

### **1.10. Financing the Implementation of NBSAP**

Implementation of the proposed projects under NBSAP will be financed through public, donor and private sector resources. Public sector sources will include:

- allocation and reallocation of existing government funds;
- improved and new methods of public revenue regeneration and allocation;
- cost-saving through more efficient budgeting and use of funds.

Private sector financing and cost-sharing will be encouraged through the dismantling of existing barriers to investment in biodiversity and the setting in place of positive incentives such as:

- establishment and improvement of biodiversity prices and markets;
- appropriate property rights;
- increased devolution of responsibilities and opportunities for biodiversity management and utilization for profit and for non-profit purposes, through private, joint and collaborative management arrangements;
- use of appropriate fiscal instruments (such as differential taxes) and financial inducements (such as credit, funds and trusts).

Donor and international funding sources will include:

- Conventional grants, loans and development assistance;
- Innovative donor funding arrangements such as debt-for-nature swaps, trusts and compacts;
- Innovative international financial flows such as offsets, transferable development rights, biodiversity sales.

## **Phase II**

### **2.1 Assessment of Capacity Building Needs and Country Specific Priorities in Biodiversity Management and Conservation in Sudan**

Phase II followed after the development of the NBSAP. The GEF Council has approved an additional fund (US\$ 100,000) to support the assessment of three priorities in biodiversity management in Sudan. An add-on Project was launched. The partnership arrangement this time has involved the UNDP, HCENR and the Ministry of International Cooperation (MIC). The project was entitled “**Assessment of Capacity Building Needs and Country Specific Priorities in Biodiversity Management and Conservation in Sudan**”.

The three country priorities specified were:

1. **Assessment of National Capacities in Implementing General Measures for *In-situ* and *ex-situ* Conservation**
2. **Assessment of National Capacity Building in Biodiversity Monitoring Programs Including Taxonomy**
3. **Assessment of National Capacity Building Needs Related to Managing Access to Genetic Resources and Benefit Sharing**

**2.1.1. Assessment of National Capacities in Implementing General Measures for *In-situ* and *ex-situ* Conservation**

**2.1.1.1. Institutions Responsible for *In-situ* and *Ex-situ***

There are a number of government institutions and departments involved in activities pertaining to *in-situ* and *ex-situ* biodiversity conservation of flora of Sudan. However, these institutions are working in a fragmented and uncoordinated manner that lacks a unifying umbrella frame. They are separate and detached empires implementing their own scientific agenda. This usually results in duplication of work and oftentimes arouses conflicts. As a matter of fact and according to its mandate, the HCENR is supposed to coordinate between these different institutions. This is handicapped by continuous change in affiliation, lack of structural set-up and infra structure, and financial constraints.

The most important of these institutions are:

**a) Forests National Corporation (FNC)**

FNC is a public institution responsible for conservation and development of forest resources of Sudan by conducting various activities related to conservation of forest genetic resources. This entails the exploration of natural forests through periodic forest inventories, reservation of forests which are supposed to reach 25% of Sudan total area according to the Sudan Comprehensive National Strategy (1992 -2002). The FNC is also responsible for development of management plans, execution of afforestation programs and encouragement of people to participate in these programs, especially protection of forest resources and empowerment of laws. It's custody on the country's forest resources is enacted by the Forest and Renewable Natural Resources Law, 2002. The FNC has close relations with many relevant institutions that have direct or indirect role on forest conservation and development. The Forestry Research Center (FRC) and National Tree Seed Center (NTSC) are responsible for conducting research on forestry and tree seed supply respectively. Many local administrations and NGOs have an appreciable role in forest protection and development. However; the most recognized link is that between the FNC and the National Tree Seed Center (NTSC) because the latter is the main seed supplier for the former.

**b) Tree Seed Center (TSC)**

TSC was established in 1990 by a project funded by the Danish Government (DANIDA) in cooperation with UNSO-UNDP. Its mandate includes the security of a sustainable quantity of good tree seed, tree improvement and gene conservation. Currently the TSC supplies the FNC with about 40 tons of seeds annually. About 90% of these amounts are indigenous species such as *Acacia nilotica*, *Acacia seyal*, *Acacia senegal*, *Acacia tortilis*, *Acacia mellifera* and *Balanites aegyptiaca*. This amount accounts for about 53.3% of the FNC total annual seed requirements.

