of disappearance. Fortunately, some few accessions were collected from the traditional runner type from South Kordofan state in 2004. Groundnut material collected so far showed a considerable variation in growth habit, seed size and colour.

Grain legumes

The grain legumes constitute important food crops in Sudan. Several species are grown in the country including winter-adapted species and summer-adapted ones. The main winter-

adapted crops include faba bean, haricot bean, chickpea, lentils, lupin, and pea. The summer-adapted species include cowpea, pigeon pea and hyacinth bean. Some other legumes are grown on a very limited scale of which the bambara groundnut is the most important.

Faba bean (*Vicia faba*.) is the major winter-adapted cultivated legume grown in Sudan. It is grown in the Northern and Darfur regions. The Northern region produces 90% of the total country produce from this crop. The varieties grown by farmers of faba bean are primarily landraces named after locality of production such as Aliab, Zeidab and Agabat. Faba bean in Darfur is produced mainly on the upper terraces of Jebel Marra and northern parts of the region where the climatic conditions are suitable for its production. Varieties grown there are mainly local cultivars introduced from the Northern region. Variation observed in a recent collection mission from Northern and River Nile states in 2005 and 2008 was on seed size and colour. Other winter-adapted legumes include haricot bean (*Phaseolus vulgaris*), chickpea (*Cicer arietinum*) and lupin (*Lupinus ulbus*). Old introduced cultivars from these crops are still grown by farmers in Sudan although a number of improved cultivars were released to farmers.

Cowpea (*Vigna unguiculata*) comes among the most important summer adapted food grain legumes in Sudan. It is believed to be introduced from West Africa to the western parts of Sudan from where it spread to other parts such as the Northern region. This has resulted in a considerable diversity of cowpea types especially in Kordofan region of western Sudan. Collection efforts conducted by the PGR Unit / ARC since 2004 resulted in collection of more than 200 accessions from North Kordofan, South Kordofan, Northern, River Nile, White Nile and Blue Nile states showing considerable variation in seed size and colour. Other summer-adapted legumes grown in Sudan include pigeon pea (*Cajanus cajan*) and hyacinth bean (*Lablab purpureus*) both of which are cultivated depending on old cultivars. Recent collection mission in 2005 and 2008 to the Northern and River Nile states resulted in collecting a number of pigeon pea and hyacinth bean accessions from farmers fields, with the latter showing a remarkable variation in seed colour and size.

Bambara groundnut (*Vigna subterranea*) is a minor leguminous crop in western Sudan. It is grown mainly in the northern part of south Kordofan state, the eastern and southern parts of Darfur and Blue Nile state. It is believed to be introduced there by immigrants from West Africa and still grown on limited scale. Cultivars grown are mixtures of several different lines originated from the original early introductions, which are clearly variable in seed size and colour as observed by collection missions to North Kordofan, South Kordofan and Blue Nile states in 2004 and 2005.

Fibre crops:

Several plant species are used in Sudan as fibre producing plants. More than 30 species indigenous to Sudan are used for fibre production. Many of them grow in the wild, and the most widely used is perhaps the Doum palm (*Hyphaene thebaica*). The most important fibre crop cultivated in Sudan is cotton and to much lesser extent Kenaf and sisal are worthy of mention. As cotton (*Gossypium spp.*) is a main cash crop grown in Sudan, breeding programme on this crop has been an active programme in Sudan within the Agricultural Research Corporation (ARC) resulting in releasing quite a number of improved varieties. However, some old local cultivars and wild relatives might be possible to be collected from different regions of the country. Kenaf (*Hibiscus cannabinus*) is grown in Sudan on small scale. Wild types of *H. cannabinus* are indigenous to many parts of the Sudan. Sisal (*Agave*

sislana) and jute(*Corchorus olitorius*) are also found as wild or cultivated in many parts of the country.

Vegetables:

A number of vegetables are grown in Sudan such as okra, onion, tomato, potato, peppers, eggplant, melons, watermelon, pumpkins, squash, sweet potato, radish, jewsmlallow, purselane, rocket and chard. Okra (*Abelmoschus esculentus*) is the most traditional popular vegetable in Sudan, where both cultivated and wild types of okra are known. Some of the wild types belong to the cultivated species *A. esculents* and others belong to other species such as *A. ficulneus* and *A. manihot*. Recent studies on okra collection of genetic resources revealed that the species *A. caillei* (West African okra) is possibly to be grown in Sudan. Farmers depend almost completely on the use and production of landraces, which in many cases are designated names relevant to the localities where they are usually produced. Recent collection efforts between 2003 and 2008 resulted in the collection of more than 200 accessions from North Kordofan, South Kordofan, Northern, River Nile, Red Sea, White Nile and Blue Nile states with variable plant and fruit characters.

Onion (*Allium cepa*) is a very important vegetable crop produced almost all over the Sudan. It is a crop seems to be introduced into Sudan long time ago. Since then a range of cultivated landraces has been known by farmers in the different parts of the country. Variability between the landraces is very prominent in the bulb characters such as shape, skin colour and storability. The landraces proved to be superior to introduced improved varieties. New improved lines have been selected from local and introduced germplasm and released to farmers by ARC vegetable breeders.

Tomato (*Lycopersicon esculentum*) is among the most the important vegetables in Sudan, where it is used for salad and paste. It is an introduced vegetable and old introduced cultivars have been observed to still exist in some parts of the country especially in the Northern, Kordofan and Darfur states. More than 50 accessions have been collected from local old cultivars of tomato between 2004-2008 from North Kordofan, South Kordofan, Northern, River Nile and Red Sea states, including 14 accessions recently collected from an old traditional area for tomato production that is famous of producing different strains of old salad tomato types in North Kordofan state.

Peppers (*Capsicum spp.*), both hot and sweet peppers are popular in Sudan. They are mainly used as spice or green vegetable in salad. Hot pepper was introduced to Sudan since a long time. Variable local cultivars are well known in the country, and in western Sudan some unique and distinct local cultivars are very famous. For example the type called 'Dingaba' which is extremely hot is produced in Darfur region, while the type called 'Gabinet' which is also very hot is produced in the Nuba Mountains in Kordofan region. A recent study in 2001 has revealed that both species of hot pepper, *C. frutescens* and *C. chinense*, are believed to be grown in Sudan.

Melon (*Cucumis melo*) and watermelon (*Citrullus lanatus*) are among the most important cucurbits grown in Sudan. Melons are believed to have originated in eastern Africa including Sudan. Four cultivated types of melons are grown in Sudan: Sweet melon (*C. melo cantalupensis*), snake melon (*C. melo flexuosus*), a salad melon known locally as (Tibish), and a melon type used for its edible seeds known locally as (Seinat). True wild melons known locally as (Humaid) and belong to the group *C. melo agrestis* grow in central, northern and western parts of Sudan. Traditional local cultivars of sweet melons were grown

in the past along the banks of White Nile. Such traditional cultivars have almost been replaced in the last few years by new improved cultivars imported from abroad. Snake melon cultivars used are totally of local landraces of which some are named after their areas where they were developed. Tibish and seinat cultivars are of local landraces and seem to be belonging to a different melon group, which is grown only in Sudan. Recent studies proved that germplasm of the true indigenous types of melons such as humaid, tibish and seinat included material which could be used as sources of resistance to known virus and fungal diseases. Watermelon used for production of seeds is a major crop in western Sudan, where variable landraces of watermelon are grown. Wild relatives of watermelon could also be found in Sudan. One of them is the wild species *C. colocynthis* (bitter apple), which grows extensively in the Northern region. Watermelon seed is an important source of income for the poor traditional farmers in Kordofan states in western Sudan, as well as an important export commodity for the country. It plays an important role in the foreign trade of the country. A single species collection mission was launched early in 2003 to West Kordofan state for collecting samples of the local genetic resources of watermelon. It resulted in the collection of 113 accessions with remarkable variation in fruit shape, size, colour, pulp colour and taste, and different seed sizes and colours as well.

Leafy vegetables have an important role in the diet of the Sudanese people. Jewsmallow, purselane, rocket and chard are the most important types of leafy vegetables. Jewsmallow (*Corchorus olitorius*) is grown in many parts of the country using local selections from the germplasm of this species. Wild *Corchorus* species grow in the different regions of Sudan. Purselane (*Portulaca oleracea*) has almost the same importance of jewsmallow. Local cultivars are the known varieties being grown. Wild *Portulaca* species also exist in Sudan. Rocket (*Eruca sativa*) is the main leafy salad vegetable grown in Sudan. Culture of this crop depends mainly on local types of which the growers report a degree of variability.

Fruits

Several fruit producing species are grown in Sudan. Some of them are ancient in the country while others were introduced not long time ago. The most well known fruit producing species in Sudan include date palm, banana, guava, citrus fruits trees and mango. Date palm (*Phoenix dactylifera*) is believed to be cultivated in the northern Sudan and upper Nubia since 3200 BC. Dry date cultivars might have originated in Southern Egypt and Northern Sudan. Different local and old cultivars and seedling races are known in the country. They are classified into three categories: dry dates, soft dates and semi-soft dates. The main area of date production in Sudan is the Northern region. Date palms are also grown in a considerable number in the northern parts of Darfur region in the west of Sudan. Some recent developments and problems in the far northern Sudan are likely to adversely affect the local germplasm of date palm. These include the construction of Merowe dam for electricity generation on the Nile, and the infestation by the green scale insect. Displacement and resettlement of local inhabitants, who are date palm growers, from the area where the dam is being constructed since 2003 to a new area might consequently result in the loss of some local adapted strains of the date palm.

Mango (*Mangifera indica*) is believed to be introduced into Sudan via Egypt. About 57 cultivars of mango are reported existing in Sudan. Main areas of Mango production extends along the main Nile banks in northern Sudan, and Blue Nile banks in central Sudan. Big areas of mango trees are also found in the southern parts of the country. Mango trees are also cultivated in some parts of southern Kordofan and in Darfur regions where the other cultivated species of Mango (*M. odorata*) is observed.

Citrus fruit: The most important citrus fruit trees grown in Sudan are sweet orange (*Citrus sinensis*), grapefruit (*Citrus paradise*) and lime (*Citrus aurantifolia*). Such different types of citrus trees are grown in different parts of the country, of which the Northern, Eastern and Central regions are the most important. Jebel Marra area in Darfur has a special importance in citrus production in Sudan as almost all the sweet navel orange fruits (seedless fruits) are produced there. Some citrus fruits are produced in different areas of Kordofan region. Cultivars of citrus grown are absolutely introduced old varieties.

Guava (*Psidium guajava*) is an introduced fruit tree. Seed propagation of guava has resulted in many variable types reported to be more than 20 in Darfur region only. Guava types in Sudan are generally classified into two groups: the white-fleshed and the red-fleshed guava. Some local cultivars have got names of the areas where they are mainly produced. It is produced almost all over the country in different areas.

Banana (*Musa sp.*) is a popular fruit species in Sudan. An old cultivar type, which is Dwarf Cavendish, is the type of banana used to be produced in Sudan for long time. Areas of production are mainly the Southern parts of River Nile State in Northern region, along the Blue Nile banks in the Central region and Kassala area in the eastern region. Recently new cultivars and lines were introduced for evaluation, and some of them have already been released to the growers since 2002. Some types of plantains are also grown in southern Sudan. The newly released banana cultivars with environmental problems such as excessive flooding on the banana fields on river banks have been exerting real threats on the old traditional banana germplasm during the last few years. Active conservation programme has, hence, been initiated in 2002 by the Plant Genetic Resources (PGR) Unit in the ARC to establish a field genebank for banana in Kassala area in eastern Sudan. More than 400 accessions have been collected from different regions and planted in the field genebank since then.

1.2.2. Status and trends of Forestry

1.2.2.1. Tree cover

Harrison and Jackson (1958) estimated the tree cover in Sudan at 36-43%. Extrapolation from the Forest Resources Assessment by FAO in 2005 indicated a tree cover of 29%. This was explained as being a consequence of the expansion in agriculture, urban expansion, fuelwood production and grazing. The Forests National Corporation (FNC) with the cooperation of FAO was able to undertake a National Forest Inventory in 1997, which covered the central part of the country between latitudes 16°N and 10°N. The area covered was 62.3 million ha (622.700 km²) or 24.9% of the total area of the Sudan. The area covered is mainly in the low rainfall savanna region, where almost all-present activities of irrigated and rain-fed agriculture, forestry, grazing, human settlements and oil fields are concentrated. A large part of forest products come from this inventoried area. This survey resulted in a forest cover in the inventoried area of 12% based on the FAO Definition of Forest (10% canopy cover).

1.2.2.2. Current state of forests

Sudan embraces diverse biological resources which represent an important national assets and heritage. Forests provide protection for a variety of genetic resources of plants and animals. There are some 535 tree species in Sudan 25 of which are exotic. It was stated that there are 184 species of shrubs including 33 exotics. Special areas with a wealth of special rare vegetation species are found in the Red Sea Coast and the bowl forests which are a relic of African tropical rain forests in the South West Equatorial region.

There is potential for forest development at present found in the community and private sector in the form of shelterbelts and woodlots and in social forestry where individuals plant trees for poles and firewood. Some of the sugar companies and agricultural schemes, such as Kenana, Rahad, Guneid, Sennar and New Halfa have adopted programmes for tree planting in their estates. These plantations mostly of the fast-growing Eucalypts provide considerable employment to casual labour as well as supply much of the market demand for poles and fuelwood. Private farmers in Jebel Marra and the Gezira have positively reacted to FNC forestry extension messages and planted their own woodlots. As wood market is currently deficient of supplies, especially in the central and northern parts of the country, it is expected that private and community forest plantations are going to increase (Abdel Magid, 2006).

In the majority of agricultural schemes, predominantly in the irrigated areas, the need to maintain crops and livestock from dry winds is usually acknowledged. The FNC, stress the significant role played by shelter-belts and windbreaks in crop production. Yields are reported to be markedly higher in fields protected by windbreaks and shelterbelts (Elfadl, 1997 and Abdel Magid, 1995). Sudan's achievements in the establishment of wood lots, windbreaks and shelterbelts typified the important "support" function of forestry to agriculture. The need to protect agricultural crops from environmental factors, is recognized, among the objectives of forestry policies. Woodlots and trees along water courses (rivers, khors canals water depressions), urban areas, wet lands and dry lands have an important role in soil and water conservation, in the production of significant quantities of timber and fuelwood, and in the provision of animal feed during critical periods of drought. In the drier areas of the Sudan scattered trees such as *Faidherbia albida*, *Acacia senegal*, add nutrients to the soil and provide protection to grasses and shelter to people and livestock from heat and sand storms. In the Sudan, agroforestry has been practiced for many years under the traditional gum Arabic production system.

In the irrigated areas, the need for fuelwood and the production of other non-wood products, such as honey, have generated interest in tree planting along canals and as windbreaks.

The most important role of NWFPs is its provision of self-reliance, employment and food security to local economy. Many communities in the Sudan receive income from collection, processing and marketing of these products. Gum arabic in particular is an important off-farm activity for the inhabitants of the Gum Arabic Belt (GAB). In this activity all the members of the family are employed for about four months of the dry season. In addition, seasonal laborers from other parts of the country migrate to the GAB area seeking employment. In a recent survey covering the GAB area it was found that, on average, 19% of total household income is gained from activities related to gum Arabic.

1.2.3. Wildlife:

1.2.3.1. Status and trends:

Desert and semi-desert areas (Arid regions): The mountains bordering the Red Sea, are host to low density populations of Nubian ibex *Capra nubiance*, Klipspringer *Oreotragus oreotragus*, jackal and leopard *Panthera pardus*, the mountains (jebels) of Northern Darfur "Medob", and Jebel Hassania of the Nile State and Jebel Elba of the Red Sea State and jebel Aweinat on the border between Sudan-Egypt and Libya are hosting few numbers of Wild Sheep *Ammotragus lervia*.

Due to lack of water, wildlife in desert areas of the Red Sea coast, Northern Darfur and Northern Kordofan are restricted to specific locations consisting mainly of dorcas gazelles

Gazella dorcas and smaller animals. Life centers on wadis and oases which are also utilized by nomadic pastoralist.

The Nile riverine strip: The Nile riverine strip is heavily populated and as such only, support birdlife (as the Nile lies on the fly-way of migratory birds from Eurasia to Africa), it also supports low populations of gazelles on isolated sites.

