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Abbreviation and Acronyms

ADS	Area Development Schemes
ARS	Area Rehabilitation Schemes
BCM	Billion Cubic Metres
CBD	Convention on biological Diversity
CCD	Convention to combat Desertification
CCC	Convention on climate Change
ESTAC	Ethiopia and Sudan Technical Advisory Committee
FAO	Food and Agriculture Organization
GWH	Giga Watthour
M & E	Monitoring and Evaluation
MIWR	Ministry of Irrigation and Water Resources
MW	Mega Watt
NCS	The National Comprehensive Strategy
NCWR	The National Council for Water Resources
NGO	Non-government Organization
NWC	The National Water Corporation
OM	Operation and Maintenance
PM	Pest Management
RWH	Rain Water Harvesting
SWCs	The State Water Corporations
TECCO NILE	Technical Committee for Nile Countries
UNDP	The United Nations Development Programme

Part 1: Introduction and Background

Introduction

Water Policy Development in Sudan

The development of policy in Sudan is an important element in the progress of Sudan Policy Development, whilst attaining international experiences will be based on the values and merits of the Sudanese people. The national water policy presented in the document brings together, for the first time, policies which are related to many aspects of water, including resources, utilization protection and management integrated document.

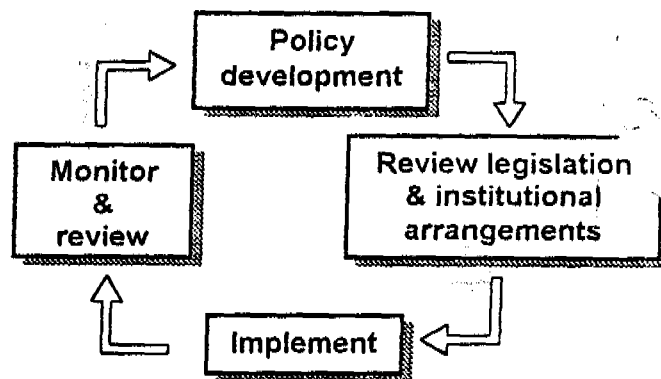
Besides many governmental aspects the document also covers a wide range of other activities such as agriculture, forestry, industry, health, energy and transportation. The document comprises an ongoing process of policy and legislation development in Sudan, dating back to a number of years. The suggested policies need to be dynamic in order to cope with the requirements of the country and its people, both in time and space. As the pressure on the limited natural resources increases, the policies should be developed and manipulated to ensure that water is used fairly and its resources protected against pollution, degradation and mis-use. Thus there will be an ongoing cycle of policy development, implementation and review. The main elements of this policy may be implemented as soon as possible. However, periodical reviews should be carried out when necessary in accordance with the cycle of policy development

Objectives

The objectives of the national water policy are as follows:-

- To bring together and clarify existing policy;
- To review and adapt water policy to meet changing circumstances within the country;

- To ensure that the water resources of Sudan are properly managed, protected and efficiently utilized for the benefit of all;
- To provide the basis for the ongoing development of water related regulations and legislation;
- To strengthen and rationalize water related institutions in both the public and private sectors in Sudan.



The Policy Cycle

Policy Development Process

The development of the Sudan national water policy has been a process which involved a large number stakeholders and has taken several months to complete. The policy is built on the work and experience of a large number of people who have contributed to the development of Sudan over many years in government, academic institutions and the private sector. This national water policy document has been compiled from the inputs of a dedicated team of Sudanese specialists and experts on a range of topics drawn from papers specially written for the purpose.

As part of the policy preparation process trips were made to some areas in Sudan where meetings were held with representatives of State governments, farmers, communities, NGOs, external support agencies and the private sector. From these meetings valuable insights were gained such as the views of all

sectors of the population and how water directly affects their lives.

The initial draft of the national water policy was referred to a large number of **technical experts** both within Sudan and in the international water sector for comment. Wherever appropriate these comments are incorporated into the policy. In addition, a national symposium was held to provide an opportunity for comment and input into the policy formulation process. In addition, draft copies of the document were widely circulated to all federal ministries and state governments in Sudan.

The Government of Sudan wishes to acknowledge with thanks all those persons who contributed to the development of this national water policy document. The following persons deserve particular gratitude of the people of Sudan.

- ♦ His Excellency Kamal Ali Mohamed, The Minister of Irrigation & Water Resources;
- ♦ Dr. Osman El Tom Hamad, the National Water Policy Project Coordinator;
- ♦ The team of national consultants:
 - Dr. Ahmed M.O. El Mufti
 - Prof. Hassan Abdel Rahman Musnad
 - Dr. Mohammed Ahmed Ali Dingle
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 - Prof. Ahmed Ali Salih
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- ♦ The Resident Representative of the Sudan office of the Food & Agriculture Organization (FAO) of the United Nations for technical support.
- ♦ The Resident Representative of the Sudan office of the United Nations Development Programme (UNDP) for financial support

Format of Document:

One of the most important objectives of this policy document is to ensure that the national water policy of Sudan is clear, simple and accessible to ordinary people in the country. **More often than not government policy is unclear** because it can only be found embedded in complicated legislation and lengthy documents

which makes the implementation of policy very difficult. In line with international trends, the Sudanese National Water Policy has been **purposely** written in ordinary language and is addressed to all the peoples of Sudan.

The document begins with an introduction to the objectives of the policy. The introduction is followed by an **insight into the importance** of water in Sudan, which provides an overview of the role of this most important natural resource in the development of the country.

This policy document is a **baseline document** which it forms part of an ongoing process of refinement and development of policy and legislation in Sudan. The next section in the document therefore provides the background to existing policy and legislation from which this policy is developed.

The **main policy issues** of the document may be found under the chapter entitled "Water Policy". This section includes the main policy principles and statements for the proper management, utilization and development of water resources in Sudan.

The institutional framework through which water resources in Sudan are managed is a key element in the implementation of water policy, together with the building of the required capacity within these institutions and the country as a whole. Policy relating to these matters follows the water policy section.

The document concludes with recommendations for the development of a strategic plan for implementation of the new policy.

Water in Sudan

Introduction

Water has an impact which extends on most of the major sectors of life, hence the statement in the Quran that Allah has made from water every living thing. "Water is Life" is a well known saying. Thus, any water policy is inevitably complex and overlaps with policies in other related fields, often crossing international boundaries. Policy is also dynamic and evolves with changes in supply and demand

parameters, the surrounding environment, advancement in knowledge and feedback from previous policies.

- * Water has an essential role in sustaining life and development in arid and semi-arid regions. The location of Sudan at the heart of Africa and its generally flat topography has resulted in more than half its area being desert or semi-desert.

The northern half of Sudan extends from the capital Khartoum, where the rainfall is 200mm per annum, northwards to the border with Egypt where there is no rainfall. Where it rains the rainy season is limited to two or three months with the rest of the year virtually dry. Rainfall usually occurs in isolated showers which vary considerably in time, location and from one year to another. The coefficient of variation of the annual rainfall in this northern half of the country could be as high as 100%.

In the quarter south of the country's centre, the annual rainfall barely exceeds 700mm per annum, concentrated in only four months from July to October. Rain-fed agriculture in Sudan is mainly practiced in this quarter. As the coefficient of variation in annual rainfall in this region is around 30% and the dry season extends for about eight months, the area cultivated and the productivity varies widely from one year to another.

In the most southern quarter, where the annual rainfall exceeds 700 mm, the area is dominated by extensive wetlands and inhabited by tsi-tsi fly and other insects, which are hazardous to humans and livestock. Perennial sources of water, which are shared with neighbouring countries, are therefore the main reliable water resource of the country.

Although Sudan is the largest country in Africa, with an area of 250 million hectare, its current population is approximately 30 million. More than half that population live on just 15% of the land along the Nile river. Most of the rest of the population live in towns and around water sources away from the Nile.

Similar to most developing countries, agriculture, which dominates the country's economic growth and development, consumes the major part of Sudan's available water. Water demand for drinking, municipal and industrial uses are presently less than 10% but are on the increase. Hydropower generation, trade, transportation, health, the environment and other socio-

economic aspects also depend on water as a resource base.

Hydrological Cycle

The hydrological cycle is a natural phenomenon through which all water, which is so essential for development and human wellbeing, is constantly moving. Through the cycle all water is inter-related. Rainfall, which is the result of evaporation by the sun, feeds streamflow and groundwater recharge. An impact on one part of the cycle has effects on other parts. These effects may be local or global, where, for example, activities in one part of the world cause climate changes in another. The development of a new national water policy in Sudan recognises the reality of the hydrological cycle and the interaction between its different components. This results in an integrated national water policy and is consistent with international standards.

Whilst the natural hydrological cycle is extremely complex and not fully understood, its basic components may be illustrated diagrammatically (See Fig. 1).

Enormous volumes of water are involved in the water cycle. There are about 1.4 billion cu km of water on the earth, slightly more than 97 percent of which is ocean water and is therefore salty. However, because the water that evaporates from the ocean is almost free of salt, the rain and snow that fall on the earth are relatively fresh. Fresh water is stored in glaciers, lakes, and rivers. It is also stored as groundwater in the soil and rocks. There are about 36 million cu km of fresh water on the earth.

The world's two main reservoirs of fresh water are the great polar ice caps, which contain about 28 million cu km, and the ground, which contains about 8 million cu km. Almost all of the world's fresh ice is found in the ice caps of Antarctica and Greenland. All the world's rivers and freshwater lakes hold about 120,000 cu km (about 0.3% of the available fresh water). Ironically, a favorite expression in hydrology is that people expect water to be cheaper than dirt.

Water Availability in Sudan

Introduction

Water resources in Sudan are very limited. They comprise rainfall, groundwater and river flows, all of which are inter-related as part of the natural hydrological cycle.

The erratic nature of rain and its concentration in a short season places Sudan in a vulnerable situation, especially in rainfed areas. Surface water and groundwater resources are mostly shared with neighboring countries. The Nile River, which is shared between 10 countries, is the primary source of Sudan's water. The four main non-Nile streams are also shared with neighbors. These are Gash and Baraka which flow from Eritrea and Azum and Hawar which are shared with Chad. The largest groundwater aquifer, the Nubian Sandstone system is shared with Chad, Libya and Egypt.

