MEDIUM-SIZED PROJECT PROPOSAL
REQUEST FOR GEF FUNDING
IMPLEMENTING AGENCY FEE: N/A

AGENCY'S PROJECT ID: 1528
GEFSEC PROJECT ID:
COUNTRY: Chad, Egypt, Libya and Sudan
PROJECT TITLE: Formulation of an Action Programme for the Integrated Management of the Shared Nubian Aquifer
GEF AGENCY: UNDP
OTHER EXECUTING AGENCY(IES): IAEA
DURATION: 30 months
GEF FOCAL AREA: International Waters
GEF OPERATIONAL PROGRAM: OP 9- Integrated Land and Water Multiple –Focal Area Operational Programme
GEF STRATEGIC PRIORITY: IW 2- Capacity Building for International Waters
ESTIMATED STARTING DATE: April 2005

FINANCING PLAN (US$)	
GEF PROJECT/COMPONENT	
Project	975,000
PDF A* (May 2003)	25,000
Sub-Total GEF	1,000,000
CO-FINANCING**	
GEF IA/UNDP	
GEF ExA/ IAEA	618,000
Government	6,283,100
Bilateral	
UNESCO	50,000
Others	
Sub-Total Co-financing:	6,951,100
Total Project Financing:	7,951,100
FINANCING FOR ASSOCIATED ACTIVITY IF ANY:	

* Indicate approval date of PDFA
** Details provided in the Financing Section

CONTRIBUTION TO KEY INDICATORS OF THE BUSINESS PLAN:

RECORD OF ENDORSEMENT ON BEHALF OF THE GOVERNMENT:

Qualbadet Magomna, Chad Ministry of Environment	Date: July 26, 2004
Mohamed S. Khalil, Chief Executive Officer, Egyptian Environmental Affairs Agency	Date: July 25, 2004
Nadir Mohamed Awad, Secretary General, Sudan Higher Council for Environment and Natural Resources	Date: Sept. 21, 2004
Mohamed Amer, Head, Office of Planning and Emergency Environmental General Authority, Libya	Date: Nov. 22, 2004

This proposal has been prepared in accordance with GEF policies and procedures and meets the standards of the GEF Project Review Criteria for a Medium-sized Project.

Name & Signature
IA/ExA Coordinator
Date: (Month, Day, Year)

Project Contact Person
Tel. and email:

TABLE OF CONTENT

ACRONYMS

CEDARE	Center for Environment and Development for the Arab Region and Europe
COB	Convention on Biological Diversity
FAO	Food and Agriculture Organization of the United Nations
GEF	Global Environment Facility
IAEA	International Atomic Energy Agency
IBWC	International Boundary Waters Commission
IFAD	International Fund for Agricultural Development
ISARM	Internationally Shared (Transboundary) Aquifer Resources Management
MSP	GEF Medium-Sized Project
NARIS	Nubian Sandstone Aquifer Regional Information System
NEPAD	New Partnership for Africa's Development
NSAS	Nubian Sandstone Aquifer System
OSS	Sahara and Sahel Obeservatory
SADA	Shared Aquifer Diagnostic Analysis
SAP	Strategic Action Programme
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization

PART I - PROJECT CONCEPT

A - PROJECT SUMMARY *(Describe project rationale, objectives, and outcomes)*

The Nubian Sandstone Aquifer System (NSAS) is one of the largest aquifers in the world covering approximately two million square kilometres of Northeast Africa in Chad, Egypt, Libya, and Sudan. The NSAS is the world's largest fossil aquifer system with its reserves estimated at 375,000 km3. In the arid desert areas of those countries that share the aquifer, groundwater is a primary source of water for human populations and the indigenous ecosystems. With growing population pressures, and decreasing water available from other sources, there is increasing pressure to enhance the abstraction of this tremendously valuable resource that, under current climatic conditions and based on current knowledge, appears to be only marginally rechargeable. This increased pressure to use these shared groundwater resources, despite unclear knowledge of the transboundary impacts, represents a potential threat to a precious resource that if unchecked, could lead to deterioration of water quality and/or irrational water use with the potential to harm biodiversity, enhance land degradation processes or even lead to transboundary conflict.

This is a region that is wrought with water shortage amidst growing human populations. Destruction of ecosystems is leading to increased desertification and loss of habitat. One challenge in developing an adequate management strategy is the continued lack of sufficient knowledge about the aquifer needed to develop a rational use of the aquifer resources that can benefit the four countries. Further issues include poor management of water currently being exploited from the NSAS including loss of springs due to poor allocation of wells, change in the natural environment including species and habitats, poor understanding of local legislation and water rights, inadequate understanding of interactions between horizons, and impacts of development on the local and regional sustainability of groundwater. In general, there is a lack of a proper database and capacity to synthesize available information as a basis for determining and undertaking future investigations and developing strategies.

The Long-term Goal of the project is to establish a rational and equitable management of the NSAS for sustainable socio-economic development and the protection of biodiversity and land resources. To achieve this goal, the Immediate Objectives of this MSP project are as follows:

i. Prepare and agree on a Shared Aquifer Diagnostic Analysis (SADA) to jointly identify, understand and reach agreement on the priority issues, threats and root causes of the NSAS;

ii. Address and fill key methodological, data and capacity gaps needed for strategic planning decisions, using appropriate technical approaches with a focus on isotope techniques and applications under the supervision of the International Atomic Energy Agency (IAEA);

iii. Undertake the preparation of a Strategic Action Programme (SAP) to outline the necessary legal, policy and institutional reforms needed to address the priority threats and their root causes as identified in the SADA for the NSAS with a focus on the environmental aspects of aquifer management;

iv. Establish a framework for developing an agreed legal and institutional mechanism towards a NSAS convention for joint four-partite management and rational use of the shared NSAS System.

The overall expected results would contribute to strengthening the institutional, legal and analytical frameworks for the sustainable management and use of the shared NSAS. The project will result in a clear understanding of transboundary issues, problems and potential solutions (SADA), a process for and significant progress in achieving a jointly developed and agreed strategic approach and action programme (SAP) to address real and potential problems, as well as a framework for developing an appropriate legal mechanisme.g. a convention etc. to underpin transboundary cooperation represented by a strengthened Joint NSAS Authority. This enhanced framework and intensified cooperation will set the basis for better management of the shared aquifer resources. Links and networks between international and national organizations to ensure future co-operation will also be established. A full integration of the NSAS activities in the respective natural resource management programmes at a national and regional level will be promoted. The basis for establishing an operational monitoring system will be available to enable the observation of any changes in the water regime and related ecosystems. Consideration will be given to the

inter-relatedness of water resource management issues with the Nile River Basin in Egypt and Sudan and thus cooperation will be assured with the Nile Basin Initiative as appropriate.

The impact of the project should support the development of sustainable socio-economic conditions in an area that depends heavily on the availability of water. Furthermore, it will be beneficial to all involved countries in terms of the control of desertification and the protection of biodiversity.

The proposed duration of the MSP is 30 months. UNDP will be the GEF Implementing Agency for the project. The International Atomic Energy Agency (IAEA) will serve as Executing Agency as well as lead the technical components of the project given its expertise in the groundwater sector, based on its utilization of isotope techniques. The project will be coordinated in the field by a Project Implementation Unit (PIU).

B - COUNTRY OWNERSHIP

1. COUNTRY ELIGIBILITY

The four participating countries are all eligible for UNDP and GEF funding.

2. COUNTRY DRIVENNESS

Clear description of project's fit within:

- *National or sector development plans*
- *Recommendations of appropriate regional intergovernmental meetings or agreements*

All four NSAS countries plan to place an even greater emphasis on groundwater resources to provide for water needs in the future. They all have similar climates, where surface water resources are scarce and groundwater resources need to be explored to meet increasing human and industrial needs. As a result all countries have attached top priority in their respective national development plans to address water shortages and explore for alternatives. The NSAS provides a unique opportunity, as it is a huge, mostly untapped water basin that lies under all four countries. Each of the respective aquifer countries are pursuing different development strategies. The NSAS lies in an area of Chad that is not heavily populated. Little is known about the NSAS resources available within Chad and currently small communities and nomadic groups dependent on these resources use the water resources primarily from wadis. The government has developed a national water development strategy that aims to secure the use of more water resources like what can be found from the NSAS. In Egypt the NSAS is the only source of freshwater in the Western Desert, which covers about 68% of Egypt's area. Egyptian national policy stresses population redistribution over the country's physical area and the Western Desert is one of the target areas. Therefore, the NSAS is seen in Egypt as a strategic resource to support national development policies. In Libya the policy is to increase the transport of water from the NSAS to the coastal and urban areas where a majority of the Libyan population is growing. Therefore, the national water development strategy is to continue to develop NSAS resources to match growing populations and water demand. In Sudan, currently a large percentage of water supplied nationally comes from the Nile, an already severely strained resource. Therefore future development plans call for the enhanced use of NSAS water resources. Nevertheless, in order for each of the countries to benefit from the NSAS, they have to manage it cooperatively to ensure that they derive the maximum benefits (Refer to annexes 3, 4, 5 and 6 for a summary of each country's groundwater sector.)

Joint Management and Cooperation – Past, Present and Future

The four NSAS countries have already embarked on a process to cooperate on the management of the NSAS water resources. Egypt and Libya initiated the process in the early 1970s and formalized it in1992 with the creation of the Joint Authority for the Management of the NSAS System (hereinafter referred to as the Joint Authority.) Sudan joined the Joint Authority in 1996 and Chad followed in 1999. The original objectives of the Joint Authority are (i) to oversee strategic planning, (ii) to develop a NSAS monitoring programme and (iii) to exchange data and information on the respective water resources and extraction (see Annex 9 for the official Joint Authority agreement).

The respective national Focal Point institutions for the Joint Authority include the Research Institute for Groundwater in Egypt, the General Water Authority of the Secretariat of Agriculture in Libya, the

Groundwater and Wadis Directorate in Sudan, and the Direction de l`Hydraulique of MEE in Chad. This regional cooperation is built on agreements on data sharing, monitoring and exchange with incorporation of data in a regional information system. The four countries have adopted a regional monitoring network and agreed to continue the joint monitoring of the aquifer. The regional monitoring network includes existing and planned wells: 42 existing wells and 5 recommended new wells for the Nubian, and 18 and 9 wells respectively for the Post-Nubian. A regional strategy has been formulated focused on joint studies and assessment of current and future impacts from growing extractions with recommended strategies to minimize negative impacts including cross-border conflicts, through e.g. optimisation of yield versus draw downs and protection of groundwater quality. Socio-economic aspects are proposed to be addressed through, among others: (a) harmonisation of groundwater access and availability between regions, (b) and between communities, production sectors and social classes, (c) improved understanding of and communication with indigenous communities, and (d) adaptation of development plans to local conditions. In order to implement common strategies, the Joint Authority requires further enhancement and strengthening including the development of an appropriate legal and institutional framework.

This cooperation was activated from 1997-2002 through important initiatives and baseline activities supported by IFAD under the project management of the inter-regional organization, the Centre for Environment and Development for the Arab Region and Europe (CEDARE). This resulted in a joint survey of the socio-economic development policies and plans in the aquifer areas and the establishment of a NSAS Regional Information System (NARIS) database. NARIS facilitates data storage, processing, display and analysis and would be instrumental in the preparation of data for GIS and mathematical models. The modeling scenarios have been based on a survey of the countries' socio-economic development programmes in the related national sections of the aquifer and provide indications of the impacts on water levels and water quality over a period of 60 years of development and abstractions. The model needs to be adapted for operational use but data gaps that will facilitate the joint management of the NSAS, including additional mechanisms for effective use and inter-country communication, need to be addressed. The Nubian countries are currently planning for the expansion of aquifer monitoring and observation well networks. There are however, important data and capacity gaps. Efforts to address these gaps have begun under a current regional project supported by the IAEA which aims essentially to use isotope techniques to expand and consolidate the technical and scientific knowledge and database regarding the aquifer system needed for developing a groundwater management plan based on a monitoring network for the aquifer.

Hence, one of the main purposes of the project will be to enhance, strengthen and activate the Joint Authority with the necessary legal, institutional, and management framework to effectively coordinate the joint management of the NSAS resource in a rational manner based on the implementation of the agreed SAP.

C – PROGRAM AND POLICY CONFORMITY

1. PROGRAM DESIGNATION AND CONFORMITY

- *Describe briefly how project objectives are consistent with Operational Program objectives and strategic priority.*

The GEF International Waters (IW) Focal Area has, as one of its priorities, the protection and utilization of "shared" (transboundary) groundwater and ecosystems dependent on groundwater. Furthermore, the Operational Strategy places an emphasis on addressing transboundary water issues in Africa. The proposed project is consistent with GEF Operational Programme 9: Integrated Land and Water Multiple Focal Area. In addition, a rational utilization of the shared NSAS offers the opportunity to the NSAS countries to work collectively in managing not only the shared aquifer, but also in managing it in consideration of groundwater dependent ecosystems (oases, desert lakes etc.) that without cooperative management might be degraded. An appropriate use of the Nubian resource can also serve to prevent further land degradation in these fragile arid areas.

The proposed project will support GEF's Strategic Priority #2 "Expand global coverage of foundational capacity building." The project will provide targeted learning in the frame of enhancing a joint management framework that should ensure sustainability of the initiative. The project will address not

only transboundary water management, but also the close linkages with land degradation and ecosystem protection.

2. PROJECT DESIGN

Describe briefly :

- *sector issues, root causes, threats, barriers, etc, affecting global environment.*
- *Project logical framework, including a consistent strategy, and details of goals, objectives, outcomes, measurable performance indicators, risks and assumptions.*
- *Global environmental benefits of project (performance indicators at objective and outcome level should refer to the environmental, socio-economic, institutional and policy/legal impact of the project).*
- *Project cost to be financed by the GEF.*[1]

Groundwater represents a major source of the world's freshwater resources. Approximately 98% of available freshwater is groundwater. Surface water resources in many parts of the world are severely stressed as witnessed by declining water levels that are catastrophic in places. Many countries are totally or largely dependent on groundwater for their freshwater supplies. Furthermore, as many aquifers are transboundary, this has the potential to lead to increased pressures leading to over impaired and/or reduced resources as the search for and utilization of water resources becomes a very important strategic activity for development and survival. One way of addressing this threat is for transboundary aquifers to be actively managed by all aquifer countries. Mechanisms for cooperation and management need to be developed just as they have been for transboundary rivers, lakes, seas and large marine ecosystems. Nevertheless, efforts to develop mechanisms to cooperatively manage groundwater are relatively new. In one example, the Swiss Canton of Geneva and the Department of Upper Savoy in France have a joint commission based on a 1977 convention on the protection and utilization of the Geneva Aquifer. The Mexico- USA International Boundary and Waters Commission (IBWC) has increasingly expanded its scope to include a framework for managing cross-border groundwater (see ISARM.)

Non-renewable palaeowaters are being mined in wide areas of the NSAS. The presently extracted groundwater from the Egyptian and Libyan oases was formed to a great extent during several humid phases of the Pleistocene in the unconfined part of the NSAS in southwest Egypt. A large part of the Nubian Aquifer groundwater has ages of around 20,000 year old indicating a recharge during the late Holocene. Recent dating, however, by using advanced isotopic techniques (i.e. 36Cl isotope,) indicate ages up to one million years for the water in parts of the aquifer system. This suggests that the recharge of the aquifer has taken place over the entire Pleistocene period.

This part of the aquifer has been in a depleting process for several thousand years. Although the models have shown that recent groundwater recharge is negligible, and that extraction from the NSAS is mining the non-renewable resources, the huge amount of groundwater allows for reasonable exploitation if managed appropriately. Based on current estimates of total volume of the NSAS in relation to the current extraction rates, the lifespan of the NSAS is estimated to be approximately one thousand years.

Sector Issues

The Importance of the NSAS System

The NSAS, shared between Chad, Egypt, Libya and Sudan, (see Figure 1) is one of the largest regional aquifer resources in Africa and in the world. It covers an area of approximately two million square kilometres extending over North-eastern North Africa and Eastern Sahara and includes also North-eastern Chad and Northern Sudan. The NSAS is a strategically crucial regional resource in this arid region, which has few alternative freshwater resources, low, irregular rainfall, persistent drought, and is subjected to land degradation and desertification. Under present climatic conditions the NSAS is sparsely recharged by Nile water seepage in a few areas, by precipitation in some mountain regions and by groundwater influx from the Blue Nile / Main Nile Rift system. The infiltration rate is estimated to be small compared to the natural

[1] The share of the project cost to be borne by the GEF should be related to the incremental reasoning of the project. The project brief should identify partners who will co-finance the project.

groundwater flow due to discharge in depressions, evaporation in areas of low depths to groundwater table and leakage into confining beds.

Under current climatic conditions, in view of the limited modern recharge, the NSAS represents a finite, non-renewable and unrelated groundwater resource. Recently, the NSAS has not been an active part of the hydrological cycle[2] as the aquifer is basically unrelated to surface watercourses including the River Nile. One consequence of the enhanced use of the NSAS, is that the joint management, use and protection of the aquifer needs to be addressed in the context of alternative sustainability concepts and different forms of management in a river basin context of renewable international surface and related and connected groundwater (because by using the NSAS resources, the water will re-enter the hydrological cycle). The planned mining of groundwater in shared aquifers for sustainable socio-economic development is a relatively new concept. This concept needs to be based on long-term socio-economic and environmental goals in an agreed joint aquifer action programme, with two direct considerations for the approach to the NSAS project:

(a) Regulation of internationally shared non-renewable and unrelated groundwater represents an area that has only recently been the subject of legal review and codification and that is not yet well covered under international law. It therefore calls for appropriate, alternative legal principles to be developed. The project approach to establishing a legal and institutional framework towards a NSAS convention therefore calls for consideration of the most recent developments in international law related to groundwater issues.

(b) The scientific approach for assessing and monitoring non-renewable groundwater differs from classical hydrogeology and calls for advanced, reliable techniques for dating and tracing the water and elucidating the different water interactions in the aquifer systems. The application of modern technology, in particular the application of isotope and geochemistry hydrology, will provide the tools to achieve the crucial understanding needed in order to make critical decisions for the optimal management of the NSAS System.

The introduction and application of appropriate "select" approaches both in the socio-economic, legal and scientific areas are therefore prerequisites for joint management and rational use of the shared NSAS. The joint management and protection of the regional NSAS by Chad, Egypt, Libya and Sudan can be expected to form a model based on a multi-disciplinary scientific, socio-economic, legal and institutional as well as environmental approach to shared aquifer management. From a global perspective, it is expected that through the course of implementing the project, lessons will be learned that would be useful for the management of similar aquifers in Africa and in the rest of the world.

Background Of the Situation in Each Country

The situation in the NSAS area of the four respective Nubian countries is summarized in the following section.

Chad

With drought and climate change, groundwater levels have declined considerably due to insufficient precipitation as well as increased evaporation. This has made it difficult for the populations affected to get water from simple wells and many people have moved because of the lack of water. However, Chad's groundwater resources are in general very poorly understood because of the lack of detailed studies on the country's different groundwater bodies. The national authorities have responded to this problem by adopting a national water resources strategy that will investigate the possibility of introducing state-of-the art technology to extract groundwater from aquifers economically. Initially, this will involve the drilling of boreholes and the setting up of modern pumping systems that require large financial and human resources for preliminary studies. Some research has already been carried out on the geology and hydrogeology of Chad working from the north to the south of the country. Investigations concerning the NSAS have been conducted in the extreme northeast of the country. The NSAS area in Chad

[2] The argument that extraction of a non-renewable groundwater brings the fossil stock resource back into the modern hydrological cycle is still being debated.

accommodates sites of high global environmental significance including desert lakes that are threatened by dune intrusion and pollution and stress from rapidly growing population migration flows passing from Africa to the Mediterranean. Chad has identified sites for monitoring wells in the aquifer area and is currently in the process of identifying donor funding for their implementation. Furthermore, additional domestic funding sources from the national petroleum and the poverty eradication funds can be mobilized for priority activities and installations in Chad under the NSAS cooperation.

The Direction de l'Hydraulique/Ministere de l'Environnement et de l'Eau is responsible for groundwater resources programmes in Chad and will be the focal point for the NSAS project.

Egypt

Until 1975, very little attention had been given in Egypt to non-Nile water resources. However, with an expanding population centred in urban areas and with water supply, principally from the Nile, unable to match demand, pressure mounted on the government to adopt policies that would not only investigate alternative water resources but also address the high urban population density. The physical setting of Egypt was reviewed including, location, area, geographic regions, population distribution and available water resources, hydrogeological framework particularly related to the NSAS. In Egypt, groundwater is the only source of water outside the reach of the river Nile in the Egyptian desert and hence the role of groundwater has been given more emphasis in recent national water policies as manifested in the report from the Ministry of Water Resources and Irrigation (1998). The Western Desert within the NSAS is characterized by scattered oases and depressions with traditional Bedouin populations based on small scale, low intensity mixed subsistence agriculture to a large extent based on springs and shallow wells.

The policy on the NSAS is to protect the resource, control demand, develop additional water resources, and raise water use efficiency. The NSAS is a strategic water reserve, and an important part of national development for present and future generations. Development policies are based on studies of the actual socio-economic and cultural conditions in the local areas and on integrated water resources management required to secure sustainable development. Current research activities in order to enhance available water resources under the established Groundwater Sector include methodology development for desalination of brackish groundwater, artificial recharge and storage for drinking, industrial, and agricultural uses. Egypt is installing 15 observation wells in the southern part of the NSAS in areas close to the Egypt-Sudan border. Past collaboration with the IAEA aimed to assess groundwater resources in the Farafra and Bahariya depressions in the Nubian Sandstone Aquifer for sustainable development of these desert regions, which were essential for directing Government policy for developing new communities and population distribution outside the crowded Nile Valley.