### c) Range and Pasture Administration (RPA)

RPA is a government agency entrusted with the administration of range and pasture lands in the Sudan. It was established in 1950, as a section within the Ministry of Animal Wealth. It carried out activities related to Rangelands conservation and management, such as proper distribution of water resources, balanced utilization of the grazing resources, and production of green forage under irrigation. In 1973, the RPA was shifted to the Ministry of Co-operation and Rural Development. Later in 1975, it was shifted to the Ministry of Agriculture, as a general administration, with three main divisions: natural Rangelands irrigated pasture and pastoral studies. Recently the RPA was divided into federal and state administrations. At the federal level the RPA has four divisions which are natural range lands, irrigated pasture, ranches and training divisions and is responsible for:

- Setting policies and national programs for Rangelands, inventories, conservation, and management and for fodder production.
- Setting rules and regulations for Rangelands protection and utilization.
- Setting plans for Rangelands genetic resource exploration, documentation and conservation and participation in land use mapping.
- Supervision, monitoring and evaluation of donor-funded projects.

At the state level, the RPA has regional head offices and district offices. Their responsibilities are to implement activities such as, seed collection of indigenous range species, seeding of degraded rangeland areas, demarcation of livestock migration routes and Rangelands protection from seasonal fires as well as the implementation of donor funded projects.

### d) National Botanic Garden (NBG)

The NBG was established in 1954 on an area of about 4.13 hectares in El Mogran, Khartoum. It is responsible for the *ex-situ* conservation of plant genetic resources, which entails collection of different tree seeds for planting in the garden and for exchange with national and international bodies. Also the NBG is responsible for propagation of different plants, adaptation of exogenous plant species, and conservation of available trees by pruning and application of fertilizers, registration and classification of different plant species.

### e) Medicinal and Aromatic Plants Research Institute (MAPRI)

MAPRI is one of the institutes of the National Center for Research (NCR) and the only specialized Medicinal and Aromatic Plants Research in its kind in the country. The National Council of Research established it in 1972 as a unit responsible for studying and developing traditional medicine. It was upgraded in 1983, to the status of an institute and became MAPRI, and was entrusted with the responsibility of medicinal and aromatic plant research. The efforts of the Institute are geared to exploration, documentation, protection, and utilization of medicinal and aromatic plants including the traditionally cultivated ones. Its major program falls into six multidisciplinary areas namely Traditional Medicine, Agro-technology, Pharmacology and Toxicology; Microbiology, Phytochemistry and Taxonomy. The major objectives of the institute are basic and

applied botanic, horticultural and related photochemical and biological activity researches.

**f) Plant Genetic Resources Unit (PGRU)**

- PGRU was established in 1985 for the conservation of horticultural germplasm. In 1995 the PGR became a central unit for the conservation of the genetic resources of different crops. The objective of the PGR unit is to conserve the agricultural biodiversity of the different crops from loss or extinction and to enhance their utilization in genetic improvement. This was achieved through the following activities:
- Exploration and collection of samples from the local genetic resources of crops from various ecological zones.
- Conservation and maintenance of seed germplasm of different crops using different systems in a seed gene bank.
- Utilization, which, is usually done after characterization and evaluation of germplasm to assist in its utilization through the use of the information, gained in crop improvement.
- Documentation of all relevant data collected during the collection, characterization and evaluation time.

**g) Other Academic and Research Institutes:**

These include:

- A) The Hydro biological Research Unit, Institute of Environmental Studies, University of Khartoum.
- B) Department of Zoology, Department Botany, and Marine Laboratory, Swakin, Faculty of Science, University of Khartoum.
- C) Faculty of Agriculture, University of Khartoum.
- D) Faculty of Animal Production, University of Khartoum.
- E) Faculty of Natural Resources/ University of Juba.
- F) University of the Red Sea,
- G) University of Neelain.
- H) Fisheries Research Center.

**2.1.1.2. Assessment of the Present Capacities:**

**a. Human Resources**

The following table shows the number of staff, technicians and skilled workers found at present in some institutions related to biodiversity conservation:

<b>Sector</b>	<b>Institutions</b>	<b>Affiliation</b>	<b>Professionals Researchers</b>	<b>Technicians</b>	<b>Skilled laborers</b>
Wetlands	Hydro-biological Research	University of Khartoum	2	2	-
	Zoology Department	University of Khartoum	3	2	-
	Botany Department	University of Khartoum	2	4	-
	Faculty of Natural Resources	University of Juba	2	-	-
Research	Fisheries	Ministry of Science and Technology	3	-	-
	MAPRI	National Center for Research	4	4	5
	NTSC	Agricultural Research Corporation	8	6	4
	PGRU	Agricultural Research Corporation	3	3	10
Agriculture	FNC	Ministry of Agriculture and Forests	249	193	
	RPA	Ministry of Agriculture and Forests	209	53	77
	NBG	Ministry of Agriculture and Forests	3	4	