The Nile System

Ten countries share the Nile, which dominates the map of Sudan. These are: Burundi, Democratic Republic of Congo, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Tanzania and Uganda.

The Nile is the dominant geographical feature of Sudan as around 70% of the area of the country is situated within the Nile River catchment area. On the other hand, although ten countries share the Nile, about 60% of its length lies within Sudan. The share of the Nile waters utilized by Sudan is substantially less than this ratio. Out of an average annual flow of 84 billion cubic metres (bcm) of water that reach Aswan in southern Egypt, 10 bcm were estimated for evaporates from the High Aswan Dam, and 55.5 bcm flow downstream as Egypt's share according to the 1959 Nile Water's Agreement between Sudan and Egypt. Sudan is allowed to abstract up to 18.5 bcm according to the agreement, which is 22% of the Nile flow.

The three main tributaries of the Nile unite in Sudan and the Nile leaves as a single artery through the Sahara Desert to Egypt. The Blue Nile and the White Nile join at the capital Khartoum carrying, 54 and 27 bcm of water respectively as a long term average.

The combined river is named the Main Nile which is joined by Atbara river at Atbara town

320 kilometres north of Khartoum bringing in about 12 bcm of water. Thus, the annual average flow of the Nile in central Sudan is around 93 bcm. Approximately 10% (9bcm) are lost along the journey through the Sahara Desert leaving 84 bcm of water to reach Aswan. The Sudanese share, which is 18.5 bcm of the Nile water measured at Aswan, is equivalent to 20.5 bcm when measured in central Sudan, again 22% of the flow there.

Sudan has a unique position in the Nile system. It is a sink, a path and a source of the Nile. It is on one hand one of the two dry downstream countries, with Egypt sharing the fate to act as a drainage basin and a sink for the sediment and debris flowing down from the highlands. It also embraces 60% of the Nile within its borders. On the other hand, it contributes to the flow of the Nile from Bahr El Ghazal, Bahr El Jebel and Pibor basins as well as the seasonal streams which join the Nile along its journey to the north.

Sudan has also the potential to increase the Nile flow through conservation of the river flow through the wetland areas in its south. If appropriate measures are taken to minimise environmental and social impact in the wetland areas, the Nile flow might be increased by another 12 bcm.

The amount of sediment carried down to Sudan during the flood season of one year appears to be influenced by the rainfall over the upper catchment during previous years (Hamad and Mohammed, 1986). It was noticed that when a wet year follows a succession of dry years, the sediment concentration is higher than normal and the flood flow recedes at a higher rate. This is particularly true for the Blue Nile and Atbara River flood flows. A succession of dry years were experienced from 1978 to 1987 while four distinct high floods occurred after that in the years of 1988, 1994, 1996 and 1998. Such a phenomenon has to be addressed in the policy development and planning process.

Sudan is seriously affected by the dry years because of its limited storage facilities. Conversely, the high floods destroy infrastructure and increase the effects of sediment and scourge along the river banks. Mitigation of floods to alleviate their adverse effects on human life and property has to be reflected in policy developments and planning as well.

Non-Nile Streams and Wadis

The major four streams, which fall under this category, are Gash and Baraka, which are shared with Eritrea, and Azim and Hawar, which are shared with Chad. The combined flow of these streams forms more than one third the total flow of all the streams which are not part of the Nile system. Flow from the non-Nile streams varies considerably from one year to another following the erratic nature of the rainfall in the region. Their total annual flow varies from 3 to 7 bcm. They may flow for a few days or hours during the period from July to October and are usually dry for the rest of the year. Most of these streams are not monitored regularly.

Monitoring was neglected in many streams after the Decentralization Act of 1994 because of shortage of funds or lack of clarity of responsibilities of different government bodies. As any planning requires sound temporal and spatial data, the issue of scarce data is addressed later in the policy document.

Groundwater

The sedimentary Nubian sandstone and Umm Ruwaba formation are the main aquifers in Sudan. They extend to a depth ranging from 40 to 400 meters and have total dissolved solids ranging from 100 to 2,000 ppm. Some research was carried out by experts funded by Germany on the Nubian Sandstone, which is shared by Chad, Egypt, Libya and Sudan. As a result of this research it was concluded that the Nubian Sandstone groundwater is largely of fossil origin. Quantification of groundwater is difficult under the economic hardship facing a

third world country like Sudan without the assistance from international agencies. Thus the annual recharge of groundwater is difficult to assess accurately. It has been estimated to be about 4.0 bcm.

Summary of available water resources

The current annual amount of water available to Sudan from all internal and external sources amounts to about 30 bcm (Box 1). This is the summation of the Sudan's share of the Nile waters according to the 1959 Agreement with Egypt (20.5 bcm), the average flow of the non-Nile streams (5.5 bcm), and the renewable groundwater (4.0 bcm).

It should be noted here that a good portion of the non-Nile flow is shared with neighboring countries.

Evapo-transpiration in Sudan ranges from 3000 to 1700 mm per year from the north to the south. One hectare of a seasonal crop in central Sudan needs 12 000 m³ of water. The 30 bcm of water available to Sudan may cover 2.5 million ha which is 1% of the area of the country and less than 5% of its arable land. If more than one crop is rotated on the same plot or if the country expanded the area covered by perennial crops, the area which could be irrigated by the 30 bcm will be considerably less than 1% of the area of the country. It should also be noted that there are other uses of water, such as municipal and industrial needs, which are expected to increase at the expenses of irrigated agriculture. Moreover, harvesting all the water in the seasonal streams is not easy. Also abstraction of the desired amounts of ground water may prove to be difficult as explained later.

Box 1 : Internal and external water available in billion m³ /year (Km³ /year)

Water Resources	Quantity	Constraints
Sudan present share from the Nile	20.5	Seasonal pattern coupled with limited storage facilities
Non-Nile streams	5.4	Highly variable, short duration flows which are difficult to monitor or harvest. Some are shared with neighbours
Renewable Ground Water	4.1	Deep water entailing high cost of pumping. Remote areas of weak infrastructure
Present Total	30.0	
Expected share from reclamation of swamps	6.0	Capital intensive with considerable social and environmental cost
Total	36.0	

Sudan may increase its share of the Nile waters by working with Egypt to conserve some of the water which evaporates from the southern swamps. The amount conserved should be divided equally between the two countries as stated in the 1959 Agreement. Despite the social and environmental impacts, which have to be taken care of, such projects take time and money because of their very large size. Work on Phase I of the Jonglei canal has begun but has been halted since 1983 due to security reasons. Other projects might start after the successful completion of Jonglei project.

As the rate of growth in population is 2.9 % annually, and as the need for water increases with development, any possible increase in the availability of water will be consumed as it becomes available. Thus the water shortage situation is expected to continue. The demands of other Nile Basin countries and those sharing non-Nile streams with Sudan might influence the amount of water available and its distribution in the region.

EXISTING POLICIES AND LEGISLATION

Water policy and legislation development in Sudan can be divided into two eras as follows:

Prior to 1992 when the policies and legislation were fragmented, and post 1992 after a comprehensive review of policies and legislation. This section provides a brief overview of these developments.

Fragmented policies and legislations before 1992

The main water regulations in Sudan are based on the 1951 Regulations, which are licensing regulations for pumping water from the Nile according to the Nile Pumps Control Act of 1939 (repeated). Recent instruments have modified the 1951 regulations, e.g. the Water Resources Act of 1995. In the licensing policy there are provisions for the following:

- a. Solving disputes through arbitration;
- b. Obliging the licensee to maintain the canals to avoid seepage;

- c. Organisation of the rotation of crops;
- d. Obliging the licensee to cultivate crops making optimal use of the waters pumped under the licence;
- e. Annual fees to be paid for each licence.

In addition there are several other pieces of legislation which illustrate a variety of different policies. These are shown on Box 2

Financing water use

Water is a source of life, so there is no policy for selling water in Sudan. Therefore, under the Civil Transactions Act of 1984, the landowner in a Muzara lease shall hand over the land to the tenant with its rights including the right to use the water and the tenant bears the cost of irrigation canals.

On the Gezira Irrigation Scheme there is no policy for full cost recovery for water use. In order to meet its financial obligations, the Scheme sometimes take part of the fees for water and land, when faced with a deficit in the budget. The Government shall then be obliged to finance the deficit. The fees for land and water used to be determined by the Minister of Agriculture in consultation with the Minister of Finance and National Economy (fees are determined by regulations and not market forces). Tenants are allowed to pay water and land fees after the end of the season or even later.

Comprehensive Policies and Legislations as of 1992

Since 1992 the institutional and legal framework for water resources development, utilisation and management in Sudan have been reviewed and revised through the introduction of a number of instruments as follows.

The National Comprehensive Strategy (NCS) of 1992

According to the National Comprehensive Strategy (NCS) of 1992, the irrigation and water resources sector is considered as a sub-sector of the agricultural sector. Its policy objectives and strategies are defined as follows:

- Full and efficient utilization and development of surface and groundwater resources;

BOX 2: Legislation before 1992

ACT	OBJECTIVES
The Protection of Agricultural Tenants in Gash Delta and Toker Act of 1928 and the Agricultural Tenants Protection Act of 1950	The protection of agricultural tenants
The Fresh Water Fisheries Act of 1954	To protect the freshwater fisheries of the Sudan and to regulate and control fishing
The Water -hyacinth Control Act of 1960	To control and prevent the spreading of water - hyacinth in rivers and waterways in Sudan
The Environmental Health Act of 1975	To preserve environmental health including provision and preparation of public drainage and drain rain water and sewage water.
The Rahad Corporation established by the Rahad Corporation Act of 1972	The development of the area allotted or acquired under the Act for the promotion of agricultural production, and efficient irrigation
The Corporation established by the Western Region of Savannah Development Corporation Act of 1978	a. To establish integrated agricultural and rural development in the project area through the optimal utilization of natural resources; b. To develop water resources in the project area; c. To rally the citizens, to cooperate with the Corporation
The Civil Transactions Act of 1984	Regulates the relationship between landowners and tenants
The Gezira Irrigation Scheme Act of 1984	To utilize the natural and agricultural resources of Gazira and to develop and promote them on a scientific and commercial basis.
The Irrigation and Drainage Act of 1990.	All irrigation and drainage activities require a licence from the Ministry of Irrigation and water Resources (MIWR)
The High Council for Environment and Natural Resources Act of 1991	Include the sustainable development of natural resources and their optimal utilization, environmental protection in co-ordination with State organs and public awareness.