The main issues facing Egypt's development include, among others: (i) partial utilization of its land area territories (less than 10%); (ii) unbalanced population distribution and continuous immigration from rural to urban areas; (iii) a decreasing per capita share in water and agricultural land; and (iv) lack of proper water supply and sanitation in the rural and desert areas.

The Ministry of Water Resources and Irrigation plays a key role in the development and management of the water system in the country.

Libya

Due to the arid climate, Libya is located in an arid region that suffers from the scarcity of surface water with an average rainfall less than 600 mm per year. This makes groundwater the main source of water for domestic, agricultural and industrial needs. However, groundwater abstraction is difficult in the absence of a substantial groundwater recharge and the country depends on fossil groundwater resources, estimated to be more than 20,000 years old. Since 1970, the Libyan government has invested a lot of time and money in the field of water investigations and in building the infrastructure for agricultural projects in the coastal and desert areas. The massive oil exploration in the country provided a major source for updating hydrogeological data which was subsequently used to evaluate groundwater resources and which led to the discovery of three huge fresh water reservoirs in the Sahara desert; Hamada, Murzuq and Kufra basins. Studies of these basins led to the implementation of several agricultural projects in remote areas in the desert and in Kufra a large irrigation programme has been launched for wheat production. Fertile lands

are, however, found along the coastal area together with the main population distribution. These facts led to the establishment and implementation of the world's largest groundwater conveyance scheme known as the "Great Man-made River" which will transport about 6.5 million cubic meter of water per day from the desert to the coastal areas.

All of these developments encouraged the Libyan authorities to continue studying the water resources in the three basins in detail and to seek more information from other neighboring countries sharing the basins. A mechanism for data and information exchange has been established. One of the forms of co-operation between the four countries sharing the Kufra basin in the NSAS, is the Joint Authority for the studying and development of the Nubian Sandstone Aquifer with its headquarters in Tripoli.

Much effort has been made in order to evaluate such huge reservoirs, but still more studies are needed in order to answer numerous questions concerning the recharge and connection between the sub-basins as well as age determination of the fossil water. It is foreseen that isotopic investigations can assist in resolving some of these critical unanswered questions related to the NSAS.

The lack of knowledge on the geo-hydraulic effects of the groundwater abstraction and the probable deterioration of the quality of fresh and fossil groundwater, due to the mobilization of brackish or saline groundwater, warrants further studies using isotopic techniques, which is the subject of a current project with the IAEA. This project is aiming to evaluate groundwater resources in Kufra and Sarir Basins within the NSAS using isotopic techniques. The main area of study for this new project is known as zone Five and is located in the south-eastern part of Libya. It is considered to be one of the most important groundwater resources in Libya. The Libyan government has planned to convey about 3.6 million cubic meters of groundwater to the coastal area through a giant pipe line (4 meters in diameter) as part of the Great Man-made River. The water quality in the study area ranges from 85 to 1500 ppm TDS.

Sudan

The NSAS area in Sudan is predominantly desert in the north and central parts changing to semi desert in the south. The temperature is influenced by arid and semi-arid conditions, with the maximum rainfall of 0-50mm/a in the north and 50-300 mm/a in the south. Drought episodes of 2-3 years duration are normal. The area has a population size of about 285,000 people with 77% in North Darfur State and the rest in Northern State. Most of the settlement is along the Nile Valley around the oases and in the Qaab depression. The Nile River system, with the confluence of the White and Blue Nile rivers at Khartoum, is a major source of water for Sudan and forms an important north-south axis within the country. The Northern State and the Nile State to the north of Sudan lie within the Sahara region, and because of the lack of water resources, life is confined to the very narrow, low areas adjacent to the Nile. The fast-growing population of the country and the switch of large parts of the population from sorghum to wheat as a staple food has meant that the Government is using more land in the two northern states to grow wheat thereby putting a big strain on the limited water resources. Furthermore, limited water resources and the very narrow river basin have resulted in mass migration of the younger generation from rural areas to urban areas.

The economic activities are largely of primary nature such as agriculture, animal husbandry, and mining. They are dependant on natural resources, which are subject to both human misuse and naturally harsh conditions such as land degradation, desertification, and repeated droughts. These adverse conditions are coupled with poorly developed infrastructure, long distances to markets, a shortage of public finance, and planning limitations, all of which serve to deter development.

A number of IAEA-assisted technical cooperation projects have been executed for some years, mainly to investigate the influence of the Nile River system and big seasonal wadis on the adjacent parts of the Nubian Sandstone Aquifer System (NSAS). While information gathered has been very useful and has also allowed for the updating of hydro-geological maps, there is still an urgent need for additional isotopic investigations in the NSAS area and other parts of Sudan.

Linkage to Biodiversity and Land Degradation Issues

There are clear linkages between the rational management of the NSAS and both the protection of Biodiversity as well as the prevention of Land Degradation. All four NSAS countries have signed and ratified the Convention on Biodiversity (COB.) Chad and Egypt already have completed National Biodiversity Plans underlining the importance of protecting oases ecosystems. Further, all four NSAS countries have signed and ratified the United Nations Convention to Combat Desertification (UNCCD) and national strategies have been or are being developed. However, not much is known about cause and effect relations within the NSAS area. This MSP will serve as an important contribution to showing the inter-linkages between water management, biodiversity protection and the prevention of land degradation. These considerations will be built into the TDA/SAP process.

Wadis and Oases, fed by the NSAS, can be central to the biodiversity in the NSAS countries. Therefore the protection of the oases and such groundwater dependent ecosystems is a pre-requisite for protecting the biodiversity of these arid areas. Ecosystems of dry and arid regions naturally tend to be highly dynamic systems and the assessment of the status and trends of the biological diversity of these areas are therefore particularly challenging. The NSAS system and the Northern Africa desert area are not exceptions. The NSAS region has a surprisingly rich fauna and flora that could easily be damaged in a poor management of these resources. The unique flora is found in oasis areas, such as Kufra in Libya and Farafra and Baraya in Egypt. These areas also host a fauna that is not highly visible due to the small population and consequently they are very vulnerable. Destruction of ecosystems is leading to increased desertification and loss of habitat and therefore remains the largest threat to biodiversity. This offers new challenges for a development of a sustainable conservation programme of the biodiversity for these oases which have a unique historical and cultural setting.

Most of the oases in the NSAS area are classified as Natural Monuments (according to the categories by the World Conservation Union) and therefore represent areas that need to be managed mainly for conservation of specific natural features.

The national strategy on biodiversity in Chad is in principle to stop the general trend in the reduction of the biologic resources and as a first target maintain the total diversity of the biomass in Chad. The expected outcome is to establish a durable programme with a broad political consensus to restore some of the damaged areas and re-introduce plants that has disappeared from recognized environments. Specific eco-systems and areas are selected in the action plan. Those are the forests in Tibesti the fauna and flora in the in Logoni and Chari basins as well as the lake Trene.

In Egypt, in efforts to implement the Egyptian biodiversity strategy there have been recommendations to designate oases in the Western Desert as protected areas. Sudan has a national strategy on biodiversity that promotes the development of an integrated policy. This includes the development of a national programme based on observation and investigation by establishing system of monitoring marine and coastal resources, freshwater resources biodiversity, ecosystems and fish resources.

In order to prevent changes in the natural environment including species and habitats, some key steps to strengthen biodiversity in the respective water resource management programmes are needed. This includes the development of clear national policy guidelines for the supervision and enforcement of a management protection strategy to promote the integration of biodiversity concerns in the NSAS Development programme. This needs to be in harmony with other relevant thematic programmes and it should promote effective stakeholder participation including the identification of priorities in planning as well as in the monitoring and evaluation stage of the project. One challenge in developing an adequate management strategy is the continued lack of sufficient knowledge about the aquifer needed to develop a rational use of the aquifer's resources for the four countries. Hence a detailed monitoring of the environmental impact and changes of the ecosystems due to the abstraction of water resources is therefore crucial. This implies the need for the establishment of a protection programme in these areas, based on the hydrologicial and isotope information that will be provided by the project.

In terms of land degradation, the utilization of NSAS water resources represents both a risk as well as an opportunity. The depletion of oases can lead to the degradation of surrounding lands dependent on that water. Further a misuse of groundwater can lead to salinization of land. A dropping of water levels due to pumping of groundwater has been observed in some areas of the NSAS. In Libya for instance, desert lakes, linked to oases in the Kufra area have been gradually drying up. The first annual Report on the Egyptian National Programme

to Combat Desertification (May 1999) points to problems, for example in the Siwa Oasis, such as the accumulated excess water which has caused rising water tables, salinization and in short land degradation.

On the other hand, NSAS water resources can also be used in measures to stop and/or reverse land degradation/desertification processes. In Egypt, for example, according to the National Plan to Combat Desertification, groundwater resources can be used in measures to stop the advancement of desert dunes that are advancing and will threaten oases communities (e.g. Kharga and Farafra Oases etc.) and palm plantations if not stopped. There are similar situations in Chad and Libya.

The inter-relationship between water management and land degradation in the NSAS region has already been recognized by the GEF Council when it developed its approach to land degradation and recommended that "initial attention be given to project activities in arid, semi-arid and dry sub-humid areas which address one or more of the following…. including "activities which address the problems of international use of surface or sub-surface water resources in the context of land degradation in the drylands, like the Nubian Sandstone aquifer…" (GEF Council 9, 1996.)

Threats, Root Causes, Barriers and Challenges

It is generally assumed that the large and non-renewable NSAS storage volume of water could be sufficient, if managed carefully, for many centuries of planned mining. In some areas, due to the apparent low transmissivity of the aquifer, the impacts of growing extractions can be expected to remain local. In other areas it is still not clear whether there are effects on the regional scale. It is also understood that extractions will grow naturally with the increase in socio-economic demands. For example, recent projections have indicated that total annual extraction in a 50-100 year perspective will more than double and exceed 5 billion cubic meters per year - this could affect parts or all of the shared aquifer considerably. The rapidly increasing demand and potentially uncontrolled development of the NSAS could result in threats to the aquifer and related ecosystems. This could include (i) depletion and successive dissecting of the interconnected sub-basins leaving large intermediate areas without supplies, (ii) deterioration of water quality from up coning and lateral inflows from saline aquifers with local and aquifer wide responses and effects on water quality, water levels, economic feasibility and dry land ecosystems including oases (iii) other expanding local and aquifer-wide hydrogeological threats (e.g. poor recharge practices, agricultural pollution, waste water etc.) that, if uncontrolled and unaddressed, could have far-reaching local as well as regional social and environmental consequences.

Vulnerability of the water resources of the NSAS systems is evident and amplified by planned expansion in southern Egypt and northern Sudan. An integration of the natural isotopes in the groundwater management programme is crucial to have early warning signals for these threats. Therefore a synthesis of existing groundwater data and the development of a monitoring network in all four countries will provide valuable information for the understanding and rational management of the NSAS. The establishment of a conceptual model for the aquifer system will be the basis for the planning of the management programme.

In the past three decades Egypt, Libya and Sudan have made substantial individual attempts to develop and tap the NSAS for drinking water and agriculture. For example, the main focus in Sudan will be to use the NSAS for agriculture in the southwest of the country, on the border with Chad, where there are scare water resources for agriculture. In Chad, Libya and Egypt, there are already private bottling firms, which are extracting water from the NSAS and selling them for commercial purposes. However, the main concern for Chad is in the protection of vulnerable ecological values, including humid zones with oases and desert lakes that depend on seepage and springs from the NSAS. Overall, the challenge is to gather essential data needed to extract the water rationally and economically. Therefore it has been proposed that under the SADA preparation a focus should be on gaining the technical knowledge to better understand the Nubian resources especially in Chad and Sudan.

In several other locations within the NSAS where there is a longer record of groundwater extraction, there are parallel indications of the loss of humid zones and artesian levels as well as salinization. The NSAS is affected by the dynamic increasingly deep saline water intrusion in its northern sections.
A major challenge is to gain a clear understanding to what extent modern recharge occurs. Isotope studies play a crucial role in defining palaeowater occurrence and in estimating the extent of the recharge. Along with this, it is clear that artificial recharge will be a major activity in this region in the future. This

represents both a threat, as well as major opportunity, depending on the appropriateness of the practices adopted.

The four aquifer countries already have an established mechanism for managing the aquifer in the form of the Joint Authority. This is a solid foundation for promoting cooperation among the countries and for implementing the project. Nevertheless, one major challenge is to strengthen the technical and institutional capacity of the Joint Authority. In the context of the overall joint management of the NSAS, further challenges will be to address the following issues:

- Impacts on the aquifer that could be caused by inappropriate abstraction as well as inappropriate artificial recharge i.e. due to lack of knowledge of "cause and effect" of actions;
- Inadequate understanding of inter-actions between horizons and impacts of development on local and regional use of groundwater;
- Change in the natural environment including species and habitats;
- Poor understanding of local legislation and water rights;
- Rapid harvesting of finite groundwater resources due to inefficient use and limited recognition of renewable and locally available water resources (e.g. shallow groundwater, wadi resources, water harvesting, artificial recharge etc.),
- Land Degradation (soil pollution, salinization, subsidence, etc.) caused by inappropriate water and land use,
- Climate Change and its impacts on water extraction and utilization strategies and plans,
- Biodiversity Loss caused by falling and/or raising groundwater levels (e.g. in humid zones, oases systems with globally significant biodiversity);
- Poor management of water currently being exploited from the NSAS including loss of springs due to poor allocation of wells;
- Lack of sufficient knowledge about the aquifer.

The root causes to potential problems are primarily those associated with very limited and finite water resources in arid and desert climates, matched with increasing water demand due to both population growth and in some cases growth in economic development. More immediate causes are insufficient/inadequate legal and regional policy and institutional frameworks, insufficient/inadequate information (monitoring etc.), lack of appropriate capacities as well as lack of public awareness of importance of the shared aquifer resources. In order for these threats and challenges to be addressed and managed effectively, it is essential that the aquifer countries jointly identify and agree on them and their immediate and root causes in the frame of a Shared Aquifer Diagnostic Analysis (known as a Transboundary Diagnostic Analysis). This can be tackled under a common strategic action programme.

PROJECT OBJECTIVES

THE OVERALL OBJECTIVE OF THE PROJECT IS:

RATIONAL AND EQUITABLE MANAGEMENT OF THE NSAS TOWARDS SUSTAINABLE SOCIO-ECONOMIC DEVELOPMENT AND THE PROTECTION OF BIODIVERSITY AND LAND RESOURCES.

The Immediate Objectives of the project are to:

i. Prepare and agree on a Shared Aquifer Diagnostic Analysis (SADA) to jointly identify, understand and reach agreement on the priority issues, threats and root causes of the NSAS;

ii. Address and fill key methodological, data and capacity gaps needed for strategic planning decisions, using appropriate technical approaches with a focus on isotopic techniques and applications under the supervision of the International Atomic Energy Agency (IAEA);

iii. Undertake the preparation of a Strategic Action Programme (SAP) to outline the necessary legal, policy and institutional reforms needed to address the priority threats and their root causes as identified in the SADA for the NSAS with a focus on the environmental aspects of aquifer management;

iv. Establish a framework for developing an agreed legal and institutional mechanism towards a NSAS convention for joint four-partite management and rational use of the shared NSAS System.

PROJECT COMPONENTS

Efforts to achieve the four objectives under this MSP will involve the implementation of activities under 5 components as follows:

Component 1: Preparation of Shared Aquifer Diagnostic Analysis and Addressing Gaps in Capacity and Data Component 2: Preparation of a Strategic Action Programme (SAP) Component 3: Establishment of a Framework for developing the Legal and Institutional Mechanism/ - Convention for the NSAS Component 4: Project Management Component 5: Project Monitoring and Evaluation

Component 1: Preparation of Shared Aquifer Diagnostic Analysis and addressing gaps In Capacity And Data

This component will essentially try to achieve objective 1, which is to *prepare and agree on a Shared Aquifer Diagnostic Analysis (SADA) to jointly identify, understand and reach agreement on the priority issues, threats and root causes of the NSAS* through the preparation of the SADA and objective 2, *Address and begin filling key methodological, data and capacity gaps needed for strategic planning decisions, using appropriate technical approaches with a focus on isotopic techniques and applications under the supervision of the International Atomic Energy Agency (IAEA)* through addressing gaps in capacity and data. The component will be structured so that efforts to fill in data gaps will be initiated early in the project to feed into the TDA process to the degree possible in the time frame.

The outcome of this component will be agreement reached on a SADA and a better understanding of the priority issues, threats and root causes of the NSAS.

1.1 SADA Preparation

Approach

It was agreed that initially each country would have its own national SADA meeting with relevant stakeholders. Thereafter a regional meeting, where all national technical findings would be integrated into one NSAS SADA report, would be convened when all countries had completed their individual SADA consultations. Methodological guidance from the new Train-Sea-Coast TDA/SAP Course will also be used and adapted to the SADA process. In Egypt, Libya and Sudan, the process will draw upon an already established inter-ministerial consensus in the country status reports. The national project focal points will prepare the national reports on identified and agreed threats and related issues. The project will support the compilation and adoption of national SADA reports at an inter-ministerial meeting in each country. The national focal points responsible for the formulation of the national SADA are foreseen as follows: Egypt, The Representative of the Ministry of Water Resources; Libya: General Water Authority; and Sudan: Directorate of Ground Water; Ministry of Irrigation.

In Chad, the SADA process would be seen as an opportunity to enhance the Government's awareness of the NSAS. An inter-ministerial committee will be established to conclude the national SADA in a consultative process in working meetings and a national consultant will prepare the final national SADA report.

An independent consultant will finalise the joint regional SADA report, which would depict the outcome of the SADA process as well as serve as the main input for the formulation of the SAP. The requisite time frame for the SADA is estimated to be 16 months months with the SADA being initiated as early as possible in the project but allowing time to incorporate new technical information and analysis obtained in Component 1.2.

Activities/Inputs:

- Establishment and support to work of national technical task teams,
- Formation of national inter-ministerial committees,
- Strengthening and providing support to work of regional technical task team,
- Compilation and integration of a joint draft SADA,
- Stakeholder Review and Steering Committee adoption of the Joint NSAS SADA.

1.2 Addressing Gaps In Capacity And Data

This part of the component will try to achieve objective 2, *Address and fill key methodological, data and capacity gaps needed for strategic planning decisions, using appropriate technical approaches with a focus on isotopic techniques and applications under the supervision of the International Atomic Energy Agency* (These activities are supported by IAEA co-financing.)

The progress on the SADA and eventually on the SAP preparation could be constrained by a number of immediate gaps related to new alternative methodologies including gaps in the knowledge base and in existing monitoring tools, data and networks as well as in manpower capacity for cooperation on an equal basis. It will therefore be important to review the present approach and available capacities to identify the options for change and to focus on gaps directly and immediately related to the joint management of the aquifer system. This component will address efforts to increase the basic knowledge especially in Chad and Sudan. This will involve training, field work (including preparatory work for drilling,) the compilation of existing and new data as well as additional activities as listed in Component 2 (section 2.2). The capacity build-up will be implemented to complement the activities in the already ongoing IAEA RAF/8/036 project on NSAS System. The training events will be coordinated for all countries, however the complementary field exercises and preparations for drilling will be enhanced in Chad in order to ensure new data collection and the establishment of a groundwater monitoring system.

Approach

The agreed approach is to: (a) identify and address missing data in the entire Aquifer needed for an overview and better understanding of the NSAS, considering the current expansion of new observation wells that are being drilled in the aquifer area, and (b) provide priority capacity building to bring all aquifer countries to a common level of capacity needed for the NSAS MSP.

It is important that efforts are maximized in a joint effort to bring about mutual benefits and reduce costs at the aquifer wide level. One example is by locating new observation wells close to national borders and to address gaps towards an even regional distribution. The gaps are mainly in the southern parts of the aquifer where current development activities are sparser. The countries under the guidance and coordination of the Joint Authority will define different data gaps related to geographical coverage, topographical leveling, and the continuity of the time series. They will then balance these identified gaps against agreed criteria and identified needs as well as existing and planned actions for drilling/establishing of observation wells, isotope studies and updating of both data bases and the aquifer model. A regional expert will review the identified country data gaps and reconcile and summarize the data gaps for the NSAS. The capacity gaps are mainly in Chad and Sudan and these will be addressed through training in isotope hydrogeology and groundwater monitoring methodology. It is envisaged that the capacity building will build on regional exchange and involvement in the NSAS countries making use of existing training facilities and centres in the region.

The Executing Agency, the IAEA, would take the lead under this sub-component, and will work with CEDARE in relation to the NARIS database as appropriate.

Activities/Inputs

1 - Data Collection and Compilation

- Peer review of the NSAS model and the NARIS Database and their applicability, use and practicality for regional aquifer management,
- Compilation and interpretation of existing hydrological and isotopic data,
- Compilation of historical data about the aquifer system,
- Entering of new data in present or adjusted database (NARIS,)
- Data review and interpretation of existing information,
- Identification of data gaps in relation to priority needs for NSAS management, flow model, spatial sub-basins and aquifers coverage,
- Preparation and adoption of specific actions within the strategic action programme to address the data gaps.