## b. Equipment, Logistics and Buildings

Many research institutes, which are conducting research pertaining to *in-situ* and *ex-situ* conservation of wetlands, suffer from lack of adequate scientific equipment, chemicals and logistics. The Departments of Zoology and Botany, which belong to the University of Khartoum, carry out their routine research (flora and fauna) in the Nile around Khartoum. The Hydro biological Research laboratory at the Institute of Environmental Studies (IES) has a research vessel that can cruise south up to Juba. It has "Sonar", which is a useful tool for population dynamics of fishes, but it is not working. There are some laboratories at the Hydro-biological units of the Departments of Zoology and Botany, Marine Laboratories at Swakin, University of Khartoum, Faculty of Natural Resources, University of Juba and the University of the Red Sea. However, these laboratories lack many scientific equipment and chemicals.

The PGRU has its center in Wad Madani with two offices, two laboratories and a cold room. Equipment available at present include 11 deep freezers, 3 sealing machines, one incubator, one oven, 3 desiccators, one sensitive balance, 2 computers, one dehumidifier and one car. This equipment is currently used for *ex-situ* conservation.

The NTSC is composed of four units; NTSC at Khartoum and three Regional Tree Seed Centers in El Obied, El Damazeen and El Gedarif. Each seed center has a seed technology laboratory (temperature and light controlled), germination room, extraction and cleaning room, cool seed store (12+ 1 C°). A cold dry store or gene bank is found at the NTSC. Equipment available at each tree seed center includes seed testing equipment for the check of seed physical and physiological quality, cooling split units at the cold stores, extraction and cleaning machines, seed collection equipment, a total of six computers and cars for seed transportation.

The MAPRI is conducting an *ex-situ* conservation of medicinal and aromatic plants. The facilities available at present, include 11 staff offices, 4 laboratories, 2 experimental farms (one is rented from the Faculty of Agriculture, University of Khartoum at Shambat, and the other is owned by the Center of Veterinary Research at Soba), a herbarium, 7 computers and 3 cars.

The NBG is also conducting activities concerned with *ex-situ* conservation. It has a single room, which is used, as an office in El Mogran, Khartoum. It has a lath house and equipment, which are used for plant cultural practices.

The FNC has two levels of administration; the federal level and state level. At the federal level, the headquarters is located in Khartoum. It is composed of three administrative sectors, the technical sector, the financial sector and the investment sector. Each sector has its own staff-offices and equipment. The equipment available at present includes computers, GPSs, a GIS, measuring tapes, compasses and audio-visual equipment. At the state level forest administration is composed of sub-administrative units which are responsible for the execution of the actual fieldwork. Each administrative unit has its own buildings and equipment, which are mainly surveying and planting equipment.

The RPA facilities available at the federal level are 3 vehicles (all of them need maintenance), one photocopying machine, 2 computers (one of them is not working) and one electric typing machine. There are ten offices in addition to the herbarium building. At the state level, the facilities available are 5 tractors, 11 vehicles, 2 lorries, 2 trailers, 5 discs (plough and harrow), one baler, 2 threshers, 2 ridgers, one scraper and 2 computers. Survey equipment is inadequate in many states. The field equipment, farm implements, computers and vehicles are insufficient in all states.

### 2.1.1.3. Critical Capacity Constraints

The capacities of the different institutions addressing various activities pertaining to *in-situ* and *ex-situ* conservation were limited by a number of constraints. The most critical ones could be numerated as follows:

#### - **Absence of strategic planning**

Lack of sustainable economic planning has far-reaching repercussions on biodiversity conservation. Removal of plant cover due to urbanization, agricultural expansion, oil exploration and mining are common practices.

Absence of a general land use policy, which integrates the different land uses resulted in conflicts among the various stakeholders.

#### - **Affiliation**

There is no lead authority to observe the overall management and conservation of Sudan genetic resources. The different components of the natural resources are scattered among different sectors and institutions. Improper affiliation and impending and continuous changes in affiliation may have a direct negative impact on the performance and administrative stability of these institutions. Change in leadership may entail change in policies and plans and may affect the relationship and linkage with other related institutions. This is mainly due to the whims and attitude of the leader himself.