- Building of dam on rivers other than the Nile and on seasonal valleys.

equipment, pipes, reservoirs and spare parts; (practical steps have been taken in
- Addressing the problem of silt in reservoirs, the enlargement of existing reservoirs through increasing their height and the construction of new dams;

this connection through the National Water Equipment and Manufacturing co., the National Drilling and Investment Co. and the National Water Resources Development Co. established in 1994);
- Eliminating thirst and develop safe water supply networks all over the country; and to procure water for human and animal life completely by the end of the duration of the NCS;

- Developing economic criteria for the utilization of water in such a manner as to maintain a balance between the cost on the one hand and the economic and social return on the other.

These issues and whether they have been put to action formed an important source in developing this national water policy.
- Developing the water sector manufacturing industry to supply water pumps, drilling

The Ministry of Irrigation and Water Resources (MIWR).

All water affairs were brought under one umbrella – the Ministry of Irrigation and Water Resources

(MIWR). Section 10 of the Council of Ministers Resolution dated 12 November 1995 defines the powers of the national focal point for water resources – the Ministry of Irrigation and Water Resources (MIWR). Some of its main policy functions are:

- To assess, formulate and develop the national plan for irrigation;
- To formulate policies for the use of water resources and review and update such policies according to new developments.

The National Council for Water Resources (NCWR)

The National Council for Water Resources (NCWR), established in 1995 is headed by the Minister of MIWR with representatives from major suppliers and users of water nationally and at state level. Its mandate includes the following:-

- To formulate the general policy for water resources;
- To formulate a long term federal plan for optimal and balanced use of water resources, and determine priorities.

The National Water Corporation

The National Water Corporation Act of 1995 has established a corporation with the following main policy powers:

- Formulating the general policy for drinking water at national level and protection of the surrounding environment.
- Proposing legislation regulating the use of water for drinking, the integration of such use and associated training.
- Management of foreign aid for drinking water.

The financial resources of the Corporation are derived from three sources: allocations from the government, the cost of work done or services rendered by the Corporation and donations accepted by the board.

The Irrigation Water Corporation

The Irrigation Water Corporation was established by the Council of Ministers to provide services in connection with irrigation water and be financed by the agricultural corporations, which collect the fees from the farmers. However this corporation was dissolved in May 1999 so that irrigation services at the minor canal level would be shouldered by each irrigated scheme under the technical supervision of the Ministry of Irrigation and Water Resources. The Ministry is financed by the central governments to maintain and operate the major irrigation infrastructure.

Division of Federal and State Responsibilities

Major federal development projects are considered by the Constitutional Decree No. 14 as national wealth, to be managed at the federal level. The Federal government shall ensure the participation of the State Governments in the management of such projects. Also the federal organs exercise powers in relation to the national electricity network. The State organs exercise powers in accordance with the federal plans, policies and legislation in relation to State electricity networks and irrigation.

In the event of dispute arising about the residual powers between a State and the federal government, the dispute shall be referred to the court. According to the Constitution, the Constitutional Court has the jurisdiction to decide upon claims concerning conflicts between state and federal authorities over their powers.

According to the Constitution of 1998, the federal government is responsible for planning, regulating and executing inter-state waters and national electricity projects. Each State exercises legislative, executive and planning functions in non-transit waters and electric power within its boundaries.

Observations and Recommendations

Currently the water sector in Sudan, apart from the NCS, is governed by three overlapping legal regimes:

- The first legal regime was established by the Nile Pumps Control Act of 1939 and the 1951 Regulations made thereunder. That regime was limited to the waters of the Nile and its tributaries and was confined to control over the pump-

ing of water from the Nile for the purposes of cultivation.

- The second legal regime which was established by the Irrigation and Drainage Act of 1990 complements the first legal regime and, therefore, the Nile Pumps Control Act of 1939 was not repealed. The two major developments introduced by this second legal regime were that it broadened the scope of the existing legal regime to include drainage activities, and it has made the Minister of Irrigation and Water Resources the concerned authority. However, the 1990 Act neglected making certain key legal amendments, for example, the concerned authority under the Nile Pumps Control Act of 1939 is a Board chaired by the Minister of the People's Local Government which no longer exists. Also, the 1990 Act does not define the waters which it should be applied.

- The third legal regime which is currently in force is the regime established by the Water Resources Act of 1995. It has repealed the Nile Pumps Control Act of 1939 while keeping the 1951 Regulations. Also it has not repealed the Irrigation and Drainage Act of 1990. Therefore, there is an overlap between the three legal regimes.

Other inconsistencies exist, for example the MIWR has been given the power to licence water pumping for irrigation under both the Irrigation and Drainage Act of 1990 and the Water Resources Act of 1995, and licensing power is given to both the local authori-

ties under the 1951 Regulations and to the MIWR under the Water Resources Act of 1995.

However, the third legal regime is more comprehensive as may be seen from the following:-

- ♦ It applies to water resources and not to the Nile alone, and it has defined "water resources" to mean surface and groundwater resources whether crossing the national borders or not.
- ♦ It covers the use of water resources for all purposes unlike the two previous legal regimes, which were confined to irrigation and drainage. The new purposes include consumptive use, hydro-power generation and drainage.
- ♦ The institutions entrusted with the implementation of the 1995 Act are the NCWR chaired by the Minister of IWR, the MIWR itself (and the entities falling under its supervision) and the States' organs which act under the powers delegated to them by the MIWR.

In the light of these observations, it has become a top priority to review and integrate existing policies pertaining to water resources. One outcome of this new water policy is to remove inconsistencies, redundancies and contradictions which have developed over the years.

Within the context of a new integrated policy framework, it will also be necessary to revise the existing legal regime to remove redundancies and inconsistencies.

PART 2: WATER POLICY

INTRODUCTION

Part 2 of the document contains policy for the development, management and protection of water resources in Sudan.

It covers a wide variety of issues, most of which have both common and specific policy elements. For this reason Part 2 begins with a section on over-arching policy issues which apply to the sector as a whole and to most of the individual components.

The overarching policy issues are followed by the main specific areas of concern in water resources development, management and protection, set out according to the following categories:-

Water Resources:- The Sudan has limited water resources which need to be carefully managed. The section describes the various water resources available for development and sets out the policy applicable.

Water Utilization:- Water is used in many different ways - for human consumption, agriculture, industry and municipal uses. This section

sets out the various uses together with policy related to each type of utilization.

Water and the environment:- The natural environment is the source of all water and has a direct influence on the availability of water and its quality. This section looks at policy as it affects the environment and related matters such as pollution and catchment degradation.

Regional water issues:- Most of the water available to Sudan is regional water which introduces a number of complexities for which clear policy is required.

Socio-economic issues:-

Water has a direct impact on many areas of life and the economy in Sudan. This section highlights several issues and sets out policy related thereto.

Disaster management and public safety:-

Disasters related to water are caused both by natural and human factors. Managing disasters such as floods and drought spells requires a clear policy framework, as does factors which effect public safety in the construction of dams and other hydraulic structures.

Institutions, capacity building and technical assistance:-

Human resources and finances are a necessary requirement for effective water resources development and management.

Each of the sections in Part 2 has a brief introduction, followed by a description of issues and problems related to the matter under discussion. This is followed by brief policy and objective statements which have been formulated to address the issues and problems raised.

OVERARCHING POLICY PRINCIPLES AND OBJECTIVES

The following overarching policy principles and objectives provide a framework for more detailed specific policy for the development, management and protection of water resources in Sudan. All subordinate policy related to the development, management and protection of

✓ water resources should be tested against these principles and objectives.

1. Water is a scarce and valuable resource, which has to be equitably, economically and efficiently used.
- ✓ 2. Access to water for basic human needs is the highest priority in the development of water resources
- ✓ 3. Development of water resources must be demand driven and management should be undertaken at the lowest possible level.
- ✓ 4. Development and management of water resources, and the operation and maintenance of water services must be economically sustainable through the recovery of costs from those who benefit.
5. All water, including surface and groundwater, form part of the hydrological cycle and should be managed in an integrated manner.
- ✓ 6. Water resources management affects everybody and should be undertaken with the participation of relevant stakeholders.
- ✓ 7. People are stakeholders for water use and the national government is the custodian of all water in Sudan for the equitable benefit of all and in the public interest.
8. The gathering and management of accurate information for the recording and ongoing monitoring of water resources is essential for the proper development, management and protection of water resources.
9. The environment needs to be protected in order to ensure sustainable utilisation for present and future generations.
10. The development of water resources will be undertaken in order to maximize its benefits in the public interest whilst ensuring minimum adverse impact on the environment
11. Public institutional arrangements at federal and state levels shall be integrated, efficient and transparent whilst avoiding

duplication of functions and responsibilities.

12. Water and water related issues are an integral part of the wider economy and have direct effects on many other sectors which require inter-departmental and inter-sectoral communication and co-operation.

WATER RESOURCES

There are three sources of water available to the people of Sudan, the first two of which, surface water and groundwater, are the one in use, and the third, unconventional water sources, is only beginning to be considered now.

Surface Water

Surface water within Sudan appears to be plentiful if viewed in isolation, but the fact is that most of it is shared with neighboring countries. Sudan can only use 22% of the Nile water that passes through it. The non-Nile streams are erratic and run for short periods each year. The major non-Nile streams are also shared with neighbors.