2 - Collect additional isotope data to establish a regional chemical and isotopic database

- Application of isotope techniques to address specific issues (e.g. natural recharge and discharge relations, inter-aquifer connection, aquifer contamination, and groundwater flow paths and travel time,)
- Identification of new sampling points,
- Establishment of a network for data collection,
- Undertaking quality assurance of existing data,
- Compilation of all existing data,
- Continuous measurement of flows, precipitation and piezometric levels at selected stations,
- Collection of precipitation, surface water and groundwater for isotope analyses,
- Evaluation of groundwater age,
- Delineation of the recharge and possible discharge zones,
- Evaluation of the effects caused by pumping,
- Definition of aquifer flow dynamics in the shared aquifer system,
- Recalibration of the groundwater flow model after the update of the database.

3 - Introduce isotope hydrology in the monitoring programme at a regional level

- Installation of a isotope hydrology into the regional monitoring network,
- Collection of precipitation, surface water and groundwater for isotope analyses at a region-wide level.

4 - Collect data and apply isotope techniques to understand evaporation rates, climatic changes and land and water interactions

- Collection of isotope and chemical data to monitor micro climate changes in the region,
- Collection of data from natural lakes to evaluate estimates of evaporation,
- Continuous sampling of groundwater and surface water data to estimate inflows and outflows (aquifer water exchange) and improve water budget,
- Collection of isotope data for estimating the impact of irrigation return.

5 - Filling other data gaps

- Compilation and updating of already existing data about the aquifer system,
- Data review and interpretation of existing information,
- Entering of new data into existing databases (NARIS,)
- Integration of new data into existing conceptual and mathematical model of the NSAS system.

Component 2: Preparation of a Strategic Action Programme (SAP)

This component is designed to achieve objective 3, Undertake the preparation of *a Strategic Action Programme (SAP) to outline the necessary legal, policy and institutional reforms needed to address the priority threats and their root causes as identified in the SADA for the NSAS*.

The outcome of this component will be an established process, timeframe and primary input for reaching the agreed programme of action to tackle the issues raised in the SADA.

Approach

The SAP process should be initiated by the national technical task teams, who would naturally draw upon the SADA findings. The SAP process would try to formulate a common "Aquifer Vision" for the NSAS and would identify the ecological and socioeconomic objectives for the management of the NSAS. The process addressed by national and regional SAP formulation teams will have to involve key participation from the top decision-making and technical levels in the respective aquifer countries. The SAP formulation includes initial development of and agreement on objectives and targets along with monitoring and evaluation indicators (process, stress reduction, environmental status) and should be built on the feasibility study of the options for action and their social and financial soundness. A key element of the SAP process is the defining of national and regional institutional framework(s) and policies and then mobilizing the participation and the commitment for cooperation amongst the stakeholders at the different levels. All countries have an established long-term water sector strategic plan. For example, in Egypt, a long-term water strategy report already exists up to 2025 and in Libya the existing National Strategic Committee would be involved in the SAP process. The SAP will be focused on the regional process under the auspices of the Joint Authority. Further, capacity building relevant to the development of the SAP, focused on Chad and Sudan, will be continued based on activities initiated in component 1.

2.1 SAP Preparation

Activities/Inputs:

- Capacity building for SAP preparation (in cooperation with Train/Sea/Coast,)
- Appointment of national and regional SAP formulation teams,
- Development of Nubian Vision Statement by SADA technical task team,
- Supporting the work of national and regional SAP formulation teams,
- Conducting the feasibility study on options and social soundness,
- Definition of the respective national and regional institutional frameworks,
- Development of Process, Stress Reduction and Environmental Status indicators for long-term monitoring of SAP implementation,
- Development of draft SAP,
- Regional Meeting to discuss and revise the draft SAP.

2.2 Capacity Building for SAP Development (with a focus on Chad and Sudan)

The initial capacity building as listed below will have a focus on Chad. Additional needs for training and field exercises in Sudan will get a high priority in the activity.

Activities

- Training in groundwater field methods and sampling techniques,
- Basic training in Isotope Hydrology,
- Modeling exercises on existing data,
- Training using the database with GIS and remote sensing,
- Field exercises and interpretation training on geophysical methods,

- Locating and preparing for the development of deep observation wells with piezometers in the Chad section of the NSAS.

Component 3: Establishment of *of a Framework for developing the* **Legal and Institutional Mechanism/ Convention** *for the NSAS*

This component will work to achieve objective 4, *to establish* a framework for developing *an agreed legal and institutional mechanism towards a NSAS convention for joint four-partite management and rational use of the shared NSAS System*. It is expected that this component will be implemented with the contribution of UNESCO/ISARM.

The outcome of this component will be a draft agreement on a framework document for the establishment of for the NSAS.

Approach

The development of a joint regional NSAS framework is focused on reconciliation and harmonization of national legal and institutional policies towards a legal aquifer mechanism/ convention and a regional institution. The process comprises the review of the national legal, institutional and socio-economic and environmental development policies and programmes followed by the drafting of an Aquifer legal framework leading to a formal mechanism or Convention as the prelude to signature and ratification. In view of the limited legal provisions as codified in international groundwater law, the development of a regional legal agreement for the joint management, use and protection of this common property forms a legal challenge for review and application of international water law and other legal principles for substantial legal development. Furthermore, close attention must be paid to current efforts to fill in the gap at the international level concerning groundwater law. As a consequence, it is important to secure a high level of commitment from the respective governments and the involvement of the national ministries of foreign affairs as well as allow sufficient time and resources for this process. It will also be imperative to mobilize the support of an independent and internationally recognized institution with a high level of integrity, with a long record of international basin agreements and active participation in the development of codified international groundwater law[3]. In this regard, it is important that lessons be drawn and information be exchanged from other parallel GEF Aquifer projects including the Guarani, Iullemeden and North Sahara aquifers using established networks and information management mechanisms under IW-LEARN together with IGRAC and WHYMAP.

Activities/Inputs:

i. Informing relevant decision makers and/or Ministry of Foreign Affairs about the development of a legal framework leading towards a formal mechanism/possible convention,
ii. Mobilization of respective national and regional legal expertise,
iii. Review of national groundwater legislation and policy documents which would be consistent with the legal and institutional review of the SAP process,
iv. Review of existing bilateral and multilateral aquifer and water resources agreements, regional legal and institutional mechanisms, as well as international water law sources relevant to the management of the NSAS,
v. Preparation of a background document on legal requirements for use and protection of the shared non-renewable NSAS resources,
vi. Meeting of legal experts,
vii. Formulation of options regarding the nature, the structure and the mandate of an arrangement for four-country consultation for the management of the NSAS,
viii. Drafting of the required texts for options retained, concerning the arrangement for four-country consultation for the management of the NSAS,
ix. Convening of a national legal workshop in each country for the discussion of the proposals,

[3] With reference to UNESCO-ISARM, currently providing technical and legal advice to the UN-ILC Special Rapporteur responsible for the formulation of a Convention on International Groundwater Convention.

x. Convening of inter-governmental negotiation sessions of empowered representatives of the NSAS countries,

xi. Drafting of a legal framework with agreement on process and content for a legal mechanism.. It is important that this process involves the national Ministries of Foreign Affairs as important stakeholders as they are usually the lead ministry on international and regional conventions and ratifications.

Component 4: Project Management

This component would address management issues necessary to support project implementation and hence would support the other components above as well as the four main objectives. The purpose of this component is to manage project implementation efficiently and effectively and also to build institutional capacity, with a focus on strengthening the Joint Authority. The project management arrangements include the Project Steering Committee (PSC) with participation of the national focal institutions and the cooperating international agencies such as UNESCO. A Project Implementation Unit (PIU) under the supervision of a regional coordinator, who would be supported by technical and administrative staff as well as international expertise as needed, would be responsible for reporting to the PSC and coordinating project activities on the ground (in the Aquifer region).
PIU, in addition to its responsibility to coordinate and deliver the project activities, will also have as one of its objectives, the role of establishing permanent institutional capacity for the coordination of the subsequent post-project implementation of the SAP including implementation and enforcement at regional and national levels of the legal and institutional framework developed under the project. The PIU would be crucial for the eventual implementation of activities under a full sized project.

In support of the PSC, there will be a scientific review function to ensure quality and inter-compliance of project outputs and to secure international contact, communication and exchange of project information through existing international networks on shared aquifer resources management – including IW-LEARN, UNESCO-ISARM, IGRAC, etc. and other parallel GEF-IW aquifer projects. This will ensure the scientific quality as well as the dissemination and exchange of information with regional and international institutions for the benefit of parallel international aquifer projects.

The outcome of this component will be a strengthened regional/national coordination mechanism for integrated management and rational use of the NSAS System.

Activities/Inputs:

i. Identify, establish and support a PIU team - 1 Regional coordinator, 1 administrative assistant, 4 national focal points as counterparts placed in the Joint Authority offices focal point in each of the four aquifer countries,

ii. The PIU will be responsible for implementing day-to-day activities and would work in close contact with the executing agency, the IAEA,

iii. Scientific review for quality, inter-coherency and international exchange and dissemination.

Component 5: Project Monitoring and Evaluation

This component is essentially an extension of component 4, as this activity would be one of the major tasks of the PIU regional coordinator.

The outcome of this component will be an agreed monitoring and evaluation plan and subsequently completed evaluation of project progress and results based on project objectives and performance indicators.

Activities/Inputs:

- Regular (quarterly) progress reporting to UNDP/GEF, IAEA and the Joint Authority,

- Establishment and regular updating of project execution plans and project budgets,
- Annual reporting to GEF and UNDP (APR/PIR)
- Arrangement of one independent final project evaluation exercise,
- Prepare follow-up project that will include the the monitoring of SAP implementation.

Global Environmental Benefits

The global benefits arising from the GEF MSP project and the management mechanisms to enhance aquifer cooperation and the level of joint management of the resources are expected to be significant. The most evident benefit is the addressing of potential international pressures from intensive use of a common non-renewable resource; this includes reducing the threats of hydrogeological disasters and irreversible loss of water resources and land productivity in the basin areas together with the prevention of long term degradation of strategic regional water, land and environmental resources, including globally significant biodiversity. This can be expected to reduce pressures in the international and regional water environments (including other regional transboundary water resources like the Nile Basin), prevent harmful long-term impacts on the global and regional climate as well as to protect the significant drylands humid zones, wetlands and freshwater eco-systems.

Project cost to be financed by the GEF (Incremental Reasoning)

There is a significant level of base-line activity going on in the NSAS. There are important, either planned or ongoing efforts, at the national level, to develop and exploit the aquifer in the frame of national water sector development plans in relation to overall national socio-economic development objectives. There are also important activities at the regional level that reflect both baseline and co-financing support i.e. the Joint Authority has been established and is functioning and has plans for joint monitoring and information dissemination to support development goals. The baseline activity of 99,791,882 USD reflects the large amount of efforts to utilize the NSAS (see Table 1.)

Nevertheless, the GEF incremental funding is very important in order to provide the means to develop a regional strategic approach for the joint management of the shared aquifer. Without the GEF funding, there would be no consistent approach to jointly identify potential problems and causes, jointly decide on needed actions nor would it be feasible to develop a more comprehensive legal and institutional framework for the joint management. Nevertheless the baseline/available data is essential for the implementation of the MSP just as the Joint Authority provides an existing, promising mechanism for project implementation that will facilitate the commitment-seeking process and lead to, hopefully, considerable time-savings in implementing the components of the project.

The base-line activities highlight studies at the aquifer level on hydrogeological data collection, assessment and modelling for enhanced general knowledge of the groundwater resources of the NSAS. The baseline also includes recent investments made in the establishment of the four-partite Joint Authority. In short, when support to the JA is primarily for domestic purposes, it is considered baseline costs. When the support, furthers cooperation and the shared management, it represents co-financing. The baseline activities of the Joint Authority have however, been focused on data collection and less on joint management action for the rational use and protection of the common aquifer resource. In particular, these activities, have not, with some exceptions, addressed nor triggered preventive action on the linkages between the impacts from land use and climatic change. In addition, the linkages between appropriate water management, biodiversity in the oases as well as the threat of land degradation are not well-defined nor reflected in appropriate strategic actions at the national nor at the regional level. The current knowledge base, when referred to the size and the complexity of the NSAS remains limited and with a high scientific and policy uncertainty and further has not been fully organised to address common, cross-border issues. While significant, the outputs from these and other baseline activities including data gathered under other programmes have mainly domestic impacts.

Therefore, the joint management of the aquifer, without the GEF co-funding, can be expected to proceed in a setting of high uncertainty. This data and assessment uncertainty is further enhanced with the inherent uncertainty of the scope and time frame for climatic change. Given this situation, the approach to joint

management requires well-defined responsibilities, preparedness, participation and communication. Uncertainty should be addressed through active monitoring and frequent feedback based on dating, fingerprinting and early warning using modern technology and isotope hydrology. In view of the significance of the potential threats in the NSAS addressed under the project and the insufficiency of the current development-oriented and country based management approaches, the incremental activities for joint management for rational use and planned mining of the common aquifer resource under the alternative GEF course of action can therefore be expected to result in high payoffs.

Table 1: Baseline Funding, Co-funding and GEF Funding

Country	Baseline (USD)	Co-funding (USD)	GEF Funding
Chad	8,380,882	290,000	
Egypt	7,575,000	738,000	
Libya	76,636,000	4,415,100	
Sudan	7,200,000	840,000	
UNDP			
IAEA		618,000	
UNESCO		50,000	
Total	99,791,882	6,951,100	1,000,000

Component 1: Preparation of Shared Aquifer Diagnostic Analysis and Addressing Gaps in Capacity and Data. The baseline situation is that countries are investing in developing the aquifer at the national level, monitoring to support national programmes etc. They have also begun coordinating and sharing information with other NSAS countries. However, there is no assessment of aquifer-wide threats, root causes and challenges; the basis for coordinated strategic planning. Thus the incremental actions will include the identification and agreement on joint threats and their causes (TDA) and the systematic approach to improving the aquifer-wide knowledge base. The increment will also include a coordinated approach for developing an aquifer-wide monitoring programme consistently. This will form the basis for the shared management of the aquifer. Without this incremental activity, there will be no systematic assessment needed for understanding cause and effect relationships for actions that lead to transboundary problems.

Component 2: Undertake the preparation of a Strategic Action Programme (SAP). The baseline situation is that, while efforts have been made in the frame of previous cooperation to define a development plan, there is no agreed plan of action for the rational use of the NSAS and protection of dependent ecosystems (with appropriate linkages to land degradation and biodiversity issues.) Therefore the incremental action is the process of defining a Strategic Action Programme based on the Shared Aquifer Diagnostic Analysis (SADA.) Without this increment, the countries are likely to continue to pursue a national approach to utilizing the regional resource with insufficient consideration of land degradation and biodiversity issues.

Component 3: Establishment of Framework for Legal and Institutional Mechanism/ Convention for the NSAS. The baseline situation is that the Joint Authority exists and meets from time to time. Nevertheless, the NSAS Joint Authority has a low level of activity and the mechanisms for further development are not clearly defined. It is not currently proactively addressing transboundary issues nor is it dealing with cross-sectoral issues (land degradation, groundwater dependent ecosystems etc.) The incremental activity will lead to a legal basis for the Joint Authority in the form of a legal mechanism/ convention that will solidify the respective national commitments needed to take action together to protect and rationally use the NSAS. The capacity of the joint authority to guide the shared management of NSAS will also be greatly enhanced.

Component 4: Project Management.
There is no baseline activity for this as there are currently no joint activities in the NSAS being undertaken. The increment will provide for effective project management of the MSP supported activities and assure good communication and cooperation between the NSAS countries as well as other partners and stakeholders.

Component 5: Monitoring and Evaluation

There is no baseline activity for this as there are currently no joint activities in the NSAS being undertaken. The increment will support activities to review and assess the effectiveness of the MSP supported interventions forming the basis for the on-going monitoring and assessment of the NSAS SAP once it is approved.

3. Sustainability (including financial sustainability)

- *Describe briefly specific actions to be undertaken, within and/or outside the project, to address factors that influence continuation of project benefits after completion of project implementation.*

With the establishment of and their commitment to, the Joint Authority for the Nubian Sandstone Aquifer System, the four countries have already laid the foundation for the sustainability of project activities. The Joint Authority, as a beneficiary as well as a partner in project implementation, will be strengthened such that it will be a primary means to assure the sustainability of project benefits after the course of the project. These clearly demonstrated benefits will encourage the member countries to provide the modest financial means to sustain a more active and effective Joint Authority.

The demand for the project originated in the countries and from the need to enhance the Joint Authority and regional cooperation to protect and manage the NSAS. The project design is based on information from the principal stakeholders in the NSAS, at the national, sub-regional and local levels. As long as the project responds to the priority needs and demands for specific project outputs that originated in the countries and have been further defined by project stakeholders during project formulation (see PDF A Formulation Meeting Report in Annex 1), there is stakeholder commitment including the Joint Authority and the four governments to support the formulation and implementation of the measures identified and agreed under the SAP, after completion of the project. The sustainability of project activities and post-project implementation should be assured by the continued involvement of key stakeholders during the project activities. Further, public awareness activities, targeted at important stakeholders, will be undertaken to build a broad level of support for jointly managing the NSAS. Based on the strong support of the four governments and other stakeholders, the MSP could lay the foundation for a full GEF project to support incremental elements of SAP implementation and/or the support of other donors interested in facilitating cooperative management of shared water resources in Africa.

One potential risk is that the specific characteristics of the aquifer as well as the approach for jointly planned mining and protection of the non-renewable and unrelated resource are not fully addressed and/ or agreed under the project. This risk is related, in particular, to the time-consuming and complex process for the development of a NSAS legal and institutional framework. This work is complicated by current gaps in international groundwater law especially in relation to unrelated and non-renewable groundwater.

However, as evidenced by the important NSAS baseline activities that have already taken place, along with the strategic importance given to the common aquifer resource and its shared use and protection, this project, representing an alternative approach to “business as usual”, is expected to attract high political priority and attention both at regional, national and local levels. The costs of the project, such as provision of manpower and institutions for maintaining the monitoring and information systems and for administering and operating a joint cooperative framework, is expected to be borne by the Nubian countries after the project.

Institutional and financial sustainability, broad participation, involvement and commitment at the decision-making level in the countries will form necessary conditions for identification, design and establishment of the joint aquifer cooperative framework. This forms a necessary foundation to secure country commitment and endorsement of the collaborative framework as well as for the implementation of the Strategic Action Programme after the end of the project.

The common risk of sector barriers to integrated land and water resources management will be minimized through the structuring of the consensus- and commitment- seeking SADA/SAP formulation process in an integrated way with the involvement of the main water related sectors.

If adequately addressed, the management and protection of the NSAS will attract international attention and donor support. To this end, the project will facilitate continuous communication and dialogue with internal and external development partners to maintain a cooperative environment, to build human and institutional capacities as well as to sensitize these stakeholders to support and maintain consistent management approaches at the respective regional, national and local levels both during as well as after the completion of the project. Perhaps more importantly, modalities for more sustainable sources of funding for the Joint Authority will be explored first with the respective national governments and possibly complemented by interested development partners.

The countries will be involved in the formulation and reconciliation of an agreed SADA document. The SADA will be prepared early in the project to form evidence of the countries commitment to the project at a technical level and to build country commitments to the Nubian SAP formulation process under the project and its post-project implementation. The project outputs, including an agreed SADA and a widely committed SAP underpinned by a common legal and institutional mechanism under a NSAS convention, can be expected to lead to country commitments to reforms and investments in effective groundwater management and rational and efficient use and protection of the common non-renewable aquifer resource.

In addition to the policy and management risks, there are also risks related to the scientific approach for investigation, assessment and monitoring and, in particular, for ensuring the direct usefulness of technical work as a basis for effective and affordable management of the NSAS. There is the risk of an over-emphasis on costly studies and data collection that is not balanced with the political and institutional capacity for joint policy and management action in the four countries. This risk is being addressed via the project focus on strategic planning and commitment building on the one hand, and with the technical emphasis being on practical, efficient and effective approaches, including a focus on modern isotope hydrology techniques that provide for efficient finger-prints and early-warning indication as part of a more management-focused data collection and assessment effort on the other hand.

The project risks that could influence the project results are identified in Table 2. As mentioned above, the risks reflect mainly the policy uncertainties related to creating and implementing a joint management framework for the NSAS System by the four countries.

Table 2: Project risks and mitigation measures

Project Risk	**Risk level; /mitigation of project risk**
Countries discontinue to assess, create and share data about the aquifer; relevant data and information is not made available or shared.	*Low Risk*: Compilation and sharing of a common data base forms the original rationale and a major justification for the project by the countries. It is also a primary objective of the existing Joint Authority. Component 1. The strong collaborative environment established during project preparation will be maintained through frequent and transparent communication, during project implementation assisted by common information dissemination mechanisms. Further, the SADA process should also serve as a confidence building process.
Legal and Institutional arrangements (Convention, protocols, methodologies, processes and organizations) are not agreed or do not function.	Medium Risk: addressed in the text above.
Country contributions late or not available.	Low Risk: This is an established procedure as the countries contribute already to the Joint Authority.
Capacity building results uneven and do not produce good quality contributions from all countries.	Medium Risk: Targeted strengthening is provided under the project based on the relative situation of the four countries.
Agreement on legal and administrative structure for aquifer management will not be reached.	Medium Risk: Discussions need to start early. This risk should be minimized by the involvement of international organizations that have expertise in this area and that can serve as a neutral party thereby winning the confidence of the countries.
Local stakeholders, communities and NGOs, not properly involved.	Medium Risk: The task to involve key project stakeholders is considerable and has to be addressed with rational information dissemination and expansion of stakeholder involvement processes as appropriate.
Institutional roles not clarified or supported at sub-national government levels.	Medium Risk: Frequent and transparent communication, based on the roles and responsibilities defined during the Inception period, should serve to minimize this risk.
Coordination with parallel projects and initiatives weakens.	Medium Risk: the Project Steering Committee(s) if it functions as foreseen, should address this risk.
Collaboration between project partners weakens.	Medium Risk: Continued interaction, monitoring of joint project results.