The low-rain fall savanna (The Sahel belt, including the central dryland agricultural belt. The combination of agricultural development and pastoralism effectively excludes large wildlife, although the region host migratory birds, particularly in the seasonal wetlands and irrigated areas. The Dinder National Park is exceptional within this area. There are recent reports of sightings of soemmerring gazelle *Gazella soemmerringei* along the Sudanese Eritrean borders.

The Jebel Marra plateau. The forests of Jebel Marra historically hosted significant populations of wildlife, including lion *Panthera leo* and greater kudu *Tragelaphus strepsiceros* and no recent information is available on current status due to the conflict in Darfur.



The Nuba mountains: The wooded highlands of the Nuba mountain historically held large populations of wildlife, but all recent reports indicate that the civil war led to a massive decline in numbers and diversity, even though forest cover is still substantial. The Jebel EdDair to the north of Nuba Mountains is still having the greater kudu and other associated species.

The high rainfall Savannh:

Most of the Sudanese wildlife (diversity and numbers) are found within the high rainfall Savanna. Due to the conflict in Darfur there is no recent information from the Radoam National Park in Southern Darfur, bordering the Republic of Central Africa. It is believed that extensive poaching is greatly reducing numbers and diversity of wildlife in the park.

Wildlife of Southern Sudan: Recent aerial surveys covering a 150,000 km² survey block was surveyed in Jan. to Feb. 2007. The survey covered the most important protected areas and species ranges as well as potential new protected areas in Southern Sudan. This includes

Africa's 9th and 10th largest national park in Africa, Boma and Southern National Parks respectively.

Results of the surveys indicated that there are still very large numbers of migratory wildlife species remaining in Southern Sudan. This group includes white-eared kob *Kobus kob leucotis*, tiang *Damaliscus lunatus tiang* and Mongalla gazelle *Gazella rufifrons albontata*. Together they make up one of the largest mammal land migration in the world containing what the survey estimated to be about 1.2 million animals. Comparison of results from aerial surveys in 1980's with those of 2007 indicate, with a few exceptions, a considerable downward trend for most species to levels estimated 25 years ago. Although reduced, there is significant potential for wildlife populations to recover in many areas.

The results suggest that the larger and sedentary ungulate species were at much lower numbers or absent in many of the surveyed areas in comparison to observations from the early 1980's. This group included zebra *Equus burchelli boehmi*, eland. *Taurotragus oryx* *Buffalo Syncerus caffer caffer*, and waterbuck *Kobus ellipsprymuns*.

The survey identified an important elephant *Loxodonta africana africana* population in the Jonglei block estimated at 5462. Compared to earlier surveys there was a significant reduction in large carnivore observations. No direct observations or signs of rhino were recorded during the survey. There has been a considerable increase in cattle populations within all the survey blocks, particularly in Boma.

The survey confirmed that important populations of endemic species (i.e. Nile *lechwe Kobus megaceros* in the Zeraf Reserve, white-eared *Kob Kobus kob leucotis* in Boma National Park), globally threatened species and migratory herds remain in Southern Sudan. The survey also revealed additional areas requiring protection and management in order to ensure the long term conservation of migratory species.

The survey confirmed the importance of the Jonglei area as the main stronghold for shoebill stork *Balaeniceps rex* and the most important area in the world for black-crowned crane (*Balearica pavonina*)

The resulting information on wildlife, livestock human activities and habitat contributes to an assessment of threats and the formulation of specific recommendations for strategic planning of wildlife protected areas, and natural resource management in Southern Sudan.

Wetlands and flood plains: wetlands on the Red Sea Coast, desert oases, lakes created by dams (Sennar, Roseries, Khashm el Girba, jebel Aulia and Merowe) in-land lakes such as (Kundi, Kailak and Abyiad) are all considered important wildlife sites for resident and migratory birds. River Nile and Red Sea Coast are part of fly way for soaring birds and other migratory birds from Eurasia to Africa. The vast wetlands and flood plains of south Sudan, which include the Sudd and the Machar marshes are internationally significant wildlife haven, particularly for migratory waterfowl. These unique habitats also support many species not seen or found in large numbers outside of Sudan, such as Nile *lechwe*, the shoebill stork *Balaeniceps rex* and white-ered *kob*.

The subtropical lowlands form the northern and western limits of the central African rainforest belt and thus host many subtropical closed forest species, such as chimpanzee *Pan Troglodytes*. Due to conflict and war no recent information is available.

1.2.4. Range and Pasture

1.2.4.1. Status and trends

Rangelands in Sudan are very variable and extend over seven ecological zones: desert, semi-desert, low rainfall savanna on sand, low rainfall on clay, flood region, high rainfall savanna and mountainous regions. These variations support diversity of vegetation and production systems. Rangelands is estimated to be 110 million ha, and it is estimated that the total forage production is about 85.6 millions tons (dry matter), which includes natural range production estimated at 62.4 million tons and 23.2 million tons is agricultural residue, green fodder, dry fodder and concentrates.

About 204 range species have been collected and identified. However, no complete ecological surveys of the rangelands were made since the comprehensive study of Harrison (1958).

The rangelands cover has been subjected, particularly in the semi-desert and savanna ecological zones, to recurrent droughts in the last three decades. Rangelands are showing a decrease of palatable “desirable” species and increase in unpalatable and invader species. The livestock populations are tremendously increasing due to improved veterinary and drinking water services. However, high rates of mortality of livestock took place during drought years. Over-grazing is among the causes of desertification in the Sudan.

Pastoralism is integrated with traditional crop production which is combined with village based livestock raising. Also, it is practiced by rural and by traditional sedentary population, traditional pastoralism, practiced by tribal groups, through nomadic and transhumance systems..

The gizzu vegetation is an example of unique range plants. It is a group of plants, which grow in desert areas after the scarce rainfall which rarely, falls in the desert. The nomads seek the gizzu as highly desirable nutritious winter grazing.

The gizzu disappeared from the desert areas during the drought periods for more than 20 years. However, during the last few years, the gizzu appeared in vast areas of the desert in Darfur.

The Butana area in Gedarif, Kassala and Khartoum states is also an important grazing area used by nomads during the wet season. The Bahr Al Arab areas in Southern Kordofan and Southern Darfur states are important dry season grazing land for cattle herders.

1.2.5. Coastal and Marine Life

1.2.5.1 Status and trends

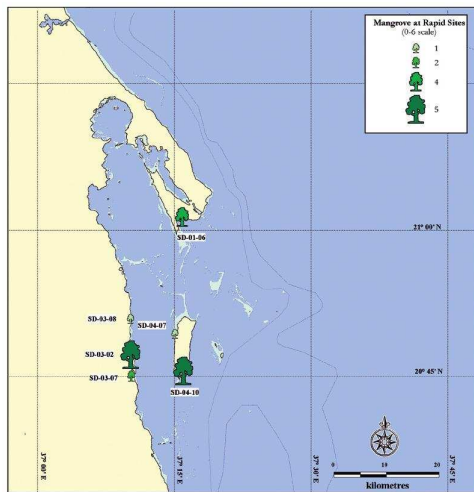
The Sudanese coastline of the Red Sea is about 750 km long, including bays and inlets. Typical feature of the coast are costal lagoons and sheltered bays (marsas) that form natural harbours and fish landing places. Several of these lagoons are fringed by mangroves. Sea grass beds are frequently found in the shallow waters of marsas, and in the lagoons, between the coast and the reefs.

Mangroves

Avicennia marina was the only mangrove species found in the Sudanese coast during a recent survey (PERSGA, 2004). Mangroves are distributed along the Sudanese coast from Mohammed Qol north of Port Sudan to Shabarango-Gafud south of Suakin. Mangrove lagoons and channels are occupied by numerous fish species including many commercially important species. The leaves and shade zones provide additional habitat. The mangrove fauna includes: true residents that spend their entire life cycle in mangroves (e.g. *Aphanius dispar*, *Gerres oyena* and some gobiids), closely associated species that are found there as juveniles (e.g. *Acanthopagrus berda*, *Chanos chanos*, *Crenidens crenidens*,

Hypoatherina temminckii, *Leiognathus equulus*, *Terapon jarbua*, *Pomadasys commersonni* and some mugilid species), and loosely associated species that are occasional visitors seeking food or shelter (e.g. *Sil ago sihama*, *Thryssa baelama*) (PERSGA/GEF 2004b). In addition to marine organisms, mangroves are used as a food source by terrestrial vertebrates and as a roosting and nesting site by many species of birds.

The majority of mangrove stands are affected, at various levels of severity, by camel grazing, felling and limb cutting; however, the mangrove at Klanieb is affected, in addition, by hydrological changes (channels and salt production ponds).



The distribution and relative abundance of mangroves around Dungonab & Mukawar Island MPA (Source: PERSGA/GEF 2004f)



Mangrove at Dungonab-Mukawar Island MPA
Photo: M. Younis

Corals and Coral Communities

The Sudanese coast is characterized by the extreme diversity of its reefs compared to the rest of the Red Sea. The primary coral reef habitats are barrier reefs, fringing reefs, isolated patch reefs, and one oceanic atoll (Sanganeb). The 12 km² Sanganeb atoll is one of the most unique reef structures in the Red Sea, with steep slopes rising from the seafloor at over 800 m depth. Sanganeb atoll has highly diverse and complex coral reefs, diverse reef-associated fauna, sharks, marine mammals and mantas. The Dungonab Bay and Mukawwar Island MPA has a great diversity of corals and coral habitats. Eight coral habitats have been identified and mapped (PERSGA/GEF 2004f).

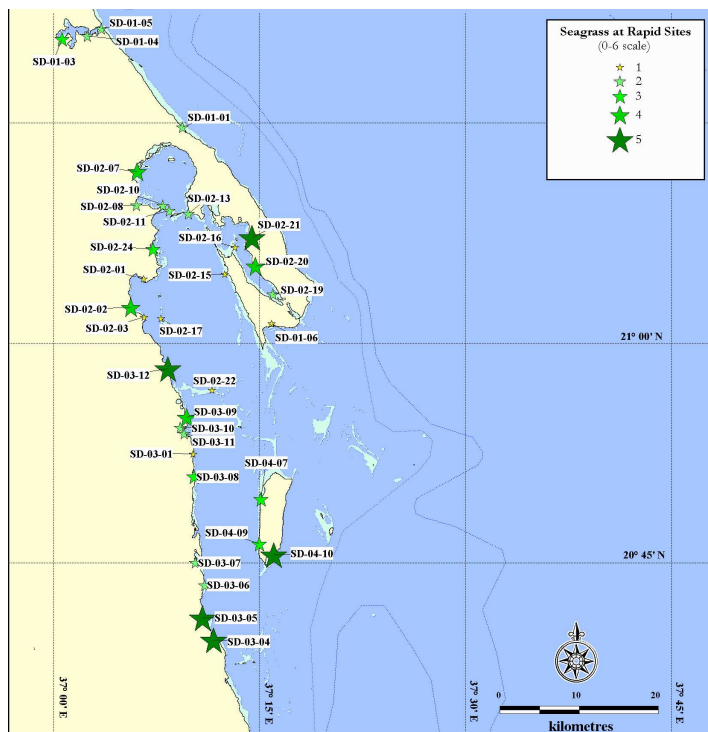
The assessment of the condition of Sudan's coral reefs showed that average live coral cover on reefs in less than 10 m depth ranged from 5–75%. Healthy colonies of framework corals were observed below 10 m. Algal film was the dominant substrate cover in water less than 10 m deep and was attributed to a thermal event. Live coral cover ranged from 5–60%, with dead coral cover higher than 1% noted at only five sites (NASR & AL-SHEIKH 2000; PERSGA/GEF 2003b).

Assessment of coral reefs in the Dungonab Bay and Mukawwar Island MPA showed major differences in the health of coral communities between parts of the MPA. The coverage of living coral was generally greatest within Dungonab Bay (PERSGA, 2006).

Sea-grass

Although sea-grass beds are widely distributed in sheltered shallow water and bays along the Sudanese Red Sea coast, only Dungonab Bay and Mukkawar Island MPA was extensively surveyed.

The survey showed that it included at least seven species of seagrass (*Thalassia* sp., *Thalassodendron* sp., *Halophila stipulacea*, *H. ovalis*, *Halodule uninervis*, *Cymodocea* sp., *Enhalus* sp.). The total area of seagrass estimated from Landsat 7ETM image is 11.68 km²; a very substantial area. The extensive seagrass beds are a nationally and regionally important feature of the Dungonab Bay – Mukawwar Island area, particularly given the probably substantial population of globally endangered dugong found here (PERSGA/GEF, 2004).



The distribution and relative abundance of seagrasses at Rapid Site surveys in the Dungonab Bay and Mukawwar Island survey area (PERSGA/GEF, 2004).

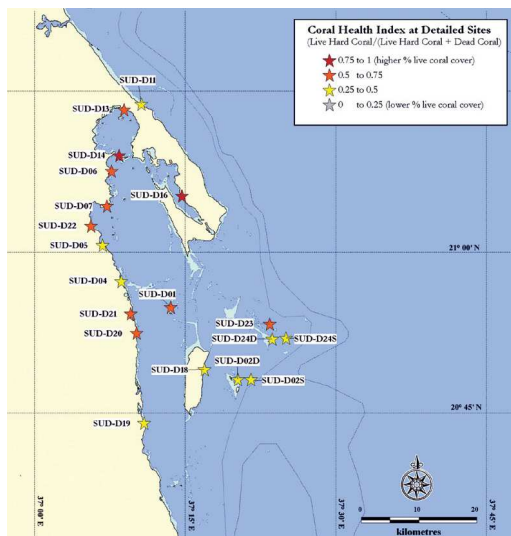
Marine Plankton

Very few studies have been carried out on plankton in the Sudanese Red Sea although currently some post graduate studies are being carried out. Previous investigations included studies in planktonic populations in Port Sudan coastal area (EL Hag et. al., 1989) and studies in coastal plankton fauna of the Sudanese Red Sea (Nasr, 1980).

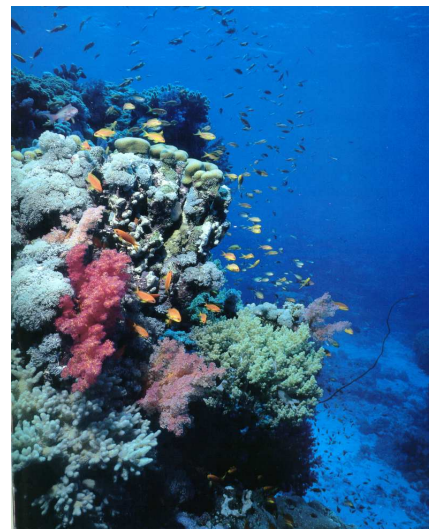
Other Invertebrates

There is severe over-fishing for sea cucumbers in the vicinity of Dungonab Bay where sea cucumbers have been fished out from many shallow areas forcing divers to travel further and exploit deeper waters (PERSGA/GEF 2004f).

Similarly, the mollusks *Trochus* spp., *Strombus* spp., *Lambis* spp., and *Murex* spp. have been severely fished. Most individuals of these species observed in the wild are small and occur at low densities (PERSGA/GEF 2004f). Dungonab Bay is the home for the pearl oyster (*Pinctada margaritifera*).



Coral health indices in the Dungonab Bay–Mukawwar Island MPA in 2002 (source: PERSGA/GEF 2004f).



Coral reef at Sanganeb MPA
Photo: P. Vine

Fishes and Elasmobranchs

The Dungonab Bay and Mukawwar Island MPA is significant for the conservation of fish diversity in Sudan. Major differences exist between the inside and outside of Dungonab Bay in the communities of butterfly fish (family Chaetodontidae) and angelfish (family Pomacanthidae). Communities inside Dungonab Bay closely resemble communities from the southern Red Sea while communities outside the Bay are similar to communities from the north-central Red Sea. The basis of this pronounced difference in community structure is likely to be differences in water quality, temperature, and turbidity (PERSGA, 2006). Additionally, the Dungonab Bay–Mukawwar Island MPA is also well known for its aggregations of whale sharks (*Rhincodon typus*) and manta rays (*Manta birostris*) during summer (VINE & SCHMID 1987; PERSGA/GEF 2004f).

Groupers were more abundant in Sudan in comparison to other sites in the Red Sea, with more than 20 grouper recorded in over half of 20-minute timed swims (PERSGA/ GEF 2003b).

Parrotfish (family Scaridae) are important consumers of algae on coral reefs and contribute to coral dynamics and habitat formation (BELLWOOD et al. 2003). Their conservation is therefore important for the maintenance of coral reef ecosystems.

