DRAFT SSEA STAGE 1

VOLUME II - BASELINE

EASTERN NILE TECHNICAL REGIONAL OFFICE

CONSULTING SERVICES FOR STUDIES ON IDENTIFICATION OF PROJECTS CONSTITUTING THE FIRST JOINT MULTIPURPOSE PROGRAM (JMP 1) ON ABBAY/BLUE - MAIN NILE

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in association with national sub-consultants:

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LIST OF ABBREVIATIONS AND ACRONYMS

ADLI	Agricultural Development Led Industrialization
AEWA	African – Eurasian Waterbird Agreement
AfDB	African Development Bank
AHD	Aswan High Dam
BCM	Billion (1,000,000,000) cubic meters
BOD	Biological Oxygen Demand
CADD	Computer Aided Design and Drafting
CBA	Working Session and Communications Based Assessment
CBSI	Confidence Building and Stakeholder Involvement Project
CBWS	Comprehensive Basin-wide Study
CCDD	Convention to Combat Desertification and Drought
CDM	Clean Development Mechanisms
CDO	Civil Defense Office (Sudan)
CFA	Nile Basin Cooperative Framework Agreement
CLEQM	Central Laboratory for Environmental Quality Monitoring
COD	Chemical Oxygen Demand
COMESA	Common Market for East and South Africa
CRA	Cooperative Regional Assessment (Studies)
CSOs	Civil Society Organizations
DaNSS	Database for Nile Secondary Stakeholders
DO	Dissolved Oxygen
DSS	Decision Support System
EAPP	Eastern Africa Power Pool
EEAA	Egyptian Environmental Affairs Agency
EEPCO	Ethiopia Electric Power Corporation
EFTCA	Egyptian Fund for Technical Cooperation
EGYPTERA	Egyptian Electric Utility & Consumer Protection Regulatory Agency
EIA	Environmental Impact Assessment
EMA	Ethiopian Mapping Agency
EN	Eastern Nile
ENCOM	Eastern Nile Council of Ministers
ENPTS	Eastern Nile Power Trade Study
ENSAP	Eastern Nile Subsidiary Action Program
ENSAPT	Eastern Nile Subsidiary Action Program Team
ENTRO	Eastern Nile Technical Regional Office
EPA	Environmental Protection Authority (Ethiopia)
EPFIs	Equator Principles Financial Institutions
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
EWUAP	Efficient Water Use for Agriculture Production
FeMSEDA	Federal Micro and Small Enterprises
FPEW	Flood Protection and Early Warning
FSL	Full Supply Level
FtC	Facing the Challenge
GAFRD	General Authority for Fish Resources Development
GHG	Greenhouse gas
GIS	Geographical Information System
GWWCL	Groundwater and Wadis Central Laboratories
GWWD	Groundwater and Wadis Directorate
Hec-RAS	Type of hydrological / hydraulic model
HAC	Humanitarian aid Commission (Sudan)

HRS	Hydraulic Research Station
IDEN	Integrated Development of the Eastern Nile (Projects)
IFC	International Finance Corporation
IOGD	Irrigation Operation General Directorate
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent Power Producer
IPP	Indigenous Peoples Plan
IPPF	Indigenous Peoples Planning Framework
IWMI	International Water Management Institute
JMP	Joint Multipurpose Program
JMP 1 ID	Joint Multipurpose Program 1 Identification Studies (this Consultancy)
MALR	Ministry of Agriculture and Land Reclamation
MCA	Multipurpose Criterion Analysis
MCM	Million Cubic Meters
MHUNC	Ministry of Housing, Utilities and New Communities
MoE	Ministry of Electricity
MoIWR	Ministry of Irrigation and Water Resources (Sudan)
MoHP	Ministry of Health and Population
MoLD	Ministry of Local Development
MoP	Ministry of Planning
MoT	Ministry of Transportation
MoU	memorandum of Understanding
MoWR	Ministry of Water Resources
MSE	Micro and Small Enterprises
MSEA	Ministry of State for Environmental Affairs
MWRI	Ministry of Water Resources and Irrigation
NBCBN	Nile Basin Capacity Building Network
NBI	Nile Basin Initiative
NCWR	National Council for Water Resources (Sudan)
NEC	National Electric Corporation
NIOF	National Institute of Oceanography and Fisheries
NRI	Nile Research Institute
NTEAP	Nile Transboundary Environmental Action Project
NTFP	Non-timber forest products
NWC	National Water Corporation
NWD	Nile Waters Directorate
OSI	One System Inventory
PAP	Project Affected People
PASDEP	Plan for Accelerated and Sustained Development to End Poverty
PDF	Portable Document Format
PFS	Prefeasibility Study
PJTC	Permanent Joint Technical Joint Commission for Nile Waters
POE	Panel of Experts
RAP	Resettlement Action Plan
RAPSO	Type of hydrological / hydraulic model
RCC	Roller compacted concrete
ROW	Right of Way
SDO	Social Development Office
SIA	Socio-economic impact analysis
SICAS	Stakeholder Consultation and Communication Strategy
SMA	Sudan Meteorological Authority (Sudan)
SMEs	Small and Medium Enterprises
SNWP	Sudan National Water Policy
SPOT	Système Pour l'Observation de la Terre (satellite imagery)

SSEA	Strategic Social and Environmental Assessment
STRM	Shuttle Radar Topography Mission
ToR	Terms of Reference
TWRO	Technical Water Resources Organ
UNEP	United Nations Environment Program
UNESCO	United Nations Education, Scientific and Cultural Organization
USBR	United States Bureau of Reclamation
WB	World Bank
WBISP	Wood Biomass Inventory and Strategic Project
WHO	World Health Organization
WSS	Water Supply and Sanitation
WUA	Water User Associations

1. INTRODUCTION

1.1 CONTENT OF VOLUME II

The present document constitutes the second volume of the Strategic and Social Environmental Impact Assessment (SSEA) and contains the baseline data from which is built the Main SSEA Report found in the first Volume.

1.2 DETERMINATION OF SPATIAL AND TEMPORAL BOUNDARIES

The SSEA methodology starts by establishing a baseline of actual conditions in a determined geographical area, taking into account near future impacts based on existing trends and probable impacts anticipated during the study time horizon 2030 considering the No-JMP option and unilateral development.

This approach allows the Stage 1 SSEA to identify the risks and opportunities of the JMP 1 against conditions expected to evolve based on present trends, as well as future conditions likely to arise with each country pursuing unilateral development, without cooperation with other countries.

The **spatial boundaries** have been determined as the area in which the development of water resources of the Abbay/blue and Main Niles could have environmental and social impacts, whether direct or indirect. Although that investment is planned upstream on the Abbay River or its tributaries and that impacts will occur downstream, mostly on the flood plain, it is recognized that linkages and value chains may extend well beyond the flood plain. Consequently the length of the Study Area extends from just downstream of Lake Tana to the Aswan High Dam, fully recognizing that it will extend to the Nile Delta for a number of issues such as water quality, and will also cover the White Nile from its confluence with the Blue Nile upstream up Jebel Aulia.

The width of the Study Area also needs to be determined at the strategic level. Because the planned interventions discussed, whether unilaterally or jointly, are limited to a large extent to the Abbay/Blue – main Nile River and the Abbay tributaries, it is necessary to define a corridor on either side of the river that would be affected by the investments. Since the most obvious physical manifestation of river is the seasonal flooding during and after the rain season, it is reasonable to limit the Study area to the corridor affected by flooding during extreme events. It also has to be recognized that some impacts will manifest themselves beyond that zone, for example atmospheric emissions from biomass decomposition or thermal development. This has been taken into consideration as appropriate. Figure 2-1 in next Chapter presents the study area.

2. BIO-PHYSICAL BASELINE IN THE STUDY AREA

This chapter presents a description of the bio-physical and socio-economic conditions prevailing in the region. The study area encompasses two major watersheds: the Abbay/Blue Nile from Lake Tana in Ethiopia down to Khartoum in Sudan; and the Main Nile from Khartoum down to the Aswan High Dam in Egypt. Also, where specific information is available and relevant for the stretch downstream of Aswan and to the Abbay tributaries, it has been included.

The following descriptions focus on providing the baseline from which the most strategic and critical issues were selected to be part of the Main Report. They are based on existing and available information and are not intended to be exhaustive; emphasis is placed on capturing those key aspects that are necessary to inform decision-makers at the strategic and sectoral levels. Where it is felt that critical gaps exist in the available information to properly inform the decision-making process, they are highlighted for future studies.

2.1 PHYSICAL ENVIRONMENT

2.1.1 Regional Setting

From a regional perspective, the entire Eastern Nile watershed is of paramount importance to the subsistence of the riparian populations, as it offers a number of ecosystem services providing water and dietary requirements, sources of income, transport avenues, water for irrigation, agriculture and electricity, just to name a few.

To illustrate its importance, the Eastern Nile basin covers some 1,787,624 km^2, of which the Main Nile, the Baro-Akobo-Sobat, the Abbay/Blue Nile, and the Tekeze-Atbara respectively cover 44%, 26%, 17%, and 13% respectively. It is estimated that 152 million of people live in the four sub-basins combined. The Abbay/Blue Nile and the Main Nile are the most heavily populated, accounting for 79% of the total population. The largest part of this population, over 100 million, depends on the Eastern Nile for its subsistence.

At the head of the region, the river starts with the Abbay River in the Ethiopian Highlands where it runs for a distance of approximately 800 km from Lake Tana to the Ethiopian border with Sudan, where it becomes the Blue Nile and runs for another 650 km to Khartoum where it merges with the White Nile to form the Main Nile (Figure 2-1). The entire Abbay/Blue Nile Sub-basin covers an area of 311,548 km^2.

Two very distinct landscape units are found in the Abbay/Blue Nile Sub-basin. First, a very mountainous relief found in Ethiopia that tapers down towards the west close to the Sudanese border, and flat lowlands that extend west to Khartoum where the Blue Nile merges with the White Nile to form the Main Nile.