#### - **Job Satisfaction**

Due to lack of job satisfaction and training as well as wrongful dismissal, many professionals working in the field of biodiversity conservation had given up their jobs while others were forced to do so. The available professionals lack enthusiasm and oftentimes are depressed.

#### - **Security Constraints**

Southern and western Sudan, which are rich in biodiversity are suffering from civil strife and armed robbery. This resulted in the following:

1. Their vegetation is not fully explored and documented.
2. There is indiscriminate removal of trees for road construction, security purposes and fuel wood.
3. Movement of heavy military machinery may destroy the vegetation and compact the soil. This is further augmented by removal of vegetation due to oil exploration activities. This is indeed, a good manifestation of lack of strategic planning.

**- Financial Constraints**

The institutions dealing with the conservation and management of genetic resources are by and large public corporations. The finance of these institutions usually comes from the following sources:

1. General government budget.
2. Development budget
3. Donations from local and foreign organizations
4. Self-generated income.

It is sad to mention that both development budgets and donations have come to a halt since 1996. There is now complete dependence on the general budget, which is either inadequate, precarious, or does not come in time. Self-Dependant Corporation such as the FNC suffers from budget cuts because the income levied by this corporation is shared between the FNC and the Federal States. Shortage in financial allocations may lead to freezing or complete abandoning of activities such as surveys, inventories, and afforestation programs. Lack of adequate funds is also hampering the activities of the NBG such as collection of endangered plant species. The rehabilitation program of 1992 was executed with the collaboration of the related institutions so as to collect and restore endangered and extinct plant species.

It is deplorable to mention that research activities related to medicinal and aromatic plants have been treated just like other horticultural and field crops whose infra-structures are well established. Since 1998 due to lack of annual budget and financial allocations, inventory and documentation were stopped. Activities such as scientific expeditions, maintenance, procurement of logistics and training suffered a serious setback.

**- Lack of Adequate Qualified Scientific Staff**

Most institutions and corporations are suffering seriously from lack of adequate qualified scientist, technicians, and skilled supporting staff. The shortage and scarcity of taxonomists in the country at large could not be overlooked. It is regrettable that there are only a few taxonomists in the FNC, RPA, NBG, IES and the Faculty of Science, University of Khartoum. The number of technicians, and supporting technical staff (lab assistants and skilled labor) has sharply declined.

**- Logistics and Infrastructure**

The majority of institutions working on issues related to biodiversity conservation are lacking, appropriate and functional buildings, logistics, and continuous supply of power, up-to-date sophisticated scientific equipment, chemicals and needed technologies.

**- Coordination**

The different institutions working on biodiversity conservation are suffering from lack of coordination, synchronization that results in the following.

1. Scientific endeavors and initiatives are scattered, fragmented and rarely lead to meaningful results.
2. Duplication of work and redundancies.
3. Loss of mutual and reciprocal benefits.

**- Awareness and Education**

Awareness and knowledge of the strategic importance and the biological values of the different components of the genetic resources of the country leave much to be desired a part from fragmented and poorly concluded media initiatives. The efforts of some NGOs such as the Sudanese Environment Conservation Society (SECS) cannot be overlooked.

There is a virtual absence of syllabi related and pertinent to conservation and protection of biodiversity in the general education curricula and little, if any, in the higher education curricula.

**- Legislation**

The present legislation does not have neither regularity nor effective penalty and they are sector-based. Their improvement depends on the strength and structure of the individual institutions. Weakness in the legislation and relaxation in their implementation may lead to serious impacts such as illegal introduction of plants and animal species, degradation of forest and rangelands, absence of prompt and effective penalties on pollution and smuggling of genetic resources due to poor quarantine measures.

**- Protocols, Academic Links and Training Abroad**

The turn of the last decade of the last century witnessed virtual cessation of cultural and academic protocols. Arranged visits and training programs were declined due to financial constraints and political hinges.

**2.1.1.4. Project Profiles to Implement General Measures for *In-situ* and *Ex-situ* Conservation (Flora and Fauna)**

- (i) Exploration and Documentation of Forest.
- (ii) Protection of Forest Natural Resources.
- (iii) Rehabilitation of the Extension Unit of the Forests National Corporation.
- (iv) Community-based Rangelands Rehabilitation and Conservation.
- (v) Establishment of Pilot Ranches.
- (vi) Rehabilitation of the National Botanic Garden in Khartoum and the Establishment of New Ones in four other states.
- (vii) Conservation of Medicinal Plant Diversity through a Network of In-situ Gene Banks.
- (viii) Establishment of Medicinal and Aromatic Plants Garden.
- (ix) The Aquatic Flora of the River Nile in Sudan.
- (x) Proposal for Strengthening Sudan Tree Seed Center.