Assessment of fishes in Mukawwar Island and Dungonab Bay MPA prior to the MPA declaration in 2005 (PERSGA/GEF 2004f) showed that large groupers (family *Serranidae*) were rare and Nagil (*Plectropomus* spp.) over 30 cm in length were rarely observed, suggesting a high fishing pressure on these species. Fishing pressure was intense at spawning and nursery sites for Nagil and other species especially at the southern end of Mukawwar Island. Continuation of this form of fishing will undoubtedly lead to the loss of some of the most important fisheries species.

Turtles

The eastern shore of Mukawwar Island is a turtle nesting site of regional and possibly international significance. Several thousand nesting pits were likely to have been present over 8–10 km of the shore of Mukawwar Island in 2002. There is no deliberate capture of turtles within the MPA (PERSGA/GEF 2004f).

Green turtles nest all year at the following key nesting sites: Seil Ada Kebir Island, Suakin Archipelago and Mukawwar Island. Hawksbill turtles, on the other hand, nest during March – July at the following key nesting sites: Mukawwar Island, Seil Ada Kebir, Suakin Archipelago. Key Foraging Sites for Hawksbill include all fringing and barrier reefs.

Seabirds

The whole area of Dungonab Bay and Mukawwar Island MPA is internationally recognized as an Important Bird Area (IBA). Breeding seabird species include: *Sterna bengalensis*, *Sterna repressa*, *Sterna anaethetus*, *Larus hemprichii* *Larus leucophthalmus* (PERSGA, 2006).

Suakin Archipelago, which is an unprotected area, is also an Important Bird Area including the following breeding seabird species: *Sterna bergii*, *Sterna bengalensis*, *Sterna repressa*, *Sterna anaethetus*, *Anous stolidus*, *Sula leucoaster*, *Larus hemprichii* (PERSGA, 2006).

Marine mammals

Dugong occur in the Mukawwar Island and Dungonab Bay MPA. The population there may be the most important remaining on the coast of Africa. However, numbers have declined sharply in recent years. The cause is most likely accidental capture in fixed fishing nets. Two species of dolphin occur in the MPA (PERSGA/GEF 2004f).

1.2.5.2 Conservational progress

A regionally applicable manual of standard survey methods for key habitats and key species in the Red Sea and Gulf of Aden was produced by PERSGA (English & Arabic).

Collection of essential baseline data on key habitats and species (coral reefs, mangroves, seabirds, turtles) and preparation of up-to-date status reports has taken place.

Regional action plans (following regional surveys) were developed for corals, mangroves, turtles and breeding seabirds and are being implemented nationally via national action plans.

Two protocols were signed by Sudan in 2005: ‘The Protocol Concerning the Conservation of Biological Diversity and the Establishment of Protected Areas’ and the ‘Protocol Concerning the Protection of the Marine Environment from Land-Based Activities in the Red Sea and Gulf of Aden’. Both Protocols are additions to the ‘Regional Convention for the Conservation

of the Red Sea and Gulf of Aden Environment' (the Jeddah Convention, 1982).

Survey design guidelines for marine protected areas (MPAs) have been prepared by PERSGA and ecological and socio-economic surveys have been completed at Mukawwar Island and Dungonab Bay (300 km²) which were declared as MPAs in 2005.

Site-specific master plans, with management guidelines, have been written for Dungonab Bay and Mukawwar Island MPAs with the involvement and participation of local stakeholders.

A number of scientists have been trained (via training workshops organized by PERSGA) in marine protected area management and field surveys, integrated coastal zone management, environmental impacts of development projects, management of solid wastes in industrial areas, and improvement of wastewater management.

Substantial progress has been made in the field of integrated coastal zone management (ICZM) in Sudan including completion of coastal profiles and preparation of an ICZM plan (awaiting official approval).

With regard to Sea-based and land-based sources of pollution two national plans have been prepared: the National Oil Spill Contingency Plan (approved by the Government) and the National Programme of Action for the Protection of the Marine Environment from Land-Based Activities.

Demonstration activities (funded by PERSGA) are being carried out by Sudanese scientists in the field of coral reef monitoring.

However, there is a need to develop community education programmes that highlight the impacts of coastal communities on reef ecology, including degradation, anchor damage, littering, waste disposal and souvenir collection. These could be integrated with programmes of community-based monitoring that involve recreational scuba divers or fishers.

With regard to the two marine protected areas there is a general lack of enforcement, a lack of management expertise and experience, and often a weak implementation of management plans.

Specific conservation action is required for dugong in the Mukawwar Island and Dungonab Bay Marine Protected Area. This should include a ban on fixed fishing nets in those parts of the marine protected area important for dugong.

1.2.6 Status and trends of Insects

1.2.6.1. Overview of insect Biodiversity in Sudan

Insects constitute about 70% of the animal kingdom. In nature, insect populations are characterized by a wide range of genetic variability which maximizes their fitness in the presence of genetic diversity of their hosts and the heterogeneity of their habitat.

The importance of insect biodiversity arises to support and comprise ecological functions that are vital for natural balance and sustainable crop production.

Sudan, the largest country in Africa, occupies about one million square miles, extending from the desert in the north to the equatorial rain forests in the South. This unique geographical coverage makes Sudan one of the richest environment of diverse insect species.

This report outlines the status of insects biodiversity in Sudan. The geographical distribution and the factors that threaten them are also discussed. The report also suggests some recommendations to alleviate these threats.

1.2.6.2. Current status of insect biodiversity

Welcome Tropical Research Laboratories in Khartoum started insect collection and identification efforts in Sudan in 1902. Since then, intensive surveys were made to cover all

geographical regions of Sudan. Although the national insect collection is concentrating on insect species of agricultural and environmental importance, it is considered as one of the biggest and oldest insect collections in Africa. Collected and identified insect species in Sudan (Table 2) is composed of about 15 orders, 248 families and over 4000 species.

Table 2: Identified insect orders, families and species of the Sudan

| No. | Order | No. of families | No. of species |
|-------|---------------|-----------------|----------------|
| 1 | Orthoptera | 10 | 347 |
| 2 | Neuroptera | 3 | 28 |
| 3 | Dermaptera | 1 | 6 |
| 4 | Ephemeroptera | 1 | 3 |
| 5 | Trichoptera | 2 | 6 |
| 6 | Odonata | 5 | 48 |
| 7 | Hemiptera | 20 | 503 |
| 8 | Homoptera | 15 | 115 |
| 9 | Lepidoptera | 45 | 876 |
| 10 | Diptera | 43 | 577 |
| 11 | Hymenoptera | 28 | 392 |
| 12 | Coleoptera | 69 | 2089 |
| 13 | Isoptera | 1 | 5 |
| 14 | Thysanoptera | 2 | 18 |
| 15 | Siphonoptera | 1 | 2 |
| Total | 15 | 278 | 5015 |

The orders coleopteran (beetles), Lepidoptera (moths and butterflies) represent the most dominant insect species in Sudan, while insect species belonging to *Siphonoptera*, *Isoptera*, *Ephemeroptera*, *Dermaptera* and *Trichoptera* are the most less prevent species.

The invasive fruit fly *Bactrocera invadens* (Diptera: Tephritidae) was reported in 2006 for the first time from several fruit growing areas in Sudan. Since 2006, this pest is causing considerable production losses in mango and guava in Sudan. Insects can be classified in the following groups according to their economic importance.

Insect pests

This is the most studied group of insects due to its economic importance as pests of field and horticultural crops (Table 3).

Insects as natural enemies of insect crop pests

Several insect predators and parasites of crop insect pests have been reported in Sudan. These predators and parasites help in checking the outbreaks of some crops insect pests provided that the environment is favorable for their population build-up. Order Hymenopter, *Diptera*, *Coleoptera*, *Dermaptera*, *Hemiptera* *Neuroptera* are the orders that include member insects as natural enemies.

Insects as pollinators of flowering plants

These are insect groups that play an important role as pollinators of flowering plants and, therefore, increase the productivity of field and vegetable crops and fruit trees. Among these insects, the honeybee (*Apis mellifera* Hymenoptera), butterflies (*Lepidoptera*) and some beetles (*Coleoptera*) are the most important ones.

Insects as food

Several insects such as tree locust (*Anacridium melanorhodon melanorhodon*), Dura andat (*Agonoscelis pubescens*) and the queens of termites are eaten by the native people in some parts of the country. Insects also serve as food for birds and fishes.

Table 3: Key insect pests of field and horticultural crops in the Sudan.

| Order | Latin Name | Host Plants |
|-------------|---|---|
| Lepidoptera | <i>Chilo partellus</i> swinh. | Sorghum, maize, millet and wild sorghum. |
| | <i>Antigastra catalaunalis</i> Dup. | Sesame and wild sesame species |
| | <i>Maruca testualis</i> Gey. | Legumes e.g. cowpea. |
| | <i>Syleptra Derogata</i> F. | Cotton, okra and roselle. |
| | <i>Coniesta ignefusalis</i> Hampson. | Millet, Digitaria sp. And Andropogon gayanus |
| | <i>Sesamia</i> Spp. | Sorghum, millet and maize |
| | <i>Earias</i> Spp. | Plants belonging to the genera Gossypium, Hibiscus, Abutilon, Malva |
| | <i>Heliocheilus albipuncella</i> de Joannis | Cultivated and wild millet. |
| | <i>Ephestia</i> Spp. | Cereals, dates, oil seeds |
| | <i>Helicoverpa Armigera</i> Hb. | Cotton, okra, sorghum, millet, maize, lobia, groundnut, tomato, egg plant, sunflower and Ipomea cordofana |
| | <i>Sitotroga cerealela</i> Ol. | Sorghum |
| | <i>Phyllocnistis citrella</i> Stnt. | Lemon, grapefruit, tangerine and orange. |
| | <i>Papilio Demodocus</i> Esp. | Lemon, grapefruit and orange. |
| | <i>Auchmophila kordofensis</i> | Acacia spp. e.g. Acacia nubica and A.tortilis. |
| Coleoptera | <i>Rhinyptia Infusata</i> Burm. | Millet. |
| | <i>Henosepilachna elaterii</i> Rossi. | Water melon, melon, cucumber pumpkin and vegetable marrow. |
| | <i>Mylabris</i> Spp. | Okra |
| | <i>Tribolium</i> Spp. | Sorghum and millet. |
| | <i>Trogoderma granarium</i> | Sorghum, Wheat, legumes |
| | <i>Rhyzopertha domenica</i> | Cereals. |
| | <i>Oryzaephilus</i> Spp. | Cereals, dates. |
| | <i>Aulacophora africana</i> Weise. | All cultivated cucurbits, lobia, cowpea, groundnut, cotton and wild cucurbits and legumes. |
| | <i>Callosobruchus</i> Spp. | Cowpea |
| | <i>Caryedon serratus</i> Oliv. | Groundnut and pods of Acacia trees |
| | <i>Podagrica</i> Spp. | Cotton, okra, roselle and sesame. |
| Diptera | <i>Contarina Sorghicola</i> Coq. | Cultivated and wild Sorghum. |
| | <i>Dacus vertebratus</i> Bez. | Sweet melon, watermelon, cucumber, pumpkin and mango. |
| | <i>Ceratitidis</i> Spp. | Guava, mango, |

| Order | Latin Name | Host Plants |
|--------------|--|---|
| | <i>Bactrocera invadens</i> | Mango, guava, bananah |
| Orthoptera | <i>Schistocerca gregaria</i> <i>Forsk.</i> | Sorghum, millet, cotton and sesame. |
| | <i>Anacridium melanorhodon</i> <i>melanorhodon Wlk.</i> | Acacia senegal, Balanites aegyptiaca, dura, cotton and fruit trees. |
| | <i>Oedaleus senegalensis</i> <i>Krauss.</i> | Millet, sorghum, sesame, cotton, groundnut, grasses and vegetables. |
| | <i>Harpezoatantops</i> <i>stylifer</i> | Millet, sorghum, sesame, cotton, groundnut, grasses and vegetables. |
| | <i>Diaboloatantops axillaris</i> <i>Thunberg.</i> | Millet, sorghum, sesame, cotton, groundnut, grasses and vegetables. |
| Thysanoptera | <i>Thrips tabaci</i> Lind. | Onion. |
| | <i>Caliothrips impurus</i> Pr. | Cotton, groundnut and lubia. |
| Hemiptera | <i>Bemisia tabaci</i> | Cotton, tomato, cucurbits, eggplant |
| | <i>Aspongopus viduatus</i> | watermelon |
| | <i>Nezara viridula</i> | Okra, melons, cwopea, lubia and sorghum. |
| | <i>Elasmolomus sordidus</i> F. | Sesame and groundnut. |
| | <i>Lygaeus pandurus</i> Scop. | Sorghum, millet, chilli, okra, sesame and cotton. |
| | <i>Lygaeus equestris</i> | Sorghum, millet and sesame. |
| | <i>Agonoscelis pubescens</i> Thnb | Sorghum and Sesame. |
| | <i>Dysdercus fasciatus</i> Sign. | Baobab tree, cotton and okra. |
| | <i>Jacobiasca lybica</i> | Cotton, okra, other Hibiscus spp., egg plant, tomato and cucurbits |
| | <i>Aphis gossypii</i> Glov. | Cotton, okra, chilli, egg plant, tomato, groundnut, cowpea, watermelon and other cucurbits. |
| | <i>Rhopalosiphum maidis</i> <i>Fitch.</i> | Rhopalosiphum maidis Fitch. |

1.2.7 Overview of Livestock biodiversity in Sudan:

1.2.7.1 Status & trends of livestock biodiversity

The Sudan possesses an immense and diversified wealth of animal resources, ranging from the domesticated livestock species to the wild and aquatic life which contribute significantly to the food security as well as a considerable base for the economy of the country .Indeed, the livestock accounts for some 20 – 22% of the country’s GDP and 53 – 56% of the agricultural GDP. The country is self-sufficient in meat and the raw material of hides and skins for industry.

Livestock production systems

The livestock production systems in the country generally fall under five major systems:

- Pastoralist system (i) nomadic and (ii) transhumant.

- Sedentary and semi-sedentary.
- Intensified livestock/crop production system.
- Commercial fattening, daily and poultry production system.
- Intra-urban backyard production system.

A. Traditional system

(i) Pastoralist nomadic

Pastoralists depend on rangelands and move animals where feed and water are available, in specific geographical zones (camel) and cattle owners in Kordofan and Darfour). These groups own 80- 90% of the total number of cattle, 100% of camels, 80% of sheep and 60% of the goats of the country. The herd sizes in the system vary, averaging 200, 70, 90 and 200 for cattle, sheep, camels and goats, respectively. The system is the main source of meat for the local demand and for export.

(ii) Transhumance system

This is practiced in the Southern part of the country where herdsmen move away during the flood time and to it when recedes. The herds are kept in enclosure (luaks). The seasonal movement is short for distances as compared to the nomadic system. Herd sizes are small and are mainly cattle, which represent the pivot for the economic and social life of the people.

(iii) The sedentary and semi-sedentary system

This includes livestock owners who practice rainfed agriculture and also send their animals with the nomads to feed on agricultural by- products in the area. The system also includes farmers in the irrigated schemes who raise small ruminants for supplementary financial support. Owners keep milking animals and send dry ones with the pastoralist nomads. The system supplies milk to towns and urban areas, and is characterized by low technology.

(iv) The Intra-urban backyard system

In this system, mainly goats and poultry kept for domestic supply. This system is widespread in rural and around urban areas for “productive families” Animals and birds live on household waste and as scavengers.

B. The Improved modernized systems

(i) Integrated intensive livestock/crop production system

In this system, intensive dairy production is using irrigated fodder and concentrates with exotic breeds or indigenous local breeds. This system is seen as the promising system for the future supply of milk and meat for the increasing demands of the communities in the country.

(ii) Commercial production system:

This includes: Milk cooperatives, specialized large dairy enterprises and individuals that own high producing milking cows. The system is particularly seen around big towns.

Feedlots for fattening cattle and sheep trekked for long distances from the western regions of the country to urban areas and markets. Fattening is also practiced in big privately owned rainfed mechanized agricultural schemes on crop residues;

(iii) Transitional system

Improvement of the traditional system is a progressive activity recently practiced where animals are raised on natural range (especially sheep), and water and feed supplements are

transformed to those areas. Another recent activity is raising animals on mechanized rainfed agricultural schemes.