2.1.2 Climate

Climate in the upper course of the Abbay/Blue Nile Sub-basin is of the humid and sub-humid tropical type. Westerly dry moist winds cover much of the Ethiopian highlands plateaus causing wet seasons in the western highlands of Ethiopia, including the Abbay river Sub-basin. The south has a relatively longer wet period and has a humid tropical type of climate while the northern portion, with relatively shorter wet period, has a sub-humid type of tropical climate.

Figure 2-1 Abbay/Blue- Main Nile Sub-basins - Location Map

Climate in the lower course of the Blue Nile (beyond the Ethio-Sudan border) is hot tropical with a dominant dry season. Further to the south where the altitude is higher (in the Sudd watershed) climate is of the sub-humid tropical type while to the north, around Khartoum and Roseires reservoir, climate is hot tropical. The dry and hot tropical climate dominates the further northern reaches, as part of Sahara desert.

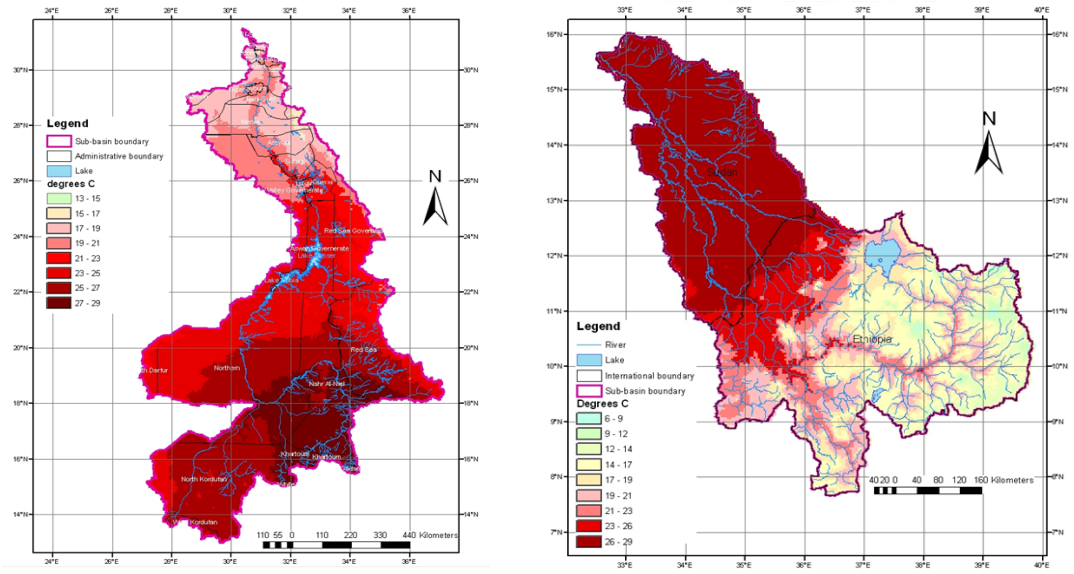
The Main Nile is characterized by an arid climate where moisture is almost non-existent. The presence of the Nile has enabled the support of life along the narrow strip on its banks downstream of Khartoum and down to the Aswan High Dam (AHD) and into the large delta.

2.1.2.1 Temperature

Mean annual temperatures in the Abbay/Blue Nile and Main Nile Sub-basins are shown on Figure 2-2. At high altitudes (>2,300 masl) in the western highlands plateau of Ethiopia, mean annual temperatures are in the range of 17ºC to 19.5ºC. Temperatures rise, ranging from 24ºC to 26.5ºC, toward the Ethio-Sudan border where altitude drops to less than 1,000 masl,. At the confluence of the Blue Nile with the Main Nile, around Khartoum, the altitude is below 500 masl and temperatures range from 28.5ºC to 30.5ºC.

Temperature in this Sub-basin is very hot, due to the desert climate, with mean annual daily temperature varying from above 30ºC (around Dongola and AHD) to 18ºC in the coastal areas (Alexandria). The maximum air temperature increases generally from north to south and the difference between the maximum temperatures from north to south reaches 15°C in May and June, and 5°C in January. The hottest month in the north is June, while August is the hottest month on the northern coast. The minimum air temperature in the Egyptian part of the Sub-basin is found during January.

Figure 2-2 Mean Annual Temperatures in the Abbay/Blue Nile and Main Nile Sub-basins



Source: Hydrosult et al, 2007.

2.1.2.2 Precipitation

Rainfall in the Abbay/Blue Nile Sub-basin varies both seasonally and spatially. Spatial variability is both horizontal (south-north direction) and vertical (along the river course). Horizontal variation ranges from above 1,500 mm in the southern portion of its upper course to about 1,000 mm in the northern portion of its upper course. Similarly, in its lower course mean annual rainfall ranges from 700 mm (south portion at El-Damazin station) to less than 500 mm in its northern portion. Vertical variation ranges from above 1,500 mm (at the western highlands of Ethiopia) to 120 mm at Khartoum at its mouth. In the southern half of the upper course, the length of the wet spell is relatively longer, lasting for more than five months (April/May to October/November). In most of the northern part of the upper course of the Blue Nile Sub-basin, the wet period is limited to less than three months and seasonal variability is higher.

More than 65% of the Main Nile Sub-basin has a mean annual rainfall of less than 50 mm and only 17% of the Sub-basin has a mean annual rainfall of above 100 mm. Mean annual rainfall at Khartoum is below 200 mm, which reduces to less than 20 mm at Atbara, and to less than 5 mm at Dongola and the Aswan High Dam. At Cairo it is 25 mm and increases to 200 mm in Alexandria on the Mediterranean coast. Main seasonal precipitation is concentrated in the May – October period in the

southern part of the Sub-basin while it is spread over October to March in the northern part. The Lake Nasser/Nubia area is by far the driest part of the entire area.

Mean annual spatial distribution of precipitation in the Eastern Nile is shown on Figure 2-3.

Average runoff over the entire area of the delta in Egypt is estimated at 1 (billion cubic meters (BCM), accounting only for 3% of the runoff reaching the Delta through the Nile system.

2.1.2.3 Evaporation

Temperature and evaporation are well correlated with altitude in the Abbay/Blue Nile Sub-basin, following the same pattern as temperature. In the upper course, evaporation is lower due to the high altitudes and cooler temperatures. Mean annual potential evaporation ranges from about 1,500 mm in the Highlands of the Sub-basin to more than 6,800 mm around Khartoum. Horizontal variation of evaporation is also significant. In the southern half of the upper course, mean annual evaporation falls below 1,500 mm and in the northern half, especially at its northern tip, evaporation is above 1,800 mm.

Potential evaporation in the Main Nile Sub-basin is considerably higher than in the Blue Nile. It is estimated at 6,800 mm at Khartoum, 7,800 mm at Dongola, 5,800 mm at AHD and 1,800 mm at Alexandria on the coast of the Mediterranean Sea. Lake evaporation at HAD is estimated at 2,600 mm per year (Egypt OSI report Water Component, May, 2006), which could represent over 10 BCM per year according to available estimates, and a lake area of 5,250 km^2 (Jeuland 2008; OSI, 2009).

Annual evaporation in the Abbay/Blue Nile Sub-basin is shown on Figure 2-4, and for the Main Nile Sub-basin on Figure 2-5.

Figure 2-3 Mean Annual Rainfall Spatial Distribution (Isohyets), Abbay/Blue-Main Nile Sub-basin