In areas far from the Nile system, especially in basement complex formations which cover 60% of the country, seasonal streams and surface run-off are the focus of development and environment rehabilitation

Key issues and problems

There are a number of issues and problems associated with the development and protection of surface water resources in the country which need to be addressed when formulating the surface water resources policy. Some of these are:-

Floods & Drought Spells

Sudan has experienced many devastating floods and drought spells during the last two decades. Loss of property, damage to irrigation facilities and water services, and the spread of water related diseases result from floods. On the other hand, drought disrupts social and economic life, different elements impacting heavily on the economy and aggravating environmental degradation, threatening the sustainability of the ecosystem and the

fragile environments. Climate change and population increase intensify the impact of droughts. National efforts and regional cooperation are required to establish national and regional early warning systems, public preparedness and other disaster management measures. More will be said about this later on.

Storage Facilities for the Highly Variable Flow

The Blue Nile, Atbara River and the seasonal streams have a short flood season with high silt loading and a prolonged dry season of eight months. Unless adequate storage facilities are developed, water shortage during the dry season will continue to be the main factor curtailing social and economic development in the country. The present storage facilities provide less than 20% of the country's need for water and is continuously decreasing as a result of silt accumulation.

Policy should be geared towards increasing the storage facilities and minimizing siltation in the reservoirs and irrigation networks. Water harvesting and spreading techniques on seasonal streams and wadis should also be pursued where appropriate.

Many of the traditional rainwater harvesting techniques in practice (hafirs and small earth dams) are rather expensive structures with very low hydraulic efficiency, high failure rates and short life spans. Improvement of this situation requires upgrading of hydrological data and engineering studies, choice of economical designs, low cost construction techniques and community involvement in construction and O&M of these systems.

Tested techniques which increase crop productivity have to be widely applied. This requires training of communities and the use of indigenous tools and equipment.

Upkeep of Irrigation Infrastructure

Sedimentation and growth of aquatic weeds in irrigation canals are the main problems facing water managers. Other operation and maintenance problems are the unavailability of fuel and spare parts for pumps and machinery and the deterioration in the condition of regulating gates and structures.

The cost of operation and maintenance (O&M) has been passed to the water users in accordance with the new economic policy. Hence, policy should target the raising of productivity

and cost recovery arrangements with full participation of the water users. The government should oversee the upkeep of irrigation infrastructure to avoid frequent expensive rehabilitation cost.

Regional cooperation and international help are needed to address soil erosion and sedimentation through water shed management of upper catchment areas, which in many instances are situated in neighbouring countries.

Another area of intervention is combating of water-borne disease and water hyacinths in the lakes, swamps and slow moving waters.

Supply and Demand Management

The supply of water could be maximized by regulating the flow through a series of dams and by capturing some of the water which evaporates from the wetlands. Such a supply oriented policy, although highly needed, is capital intensive and may have adverse social and environmental effects. Hence demand management should be pursued as well, in order to ensure that more is produced with less water by raising the water use efficiency. Demand management measures could include the application of appropriate conveyance technology, improved cropping patterns, incentives and penalties relating to the use of water, public awareness and participation and an integral and a multi-disciplinary approach to the planning and management of water resources systems. Favorable production relations, taxation and financing policies may help to increase productivity per unit of water.

Water charges in the irrigated agricultural schemes should be based on the actual volume of water applied, out on the basis of area or crops grown.

Surface Water Quality Management

Unsafe water supplies from surface water systems result in 80% of the diseases in rural areas and irrigation schemes. Quality standards, design modifications, simplification of surface water treatment processes, training of operators, community involvement in O&M, revenue collection and water utilization issues all need to be addressed in an integrated way to make an impact.

Monitoring and Assessment of the Resources

Reliable water resources data are a pre-requisite for planning, assessment, design and management of the resource. Water resources data have to be continuously measured, especially in the extreme events of high rainfall and floods. Hence, a system has to be in place with the appropriate manpower and equipment which functions irrespective of budget constraints. The present monitoring system on the Nile and the non-Nile streams is deteriorating rapidly. The major causes for this are the negative effects of the free market and excessive profit making attitude, unclear responsibilities and accountability after decentralization, lack of funding and confusion as to the linkage

with the bodies dealing with water at the national and regional level.

Human resources

An atmosphere of discontent has precipitated amongst the water resource staff at national and state levels alike. Funds for data collection, analysis and maintenance of water systems are continuously shifted to more urgent needs for national security, quick return activities and new development. Unfavorable working conditions, low salaries, meagre chances for training and exposure to national and international knowledge have resulted in the Ministry of Irrigation being incapable of keeping its current staff, let alone attracting new persons. About 20% of the qualified engineers leave the Ministry every year against a replacement of less than 5% from the new graduates. It should be noted that knowledge in the field of water resources management is mostly gained by experience, on-job training and contact with professionals inside and outside the country. Thus, such an alarming staff turn-over has to be addressed by the country's water policy.

Policy principles and objectives

1. Surface water planning and development must be integrated at all levels.

Surface water resources development plans have to be integrated to achieve equity among different water users and to maximize socio-economic benefits, sustainability and economic return.

Efficient utilization of surface water resources call for research, exchange of information technology and experiences to increase the efficiency of the systems and awareness of the users.

2. It is the obligation of all to protect surface water resources

Surface water must be protected to minimize water borne and water related diseases. Funds must be budgeted to install low cost appropriate water treatment plants for systems (hafirs, dams, canals) and to protect these systems from human and animal wastes. Legislation should be developed to penalize those who pollute water through industrial and domestic waste disposal and other activities which impact negatively on the environment and the ecosystem.

3. Surface water development policy should be clear and accessible to communities.

Public awareness and community participation should be an integral part of the formulation and implementation of water resources policy & development programmes. The water policy should stem from the grass roots, be clear, transparent, flexible and adaptive to the dynamic nature of life.

4. A reliable data base and information system is a pre-requisite for sound assessment, planning, management & development of surface water resources

This will entail the strengthening of existing water resources entities through training and motivating staff, ensuring the availability of necessary equipment and tools, and the rehabilitation of hydro-met stations.

5. The operation and maintenance of surface water systems should be based on cost recovery - the user pays principle.

To ensure continuity of services, water users (for irrigation, industry, domestic supply etc.) should pay for the actual cost of the service including operation, maintenance and replacement cost. Economic use of water and the use of appropriate technology would raise the ability to pay.

6. The storage capacity has to be increased to meet the increasing demand for water

7. Optimum and equitable use of surface water should be promoted through co operation between the national water users.

8. The Government has a regulatory function to ensure that the appropriate standards of service quality, sustainability and environment friendliness are met by the water suppliers and users.

Groundwater

Groundwater in Sudan is important for the following reasons:

- ♦ Over 50% of the country lies within desert or semi-arid zones where rainfall and runoff are scarce. However, this scarcity is partially offset by the presence of large groundwater reserves;
- ♦ Groundwater is present under about 50% of the surface area of Sudan. Its distribution is highly controlled by the geological setting. The estimated recharge of groundwater basins is about 4 bcm. This will assist in the formulation and implementation of integrated and well-balanced development projects especially in the rural areas of the country;
- ♦ Persistence of drought and erratic rainfall in the country over the last few decades has emphasized the importance of groundwater as a reliable source in rural areas as well as the major urban centres away from the Nile;
- ♦ Groundwater can be developed and abstracted using different techniques, varying from simple traditional systems (e.g. hand dug wells) to complex well fields.

Key issues and problems

Key issues and problems pertaining to groundwater resources can be summarized in the following headings:-

Groundwater monitoring and information base

Detailed information on groundwater resources and use in Sudan is limited, particularly in the field of:

- ♦ Exact boundaries and extents of aquifers;
- ♦ Quantification of their annual recharge
- ♦ The annual recharge particularly in response to high pumping rates from shallow aquifers mainly for irrigation purposes;

- ♦ Water quality changes as a result of recharge, pumping, sanitation, waste disposal and industrial activities.
- ♦ Total groundwater abstraction from the aquifers/basins and the impact of that on use
- ♦ Spatial availability of groundwater in the basement rocks;
- ♦ Hydro-geological conditions and characteristics of the aquifers;
- ♦ Collection, synthesis and interpretation of groundwater information.

The limitation in the groundwater information base has resulted from:

- ♦ Vastness of the groundwater basins;
- ♦ Slowing down of the groundwater research studies due to budget limitations;
- ♦ Shortage in qualified and trained staff;
- ♦ Instability of the groundwater sector.

Groundwater quality and pollution

Generally quality of groundwater in Sudan is good, except in a few localities. However, certain aquifers in residential areas and with shallower groundwater levels are susceptible to pollution and contamination especially the alluvial aquifers. Possible sources of pollution are:-

- ♦ Domestic solid wastes which are normally washed down the wadis with the first seasonal run off;
- ♦ Industrial wastes represented mainly by hazardous waste from traditional tanneries and slaughter houses; as in the case of Nyala town alluvial aquifer;
- ♦ Sanitary and waste disposal wells. Particularly in residential areas such as Khartoum, Kassala and Nyala where, due to the high permeability of shallow aquifers and direct connection of pit latrines and sewage – disposal wells to the water table, the risk of bacteriological contamination is high.

Environmental degradation

Development and utilization of groundwater resources by water yards, particularly in the rural areas, have resulted in environmental degradation in some instances. The general policy, established as early as 1969 (by the Land Use Department), linked development of groundwater (water yards) with the primary capability of the land, which is its present and expected use in different ecological zones.

However, due to improper planning, political pressures, urgent water needs and drought, water yards became a cause of environmental damage, contributing to desertification and soil degradation. This was caused mainly by the concentration of livestock beyond range capacity, combined with wood cutting, clearance of lands for cultivation and charcoal production practiced by sedentary communities around the water yards.