Livestock feed resources

About 86% of the feeds for animals in the Sudan are derived from rangelands. Crop residues and agricultural by-products contribute 10% whereas 4% of the feed is from the irrigated forage and concentrates. The Sudan produces all the raw material necessary for feeding cattle and small ruminants on feedlots and dairy farming systems. The agro-industrial by-products of the country include molasses, cottonseed cakes, groundnut cakes, sesame cakes, sunflower cakes and wheat bran.

Livestock census

Attempts to carry out the livestock census in the country started as early as 1916. These were often complemented with data from other sources such as vaccination figures, livestock taxes etc... In 1975/76, an intensive effort was made to carry out an aerial survey. Till now this was considered the most reliable census undertaken in the country. The livestock figures that follow were estimates based on growth rates, mortalities, off-takes...etc extrapolated from that source.

The recent estimates for the livestock in the country stand at 138.965.000 head of animals as follows:-

| | |
|--------|------------|
| Cattle | 41.138.000 |
| Sheep | 50.561.000 |
| Goats | 42.938.000 |
| Camel | 4.238.000 |

Types and breeds of livestock

The majority of the livestock breeds or types is raised within tribal groups and often carries the name of the tribe or locality. The same type may also carry different names. However, major classifications of the different ecotypes were agreed upon.

Cattle

Cattle in the Sudan are descendents of *Bos indicus* (zebu) they are adapted to the tropical environmental conditions because of their high degree of heat tolerance and partial resistance to many diseases particularly tick and tick borne diseases.

The cattle populations in the Sudan reached 41.138.000 heads .They are generally classified into

1. The Northern Sudan short horned Zebu

That includes three main types:

- The Kenana type (Rufai) which is found in Eastern & Western Banks of the Blue Nile, (fung area). White Nile and Gazira states in a Triangle bounded by Sennar, Singa, Roserires and Kosti. The total population of Kenana cattle has been estimated at more than 2 million heads own by nomadic & semi nomadic tribes including Kenana , Rufaa EL Hoy and Beni Muharib .The characteristic color of Kenana is light blue –grey with gradation from white to steel grey, the horns are short and a well developed dewlap .Kenana cattle are among the best milk producing African dairy breeds.

- Butana type is found mainly in the Butana Plateau in a triangle of River Atbara, Blue Nile and River Nile and a round Kassla, their total number was estimated about two millions owned by Shukria and Batahein tribes. Generally are of big size, reddish in color resemble Kenana in size and milk productivity. Very pure breeds of Butana cattle were kept in Atbara Research station.
- Baggara type are localized mainly in western part of the Sudan, owned by many tribes in Darfur, Reziagat, Habania, Falata, Taaisha their number reaching 8 million heads and in Kordofan about 5 millions owned by Mysaria and Hawaza tribes. Baggara cattle are considered the meat animals for local consumption as well as for export, milk production is extremely poor. Various coat colors are found. Black, Red, White and has a well developed hump, long horns & dewlap. Other types of Northern Sudan Zebu cattle include White Nile Cattle, Fuga or Dar EL Reeh cattle of Northern Kordofan, Nuba Mountain cattle and Aryashai of Eastern Sudan.

2. Southern Sudan Zebu Cattle (Nilotic)

Includes, Murle, Taposa and Mangala cattle types owned by Taposa and Murle tribes in the Southern States of the Sudan. Murle & Taposa cattle are concentrated on the South Eastern part of Equatoria its of big size, long horns and different colors Black- grey and white. Mangala cattle found in Equatoria states Eastern part of White Nile it has small size of middle hump & dewlap & short horns.

3. Zebu Sanga or Nilotic

Consider one of the ancient cattle breed in Sudan owned by Dinka, Shuluk and Nuer tribes, the major characteristics is the very thick long horns and small hump, color white – dark red or black, yellow. They are meat breeds but has a social importance.

4. Umbororo (white fulani)

Found in Western Sudan moving from Nigeria, Chad, Cameroon up to Ethiopia, owned by Falata Umbororo tribes, they are of big size very long horns and dark red color.

Sheep

Sheep are primarily bred for purpose of meat & milk they produce best sheep skins for export also provide very important local containers (girba, khurj) for transport of water while some hair is used by some tribes for making tents & carpets the number of sheep due to the last census are 50.651.000, sheep are found in every state but are concentrated in Kordofan, Darfur, Blue Nile, Gazira.

The sheep of the Sudan belongs to a number of ecotypes of tribal breeds.

- The Desert ecotype is an export animal with excellent meat and carcass characteristics its live-weight reach 68-77kg includes Kabashi, Hammar, Meidob. Butana watis, Ashger Dubasi, Beja found in Northern, Central and Western Sudan.
- Arid up land ecotype Zoghawa, Fallata or M'Baroro.
- The small size Nilotic ecotype, Dinka, Nuba, Mongalla and the Toposa and Murle of the Southern/East equatoria.

Goats

Sudan goats have apparently spread all over the country, around the Nile basin Desert areas, rich & poor savannah, Foresty areas in the South & in small & big towns, its called poor mans cow it can withstand all the adverse climatic conditions. The total Number reaches. 42.756.000 divided into four major ecotypes.

- Nubian goat which is the predominant type represents more than 50% of the goat population in the country its milk breed , weights up to 40/kg were recorded . It is of Black color long-legged with pendulous ears long hair , long udder, it has a good reproductive potential that can give birth three times every two years and 50% of the females give twins or triples .
- The Desert goat (17%) with long-legs dark brown in color raised by the Savannah belt in scarcely of water & depending on the Succulent plants, it is a breed for meat.
- Nilotic goat were found predominantly South of 12 latitude it is a descendant of the Dwarf goat of Africa widely spread all over Southern part of Sudan especially with tribes of Asholi , Latoka , Baria & Tabosa, it has small legs and strong body , the weight is 11/kg , its color white or black or mixed , the body is fleshy & full of meat but of neglected milk production.
- The mountain goats (tagar) have a short legs and ears, grey or brown in color long hair around the neck represent 3% of the goat population found in Nuba mountain, Alengasna, and Jabel murra well known with rapid, light movement and leap that assist in climbing mountain and escape from beasts, bred for meat only and have a very few amount of milk for the kids.
- Exotic breeds a number of exotic breeds have been imported into the country i.e. Anglo-Nubian which is a British crossbreed from indigenous Nubian goat with the Indian Gamna pari the color dark brown with white face & ears or black mixed with white it is milk production reached 3.5 kg/day it was kept in Kuku research station to improve the genotypic characters of the local breeds but it was exposed to different diseases.
- Saaneen (temperate breed) males were imported from Holland for cross breeding proved to be an adequate breed of high milk production. Damascus (Middle East)

A number of male goats were given as a gift to the gazira scheme so it spreads around the gazira and it's famous for big broad udder Toggenburg was imported to the Research stations it was spread far from the stations.

Camels

The number of camels in Sudan reached 42.238.000 heads distributed between latitude 12 and 16 north. The one hummed camel (*camelus dromedarius*) is the type which exists in the Sudan classified into two major types.

1. Pack camels or baggage camel

Constitutes 90% of the total population and is widely distributed in the desert & semi desert regions have large heavy body short legs and of slow speed & it includes:

Rashaidi (Zubiadi) strong short legged animal raised by Rashaida tribes in Kassala, Toker and Red sea areas, brown -red color.

Arabi camels the light type raised by Hadandawa , Beni Amir and Amarar tribes and the large sizes is raised by shukria , Bataheen and Lahawean .

Kabashi camels is the largest massive sized of the baggage type in the country , have long neck big head , thick lips , and well build hump & small hair, color is white grey to red, distributed west of the Nile and raised by the Kababish, Hawawir , Kawahla tribes in Kordofan. The Gharbawi (Western) mainly found in Darfur states

2. Riding Camels

Represents 10% of the total population of camels in Sudan, distributed between the Nile and the Red Sea includes:-

Anafi (Shukri) Found in Butana area and Kassala state , the body is long, small size and light weight color is white-brown , having soft hair , used for riding and racing for small distance . Bushari Camel (Hadandowi) owned by the Bija and Hadandowa tribes found in EL Gadarif , Kassala and Red Sea states of long body strong muscles , small size & light weight color is white sandy an excellent race camel.

Although camels are used for riding and carry baggage but they are good meat and milk producers. The milk is used by different tribes as a medicine for treatment of many diseases like ascites, Jaundice, Anaemia, Pneumonia e.al and from camel hair, (wabar) they produce clothes, carpets and tents.

Equines

1. Horses

Two groups of horses are recognized in the Sudan.

- Arabian type (Ghorbawi) this found specifically in Northern Darfur States and in Kordofan states has light brown color, some are white in color of medium size used for riding, carrying baggage and looking after the grazing cattle stocks.
- Dongolawi type found in North and Central Sudan and Northern Darfur state has a large smart body and black withers & tail.

Crossing with some exotic breeds of horses especially the pure Arabic breeds and the English breeds from England & Kenya is practiced in Khartoum , Nyala , EL Fashir and excellent by breeds are now recognized as a race horses. The total number of horses in Sudan reached 747.112 head.

2. Donkeys

The donkey's population in Sudan is more than the horse population reaching (7.367.096) divided into two types.

- Pack donkeys carrying local names Mackady, Darawy, has short legs, thick & short neck & ears, it is slow animal used in carrying water inside & outside villages and small towns and pulling small carts.
- Riding donkeys Donglawy (Rifawi) Its high –fast animal used for riding, the color is black or white grey or white, found in the Northern part of the Sudan in the Agriculture schemes around the Nile and in Eastern states, Darfur and Kordofan. Its also used for distribution of milk & vegetables in side the towns.

3. Pigs

Indigenous breeds of pigs are raised by the Alangasana tripe at Blue Nile state and AL Maban tribes in the Upper Nile states in restricted areas and limited numbers.

4. Poultry

The local beladi fowl (*Gallus gallus*) is well adapted in the backyard system everywhere in the country .It is a small bird, supporting families in rural areas with eggs.

With developing poultry industry in the country, a number of exotic breeds were introduced: White leghorn, Brown Sussex, Fayoumi for both broiler and egg production.

Threats

Decision-makers and public opinion underestimate the roles of natural resources and their importance for socio-economic development and environmental protection; the investment budgets geared to natural resources conservation and development do not attach sufficient

priority to, or allocate adequate economic motivation. Domestic markets and marketing channels for local natural resources products are inadequate;

Abdel Magid and Badi (2008) stated that the natural resources were subjected to heavy overexploitation for agriculture, felling for fuel and overgrazing to the extent that extensive stretches of land lie bare of vegetation. In the areas accessible from the capital city and Gezira such as White Nile and Northern Kordofan and Darfur are considered to be most affected due to factors of erosion. Certainly that the removal of trees and other types of vegetation will reduce rainfall and promote drought.

In the absence of legislation enforcement, implementation of conservational action plans and management plans, marine and coastal ecosystems will continue to face various kinds of threats. Community education programmes that highlight the impacts of coastal communities on reef ecology, including degradation, anchor damage, littering, waste disposal and souvenir collection will play an important role in mitigating such impacts.

Specific conservation action is required for dugong in the Mukawwar Island and Dungonab Bay Marine Protected Area. This should include a ban on fixed fishing nets in those parts of the marine protected area important for dugong.

Table 4. Shows an analysis of the goals, objectives, targets and status of strategies and actions developed under the NBSAP

| Threat | Status /Impact | Key indicators |
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| Energy Consumption | Sudan depends mainly on forestry sector as energy source. Forests contribute by a total of 4.11 million T.O.E representing 70 - 81 percent of energy supply in the country (FNC, 1995). Demand for wood fuel increased in last years due to rapid population growth, urbanization and shortage in supply of other forms of energy. Figure below shows the total energy supply in the period (1993-94) indicating that wood energy supply was equivalent to 81% of total energy. | Recent projections revealed that still there will be an increase in total quantities demanded from wood fuels, even if the level of substitution of petroleum fuels for cooking in household sector is increased annually by 15%, the total quantities of wood fuel consumed will remain at the same level. Poverty will be a determinant factor affecting the degree of substitution (Abdelsalam, 2000). |
| Traditional shifting cultivation | Elsiddig etal (2006) reported that the bush – fallow practice is kind of agroforestry production system developed and controlled by farmers. It is based on indigenous knowledge associated with gum production system acquired by farmers in the gum belt communities over long time and continuous to be developed and inherited through generations. The system is sustainable as long as it is maintained along its cycles. However, in many areas in West Sudan, the frequency of the cycle is shortened because of population pressure and the increasing need for the land. The soil potential is poor, unstable, and can only offer a limited degree of use with shortened fallow cycles. This situation of shortened fallow cycle period, coupled with increasing in number of people and their livestock, exert great pressure on what was already a fragile system. | The projection of UN reflects that urbanization will increase by 110%, so expansion of human settlements will be at the expense of tree cover. Rural-urban migration affects demand for natural resources and plays an important role in urban growth. In 1980 urban population was estimated as 3.7 million, increased to 10.7 million in 2000. Hence as urbanization is accelerated, expansions into protected forest areas will take place e.g. Sunt forest-Khartoum. In spite of large flows of rural to urban areas, high fertility rate in rural areas resulted in substantial growth, exerting pressure on natural resources. |
| Mechanized Agriculture: | In this type where the machinery is used, an area varying from a few thousand feddans to a couple of million | The advent of the mechanized farming in east and central Sudan caused eradication of forests and |

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| | <p>feddans is selected by virtue of suitable fertile flat soil and optimum rainfall for rain-fed agriculture and demarcated for crop production. The forest is totally removed using heavy land clearance machinery resulting in vast expanses of bare land. This contributed in shortage of natural animal feeds that Leads to overgrazing.</p> <p>The modern agriculture is characterized by the use of advanced improved cultivars in a mono-cropping system of agriculture.</p> | <p>range resources from large areas, currently estimated at over 14 million feddans (1.0 feddan = .42 hectare).</p> <p>Many improved high yielding varieties are being released and / or introduced for different crops. This occurs at the expense of indigenous landraces or old cultivars. Several new varieties have been released by the ARC during the last six years 2003 – 2009, which will definitely have adverse effect on the local genetic resources of crops.</p> |
| <p>Illicit felling</p> | <p>The needs of the population for natural resources products such as timber for construction purposes and implements for agriculture and their daily need for fuel are satisfied through organized exploitation within officially demarcated forest areas known as forest reserves. The official production usually falls short of the demand and it is supplemented by other fellings mainly for fuel in areas demarcated for agriculture and areas where natural regeneration is possible.</p> | <p>Pressures on natural resources continue to mount because of population growth, not only due to the natural increase of the Sudanese but also due to the influx of migrants and refugees from other countries; some as remote as Nigeria in West Africa. The rural people in general, including nomads, have been worst affected by the decline of the forest resources because their livelihood is much dependent on trees and forests. Where those income generating systems, which are marginal by nature, fall bellow the threshold limits and fail to support living requirements those adversely affected are displaced to towns to join the urban poor. Those who, for one reason or another, remain and struggle to earn living from their home lands contribute to further</p> |

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| | <p>Conservation status in most areas is unsatisfactory</p> <p>Socio-economic factors usually influence the types of crops grown by farmers.</p> | <p>environmental degradation through expanded rates of deforestation and hence more poverty. Civil war, and political conflicts in neighbouring countries have created large flows of refugees estimated about one million, residents in Western, Central, Eastern and Southern Sudan. Although their movements have been too small to significantly influence national population growth, the refugees have significant role in environmental degradation. The refugees concentrated in camps, exerting pressure on surrounding forests and range resulting in deterioration of natural resources, increasing competition and conflicts with local communities over the scarce resources. The main cause of conflict in land use practices is the absence of national land use policy and map. Habitat destruction and fragmentation, encroachment of agricultural projects into forests and wildlife areas, poaching, and limited economical revenues from legal wildlife development. The land tenure system and the consequent land fragmentation have forced farmers in the Northern region to shift to high yielding varieties or to crops with low input cost and high revenues.</p> |
| Over-Grazing | Grazing domestic herds consume the young tree seedlings in forest gaps caused by felling and shifting cultivation causing severe hindrance to the natural | Rangeland degradation as a result of the overuse of dwindling resources is the most well-known environmental problem associated with livestock |