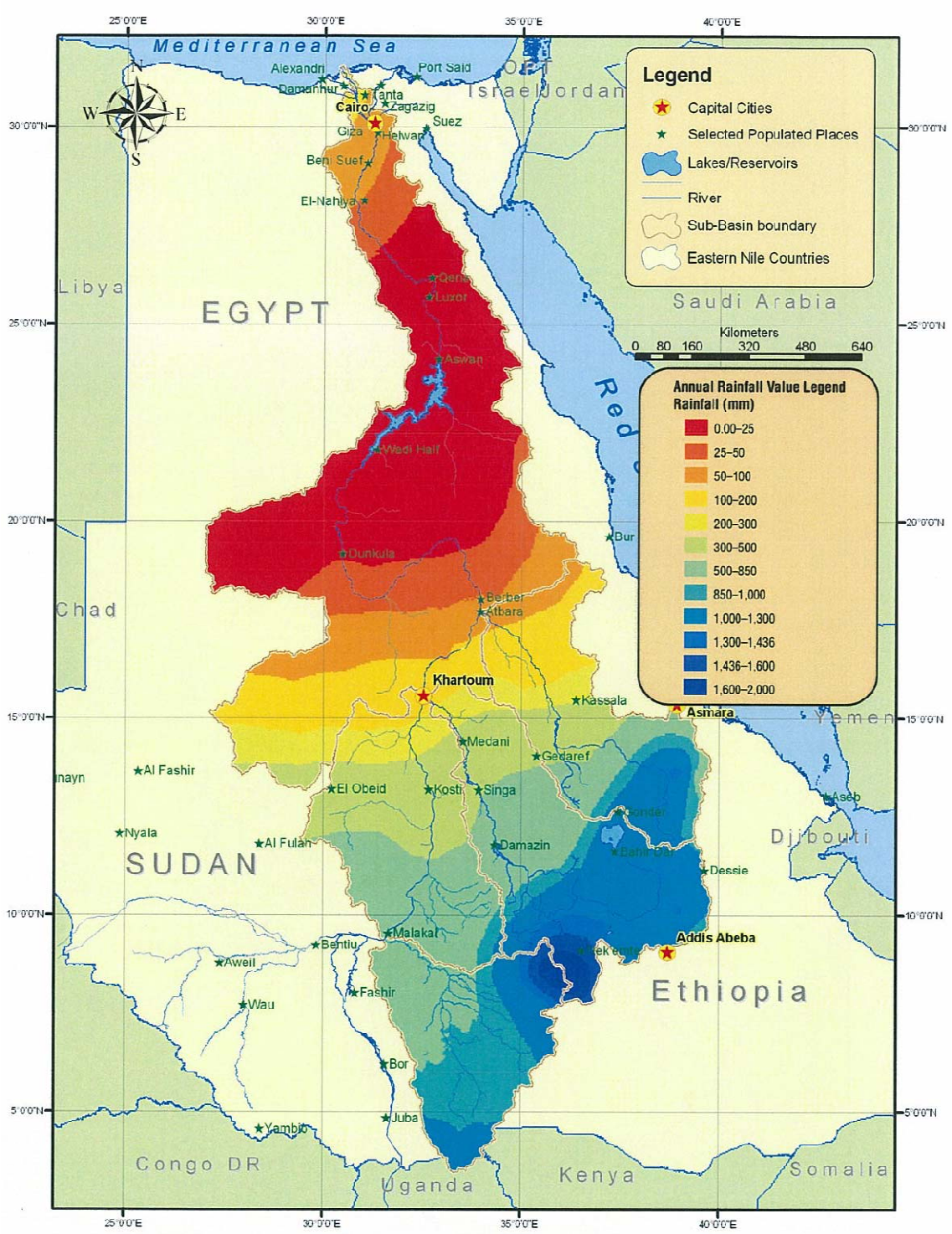


Figure 2-4 Annual Potential Evaporation in the Abbay/Blue Nile Sub-basin

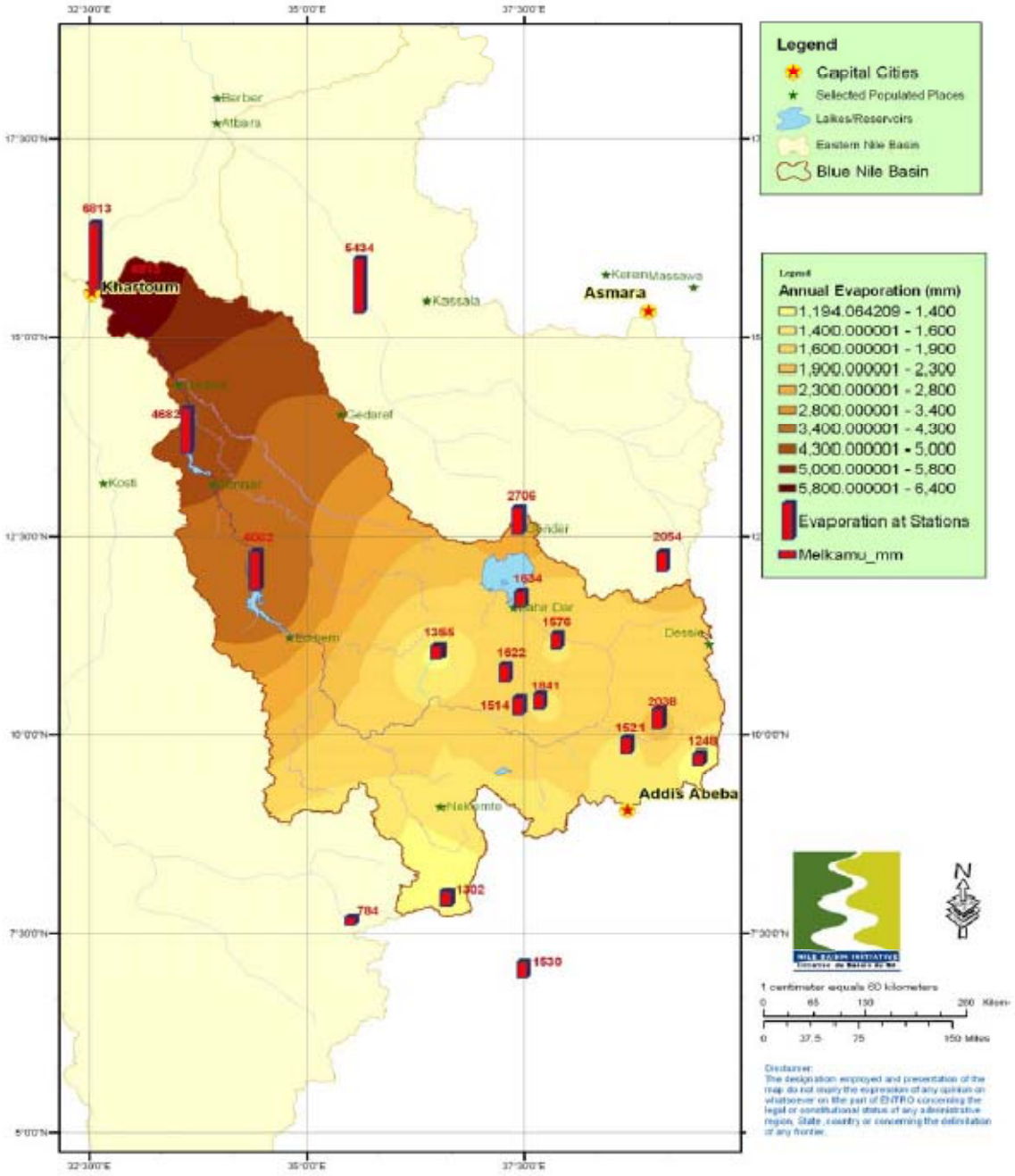
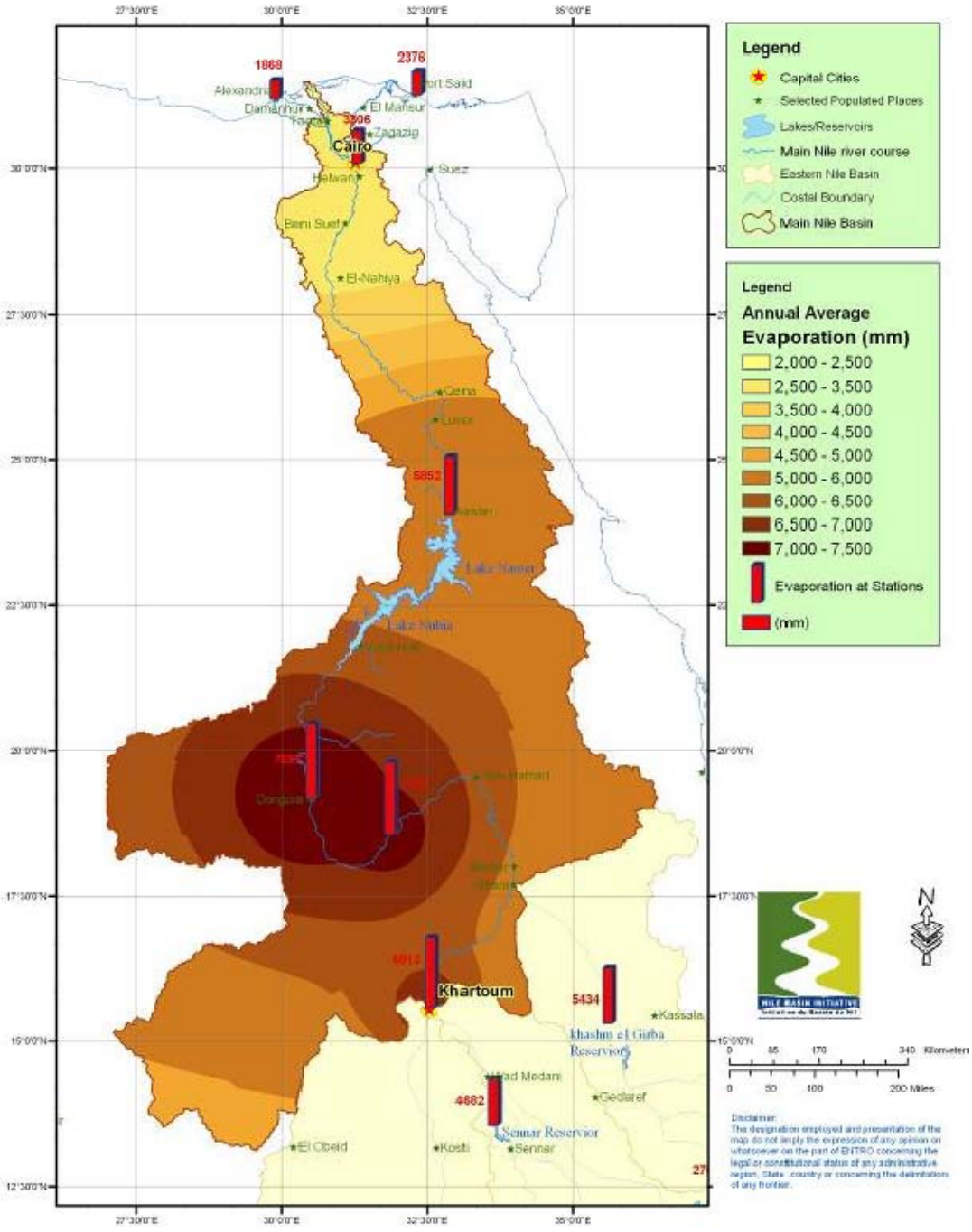