Development and utilization of groundwater resources

Sustainable development and utilization of groundwater for drinking and irrigation purposes is constrained by a number of factors including the following:-

- ♦ Deep pumping levels (deep aquifers)
- ♦ High cost of construction materials particularly well casings, filters and pumping units;
- ♦ Low yielding wells mainly caused by poor design of bore-holes and the pumps used (reciprocating pumps);
- ♦ High cost of groundwater abstraction and lifting due to shortages in fuel, lubricants, spare parts and the technology used;
- ♦ Poor and inefficient back-up operations and maintenance services;
- ♦ High water losses particularly in agricultural uses and associated irrigation systems;
- ♦ Lack of reliable and coherent information about the availability and distribution of groundwater in terms of quantity, quality and recharge/discharge relationships, as well as the economics of groundwater development;
- ♦ Remoteness of the groundwater basins as most of them (the Nubian basins) are in uninhabited desert areas with harsh natural conditions and minimal infrastructure;
- ♦ Lack of a planning process on which development and utilization of groundwater can be based. Development is taking place on adhoc basis i.e. only when and where need arises.
- ♦ Lack of a meaningful holistic plan for the development, utilization and management of groundwater, which is compounded by the lack of an adequate legislative basis for proper management;
- ♦ Ineffective enforcement of local acts and regulations, particularly in respect of the management of alluvial aquifers;
- ♦ Lack of coordination, regulations and linkages as regard development and utilization of interstate and/or inter-regional aquifers such as the Nubian basin;

- ◆ Poor public awareness in the field of water use, water rights, the economic value of water and its susceptibility to pollution by man-made activities;
- ◆ Poor integration of groundwater with other natural resources and land use planning systems. Integration and management of conjunctive use of surface and groundwater is not fully implemented, despite its importance;
- ◆ Poor groundwater information base which makes meaningful management and planning rather difficult.

Institutional arrangements

Presently groundwater is the responsibility of the Ministry of Irrigation and Water Resources (MOIWR). However, the groundwater sector is inefficient and suffers from the following factors:

- ◆ Frequent institutional changes and instability;
- ◆ Diminishing capacity for exploration and research in terms of equipment and skilled staff;
- ◆ Limited budgets and continuous trimming of these limited budgets;
- ◆ Poor or no linkages with other sectors and lack of affiliations with similar institutions at state and regional levels;
- ◆ Lack of training and capacity building plans;
- ◆ Low motivation of the staff

Policy principles and objectives:

1. Groundwater resources are an indivisible part of the hydrological system, the national water balance and the natural resources base.

This principle recognizes groundwater resources as part of the hydrological cycle. The principle implies that groundwater resources must be recognized as part of the country's eco-system, and should therefore be protected and rehabilitated where possible if degraded.

2. Groundwater resources are a national property, the equitable use of which is common to all subject to national authority and control.

This principle stems from the Islamic principle whereby water is regarded as a common property to be shared by all people, but must be protected, conserved and utilized with care. Sudan's Federal system vests responsibility for

operation and maintenance of water development facilities with the states while overall management and protection of water resources are national government responsibilities.

The main difficulty in the implementation of this policy principle will be the growing political pressures from state governments to exercise their claimed rights to manage and develop the water resources within each state autonomously.

3. Proper planning, assessment, development and management of water resources can not be achieved without strengthening the information base at the national and the states level.

The need and importance of a water information base has been realized in the past by the Groundwater and Wadis Directorate in establishing the Information Centre.

The present Information Centre falls short of achieving the stated objectives. The Information Centre is in need of strengthening through trained manpower, improved equipment and the development of strong affiliations with similar centres at regional and international levels. Strengthening of the Information Centre and database can not be addressed in isolation, but should be a component of institutional capacity building and reform of the sector at large.

4. Present and future water users have a right of access to clean and unpolluted groundwater resources and an un-degraded environment.

The principle aims to protect groundwater resources from pollution particularly by human activities. Unlike surface water, it is extremely difficult to rehabilitate groundwater aquifers after they have been polluted. Pollution is generally an irreversible process. Therefore it is of the utmost importance to maintain unpolluted aquifers not only for the present users but also for future generations.

The main implications associated with the policy principle are:-

- ◆ The need to develop adequate waste treatment facilities as the lack of sewers leads to the construction of private disposal wells which is a potential source of groundwater pollution;
- ◆ Present demands for groundwater development and utilization grows with time.

5. Groundwater is to be recognized as having a social and economic value, its value is based on the cost of the development, operation and maintenance of groundwater resources.

Failure to recognize the social and economic value of groundwater and its competitive uses, whether domestic, agricultural or industrial, leads to wasteful water use, mismanagement, no sense of the need for protection and conservation of the resource by the users, and ultimately a threatening of the sustainability of groundwater resources. Establishing the value of groundwater requires proper pricing of water to cover the following:

- ◆ Full operation and maintenance (recurring costs);
- ◆ Depreciation and replacement of assets;
- ◆ Water resources management costs

However, the economic benefit derived from water use and the recovery of the costs of providing water should not be regarded as a matter of the pricing of water alone. It must be considered in conjunction with other inter-related reforms including proper water use management, the need to improve the efficiency with which water is used, the value of agricultural outputs and public awareness as well as the social dimension.

6. Groundwater abstraction, particularly from alluvial and shallow aquifers, shall be based on recharge and safe yield concepts.

Though this appears to be a conservative policy, the safe yield concept is recognized as an optimum management tool for allowing the development of an aquifer while conserving it for future uses.

The demands of state governments to manage their resources independently, political pressures and competition between water users to meet present needs will be the main difficulties associated with implementing this policy principle.

7. Sustainability of groundwater development and supply services shall be planned for and considered as part of development and management policy of the water resources systems.

Failure to recognize sustainability of the system as a primary policy objective always impacts on water quantity, accessibility, reliability, quality and affordability.

Unconventional Water Resources

Many countries in arid-zones have explored unconventional means to augment their meagre water resources. Methods include the recycling and reuse of drainage water from agricultural, domestic and industrial sources after appropriate treatment. Desalinization of sea water is practiced in some Gulf oil countries.

Such unconventional water sources are rarely used in Sudan at present but as the current sources and options are exhausted by the ever increasing demand for water, alternative sources may have to be resorted to. Water policies and long-term planning has to take the use of alternative sources into consideration. Drainage systems, for example, should be designed to allow for possible future recycling and reuse. The availability of solar and wind energy in the hot dry areas could be put to beneficial use. New discoveries of oil and gas reserves and advances in desalinization technology may help to provide fresh water for the coastal areas outside the Nile system.

Policy principles and objectives

1. Research planning and development of unconventional water resources will be undertaken in order to use unconventional alternative water sources for Sudan.

This is a long-term objective which will contribute to the future of Sudan. It will require co-operation with other countries and institutions which are also engaged in such activities.

UTILIZATION

Water Supply & Sanitation

Preliminary surveys reveal that only 30% of rural population have access to an adequate water supply. Nearly 40% of the urban population and 90% of people living in rural areas lack basic sanitation services.

The inadequacy of water supply is seriously felt all over the country. Water supply is a key factor of production in rural areas where development activities (rain fed farming, gum Arabic production, livestock production) can not be maintained without availing the basic essential

amount of water for peoples' physical survival, personal hygiene and household uses.

Similarly, basic sanitation services are required to ensure personal and public health. They are also needed to protect water sources so as to minimize water-related diseases which are a major cause of poverty, under-development and poor quality of life.

Key issues and problems

Supply demand imbalance

It has been observed that the per capita consumption rate in urban and rural communities is far below the acceptable limit of 25 lit/cap/day in rural communities and 70-100 lit/cap/day in urban communities. This is due to:

- ◆ High growth rate in urban population due to desertification, migration, epidemics and war.
- ◆ High cost and scarcity of spare parts and power for the water supply system.
- ◆ Conflict among users and local authorities regarding issues of ownership, responsibilities and obligations;
- ◆ Low coverage of distribution systems;
- ◆ Low yield of pumping units
- ◆ Inefficient use of water due to high losses in water supply systems. This is mainly due to breakage, evaporation, seepage and the high rate of siltation;

Sustainability of water supply system

Continuity of services has been interrupted due to:-

- ◆ Aged pumping units – most of them require replacement;
- ◆ Low yield bore-holes due to damage in screens and casings, entry of fine sand etc.;
- ◆ Poor O&M and management practices;
- ◆ No protection devices for pumping units
- ◆ Low tariff compared to high O & M cost especially pump spare parts and power supply
- ◆ Poor operational procedure due to:
 - Untrained, unmotivated operators;
 - No preventive maintenance;
 - Absence of operation and maintenance manuals and procedures

Unsafe surface water supplies

Rural surface water supply systems (hafirs, dams drains and irrigation canals) provide poor quality water that causes nearly 80% of the disease in rural areas in Sudan. The high cost of treatment and shortage of funds is the major constraint. Similarly, hafirs need to be protected by fencing to eliminate man-animal water contact.

Sanitation and waste water disposal

The level of adequate sanitation is very low in urban and rural areas due to:-

- ◆ Lack of sewerage systems and adoption of high cost technologies (e.g. septic tanks and deep lined soak-away wells in urban sanitation);
- ◆ Low level of awareness among rural communities;
- ◆ Utilization of deep soak-away well drilled below water table causing pollution of groundwater;
- ◆ Untreated industrial waste (from tanneries, slaughters, abattoir and soap factories) which is dumped on the ground

Water supply & sanitation sector institutional reform

- ◆ Unlike many countries in the world, there is no clear link between the water supply and sanitation sectors as well as between the water sector and other parts of economy;
- ◆ Even within the water sector, there are poor linkages between federal and state water corporations.
- ◆ The water sector itself has experienced ten major institutional changes since independence.