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- (xi) *Ex-situ* Conservation of Sudan Forest Genetic Resource in the Gene Bank (Seed Bank) at Soba- National Tree Seed Center.
- (xii) *Ex-situ* Conservation of Agricultural Bio-diversity.
- (xiii) *Ex-situ* Conservation of Animal Genetic Resource “Animal Gene Bank”.
- (xiv) Classification of Indigenous Animal Breeds.
- (xv) *In-situ* Conservation of Indigenous Breeds of Sudanese chicken.
- (xvi) *In-situ* Conservation and Artificial Breeding of Endangered Domestic Animal Species.
- (xvii) *In-situ* Conservation of Kenana and Butana Cattle.
- (xviii) Survey Of the Flora And Fauna of the Dinder National Park.
- (xix) Conservation and Assessment of Sudan Wildlife Resources.
- (xx) Establishment of Wildlife Research and Experimental Farm.
- (xxi) Conservation of Avifauna of the Red Sea.

### **2.1.2. Assessment of National Capacity Building in Biodiversity Monitoring Programs Including Taxonomy**

#### **Needs for Capacity Building:**

In view of the limitations outlined in the above, a number of needs are formulated in order to contribute to a brighter future in the area of taxonomy and biodiversity. These are enlisted below:

- A. Establishment of infrastructures in the form of:
  - Central Botanical Garden, Herbarium, Arboretum, Central Zoo and Natural History Museum, beside similar units in the States;
  - Showrooms at National Parks, Game Reserves and Protected Areas.
- B. Rehabilitation and upgrading of existing infrastructures.
- C. Extension of research to:
  - the study of faunal and floral species not studied so far;
  - the execution of programs to revise and update the existing classification of fauna and flora, and diversity of various components.
- D. Setting a well articulated training, educating and awareness policy that would lead to:
  - introduction of taxonomy in school and undergraduate curricula;
  - provision of scholarships and fellowships to encourage research on taxonomy;
  - exposure of trainees to modern techniques;
  - setting crash programs that promote skills among personnel at all levels.
- E. Surveillance and monitoring of changes in fauna and flora resulting from natural intervention.
- F. Promotion of scientific and technical cooperation with other parties, through long-term monitoring and database updating.
- G. Developing interest in economic benefits from fauna and flora as to lead to expansion in:
  - collection and cultivation of medicinal and aromatic plants, forest trees and fish;
  - encouraging game ranching;
  - encouraging bee-keeping;
  - taking care of amateur bird watchers, herbalists and various naturalists.
- H. Involvement of Sudanese scientists in checklist preparations and updating.
- I. Establishment of a Technical Committee to advice the HCENR in matters related to systematics.

### **2.1.2.1 Proposed Action Plan**

The capacity building could be achieved through the execution of a number of named projects that are integral parts of the Sudan's Biodiversity Strategy and Action Plan. The projects are:

#### **i. Biodiversity Assessment in Woodland Savanna**

The wooded savanna, which embraces approximately 6% of the Country's area is one of the most important ecozones in terms of biodiversity and species richness. Lying at the southwestern part of the country, the wooded savanna buffers two important ecozones: The rainforest and the montane forest, both of which are inhabited by important species. These are the chimpanzee and the bongo in the rainforest and Giant bushbuck and Wyen's duiker in montane forest.

#### **ii. Taxonomy of Antelopes in Sudan**

Taxonomical studies of antelopes in Sudan started early in 1950's when the basis of the antelope classification was laid down by the Sudan Natural History Museum in collaboration with the exhibition from Harvard University. Since then, much work has been done through morphological studies of specimens from Natural History Museums in Europe and United States of America. These specimens were collected from different geographic regions in Sudan during the colonial times.

#### **iii. The Impact of Overhunting on in-situ Conservation in Desert and Arid Zones Ecosystems**

The ecosystems in the desert and the arid zones are very fragile. They receive low rainfall so plants are ephemeral and animals move sporadically to utilize these plants before they dry out. Low rainfall is associated with low primary productivity and low biodiversity. The food chain is simple and can easily be disturbed by the unsustainable use of the natural resources.

Overhunting is one of the most unsustainable use of wildlife in the desert. Safari hunters, mostly from the Middle East, enter the country during the cool season from December until February. They mainly hunt dorcas gazelle, small mammals and game birds.