Project activities are not carried out in time.	Medium Risk: Monitor input, strengthen where needed.

4. REPLICABILITY

Describe briefly specific actions, with work plan and budget, if any, to foster knowledge transfer (for e.g., dissemination of lessons, training workshops, information exchange, national and regional forum, etc. and provide the budget associated with these efforts. It could also be within project description)

This project represents one of the initial GEF projects to develop mechanisms and approaches for the cooperative management of transboundary/shared aquifer resources. While this project will draw on lessons from other GEF transboundary groundwater projects in the region, the results and lessons learned in this NSAS project can also benefit other efforts to manage transboundary aquifers. In this context, efforts will be made to cooperate and share information with other transboundary water management efforts in the region (Nile, Iullemeden, NW Sahara etc.) This is in part assured through the involvement of organizations that are actively engaged in these other initiatives (UNESCO, FAO, OSS, etc.) The project will seek cooperation with the UNDP Train/Sea/Coast programme and in particular serve as a pilot activity for their new Training Module on TDA/SAP development. The project will also establish cooperation with IW Learn and explore possibilities to develop learning tools for groundwater management. Finally, the project will be presented and discussed at regional fora like the biannual Arab Water Conference as well as at relevant national water resource management related meetings.

Concerning meetings, workshops and training courses needed for project implementation, please refer to the section on project components.

5. STAKEHOLDER INVOLVEMENT/ INTENDED BENEFICIARIES

- *Describe briefly how stakeholders have been involved in project development.*
- *Describe briefly the roles and responsibilities of relevant stakeholders in project implementation.*
- *Describe how the marginal groups are going to be involved in the project implementation.*

The main stakeholders are the relevant Ministries mandated to lead on water policy in the Aquifer countries. Representatives from these ministries have been instrumental in the development of this MSP. The scientific impetus with data and information on the Nubian originated to a large extent through the Joint Authority and the national water ministries in the four NSAS countries involved in aquifer research and through previous collaboration with the IAEA. , A technical consultation workshop on the aquifer system and for the formulation of the MSP project, was held at the IAEA in Vienna in March 2004 and was attended by national water resources officials and groundwater experts from Chad, Egypt, Libya and Sudan as well as representatives of the Implementing Agency, UNDP-GEF, the Executing Agency IAEA and representatives from UNESCO-ISARM and CEDARE with the support of PDF-A funds (see meeting report in Annex 1.) The country representatives identified and agreed upon the objectives and the scope of the project as well as the key stakeholders and the potential project partners and began the process of defining roles and responsibilities in the stakeholder involvement process as outlined in Table 3. Thereafter the preparation of the draft MSP was coordinated by the IAEA and circulated to the countries and the international agencies for consideration.

Based on these efforts, a full stakeholder involvement plan will be defined in the inception phase of the project. It is foreseen that the development of the SADA and the SAP will be a participatory process that will include important stakeholders as agreed during the inception phase.

The direct stakeholders and participants in the project can be grouped as follows: (a) national officials in water, land and environmental administrations; in the water and land use sub-sectors; and in other national agencies at central and local levels of the country governments (b) local communities and the direct water and land users and beneficiaries, and (c) the sub-regional and bi-lateral bodies and in particular the Joint Authority.

The issues and needs of the different groups of stakeholders, with expectations, potentials and drawbacks, and the consequences for the projects are reviewed in Table 3.

Table 3. Stakeholders and Project Partners

Chad	Egypt	Libya	Sudan	Reg./Intern. Orgs	African Initiatives	Donors
Ministere de l'environnement et de l'eau/Direction de l'Hydraulique pour les eaux *souterraines/Direction des resources en eau et la meteorologie pour les eaux de surface/Direction des forêts et de lutte contre la desertification/Direction de la faune et de la flore/Direction des parcs	MWR&Ir Groundwater Sector*	GWA*	Ministry of Irrigation & Water Resources/ Dir. Of GW and Wadis Lead (focal point for JA)*	CEDARE	NEPAD	EU
Ministere des Affaires Etrangeres	Ministry of Foreign Affairs	Ministry of Foreign Affairs	Ministry of Foreign Affairs			AFD
Ministere de l'agriculture et du developpement rural/Direction du génie rural (irrigation et drainage)	RIGW	GMMRA	Govt of N.Darfour State	Joint Authority*	AMCOW	IFAD
Ministere de l'elevage/Laboratoire de Farcha (analyses)	CLEQM	Local Agric Ministries	Govt. Of Northern State	UNESCO/ISARM*		IDB
Ministère de l'enseignement supérieur et de la recherche scientifique/Université de Farcha	EAEA	Asst PM for Agric Prod Affairs	Govt. Of Kurdufan State	UNDP-GEF Implementing Agency*		GEF
Ministère de l'Aménagement du Territoire/Communes	New Valley Governorate	Private Farmers	Min of Environ. & Tourism	IAEA Executing Agency*		AFESD
Ministère du Pétrole/Comité technique national de suivi et de contrôle du projet pétrole (CTNSC)	Matruh Governorate	General Co for water distr.	Min of Agriculture			KFW
Ministère du Développement touristique	Groundwater user Association (farmers)	Oil Co./NOC	Min of Livestock			GTZ
Zamzam (Compagnie privée)	Min of Agriculture	End users of GMMRA project	Min of Energy			
STH (société tchadienne de l'Hydraulique SA)	Min of Housing/New Valley Authority	Local investors/ Bottling co., tourism	Min of Interior/Wildlife Dept/Dept of Customs & Taxes			
Hydrotech	Local Investors (agriculture, tourism, bottling co.)	GEA	SAEC			
EFORCO (forage)	EWP	Agric Research Centre	National Water Corp.			
Association des usagers de l'eau	ASRT	Drilling Companies	Rural Water Corp			
Organisations paysannes	Mining Industries		Uni of Khartoum			
Schéma directeur de l'eau et de	Min of Environment		National Council for Res.			

l'assainissement/GEDEL (Bonne gouvernance et développement local) appuyé par le PNUD						
			National Comm for Desertification & Drought Control			
			UNESCO Chair for Water			
			Wadi Hawar Dev Corp.			
			Local investors (Road Construction co.)			
			National Water Res Centre			
			Council for Natural Resources			
			Gum Arabic Corp.			
			Camel marketing centre			
			Farmers union			
			Livestock breeders union			
			Environmentalist Assc			
			Inst. of Environ Studies			

***) = Represented in project steering committee**

Table 4: Analysis of Stakeholders

Stakeholder Groups	Problems/needs	Expectations	Drawbacks	Potentials	Consequences for the project
National Governments officials National experts	Limited public resources focused on immediate social necessities. Limited local initiative and participation. Top-down donor-driven programs	Integrated NSAS management Improved information, computer, survey and exploration technology	Sectoral positions and barriers. Limited incentives and motivation Food security and Development priorities	Devoted high human capacity groups of national professionals. National universities: human resources, studies and data	Involvement, enabling and support of national officials and expertise. Introduction of modern information approaches/ technology
Water, land users-farmers	Accelerated human-induced land and water degradation, loss of productive land, desertification, desiccation and drought, Inadequate water supplies. Government induced development programs.	Drought secure agriculture. Improved yields. Cash cropping with enhanced farming and off-farm income. Safe drinking and livestock water supplies	Rural related poverty. Population pressures. Land scarcity. Capital scarcity, limited access to technology. Lack of alternative to farming income. Common open access, no land ownership and tenure structure. Lack of information and knowledge of environmental threats	High but rapidly declining biodiversity for traditional subsistence; traditional knowledge of land use, water management and use of local resources. High motivation to change to conserve common resources change. Rural women and land and water conservation.	Focus on: Rural related poverty alleviation. Local awareness, participation and organization of farmers. Alternative strategies to food security. Mobilize rural women for conservation.
Regional, Sub-regional (Africa, NSAS area) representatives	Limited socio-economic cooperation and trade. Lack of sub-regional authority. Limited financial sustainability of sub-regional institution. Country differences, backgrounds and languages	Establishment of an independent water sector. Sub-regional cooperation on integrated land and water resources.	Sectoral structure and barriers to integrated approaches. Lack of authority, and jurisdictions and established basin focused management frameworks.	Enhanced existing sub-regional and bi-lateral frameworks (NBA, NNJC, PPNMC) Sub-regional scientific water and land resources and agricultural research centres in the basin.	The project PMU accommodated in the Joint Authority as the Coordinating agency of the project. Existing mechanisms and institutions are reconsidered in the cooperative framework.

At the regional and international scale the NSAS was considered at the UNESCO-GWA/Libya sponsored International Conference on regional aquifer systems and managing non-renewable resources, in Tripoli in 1999. The NSAS forms a priority under the African ISARM Strategy compiled and adopted in the International Workshop on Transboundary Aquifers in Africa in Tripoli, June 2002.

The IAEA has implemented national technical cooperation projects related to water resources management in the region for many years. Further the IAEA has been working with three (Egypt, Libya and Sudan) of the four countries since March 2003 on a regional project funded by the IAEA for the NSAS. Based on this past and on-going cooperation, the IAEA has already established a good basis of cooperation with many of the key stakeholders in these countries.

6. MONITORING AND EVALUATION

- *Describe briefly M&E Plan, based on the project logical framework, including the following elements:*
- *Budget.*
- *Organizational arrangements for implementing M&E*
- *Specification of indicators for project objectives, outcomes, including intermediate benchmarks, and means of measurement.*

The monitoring of the project will be based on the project monitoring and evaluation plan as described in Component 5 "*Project Monitoring and Evaluation*." This will be complemented by monitoring feedback from stakeholders, who will be consulted and supported to communicate with the Joint Authority and the Project Steering Committee on observed issue and specific objectives and interests.

The M & E Plan will include the following Activities:

- Regular (quarterly) progress reporting to UNDP/GEF, IAEA as well as the Project Steering Committee,
- At least 3 meetings of the Project Steering Committee,
- Preparation of project implementation plan including budget (updated as needed,)
- Annual GEF APR/PIR,
- One independent project evaluation exercise (end of project.)

The budget allocated for this activity is foreseen to be 20,000 USD. The project based monitoring will be organized by the Project Coordinator with the guidance of the Steering Committee. The Executing Agency, in cooperation with the Implementing Agency, will initiate and coordinate the external review processes.

Project Monitoring and evaluation is based on and facilitated by pre-agreed general, process, stress reduction and environmental status indicators on the achievement of the overall and immediate project objectives and the introduction of change. Examples of these indicators are:

General indicators

- A mechanism for joint identification of threats and issues is introduced and applied,
- Long term threats and impacts of low visibility are jointly identified and addressed,
- The threats are addressed through joint aquifer policies built on transparent arrangements and shared responsibility.

Process indicators

- Establishment of a jointly prepared and agreed regional SADA based on cases from the country and local area level,
- Transboundary threats are jointly determined and needed actions identified,
- Existence of an inclusive and coherent regional process with supportive elements for well informed review of development and conservation policy planning and implementation in the NSAS system,
- Existence and operational application of a cross-country aquifer monitoring and assessment system.

Stress reduction indicators

- Development and conservation of the common aquifer system follow the provision of a jointly prepared and agreed strategic Action programme (SAP,)
- Improved water use efficiency in industry and agriculture,
- Application of "best practices' in groundwater recharge,
- Definition of groundwater protection zones,
- Creation of protected areas for groundwater dependent ecosystems/ biodiversity.

ENVIRONMENTAL STATUS INDICATORS

- Environmental goals and criteria are jointly identified in a SADA, including quantitative and qualitative indicators upon which priority actions can be identified and implemented,
- Water quality of groundwater extracted;
- Land degradation and protection of humid zones with related shared issues of adverse environmental impacts are jointly monitored and managed (indices of land quality i.e. desertification, salt levels etc.),
- Indices of groundwater dependent ecosystems (biodiversity indices etc.)

D – FINANCING (FINANCIAL MODALITY AND COST EFFECTIVENESS*)

1) FINANCING PLAN

- *Project cost, including:*
- *Costing by activity and sub-activity*
- *Project Implementation Plan.*
- *Financing plan, including commitments by co-financiers.*

Costing by activity and sub-activity
A summary of the financial breakdown per component is provided in Table 5.

Table 5. Financing Plan

Component	GEF Funding	Co-funding	Total
1. SADA & Addressing Capacity and Data Gaps	146,600	3,743,100	3,889,700
2. Preparation of SAP	234,400	1,620,000	1,854,400
3. Establishment of Legal Framework	170,000	838,000	1,008,000
4. Project Management	324,000	750,000	1,074,000
5. Project Monitoring and Evaluation	20,000	0	20,000
6. Executing Agency Costs (8%)	80,000	0	80,000
7. PFD-A	25,000	0	25,000
TOTAL	**1,000,000**	**6,951,100**	**7,951,100**

Comment [n1]: This figure excludes the Executing Agency costs

The input based budget is provided in Annex 2. A summary of the budget provided by GEF funds is provided in Table 6.

Table 6: Summary Budget (US$)

Component	GEF
PDF:	25 000
MSP: Project Costs 10 Personnel	 263 800
20 Sub-Contracts	130 000
30 Training	408 200
40 Equipment	10 000
50 Miscellaneous (incl Executing Agency Costs)	163 000
TOTAL	**1 000 000**

IMPLEMENTATION PLAN

The following represents the UNDP/IAEA/GEF Nubian Sandstone Aquifer Project Time Frame. This assumes a project start up date of April 2005. A full Project Implementation Plan will be detailed during the Project Inception Period.

Project Time-Chart 2005-2007

Project Components/Activities	Duration mts	A-Jul 2005	Jul-Sep 2005	O-D 2005	J-M 2006	A-Ju 2006	J-S 2006	O-D 2006	J-M 2007	O-D 2006	J-M 2007
PROJECT	**30**										
Inception Period	**3**										
1.1. SADA	**16**										
1. 2 Data Gaps, Capacity Building	**20**										
2. SAP preparation	**18**										
3. Legal Framework /Convention	**24**										
4. Project Management	**30**										
5. Project M&E	**30**										

2) Cost Effectiveness

- *Estimate cost effectiveness, if feasible.*

The project is seen to be cost effective with high leveraged co-funding component as outlined in the co-funding table. If successful, the project would represent one of the most cost effective GEF projects in delivering the three key outputs of an SADA, SAP and Convention. Further there is a strong baseline to build upon considering the already existing Joint Authority, national commitments, on-going IAEA projects and planned co-funding as well as the linkage with the ISARM initiative and other transboundary aquifer projects in the region.

3) Co-financing **(estimated):**

- *Fill in the table provided to indicate the sources of co-financing*
- *Clearly identify if co-finances are in-kind or in-cash contributions.*
- *Letters of commitment from co-financiers should be attached.*

Table 7: Co-financing Sources

CO-FINANCING SOURCES				
Name of Co-financier (source)	Classification	Type	Amount (US$)	Status*
UNDP	Implementing Agency			
IAEA	Executing Agency	Project funding from IAEA Technical Cooperation Fund	618,000	Amount available in accordance with TC cycle from Jan 2005
UNESCO	Cooperating Partner	Co-financing and in-kind	50,000	
National Governments	Government	Co-financing and In-kind	6,283,100	
Sub-Total Co-financing			**6,951,100**	

E - INSTITUTIONAL COORDINATION AND SUPPORT

Describe core commitments and linkages; consultation, coordination and collaboration between and among IAs and ExAs, if appropriate)

CORE COMMITMENTS AND LINKAGES

Describe how the proposed project is located within the IA's:

- *Country/regional/global/sector programs.*
- *GEF activities with potential influence on the proposed project (design and implementation).*

All countries as well as international institutions have recognized this need and have begun to take action towards protection and sustainable management of international waters and have only recently been extended to address shared aquifer resources. Given the importance of international groundwater and their life-supporting role and linkages with most other GEF focus areas such as climatic change, sustainable land development, land degradation and biodiversity in many countries around the world, especially in arid and coastal zones, and as global awareness is growing and emerging from regional inventories of shared aquifers (e.g. ISARM–UNESCO in Africa; OAS/UNESCO-ISARM in the Americas; and UNESCO-ISARM-MED in the Mediterranean basin), the momentum to introduce change under alternative GEF approaches and to develop appropriate transboundary management frameworks under this can be expected to continue to grow in the coming years.

This gap is now being actively addressed and is currently reflected in the GEF pipeline. The GEF is currently implementing several transboundary aquifer projects under the IW-focal area (OAS/World Bank/GEF Guarani Aquifer project, UNEP/OSS/GEF Iullemeden Aquifer project and UNEP/OSS/GEF Northern Sahara Aquifer project) and another related project (SADC/World Bank/GEF Groundwater Management in Drought Prone Areas project has recently been approved. The UNDP/GEF MSP on "Developing Renewable Groundwater Resources in Arid Lands in The Eastern Desert of Egypt", working to develop alternative techniques for optimal management of groundwater, is also now under implementation. Further, the GEF, under the guidance of its STAP, is in the process of developing a strategy for GEF interventions in the groundwater field. This will involve the development of a "Groundwater Vision" on the one hand as well as considerations on how to include groundwater components in existing GEF supported international water initiatives in river basins, lakes and large marine ecosystems.

CONSULTATION, COORDINATION AND COLLABORATION BETWEEN AND AMONG IMPLEMENTING AGENCIES, EXECUTING AGENCIES, AND THE GEF SECRETARIAT, IF APPROPRIATE.

- *Describe how the proposed project relates to activities of other IAs (and relevant ExAs) in the country/region.*

The IAEA is currently very actively cooperating with countries in this region to address water resource management issues. The IAEA is a co-operating partner and co-funder in the UNEP/OSS/GEF Iullemeden Aquifer project and UNEP/OSS/GEF Northern Sahara Aquifer project. It is also providing technical assistance to Nile Basin countries to develop a more accurate, complete water balance with activities currently focused on the water balance of Lake Victoria. Currently, the IAEA, the executing agency and principal co-funder of this MSP has already been working with 3 (Egypt, Libya and Sudan) out of the 4 countries since March 2003 on a regional project that it is funding which aims to promote and support the development of a framework for the sustainable management and use of the NSAS. The project aims to use isotope techniques to expand and consolidate the technical and scientific knowledge and database regarding the aquifer system and to develop a groundwater management plan based on a monitoring network for the aquifer. A sampling campaign is underway and several pieces of equipment needed for analysis have already been delivered. Thus a good basis of cooperation has already been established with key stakeholders in these countries. The use of groundwater as an archive of information both for resource studies and as an archive of information on past climatic conditions and history of recharge will be the basis of the build-up of the conceptual model. Previous studies and synthesis of groundwater data in Northern Africa on stable isotope measurements had been made on "dated" groundwaters (^{14}C expressed as pmc). These studies provided a resolution into the modern, Holocene and late-Pleistocene periods. Similar isotopic analyses in Senegal/Mali showed that the groundwaters had not evolved significantly

from the Atlantic moisture source over the period. In NE Africa in contrast, groundwaters of late-Pleistocene age showed much lighter values (continental effect) but showed also distinct differences from basin to basin suggesting local recharge had been important. A gap in data from 20-12kyr BP indicated the period of aridity. Holocene waters in Sudan also were very light isotopically and this was suggested to reflect the intensification of rains associated with the Holocene monsoon. The importance of recharge measurement at the present day is therefore emphasized even in these arid areas, extreme events took place with possible recharge especially via wadis.

- *Describe planned/agreed coordination, collaboration between IAs/ExAs in project implementation.*

The IAEA will develop the UNDP project document in the appropriate UNDP format. Once this is agreed, this prodoc will serve as the official agreement between UNDP and the IAEA defining coordination arrangements etc. and will be in the frame of the normal IAEA collaboration already established with UNDP. UNDP and the IAEA will have regular consultations to assure that project implementation is proceeding effectively.

Provide documentation to support these consultations and agreements (e.g. minutes of the meetings, memos, MOUs, etc.)

The results of the PDF-A consultation meeting (Annex 1) held in March 2004 confirm that the project stakeholders accept these arrangements.

IMPLEMENTATION AND EXECUTION ARRANGEMENTS

Attach a written plan for implementation/execution arrangements.

The overall arrangements for project implementation can be defined as follows:

- UNDP/GEF as Implementing Agency
- IAEA as Executing Agency, lead technical Agency on the scientific component and principal co-funding Agency
- The Joint NSAS Authority as lead coordinating Institution
- UNESCO and its ISARM partners as co-funding and cooperating Agencies.

Other potential partners such as CEDARE would be involved as agreed by the participating countries. The Project would be steered through the Project Steering Committee with participation of the National Country Focal Institutions, the Joint Authority, The Implementing Agency (UNDP/GEF), The Executing Agency (IAEA) and project partners, including UNESCO.

Related to the detailed roles of intergovernmental organizations under the project, the Joint Authority will advise and recommend on their exact involvement and cooperation.

PART II – SUPPLEMENTAL ANNEXES (this Part applies to Targeted Research proposals only and may be deleted if not applicable)

Not applicable

Part III – Response to Reviews

A - CONVENTION SECRETARIAT
B - OTHER IAS AND RELEVANT EXAS
C - STAP

to be added upon receipt

Part IV – Project Category Annex

Check all the appropriate "keywords" that would describe the various elements of the project proposal.