Figure 2-5 Annual Evaporation in the Main Nile Sub-basin



Source: ENTRO OSI data base

2.1.3 Hydrology

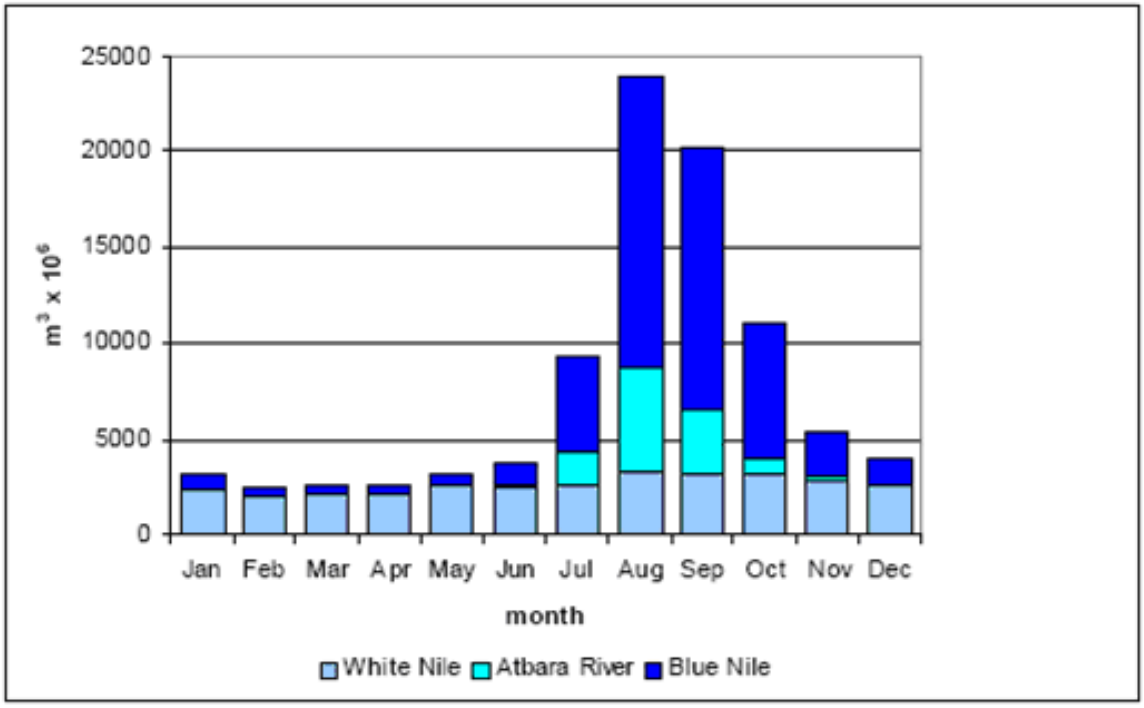
2.1.3.1 Surface Water

In the Ethiopian Highlands, the Abbay River and its tributaries are deeply incised into the plateau leaving a series of isolated tableland separated by deep gorges. This contrasts sharply with the Blue Nile portion where the relief is almost flat with slopes less than 2.5%.

The Abbay Sub-basin is extremely important to the Eastern Nile system. It constitutes the second largest drainage area in Ethiopia, but has the highest runoff, accounting for 50 percent of the total water runoff in Ethiopia at 51 billion m3/y (BCM) at the Ethiopian – Sudan border, due to high precipitation in the Ethiopian Highlands. In the Sudan area of the Abbay/Blue Nile, the water balance shows that the contributions of the Rahad and Dinder rivers is slightly smaller than the loss to evaporation and the use of water for irrigation. This results into a slight decrease to 48.7 BCM/y at the junction of the Blue Nile with the White Nile to form the Main Nile (OSI, 2009).

Figure 2-6 drawn from the Karadobi Initial Environmental Assessment (Norplan, et al., 2006) illustrates the importance of the Abbay/Blue Nile to the Eastern Nile basin. It also shows that the flow is up to 5 times higher during its peak during the month of August. It is interesting to note that the water of the White Nile is relatively unchanged during the course of the year while the waters coming from Ethiopia (through mostly the Abbay/Blue Nile and from the Atbara to a lesser extent) that are responsible for the peaks and flooding.

Figure 2-6 Relative importance of the Abbay/Blue Nile to the Eastern Nile



Source: Karadobi Initial Environmental Assessment (Norplan, *et al.*, 2006)

From the One-System Inventory (OSI, 2009) the following figures may be used to represent the annual flow of the Abbay/Blue Nile at different nodes (Table 2-1).

Table 2-1 Flows and Abstractions along the Abbay/Blue-Main Nile (OSI, 2009)

Node	BCM/year Average[1]
Abbay at the Ethiopia – Sudan Border	51.0
Blue Nile at the Roseires Dam	49.3
Abstraction between Roseires and Khartoum for irrigation	- 6.3
Rahad and Dinder contribution	4.0
Blue Nile at Khartoum (long-term average)	48.7
White Nile at Khartoum	25
Total Main Nile Khartoum	74
Tekeze – Setite - Atbara contribution	12
Main Nile at Atbara	86.3
Abstraction for irrigation in Sudan between Atbara and Dongola	- 1.2
Mean inflow reaching Lake Nasser/Nubia	85.1
Discharge at the AHD	55.5
Abstraction between AHD and Cairo	-17.5
Flow passing Cairo	35
Abstraction between Cairo and Delta Barrage	- 17.4
Abstraction Between Delta barrage and Edfina and Farascour Barrages at the mouth of the Main Nile	- 15.6

1) Does not take into account evaporation.

Overall, it is estimated that the Abbay contribution to the Main Nile discharge into Lake Nasser/Nubia is around 62% and the total Ethiopian contribution to the Nile waters is 72%.

The flow passing Khartoum and entering the main Nile is developed from two major Sub-basins: the Blue Nile, constituting 66% of its flow and entering the main Nile from a easterly direction; and the White Nile, constituting 34% of its flow, entering from a southerly direction. It is generally accepted that the base flow in the Nile accounts for nearly 40% and comes from the White Nile, while the runoff of about 60% comes from the East, mostly from the central and western highlands plateaus of Ethiopia through the Blue Nile, with some runoff elements added from the south western highlands plateaus of Ethiopia through the Baro-Akobo Sub watershed.

The Main Nile Sub-basin is one of the four major Sub-basins in the eastern portion of the Nile Basin and is located in the northern-most portion of the Eastern Nile Basin. The Main Nile Sub-basin starts at Khartoum upstream of the White Nile/Blue Nile confluence and extends downstream to the Mediterranean Sea. From Khartoum to Wadi Halfa, at the Sudanese – Egypt border, it runs for 1,490 km, and then runs for an additional 1,532 km inside Egypt to the south, ending in the Mediterranean Sea. It covers a total area of 789,660 km^2; 89% of which lies in Egypt and 11% in the Sudan. The Main Nile enters Egypt through Dongola station, the last gauging station in the Sudan, then through the Nubian Lake, an extension of the Aswan/Lake Nasser in Sudan.

The construction of Aswan High Dam (AHD) created Lake Nasser with a length of 500 km (350 km in Egypt and 150 km in Sudan usually known as Lake Nubia). The lake has an average width of 12 km and surface area of 6,000 km^2 at the highest water level.

Its only tributary along the way is the Tekeze-Atbara River which enters the Main Nile at Atbara. Except in years of exceptional rainfall (e.g. August 1988) there is no other inflow. On the Main Nile, between Khartoum and the AHD the only construction or storage is the Merowe Dam at the Fourth Cataract, about 400 km north of Khartoum.

With the exception of the Sabaloka gorge about 80 km north of Khartoum, the Main Nile flows through an arid plain with occasional rocky outcrops. It is estimated that most of the Main Nile Sub-basin (96%) has a slope of less than 5%, while slope ranging from 5% to 10% cover about 3% of the

Sub-basin and the remaining area (less than 1%) is identified to have a slope greater than 10%. Therefore, the area is considered relatively flat compared to the relief found along the Abbay.

The mean annual flow contribution from the south Sub-basins through the White Nile at Khartoum averages 25 BCM and the inflow entering from the east Sub-basins through the Blue Nile averages 48.7 BCM (long-term average is normally taken as 50 BCM). This makes the mean annual inflow to the Main Nile at Khartoum 74 BCM (see Table 2-1).

2.1.3.2 Groundwater

Groundwater in the Eastern Nile region is important as it used by a large portion of the population as drinking and irrigation water. Available quantities are, however, not well studied and the recharge mechanisms are poorly understood.

In Ethiopia the groundwater potential is not known with any certainty, but it is guessed that, so far, only a small fraction of groundwater has been developed and this is mainly for local water supply purposes.

In the highlands of Ethiopia, groundwater is almost exclusively confined to consolidated rocks where the retention capacity is low and any groundwater is confined to the occurrence of fractures. The recharge is generally restricted and shallow aquifers are not exploited. In addition, the presence of deep gorges along the Abbay escarpment provide relatively free drainage for the aquifers which may emerge as springs in the lower slopes, thus drawing the groundwater table down deeper in the locality of this escarpment and further reducing their potential storage ability. Yirgalen *et al.* (2008) have determined that the flood plain around Lake Tana receives about 160 MCM from base flow of the rivers, while the flood itself contributes 100 MCM to Lake Tana. The difference, 60 MCM or 37% is being stored in the flood plain and can recharge the aquifer.

Groundwater is found under about 50% of the area of the Sudan. The groundwater basins are found in simple or complex forms according to their geological formations which can be classified as follows:

- The Nubian Sandstone Aquifer which includes; Sahara, Nile Basin, Wadi El Magadam, Wadi El Qa'ab, El Khowi and Wadi El Selaim. This aquifer, shared by Sudan, Egypt, Libya and Chad is likely the most important aquifer in the region. The depth of this aquifer is up to 1,500 meters (FAO, 2005). Maison (2003) differentiates between fossil groundwater and the groundwater from the Nile aquifer. The latter is renewed by the Nile water and irrigation water, and can therefore not be considered as separate from the Nile.
- Sahara Nubian Basin: This covers the northern part of northern Darfur State
- Nuhud Basin: It covers parts of the central part of northern Kordofan State
- Other basins include: Sag El Na'am, River Atbara, Umm Rawaba, Sudd, Eastern Kordofan, Blue Nile, Nubian Basalt, Shagara and the Alluvial Basins.

On the Sudanese plains the hydrogeological system comprises two aquifers: an upper and a lower. The upper aquifer includes mainly the Upper Geezer Formation, the upper part of the Lower Geezer formation in the area between the Blue and White Nile, and the upper part of the Lower Motorman Formation to the north of the Blue Nile. The water storage in the lower aquifer is some eight times that of the upper aquifer.