#### **iv. Rehabilitation of Forest Herbarium at Soba**

##### **Introduction**

Plant taxonomy is the science that deals not only with description, identification and nomenclature of plant, but also deals with their classification into different categories so as to make their study easier. The principal tool used by taxonomist in Forest Botanical Research classified collections of well maintained, preserved, dried plant specimens called the Herbarium, which represents the laboratory of the taxonomists. The other tool

is of course scientific literature. This is the record of observations and conclusions of workers since science began. Because it is recorded information it must be regarded as secondary source. It is subjected to error because it has been written by human hands. The only primary sources are the actual objects of study. For taxonomist this object is the organism itself. Since 1966 a herbarium of an overgrowing collection of authentically identified specimens, nearly about 7000, is being built up at the Forestry Research Centre, Soba. The work in the herbarium has been described mainly towards plant collection, perfecting herbarium techniques of preservation, mounting and repair of old specimens, exploration, identification, nomenclature and systematic classification of the herbarium and finally building up of carpological collection and revision of taxa.

Justification of rehabilitation:

For the advancement of Scientific Research in the Sudan and assessment of plant biodiversity, it is necessary to have large herbarium (could be central) located in Khartoum, well staffed with taxonomists and other supporting staff, well equipped, air conditioned so that the cited specimens last indefinitely with a good reference library.

- v. Rehabilitation of Range and Pasture Central Herbarium
- vi. Upgrading of Systematic Knowledge in Flora and Fauna
- vii. Flora and Fauna of the Desert in Sudan
- viii. Exploration, Collection, Preservation and Documentation of Flora of the Red Sea Coastal Plains.
- ix. Avifauna of Sunt Forest ( Bird Sanctuary) and Umm Shigerah Island
- x. Sudan Water-bird Survey and Census
- xi. Plant Taxonomy as a Tool for Biodiversity
- xii. Monitoring in the Sudan

### **2.1.3. Assessment of National Capacity Building Needs Related to Managing Access to Genetic Resources and Benefit Sharing**

#### **Capacity Building Needs**

##### **A. Field and Horticultural Crops**

###### **Needs**

To establish a national system for access to crop genetic resources and equitable sharing of benefits arising from their utilization (ABS), there is a need for building the capacity in the following specific areas:

###### **1- Awareness**

By providing information to policy makers, legislators, scientists and the public on the issue of ABS and the relevant international and regional conventions. This could be provided through:

Training courses:

- Workshops.
- Use of media etc.
- High policy level meetings.

###### **2- Policy and Legislative Frameworks**

A process should be initiated to develop a comprehensive national framework on ABS. It is a process that involves wide consultative activities and a drafting process in order to attain the following objectives:

- Determine the main principles that should be followed when drafting any legislation on ABS.
- Determine the most effective administrative structure to be set up for a national system of ABS including the focal points and national competent authority (ies).
- Determine the most effective procedures for the decision making process.
- Determine the alternative benefit types for sharing with utilizers of the genetic resources.

###### **3- Inventorying and Monitoring**

Buildup of capacities in the area of inventorying and monitoring of crop genetic resources necessitates the following:

- Strengthen the capabilities of the Plant Genetic Resources Programme in the ARC for surveying and exploration of the crop genetic resources in Sudan.
- Strengthen the capacities in plant taxonomy within the universities and research centers, including establishment of a national herbarium for agricultural crops and their wild relatives.
- Establishment of a molecular biology laboratory within the PGR center for DNA fingerprinting of crop genetic resources

#### **4- Information Systems**

- A modern electronic information system on crop genetic resources should be established with a network connecting the national competent authorities and the technical institutes.
- Information needed for the decision making process should be disseminated to the relevant stakeholders including farmers and local communities.

#### **5- Technical Capacities**

Adequate facilities for the conservation, evaluation and enhancement of the crop genetic resources in the country are needed. This could be attained through the development of the present PGR Unit in the ARC into a national Crop Genetic Resources Center to which five regional units may be attached.

#### **6- Economic Valuation of Crop Genetic Resources**

There is a need in general to find and raise the national capabilities in biodiversity economics. Economic valuation of crop genetic resources should be given a high priority being a necessary step towards obtaining and sharing benefits arising from the utilization of such genetic resources.

#### **7- Human Resources**

Recruitment and training of personnel are required to raise the skills as follows:

- Training in the legal and regulatory frameworks.
- Training of scientists and technicians in different disciplines related to ABS (e.g. taxonomy, molecular biology, documentation and information management).
- Training of teachers and journalists to play roles in the awareness activities.