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| | <p>restocking of forest stands, while in browsing the animal eats up the leading shoots and tips of branches causing the trees to remain stunted and unable to develop to maturity.</p> <p>Large number of livestock occupying some rangeland beyond the optical carrying capacity that may lead to deterioration in range land productivity.</p> | <p>husbandry in Sudan. According to UNEP, (2007) and different studies three negative trends can be clarified:</p> <ul style="list-style-type: none"> • Unsteady increase in livestock numbers, mainly in central Sudan; • Major drop in the total area of available rangelands; and • Widespread deterioration of the remaining rangelands, caused mostly by drought, climate change and overstocking. Extensive annual rangeland burning in south and central Sudan is an additional significant environmental issue, as this practice degrades and changes the natural environment in low rainfall savannah regions. |
| Pests and Diseases | <p>The most important epidemic for forests in Sudan is the dieback of Sunt (<i>Acacia nilotica</i>). This affects many of riverine forests. It considerably reduces increment but rarely kills the trees. Certain insects make difficult the artificial regeneration of some species. Termites are a serious problem in Eucalyptus plantations. Most other pests and diseases only do minor damage. Insect attack on seed has probably more effect on natural regeneration of certain species like Acacias, <i>Balanites aegyptiaca</i>, <i>combretum spp.</i>, etc. Sariallial Locust, <i>Anacridium sp.</i> attacks Acacias mainly the gum tree <i>Acacia senegal</i> in large numbers. The locust outbreaks affect the production of gum Arabic eating the tree leaves.</p> <p>Sudan long borders crossed by livestock & game animals running after water & pasture carrying very serious eizootic diseases to the local breeds such as to PPR, Rift valley fever ect. Game animals proved to be reservoirs of trypanosomiasis which is wasting and killing</p> | <p>FNC possesses weak information about diseases and insects in forestry like research and education institutions. The tree locusts (<i>Anacridium melanorhodo melanorhodon</i>) and grasshoppers represent the most destructive flea concerning gum Arabic production. The tree locusts have heavily impacted production in the Upper Nile state and Southern Kordofan where the production did not exceed 20% of the then prospective estimates. This was negatively reflected on the Gum Arabic Company sales which decreased to 21% in the Upper Nile state and to a very marginal ratio in Southern Kordofan state. The tree locust has also been a major factor contributing to the failure of the summer season in Western Kordofan and Greater Darfour states.</p> |

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| | <p>disease transmitted by Tsetse flies.</p> <p>Pests and diseases that attack crops usually have negative impacts on the genetic variability within the crops.</p> | <p>They exert selection pressures on such crops leading to the extinction of those susceptible strains of cultivated species. A good example is the introduction of the green scale insect in the 1970s, which is leading to damage and loss on many date palm trees in the Northern region, including traditional old cultivars.</p> |
| Fires | <p>Fire is a serious problem in all areas of natural resources in the Sudan. Only the semi-desert area, where the grass is normally too sparse to burn, and the small areas of closed forest in the South Sudan, where there is no grass, are relatively free from fires. Even in these areas fires sometimes occur, and do considerable damage.</p> <p>Fire usually seted for land preparation for cultivation but it also destroy the range land, large animals leave their habitat to remote areas or may be subjected to death.</p> | <p>Out of a total of 4 million tons of wood annually removed for various purposes from the natural and managed forests of Sudan, fire is responsible for the destruction of 250,000 ton; most of the fires in low rainfall savannah region are surface fires spreading through the tall grasses in the open stands with very high flames. Surface fires are a much greater menace to natural regeneration; man made young plantations trees in all stages of development and seeds stored in the soil.</p> |
| Petroleum Industry | <p>A recent survey was conducted by FNC in the petroleum sites in different states, to assess forest areas removed due to several exploration activities. The survey revealed horrible results.</p> <p>Huge areas of range lands were removed due to several exploration activities the chemically treated water extracted covering the land is highly toxic causing death to livestock at the area.</p> | <p>Oil exploitation since the 1980s has had a detrimental impact both on the environment and on population livelihoods. Oil facilities (drilling sites, pipelines and roadbeds) were planned and built without considering the impact on local livelihoods. Pipelines were constructed on farmland and grazing areas, stock routes were blocked, forest areas, farmlands and access to good water sources were all reduced and the flow of water into farm and pasture areas was obstructed (IFPRI, 2006; Siddig et al., 2007).</p> |

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| Mesquite in the Sudan | Abdel Magid (2007) stated that in a number of locations in the irrigated agricultural schemes in the Sudan, under certain environmental conditions, mesquite invaded valuable agricultural lands and sometimes grows into impenetrable thickets causing enormous problems to farmers and agricultural managers. | Consideration of socio-economic and management factors forms the basis for development of a more rational approach to species control. It is recommended to increase the level of awareness among local people to secure their support and willingness to participate in mesquite management and other forestry related activities. To reach a balance between the needs of the population of the areas invaded by mesquite and improving the environmental conditions, sustainable integrated management plan is recommended to be prepared and implemented. Research is needed to guide the best way and economically feasible means of mesquite control. |
| Oil pollution | New oil terminals have been constructed: El Khair Oil Terminal handling a range of import and export products, Bashayer Crude Oil Export Terminal handling more than 750,000 barrels per day in 2006, and Bashayer 2 Terminal providing a similar capacity for oil exports. | One recent accident took place at Bashayer 2 Terminal resulting in some damage to coastal ecosystems. Similar accidents pose threats to marine and coastal fauna and flora. |
| Port Expansion | New berths are being built on Port Sudan harbour on the south side of the entrance channel to handle larger container ships. Since 2004, four large berths (970 m of quay) have been built into the coral reef on the seaward side of the main port to handle bulk carriers and general cargo. This area uses the remaining strip of reef to protect the new berths from waves. Jetties for liquefied | The expansion of ports involves dredging and land-filling resulting in large quantities of sediments which affect coral reefs and associated communities. |

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| | natural gas, livestock and other products have recently been constructed on Suakin Port. | |
| Anchorage | Current threats to the coral reefs of Sanganeb MPA include anchor and fin damage from recreational diving. | A number of tourist boats frequently visit Sanganeb reefs causing physical damage to corals. Mooring buoys are planned to be deployed in diving sites to mitigate anchorage problems. |
| Mining activities | Most mining activities occur far from the coast. However, mining products are concentrated in the coastal area (e.g. gypsum, salts, cement) and chemicals used for gold mining (e.g. cyanide, mercury) are stored and transported to be used for gold mining (e.g. cyanide, mercury). | Such chemicals may have serious impacts on the coastal and marine environment. In particular, the open storage of large amounts of cyanide poses a serious threat. |
| Sewage | Discharge of untreated sewage, especially in Port Sudan harbour, and vessel sewage affect corals. | Increase in algal cover on corals. |
| Grazing & limb cutting | The majority of mangrove stands are affected, at various levels of severity, by camel grazing, felling and limb cutting. | Decrease in the number of trees. |
| Use of pesticides, herbicides & insecticides | Extensive agricultural use of pesticides, insecticides and herbicides is known to occur along the coast of Sudan. Potential hazards include the Tokar Delta Agricultural Scheme and the country's Locust Control Programme. | These pose general threats to breeding seabirds. |
| Predation | The black rat, <i>Rattus rattus</i> , is recorded on Suakin Archipelago. The black rat preys on both birds' eggs and chicks, and affects gulls (PERSGA, 2006). | Such affects the population of breeding seabirds. |
| Human settlement | There are large numbers of nesting osprey (<i>Pandion haliaetus</i>) in the Mukawwar Island and Dunganab Bay MPA. Of particular note is the occurrence of occupied and undisturbed nests close to human settlements within the MPA (PERSGA/GEF 2004f). New developmental constructions: | Human settlement causes disturbance to breeding seabirds. At present several developmental activities are |

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| | | taking place in the country, which might affect the local agrobiodiversity. |
| Over-fishing | High fishing pressure on large groupers (family Serranidae) and Nagil (<i>Plectropomus</i> spp.) over 30 cm in length especially at the southern end of Mukawwar Island. | Decrease in the number of these species. Continuation of this form of fishing will undoubtedly lead to the loss of some of the most important fisheries species. |
| Accidental net catch | Accidental capture of Dugongs in fixed fishing nets causes drowning. | Numbers of Dugongs have declined sharply in recent years (PERSGA, 2006). |
| War and Civil Strife | Many of the richest areas in animal biodiversity were located in the war zones either in Western or Southern part of the country. The animals either get killed or robbed and sometimes flee across the borders to the neighboring countries. | |
| Customs & Taxis | The local governments at the levels of the States & localities put a very high customs and the veterinary services given are very poor & not free of charge. | |
| Environmental changes | drought spells and fluctuations in rains | Loss of farmer's varieties and complete failure of crops. Farmers used to select the outstanding strains of crops within their fields for the future cultivation. They tend to do that on the basis of their knowledge on the environments and crops. Such selection practice results in the dominance of some genotypes at the expense of others. |

Chapter II

2. Current Status of National Biodiversity Strategies and Action Plans

Following the signature in 9 June 1992 and ratification of the Convention on Biological Diversity (CBD) in October 1995, the Government of Sudan has requested the assistance of the GEF and UNDP to meet its initial obligation to the Convention through the development of a National Biodiversity Strategy and Action Plan (NBSAP).

As a first step in meeting its obligations, the Government of Sudan in accordance with Article 6a of the CBD, has undertaken a participatory process for development of the NBSAP. The NBSAP first draft document was prepared between November and end of December 1999. It was first reviewed by IUCN Eastern Africa Regional Office (EARO). As part of stakeholders' involvement and building consensus the NBSAP draft was distributed to ministries, institutes, agencies and departments of relevance for comments (listed below). To widen the circle of participation five regional-based workshops were held in different parts of the country. The NBSAP was also presented in the project's final national workshop held from 17th to 18th April 2000. It was then subjected to more discussion and written comments were also received from expert individuals. The participants agreed to adopt the NBSAP provided that useful comments that have emerged during the review and discussion of the NBSAP draft are incorporated and it is amended.

In response to the list of challenges facing biodiversity and sustainable development, Sudan outlined a number of issues and identified those which affect biodiversity conservation and ecosystems. Besides, there are opportunities for better management if there are appropriate structures and political will. Accordingly, the (NBSAP) suggested several actions and means of implementation including among others:

- Creation of conducive atmosphere through strengthening national institutions and integration of biodiversity policies in the national decision-making process, marketing incentives and strengthened synergies and collaboration,
- Expansion in establishment of biosphere reserves (in-situ and ex-situ conservation),
- Policies and actions to ensure sustainable use of biodiversity, and
- Supporting and updating institutions involved in genetic resources.

2.1 Vision

The vision of National Biodiversity Strategy is:

“Conservation of diversity and related indigenous knowledge for sustainable national development of Sudan”.

2.1.1 Guiding Principles

The following are guiding principles that were followed in developing the NBSAP:

- Protection of the natural environment and its constituent biological, ethnic and cultural diversity, the development and good use thereof is an authentic aspect of fulfilling man's role as vicegerent on earth. Conversely, the destruction of environment is a mischievous sort of corruption. Thus, furnishing a healthy social environment, its improvement and development is an essential demand in responding to the principle of sustaining the dignity of mankind;
- Every Sudanese citizen has a constitutional right to a healthy environment that secures health, abundance and prosperity;
- Stakeholders at the local, state and national level should have an equitable share of benefits accruing from biological and other dimensions of diversity;

- The formulation of a national biodiversity strategy and an attendant implementation action plan require the voluntary and democratic participation of the society at large; and
- Some aspects of the natural environment and its constituent biological, ethnic and cultural diversity recognize no political or geographical boundaries within or between countries which necessitate subregional, regional and international cooperation for the protection of the environment and its development in the context of international conventions and agreements.

2.1.2 Overall goal

To conserve and enhance biological diversity for the prosperity and development of the Sudan.

2.1.3 Specific goals

The specific goals are:

- a. Conservation of biodiversity (CBD articles 12 and 17).
- b. Promotion of sustainable use of biodiversity products (CBD article 10)
- c. Promoting awareness on biodiversity conservation (CBD article 13)
- d. Creating an enabling environment for biodiversity conservation.
- e. Complying with and benefiting from regional and international agreements and mechanisms (CBD article 22 and COP decisions)

Table (5) shows an analysis of the goals, strategies, indicators and Current status of actions developed under the NBSAP

| Goals | strategies | indicators | Current status |
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| <p>Conservation of biodiversity (CDB articles 12 and 17)</p> | <ul style="list-style-type: none"> Strengthening research and monitoring and assessment activities: by improving inventories, database and documentation. This includes indigenous knowledge of the flora, fauna and microorganisms. Collaborative efforts from home and abroad will be necessary for the benefits of all concerned; | <p>Conservation of genetic resources</p> <p>An in-country regional forum on agro-biodiversity was convened.</p> <p>The aerial surveys of wildlife, livestock and human activity in and around existing and proposed protected areas of Southern Sudan.</p> | <p>A national workshop was organized on the Plant Genetic Resources for Food and Agriculture (PGRFA) in Sudan: Policies and Programmes It was convened for two days on 5 – 6 March 2007 at Khartoum.</p> <p>A national stakeholders' workshop was organized in collaboration with the Federal Ministry of Agriculture and Forestry on the Implementation of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) in Sudan during 25-26 August 2008 in Khartoum</p> <p>An in-country regional forum on agro-biodiversity was convened in Kordofan region of western Sudan during the period of 27-28 October 2008. in collaboration with the Resources Management Programme for Western Sudan, which is funded by IFAD?</p> <p>The aerial surveys of wildlife, livestock and human activity in and around existing and proposed protected areas of Southern Sudan, conducted during the dry season of 2007 by the wildlife conservation society WCS in partnership with GOSS with funding from USAID, presented reasonable estimates of wildlife presence in some parts of Southern Sudan</p> |

| Goals | strategies | indicators | Current status |
|-------|--|---|---|
| | | Post-conflict environmental assessment was conducted. | The post-conflict environmental assessment conducted by Sudan Government and UNEP in 2007 and funded by Governments of Sweden and the United Kingdom presented assessment of wildlife resources of the country. The post-conflict assessment included specific action plan specifying needed institutional and legal reform, capacity building and priority areas. |
| | <ul style="list-style-type: none"> In-situ conservation (CBD article 8): Conservation of representative samples of ecosystems including terrestrial, marine and fresh water ecosystems through nature reserves, national parks, on-farm conservation, forest reserves and restorative procedures. | <p>Increase of forests reserve areas</p> <p>A number a livestock research stations were established in various parts of the country in order to study, improve and preserve the local breeds.</p> | <p>The Government forest reserves increased by approximately nine times by 2005, taking the period from 1901 to 1985 as base. That means in 85 years the government forest reserves area reached only 1.25 million ha. while in 20 years the forest reserves increased by nearly 10 million ha.</p> <p>The livestock stations related to the principal breeds of cattle in Northern Sudan were at:-</p> <ul style="list-style-type: none"> Umbinin in Sennar state for Kenana breed. Atbara in Nile valley state for Butana breed Ghazala Gawzat in Southern Darfar for Baggara breed Kassala in Kassala state for Aryshai breed <p>Other stations for study and improvement of productivity of Sudan desert sheep & goats. Have also been set up.</p> <ul style="list-style-type: none"> El Huda in Gazira state for Dubasi, Ashgar and Watish sheep. El Nuhood in western kordofan for El hamari and El kabashi Dongola in Northern state for Nubian goat Kuku in Khartoum state for study, improvement and preservation of all domestic animals, |

| Goals | strategies | indicators | Current status |
|-------|---|--|---|
| | | Several protected areas are established | <p>poultry cattle sheep goats, and camels.</p> <ul style="list-style-type: none"> • Tambool in gazira state for camel breeds. <p>Several protected areas are established in Hassania Jebel, Nile state, Wadi Howar, Northern Darfur and Dungunab Marine Park at Red Sea and management plans are to be developed and/or implemented</p> |
| | <ul style="list-style-type: none"> • Ex-situ conservation (CBD article 9). | <p>Establishment of arboreta, botanic gardens, herbaria and zoological gardens at national and state levels.</p> <p>Establishment of Plant Genetic Resources (PGR) Unit</p> <p>Artificial insemination biotechnology for conservation and development of</p> | <p>Soba herbarium and Khartoum Botanic Garden are rehabilitated. Soba herbarium is now including about 5000 herbarium specimens.</p> <p>The Plant Genetic Resources (PGR) Unit in the Agricultural Research Corporation (ARC) is playing the major role in that. It was established early in 1985 as a unit within the Horticultural Research Section for the conservation of the local genetic resources of horticultural crops. The mandate of the unit has been expanded since 1995 to cover the genetic resources of all crops. Since then the PGR Unit / ARC has been active in collecting and <i>ex-situ</i> conserving the genetic resources of different crop plants.</p> <p>The first center was established to disseminate this technology and now other few centers are providing this service, Cimex company and Animal Production Research Centre at Kuku.</p> |