In arid areas such as Sudan, rain usually comes in sudden storms and flows down the wadis which normally have an impermeable layer beneath their beds. It has been estimated that about 80% of runoff in a typical storm is lost to human use because of high evaporation and therefore this water is not used to recharge the aquifer. The recharge usually occurs from irrigation and wetlands. Indeed, flooding during and after the rain season are important to allow some recharge of the aquifer in the flood plains. Eldaw (2003) has estimated that the total annual recharge in Sudan is at around 4 BCM.

In Sudan groundwater constitutes the main water supply source for drinking and domestic use for more than 80% of the human population and their livestock in the country.

In Egypt, four categories of groundwater basins have been recognized based on the geological formations where they are found.

- Basement complex rocks only have a limited groundwater yield.
- The Nubian Sandstone Aquifer forms the most extensive and largest groundwater basin in Sudan and Egypt. Although recharge from rainfall is very limited a substantial annual amount is received from the Nile River system. The quality is good to excellent with salinity values rarely exceeding 600 mg per liter.
- The Quaternary-Tertiary aquifers are located in a steep sided rifted basin in the Blue Nile Rift in Sennar State. The total annual recharge is estimated at 160 million m^3. Water quality is variable with local highly salinized zones.
- The alluvial basins are located along most seasonal streams and are recharged from rainfall and seasonal flows. Water quality is generally good. Along the Gash and other streams shallow hand dug wells are used to irrigate small plots of vegetables.

The Nubian Sandstone Aquifer found in Egyptian Western Desert and Sinai aquifers is mostly deep and non-renewable. The total groundwater volume has been estimated at about 40,000 BCM. However, current abstraction is estimated to be only 0.9 BCM/year. The main obstacles in utilizing this huge resource are the great depths (up to 1,500 m in some areas) of these aquifers and deteriorating water quality at increasing depths.

In Egypt, groundwater is extensively used in the delta area for irrigation purpose. Just as in Sudan, groundwater in the Nile aquifer in Egypt cannot be considered a separate source of water. The aquifer is recharged only by seepage losses from the Nile, the irrigation canals and drains and percolation losses from irrigated lands, wetlands and seasonal flooding. Hence, its yield must not be added to Egypt's total water resources. Therefore, it is considered a reservoir in the Nile river system with a large capacity but with only 7.5 BCM/year rechargeable live storage. The current abstraction from this aquifer is estimated at 7.0 BCM in 2009 (MWRI, 2010).

2.1.4 Water Quality

2.1.4.1 Surface Water

Generally the main sources of water quality data are found in individual country reports on water quality. Data is generally available on basic chemistry, anions- cations and very little data is available on heavy metals, organics and sediment quality as well as for aquatic invasive alien species.

Contaminants

In Ethiopia, the industrial activities in the Abbay Sub-basin are currently limited to the regional capital towns and the main industries are textiles, soft drinks, food, metals & tanneries. Most of these industries do not have any waste treatment facilities. One notable pollutant is chromium from the tannery industry, which is expanding. There is however no specific data available on Chromium in surface water. Other pollutants include hydrogen sulphide, dyes and caustic soda (NBI, 2005).

Historical records of water quality on the Abbay are generally not available and no data is available for Ethiopia from the United Nations Global Environment Monitoring System Gemstat. As part of the fieldwork for the Mandaya, Border and Karadobi pre-feasibility studies single water quality samples were obtained from Abbay River at the Bure-Nekemte Bridge at the upper end of the potential Mandaya Reservoir, at the proposed Border dam site downstream, and also at the Karadobi site. A sample was also taken of Beles River at Beles River Bridge (23 kilometers from Mankush). These records are snapshots only. They cannot begin to describe water quality in flood conditions in July to September when most water is delivered. Also, they cannot be used to assess trends by comparing them to the data from USBR 1964 and BCEOM 1996 in NBI 2005 because they do not represent

annual means that can be compared. Having noted this, no pollution or nutrient level is out of the expected range.

According to the OSI Summary of 2009, apart from high sediment loads, the water quality of all rivers in the Abbay sub-basin that are distant from urban centers is adequate for most uses. However, NBI (2005) reports a high fluoride and potassium content, and suggests further investigation. In the Ethiopian Country Report presented at the 6th Regional Water Quality Working Group Workshop conducted from 28th to 30th July 2008 in Kigali, Rwanda, it was indicated that it was too difficult to describe water quality status and trends of biological and chemical parameters due to the lack of seasonal regular water quality monitoring. However, based on the evaluation of available data, an attempt was made to portray the water quality status. Accordingly, water quality was described as having neutral pH (5.5-8.5), low salinity (139-622 µs/cm) and low nutrients (2.6-24 mg/L of NO_3) (Abyi, 2008).

In Sudan, a survey was undertaken in the Khartoum area in 2002 and 2004 to identify sources of pollution. It revealed the following:

- Two sites at the Blue Nile and at the White Nile confluence recorded BOD values higher than the maximum World Health Organization (WHO) guideline value.
- All the sampling sites, apart from one, exceeded the WHO Oil and Grease guideline values, with maximum values of 231 and 237 recorded at the power stations on the Blue Nile. However it should be noted that the WHO does not have any criteria for Oil and Grease in surface waters, but the World Bank suggests 10 mg/L for discharge into surface water.
- The chromium (Cr+6) level of one sample from the White Nile was 0.42mg/L - ten times greater than the WHO guideline value. This criterion has now been changed to a guideline for total chromium (0.05 mg/L) because of difficulties in analyzing for the hexavalent form only.
- The White Nile samples were more bacteriologically polluted than the Blue Nile samples.

Sudan is also very committed to agriculture and has used pesticides since the 1930's, DDT was used in the Gezira scheme in the mid-forties until 1982, after which it was replaced by organophosphates and carbamates, and in 2004 neo-nicotinoids were introduced. Often rules of safe applications are not followed and a number of pollution incidents occurred and pesticides were found in fish in Lake Nubia/Nasser (NBI, 2005).

Fertilizers also cause severe problems in run-off and supplement the rise of the nutrients in the rivers leading to algal blooms, multiplication of macrophytes and alter the phytoplankton species composition and hence all the ecosystem components. Also owing to the increased eutrophication of lakes, there has been a proliferation of water hyacinth. The pesticide 2-4D has been used in chemical control of the water hyacinth, which was efficient but the ecological consequences were considered to be too dangerous and its use has been discontinued.

Several areas and cities in Sudan depend on the Nile system for their drinking water. The presence of sediment in the Blue Nile water increases turbidity and suspended solids, therefore resulting in poor quality of water for domestic use with several impacts, particularly during the flood season. It has also a number of detrimental consequences:

- Accumulation of sediments at the dead ends of water network, which encourages after growth of micro-organisms, and hence affects the health of consumers.
- Clogging of pipe networks and increasing incidence of pipes bursting and occurrence of cross connections polluting drinking water. When chlorine is utilized for disinfections of such water of poor quality, chlorine oxidizes organic matter in water usually generates complex compounds leading to health hazards.
- Use of high doses (more than 5 mg/L) of polymers of organic nature for treating water during the flood season has been during the flood seasons of 1999-2002. Accumulation of polymer residual in water may cause serious health risks for consumers, if it is utilized over a long period of time.

- Combination of inorganic salts such as Alum and Poly Aluminum Chloride produces better water quality during the flood season. However, the effects of both salts in combination over a long period of time have not being determined.

Finally, it should be noted that the list of parameters that have been analyzed and reported is very limited, particularly in light of the fact that some 600 agro-chemicals, many of which are hazardous to humans and livestock, are used on irrigated farms and much of the residue is washed into drains and eventually to the Blue Nile (Hydrosult et al,. Sudan Country Report, 2007).

Two sets of data are available in order to compare trends of water quality in the Blue Nile in the Khartoum area. There is first a set of data covering the period 1980 to 1992 from the United Nations Global Environment Monitoring System Gemstat, and a second one found in the NBI (2005) report for 2003 - 2004. Unfortunately, the data found in the Appendix of the NBI report is not presented in a format that allows comparison of annual averages. Nevertheless, the following trends could be detected in the 1980 to 1992 period.

Augmentation of most of the parameters presented in Figure 2-7: Biological Oxygen Demand, Conductivity, Alkalinity, Ammonia, Total Phosphorus, Temperature, Potassium (not presented) has also increased slightly.

Sulfates and Fluorides have decreased during the same period.