- Shared Aquifer Diagnostic Analysis
- Strategic Action Programme Development
- Freshwater Basin
- Mid-sized
- Input to Regional Strategy
- Participation in Consultation
- Technical Input

FIGURE 1. : NSAS, Project Area

ANNEXES

1. Report on the IAEA/UNDP/GEF Project Development Meeting (PDF-A) on the Transboundary Management of the Nubian Aquifer
2. Budget: Input, Budget Costs and Financing Sources
3. Chad: Groundwater Sector description
4. Egypt, Groundwater Sector description
5. Libya: Groundwater Sector description
6. Sudan: Groundwater Sector description
7. 1992, Constitution of The Joint Authority for the Study and Development of the Nubian Sandstone Aquifer Waters, (English translation)
8. Letters-Confirming Co-funding
9. Letters-GEF Focal Point Support

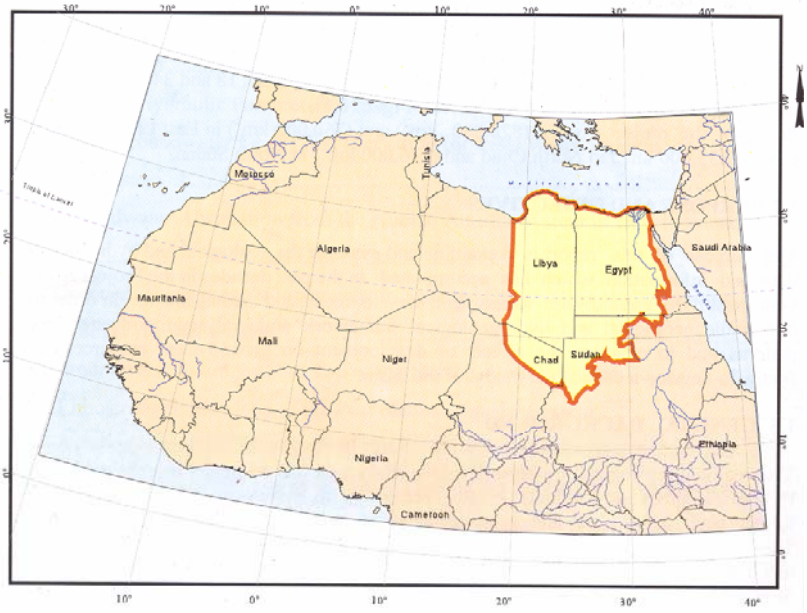

Figure (1.1)

General Location Map of Project Area

800 0 800 1600 Kilometers

ANNEX 1

REPORT ON THE IAEA/UNDP/GEF PROJECT DEVELOPMENT MEETING (PDF-A) ON THE TRANSBOUNDARY MANAGEMENT OF THE NUBIAN AQUIFER

1. BACKGROUND and OBJECTIVE OF THE MEETING

In June 2003, the United Nations Development Programme/Global Environment Facility (UNDP/GEF) agreed to work with the Agency to promote and support the development of a framework for the sustainable management and use of the Nubian aquifer systems among the countries that share the aquifer (Chad, Egypt, Libya and Sudan). The UNDP has provided funding of $25,000 to the Agency to help coordinate activities under a new regional project *RAF/8/039 - Towards a Sustainable Development of the Nubian Aquifer,* which will aim to use isotope techniques to expand and consolidate the technical and scientific knowledge and database regarding the aquifer system and to develop a groundwater management plan based on a monitoring network for the aquifer. A full integration of the Nubian Aquifer activities in the natural resource programmes at the national and regional level will also be promoted. Links and networks between international and national organisations will be made to ensure future cooperation among the counterparts.

In this regard, the Agency organised a meeting with a view to formulating a multi-million dollar medium-sized project that would eventually be submitted to other donors. The meeting aimed to bring together representatives from different hydrological communities from the four countries that share the aquifer, ie Egypt, Libya, Sudan and Chad, as well as representatives from the following organisations, UNDP/GEF, UNESCO and the Centre for Environment & Development for the Arab Region & Europe (CEDARE).

The workshop represented an important step for the conclusion of the project formulation process, in the frame of GEF PDF-A co-funding that started in 2003. As a result of the process the project has been oriented towards the enhancement of the regional coordination and management mechanisms and addressing specific data and capacity gaps that are critical for effective joint management of the Nubian aquifer. With this direction the workshop focused on the specific practicalities for the formulation and subsequent implementation of the Nubian GEF-IW project.

THE OBJECTIVES OF THE WORKSHOP WERE:

- To review current state of knowledge of the Nubian Aquifer: functioning, utilization (current and planned), management, and governance framework;
- To reach a common understanding of the benefits and challenges of cooperatively managing the water resources of the Nubian Aquifer;
- To reach agreement on the objectives, components, activities, and expected results of a potential GEF Medium-Sized project proposal for submission in 2004; and

2. OPENING OF THE MEETING AND WELCOME REMARKS

- To discuss and agree about the roles of other organizations in project implementation and possible co-funding sources.

The meeting was held at the International Atomic Energy Agency's headquarters in Vienna and was attended by representatives from Chad, Egypt, Libya, Sudan, UNDP/GEF, UNESCO Centre for Environment & Development for the Arab Region & Europe (CEDARE) and one expert. The meeting was opened by the Deputy Director General of Technical Cooperation (DDG-TC), Ms Ana Maria Cetto and the Deputy Director General of Nuclear Application (DDG-NA) Mr Werner Burkhart. The Section Head of the Isotope Hydrology

Unit and the Section Head of Africa Section (Department of Technical Co-operation) also attended the meeting as well as the Project Officer, the Technical Officer and staff members from the Isotope Hydrology Unit.

Mr Abdin Salih, UNESCO and Mr Andrew Hudson, UNDP/GEF made short welcoming remarks at the commencement of the meeting. Mr Andrew Hudson was selected as the chairperson and Mr Bo Appelgren was selected as the rapporteur for the meeting. The Agenda was adopted as a working document.

Mr Boussaha, Section Head of Africa section, Department of Technical Co-operation then gave a presentation on the Agency's Technical Co-operation Programme, which had a strong focus on the background and history of the Agency's technical co-operation with Member States in isotope hydrology. This was followed by a short presentation on the Agency's current Isotope Hydrology focus by Mr Aggarwal, Section Head of Isotope Hydrology.

3. SUMMARY OF LECTURES

Chad Country Presentation (Mr. Djougoun Abdoulaye Mourra and Mr. Abderamane Saidou)

The representatives from Chad presented the key features of their part of the Nubian Aquifer in Chad including the existence of environmental humid zones, lakes and springs in this arid area supported by Nubian Aquifer seepage. They pointed at the gap of updated hydrogeological data in the Chad section of the Aquifer and mentioned the capacity constraints at national level in human and other resources for full participation in the possible project.

Egypt country Presentation (Dr Taher Hassan)

The representative from Egypt emphasised the basic importance of the Nubian Aquifer as the only available major water resource, critical for the support of the people and for socio-economic development, in Egypt. He highlighted the major importance of the government's commitment to tackle the national development policy objective of pursuing a more evenly distributed population programme across the country. For example, at present, Egypt uses only 2% of the territory and the goal is to increase this to 50% by 2050. He presented an overview of the current and planned developments in research for the Nubian aquifer, including artificial recharge, re-use, water harvesting and other drought management measures. The current and planned developments in the Nubian aquifer are focused on social objectives, which have a lot of support from local populations in the Western Desert oasis areas. He referred to their roles and emphasised the importance to involve and enhance the established Nubian Aquifer Joint Authority.

Libya Country Presentation (Mr. Lotfi A. Madi Farag and Mr. Al Mahdi Megrbi)

The representatives from Libya recalled the age of the Nubian waters – from 2 300 to 30 000 years - and referred to available monitoring data and observations on the actual draw-down development, including the early well fields with data from more than 30 years of monitored pumping. They presented an overview of the resources and the monitoring data in the Nubian and Post-Nubian Aquifers. They also presented the existing and planned well fields under the Great Man-Made River Project for the transfer of water to supply the populated urban and rural development areas in the coastal areas of the country. In Mr Madi Farag's capacity of Executive General Director of the Joint Authority, he provided information on the 1992 protocol of the Constitution of the Joint Authority and distributed an English translation of the document. The Joint Authority, made up of all four countries that share the Nubian Aquifer, is presently based in Tripoli with branches in the relevant Water Ministries of the four Nubian Aquifer countries. The presentation gave examples of the signs of environmental effects humid zones and lakes within Libya as a consequence of extensive extraction over many years.

Sudan Country Presentation (Mr Abd Alla M.Kheir Fadl El Moula and Mr Mustafa Abbas)

The representatives of Sudan presented the limited existing and planned uses from the Nubian Aquifer in Sudan and emphasised the need for an improved knowledge base. They provided information on the dating of the Nubian aquifer water and indications on the close to zero recharge and impact of the Nile River Water. In this relation it appears that the Nubian is not significantly related to the Nile surface water resources and that the unrelated aquifer continues to the east of the River Nile. He underlined the need for pilot area studies and suggested 3 pilot areas to address the Nubian- Basement interface, (i) rural development areas, (ii) areas in the vicinity of the River Nile and representative issues and (iii) areas where the Nubian modelling studies have been based on estimates and assumed data.

In the subsequent discussion, it was argued that that in view of the general hydrogeological characteristics of the Nubian aquifer, effective management and control of the cross-border impacts can be restricted in space and frequency. The common perspective is that the Nubian Aquifer is a shared resource and a joint commitment is needed to effectively manage and protect the resource for the joint benefit of all four countries. The management challenges are mainly at the national and local levels. These challenges would have to be addressed through the Joint Authority as an aquifer-wide cooperation for sustainable socio-economic development.

Background to Developing a Nubian Aquifer Project (Mr Appelgren, Expert)

The IAEA Expert gave a brief presentation the establishment of a Nubian management framework, drawing on the state-of-the-art approaches and experience on multidisciplinary options and international references on the management of shared aquifer resources. Some concrete suggestions for the approach to management of the Nubian aquifer were made for considerations under the project.

Presentation on the Framework for the Implementation of a Regional Strategy for the Utilisation of the Nubian Sandstone Aquifer System by Centre for Environment & Development for the Arab Region & Europe (CEDARE) - Dr Khaled Abu-Zeid

Dr Khaled began with a brief overview of CEDAREs role in Nubian Sandstone Aquifer System (NSAS). CEDARE is a non-profit regional organisation with a mandate to provide capacity building in environment and development. CEDARE are also responsible for managing the Nubian Aquifer Regional Information System (NARIS), which is essentially a database of the NSAS. NARIS facilitates data storage, processing, display and analysis and would be instrumental in the preparation of data for GIS and mathematical models. The modelling scenarios have been based on a survey of the country's socio-

economic development programmes in the related country sections of the aquifer and provide indications of the impacts on water levels and water quality over a period of 60 years of development and abstractions. The model needs to be adapted for operational use but data gaps that will facilitate joint management of the NSAS including additional mechanisms for effective use and inter-country communication need to be addressed. CEDARE underlined its continued commitment and suggested comparative advantages as a cooperative agency and offered to participate in the process for the completion of the database and the models. This contribution would be needed for the implementation of the proposed UNDP/GEF Medium sized Project (MSP).

Presentation by UNESCO – Ms A. Aureli

Ms Aureli presented a comprehensive brief on the various international field activities and initiatives on groundwater and international aquifer management in different regions under the UNESCO/International Hydrological Programme (IHP) and the Internationally Shared Aquifer Resources Management (ISARM) and SIMDAS programmes, which included many partners such as FAO, IAEA, IAH, OAS, Southern Africa Development Community (SADC) and the UN Economic Commissions. She emphasised the importance of a multidisciplinary approach to shared aquifer resources management and confirmed the commitment and availability of UNESCO and its partners to participate and contribute within their mandatory areas. These could include assistance with legal and institutional frameworks and capacity building under the UNDP/GEF Nubian MSP. Mr AbdulRazzak, Director of UNESCO-Cairo and Mr Salih (UNESCO Field Expert – Tehran) both highlighted the many on-going programmes in the region with established networks relevant to the NSAS. The questions and discussion focused on identification of the training needs and mobilization and participation of UNESCO in capacity activities under the MSP.

Presentation by UNDP/GEF on Setting the Stage: Background and Status of Developing a GEF Medium-Sized Project (MSP) proposal for the Nubian Aquifer (Mr Andrew Hudson)

Mr Hudson presented the GEF Awareness brief related to the GEF programme and its focal areas and operational programmes. He emphasised the expectation of substantial one-to-one co-financing partnerships under GEF projects and mentioned the baseline activities at national and regional level that the countries would need to identify and quantify as co-financing contributions under the GEF project. He explained the concept of baseline and alternative GEF approaches and the incremental cost to be included in the MSP. He highlighted the GEF alternative approach and the principal mandatory components in GEF jargon;

(i) Transboundary Diagnosis Analysis (TDA) which was later changed to the Shared Aquifer Diagnostic Analysis (SADA);

(ii) Preparation of a Strategic Action Programme (SAP);

(iii) Identifying the measures and actions (legal, policy and institutional reforms and investments) for addressing the root causes of priority environmental threats to the Nubian Aquifer System.

The GEF project cycle process involves 3 distinct steps, (i) the SADA, (ii) the SAP and (iii) the implementation of the SAP by the participating countries and possibly/preferably with additional GEF financial support.

The Nubian Aquifer MSP would fall under the International Waters (IW) focal area and more specifically under Operation Programme 9 (Integrated Land and Water/Multiple Focal Area, Land Degradation Component). In the above context and as had been communicated from the GEF Secretariat the priority focus of the current MSP is on SADA, SAP preparation and strengthening of the legal and institutional

cooperative framework. The subsequent discussion focused on the institutional arrangements for project implementation and the importance to involve the existing Joint Authority and the countries to be enhanced, strengthened and activated under the project, with the possibility to involve cooperative agencies. Other questions related to the GEF practice, concerned overhead costs for project support, which are limited to a ceiling of maximum of 8 % of the project budget. The *IAEA will be the executing agency of the project* and TC-Africa Section Head; IAEA confirmed that the discussed arrangements were consistent and acceptable to and in accordance with the practices of the IAEA.

Presentation by IAEA Expert on the Challenges of Developing Transboundary Management of Groundwater (Mr Appelgren)

A brief overview of the detailed considerations and required baseline and activity information from the countries now needed for the preparation of the GEF MSP brief was presented and these included;

domestic legal and institutional arrangements and annual national budget on groundwater for each country
specific on-going development, monitoring, research and awareness/participation activities that would be relevant and qualify as co-financing also identifying specific gaps,
country/government contribution in kind under the project in US$ terms
a background history of the domestic groundwater sector in each country.

The information requested from the country representatives was discussed with the IAEA Expert for inclusion in the MSP brief that is now being prepared for submission in the second quarter of 2004.

The issues raised in the presentation were discussed among the countries and the project partners. The following issues of immediate importance for the preparation of the MSP were raised and concluded upon:

The overall objective of the project is cooperation for management and sustainable development of the NSA.

The Joint Authority was established by a bilateral Egypt- Libya protocol dating from 1992 with a defined mandate and with plans for an Executive Director and permanent secretariat in Tripoli. Chad and Sudan joined the Nubian cooperation in 1998 and the Authority operates branch offices in the water ministries of the four countries. One of the main purposes of the project will be to enhance, strengthen and activate the Joint Authority; including the legal and institutional framework, the management tools, addressing data gaps and enhance mechanisms and access for active joint use and communication to share the database and decision-support through the Nubian Aquifer model.

the priority to strengthen capacity and the aquifer knowledge would be in Chad and Sudan to secure joint participation and management of the NSA on equal terms. The capacity support should include investments for installation of piezometers and other equipment in Chad.

The focus of the MSP will be on conducting the SADA, preparation and country commitments of a SAP, legal and institutional support for establishment of a Nubian Aquifer Convention and enhancement of the Joint Authority as the regional coordination mechanism. Focus would be directed towards filling data gaps and improving the joint management and decision-supporting tools including the common data base, the aquifer model and establishment of regional monitoring and assessment mechanisms and network.

IAEA confirmed its contribution to address the data and monitoring gaps and to expand the introduction of isotope hydrology technology for monitoring and assessment of management issues including pressures on the resources and an effective approach for a early-warning system for the aquifer.

The project will benefit from established networks on capacity building and international groundwater resources management of UNESCO/IHP and its ISARM partners and from CEDARE´s specific recent experience and involvement in the NSAS.

It was concluded at the end of the discussion, that the 2 years MSP would be focus on the SADA and the SAP preparation and the elaboration of a Nubian Convention. A subsequent expanded SAP implementation phase heavily based on country supported activities and inputs with the commitment and reference given to potentially available resources confirmed by the countries would be ideally necessary for the next GEF replenishment phase (2007-2010).

4. WORKING SESSIONS

Working Session on Stakeholders Analysis

The workshop initiated a stakeholder analysis, listing the project stakeholder groups at the national/sub-national, regional and international level. A stakeholder analysis matrix, expanded to include the interests, involvement/role, and contribution of the individual stakeholders, guided the discussion. The many and substantial ongoing baseline activities directly related to the objective of the MSP and therefore qualifying as co-financing under the project point at the important role of the MSP to establish the necessary framework and legal mechanisms for a concerted and focused joint management approach. The participants agreed to send the completed stakeholder analysis to the IAEA.

Working Session on the Components of the MSP

As it was agreed that the MSP would focus on the SADA, SAP and the Legal Convention process, the UNDP/GEF (Mr Hudson) proposed a possible structure for the MSP project. This handout was distributed to all participants at the workshop for consideration and discussion. The meeting participants then broke out into two working groups with the tasks to address the different project components:

Working Group 1: SADA, Capacity building and Data Gaps
Participation: A. Saidou (Chad), T. Hassan (Egypt), M. Lotfi (Libya), A. El Moula (Sudan), B Appelgren (expert) B Wallin and K. Hollett (IAEA).

Confirmed that the possible threats, as listed in the "Possible Project Structure" are applicable to the Nubian Aquifer, but added the qualification as "*Transborder threat of conflict over uncontrolled extraction*". (Please refer to the handout for further information)

For the SADA, the countries underlined the need for detailed templates and guidelines for the SADA/SAP process. It was proposed that the key project counterparts would ideally need to participate in an established training on SADA/SAP, scheduled to be held in New York in the autumn of 2004. The idea is that each country has its own SADA meeting with relevant stakeholders and that a regional one would be convened when all countries had completed their individual SADA consultations. In Egypt, Libya and Sudan, the process will draw upon an already established inter-ministerial consensus in the country status reports. The national project focal points will prepare the national reports on identified and agreed threats and related issues. The project will support the compilation and adoption of national SADA reports at an inter-ministerial meeting in each country. The national focal points are responsible for the formulation of the national SADA as: Egypt, The Representative (counterpart) of the Ministry of Water

Resources; Libya: General Water Authority; and Sudan: Directorate of Ground Water; Ministry of Irrigation.

In Chad, the SADA as well as the SAP process would be seen as an opportunity to enhance the Government's awareness of the Nubian Aquifer. An inter-ministerial committee will be established to conclude the national SADA in a consultative process in working meetings and a national consultant will prepare the final national SADA report.

The four national SADA reports will be exchanged, reviewed and reconciled at a regional workshop. An independent consultant will finalise the joint regional SADA report, which would depict the outcome of the SADA process and the main input for the formulation of the SAP. The Group estimated the required time frame for the SADA to be 8 months with the SADA initiated as early as possible in the project.

To address Capacity and Data Gaps, the agreed approach is to (a) identify and address missing data in the entire Aquifer in the perspective and understanding of the NSAS, considering the current expansion of new observation wells that are being drilled in the aquifer area, and (b) provide priority capacity building to bring all aquifer countries to a common level of capacity for the NSAS MSP.

The group underlined the importance of maximising joint monitoring efforts to bring about joint benefits and reduce costs at aquifer level. For example, by locating new observation wells close to national borders and to address gaps towards an even regional distribution. The gaps are mainly in the southern parts of the aquifer where the current development activities are sparser. The countries under the guidance and coordination of the Joint Authority will define different data gaps related to geographical coverage, topographical leveling, continuity of the time series, balance identified gaps against agreed criteria and identified needs and existing and planned action for drilling/establishment of observation wells, isotope studies and updating of data bases and the aquifer model. A regional expert will review the identified country data gaps and reconcile and conclude on the data gaps for the NSAS. The capacity gaps are mainly in Chad and Sudan and these will be addressed through training in isotope hydrogeology and groundwater monitoring methodology. It is envisaged that the capacity building will build on regional exchange and involvement in the Nubian aquifer countries making use of existing training facilities and centres in the region.
Participants also shared information about on-going and planned installations of observation wells with piezometers, including (i) ten medium-depth wells to 200m depth drilled in Sudan at a cost of $2 million (ii) observation wells in Libya along the Libya Egypt border (iii) production wells along the Libya Sudan road and between Libya and Chad and (iv) the drilling of fifteen deep and fifteen shallow observation wells in Egypt, close to the Egypt/ Sudan border. In Chad and Sudan, where the joint data base and the modelling has been based on old or assumed data, the importance of the flow model concept to screen the data gap was underlined and in the same context the need for sub-aquifer management and modelling approach was raised. CEDARE informed that the aquifer data gaps had been identified in their studies. It is expected that the data gap issue will represent an important outcome under the SADA and SAP process.

IAEA highlighted the importance of the unique qualities of isotope hydrology technology as a prerequisite for filling the data gaps. The training needs were focused on isotope hydrology but also included GIS, remote sensing and applied hydrogeology.