| Goals | strategies | indicators | Current status |
|-------|------------|--|---|
| | | <p>livestock breeds in Sudan started.</p> <p>Promotion of sustainable use of biodiversity products.</p> <p>A Zoo park is planned</p> | <p>Scientists, of ARRC have already produced a high level biotechnology for development of vaccine production to vaccinate animals in Sudan. Against all contagious diseases reported, such as</p> <p>Virual vaccine</p> <ul style="list-style-type: none"> • sheep pox vaccine • fowl pox vaccine • Newcastle disease vaccine • African horse sickness vaccine • PPR vaccine (small ruminant plaque) • infectious bronchitis vaccine poultry <p>Bacterial vaccines</p> <ul style="list-style-type: none"> • haemorrhagic septicemia vaccine • anthrax vaccine • black quarter vaccine • brucellosis vaccine • contagious bovine pleuropneumonia vaccine • contagious caprine pleuropneumonia vaccine • morel's disease vaccine <p>A Zoo park west of the White Nile in Khartoum State is planned and partial funding for execution is approved as part of Agriculture Revival (Nahda) programme</p> |
| | | <p>Increase coverage of protected areas in</p> | <p>Coverage of protected areas in Sudan exceeded the 10% global target. In Sudan following declaration of</p> |

| Goals | strategies | indicators | Current status |
|-------|------------|--|--|
| | | <p>Sudan.</p> <p>Developing a management plan for DNP.</p> | <p>Wadi Howr, Jebel Hassania, and Dongonab parks (2002 to 2005) the Sudan area of protected areas exceeded 10% of the area of the country.</p> <p>Trends in extent of selected biomes, ecosystems and habitat did show excellent improvement through establishment of Wadi Howr (desert area), Dongonab (Marine), and a designated Ramsar Site in Sudd.</p> <p>GEF-UNDP project 2000-2005 succeeded in developing a management plan for DNP involving all stakeholders and based on the concept of biosphere reserves. The DNP succeed in raising awareness among neighboring communities, establishing Village Development Committees VDCs, and adapting models for alternative livelihood. The Sudan Government could not allocate funds for implementing a 5 year action plan, which had been part of the management plan and addressed problems of pastoralists trespassing into the park, upgrading capacities and promotion of the park management. A new project is being started soon as part of the Nile Basin Initiation to follow upon success track of DNP.</p> <p>The Sudan Community Watershed Management Project (CWMP) is approved with funding from World Bank; CIDA FINIDA aimed at strengthening the knowledge base and human resource capacity for cooperative action on watershed management.</p> <p>A GEF project with a total budget about US \$ 4 Million is approved to up grade management of protected areas in Sudan</p> |
| | | Central genebank for the important species. | The central genebank is to be responsible for the base collection of the germplasm under conservation, while |

| Goals | strategies | indicators | Current status |
|---|--|---|--|
| | | <p>has been established.</p> <p>Tree seeds centers were established</p> | <p>the regional units are to be equipped with small genebank units for the conservation of the active collections for those accessions collected from within the different regions. Some specialized laboratories are envisaged to be attached to the central genebank such as an in-vitro culture facility and a molecular biology laboratory.</p> <p>4 Tree seeds centers were established at Soba Obied, Gadarif and Damazin through financial and technical support from DANIDA. Forest genetic resource's conservation unit established in 2009 under the regional tree seed centre. Tissue culture laboratories established at Forest Research Centre in 2009. Current research activities focus on propagation of endangered tree species and trees of significant economic values.</p> |
| <p>Promotion of sustainable use of biodiversity products (CBD article 10)</p> | <ul style="list-style-type: none"> Reducing, halting and ultimately reversing the over-exploitation of biological resources through appropriate land use, especially the horizontal expansion in crops on marginal lands of fragile ecosystems, overgrazing and deforestation, and by promoting efficient farming techniques and multiple use of the resources to realize their inherent potential. | <p>Application of sustainable management of forests</p> | <p>The forest area under working plans inside forest reserves increased from 0.4 % to 1.0 % of the forest reserves area.</p> |

| Goals | strategies | indicators | Current status |
|--|--|--|---|
| | | | |
| | <ul style="list-style-type: none"> • Creating alternative products and sources of alternative income; and controlling the formal introduction of germplasm especially noxious species in forests and food crops and in livestock. | Mesquite invaded valuable agricultural lands | In a number of locations in the irrigated agricultural schemes in the Sudan, under certain environmental conditions, mesquite invaded valuable agricultural lands and sometimes grows into impenetrable thickets causing enormous problems to farmers and agricultural managers. Consideration of socio-economic and management factors forms the basis for development of a more rational approach to species control. |
| Promoting awareness on biodiversity conservation (CBD article 13 | <ul style="list-style-type: none"> • Informing the public and decision-makers by providing adequate information through the media, improved | National awareness activities | Following a request made by the PGR Unit / ARC in 2006 a fund was made available by EAPGREN to finance national awareness activities including mainly production of information and awareness materials |

| Goals | strategies | indicators | Current status |
|---|--|--|--|
| | extension service and networks. | | |
| | <ul style="list-style-type: none"> Assigning real economic and other values to biodiversity products, so as to formulate sound policies for stakeholders through incentives in conservation activities. Initiatives from NGOs (national and foreign) and the private sector should be encouraged. This includes promotion of environment friendly activities like ecotourism, wildlife ranching and upfront preventive activities like environmental impact assessment. | A national partial waterfowl census was conducted. | A national partial waterfowl census is conducted every January, and June in identified sites along the Nile Flyway. The waterfowl census is conducted by the an NGO the Sudanese Wildlife Society SWS and Wildlife General Administration WGGGA where volunteer bird watchers participate. |
| Creating an enabling environment for biodiversity conservation. | Promoting political goodwill for the cause of biodiversity and availing incentives to stakeholders; | The Khartoum Declaration of 2003, issued by the President, states a very strong commitment to conserve wildlife and protected areas. | The Declaration is often used in environmental awareness campaigns. Biodiversity conservation principles are included in development strategies, poverty alleviation action plan. |
| | <ul style="list-style-type: none"> Strengthening the | Capacity building | A significant progress in the training aspect of the staff |

| Goals | strategies | indicators | Current status |
|-------|--|--|---|
| | <p>institutional technical capacity by improving the technical infrastructure and strengthening the manpower base through training to carry out the tasks;</p> | | <p>of the biodiversity institutions has been achieved since then in the areas of post graduate studies as well specialized training in and outside the country. Wildlife Legislation revision is under taken and an upgraded legislation is submitted to the National Assembly.</p> |
| | <ul style="list-style-type: none"> Enacting a comprehensive and effective biodiversity conservation policy and practice that addresses, among other things, issues such as land allocation, land tenure and possible conflicts; | <p>A forestry sector review completed.</p> <p>Sound sustainable management of the Nile and its tributaries.</p> <p>UNESCO MAB programme sponsored an exploratory</p> | <p>A forestry sector review completed in 1986 with the World Bank and bilateral donor assistance and up dated 2007 with assistance from forest national programme highlighted the importance of the forestry sector to the economy.</p> <p>The Nile Basin Initiative NBI is a multi-donor regional project active in the Nile Basin Countries. The NBI Environmental programme includes micro-grant programmes meant to consolidate community activities which could result in sound management of the Nile and its tributaries and promote sustainable management of Nile basin, watershed areas. As a result a cooperation programme is being developed to promote a tranaboundary park including DNP in Sudan and ALATIESH NATIONAL Park ANP in Ethiopia.</p> <p>The UNESCO MAB programme sponsored an exploratory expedition in the boundaries of Sudan, Egypt and Libya in Jebel Aweinat area. The objective</p> |

| Goals | strategies | indicators | Current status |
|---|---|---|---|
| | | expedition. | of the expedition was to survey the area and to assess the feasibility of establishing a transboundary protected area. |
| | <ul style="list-style-type: none"> Adopting economically and socially sound measures that act as incentives for the conservation and sustainable use of components of biodiversity (CBD article 11). | <p>Adoption of The 25-Year Forest Products Strategy</p> <p>Declaration of the "Green Mobilization" and the preparation of the Five Year Strategic Plan.</p> | <p>The strategy is part of the Comprehensive Development Strategy for</p> <ul style="list-style-type: none"> Identification of sound production policies Efficiency production techniques: Reinforcing the competitiveness of non-wood products: Marketing policies Improving infrastructures facilities. <p>Recently, the Sudan has taken a new and strategic direction to support agriculture. This innovative trend is manifested in the declaration of the "Green Mobilization" and the preparation of the Five Year Strategic Plan. In continuation of this driving force, a high committee under the supervision of His Excellency the Vice President has been formulated to revise the current status of agriculture and articulate a future vision and action plan for Agricultural Revival.</p> |
| | <ul style="list-style-type: none"> Undertaking and considering financial resources and financial mechanisms as stated in articles 20 and 21 of the CBD | | |
| Complying with and benefiting from regional and international agreements and mechanisms | Sudan is a party to a number of arrangements and mechanisms, legally | Forest Policy Statement 1932 amended 1986 reviewed and drafted | The forestry policy in Sudan is being harmonized with environmental policies and legislation not only at the national level but also within the framework of policy |

| Goals | strategies | indicators | Current status |
|---|---|---|--|
| <p>(CBD article 22 and COP decisions.</p> | <p>binding and non-legally binding, which contain substantive elements, addressing different biodiversity and environmental aspects. Sudan should honor its commitments and benefit, to the maximum from ratified arrangements.</p> | <p>for final approval.</p> <p>Sudan ratified Ramsar Convention.</p> <p>Sudan adopted the Criteria and Indicators for Sustainable Forest management in the Sudan. The initiative is in accord with the national priorities and the seven criteria and 65 indicators of the Regional Near East process.</p> | <p>and legislation at the international level.</p> <p>The Sudan ratified Ramsar Convention in January 2005. Designated Ramsar Sites are Dinder National Park and the "Sudd" area in Southern Sudan. A national wetlands committee is established of governmental and non-governmental bodies and the committee is working on development of Sudan Wetlands Policy. Thirteen wetlands types are distinguished in the country. Which includes: large swamps such as the "Sudd", seasonal streams such as Gash, Barraka, Dinder, and Rahad, Nile and its tributaries? Mountain streams e.g. Kor Arba'at, River Gilo and Ingassana Hills, Lakes, Man-made Lake System, Dams, Hot springs, Haffirs, Coral reef, Mangroves swamps (Red Sea Coast).</p> <p>Criteria and indicators were developed in response to the needs for practical ways of assessing and monitoring sustainable forest management at the national level and as benchmarks to measure and report progress towards sustainability. The criteria define the essential elements or principles against which sustainability is judged, and the indicators help policy-makers and forest managers monitor the effects of forest management overtime, considering the productive, protective and social roles of forests</p> |

Chapter III

3 Sectoral and cross-sectoral integration or mainstreaming of biodiversity Considerations

3.1 Coordination and links with international and regional frameworks

Sudan has links with a number of international and regional frameworks that are related to agrobiodiversity including conventions, organizations and networks.

3.1.1 International frameworks

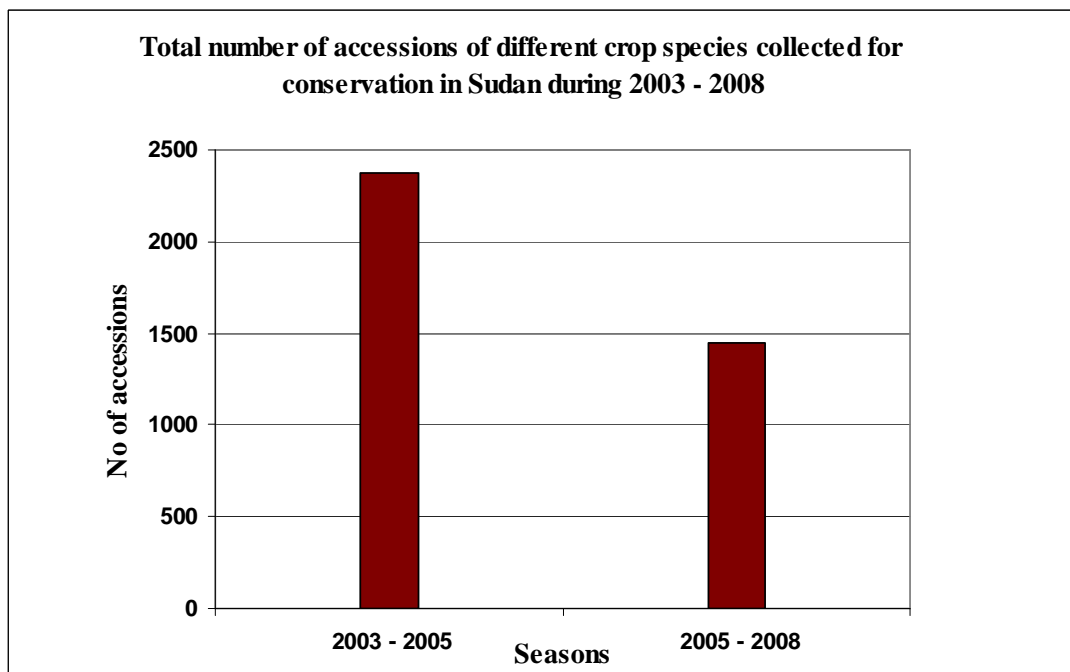
Sudan is a member in the FAO Commission on Genetic Resources for Food and Agriculture. It ratified the International Treaty for Plant Genetic Resources for Food Agriculture (ITPGRFA) on 10 June 2002, and hence it is a party to the treaty since then. It has active links with other international organizations working in the field of plant agrobiodiversity such as the Biodiversity International (BI) and Global Crop Diversity Trust (Trust). The latter is at present providing supportive fund to the PGR Unit / ARC in a project for the regeneration and safety duplication of sorghum and pearl millet germplasm which will continue for two years between 2008 and 2010.

3.1.2 Regional frameworks

Sudan is one of the founding members of the Eastern Africa Plant Genetic Resources Network (EAPGREN). It is a network initiated in 1997, and became operational since May 2003. Member countries include Burundi, Eritrea, Ethiopia, Kenya, Madagascar, Rwanda, Sudan and Uganda. The network operates under the umbrella of the Association for Strengthening Agricultural Research in Central and Eastern Africa (ASARECA). It has the sub-regional responsibility of promoting the conservation and use of plant genetic resources and enhancement of awareness of their importance and value. During the first phase, which extended for five years (2003-2008), the network operations were guided by a project document developed by a regional interim working group and signed between the ASARECA and the donor, which is the Swedish International Development Cooperation Agency (Sida). Agreements between the respective countries and EAPGREN / ASARECA on the collaboration and implementation of the network activities were also signed. Based on the guidelines in the project document, the network activities have been implemented at both the regional and national levels. The national activities cover aspects related to capacity building and training of personnel working with PGR activities, procurement of conservation and documentation equipment and transportation facilities, coordination and awareness activities and PGR activities such as collection, conservation, multiplication, regeneration and characterization of germplasm. A project proposal has already been submitted to the donor (Sida) for a second phase (2009-2013).

Sudan as a member in EAPGREN is represented by the Plant Genetic Resources (PGR) Unit of the Agricultural Research Corporation (ARC). Several national activities were implemented by the PGR Unit / ARC between 2003 and 2008 using fund made available by the donor through EAPGREN. These activities included the following:

- Launching collection missions for different agricultural crops from different regions in the country.
- Procurement of equipment such conservation equipment, one vehicle and computers.