Water policy reform is required to ensure the following:-

- Water supply and sanitation sectors and the associated projects should be integrated, adopting a community based approach;
- Clear identification is needed for roles, responsibilities and obligations of federal and state governments, NGOs, local communities, the private sector and the National Water Resources Council.
- Sectoral institutional reform is needed to clearly identify the roles, responsibilities, obligations and linkages between the national State Water Corporations.
- Water supply and sanitation services should be self-financing. To ensure equitable allocation of resources, only poor

communities should be subsidized to provide basic minimum water supply and sanitation services. Higher levels of services (urban water supply) should be financed by consumers (house connections) and state government development budgets;

- To ensure the sustainability of water supply and sanitation services, a sound tariff policy should be established for various water supply and sanitation systems in different localities taking in consideration:-
 - Operation and maintenance cost;
 - Communities paying capacities (affordability);
 - Replacement cost;
 - Expected federal & local government subsidies;
 - Level of services;
 - Consumers contributions (household, livestock and gum Arabic producers, rainfed schemes).
- Existing systems should be rehabilitated to an acceptable operational levels. Sources of finance may include:- national and state funding, loans, donations and private sector financing.
- Increase operation efficiency of existing water supply systems by:-
 - Availing of spare parts;
 - Choice of low cost appropriate technology;
 - Training of operators/communities;
 - Design modifications.
- Improve data and information systems and avail adequate budget to:-
 - Assess present situation of water supply and sanitation (baseline survey);
 - Identifying water scarcity areas (supply demand imbalance);
 - Research and studies to improve quality of design and selection of appropriate systems, materials;
 - Conduct studies, research and exchange of information to address issues as:-
 - Pollution of groundwater
 - Treatment of surface water.
 - Cost effective construction of water supply and sanitation systems
- A master national water supply and sanitation plan will be developed which is integrated within a comprehensive socio-economic national plan to ensure that water has been economically utilized in an equitable manner.

Policy principles and objectives

1. Access to adequate water supply & sanitation is a basic necessity

Adequate water supply which should be relaxed to suit national conditions, are defined as:-

- Provision of water supply at a quantity of 25 lit./cap/day in rural communities and 70-100 lit./cap/day in urban communities;
- The quality of water should meet the WHO standard;
- Water cost should be affordable to users;
- The service should be delivered at a convenient distance targeting house connections in urban water supply systems and at a distance of not more than 200m from rural water systems;
- Systems must be reliable providing a continuous service with minimum stoppage periods and quick repair and maintenance facilities.

Adequate sanitation include:-

- Ventilated improved pit latrine for rural or semi-urban sanitation;
- Public sewers, septic tanks, aqua privy for urban sanitation;
- Safe collection, transportation and disposal of solid waste;
- Safe drainage of storm water;
- Treatment and safe disposal of industrial waste

2. The achievement of sustainable and financially viable water supply and sanitation services must be the objective of service providers

Key elements for sustainability are:-

- Clear identification of roles, responsibilities and authorities of the federal government, state governments, local and community organizations;
- Financing and tariff structures must be set so as to ensure viability, efficiency and sustainability of the water supply and sanitation services;
- The engagement of the private sector as appropriate;
- Adoption of community based development approaches;
- Training and capacity building for communities;

- Strengthened links between the water supply and sanitation sectors.

Agriculture and Landuse

Sudan is characterized by over utilization of its land, pasture and forest. Current land uses include irrigated, traditional rainfed and mechanized rainfed agriculture, animal production, range, pasture, forestry, wildlife and fisheries.

Irrigated agriculture needs comprehensive management in the fields of hydraulic works, water conveyance and irrigation water management.

In the field of rainfed agriculture, the application of technologies such as water harvesting, supplementary irrigation and groundwater use may be applied to improve conditions. Other strategies may include the use of improved seeds and animal breeds, application of the right type of fertilizers, reforestation in degraded areas, and range improvement for both wild and domestic animal production.

Key issues and problems

Wind and water erosion

Overgrazing and over-cultivation has resulted in subjection the soils to wind and water erosion. Land users such as farmers are obliged to leave certain areas around the schemes, whether in rainfed or irrigated areas. Planting trees around the farms will serve as shelter belts for the crops as well as protection of the soil against wind erosion. Tree species should be multipurpose to provide fodder, building material and firewood. The disappearance of many trees from the rainfed areas has contributed to land degradation and deterioration of soil fertility.

Declining yields from crops

Due to the degraded environment crop yields are declining. Sufficient moisture should be applied either by irrigation or through water harvesting techniques and use of improved varieties, which are drought, insect and disease resistant.

Crop production should be based on a system of comparative advantage. In high rainfall areas, high yielding crops should be cultivated. High value crops can be produced by irrigation.

Research programmes should be developed to promote crop production in cereals; oil crops, pulses and several experimental trials can include water requirements, variety trials, plant population, sowing dates, fertilizer application and moisture conservation etc.

In order to use water more efficiently, future research programs should include the development of short maturing, high yielding and combinable cultivars, which are acceptable to the farmers. Methods of land preparations to eliminate the hard pan in the mechanized rainfed areas to increase the water in take into soil profile and addition of organic matter and/or soil amendments are needed. Erudition of needs by cultural, mechanical and chemical means should be continued.

Such research programs, whether for improving the productivity per unit of water or related to preventing future land degradation, should be formulated among the national institutions in cooperation with international scientists and centers working similar aspects. The attained results should be tested as on-farm demonstration and verification trials with the involvement of farmers, extension personnel and scheme managers.

Animal death and migration of rural people to towns

As a result of successive drought years, a large number of animals died forcing their owners to leave the land and migrate to towns. The remedy for this is the rehabilitation of degraded range and croplands. Water sources need to be provided according to the capacity of the natural resources. Budget constraints and lack of trained staff to undertake rehabilitation needs to be addressed. Natural grazing areas need to be improved by reseeding using good quality forage species. Veterinary services need to be provided for animals.

Excessive removal of vegetation

Environmental deterioration can be prevented through the following steps:

- ♦ Afforestation, reforestation and management of federal and state forest resources;
- ♦ Establishment of community, private and institutional forests;
- ♦ The use of shelter-belts and wind breaks around irrigated and rainfed cropping areas in terms of existing guidelines;

- ♦ The establishment of trees and bushes for erosion control and animal grazing in the dry season.

Concentration of agriculture activities in central Sudan

The concentration of agriculture activities in central Sudan leads to the migration of laborers to production areas and the spread of infectious diseases to many parts of the country. The absence of migrant workers for long periods away from home results in complex family and social problems. It is preferable to develop agricultural projects in different parts of the country using different sources of water to employ local people.

Animal production, gum tapping, small industries should be established using local raw materials to provide a range of job opportunities for local people.

Wildlife degradation

Agriculture has encroached deeply on wildlife habitats and hunters have destroyed a variety of different species of wild animals. Wildlife development and conservation is linked to water point availability and distribution.

Soil conservation

For sustainable land use systems, application of the following activities should be arranged:-

- ♦ Agro-forestry;
- ♦ Use of quick maturing, drought resistant, crop varieties, application of water harvesting and water spreading techniques, integrated pest management (IPM) and the use of bio-fertilizers in all farming systems;
- ♦ Formation and implementation of a biodiversity and desertification control strategies in compliance with commitments to the conventions on biodiversity, climate change and the convention for combating desertification;
- ♦ The right type of equipment and machinery should be used for soil cultivation operations to avoid soil deterioration through soil compaction or loosening which causes erosion. Cultivation should follow the contours to enhance soil moisture conservation, increased infiltration, improved soil structure and proper mixing of organic matter in the soil.

Poor traditional land use practices

Poor traditional land use practices have resulted in degraded environment, poverty and continuing lack of awareness amongst local populations. These problems can be solved through integrated rural development, and by making water management a high priority. Also, use should be made of improved seed varieties and animal breeds. Approaches should be applied to suit the environmental conditions and education should be oriented towards environmental conservation and control. In all these issues and problems, some of the factors constraining the activities are funding, trained staff and public awareness.

Policy principles and objectives

1. The improvement of water use efficiency in agriculture shall be a priority.

Strengthening of the central body for water use and conservation is urgently needed. This body should have the powers to control and direct water uses in all main user sectors such as domestic use, agriculture, forestry, range, wild life, mining and industry. It should have the necessary methodologies and facilities to develop and execute a programme to improve water use and promote its conservation and optimum utilization throughout the country.

2. The licensing of water use must include a rigorous assessment of water resources to be utilised.

Comprehensive information concerning the water budget, evaporation, groundwater recharge, river flow measurements, water consumption etc are required before licences for water use are approved

License terms must include:

- ♦ Location of water use,
- ♦ volume of water to be used,
- ♦ the time when it is needed and
- ♦ monitoring of water quantity and quality.

3. Water pricing must promote equitable and efficient water use.

In areas where there is competition for water, charging a price for water will not in itself achieve the objectives of efficient use unless the price is appropriate. Setting the price too high will discourage water use, whereas setting it too low might result in over use and conse-

quent shortages. Flat rate pricing should be avoided as it encourages misuse.

For irrigation water pricing the following main issues should be addressed:

- ♦ The need for political support to implement legislation aiming at substantial changes in agricultural water charges.
- ♦ Recovery of investments in irrigation works.
- ♦ Improvements in the management of irrigation schemes.
- ♦ How changes in water prices can improve irrigation efficiency.
- ♦ The impact of changes in water charges on cropping patterns.
- ♦ The relationship between water charges and operation and maintenance costs.

4. The use of water in irrigation projects should be monitored and evaluated using appropriate M&E systems.

It is very important to establish monitoring and evaluation (M&E) systems for irrigation projects. In order to effectively manage irrigation systems, projects and programmes, multi-disciplinary managerial skills and modern management techniques are required. Not only is management of the maintenance of the hydraulic works and the control of flows required but also management of the other necessary production processes.

Hydropower

The present installed capacities for hydropower generation are 280MW at Roseires dam, 15 MW at Sennar dam and 6 MW at Khash El Girba dam. The demand is in excess of the limited thermal and hydro-generation. Potential power from the Nile and its tributaries may exceed 9000 MW with a feasible power of nearly 5000 MW. Potential energy may exceed 81000 GWh per year with a feasible energy of about 24000 GWh per year. The most promising sites are on the Main Nile and the Southern rivers and streams. Being clean, renewable, and with low running cost, generation from a multi-purpose reservoir is favoured over thermal generation. Hydropower does not consume water except through evaporation losses from the resulting storage in the reservoirs.

Key issues and problems

Issues pertaining to hydropower generation are :

- competition with other water uses and system requirements,
- supply and demand imbalances, and
- financing.