Working Group 2: SAP, Legal & Institutional Framework (Convention), Project Management.
Participation: D. Abdoulay (Chad), M. Megrbi (Libya), M. Abbas (Sudan), K. Abu-Seid (CEDARE), Andy Garner (UNDP Danube Project), M. Abdul-Malik and C Yvetot (IAEA).

Confirmed the feasibility of the standard approach to the formulation of a Nubian SAP. The discussion of this and the other items addressed by the group on establishment of a legal and institutional framework

and a draft convention and mechanisms for project management continued in plenary and linked to the development of an Outline for Activities under the Nubian Aquifer MSP.

Formulation of the Medium Sized Project (title, objective and scope)

The meeting adopted the MSP project title as **"Formulation of an Action Programme for Integrated Management of the Shared Nubian Aquifer"**

The over-all objective will be **"Rational and equitable management of the Nubian Aquifer towards sustainable socio-economic development and the protection of biodiversity and land resources**".

The outline for the MSP with the activities under its 5 components will be

1. SADA and Data and Capacity Gaps;
2. SAP;
3. Legal Framework;
4. Project Management;
5. Project Monitoring and Evaluation

A time-chart for the 2 years project duration starting in late 2004 and finishing in late 2006 was agreed upon. IAEA will be responsible for coordinating and finalising the project outline and the final MSP brief.

The SAP Process

Existing national water sector policies and strategic plans of relevance for the SAP formulation and implementation include the established ground water sector policies. In Egypt they have a Strategy report to 2025 and in Libya there is the mechanism of the National Strategic Committee. All countries nevertheless have an established long-term water sector strategic plan. The participants emphasised that the SAP will be focused on the regional process under the auspices of the Joint Authority. It was highlighted that the recent water initiatives in Africa under AMCOW and the New Economic Partnership for African Development (NEPAD) focused on the mobilization of external and internal resources for water management and development.

A review of the roles and the responsibilities of the Joint Authority and the countries together with the project development partners for the activities (GEF, co-funders and partners) were discussed at the meeting. It was confirmed that the main co-funding contribution under the MSP would come from the IAEA and this would be available from January 2005 to tie in with the beginning of the IAEA TC Programme for 2005-2006. Other limited project co-funders for specific activities and inputs could possibly come from UNESCO-ISARM and from CEDARE in-kind. It was agreed that the identification of other co-funding partners will be part of the SAP formulation and would be necessary for the larger multi-million dollar full GEF project for the SAP implementation. The importance to secure counterpart contributions under the MSP was emphasized and countries will prepare for necessary provisions for their counterpart contributions in kind for 2005 and 2006.

The Legal Framework Process

During the discussion of the legal and institutional base for the management of the 1992 Nubian Aquifer, the constitution of the Joint Authority was distributed and it was concluded by the countries that a

revision of this document to create a legally based Nubian Aquifer Convention would be necessary to enhance the international recognition of the Joint Authority. Some of the country representatives confirmed that while the establishment of a Nubian Aquifer Convention would not conflict with the national constitutional provisions, they needed to discuss the issue with their respective Governments. The meeting was informed that this process would need the active involvement and approval of the relevant legislative bodies within national governments. Chad underlined the importance to provide French translations of all documents in this process as a necessary prerequisite to inform and involve the highest level of Government. In view of the priority and the complexities, several participants underlined the importance to consult with an experienced independent body from outside the region to provide top quality legal advice to enforce the integrity of the Convention formulating process. The activities under this component of the MSP will comprise;

(a) Review of existing conventions and treaties on shared groundwater and other international resources;
(b) National Ground water legislation and policy review (consistent with the legal and institutional review as a part of the SAP);
(c) Legal convention for joint four-country organization. Legal negotiations under technical guidance and team(s)
(d) Inter-governmental negotiation sessions;
(e) Drafting of an agreement for signature and prelude for a ratification process. It is important that this process involves the national Ministries of Foreign Affairs as important stakeholders as they are usually the lead ministry on international and regional conventions and ratifications.

The importance to draw from and exchange information with parallel GEF Aquifer projects including the Guarani, Iullemeden and North Sahara aquifers using established networks and information management mechanisms under IW-LEARN together with IGRAC and WHYMAP was also discussed to gain an insight on what had previously been done.

Project Management

The purpose of this component is to manage project implementation efficiently and effectively and also to build institutional capacity, with a focus on strengthening the Joint Authority. The project management arrangements include the Project Steering Committee with participation of the national focal institutions and the cooperating international agencies. A project implementation unit under the supervision of a regional coordinator, who would be supported by technical and administrative staff, would be responsible for the Steering committee and project activities on the ground (in the Aquifer region). The location of the project implementation unit was discussed at length with the conclusion to place the unit at the Joint Authority's headquarters in Libya or at one of the branch offices in Chad, Egypt or Sudan. The final decision on the project location will be referred to the Joint Authority and be subject to UNDP criteria for location of project offices.

The discussion then focused on how to maximize the regional involvement to strengthen and build the capacity for regional coordination in the Joint Authority. The discussed alternatives included, (a) the project implementation unit as a defined structural regional coordination unit with seconded staff for the duration of the project, or (b) locating a regional project unit in the Joint Authority.

5. CONCLUSIONS AND RECOMMENDATIONS

The participants of the meeting discussed and concluded the following:

The Nubian Sandstone Aquifer is a dominant shared non-renewable groundwater resource of regional and national strategic importance for environmental protection and sustainable socio-economic development.

Top priority has been assigned to water resources by African countries and endorsed at international and regional meetings and reflected under on-going regional cooperative initiatives. The focus has been towards integrated management and protection of shared water resources in Africa, giving particular attention to shared groundwater resources.

The technical cooperation between the IAEA and the African countries to build member state capacity for the sustainable development and management of water resources, particularly through the use of isotope techniques was greatly appreciated.

Recent international initiatives towards international aquifer management including the UNESCO-ISARM programme and regional efforts in Africa including the CEDARE/IFAD work on the Nubian Aquifer and the GEF-supported Iullemeden and Northern Sahara aquifer projects were highlighted.

It was recognised that there was an urgent need to address the Nubian Aquifer as a large strategic shared water resource located in one of the most arid parts of the region/the world. A significant example and global reference for rational management, utilization and protection of shared non-renewable groundwater resources and the related ecosystems and land resources was needed and the NSAS could be a good example of such a case.

It was considered that the Nubian aquifer is a critical and unique water resource to support and sustain socio-economic development in the sub-region.

The aquifer could be exposed to possible threats related to rapid harvesting and inefficient use of the finite resource, land degradation, climate change and loss of biodiversity. It was agreed that international cooperation for management and control would provide significant benefits to the countries and the region.

It was highlighted that there was a priority need to address the possible threats and related issues and prepare a joint analysis of the threats and their causes, address gaps on capacity and data, prepare a joint action programme to address these issues and establish a legal and institutional framework for joint implementation. This would for the basis and approach of the MSP.

The four Nubian aquifer countries, Chad, Egypt, Libya and Sudan are committed to long-term regional cooperation on the shared aquifer and have established a joint framework for cooperation on the study and development of the shared aquifer ie through the Joint Authority. In the context of the joint framework, the countries have undertaken important baseline activities and steps towards joint management of the aquifer. This raises important challenges on regional coordination strategy for enhancement of the existing cooperative framework at regional and national level, including legal and institutional development, and addressing capacity building and data gaps that will have an important positive impact on the management and protection of the shared aquifer.

Follow up Actions

The Nubian Aquifer Sandstone countries (Chad, Egypt, Libya and Sudan) under the auspices of the Joint Authority through the UNDP/IAEA/GEF Medium Sized Project will:

i. Carry out a Shared Aquifer Diagnostic Analysis (SADA)
ii. Address priority capacity and data gaps in the Nubian Aquifer
iii. Formulate an Action Programme for the joint Integrated Management of the Shared Nubian Aquifer,
iv. Review and strengthen the Nubian aquifer legal and institutional cooperative framework, at the regional and national level, building on existing regional and domestic level institutions,
v. Finalise the formulation of a UNDP/GEF-International Waters MSP project to accommodate the above activities with close coordination and consultation with the IAEA, to be submitted through the Implementing Agency UNDP-GEF to the GEF Secretariat in the second quarter of 2004 for possible GEF approval, so that the project can commence in late 2004 (see Annex 1). This in accordance with what all project partners have established and agreed to follow as a programme for the project preparation.
vi. Communicate to UNDP and IAEA a recommendation for locating the Regional Coordination Unit that meets accepted criteria. In the absence of a consensus, individual countries will be invited to make proposals based on accepted criteria. The final decision on the project location will be made according to established UNDP-GEF standard criteria for project locations.

Project Arrangements

The overall arrangements for project funding and implementation include:

- UNDP/GEF as Implementing Agency
- IAEA as Executing Agency, lead technical Agency on the scientific component and principal co-funding Agency
- The Joint Authority as lead coordinating Agency
- CEDARE as cooperating and potential co-funding Agency
- UNESCO and its ISARM partners as possible co-funding Agencies.

The Project would be steered through the Project Steering Committee with participation of the National Country Focal Institutions, the Joint Authority, The Implementing Agency (UNDP/GEF), The Executing Agency (IAEA) and project partners (CEDARE, UNESCO).

Related to the detailed roles of intergovernmental organizations under the project, the Joint Authority will advise and recommend on their exact involvement and cooperation.

The meeting participants express appreciation to the IAEA for hosting and coordinating the meeting.

Annex 2

BUDGET: INPUT, BUDGET COSTS AND FINANCING SOURCES

MSP Component/Activity/Input	External Project Inputs ($000)									
	Internation. consult*	Regional consult*	National consult/expert*	Subcontract $000	National Meeting**	Regional Workshop**	Equipment $000	Misc. $000	Sub-total	Financing source
1. SADA/address gaps										
1.1 Preparation of Nubian SADA								10.00		
TDA Training- Train/Sea/Coast										
Support of National TT Teams (4)	0.6		8.0		4			4.0		
Support of Regional TT Team								3.0		
Compilation of Draft SADA		2.0								
Stakeholder Review/SC SADA adoption						1				
Subtotal Component (units)	0.6	2.0	8.0		4	1				
Subtotal Component $000	9.0	16.6	24.0		56	24		17.0	**146.6**	GEF
1.2 Capacity Building; Filling Data Gaps										
Peer review, Model - Data Base	2.0									
Address data gaps			12.0			1				
Collect additional Isotope data	1.0		8.0					25.0		
Isotope Analysis (regional lab)								20.0		
Isotope hydrology-regional monitoring			4.0			1	30.0	5.0		
Climatic change, water interactions	1.0				4					
Data interpretations/modeling	4.0									
Exchange of competences	2.0									
Filling other data gaps			8.0					7.7		
Subtotal Component (units)	10.0		32.0		4	2				
Subtotal Component $000	150.0				60	50	30.0	57.7	**347.7**	IAEA
2. SAP										
Vision Statement; long-term EcoQQs					4			10.0		
National/Regional SAP formulation teams	1.0					2		10.0		
Ministerial Conference, adopt SAP						1				
Capacity Building- SAP Chad,Sudan *										
Regional training	2.0									
Fellowships/Scientific visits	2.0									
Targeted Training	2.0							56.7		

Field work (e.g. Prep. Observ. wells, Chad & Sudan)								117.0		
Subtotal Component (units)	7.0				4.0	3.0				
Subtotal Component $000	105.0			60.0	80	66		193.7	**504.7**	GEF – 234.4 IAEA – 270.3
3. Legal, Institutional mechanisms				60.0						
Review legislation-basin treaties			6.0		4			4.0		
Prepare background document			4.0							
Draft agreement			2.0					4.0		
Regional adoption and Final report			4.0			1				
Subtotal Component (units)			16.0		4	1				
Subtotal Component $000				60.0	80	22		8.0	**170.0**	GEF
4. Project Manangement+Sc. Coord										
Support of PSC		2				2		4.0		
Support of Regional Coordin team/unit		22.0	16.0				10.0			
Scientific Review/Steering Committee								55.0		

Subtotal Component (units)		24.0	16.0			2				
Subtotal Component $000		199				60	10	55.0	**324**	GEF
Component 5. Monit & Eval										
External project evaluation								20.0		
Subtotal Component $000								20.0	**20.0**	GEF
Total Project : (US$ 000)	264.0	215.6	24.0	120.0	276.0	222.0	40.0	351.4	1513	
PDFA								25	25	GEF
IAEA; Agency support cost (8% of GEF contribution)									80.0	GEF
Grand Total:									**1618**	

*unit costs: Int consultant 15000$/pm; Reg Consultant $8300/pm; Nat Consultant $3000/pm

** SADA/Cap: Nat Workshop/training course: $10000; Regional Workshop $ 24000; ** SAP/Legal : Nat Workshop/training course: $20000; Regional Workshop $ 22000;

*** counterpart staff including office overhead: $1000/pm Input/ Budget for 4 countries and Joint Authority

****Capacity-Building SAP supported by IAEA, other elements of Component 2 supported by GEF

NOTE: national experts under Components 1.2, 3 and 4 provided as counterpart contributions

ANNEX 3

CHAD: GROUNDWATER SECTOR DESCRIPTION

Source data history

With drought and climate change, groundwater levels have declined considerably because of lack or insufficiency of rain and increased evaporation. This has made it difficult for populations to get water from simple wells and many people have moved because of the lack of water. Hence the wish to introduce new up-to-date techniques to reach the groundwater. These involve the drilling of boreholes and modern pumping systems that require large resources for preliminary research studies and very high operating costs that are far beyond the reach of rural populations.

For this purpose, some research has been carried out on the geology and hydrogeology of Chad, the principal recognized units of which are (working from north to south):

- The basement of the Tibesti massif and the volcanic eruptions in the extreme north-west;
- The Nubian sandstones in the extreme north-east;
- The Primary sandstones that extend from the north-east to the north-west (Faya region);
- The terminal continental that extends from the north of Kanem (the lowlands) to the south of the country;
- The Pliocene and Quaternary formations around Lake Chad and in the riverbeds;
- Finally the outcropping basement in the eastern part and the extreme south and south-west of the country.

With regard to geological or hydrogeological maps, apart from the overviews made of French Equatorial Africa, to which the territory of Chad used to belong, which were published between 1943 and 1958, the first hydrogeological map of Chad to a scale of 1/1 500 000 was prepared by J.P. Wolf and published in 1964. It was accompanied by an explanatory note that sketched out the parts relating to the Precambrian and Primary.

After a sketch of the water table was made by J. Abadié, all the hydrogeological data available on Chad were presented in 1969 by J.L. Schneider in the form of a hydrogeological map, also to a scale of 1/1 500 000, along with an explanatory note that was not widely distributed.

An update was made in 1978 and 1985–1987, by the same author (J. L. Schneider), using new data provided in particular by deep boreholes drilled in 1969–1972 in the Lake Chad Basin, and later by Conoco petroleum research in the Cretaceous basins.

In 1987–1989, the dossier was recast as a doctoral thesis, submitted to the University of Avignon on 28 April 1991 by the same author. It was subsequently added to between 1989 and 1991, leading to a review paper mainly concerned with preserving the source data.The last update, again by the same author, was in 2001, but unfortunately it does not contain any significant changes to the source data.In short, Chad's groundwater is in general very poorly understood because there have not been any detailed studies on the country's different groundwater bodies.

The Water Office responsible for monitoring water resources was created in the colonial period. It operated until the creation of the National Office of Pastoral and Village Hydraulics (ONHPV) into which it was integrated. The tasks of the newly created Office were groundwater resource monitoring and hydraulic engineering for village and pastoral supply. In 1991, with the creation of the Directorate of Hydraulics, the ONHPV was privatized and the Directorate of Hydraulics relieved it of all matters related to groundwater, including the Water Office.

Legal arrangements

As to legal arrangements, there is law 16 with a water code, which was promulgated on 18 August 1999. It covers all legal aspects of the water sector and the qualitative and quantitative protection of water by setting regulations for its use. This text needs other implementation texts for putting it into practice. This

is what is lacking in many areas. Nevertheless, the Government has made some efforts in recent years by issuing several implementation texts on drinking water management in secondary centres. They are:

Decree

- Decree No. 149/PR/MEE/02 of 28 May 2002, defining the modalities and conditions for the provisional transfer by the State to decentralized territorial authorities of its powers related to the delegation of drinking water services.

Orders

- Order No. 028/MEE/DG/02 of 25 June 2002, setting out the model framework for an individual agreement on the transfer of the power of delegation of drinking water services from the State to a decentralized territorial authority.

- Order No. 029/MEE/DG/2002 of 25 June 2002, setting out the model framework for a contract to delegate drinking water services to a users' association or a private contractor.

- Order No. 030/MEE/DG/02 of 25 June 2002, setting out the modalities of constitution, organization and operation of drinking water users' associations.

Institutional arrangements

At the institutional level, the State has set up several structures to improve management of the water sector that cut across all development sectors. They are:

Executive body

1. The role of the Ministry of Environment and Water (MEE) is to apply Government policy on village and pastoral water supply and to oversee hydraulic engineering projects.

   – The Directorate of Hydraulics (DH) oversees hydraulic engineering projects and work relating to the exploitation of groundwater;
   – The task of the Directorate of Water Resources and Meteorology (DREM) is to monitor surface water resources and to collect pluviometric data;
   – The Water Regulation Agency (ARE) sees to the correct implementation of contracts delegating public water services.

Consultative bodies

The consultative bodies are under Government supervision:

2. The National Water Management Committee (CNGE), whose main task is to participate in defining the national water policy and to oversee the formulation and implementation of the Water and Sanitation Master Plan (SDEA).

3. The Intersectoral Water Committee (CTIE) helps the CNGE to carry out its work, in particular by preparing technical elements. It is also involved in overseeing the formulation and implementation of the SDEA.

The national budget for groundwater

The State budget for groundwater concerns only the construction of drinking water supply works. The allocated sums come from the Heavily Indebted Poor Countries (HIPC) Initiative, from petroleum income and from the regular budget.

Source of funding	Indicative amount	
	CFA francs	US dollars ($)
HIPC Initiative	772 653 000	1 545 306
Petroleum income	1 940 000 000	3 880 000
Regular State budget	1 477 788 000	2 955 576
Total	4 190 441 000	8 380 882

This budget does not cover research or monitoring activities.

Co financing budget

As regards State participation, apart from the competent staff who can be made available for the project, there is no provision for a direct cash contribution. However, the State has planned the drilling of 12 exploration boreholes in the Eastern Ennedi zone (Nubian sandstones), under the petroleum bonus, with a view to building seven productive wells. A contract for a total of 149 550 000 CFA francs ($290 000) even approved in December 2003, but the work has not started. In addition, an agreement has been signed between Chad and the Islamic Development Bank (IDB) for a total of $3 376 000 o finance the supply of drinking water to the town of Faya Largeau, located in the Primary sandstones fed by the Nubian sandstone aquifer. This financing is aimed at drilling three boreholes including a piezometer, 1000 latrines, 13.5 km of network branches, a 60 kVA generator set and a 70 m³/hour treatment plant.

Awareness activities

As for awareness activities, the Government has made efforts in all directions; it is participating practically in all regional, international and bilateral meetings on water. The Water and Sanitation Master Plan, just approved in 2003, is a strategic reference document covering all areas of water. In seeking to reduce poverty, it aims to achieve food self-sufficiency, to raise the rate of supply of drinking water to the population from 30% to 70% by 2015, and to monitor the resource for sustainable development, among other things.

ANNEX 4

EGYPT, GROUNDWATER SECTOR DESCRIPTION

Introduction

Egypt is an arid country with rainfall occurring only in winter in the form of scattered showers. The total annual rainfall is estimated at about 1.5 billion m^3, limited to the northern and eastern coasts.

The main source of fresh water in Egypt is the annual quota from the Nile, amounting 55.5 billion m^3/year. The Nile water, however, is limited geographically mostly to the Nile valley and delta. Transfer of the Nile water to other portions of the country is restricted by physical and economical constraints. Other fresh water resources are represented in the Nubian Sandstone Aquifer System, mainly found in the deserts, and flash floods, restricted to wadis.

The main issues facing Egypt's development include, among others: (i) partial utilization of the territories (less than 10%); (ii) unbalanced population distribution and continuous immigration from rural to urban areas; (iii) decrease of per capita share in water and agricultural land; and (iv) lack of proper water supply and sanitation in the rural and desert areas. This situation calls for the development of additional sources of water along with the protection of developed ones through efficient utilization and protection from pollution. Population redistribution is another important action.

The Nubian aquifer is characterized by its wide distribution all over the country. Wadis may also be considered potential sources of water if properly managed as they exist in regions where Nile water is absent.

For the above mentioned reasons, the Ministry of Water Resources and Irrigation has initiated via a ministerial decree the "Groundwater Sector", with the following mission:

> *The Mission of the Groundwater Sector is to ensure sustainable use of available groundwater and related water resources (rain and flash floods) and to develop and manage additional resources to satisfy the country's development policy without harming the environment.*

The GS constitutes of eleven General Directorates under four Central Administrations as follows (one is under the sector, technical office):

CENTRAL DIRECTORATES	GENERAL DIRECTORATES		
North Western Desert	Matruh	Baharyia	Siwa Siwa
South Western Desert	New Valley	Toshka	Owienat
Sinai & Eastern Desert	North Sinai	South Sinai	Eastern Desert
Nile Basin	Nile delta	Nile Valley	

Since the GS is one of the sectors of the MWRI, being affected by other bodies within the ministry and affecting them, the National plan has been discussed with members of the High Policy Committee. Moreover, representatives of the Groundwater Directorates shared in the meeting and discussions since they are the entities involved in the implementation of the plan.