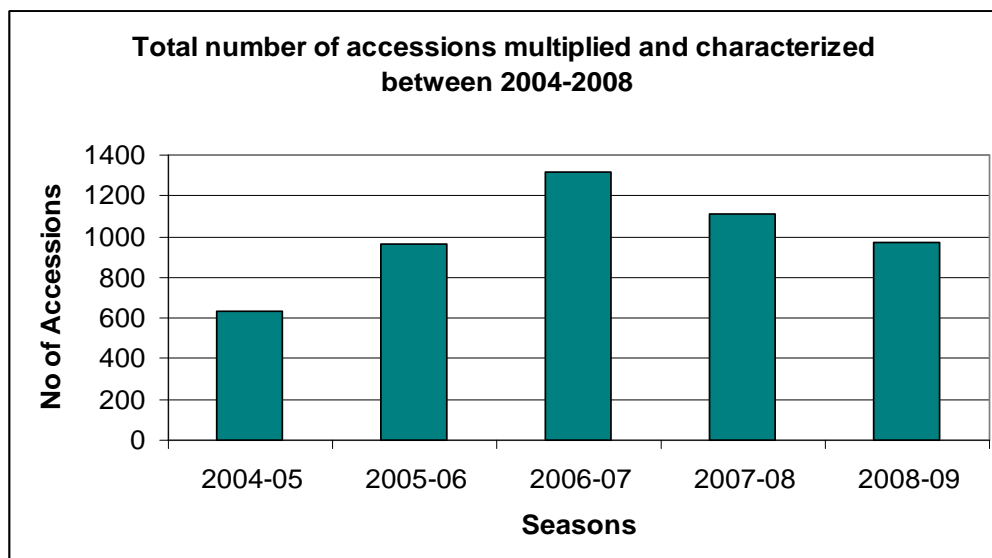


- Multiplication, regeneration and characterization of different crop genetic resources.
- Specialized and hands-on training for PGR Unit staff members outside Sudan in recognized genebanks.
- Study for a master degree on biodiversity management by one of the PGR Unit staff member in Sweden.

Initiation of a Ph. D. programme for one staff in the PGR Unit / ARC

3.2. Forestry

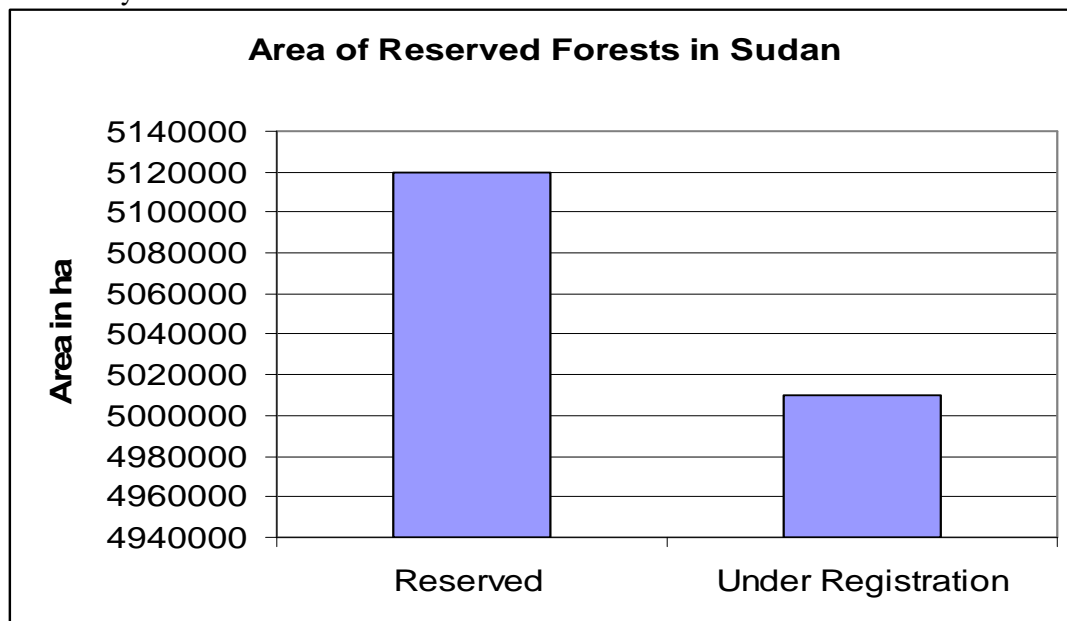
Forests exist within a larger landscape, and vitally connected to other sectors. It is, therefore, important to recognize related institutions constituting part of the forestry sector and to appreciate the cross-sectoral and interdependency relationships that exist between the different sectors. Of prime importance is that the Forests National Corporation (FNC) in Sudan has incorporated biodiversity conservation in all its policies of promoting and



developing the forest ecosystem. This is reflected also in that during the last few years and since the NBSAP development (FNC) has made intensive efforts in the way of conservation. Large areas have been designated as reserved forests, which eventually indicate more biodiversity conservation. Many amendments have been made by FNC to the exiting laws, ordinances and acts of forestry to enhance in-situ and ex-situ conservation.

The following activities are part of its mandate:

- Dissemination of awareness amongst the officials and citizen in matters relating to forests and natural resources.
- Conducting studies and researches in order to lay out the necessary plans for assessing forests and natural resources all over the Sudan and developing them.
- Increasing the forests, range and natural resources areas by reserving more areas and by increasing the required areas at a ratio not less than 25% of the total area of the country.



3.3 Wildlife:

The Sudan adapted several strategies and action plans all of which are adopting the NBSAP principles and concepts. The Sudan National Comprehensive strategy 1992- 2002 included an objective to have 25% of the area of the country as protected areas. The 25 strategy emphasized the importance of sustainable development, revision of landuse and stressed natural resources conservation. The Agricultural Revival Programme (ARP) (2007-2011) included a specific project to establish a zoo park and increase awareness about conservation.

The Poverty Reduction Programme is a cross-cutting issue which is also incorporating biodiversity conservation and sustainable use.

The Sudan is participating in most important conventions related to wildlife conservation: The conservation in trade in endangered and threatened. Species (CITES) (WCGA) is the focal point. The WRC should be consulted in relation to CITES format of export and import as WRC is the scientific wildlife authority. This issue is to be taken care of in a recent draft of the Wildlife legislation. (WCGA) is also the focal point for convention on the conservation of Migratory Species of Wild Animals.

The Sudan is a signatory of the convention concerning the Protection of World Culture and Natural Heritage. The National UNESCO committee is the focal point for this agreement. WCGA, WRC and SECS are among the members of the national committee. Recently the National UNESCO committee is preparing a proposal to nominate Sanganeb and Dongonab Marine National Parks (Red Sea Coast) as World Heritage Site.

The convention on Wetland of International Importance especially as waterfowl is administered by the Higher Council for Environment and Natural Resources HCENR. A national committee is currently preparing a Sudan Wetlands policy. The Sudan is also a party to other conventions of relevance to wildlife conservation such as: African convention on the conservation of National Resources. Regional convention for the conservation of the Red Sea and Gulf of Aden (PERSIGA) Protocol Concerning Regional Cooperation in Combating Pollution by Oil and other Harmful Substances in the Red Sea.

Nile Basin Initiative (NBI) – Regional initiative to encourage transboundary cooperation and sound management for Nile Basin, water-shed areas and biodiversity – several activities under this agreement are being implemented such as transboundary cooperation between Dinder National Park and Al Ateish Park (Sudan-Ethiopia) and wetlands management. The NBI environmental programme is located in Sudan and HCENR is the focal point for national activities and the secretary general of HCENR is the president for NBI regional environment programme steering committee. Cartagena Protocol Biosafety focal point is HCENR – Indirect impact on wildlife conservation.

The Sudan participated in efforts led by IUCN-EARO to establish an African Protected Area Initiative (APAI). The Sudan is represented by the vice-president of SECS. The APAI addressed issues of sustainability of African protected areas, regional cooperation capacity building and improved management. Unfortunately funding is not yet secured for APAI.

The FAO-East African. Commission on Forests and Wildlife-A regional meeting was held in Sudan last year and several issues related to promotion of protected areas, wildlife and forest management were discussed.

Biodiversity is mainstreamed into national strategies and in implementation of UNFCCC through:

- Inclusion of Conservation and use of Biodiversity Resources program into poverty reduction strategy, through identification of some priorities such as Update and Implementation of National Biodiversity, Development of biodiversity management Monitoring system and Management plan of Biodiversity in rangelands in the strategy.
- Biodiversity is considered in implementation of UNFCCC, this is notable in the National Communications under the UNFCCC where agriculture, forestry and land use are considered in vulnerability and adaptation assessment and mitigation. Some projects on biodiversity were included into National Adaptation Program of Action (NAPA) such as Environmental conservation and biodiversity restoration in Northern Kordofan state as a coping mechanism for rangeland protection under condition of increasing climate variability.
- Synergy between CBD, UNFCCC and UNCCD to include capacity building for Higher Council for Environment and Natural Resource to have CBD unit, training in Taxonomy, awareness cross-cutting factor, capacity building to address land use planning as a need for all conventions and strengthening of community –based natural resources.

3.4. Natural Resources & Environmental Studies Education

3.4.1 Institutions.

- University of Khartoum, Faculty of Forestry, Faculty of Agriculture, Faculty of veterinary medicine, Faculty of Animal Production, Faculty of Science and Institute of Environmental Studies.
- Sudan University of Science & Technology, College of Forestry & Range Sciences, Faculty of veterinary medicine & animal production.
- University of Juba, College of Natural Resources & Environmental Studies,
- Upper Nile University Faculty of Forestry and Range Sciences, Faculty of Animal Production.
- Sennar University, College of Natural Resources, Faculty of Agriculture.
- Kordufan University, College of Natural Resources & Environmental Studies,
- Bakht Elrida University, College of Natural Resources & Environmental Studies,
- The Red Sea University, Faculty of Marine Sciences and Fisheries.

Table (6) Research institution(s)/centre(s)

| Name | location |
|--|---|
| Agricultural Research Corporation, Ministry of Science & Technology, | Madani |
| Forestry Research Centre, Agricultural Research Corporation, Ministry of Science & Technology, | Forestry Research Centre, Khartoum, Soba |
| National Research Centre | Khartoum. |
| Animal Resources Reseach Centre | Khartoum |
| Wild life research centre | Khartoum. |
| Animal Production Research Center | kuku, Khartoum North |
| Central Veterinary Research Laboratories Centre | Soba Khartoum West |
| . Camel Research Center | Tambool |
| Regional Animal Production Research Stations | Um Banein, Atbara, Gazala Gawzat, ELHuda, ELShukkaba, ELNuhood, Gadrif and Kassala. |
| Regional Veterinary Research Laboratories | Nyala, ELFashir, ELGineana, ELObied, Kadogli, Rabak, Sennar, Edamazin, Medani, Gadarif, Kassala, Port Sudan, Atbera, Dongola, AL Fula, Abujebeha. |

Table (7) Institutions related to Natural Resources Management

| Name | Mandate related to forestry |
|--|--|
| General Administration for National Energy Affairs | The mandate of NEA is to undertake national energy planning in coordination with concerned institutions, promotion of the use of alternative renewable energy resources and energy substitutes |
| Range and Pasture Administration | Range conservation and management through proper distribution of water resources to allow balanced utilization of grazing resources and production of fodder crops under |

| Name | Mandate related to forestry |
|--|--|
| | irrigation and Protection and management of pasture and animal feed. |
| The Higher Council for Environment and Natural Resources | The laying down of general policies and long term plans for environment protection and sustainable use of natural resources; Coordination of efforts on environment and natural resources management among concerned government agencies and between the federal and state government; |
| Wildlife Protection General Administration | Management of protected areas |
| Department of Animal health and epizootic diseases control , Federal Ministry of Animal Resources & Fisheries and at the 26 states level | Safeguarding of animal health in the country against endemic & Epizootic animal diseases |
| Departments of Animal production at Federal & State levels | Improvement of Animal production of productivity |
| Sudanese veterinarians union | Training and awareness raising and Extension |
| Sudanese veterinary council | Training & awareness raising and monitoring veterinary service |
| Community based animal health workers | Extension animal diseases monitoring & treatments |

Table (8) Private sector organizations related to Natural Resources Management

| Name | Area of activity/interest |
|---------------------------|---|
| Gum Arabic Company | Gum Marketing |
| Kenana Sugar Company | Forest & tree planting and management |
| Other Sugar Projects | Forest & tree planting and management |
| Gezira Scheme | Production of cotton, wheat, livestock 7 other crops. Social development projects. Shelter belt wood lots |
| Timber Industry Workshops | Sawmilling & Woodworking |

Table (9) Civil society organizations (e.g. NGOs, associations, indigenous people organizations)

| Name | Area of activity/interest |
|--|--|
| Sudanese Social Forestry Society | Awareness and advocacy on Social Forestry & Environment |
| Sudanese Environmental Conservation Society | Environment advocacy and awareness |
| Gum Producers Association Societies | Gum production |
| Sudanese Forestry Society | Awareness & Publishing on forestry |
| Shambat Sociocultural Foundation/ Alneema | Resources mobilization and poverty reduction for the local community |
| Babikir Badri Scientific Association for Women Studies | Gender Issues |

| Name | Area of activity/interest |
|--|--------------------------------------|
| Sudanese Horticulture Society | Horticultural advocacy and awareness |
| Sudanese Society for Combating Desertification | Training and awareness raising |
| Sudanese Society for Wildlife Conservation | Wild life advocacy and awareness |
| Sudanese Environmentalist Society | Environmental awareness |

The role played by NGOs mainly relies on engaging the local communities in projects implementation through extension and provision of project components. This type of voluntary teamwork was readily accepted. Another tool, which NGOs benefited from is networking, which is also deeply rooted in Sudanese Society. The tribal system is a structured network with distinct interrelations within the tribe and with neighboring tribes. It is effective in resolving conflicts over land allocation, pasture and protection of communal natural resources and construction of firelines. (El Mahi and Abdel Magid, 2002)

Chapter IV

4. Conclusions: Progress towards the 2010 Target and Implementation of the Strategic Plan

4.1. Introduction

This chapter extracts the information presented in the preceding chapters to assess how actions taken at the national level have contributed towards achieving progress towards the 2010 target and objectives of the Strategic Plan of the CBD. The Chapter is intended to give a description of what Sudan has done to establish national targets for biodiversity; incorporation of targets into various sectorial and cross-sectoral strategies, plans and programmes.

Table (10) Progress towards the 2010 Biodiversity Target

| Goals and targets | Progress towards the Target |
|---|--|
| Protect the components of biodiversity | |
| <i>Goal 1. Promote the conservation of the biological diversity of ecosystems, habitats and biomes</i> | |
| Target 1.1: At least 10% of each of the world's ecological regions effectively conserved. | Protected areas in Sudan amount to > 10% of the area of the country. However conservation status in most areas is rated as unsatisfactory. Trends in abundance of almost all species are declining. A few species in Southern Sudan are still in good numbers. Marine species and ecosystems in the Red Sea are in good status. |
| Target 1.2: Areas of particular importance to biodiversity protected | The "Sudd" being designated as Ramsar site. Declaration of Dongonab National Park in the Red Sea Coast. Establishment of Wadi Howr in the North Eastern Sahara Desert. |
| <i>Goal 2. Promote the conservation of species diversity</i> | |
| Target 2.1: Restore, maintain, or reduce the decline of populations of species of selected taxonomic groups. | |
| Target 2.2: Status of threatened species improved. | Sudan has become a party to CITES on the 24th of Jan. 1983 Through establishment of above listed protected areas. Several threatened species protection will be improved. |
| <i>Goal 3. Promote the conservation of genetic diversity</i> | |
| Target 3.1: Genetic diversity of crops, livestock, and of harvested species of trees, fish and wildlife and other valuable species conserved, and associated indigenous and local knowledge maintained. | Environmental protection and conservation of natural resources are becoming important considerations as evident from the various strategies, policies and legislations pertaining to resource use. The knowledge of traditional communities of livestock owners enables them to make use of the natural resources available under difficult environmental conditions i.e. draught, desertification. The nomadic systems give the animal the chance to move where feed and water are available and to escape the areas of contagious diseases. Animal owners improve ways to select the good bulls |