The demand for hydropower generation may at times conflict with agricultural and other demands for water, especially when water is scarce during the long dry season. On the other hand, while water is in plenty during the flood season, reservoirs are kept at a low level to minimize siltation. Under these conditions water levels are high down stream of the dam and the head available for hydro-power generation is at its lowest, decreasing the efficiency and causing problems to the running of the turbines. The situation is aggravated by the accumulation of silt and debris at the power intakes.

Involvement of the private sector in small scale hydro-power generation, phased development of large scale plants, power pooling and linkage with neighbouring countries and the increase of fuel-fired generation are some of the measures needed to address the problems. Transparency and a multi-disciplinary approach with beneficiary participation in planning and management is vital.

The objectives of policy with regards to hydropower generation are to mitigate power shortages and optimise the use of the available resources.

Policy principles and objectives

1. Hydropower is a clean energy form which is relatively cheap to produce, it remains a high priority for investments and forms an integral part in the design and operation of multi-purpose dams.
2. Thermal backup shall be secured to fill the gap when hydropower generation decreases during the flood season.
3. In order to optimise the use of the water stored for different purposes, dam operation should be co-ordinated at all levels through appropriate institutional arrangements.
4. Beneficiaries participation in management of hydropower must be institutionalised.
5. Public awareness, clarity and transparency of energy policy is needed to gain acceptance by customers.

6. Involvement of the private sector has to be encouraged in the development of small scale hydro-power generation, phased large scale developments and the rehabilitation of existing thermal units.

7. The government must oversee the quality of service provided to the consumers.

Industry

It has been estimated that industry water use represents only 1% of the total consumption of water in Sudan. This includes the sugar industry, mining, dairies, tanneries, abattoirs and slaughter houses, oil and soap industry, refineries, and pulp and paper industry.

However, with the increased pace of industrial development in agro, oil and mining industry, the water requirement for industrial uses may increase to 5% of the utilization of water in Sudan by the year 2025.

Key issues and problems

- Safe disposal of industrial effluent to ensure that industrial discharges are not harmful to the environment and public health.
- Treated drainage water and treated water from towns and industry are means of increasing water for agriculture and general use, however, attention should be given to controlling salinity and spread of disease organisms.
- Choice of effluent treatment technology. Appropriate low cost technologies need to be adopted for example the use of stabilisation ponds to improve the quality of industrial waste water making use of low cost available land, wind and solar energy.
- Reuse of treated industrial waste in forestry, agriculture and aquaculture.

Main problems include:

- Unavailability of adequate quantity or quality of water constrains industrial activities especially in areas far from the Nile River system

- High cost of effluent treatment. Liquid waste transported and disposed in town out skirts results in pollution of groundwater.
- Disposal of industrial waste in the Nile without proper treatment is hazardous.

Policy principles and objectives

1. The use of water to transport and dilute waste and to act as a coolant has to be linked with treating it.

Excessive quantities of water are utilized in industry as a dilutant, to facilitate flow of waste and cooling. The value of using and treating that water has to be considered and ways and means need to be found to utilize water more economically and efficiently.

2. The Precautionary Principle of pollution control should be adopted with financial penalties for polluters.

Potential polluters should be asked to prove that their activities will not pollute water resources. Provision for these measures should be included in license provisions.

3. Water is a requirement for industry, but adequate legislation should prevail and be enforced to prevent pollution to the environment and surely fresh water resources.

Implications

These principles have a number of significant implications which include:

- Legislation is required to restrict the disposal of untreated industrial waste in water resources.
- Water polluters should be subject to penalties (the polluter pays principle).
- Factory Owners should indicate that budget allocations for effluent treatment have been made prior to the issuing of licenses and the implementation of development plans.
- A system will be established to exchange information, experience, research and technology with industrial countries with similar circumstances to Sudan.
- Training for water treatment technicians will need to be undertaken.

Navigation

The objective of the Sudan River Transport Corporation, established under the Sudan River Transport Corporation Act of 1973, is to develop and promote an adequate, safe, efficient, economic and properly integrated system of river transport for passengers, luggage, cargo, mail and animals on a proper scientific and commercial basis.

Sudan has developed a number of instruments over the years to regulate navigation on its domestic and international waters. These include:

- The Regulation of the Inland River Navigation Act of 1992 implements a licensing policy for vessels used in inland navigation.
- The Water Resources Act of 1995, according to which the Ministry of Irrigation and Water Resources issues required under Act above.
- On the international level, signatories to the Barcelona Convention of 1921 subscribe to the principle of freedom of navigation and transit on international navigable rivers and lakes.
- There are also Conventions regulating navigation safety and control on lakes Victoria and Kioga and there are a number of arrangements for navigation between Sudan and Egypt.

Policy principles and objectives

1. River and sea navigation constitutes an important form of transportation in Sudan and will continue to be promoted and adequately regulated in coordination and cooperation with the concerned bodies.
2. Keep our rivers clean.

Fisheries

Fisheries, whether in fresh or seawaters, are water-dependant economic activities. They are directly affected by water policy. The productivity of fisheries can be enhanced if water quality

is kept high by policy and legislation, but poor or inadequate water policy can lead to the failure of this critical renewable resource.

Currently fisheries are utilized at about 27% of their potential. Fresh water fisheries are distributed in the Nile and its tributaries and in the lakes and irrigation canals. Pollution of these bodies threatens the future potential of these fisheries. The Red Sea fisheries have begun to be affected by the destruction of mangrove forests, mining and the growing petroleum industry, including petroleum spills from ships. Water policy should also take into account mitigation of these hazards.

Policy principle and objective

1. The water resources management measures which are required to promote and protect both small scale and commercial fisheries, including water quality and quantity issues, will be identified and implemented.

WATER AND THE ENVIRONMENT

The environment as the resource base

The natural environment is the resource base from which we obtain water. There are many factors which affect the environment and hence water resources. These include:

- ♦ Population distribution. The majority of the population, together with their livestock, inhabit the arid and semi-arid zones of the country. Low rainfall of short duration in the summer season results in high population concentrations near water points with adverse environmental impacts.
- ♦ Human activities, mainly in agriculture, livestock and industry are increasing which raises the demand on water resources.
- ♦ Many of the water resources of Sudan are shared with other countries. The use of these waters are dictated by international agreements (for example the Nile Water

Agreement). Water availability is also dictated by seasonal variations due to the short summer rainy season.

Groundwater resources are expensive to develop and the location of aquifers does not coincide with the areas which are most productive and have the highest demand.

- ♦ Water harvesting techniques have proved useful but are not implemented on a large scale. In some situations conflicts between up stream to downstream users may occur.
- ♦ Pollution hazards to riverine environments may increase with increased degradation of riverine forests and an increase in water intensive industries, particularly textiles, tanneries, sugar, paper and pulp industries.
- ♦ Petroleum and future petro-chemicals industries require special attention, both as water consumers and potential polluters.

As a result of these various factors, comprehensive policy, aimed at protecting the resource base in general and water resources in particular, needs to be developed.

Pollution Control

Water is extremely vulnerable to degradation by pollution. Human-beings depend on water and cannot live without it - ironically they are also the greatest polluters of water and congregate around water bodies. Policies are required to protect water resources from pollution which, in the long term, is in the best interests of the potential polluter.

Water can be polluted in several ways through human activities. However, it is necessary that water policy concentrates on the most harmful activities, particularly where resources are limited. This should include industrial effluent, in particular those that contain heavy metals (for example from tanneries), and chemical effluent from the paper and pulp industry. Sewage effluent when properly treated can be recycled to irrigate forest trees (for example what used to be known as the Green Belt near Khartoum).

Public awareness remains the most effective method of protecting water from being polluted.

Catchment Degradation

Both water quantity and quality depend on the condition and characteristics of the catchment. Waters flowing from rocky catchments and from well-vegetated catchments generally carry little sediment. In contrast, water flowing from un-vegetated catchments or those with degraded vegetation generally carry high sediment loads.

Therefore, water policy must address care of the catchment. If such catchments are naturally prone to high rates of erosion, they should be artificially treated and managed to reduce sediment yields by terracing, introduction of vegetation cover, control of over-grazing and other factors to improve their water yield and quality. The cause of siltation of reservoirs and canals is mainly the degradation of catchments. All possible measures should be taken in catchments to avoid their degradation as a result of human development activities.

Biodiversity and wildlife

The different ecological zones reflect a rich biodiversity of plants and animals in Sudan. The number of different plant and animal species in each zone increases with increase in annual rainfall. However, human interventions destroy the ecological balance through uncontrolled agricultural expansion, hunting, over-grazing, deforestation and fire. Water plays an important role in the ecological balance. Water resources management policy should therefore

aim at providing optimum water requirements in each ecological zone for maintaining biodiversity at its optimum levels, thereby ensuring the security of Sudan's natural heritage.

Policy principles and objectives

1. It is necessary to sustain aquatic environments which are the water resource base on which human development and wellbeing are dependent.
2. People and the consequences of their development are part of the environment.
3. The impact of the development and use of water resources should not compromise the long term sustainability of aquatic environments.

4. A balance should be maintained between water resources development and utilization on the one hand and their protection on the other.

THE INTERNATIONAL DIMENSION

Most of the surface and groundwater resources in Sudan are shared with its neighbours and are therefore affected by Sudanese national water policy. As water demand grows, the importance of cooperation and integrated use of water resources increases.

In addition to customary internal law and multi-lateral conventions, the Nile has been the subject of many other international Agreements since 1891. Some of the elements of these agreements are:

- Agreement not to construct any works on the Atbara tributary which might effectively modify its flow contribution to the Nile.
- H.M. the Emperor Menelik 11, King of Ethiopia, agreed not to construct or allow to be constructed any work across the Blue Nile, Lake Tana or the Sobat which would restrict the flow of their waters into the Nile, except by agreement with Britain and Sudan.
- The Independent state of the Congo undertook not to construct or allow to be constructed any work over or near the Semliki or Isango rivers which would diminish the volume of water entering lake Albert on the White Nile, except in agreement with the Sudanese Government.
- The obligations provided for in the Agreement between Egypt and Sudan for the full utilization of the Nile Waters of 1959.