Nubian Sandstone

The Nubian Sandstone aquifer system (NSAS) is assigned to the Paleozoic-Mesozoic. It occupies a large area in the Western Desert, and parts of the Eastern Desert and Sinai (Figure 3.1). Groundwater can be found at very shallow depths, where the water bearing formation (horizon) is exposed; or at very large depths (up to 1,500 m), where the aquifer is (semi) confined. The deepest water bearing horizons are generally encountered in the north (Siwa); while the shallowest are encountered in the southern portion (East Uweinat and Kharga). The aquifer transmissivity is NSAS is a regional system. It extends into Libya, Sudan and Chad. The aquifer contains a

huge amount of fossil water dating back to the rainy period (25,000 to 40,000 years). Groundwater quality is generally good (<500 ppm) in the major part, except near the coastal regions and Sinai Groundwater recharge is limited (estimated at 500 million m^3/year) across the boundaries with Chad and Sudan.

The Fissured Carbonate Aquifer System(post Nubian)

The fissured Carbonate aquifer system is assigned to the Eocene and to the Upper Cretaceous. It predominates essentially in the north and middle parts of the Western Desert, covering about 50% of the surface area of the country. It overlies the Nubian sandstone, and underlies the Nile aquifer system. The rocks consist of limestone, dolomite, chalk and marl. Locally, they may include phosphate and shale intercalations. The formation of groundwater basins in the carbonate rocks is either a result of land and sea bed subsidence or a result of structural series of faults forming graben shapes favoring the deposition of other rocks and sediments.

The thickness of the carbonate aquifer system varies from 200 m (at Farafra oasis) to about 900 m (at Siwa oasis). The system is characterized by secondary porosity that is considerably higher than the rock porosity. Recharge of the aquifer is achieved mainly through: (i) upward leakage from the underlying sandstone; (ii) groundwater flow from adjacent formations (e.g Moghra); and (iii) infiltration from the surface (e.g. irrigation or rainfall). Groundwater quality shows large variations with salinity ranging from 1,000 to 8,000 ppm.

Egypt Water Policy

The objectives of Egypt's water policy are to:

1) Protect surface water and groundwater from pollution, and control deterioration of water quantity.

2) Control water demand.

3) Secure the future water supply from the Nile River by adopting a holistic approach to water management based on the river basin, integrating all water resources and use sectors.

4) Locate, identify, and develop new water resources.

5) Raise water use efficiency by: (i) promoting conjunctive use of surface water and groundwater; (ii) controlling unplanned use and depletion of groundwater; and (iii) promoting water recycling.

6) Increase water use effectiveness by: (i) establishing planning capacity, including appropriate planning approaches and tools; (ii) public and stakeholder participation in all steps of water management, including policy, planning, design, and implementation; (iii) establishing drought management plans, with implementation mechanisms; (iv) reviewing and adjusting water use legislation and regulations for proper implementation of the water policy; and (v) engaging and mobilizing women and building public awareness about water management by better communications particularly in rural areas.

Mission of the Groundwater Sector

As mentioned in the National Water Policy (NWP), the need for developing new water resources (augmentation) along with protection of available resources from degradation are major actions to secure the country's water supply. Population redistribution is another important action. This calls for the development and proper management of groundwater and conservation of flash floods and rain harvesting.

The mission of the Groundwater Sector (GS) is thus:

"TO ENSURE SUSTAINABLE USE OF AVAILABLE GROUNDWATER AND RELATED WATER RESOURCES AND TO DEVELOP AND MANAGE ADDITIONAL RESOURCES TO SATISFY THE COUNTRY'S DEVELOPMENT POLICY WITHOUT HARMING THE ENVIRONMENT"

Institutions Involved in the Management of Groundwater and Related Resources

Various institutions are involved in the management of groundwater and related water resources in Egypt; while others constitute the stakeholder/beneficiary community. However, the main responsibility of groundwater and related resources management is with the Ministry of Water Resources and Irrigation (MWRI) with the direct responsibility of the Groundwater Sector and RIGW.

Water resources management consists of various activities, mainly: (i) research; (ii) planning at various levels; (iii) studies, including piloting; (iv) implementation (stage and full scale); (v) monitoring and evaluation; (vi) creation of awareness; (vii) legislation and enforcement; and (viii) operation and maintenance.

Classification and Need of Stakeholder

It is worth mentioning that the GS is sometimes a stakeholder. This applies to information supplied by other (or primary) stakeholders. Examples include, among others, the following:

1) Information concerning land reclamation for consideration of water sources that may not be taken into account, e.g., desalination or direct use of brackish groundwater.

2) Information concerning new communities is important in the allocation of groundwater and implementation of protection measures from flash floods.

3) Results of research activities are of high importance especially in the planning process.

With respect to the stakeholder of the GWS plan, it was found simpler to distinguish them into categories, as summarized in the following Tables 1 through 3.

Table 1. Shows the Institutions Involved in Groundwater Management Activities In Egypt

ACTIVITIES	INSTITUTIONS INVOLVED	RESPONSIBILITY
1. Research on National and Regional Levels	1.1 The Research Institute for Groundwater (MWRI) 1.2The Desert Research Center (MOA) 1.3 Universities (MOHE)	Carry out research based on requirements. This dictates close cooperation with the GS
2. Policy development and planning	2.1 The planning Sector (MWRI) 2.2 The Horizontal Expansion (MWRI) 2.3 Various ministries 2.4 The GS 2.5 The Research Institute for Groundwater (MWRI)	Integration of plans based on demands
3. Local Studies and Investigations, including assessment of potential and piloting	3.1 The Groundwater Sector 3.2 The Research Institute for Groundwater 3.3 The Desert Research Center 3.4 Universities and individual consultants	Based on request made by the GS. To be finally approved by the GS and the MWRI
4. Design and implementation (or supervision)	[It depends on the ownership] but under the control of the GS & RIGW	To be finally approved by the GS
5. Monitoring and evaluation	5.1 The Groundwater Sector 5.2 The Research Institute for Groundwater 5.3 Ministry of Health (adhoc) 5.4 Individuals (owners)	Reporting to the GS
6. Awareness	MWRI (communication unit) & RIGW	Supported by the GS
7. Legislation and enforcement, including licensing	GS & RIGW	Supported by others
8. Operation and maintenance	8.1 The Groundwater Sector 8.2 Individuals or institutions	Monitored by the GS

Table 2 Stakeholders within the Ministry of Water Resources and Irrigation

	Planning	Expansion	Irrigation	Drainage	Nile	Nile protection	IIP	Shore Protection	RIGW	Reservoirs	HAD
Distribution and Types of aquifers	+	+	-	-	-	-	-	-	+++	-	-
Management technologies	++	+	++	++	+	-	+	-	+++	+	+
Management issues	++	+	+	+	+	-	+	-	+++	+	-
Potential	+++	+++	+++	-	+	+	+++	-	+++	-	-
Management of Wadi systems	++	+	++	-	++	+++	-	+++	+++	+	+
Vulnerability	+	-	-	+++	-	_	-	-	+++	-	-
Plans	+++	+++	+++	+	++	+	++	+	+++	+	+

- not relevant + important ++ very important +++ extremely important

Table 3 Other Major Stakeholders (Ministries)

	Agriculture	Housing	Industry	Tourism	Health	Environment	Local Governments
Distribution and Types of aquifers	-	-	-	-	-	-	_
Management technologies	-	+	+	-	+	-	+
Management issues	+	+	+	-	+	+	+
Potential	+++	++	++	+	+	_	++
Management of Wadi systems	+	+	++	++	-	+	+
Vulnerability	++	++	++	_	++	++	+
Plans	++	+	+	+	_	_	+

- not relevant + important ++ very important +++ extremely important

ANNEX 5

LIBYA: GROUNDWATER SECTOR DESCRIPTION

Libya is an arid country. It depends on more than 98% on groundwater in its supply for domestic, industrial and agricultural uses. Due to the scarcity of the rain in the northern part of the country, a lot of environmental impacts have been recorded in the last three decades. The main phenomena is sea water intrusion in the main fertile area and the area with the highest density of population (Tripoli region namely, Jefara Plane). The impacts are in the form of land degradation and soil and water quality deterioration leading to what is known as desertification. The deficit or shortage in water demand for the country is given in the attached table shows the water balance in Libya indicates that the shortage amounts about (1268) million cubic meters per year. This deficit is estimated only for the year 1998; taken into consideration the rate of growth in Libya (2.5%) per year ; the deficit will be increased by the year 2025 to reach to more than (6000) Mm^3/year.

Taken all such facts into consideration, the Libyan government made all the effort to reduce such bad impacts to remedy the water scarcity in the northern part of the country. The Great Man-Made River was part of quick solution to such problem. So water in the far desert found in the Nubian and Post Nubian aquifers conveyed in part to the coastal area where about 80% of the Libyan population are living. In order to develop these two aquifer system and to manage it properly, a regional program for the development and utilization of the Nubian Sandstone Aquifer System was established in accordance with the agreement between the four countries sharing the aquifer system; Libya, Sudan, Chad and Egypt.

. LOCATION AND AREA OF THE AQUIFER

Geologically, there exist two basins, namely the Kufra and Sarir. The first is older in age (Cambrian to Lower Cretaceous) and the letter is younger (Upper Cretaceous to Miocene). The two basins were developed under different depositional environments. In Libya they are always dealt with as two separate basins, both geologically and hydro geologically.

In Libya, the Kufra basin covers an area of approximately 200,000 Km^2 of the South eastern part of the country. On the other hand, the Sarir basin lies to the north and west of Kufra and extends over a surface area of about 450,000 m^2.

a. AQUIFER SYSTEM

i) Kufra Basin

Two aquifer systems are known to exist in the Kufra basin; the upper one is the Mesozoic (Triassic - Jurassic- Lower Cretaceous) known as the Nubian sandstone aquifer; the lower is the Paleozoic aquifer system (Cambrian, Ordovician, Silurian and Devonian).

At present, only the Continental Mesozoic aquifer of Nubian sandstone (Triassic - Lower Cretaceous) is exploited, supplying water to two irrigated areas and to the inhabitants of Kufra. The aquifer is probably saturated for a depth of 1000 m, but the wells rarely exceed 200 to 450 m. The total volume of water stored in the Nubian aquifer of the Kufra basin inside Libya is estimated to be around 20,000 billion m^3. The recoverable volume would theoretically amount to 10 billion m^3.

The Nubian aquifer is generally unconfined with water tables few meters below ground surface to about 53m below ground level. Locally, however, the aquifer is multilayered giving rise to sub-artesian conditions in the lower strata suppressed by clay.

ii) Sarir Basin

The fresh water bearing formations in the Sarir basin are of Post-Eocene age (Oligocene to Miocene). The two main aquifers are the Post-Middle - Miocene (PPM) upper aquifer and Lower and Middle Miocene and Oligocene (LMM) lower aquifer.

The total volume of water in storage in the post Eocene reservoir is estimated to be in the order of 20,000 billion m^3, of which 80 billion m^3 can be theoretically recovered. The Post- Eocene reservoir is a multi-layered system.

b. GROUNDWATER QUALITY

i) Kufra Basin

Groundwater quality of the producing zone within the Continental Mesozoic reservoir over the Kufra agricultural project area is normally excellent with total mineralization in the range of 96 to 320 mg/l (Table 4). The water of deep aquifer has a low pH value and a high CO_2 content. The free CO_2 content is 34 to 57 mg/l near Kufra, threatening the wells and increasing the construction and maintenance cost. Water quality in the overlying shallow aquifer ranges from 300 to > 8000 mg/l. The average being about 3000 mg/l. Groundwater in the producing zone even as far as north of Tazirbo (25^o 45'lat.) is still excellent.

ii) Sarir Basin

The water salinity of the Sarir Basin is relatively higher than that of Kufra and changes more rapidly in both vertical and horizontal directions depending on the litho logical and topographical changes and the mixing of water

The result of the chemical analyses show that the post Nubian aquifers contain generally poor quality (upper aquifer) with a specific conductance higher than 2000 micromhos/cm and may exceed 8000 micromhos/cm. The analyses also indicate that the occurrence of less mineralized water throughout the lower aquifer with specific conductance ranging from less than 800 to 3700 micromhos/cm (less than 500 to 2600 mg/l)

c. ISOTOPE STUDIES

The application of environmental isotope studies in groundwater investigations in Kufra began in the early seventies. Initially, these inter-related isotopic and Paleoclimatic approaches were undertaken by I.G.S(1973) in extension to their Jalo Tazirbo Phase I studies to complement hydro-geochemical analyses. Measurements of radio carbon and tritium were made principally to establish the relative and absolute ages of groundwater stratification. Stable isotopes O^{18} and deuterium were determined to assess the uniformity of the groundwater and its possible origin in relation to paleoclimatic history and evapotranspiration. As an adjunct to this work , C^{14} analyses of surface carbonaceous samples were undertaken in an attempt to relate groundwater recharge to the paleoclimate. The radio-isotope results gave C^{14} ages in the range of 24,510 to 44,510 years B.P and tritium 3.2 ± 0.7 T.U. In the case of stable isotopes, enrichment from north to south was indicated over the Kufra basin. Parent rain was evidently derived from tropical air masses south of the Sahara. KPP wells showed O^{18} levels ranging between - 10.9 to - 12.0%.

The first phase of a detailed environmental isotope program was carried out in early 1979 with a field trip to Kufra basin and the southern sector of Sarir Calanscio sub-basin when 10 water samples and 11 specimens of carbonaceous matter were collected and send to IAEA in Vienna for isotope analyses.

3. REVIEW OF ONGOING STUDIES

i) Kufra Basin:

A hydro geological study for determining the location of the third phase well field of the Great Man-Made River Project is currently underway. In this phase, it is foreseen to pump (1.68) million cubic meters per day from the area south of Kufra oasis using approximately 234 production wells. The study includes in particular:

- Geological/hydro geological mapping by interpretation of aerial Photographs, Land sat or spot imagery.
- Hydrochemistry and corrosion study of existing KSP and KPP wells.

- Exploratory drilling and testing over north of the basin.
- Surface geophysical field work.
- Regional modeling of Kufra basin.
- Identification of promising well field area.
- Exploratory drilling and testing of promising well field area.
- Modeling of well field to optimized layout and performance.

ii) Sarra Area:

The study will be conducted in the Sarra area, approximately 320 Km South-west of Kufra. The study aims at locating an agricultural settlement project. Technical specification of the study includes:

- Aerial photography with a scale of 1: 40,000, 1: 8, 000 and the preparation of topographic maps of scale 1:25,000, 1: 5,000.
- Geological study of the area on a regional and detailed basis, and preparation of geological maps of 1:50,000 and 1:100,000.
- Detailed hydrogeological study of the area.
- Reconnaissance, semi-detailed and detailed soil investigations.
- Drilling of exploratory and observation wells, and conducting necessary tests for the determination of hydraulic properties of the aquifers in the study area.

  Preparation of mathematical model.

iii) Sarir Tibesti and Haruj:

The study area is located in the south-central part of Libya. The objective of the study is to conduct a detailed investigation for the main groundwater aquifers, in order to evaluate the potential water resources of the area, and the preparation of a plan for the rational and sustainable development of the aquifers. The study will cover the following activities:

- Preparation of topographic maps from aerial photos and satellite images.
- Use of satellite images to identify the rock distribution, outcropping geological formations, structural geology, geomorphological features, land use, and inventory of water points.
- Conducting seismic surveys along prefixed profiles in order to identify subsurface structure, depth to basement, and lithological sequence.
- Conducting geological mapping of the study area.
- Collecting climatological data and installing new climatological stations at the areas of Waw Namus, Al Haruj al Aswad, Jabal Nuqay, Jabal Ben Ganimah and Jabal Tibesti.
- Conducting detailed hydrogeological and hydrochemical investigations, interrelation between aquifers in the vertical and horizontal directions, in addition to the relation between Sarir Tibesti sub-basin and the main Sarir basin.
- Drilling a number of exploratory wells and interpretation of obtained data.
- Preparation of mathematical model.
- Assessment of the water sources potential of the sub-basin.

4. GROUNDWATER MODELS

Predictions of the nature regarding the likely response of the Continental Mesozoic reservoir over the Kufra and Sarir Basins began in early seventies and continued up to the last regional model conducted by

Cedare in 2002. The model covered the Nubian and Post Nubian Aquifer system extended in the four countries. The final result of the model is shown in attached table. A more detailed model is under construction for the Kufra and Jaghboub and Tazirbo well fields.

5. NATIONAL DEVELOPMENT PLANS

a) Population Distribution:

It can be noted that most of the population is concentrated in the coastal village of Sirte and Ajdabia. In the Kufra region, only 15,000 inhabitants are living in the oases of Kufra, Tazirbo, Jalo, Oajla, Ejkherra, Mirada, Jaghboub and Rabiana. The population densities are given below in the three sub-regions (Shaabiat) of Khalij region for the year 1991.

Population densities in the Khalij region (1991)

Shaabiat	Area		Population			Population density per Km^2
	Km^2	%	Libyan	Non Libyan	Total	
Ajdabia	148,110	20.3	79,900	10,100	90,000	0.6
Sirte	41,350	5.7	54,600	8,000	62,000	1.5
Kufra	542,000	74.0	15,100	2,200	17,000	0.03
Khalij	**731,960**	**100.0**	**149,600**	**20,300**	**169,900**	**0.23**

It is apparent that the population density in Kufra and Sarir Basins is the least (.03 inhabitants/ $km^{2)}$ among the region . The region is therefore vast with scattered population living in oases. It represents a desert to semi- desert area extending fro the Mediterranean in the north to more than 1000 km southward.

Population centers in the region are relatively few for several reasons including the scarcity of good soils, arable lands and the harsh climatic conditions which is considered the main obstacle to economic development. The inhabitants of the region work in agriculture, in addition to some nomads. In the important population centers, commerce is also practiced by some inhabitants.

b. Land Resources:

i Natural Vegetation:

Natural vegetation is extremely limited in the area due to poor climatic conditions and shortage of rainfall. However, few areas have vegetation of the semi-arid climate in the north changing to desert vegetation in the south. Steppe vegetation randomly intersects the area, diminishing gradually towards the Jalo area as a result of decreases in rainfall.

A broad belt in the coastal area has poor shrub vegetation. The plant cover is denser in the spring as temporary vegetation grows as a result of the winter and spring rains. Wadi beds tend to be denser in shrub associations throughout the year. The densest concentration of shrub vegetation is to be found in Sirt.

On the fringes of the true desert in central and southern Khalij, the vegetation cover becomes extremely sparse, increasingly confined to wadi beds and areas of groundwater seepage. This zone is transitional, leading, with growing aridity, to the true desert zone of Khalij which occupies the greatest land area of the Region and is virtually without vegetation.

The economically useful vegetation in the semi-desert zone, which makes up the Khalij rangelands, is estimated to cover as much as 27,000 km^2.

Only small parts of the region are cultivated. The irrigated areas are estimated at (534) km^2. Half of this is located in the coastal area, but contains negligible amounts of vegetative cover; the other half covers the production areas in the south.

ii. Soils:

Desert sandy soils are widespread in southern Libya, such as Kufra and Sarir Project areas. From the several studies conducted in the Kufra and Sarir basins, the following summary has been prepared.

The soils are characterized by a sandy texture, undeveloped, and without clearly defined horizons. The soils generally contain more than 90% sand grains with shale content usually below 4%. Sand grains of 0.5 to 1.0 mm in- diameter are dominant in most desert soils and are usually very poor in terms of organic materials. The present material of these soils is the mobile sand soils resulting from the weathering processes. (PH) of the soil indicates alkalinity and low salinity. Their content of Calcium Carbonates is low to medium. The desert soils contain different proportions of gravel and their surface is sometimes covered by gravels and pebbles. The latter is known as "Sarir". Due to the high content of unconsolidated sand of no defined structure these soils are very poor in maintaining water. Depth of the soil profiles differ widely in accordance with topography, ranging from deep to shallow.

So it is essentially to develop the area and keep the natural live normal. In order to do so it is planned to carry out a lot of studies in the area to secure the sustainability of water supply to those scattered oases and to keep the sustainable supply of water to the coastal areas. The suggested future studies are listed below as part of the country fulfillment of the recommendations stated in the Nubian Sandstone Aquifer system strategies as a result of the studies carried out. The following are detailed studies to be implemented in the country:

1- Remodel the Sarir well fields (Post Nubian Aquifer). The new data collected from the drilling of GMRP well field and from the follow up (monitoring) piezometric and production network must be used.
2- Re-evaluate the data collected from Tazirbo well field and remodel the well field area.
3- Kufra area has to be re-evaluated and re-modeled taking in consideration the data collected from GMRA well field, Sarra well field, and existing well fields.
4- The new data collected from Jaghboub exploratory program has to be evaluated and the detailed model should be carried out.