| Goals and targets | Progress towards the Target |
|---|---|
| | for breeding purposes and to castrate the unwanted ones they knew how-to treat different animal diseases using traditional medicine i.e. using tar (gutran) to treat skin diseases & using cauterization to treat many cases. |
| Promote sustainable use | |
| <i>Goal 4. Promote sustainable use and consumption.</i> | |
| Target 4.1: Biodiversity-based products derived from sources that are sustainably managed, and production areas managed consistent with the conservation of biodiversity. | Sudan is formulating a 25 year strategy with broad visions to achieve different values and goals including rational use of natural resources. |
| Target 4.2. Unsustainable consumption, of biological resources, or that impacts upon biodiversity, reduced. | Unsustainable hunting of desert and semi-desert species (gazelles and wild sheep) are subjected to revision. Some states stopped issuing licenses for hunting (Red Sea State). |
| Target 4.3: No species of wild flora or fauna endangered by international trade. | |
| Address threats to biodiversity | |
| <i>Goal 5. Pressures from habitat loss, land use change and degradation, and unsustainable water use, reduced.</i> | |
| Target 5.1. Rate of loss and degradation of natural habitats decreased. | Sudan is committed to the development of natural resources on sustainable basis, e g long term strategy for sustainable agricultural development which is in harmony with NEPAD, MDGS and PRSPs. |
| <i>Goal 6. Control threats from invasive alien species</i> | |
| Target 6.1. Pathways for major potential alien invasive species controlled. | In a number of locations in the irrigated agricultural schemes in the Sudan, under certain environmental conditions, mesquite invaded valuable agricultural lands and sometimes grows into impenetrable thickets causing enormous problems to farmers and agricultural managers. Consideration of socio-economic and management factors forms the basis for development of a more rational approach to species control. |

| Goals and targets | Progress towards the Target |
|---|---|
| Target 6. 2. Management plans in place for major alien species that threaten ecosystems, habitats or species. | |
| <i>Goal 7. Address challenges to biodiversity from climate change, and pollution</i> | |
| Target 7.1. Maintain and enhance resilience of the components of biodiversity to adapt to climate change. | Sudan adopted several measures to adapt to climate change e g increase reserve forests and protected areas, application of sand dune stabilization programmes in the effected areas, water harvesting techniques, and encouragement of community participation in natural resources conservation. |
| Target 7.2. Reduce pollution and its impacts on biodiversity. | Biodiversity is the source of Sudan's present wealth and the driving force of its economic activity. Although Sudan has started producing and exporting petroleum, it will continue to depend on commodity production for some time to come. This situation means that Sudan has to very carefully conserve the sources of its present wealth in plants and animals. At the same time, and while developing and exporting its oil wealth, Sudan has to avoid and control the pollution hazards associated with the industry both in the hinterland where production takes place and the Red Sea coast where the export terminals are located. |
| <i>Maintain goods and services from biodiversity to support human well-being</i> | |
| <i>Goal 8. Maintain capacity of ecosystems to deliver goods and services and support livelihoods</i> | |
| Target 8.1. Capacity of ecosystems to deliver goods and services maintained. | A natural resource in the Sudan does not only provide goods and services to people, but in some cases the food security and nutritional well-being of the entire rural communities depend heavily on these resources. |
| Target 8.2. Biological resources that support sustainable livelihoods, local food security and health care, especially of poor people maintained. | The over all economic development of Sudan emphasizes food security and balanced regional development. Initiatives and actions have been taken by several institutions related to biodiversity conservation to involve civil society, NGOs and private sector for enhancing the contribution of natural resource base to food security and poverty alleviation, e g National Forest Programmes and Nile Basin Initiative. |

| Goals and targets | Progress towards the Target |
|---|--|
| Protect traditional knowledge, innovations and practices | |
| <i>Goal 9 Maintain socio-cultural diversity of indigenous and local communities</i> | |
| Target 9.1. Protect traditional knowledge, innovations and practices. | |
| Target 9.2. Protect the rights of indigenous and local communities over their traditional knowledge, innovations and practices, including their rights to benefit-sharing. | |
| Ensure the fair and equitable sharing of benefits arising out of the use of genetic resources | |
| <i>Goal 10. Ensure the fair and equitable sharing of benefits arising out of the use of genetic resources</i> | |
| Target 10.1. All access to genetic resources is in line with the Convention on Biological Diversity and its relevant provisions. | Sudan adopted the 25 year development strategy which call for the creation of national reserves and parks to protect plants and wild animals groups and to preserve the rare species in safe parks for the reservation of these genetic resources from extinction for the purpose of preserving their biodiversity and establishing botanical gardens and seeds' bank on the basis that these resources are vital for the life of human. |
| Target 10.2. Benefits arising from the commercial and other utilization of genetic resources shared in a fair and equitable way with the countries providing such resources in line with the Convention on Biological Diversity and its relevant provisions | |
| Ensure provision of adequate resources | |
| <i>Goal 11: Parties have improved financial, human, scientific, technical and technological capacity to implement the Convention</i> | |
| Target 11.1. New and additional financial resources are transferred to developing country | |

| Goals and targets | Progress towards the Target |
|--|--|
| Parties, to allow for the effective implementation of their commitments under the Convention, in accordance with Article 20. | |
| Target 11.2. Technology is transferred to developing country Parties, to allow for the effective implementation of their commitments under the Convention, in accordance with its Article 20, paragraph 4. | The PGR programme in the ARC is being at present operated through a PGR Unit, which is run by a number of specialized technical staff. The unit is equipped with facilities for a seed bank in Wad Medani, which is used for the preservation of the collected seed samples. Storage capacity of the seed bank at present is of 340 cubic feet in 17 deep freeze chests. Eight of such deep freezers in addition to other genebank equipment have been acquired during 2004 and 2008 through fund made available by EAPGREN or from other sources. |

4.2. Conclusions and Recommendations

Although some progress has been achieved in Sudan in regard to conservation of plant agrobiodiversity that progress has been achieved under inadequate infrastructures, clear policy and legislative frameworks. Gaps and constraints hindering conservation of agro-biodiversity in Sudan are summarized in the following:

- Lack of clear policy for the conservation of the local genetic resources of plants. The existing programme on crop genetic resources in the Agricultural Research Corporation is not supported by clear policies and adequate capacities.
- Capacities to conserve agrobiodiversity are very limited. The only genebank in the country is that of the Plant Genetic Resources Unit in the ARC. Although some progress has been achieved since 2003 in the infra-structure and human capacity, the unit lacks adequate personnel, buildings and equipment for the efficient management of crop diversity in a big diverse country such as Sudan.
- Lack of a national framework with legislative and institutional instruments on agrobiodiversity issues characterize the work on agrobiodiversity in Sudan. The country is a party to the CBD since 1995 and ITPGRFA since 2002. However, no national legislation were developed on matters related to access to the genetic resources, benefit sharing and farmers' rights.
- Lack of sustained coordinated efforts between and within the different institutions, groups and individuals directly engaged in agrobiodiversity conservation and utilization.
- Information relating to agrobiodiversity are not widely published or easily accessible. Access to the available information with the different institutions is hindered by lack of information and database systems at institutional and national levels.
- Information on the strategic importance and values of biodiversity in general and specifically on agrobiodiversity are fragmented, non-sustainable and sometimes poorly displayed through the media. There is absence of syllabi related to conservation of biodiversity in the general education curricula and little in the higher education curricula. Accordingly awareness limited among the experts and interested persons.
- One of the most important aspects for sustainable forestry development is the study of the human element. In the past, forestry programmes were implemented without the involvement of the local people living around the forests and depend on them for employment, grazing, collection of fuelwood and non timber forest products, in addition to the environmental and recreational benefits. This situation hindered the fulfillment forestry programmes. Accordingly policies were revised to incorporate people's participation in the plantation programmes.
- Since 1992 Rio Earth Summit 1992, the forestry profession underwent rapid changes from sustained yield forestry to sustainable forest management. The concept of sustainability can not be achieved without the due consideration of the social, economic and ecological dimensions. Significant changes took place all over the

world in regards to the concepts on nature and forests in response to UNCED resolutions in 1992. The demand for protection, conservation and recreational services has increased and this trend is likely to continue.

- The convention of biodiversity enhance the wildlife conservation issues through promotion of governmental policies and the inclusion of wildlife in strategies and implementation of activities
- Loss of habitats is growing with the increase in areas opened to development and investors. The impact of is covered by EIA. However much improvement is needed in the way EIAs are done or approved. Follow up of development project and their impact is very weak.
- Impact of petroleum prospecting, drilling and transport on habitats, specially the impact of produced water on migratory birds is very disturbing.
- Monitoring of Dinder National Park was made by Dinder Project.
- In-situ conservation is improved through the establishment of new-protected areas.
- Promotion of sustainable use is planned (ecotourism). Reduction of violations of wildlife law is also practiced. Awareness campaigns are conducted.
- Good will is indicated in government declarations and the inclusion of biodiversity in strategies and programmes such as Agricultural Revival Programme.
- Regarding legislative aspect: Revisions were made in Wildlife Ordinance of 1933, amendment 1986 to include the following:-
 1. Endorse new categories of protected areas.
 2. Revise schedules for protection of endangered and threatened species
 3. Involve communities in wildlife conservation
 4. Revise punishment acts
 5. Revise responsibilities between states, regional and national governments.
- The revised Wildlife Act is to be passed by the council of Minister prior to sending it to the National Assembly.
- Strict ban of hunting approval in and outside Sudan.
- An analysis of the effectiveness of NBSAP changes in status and trends in biodiversity cannot all be attributed to measures taken to implement NBSAP and the convention.

- The surveys of wildlife of southern Sudan could be attributed mainly to the CPA and prevailing peace condition.
- The inclusion of parts of ecosystems not previously included in the protected areas system is partly due to the recommendation of NBSAP.
- The development of management plans for Dinder National Park and Sanganeb and Dongoab are attributed to NBSAP implementation, GEF and African Parks funding.
- Significant progress in conservation of the marine environment in Sudan has been made. A number of actions are needed to ensure continued progress in marine ecosystem conservation especially coral reefs.
- It is essential that monitoring programmes are designed to incorporate all aspects of threats facing the biodiversity in marine and coastal areas.
- Management systems should consider recent concepts of principles, criteria and indicators in order to approach sustainable development in the forestry sector.
- More concern should be devoted to capacity building of the resources. Forest management should change from sustained yield to sustainable management system taking into consideration all aspects of economic, social and environmental. Application of efficient technology for resource assessment to facilitate proper planning.
- Capacity building in the field of plant and animal taxonomy.
- HCENR as the focal point of Biodiversity in Sudan should play the major role in this regard. Its capacities should be strengthened so as to fulfill its mandate as outlined in the Environment Conservation Act of 2001.
- Beneficial agro-microbial biodiversity (bacterial, fungal and algal) which play very important role in producing biofertilizers for improving and sustaining safe food production particularly legumes and cereals as well as minimizing the risks and hazards caused by inorganic fertilizers . National action plan for agro-microbial biodiversity is crucial.
- The awareness of the importance of insect biodiversity and balances continuously increasing, there are several trends to minimize the risk of the changes in insect biodiversity through:
 - ✓ Adoption and implementation of integrated pest management philosophy when dealing with insect pests to reduce the dependency of chemical control.
 - ✓ Recommendation of botanical materials (such as neem preparations) for the control of insect pests.
 - ✓ Encourage the use of selective chemicals and bio-pesticides (such as Bacillus thuringensis formulations) to minimize the hazards on non- target insects.

- Serious efforts are needed to upgrade conservation status. Protected areas in Southern Sudan cover 15% of the land area of the region. Large resources and great efforts are needed to protect these areas.
- Establish biodiversity unit in HCENR
- Control legal hunting specially hunters from rich Gulf countries and their impact on populations of dorcas gazelles.
- Wildlife conservation should be mainstreamed and included in development plan. Security is prerequisite and training of manpower is urgently needed especially in Southern Sudan.
- Wildlife conservation can only be achieved within national landuse plans and development strategies.
- The NBSAP is not adequate to address the threats to biodiversity identified in chapter I. Urgent needs are capacity building in the Higher Council for Environment and Natural Resources, the Wildlife Conservation General Administration and the Wildlife Research Center in Northern Sudan. Also efforts are needed to build up new institutions in Southern Sudan.
- Declaration of new protected areas especially in marine, desert and "Sudd" wetlands. Establishment of wetlands National Committee.
- Promote eco-tourism and plans for sustainable use.
- Local scientists need encouragement and financial and logistic support to undertake research on the information gaps.
- Specific conservation action is required for dugong in Mukkawar Island and Dungenab Bay MPA (Sudan). This should include a ban on fixed fishing nets in areas of the MPA important for dugong.
- National Action Plans for corals, turtles, seabirds, mangroves (that build on the Regional Action Plans) need to be developed as a priority and provided with sufficient funding support to allow them to be implanted. Needs for capacity building include ICZM, and management of MPAs.
- Reviewing highly tolerant plant species to salinity is promising in biosaline irrigation for producing animal fodders in Red Sea coast by using sea water without desalination. This will improve the livelihood condition of the nomads and reduce poverty level. Action plan is needed to complete the scenario of biosaline irrigation.
- Need to reduce camel grazing in mangroves and the felling and cutting of mangrove trees. Efforts to manage camel grazing and wood collecting require alternative sources of food, fuel and construction materials to be provided.

- There is a need to develop community education programmes that highlight the impacts of coastal communities on reef ecology, including degradation, anchor damage, littering, waste disposal and souvenir collection. These could be integrated with programmes of community-based monitoring that involve recreational scuba divers or fishers.

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Appendixes

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| | |
|--|---|
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Appendix (3)

PROCEEDINGS OF THE CONSULTATION WORKSHOP ON: SUDAN'S FOURTH NATIONAL REPORT TO THE CONVENTION ON BIOLOGICAL DIVERSITY

Implemented by: The Higher Council for Environment and Natural Resources (HCENR) in collaboration with UNDP and GEF

Introduction:

The workshop was organized by The Higher Council for Environment and Natural Resources of Sudan in collaboration with UNDP and GEF under the auspices of his Excellency the Minister of Environment and Physical Development . It was held at the Banks Federation Hall, Khartoum in July 2009. It was attended by 122 participants representing a wide spectrum of stakeholders. They included practitioners, academia, research, private sector, community based organizations, NGOs, UNDP and the media.

Workshop objectives

It was targeted that the Workshop will contribute to enhance the Fourth National Report on Implementation of Biodiversity. The workshop will thus serve two purposes: dialogue between major stakeholders, and sharing of information. The workshop consisted of presentations, and discussion. major inputs were provided during the workshop deliberations.

Inaugural Session:

Dr. Saadeldin I. I. Mohamed, Secretary General, Higher Council for Environment and Natural Resources (HCENR) welcomed the participants and stressed the importance of this fourth national report compared to other national reports. The Country Director UNDP addressed the workshop and praised the efforts of different sectors towards conservation of biodiversity hoping that the report will generate sound recommendations to enhance these efforts. H.E. Dr. Ahmed Babikir Nahar, Minister of Environment and Physical Development The Republic of Sudan addressed the session reiterating the numerous goods and services rendered by biodiversity. The Minister thanked all the workshop's sponsors and organizers. He expressed his worries about the degradation of natural resources in the Sudan, and appealed for raising the level of awareness and reducing the resource degradation. He pledged the Government support to the achievement of Sudan's commitment towards the convention of biodiversity, expressed his keenness for adopting the workshop recommendations and eventually inaugurated the workshop.

Workshop deliberations

Dr. Saadeldin I. I. Mohamed, Secretary General, Higher Council for Environment and Natural Resources (HCENR) chaired this session.

Reports Presentation.

Three papers were presented during the workshop. Prof Abdelbagi Mukhtar Ali, the Coordinator presented the first paper. He highlighted the following issues:

- Parties Obligations Towards CBD

- Sudan's Compliance
 - A-Biodiversity Assessment (Country Study)
- B-National Biodiversity and Action Plan (NBSAP)
- Biodiversity Series
- Assessment of Capacity Needs and Country Specific Priorities in Biodiversity Management and Conservation Project in Sudan
- Objectives of National Reporting To CBD
- About the Fourth National Report

Dr. Talaat Dafalla Abdel Magid presented the second paper. He covered the following themes

- Overview of Biodiversity in Sudan.
- Status and Trends of
 - Agrobiodiversity
 - Forestry
 - Wildlife
 - Range and Pasture
 - Coastal and Marine Life
 - Insect Biodiversity
 - livestock Biodiversity
- Threats to Biodiversity in Sudan
- Current Status of National Biodiversity Strategies and Action Plans
- Sectoral and cross-sectoral integration or mainstreaming of biodiversity

Mr Mamoun Gasim Mosa presented the third paper. The following topics were included in his presentation:

- ✚ Progress towards the 2010 Biodiversity Target and Implementation of the Strategic Plan
- ✚ Conclusions
- ✚ Recommendations

Discussions

The participants were keenly involved in fruitful and intensive discussions covering the whole topics of the report. They applauded the effort of the coordinator and the taskforce members in the preparation of the fourth national report. Many recommendations were presented by the participants during the session to improve the report. The majority of the pertinent recommendations were incorporated in the report.