Figure 2-7 Trends for Selected Parameters in the Blue Nile at Khartoum

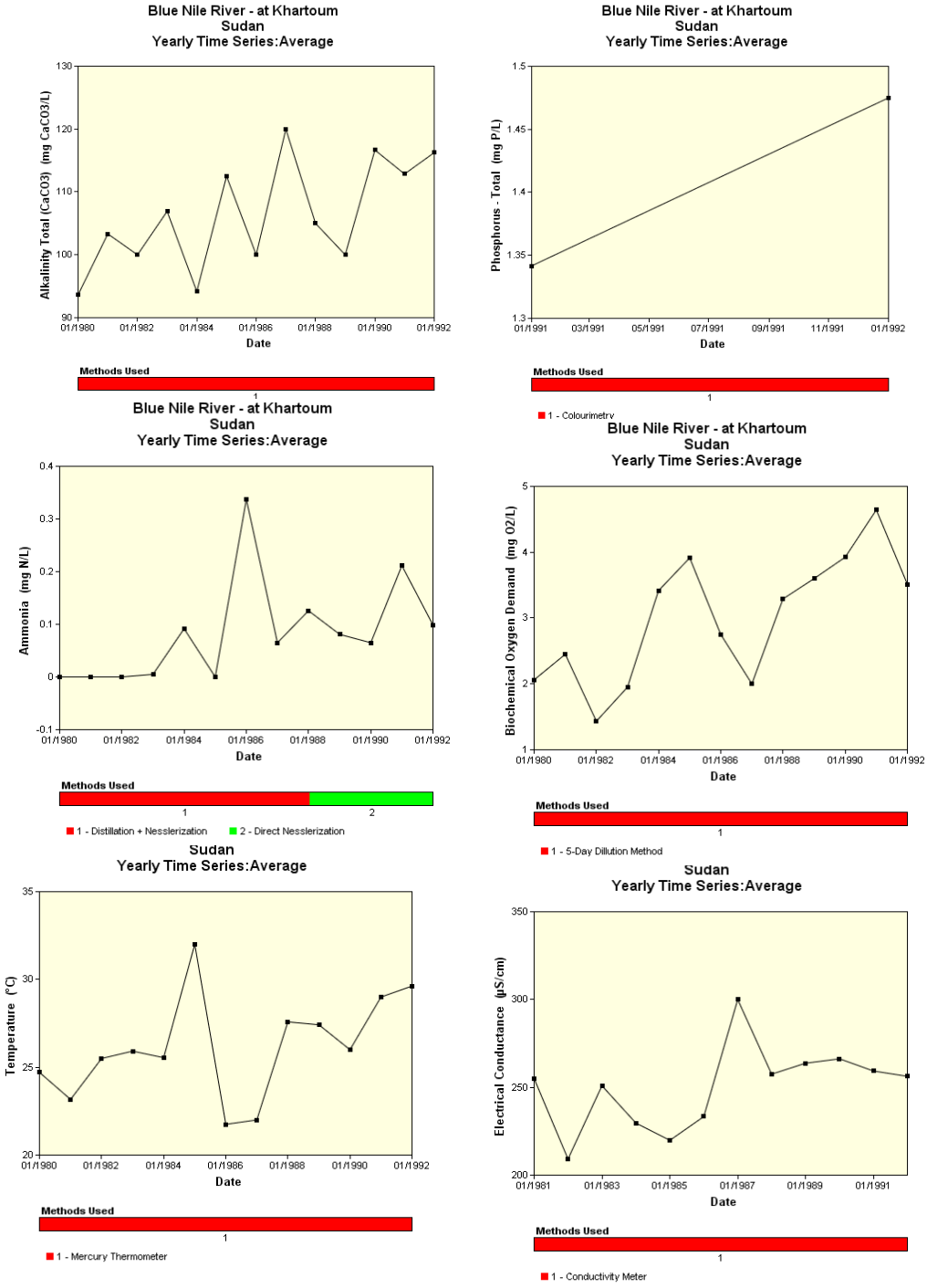


Table 2-2 presents data for the Main Nile at Dongola, Sudan for the period 2003-2004.

Table 2-2 Water Quality in the Main Nile at Dongola, Sudan, 2003-2004

Parameters	Nile (Dongola)	
	Max	Min
Water level (m)	13.5	9.26
Discharge (m^3/day)	681	49
Turbidity (NTU)	6575	5
pH	8.4	7.3
Conductivity (µmhos/cm)	278	183
Hardness (mg/L)	116	50
Alkalinity (mg/L)	178	122
Calcium (mg/L)	40	14
Magnesium (mg/L)	17	3
Chloride (mg/L)	34	7.1
Sulfates (mg/L)	39	1
Nitrates (mg/L)	12.3	0
Nitrites (mg/L)	0.99	0
Total Suspended Solids (mg/L)	8400	8
Total Dissolved Solids (mg/L)	194	126
Fluorides (mg/L)	0.85	0.2

Source: National Nile basin Water Quality Monitoring Baseline Report, 2005.

In Egypt, according to the OSI Appendices Main Nile Sub-basin (2009), water quality is one of the most important environmental issues. Because of intensive agricultural and industrial activities, pollution is significantly higher and is an important environmental problem in the Sub-basin.

Uncontrolled discharge of human, industrial and agricultural wastes is the main source of contamination. Amongst these sources, agro-industrial, small private industries and sugar cane industries are identified as important sources upstream of the AHD. Downstream, numerous other sources, including high population and areas of industrial density add to the contaminant load and decrease the quality of the water. The major water quality problems are pathogenic bacteria/parasites, heavy metals and pesticides. Other chloro-organic contaminants such as PCB have also been identified.

It is important to note that most of the sources of contamination of the Main Nile arise in the stretch downstream from the Aswan High Dam. Upstream of AHD, i.e. in Lake Nasser/Nubia, data is much scarcer and sources of contamination are mostly from agricultural drainage and sewage from settlements. Immediately downstream of the Aswan High Dam, there are several agro-industries such as sugar cane, hydrogenated oil and onion drying factories that, along with small private industries, significantly affect the Main Nile water quality.

Agriculture is the major cause of non-point source pollution, with a number of potential impacts on environmental and human health. In many agricultural areas, local surface and groundwater contamination has resulted from leaching of nitrates from fertilizers, and bacteria from livestock and feed wastes. Agricultural pesticides are both a potential diffuse source of water contamination.

The major impacts of agriculture on water quality of the Main Nile in Sudan and Egypt are:

- Increase in salinity
- Deterioration of quality due to fertilizers and pesticides
- Eutrophication of water bodies due to an increase in nutrients from fertilization

- Currently, there are strict controls on the use of fertilizer and agro-chemicals close to the Lake Nasser/Nubia shore. The Bio-organic Control project at Aswan has developed a number of biological controls of plant pests that will obviate the need to use insecticides and fungicides.

Since the construction of the Aswan High Dam, the water quality of the Nile in Egypt has become primarily dependent on the water quality and ecosystem characteristics of the reservoir (Lake Nasser), and less dependent on water quality fluctuations of the upper reaches of the Nile. Water released from Lake Nasser generally exhibits the same seasonal variation and the same overall characteristics from one year to another.

Table 2-3 summarizes the results available for Lake Nasser/Nubia and the groundwater from the deep Nubian sandstone aquifer for the period 2005 – 2009, Water quality for the Lake and Al-Sheikh Zayed canals and tributaries is similar. No results for metals or organic compounds are available for that area.

Table 2-3 Water Quality in Lake Nasser, El Sheikh Zayed Canals and Deep Nubian Aquifer (2005 – 2009)

Parameters	Unit	El-Sheikh Zayed canal (1)	El-Sheikh Zayed canal (2)	Pumping from Lake Nasser	Pumping from Groundwater well
pH	----	8.61	9.28	7.63	6.62
Carbonate CO_3	mg/L	9.20	9.28	0.0	0.0
Bicarbonate HCO_3	mg/L	117.12	107.36	0.43	2.55
Electrical Conductivity (EC)	umohs/ cm	0.362	0.350	0.27	0.782
Total dissolved solid (TDS)	mg/L	231	224	172.8	373
Ammonia NH_3	mg/L	0.1	----		
Major Cations					
Calcium Ca	mg/L	15	13	0.60	2.55
Potassium K	mg/L	11	11	0.1	0.12
Magnesium Mg	mg/L	12	7.2	0.27	0.86
Sodium Na	mg/L	31	30	1.73	3.78
Major Anions					
Chloride Cl	mg/L	8	10	1.6	2.8
Nitrate NO_3	mg/L	1.7	3.1	---------	---------
Sulphate SO_4	mg/L	84.48	48	0.59	1.96
Sod. adsorption ratio SAR	mq/l	1.44	1.65	2.62	2.86
Residual Sod. Carbonate RSC	mq/l	0.49	0.82	0.44	0.86

Source: Sustainable Development for the southern Valley Area", executed by National Water Research Center, Ministry of Water Resources and Irrigation.

A relatively recent report on the Nile entitled the *Third Study on Water Quality of the Nile River (2001*), NBI (2005) reports that:

- For ten years after 1991 the BOD value of the Nile River has remained fairly stable, though the BOD values of about 30% of the sampling points were over 6 mg/L, the Egyptian standard limit, particularly in three points at Tanta RPO and four points at the Upper Egypt.
- Nitrites concentrations are about stable, but nitrates concentrations were lower;
- Total phosphorous concentrations around Cairo were low.
- Cadmium, lead and nickel previously not detected appear to be increasing slightly;
- Some pesticides were detected at low concentrations.

Further downstream, it was reported by NRI (2001) that:

- In general, the dissolved oxygen was satisfactory as all sites DO concentrations were higher than 7.0 mg O_2 /L, indicating the high assimilation capacity of the River Nile.
- The Chemical Oxygen Demand (COD) values showed slight, but steady increase from south to north. Twenty-one sampling sites out of 35 examined exceeded the standard limit of (10 mg O_2 /L).
- The BOD value showed a random distribution but did not exceed the standard value of 6 mg O_2 /L. The correlation between COD/BOD values indicated the presence of non-biodegradable organic compounds probably from industrial sources.
- There was an increase in total dissolved solids (TDS) from 171 mg/L at Aswan to 240.

Salinity

In Egypt, an increase of salinity has been noted in the Nile Delta area likely caused by an upward seepage of brackish groundwater (OSI, 2007). Also, It is estimated that because of irrigation in Upper Egypt, between 2.3 BCM (OSI, 2007) and 4 BCM (Wahaab and Madawi, 2004) of drainage water is returned to the Nile annually, either directly or indirectly.

This means that total soluble salt concentration of the Nile is higher in Lower Egypt (250 ppm) as compared to Upper Egypt (160-200 ppm) (ENTRO, 2007). Both sources agree that this is not a very serious problem because of the high dilution effect of the Nile and that the increase in salt concentration is not significant in terms of any type of possible water use (ENTRO, 2007; Wahaab and Badawi, 2004). However, fertilizers mostly consist of nitrates and phosphates salts, which may cause eutrophication problems in drainage canals and other water bodies that indirectly receive drainage water (NBI, 2005b). The same source also warns that there is a real danger that the salinity of drainage water could increase steadily over the years and suggests that a cautious approach to increasing the use of drainage water, especially in terms of water quality, is likely to be the long term interest of the country.