#### **8- Coordination and Harmonization Mechanisms**

Development and implementation of an efficient system for access to crop genetic resources and benefit sharing should be based on a coordinated participation of different institutions, individuals and groups. Establishment of coordination mechanisms is, therefore, very vital for all stages of development and implementation of the ABS system. Parties to be involved include:

- The scientific institutions.
- Focal points and competent authorities.
- Farmers and local community groups.
- Customs authorities.
- National ports authorities.
- Security forces.
- Quarantine authorities.
- Trade authorities.
- Agriculture and seed departments.

**B. Medicinal and Aromatic Plants**

**Capacity Needs in Managing Access to Genetic Resource**

**Needs**

- 1- Inventory and Documentation: - including establishment of a digitalized database of the floristic wealth and associated traditional knowledge systems of Sudan with special reference of to MAPs.
- 2- Conservation of MAPs and other important plants of Sudan, using mainly *ex-situ* methods of conservation and *in-situ* methods for non-wood forest products “NWFP” covering:
  - i) Field Gene Bank
  - ii) Seed Bank.
  - iii) Cryo-Bank
  - iv) Pollen Bank
  - v) DNA Bank
- 3- Domestication, cultivation and commercialization of important MAPs through:
  - i) Selection of potential species for cultivation.
  - ii) Genetic enhancement.
  - iii) Development of location specific cultural practices for cultivation.
  - iv) Establishment of high tech nurseries and micro-propagation.
  - v) Development of post-harvest technology for handling the MAPs products to maintain quality, safety and standards.
  - vi) Development of diverse value-added products from MAPs.

**i. Forests**

**Capacity Needs in Managing Access to Genetic Resource**

**Awareness in Managing Access to Forest Genetic Resources**

Awareness about the importance of management of forest genetic resources in general is low among the practitioners, policy makers and the public at large. Issues related to managing access to forest genetic resources and benefit sharing has not been realized neither by forestry education institutions, forestry research nor forest administration. Massive awareness campaigns are needed to mobilize national efforts in this direction. Equally important is the accommodation of these new issues in forestry education curricula. Policy makers and development planners need to be sensitized to recognize local communities privileges to indigenous forest genetic resources and their local knowledge about them.

### Technical Support

As mentioned in the NBSAP, the vegetation of Sudan is not adequately explored or adequately documented. Equally, basic information about the current pattern of genetic diversity in forest tree species is lacking. Likewise, information about local community knowledge, practices and/ or innovations related to indigenous forest resources is scant and not documented. National inventories and surveys are therefore highly needed to obtain information on the above-mentioned areas.

While the Country has just endorsed the criteria and indicators (C&I) for sustainable forest management, appropriate (C&I) for the conservation and sustainable use of forest genetic resources are also needed.

The present role of the National Tree Seeds Center, which is confined to annual collection of tree seeds for annual plantation programmes, needs to be promoted. Gene banks and seed orchards should be established to facilitate access to genetic resources.

### Human Resources Development

Training of forestry personnel in the field of forest genetic resources in general and in management of access to genetic resources and benefit sharing in particular is of paramount importance. Such training is required for forestry academicians, researchers and practitioners. Forestry personnel also need to be trained in the area of community organization and community mobilization.

Forestry personnel at the universities and research institutions also need to be trained in related basic sciences such as flora biology, phenology, tree physiology, forest genetics and tree improvement, collection techniques and handling and storage of indigenous forest seeds.

### C. Microorganisms

Needs and Requirements for Capacity Building:

#### a. Policies

The government must have a clear policy on matters concerning the microbial resources of the country. The policy should stipulate whether this resource is of importance or not and whether it is a sovereign property.

#### b. Structures

Unlike other biological entities such as higher plants or animals, it is not practical to have an *in-situ* preservation strategy for microorganisms. It is therefore necessary to have an *ex-situ* preservation facility. In accordance with NBSAP, a gene bank for microbes - traditionally known by microbiologists as a culture collection - should be established. The legislation to be made in this field is firmly connected to this facility. It is therefore proposed here to establish a culture collection facility for the Sudan.

**c. Administration Bodies**

There must be established a council of national experts to deal with matters with any bearing on microorganisms. This Council shall supervise the activities of the SNCC and propose legislation deemed necessary and offer advice to the government. The Council can also propose training program for personnel.