Box 3: Pollution Control

Form of Pollutant	Kind of Pollutant	Damage	Policy
Spray	Pesticides, herbicides	Poison to fish and humans	♦ Avoid spray near water bodies ♦ Use safe chemicals ♦ Calm wind at time of spraying
Chemicals in the air	SO ₂ , H ₂ S, No etc.	Water bodies, plants, soils	♦ Use high chimneys in factories ♦ Recycle these gases ♦ Locate factories away from habitat
Industrial Effluents	Heavy metals, chemicals, poisons etc.	Water pollution environmental poll.	♦ Locate the hydrous industries (pulp/paper, tanneries, sugar etc.) in places where their effluent can be contained or recycled
Sewage Effluents	This carries human exerts with a lot of germs	Very dangerous to human health	♦ Treat properly ♦ Recycle the treated effluent for trees crops ♦ Do not allow it to reach other water bodies or stagnate

Over the past few decades a number of programmes have been implemented and aimed at increasing cooperation between the countries of the Nile Basin and exploring possibilities for the joint management of the Nile waters.

With the support of the United Nations Development Program (UNDP), a number of Nile Basin countries succeeded in establishing the

Hydromet Project which functioned from 1967 to 1992 with Ethiopia as an observer. The Hydromet Project evolved into a programme entitled TECCONILE. TECCONILE has recently been succeeded by the Nile Basin Initiative for the benefit of all the Nile Basin countries, under the direction of the Council of Ministers of the Nile Basin Countries. This is a transitional mechanism until a formal, which embrace all

basin-wide cooperative framework is developed. The Permanent Joint Technical Committee (PJTC) of the Nile between Sudan and Egypt evolved from the 1959 Nile Agreement. It has been functioning well since then under all political regimes. ESTAC, a joint Advisory Committee of the Nile Water between Sudan and Ethiopia was formed in 1993. Such sub-basin activities are expected to continue.

A dam has recently been built on Wadi Hawar between Sudan and Chad on the basis of shared costs and benefits. Efforts are underway to assess and manage the Nubian sandstone aquifer between Chad, Egypt, Libya and

Sudan. Cooperation and coordination between countries sharing the same water resource should be encouraged. Sudan will continue to maintain its leading role in advancing cooperation for the benefit of all.

Since water does not recognize political boundaries whether national or international, management of water resources are best carried out on a regional or catchment-wide basis. Such areas generally coincide either with natural areas with linked supply systems or with areas sharing common socio-economic interests. Conflicting interests inevitably result in the need for national management and supervision, however. The principle of subsidiarity should not conflict with the need for a national and international perspective on water use.

Policy principles and objectives

1. Sudan will seek to co-operate with other countries for the development, optimum use and protection of international waters wherever possible in its national interest and without compromising its sovereignty.

2. Watershed management inside the country and in neighbouring countries is a prerequisite for efficient water use and for strengthening political relations:

DISASTER MANAGEMENT AND PUBLIC SAFETY

Natural disaster management

Disaster Management in relation to water policy pertains to floods and droughts which threaten the safety of the public. Public safety includes the safety of infrastructure, particularly the safety of dams and reservoirs.

Ensuring that flood prone areas are not inhabited can mitigate the effects of floods. The population has to be warned to build their houses and property at the minimum safe distance from the highest flood level which is demarkated by the authorities. The 1988, 1994 and 1998 floods can be taken as a reference. A minimum distance in level should be left between the flood level and the first line of houses. Similarly, standards are required for the specification of drainage systems such as the number and size of culverts and water conduits which can accommodate flooding caused by maximum expected rainfall events.

In order to mitigate the effects of drought, the objective of water policy should be to meet optimum water requirements for each locality and to develop water storage facilities to meet demands in times of crisis. Water budgets should be established in each locality to provide information on minimum water needs. Traditional methodologies for coping with drought conditions should be encouraged. Other strategies should also be employed such as the use of drought resistant crop varieties.

Disaster management should include such factors as procedures for information collection and analysis, monitoring of resources and early warning systems. These would clearly be different for flood and drought disasters.

Policy principles and objectives

1. A national Disaster Management Plan will be developed to enable both of the avoidance of disasters and effective response to disasters.

2. International co-operation is critical for proper and adequate response to natural and other disasters. Sudan will seek to participate in and contribute to international efforts such as the Program to Combat Desertification.

Public safety

There are a number of aspects related to water resources management which may constitute a threat to public safety such as large hydrological structures, dams etc. Because of the size of these structures and the disastrous consequences should they fail, it is important to ensure that adequate steps are taken to ensure that they are safe.

Public safety implies a cost. A dam could be built with excessive factors of safety which would ensure that the probability of failure under any circumstances is extremely low but this would be very expensive. The objective is to establish a safety management régime which will ensure that a balance is maintained between safety and cost.

The management of public safety must include all factors relating to the safety of structures, design codes for structures which have a safety risk, inspection procedures during construction and operation, operating and maintenance rules, procedures for information collection and analysis, and early warning systems. Contingency plans should also be drawn up for public notification, evacuation etc.

Policy principle and objective

1. In order to ensure adequate public protection, regulatory and administrative instruments which balance the cost of safety measures with an acceptable level of risk to public safety will be developed and implemented at national and federal level as appropriate.

puterization, system analysis, GIS, remote sensing telemetry and mathematical modeling.

There is a pressing need to strengthen educational and training capacities in information management at all levels. Emphasis in training should be placed on data handling and analysis and water management monitoring. A special task force on training under the leadership of the Water Management and Irrigation Institute of the University of Gezira is suggested. It will need to work in close coordination with the Ministry of Irrigation and the UNESCO Chair for Water Resources and investigate the modifications which are necessary in the syllabi and curricula of undergraduate and post-graduate courses. There is also an urgent need to promote coordination between the different national agencies through the forum of the National Council for Water Resources.

Research

There is a need for structured research on the impact of water policy. Research is needed to, *inter alia*, analyze the effects of water allocation on equity and efficiency. National research institutions need to develop and apply methodologies for assessing users' perceptions towards water allocation, integrated land and water resources uses, the use of modeling tools and procedures for stake-holders involvement.

Capacity building

Building the capacity of the water sector at large in the country is one of the fundamental requirements for achieving proper water resources management. This is a very large undertaking, however.

By adopting a modular approach to larger capacity building programmes, training events can be planned with application in the work environment. This method will allow the integration of theory and practice and encourage participants to discuss and review their experiences. The end result is a more sustainable improvement in water assessment and management techniques.

The modular combinations suggested for adoption at federal and State levels are:

- ♦ initiating monitoring programmes for uses from different water resources;

- ♦ improving and expanding analytical and data management capacities;
- ♦ assessing performance of water supply and sanitation agencies;
- ♦ assessing performance of water resources management agencies.

There is a need to emphasize the fact that the types of training offered are to be consistent with the full range of training possibilities. The priority areas are:-

- the sedimentation problem,
- water measurement problems,
- irrigation system performance,
- operational efficiency constraints,
- environmental concerns,
- participatory approaches,
- the role and empowerment of women,
- water conservation and quality,
- planning, control and coordination, and
- strategic planning.

For each capacity building intervention, there has to be a set of measurable objectives. Wherever possible the targeted groups are to be consulted before capacity building programmes are planned. Capacity building programmes are to be targeted at the full range of skilled personnel, from operation and maintenance activities, to design and technician levels, to the higher technical, managerial and professional levels.

External assistance

External donor assistance will be needed to support capacity building programmes, especially those that focus on users' groups. The output of such assistance is to encourage the devolution of responsibilities, tasks and authority to local level users' groups. The kinds of technical assistance to be extended are to be directed to developing and evaluating water databases, agricultural knowledge systems and methodologies for water development and evaluation.

A specific capacity building programme for the water sector is recommended within the context of Sustainable Human Development as stated in the Country's Strategy Note drafted jointly by the government and the UNDP. The programme is to be entrusted to a specialized task force representing the various disciplines of the water sector. The focal point will be the Ministry of Irrigation and Water Resources which will be responsible for appointing a coordinator. The Coordinator is the contact member of the

task force who will cooperate with training institutions inside and outside the country and be responsible for arranging funding and agreeing allocation principles with the Donors, the Ministry of Finance and the Focal Point. In addition to directing the Task Force, the Coordinator will monitor the progress of the programme and ensure timely implementation.

The experience of the community-based systems under the Area Development Schemes and Area Rehabilitation Schemes (ADS/ARS) approach of the UNDP funded programme in Sudan are to be used as additional input to the project. Despite some shortcomings, they provide effective modalities of participatory capac-

ity building activity. They are ideal as examples of community water resource management and self-governance.

Other themes of relevance to capacity building in the water sector in Sudan are the national strategies to be drafted in compliance with the Convention on Biological Diversity (CBD), the Convention on Climate Changes (UN FCCC) and the convention to Combat Desertification (UNCCD). The Action Plan for Sudan will certainly involve issues aimed at water resources conservation, managing and monitoring, with relevant capacity building dimensions.

PART 3: CONCLUSION

CONCLUSION

The establishment of this National Water Policy for Sudan marks a milestone in the water sector and in the history of our development as a nation. This policy is commended to all the people of Sudan who use water everyday in their homes, on their farms, with their cattle and in their factories.

Water is precious and we have a duty to look after it in our own interests and in the interests of our children. This policy points to many areas where the use and protection of our water resources could and should be improved in the interests of all our people. The Government of Sudan is committed to implementing the policies contained in the document and to taking action where necessary if our water resources are abused or threatened.

It should be realized that water scarcity in future would result due to the fact that an expanding population is using ever-increasing quantities of a finite resource. However, the potential for water saving is enormous if all users are urged to manage their supplies in order to ensure that future generations live in a world of water security not water scarcity.

Policy is never static – it needs to develop and grow as our economy and our technology grows. Many people have contributed to the writing of this policy document and all people in Sudan are invited to comment on it and contribute to its ongoing development and refinement.

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