Sanitation

Although, as reported by the OSI Summary of 2009, water quality of all rivers in the Abbay Sub-basin distant from urban canters appeared to be adequate for most uses, it can be seen from Table 2-4 presenting data on the sanitation facilities, that there is clearly a lack of sanitation in the Sub-basin for the cities reported. In Ethiopia, in the Abbay Sub-basin, over 60% of the population does not have access to sanitation facilities in the regions of Amhara and BSG. The proportion of people with no sanitation facilities is even higher in the woredas where it may reach as much as 80%.

These figures suggest important organic loading with other contaminants associated with rural and/or urban settlements, including organic contaminants.

In Egyptian rural areas, which are predominant in the Lake Nasser/Nubia area, only 5% of the population is connected to sewers and only about 25% is considered as having some sanitary facilities (Egypt Environment Action Plan). Table 2-5 drawn from the Hydrosult et al. – Main Nile Sub-basin (2006) presents the situation of the sanitation along the Main Nile in Sudan and Egypt.

Table 2-4 Sanitation facility by type in the Abbay/Blue Nile Sub-basin (expressed as % of the population with access to facilities)

State	Flush to Sewage System	Flush to septic tank	Traditional pit latrine	Soak away pit	Others	Missing	No facilities
Blue Nile	--	3.5	56.0	3.2	0.4	0.8	36.0
Gaderif	--	5.0	31.7	3.1	0	0	60.1
Khartoum	1.1	11.2	73.8	0.9	3.1	0.4	9.5

State	Flush to Sewage System	Flush to septic tank	Traditional pit latrine	Soak away pit	Others	Missing	No facilities
El Gezira	--	4.2	51.7	2.1	1.7	0.2	40.0
Sinnar	--	2.7	46.6	5.3	2.1	0.7	42.7
	Flush - private	Flush – shared	Pit - private	Pit - shared	Other		No facilities
Amhara	1.6	1.2	18.2	16.2	1.1		61.7
BSG	2.2	3.9	30.3	0.3	1.7		61.6
Oromia	1.8	1.4	33.4	22.4	1.1		39.9

Sources: Sudan: UN Population Fund & Sudan Central Bureau of Statistics. (2002). Ethiopia: World Bank, 2004.

About 20% percent of the total population (5% urban and 25% rural) lacks safe public drinking water supplies and rely instead on potentially contaminated, untreated surface water or hand pumps which tap often contaminated shallow groundwater. This accounts for the fact that Egypt in particular has been plagued with epidemics related to water- borne or water-related pathogens in the past. Salmonella, Shigella, Vibrio-cholera, hepatitis, gastroenteritis and other parasites have caused a number of epidemics over the years.

Table 2-5 Sanitation Facility by type in the Main Nile Sub-basin (% of population)

State	Flush to Sewage System	Flush to septic tank	Traditional pit latrine	Soak away pit	Others	Missing	No facilities
Northern	--	7.7	69.2	1.6	1.6	--	19.9
Nile	--	12.3	72.6	0.7	0.7	0.1	13.5
Red Sea	--	20.9	26.1	4.2	0.7	0.2	47.9
North Kordofan	--	2.9	31.4	1.9	1	0.1	62.6
North Sudan	--	7.7	69.2	1.6	1.6	--	19.9

Source: Hydrosult et al, 2006.

2.1.4.2 Sediment Loading / Erosion

Sediment

Erosion and sediment loading are two interrelated consequences of several characteristics of the watershed. In the Abbay Sub-basin, agriculture expansion and overgrazing onto steep slopes and the consequent loss of vegetation have accelerated geological rates of soil erosion. In turn steep slopes and lack of vegetative cover have resulted in high rates of sediment delivery to the main rivers.

In Sudan, the situation is similar, with the difference that the relief is less steep, somewhat reducing the sediment loading in the Blue Nile compared to the loading of the Abbay in Ethiopia. However, bank erosion naturally occurring because of river meandering is exacerbated by excavation of soil for brick making and building, the removal of tree vegetation along the banks, different cropping patterns and dumping of material into the river. The quantity of sediment originating from bank erosion is not known.

Apart from a direct effect on water quality, increased suspended matter, higher turbidity and reduced light penetration, the most important off-site negative impacts of soil erosion are sedimentation of streams and water storage infrastructure. High sediment loads in streams pollute water supplies, and cause siltation of dams, reservoirs, water-harvesting structures and irrigation canals, reducing their effective capacities, shortening their service lives, and incurring high maintenance costs, at national, community and individual levels.

Establishing a reliable sediment portrait in the Abbay/Blue Nile watershed is a difficult task. Previous studies carried out for the Cooperative Regional Assessment, the individual EIAs done for the pre-feasibility studies of Karadobi, Mandaya and Border, as well as the data reported in the OSI, plus the special study conducted by the NBCBN/River Morphology Research Cluster (Nile Basin Capacity Building network, 2005) all indicate data gaps, discrepancies an uncertainties in the data available. Notwithstanding these constraints it is possible to draw the following picture.

- There is presently little or no storage capacity of sediment within the Abbay river system, which is to be expected given the steep gradients in both tributary and main rivers. It would appear that the Abbay River system is relatively efficient in delivering and removing eroded sediment from the landscape.
- From the data on suspended sediment discharge at three key stations on the main Abbay River, it appears that most of it comes from the tributaries located in the south and west parts of the sub-basin.
- The value of approximately 128 to 168 million tons per year of average suspended sediment measured at the El Diem station of the Sudanese border and reported by the Abbay Master Plan Report and the NBCBN/River Morphology Research Cluster seems like a minimal value that may in fact be as much as double that value according to the Mandaya PFS and the CRA Ethiopia Country Report. Table 2-6 presents the range of values estimated by various sources.

Table 2-6 Estimates of Sediment Transport at Mandaya, Border, El Deim and Roseires

Location	Estimate of sediment transport Mt/year	Source	Notes
Mandaya	124	Abbay Master Plan, Phase 2, Data Collection – Site Investigation Survey and Analysis. Section III, Volume 2: Dam Project Profiles. (February 1998)	Estimate appears to be made on the basis of sediment sampling in a seven month period in one year (March to September 1961), now more than 45 years ago
Mandaya	285	Mandaya pre-feasibility engineering report, this study, 2007	Based on estimate based on sampling at Kessie in 2004 only, and yield of 900 t/km^2/year downstream of Kessie. Includes estimate of bed load.
Roseires	40	NBCBN/River morphology research cluster (2005)	Annual silt deposit behind Roseires dam in 1965
El Deim	140	NBCBN/River morphology research cluster (2005) and CRA Country Report (September 2006)	Includes estimate of bed load. Based on bank-side bottle sampling, approximately 125 samples in the months of July, August, September and October in 10 individual years spanning from July 1970 to August 1994
Border	168	Abbay Master Plan, Phase 2, Data Collection – Site Investigation Survey and Analysis. Section III, Volume 2: Dam Project Profiles. (February 1998)	Assumed to include bed load and thought to be based on sediment sampling in 1961 only.

Location	Estimate of sediment transport Mt/year	Source	Notes
Roseires	273	Tekezi Medium Hydro Study (1998) cited in CRA Country Report (September 2006)	Mean annual suspended sediment load at Roseires
Roseires	335	Abbay River Basin Master Plan (1999)	
Border	318	Border pre-feasibility engineering report study (Border EIA 2007)	Includes estimate of bed load
Aswan Reservoir	45 to 180	Ahmed and Ismail, 2008	

It is unlikely that a single value can adequately represent the sediment load in the Abbay/Blue Nile system as there are several parameters to consider that could significantly affect the quantity of sediment reaching the river:

- Quantity of rain over during the rain season
- Intensity of precipitation
- Location of precipitation in the watershed
- Velocity of the flow

For the purpose of evaluating the impacts of the JMP 1 or No-JMP alternatives, precision is not absolutely necessary as the differences between no dams, small dams and large dams on the Abbay or its tributaries will be significant and will be sufficient to discriminate between the alternatives.

Both dams on the Blue Nile, Roseires and Sennar, are well known to be affected by siltation. The Sudan Ministry of Irrigation and Water Resources reports that sedimentation in the Roseires Dam increased from 300 MCM in 1970 to 1,264 MCM in 2000, thus resulting in a loss of 38.3 percent of its design capacity and sedimentation now has caused a serious reduction in live storage. This also has impacts on the operation of the dams because the gates are kept open and turbines closed down during the high flood peak to avoid excessive siltation and damage to the turbine blades, thereby resulting in less than optimal operation of the dams, causing losses of irrigation water and hydro power.

The sediment carried by the river, particularly in the season of high flows, enters the Nasser/Nubia Reservoir where they decant. The sediment loading comes from several sources:

- The portion coming from the Abbay Sub-basin not trapped by the dams at Roseires, Sennar and Merowe
- Sediment coming from other watersheds such as Atbara and Tekeze
- The portion coming from erosion of banks
- An undetermined quantity coming from sand dunes either tipping in the river or blown by winds

The following Table 2-7, modified from the CRA Main Nile report (Hydrosult *et al.*, 2007), presents what would be the reduction in sediment loading in lake Nasser with the completion of the dams presently under construction, plus the Karadobi dam in the event it were to be built. Indeed, if more dams were to be built on the Abbay, the reduction of sediment loading would be even higher.

Table 2-7 Estimated Sediment Retention in Reservoirs of Dams under Construction and Proposed in Ethiopia and Sudan

Dam	Low sediment retention (million tons/yr)	High sediment retention (million tons/yr)
A EXISTING or UNDER CONSTRUCTION		
Tekeze (Atbara)	9.33	31.10
Tana-Beles (Blue Nile)	0.47	1.56
Micro dams – Ethiopia	0.50	1.30
Merowe (Main Nile)	33.00 [1]	97.24
Total	**43.30**	**131.16**
B. PROPOSED		
Karadobi	60.50	99.40
Total	**60.50**	**99.40**

1. Assumes 120 million tons + reduced sediment load at Merowe due to reductions in Ethiopia (109.7million tons)

Bank Erosion

River bank erosion may occur at any point along the course of the Main Nile from Khartoum to Lake Nubia. At the onset the movements of meanders that are causing river bank erosion and subsequent sedimentation are a natural phenomenon. However, in a number of areas this natural process has been accelerated through human interference of the river hydrology.