**d. Legislation**

Laws and regulations should be developed to organize dealings with the microbial genetic resources of the country, in particular in matters of access and benefit sharing through the SNCC.

**e. Training of Personnel**

There are a number of important techniques in microbiology that have been developed recently. Most important among these are the new molecular biology techniques particularly in the area of systematics. Young scientists must be trained in this area.

**f. Boosting Awareness**

Scientists and the public at large must be well-informed of the usefulness of microorganisms. Only then can real progress be made in realizing the potential of this very important genetic resource. The various media such as press, radio, television as well as workshops and symposia can be used as channels of dissemination of knowledge. School and university curricula should have material on microbiology.

**g. Microbiology Laboratories**

These are very poor in Sudan, but if we are going to have access and benefit sharing in the area of microorganisms we must first find these microbes, isolate them, purify them and study their potential. This job is done by the various microbiological laboratories scattered in the country. And in order that these labs do their jobs right they must be competent. Minimum requirements of such labs should be furnished.

**ii. Livestock**

Areas that need capacity buildings:

**a. Institutional Arrangement**

- Establishment of a national committee responsible for planning, co-ordination and support of policies and initiatives regarding genetic resources conservation of livestock.
- Creation of a national program for livestock genetic resources conservation under the umbrella of Animal Resources Research Corporation (ARRC) and the Ministry of Animal Resources and Fisheries, making use of the artificial insemination biotechnology to collect semen samples from the different local breeds and their conservation in a gene bank.
- Strengthening the research institution and animal production research stations working in improvement and conservation of the local breeds i.e. Um Benain, Atbara, Gazala Jawazat, El Huda and El Nohud, by supplying technical supports and funds to improve the database and documentations on the genetic resources.

**b. Legislative Arrangement**

- Promotion of legislative arrangements to regulate access to livestock genetic resources.
- Establishment of national legislations to protect local pastoralists' rights to biological resources and their indigenous knowledge and practices.
- Rangeland legislation should be passed to address land use in rangelands and integration of animal production and crop production in the irrigated areas.
- Development of national legislation to regulate the movement of the local animal breeds out of the country for breeding purposes and of the exotic breeds coming into the country.

**c. Awareness**

- Strengthening extension facilities promote awareness about conservation of genetic resources and benefit sharing among veterinarian resources and policy makers.
- Creation of an extension policy in rural areas between indigenous animal owners who are raising pure breeds of life stock, to make annual shows (with prizes), and register their animals for the follow up.
- Create a Sudanese association for livestock breeders.

**d. Documentation**

- Collection of published information and documentation characterizing different breeds of livestock.
- Establishment of network of information about the animal genetic resources in Sudan so that it can be used by researchers and scientists.
- documentation of indigenous knowledge and practices.

**e. Training**

- Training of scientists, researchers and technicians working in the research stations to increase their capacities to use the available knowledge about conservation of genetic resources.

**f. Wildlife**

**Needs:**

To promote and establish a national system for access to wildlife genetic resources and benefit sharing, the capacity building needs should include:

**a. Legislations and Policy**

To satisfy the need for building up of an access to wildlife genetic resources and benefit sharing legislation and policy aspects, the following points should be considered:

- The policy and the legislation should show the Sudan commitment to the global conventions (CITES, CBD etc.).
- To submit an up-listing or down-listing of wildlife species proposal to CITES secretariat should be proposed by the relevant scientific authority.
- Amendments of the existing law to guarantee the biosphere reserve's local community involvement in the management plan.

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- The frequent updating of the species listing in accordance with their abundance in their habitat.
- The current law (The Wildlife and National Parks Conservation Ordinance, 1986) should be amended to cover fauna and marine life.

**b.** Surveying, monitoring, evaluation and documentation of the genetic resources. Also a build up of an information system necessary for access and conservation of wildlife genetic resources and benefit sharing is needed. Promotion of a documentation system necessary for the conservation programs (Awareness programs).

**c: Awareness**

Establishment of awareness programs to address:

- Decision makers.
- Governmental institutions.
- Universities and Research institutions.
- Communities associated with wildlife resources.
- NGOs.

The programs to educate, enlighten and sensitize people about the wildlife genetic resources management and benefit sharing will be enhanced by establishment of zoological gardens, wildlife farms and ranches and museums as tools of awareness.

**d. Training**

WCGA and other governmental staff should be trained and technically equipped to satisfy wildlife resources conservation duties.

**e.** Efforts should be exerted to restore the distinct species as a source of genetic resources and as a pre-phase for the access to wildlife genetic resources and benefit sharing.