7. ADDITIONAL STUDIES TO CLOSE EXISTING GAPS IN THE FIELD OF HYDROGEOLOGY

a) Completing of the piezometric network by drilling an additional number of observation wells. The new wells should be geographically distributed in order to close existing gaps in the Kufra and Sarir basins.

b) Drilling a number of deep exploratory boreholes especially in the zones that contains no data, in order to establish the stratigraphy in the whole area, along with identifying the groundwater aquifers and their physical and hydraulic properties, as well as the quality and age of water. The following tests are, therefore, required:

- Multi-stage and long duration pumping tests.
- Sieve analysis for sandstone samples (cuttings)
- Collection of cores for the determination of porosity, vertical and horizontal conductivity, geological age of penetrated rocks.
- Geophysical logs.
- Chemical analysis of water samples.
- Isotope analysis for determination of possible natural recharge and age of water.

c) Determining the relationship between Kufra and Sarir aquifers.

d) Completion of the Geological mapping of the area on a scale of 1: 250,000.

e) Completion of the aerial photo coverage for both Kufra and Sarir.

f) Installation of hydro climatic stations, especially in the high altitude areas, such as Jabal Uweynat, Jabal Arkanu, Jabal Al-Haruj, Jabal Nuqay and Tibesti.

g) Preparation of a program for a detailed study aiming at determining the possibilities of natural recharge in both Kufra and Sarir basins.

h) Establishment of a data base to complete all relevant data and information from the two basins and link such data with that of Egypt, Sudan and Chad, particularly for the Nubian sandstone aquifer, as an entry to a detailed geological and hydrogeological study along with a hydrogeological map for the basin.

i) Updating the existing mathematical models and recalibrating them and preparing a regional model.

8. THE EXISTING INSTITUTIONAL FRAMEWORK.

a) General Water Authority:

The General Water Authority of Libya (GWA) is a central body with a head office in the city of Tripoli and five regional branches and offices. GWA is responsible for the planning, study, development, management and implementation of water resources schemes. The Authority acts also as a consulting body to all governmental institutions in the field of water resources, as well as being the responsible body for regulating water legislation. The Authority is entrusted to conduct regional hydrological and hydrogeological studies either nationally or in cooperation with neighboring countries. GWA defines the upper limits for groundwater extractions from aquifers, and has the right to put certain areas under restrictive use or to completely ban groundwater extractions.

GWA conducts its activities through six technical departments (directorates) namely: the Water Resources Department, the Dams Dept., the Irrigation and Drainage Dept., the Planning and the Follow-up Dept., the Soil Department and the Administration and Finance Dept.

Each of the departments consists of a number of technical sections. Further, there are five regional branches, each representing one of the water resources zones. The Kufra and Sarir basins, for example, fall under the authority of the Zone V branch. This branch is temporarily located in Tripoli, with local offices in Kufra and Jalo. The main task of the central departments and regional branches can be summarized as follows:

- Study and research in the field of water resources.
- Implementation of exploitation programs in order to achieve optimal use of existing resources.
- Exploration of new resources.
- Preparation of technical specifications and design for water wells and well fields.
- Supervision of drilling activities.
- Inventory of water points, volume of exploitation, recharge.
- Monitoring water quality and water level fluctuations and preparing water quality and water level contour maps.
- Geophysical surveys and well logging.
- Evaluation of water resources by mathematical models.
- Licensing of new water wells.
- Registration of drilling contractors.
- Drilling of exploratory wells to determine aquifer parameters and extensions.
- Preparation of water resources maps.
- Laboratory analysis for rock and water samples.
- Study of dam sites, construction and operation of dams and other surface water projects.

- Design of irrigation and drainage projects.
- Proposing water legislations and their implementations.
- Advising other government bodies on the proper use of water resources.

b) Secretariat of Utilities

The Secretariat (Ministry) of Utilities; through its General Water and Sewage service Company, is mainly involved in domestic water supply and distribution as well as sewage collection and treatment. The main tasks of this Secretariat are:

- Defining municipal water demand.
- Construction of well fields for domestic water supply.
- Operation and maintenance of well fields, pumps, pumping stations, reservoirs and distribution networks.
- Treatment and chlorination of drinking water.
- Metering water supply for households and other public and private installations.
- Collection and treatment of sewage.
- Design, execution and operation of distribution networks.
- Chemical and bacteriological analysis of drinking water.

c) Secretariat of Health

The Secretariat of health, through its Public Health Dept., and the Technical Centre for Environmental Protection and General Environment Authority is responsible on the following matters;

- Issuance of drinking water standards.
- Detection of water-born diseases.
- Monitoring drinking water quality.
- Issue of legislations of water pollution.
- Detection of pollution sites.
- Control of pesticides and fertilizer use.
- Study and research in the field of environmental protection.

d) The Great Man-Made River Authority

The Great Man-Made River Authority (GMRA) is a newly introduced body (1983) specifically concerned with the water conveyance project. It is mainly involved in:

- Drilling and construction of the well fields, pipelines, reservoirs, pumping stations and other related works to transport water to the coastal areas for irrigation and domestic uses.
- Operation and maintenance of the water conveyance system.
- GMRA, in cooperation with GWA conducts hydrogeological investigations aiming at locating production well fields and modeling the water extraction and response of the aquifer over the foreseen exploitation period. The studies are also designed to investigate the choice of materials, the proper spacing between production wells and the optimal well field design.

All the above-mentioned public institutions are closely related and coordination of their activities is secured by the Secretariat of Planning. On the other hand, the Secretariat of Agriculture is mainly involved in the organization of the plant and animal production. On the local scale, i.e., at the level of Kufra and Sarir, a local “government” consisting of regional Secretariats in parallel with central ones, is fully responsible for the administration of all sectors.

e) GMMR Utilization Authorities

- **Hassaouna Jefara Utilization Authority**; covers the northern western part of the country
- **Central Area Utilization Authority**; covers the northern central part of the country
- **Eastern Utilization Authority**; covers the northern eastern part of the country

All the above mentioned authorities are responsible on the GMMR water distribution, collecting the outcomes, building the infrastructural for the irrigation networks, building farms and distributing them, and following up with all the end users of this water.

f) The Nubian Sandstone Aquifer Joint Authority

The Joint Authority on the Nubian Sandstone Aquifer was previously formed between Egypt and Libya in the early nineties, and then later Sudan and Chad joined the group. The Authority was revitalized again in February 1998. The Joint Authority acted as the Regional Program Steering Committee (RPSC) for the previous studies in the region.

Thus, the Joint Authority included Dr. Mona ElKady, Dr. Fatma Abdul Rahman Attia, and Dr. Taher Mohamed Hassan from the Ministry of Water Resources and Irrigation of Egypt, Dr. Omar Mohamed Salem, Dr. Mohamed Abu Elqassem Bakhbakhi, and Dr. Salem Rashrash from the Libyan Arab Jamahiriya, and Dr. Mohamed Kheir Saleh from the Ministry of Irrigation and Water Resources of Sudan. Eng. Abdoulaye Mourra , Eng. Abderamane Saidou ,and Eng. Ismail Musa from Tchitchaou, Directeur de l'Hudraulique, le Ministere de l'Environnement et de l'Eau of Chad.

The Joint Authority is taken care of all the mechanisms and plans for working and managing the NSAS in order to continue the regional cooperation between the four countries, which will lead to the sustainable development of the NSAS.

Basin	Available Water Resources in 1998 (Mm^3/y)						Water Consumption in 1998 (Mm^3/y)				Water Balance (Mm^3/y)
	Conventional Water Resources		Unconventional Water Resources				Irrigation	Domestic	Industrial	Total	
	Groundwater	Surface water	Sewage Treatment	Desalination	GMRP	Total					
Jeffara Plain	250	26	7.5	-	+110	393.5	1476.8	188.1	10.1	1675.0	-1281.5
Jabal al Akhdar	250	16	1.82	5.1	+113	385.92	80.2	119.3	4.6	204.1	+181.82
Ghadamii	400	17	4.9	12.0	-	433.9	540.3	56.8	5.1	602.2	-168.3
Murzuk	912	-	8.76	-	-110	810.76	746.0	58.06	6.7	810.76	-
Kufrah and Sarir	741	2	1.2	0.5	-113	631.7	492.0	30.3	109.4	631.7	-
Total	2553	61	24.18	17.6	0	2655.78	3335.3	452.56	135.9	3923.76	-1267.98

Source: GPC (1990)

Highest development scenario – Nubian - Results of the model

	Development zone	Present extraction in Mm^3/yr	Planned future extraction in Mm^3/yr	Additional drawdown from 2000 to 2060
LIBYA				
	Unconfined part of the Nubian (Kufra, Tazerbo)	200	1455	25-30 m
	Confined part of the Nubian (Jaghbub)	0	68	30-40 m
EGYPT				
	Unconfined part of the Nubian (East Oweinat, Tushka[1])	0	1449	40-60 m
	Confined/unconfined part of the Nubian (New Valley)[2]	547	847	30 – 60 m
	Confined part of the Nubian (Siwa)	20	68	30-40 m
SUDAN		0	0	
CHAD		0	0	

ANNEX 6

SUDAN: GROUNDWATER SECTOR DESCRIPTION

Proposed Development Projects:

Different authorities have proposed the following development projects. Some of the proposals have been planned since 1962 (eg. Protected area for Wildlife: updated 1975, 1983 & 1995). Nevertheless the sustainability of those projects substantially depends on the development of groundwater in the area.

The Development Projects are:

- El Fasher – Owienat (to Kufra in Libya) road
- Dongola – Oweinat road
- Camel routes (North Dar Fur State & North Kordufan State to Aswan in Egypt and to Libya).
- Green Oases along the camel routes for the production of fodder, water and veterinary services to reduce mortality rates.
- Wadi Hawar Area Development Project
- National Protection Area for wildlife
- Development of Trona Deposits (Na2CO3) at Atron and Nukheila oases
- Salima Oasis tourism area
- Wheat production (200000 feddans) west El Golid
- Petroleum exploration (Jebel Abyad area and Salima oasis)

Groundwater Development:

There are many constraints that limited the development of groundwater in the country. These are technical, financial, managerial, socio-economic and environmental constraints. Due to the great depth to the groundwater in the Nubian basins, development of groundwater requires high technology, information and expertise. These are linked to the capital investment, which is bared by limited resources. In Sudan the managerial capabilities are very poor due to the absence of information and management systems. Since groundwater in the Nubian Sandstone is fossil water, uncontrolled extraction of water from the aquifer may lead to drop in the water table leading to environmental hazards. And since there are no environmental examinations of pre-development programmes, most of the development projects yielded negative environmental impacts. The environmental impacts affecting the project area are: sand dunes, erosion, desertification, subsidence, drought in the oases and extinction of wildlife. The sustainability of the mentioned development projects required good management of the water resources in the area.

Institution name: **Directorate of Groundwater & Wadis**

Ministry: **Ministry of Irrigation and water resources**

Annual budget allocated for the management and development of groundwater:

Institution	**$**
Directorate of Groundwater and Wadis, **Mini. of Irrig & water resources**	20000000
National Water corporation **Mini. of Irrig & water resources**	200000000
Rural water corporations (**16 States Ministries for water works**)	500000000
Total	**720000000**

Activities carried out by Directorate of Groundwater and Wadis**:**

- Gash basin water resources management
- Wadi Nyala basin water resources management
- Sahara Nile basin water resources management
- Sahara Nubian basin water resources management
- Khartoum basin water resources management
- Updating of Hydrogeological map of Sudan
- Geophysical investigations
- Well siting using geophysical methods

- Chemical analyses for water samples
- Consultation on groundwater issues

Activities carried out by National Water Corporation:
- Drilling wells for water supply for Urban areas

Activities carried out by Rural Water Corporation:
- Drilling wells for water supply for Rural areas

Data Gaps:

It is strongly needed to extend the real network and grid points to the south (south latitude 22 00 in Chad and Sudan) so that the work conducted on this aquifer can depend on reliable data.

Required Data:
- Topographical data (elevation with respect to sea level)
- Hydrogeological data:
    1. Exact location of water point
    2. Elevation of water point amsl
    3. Lithological data
    4. Design of wells
    5. Distribution of screens to know the tapped layers
    6. Water level data
    7. Water quality data
    8. Directions of flow of groundwater
    9. Recharge areas
    10. Precipitation
    11. Isotope data

The northern part of the Nubian aquifer (in Egypt & Libya) is highly developed. Exploratory & observation wells as well as production wells exist in a reasonable manner. The occurrence of these well-distributed water points helps a lot in the understanding of the aquifer mechanism on local basis. The results of the mathematical models and other studies depend on generation of data in the area south latitude 22 00.

Expected actions: To overcome and cover data gaps the following actions are needed:

For topographic data:
TOPOGRAPHICAL SURVEY USING PRÉCISED GPS TO DETERMINE ELEVATIONS OF THE WATER POINTS

For precipitation:
INSTALLATION OF RAIN GAUGES TO RECORD PRECIPITATION DURING RAINY SEASONS

For recharge and flow directions:
GEOPHYSICAL INVESTIGATIONS ARE REQUIRED

For hydrogeological data (No.2 to No. 9):

Drilling of exploratory wells:
The following drilling sites in Sahara Nubian Basin are proposed (taking into consideration other wells to be drilled in the area)

Proposed sites for drilling exploration wells in Sahara Nubian basin

No.	Location	Long.	Latit.	Cost $
1	Salima Oasis	28 15	21 00	60000
2	Laqiya Omran	28 00	19 30	60000
3	Nukheila	26 15	19 28	60000
4	Nubi 1	25 00	19 25	60000
5	Nubi 2	28 00	18 00	60000
	Total			**300000**

PLANNED ACTIVITIES (RELATED TO THE IAEA/UNDP/GEF NSAS PROJECT:

No	Activity	Year 2005				Year 2006			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	Well inventory								
2	Procurement of equipment								
3	Identification of observation wells								
4	Construction of observation wells								
5	Installation of data loggers								
6	Geophysical investigations								
7	Monitoring water levels and water quality (Northern state)								
8	Monitoring water levels and water quality (Darfur state)								
9	Field campaign for water sampling (Northern state)								
10	Field campaign for water sampling (Darfur state)								
11	Analysis and interpretation of data								
12	GIS & Groundwater modelling								
13	Reporting: - Progress - Technical								
14	Training: - Remote sensing - Isotope hydrology - G.I.S. & modelling - Geophysics								

Government contribution in kind

- Furnished Offices for project staff
- Transportation means
- Customs for equipment
- Staff (salaries. Allowances, motivations …etc
- Laboratory (furnished building with relative equipment)

ANNEX 7

1992, CONSTITUTION OF THE JOINT AUTHORITY FOR THE STUDY AND DEVELOPMENT OF THE NUBIAN SANDSTONE AQUIFER WATERS, (ENGLISH TRANSLATION)

Constitution of the Joint Authority for the Study and Development of the Nubian Sandstone Aquifer Waters

"Chapter one"
Establishment, headquarters, purpose and membership

Article (1)

An authority has been established between the signed countries under the name "Joint Authority for the Study and Development of the Nubian Sandstone Aquifer Waters"

Article (2)

The Headquarters of the Authority shall be in Tripoli, Great Socialist People's Libyan Arab Jamahiriya. The Board of Directors may establish branches or offices inside or outside the member countries.

Article (3)

The Authority shall undertake the following tasks:

(1) Collection of all information, data, and results of studies made by relevant countries. Classifying, analysing and correlating such information, data and study results.

(2) Prepare and execute all complementary studies required for the determination of the complete features of this Aquifer as to quantity and quality.

(3) Develop programmes and plans for the utilisation of water, propose a common policy for the development and utilisation of water resources, nationally and regionally, execution of the common policy for water resources, and drawing plans, programmes and the necessary frameworks for their execution.

(4) Adopt scientific basis for water management of this Aquifer.

(5) Establish co-operation in the field of training and habitation activities related to water resources.

(6) Undertake to ration the consumption of Nubian Sandstone Aquifer Waters in member countries.

(7) Study of environmental aspects of underground Aquifer development, desertification control and renewable energy use.

(8) Organise symposiums and disseminate information on this Aquifer and to consolidate relationship with relevant regional and international organisations and institutions.

Article (4)

Other countries may join this Authority, provided that such countries are within the Nubian Sandstone Aquifer countries.

"Chapter Two"

Authority Management

Article (5)

Aboard of directors consisting of three part time members for each member country shall manage the Authority. The Directors shall be appointed by the Minister of public works and water resources of Arab Republic of Egypt and the Secretary of General People's Committee for Agricultural Land Reclamation and Animal Wealth of the Great Jamahiriya and their counterparts in member countries.

Article (6)

Chairmanship of the Board of Director of this authority shall be on a rotation basis. The competent Secretary or Minister shall appoint the Chairman, for the duration of one year.

Article (7)

The Board of Directors shall hold its meetings in the main offices of the authority once every four months, to be convened by the chairman. Meetings may be held outside the main offices at the place indicated in the convention notice, and may be held on other dates at the request of a member country. The call for meeting made by the chairman shall be in writing, stating date and place of meeting and the agenda, three weeks before the date of meeting.

Article (8)

A Board meeting shall only be valid if attended at least by two thirds of members from each party. In the failure to attain such quorum, the meeting shall be deemed as valid if attended by any number of members after the second call. Resolutions of the Board of Directors shall be made by the majority of the present voting members, provided that the agreement of two thirds of the members on the following resolutions:

(1) Resolutions in regard to Budget consideration and approval.
(2) Resolutions with respect to proposals for establishing relationships with regional and international organisations and institutions and donor countries.
(3) Resolutions on the opening of branches or offices in founder countries or new members countries.

Article (9)

The Chairman of the Board of Directors or his deputy may invite representatives of international organisations, and donor countries and institutions to attend the meetings of the Board of Directors as observers.

Article (10)

The Board of Directors shall undertake to carryout all works related to the management of the Authority Affairs, consider all the necessary means for the achievement of its interests, guiding its activities towards meeting its goals and in particular:

(1) Payment of initial expenses for establishment and registering the authority making all the necessary procedures and the determination of general administration expenses or the establishment period.
(2) Audit and approve the authority's annual draft budget.
(3) Draw an annual report on the authority's activities at the end of each financial year, and submit it to the governments of member countries to be sent by certified mail to the concerned authorities.
(4) Establish branches and offices for the Authority inside or outside member countries.
(5) Appoint a general Director for the Authority and define his duties.
(6) Appoint Directors for branches and offices to be opened in accordance to this constitution.
(7) Draw plans and polices aimed to the achievement of the purposes of the Authority.
(8) Issue By-laws and instructions for the management of administrative and financial affairs.
(9) Approve the organisational structure and personnel cadre of the authority, to be proposed by the Executive General Director.

Article (11)

The Chairman of the Board of Directors shall represent the Authority in its relation with others and before courts. Also he shall act on behalf of the Authority in signing contracts and agreements in accordance with the recommendations of the Board of Directors.

Article (12)

The Chairman of the Board of Directors shall be paid an annual remuneration of USD ( ), and each board member USD ( ).

Article (13)

The Authority shall have an Executive General Director, appointed by a resolution of the Board of Directors, which shall also decide on his salary, with work term of three renewable full years, to exercise the following powers:

(1) Execution of the recommendations and resolutions of the Board of Directors.
(2) Follow-up technical studies related to the activities of the Authority.
(3) Record meeting minutes and decisions of the Board of Directors.
(4) Direct supervision of the technical, administrative and financial departments of the Authority.
(5) Execute memos and letters related to the Authority operations and activities.
(6) Any other works assigned by the Board of Directors of the Authority.

Article (14)

The Authority shall have an administrative body including a number of technical, administrative, legal personnel and others to perform jobs concerned with the achievement of the Authority's objectives, and to execute recommendations and resolutions of the Board of Directors.

The number and powers of these personnel shall be determined in accordance to the organisational structure and personnel cadre proposed by the Executive General Director of the Authority, be approved by the Board of Directors as per Paragraph nine in article ten of this constitution.

(Article 15)

The necessary personnel shall be selected to work with the Authority on transfer basis, from member countries governments. The Authority shall bear all the necessary costs. The Authority may fill certain department posts by appointment or inclusive remuneration.

"Chapter three"
Budget, Accounts and Financial Resources

Article (16)

The governments of member countries shall bear budget funds for the Authority on equal shares. Governments shall observe the payment of all financial funds required for budget, in order to enable the Authority to execute its mission.

Article (17)

The Authority shall draw an annual budget, which will include the necessary financial funds for that year. The Board of Directors shall submit the draft budget to the governments of the member countries three months before the beginning of the financial year of the Authority.

Article (18)

The fiscal year of the Authority's budget shall commence and ends by the beginning and end of the financial year of the country in which the Authority Headquarters are located.

Article (19)

An account or more shall be opened in a transferable currencies and local currency with a bank operating in the Authority's seat country, in which accounts the annual funds are deposited for expenditure the limits defined in the budget. Other accounts may be opened in member countries.
The fiscal year of the Authority's budget shall commence and ends by the beginning and end of the financial year of the country in which the Authority Headquarters are located

Article (20)

Expenditure shall only be approved within the limits of the funds allocated in the budget, with no funds to be used for other purposes unless approved by the Board of Directors.

Article (21)

Financial resources of the Authority shall consist of annual contributions from member countries and donations from national and international institutions and organizations and donor countries.

Article (22)

The Authority may enter into financial obligations against future annual budgets for operations extending for more than one year, provided that the value of obligations or relevant contracts shall not be in excess of total allocated costs.

Article (23)

The Executive General Director of the Authority shall prepare final accounts for the annual budget of the Authority within at maximum three months before the end of the financial year to be submitted for approval by the Board of Directors, after having been audited by a certified accountant.

"Chapter four"
General Provisions

Article (24)

The Authority- shall have a corporate body with relevant rights. The Board of Directors shall draw internal By-laws, administrative and financial regulations without being bound by the regulations current in member countries, such regulations shall be issued by resolutions of the Board of Directors.

Article (25)

Financial and administrative regulations adopted by Arab States League and its organisations shall apply until detailed financial and administrative regulations for the Authority shall be made.

Article (26)

The Board of Directors of the Authority may amend certain items in this By-laws if necessary, subject to approval of two thirds of the Board of Directors.

Article (27)

This By-Laws will all come into force as of approval date.