In the Ed Debba-Dongola reach, tipping sand from shifting dunes is said to cause shifts in the main channel, which cause bank erosion downstream. In other areas inappropriate land use (e.g. banana plantations, clay pits for brick making) is believed to be a major cause of bank erosion.

Sand Dunes

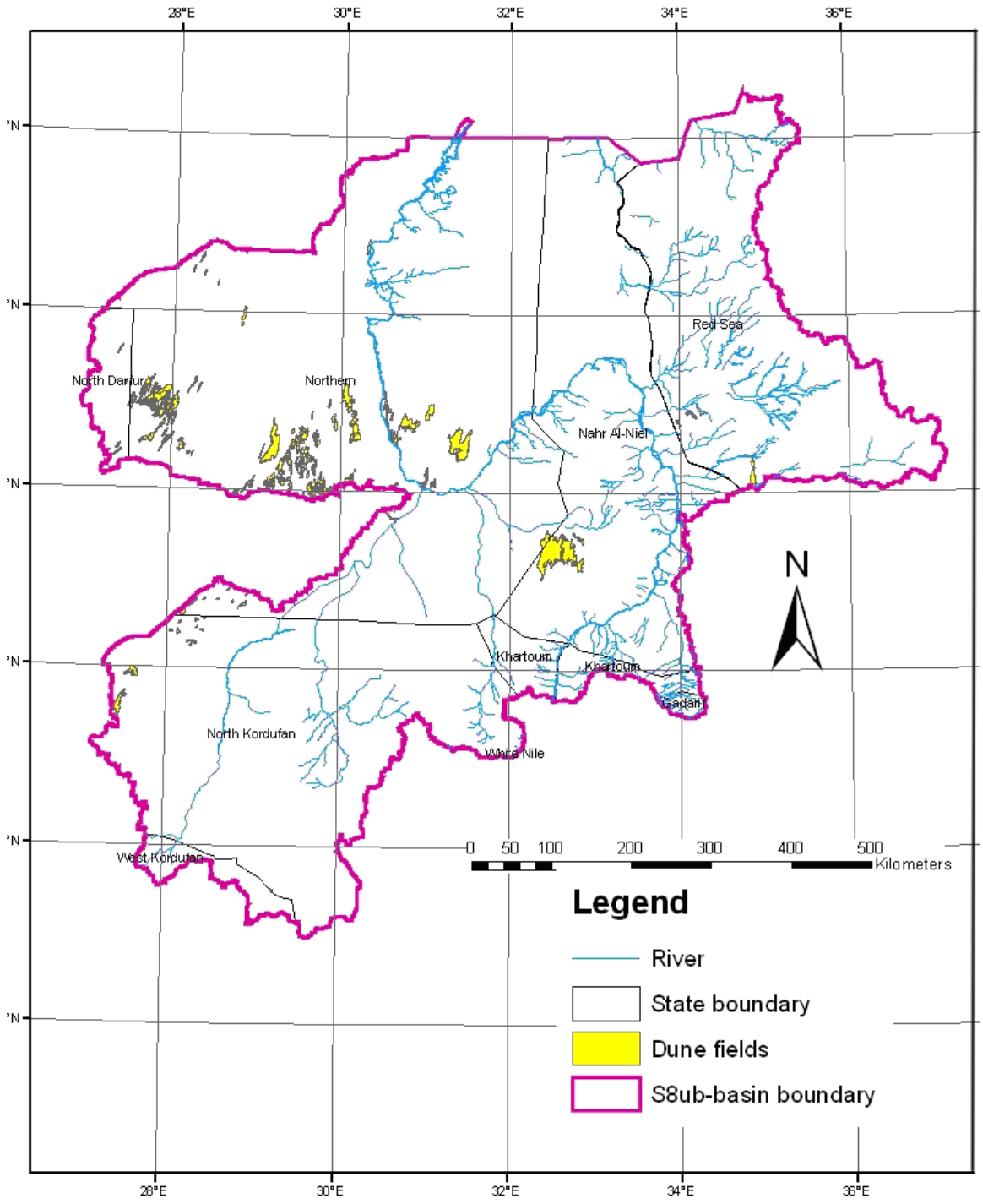
Shifting sand dunes are a problem in the Main Nile Sub-basin, particularly in Sudan between Khartoum and the Sudan-Egypt border, mostly, in the area between Dongola and Karima because of northeast prevailing winds (Figure 2-8). Some are already on the shore of the river, while others are still 20 to 60 km away. Those on the river present an actual high risk of tipping sand into the river; but in the absence of any measurements it is difficult to estimate the amount of sand tipping into the River.

The other dunes farther away are a hazard to settlements, irrigated fields, and roads. According to the Africacover map of the area, approximately 6,200 feddans[1] (2,570 ha) of currently irrigated land are immediately threatened (Hydrosult *et al.* – Transboundary Analysis: Main Nile Sub-basin, 2006).

While there is no doubt that they contribute to the accumulation of sand and sediment in the Main Nile, and likely to the accumulation of sediment in the Lake Nasser/Nubia reservoir, the quantity of sediment directly due to the sand dunes tipping into the river is not quantified at the present time.

[1] One Feddan equals 0.42 ha

Figure 2-8 Sudan – Main Nile Dune Fields



Source: (Hydrosult *et al.* – Transboundary Analysis: Main Nile Sub-basin, 2006)

Furthermore, none of the three development alternatives as considered in this document has any direct impact on the occurrence of sand dunes or the quantity of sand discharged into the river. There exists mitigation measures considered at the local level to protect irrigated areas as much as possible, but they are independent of the three alternatives considered.

2.1.4.3 Groundwater Quality

No significant and relevant information is available regarding groundwater quality in Ethiopia in the Abbay watershed.

In Sudan, it is thought that the water quality of the groundwater is generally good for drinking and irrigation requirements with the exception of a few isolated localities (OSI, 2009). This is however a very general statement that needs validation. ENTRO is conducting a Special Study into groundwater which should help to provide more information.

In Egypt, in several areas, groundwater quantity and quality was found to be decreasing, on one hand because of its use for irrigation, and on the second hand because of contamination in nutrients and other agro-chemicals used in irrigated areas. Groundwater is contaminated from nitrogen and fertilizers, the use of which has quadrupled between 1960 and 1988, and the impact of pesticide and herbicide use, the latter having been used to control weeds in canals. Shallow aquifers, in particular in the Nile Delta, are often heavily contaminated.

2.1.5 Summary of the Physical Environment

The main physical characteristics of the Eastern Nile can be summarized from upstream to downstream in the following manner. The Ethiopian highlands plateaus present an extremely steep relief where most of the precipitation occurring in the Eastern Nile is concentrated and where very high sediment loading into the Abbay River occurs during the rainy season. As the river moves downstream in Sudan and then to Egypt, the relief becomes flatter and precipitations decrease rapidly to become almost nil at the Sudan – Egypt border in Lake Nasser/Nubia area. Evaporation increases significantly from upstream to downstream and is the most important in Lake Nasser/Nubia where up to 10 BCM of water might be lost every year.

With the data available, water quality of the river appears relatively acceptable in most of the river stretch, but there are concerns of increasing concentrations of heavy metals, nutrients, and organic loading along the river, particularly downstream of the Aswan Dam.

2.2 BIOLOGICAL ENVIRONMENT

2.2.1 Land-Use

2.2.1.1 Vegetative Cover

In the Abbay/Blue Nile Sub-basin, woodland and shrub lands cover some 28% and grassland 25% of the Sub-basin. Sedentary rain fed cropping covers nearly 26 % of the area mainly located in the Ethiopian Highlands. In Sudan, semi-mechanized farms cover 10% but irrigated cultivated land is only 2.6%. Rain fed crops and grassland account for 50% of the total land uses.

Table 2-8 provides detailed information for the Sub-basin (OSI, June 2009, Hydrosult et al., 2007).

Table 2-8 Abbay/Blue Nile Sub-basin: Dominant Land Cover

Land Cover Type	Area (km^2)	% Total
Rain fed Crops: Sedentary	80,373	25.8%
Grassland	77,772	25.0%
Woodland	52,256	16.8%
Shrub land	36,719	11.8%
Cultivated land: Semi-mechanized farms	31,231	10.0%
Cultivated land: Irrigated Crops	8,155	2.6%
Rock	7,324	2.4%
High Forest	4,298	1.4%
Water	4,201	1.3%
Cultivated land: Rain fed Crops: Shifting	3,409	1.1%
Plantation	21,209	0.7%
Bare land: Loose sand	1,288	0.4%
Seasonal Swamp	945	0.3%

Land Cover Type	Area (km^2)	% Total
Permanent Swamp	518	0.2%
Built up: Urban	651	0.2%
Grassland: Afro-alpine	287	0.1%
SUB-BASIN	**311,548**	

Under human pressure, the land cover has been significantly modified. Figures from Table 2-9 suggest that at least 40% of the total area is actually under cultivation or other type of human activity. Figure 3-9 illustrates the land cover for the Sub-basin.

No area of undisturbed forest remains in the Abbay Sub-basin and only 1% (2,300 km2) of disturbed forest remains today. The assessment made by FAO in 1984 showed that at that time, 4% (8,000 km2) of the sub-basin was covered by forest. This represents a conversion of about 475 km2 per year. At that rate, it is only a matter a few years before the remaining forest is completely gone. The main cause of deforestation is the need of a rapidly growing rural population for fuel wood (estimated at about 1.8 m3 /person/year), building materials, and agricultural land, which is also responsible for the conversion of forests (OSI, Environmental Assessment, 2009).

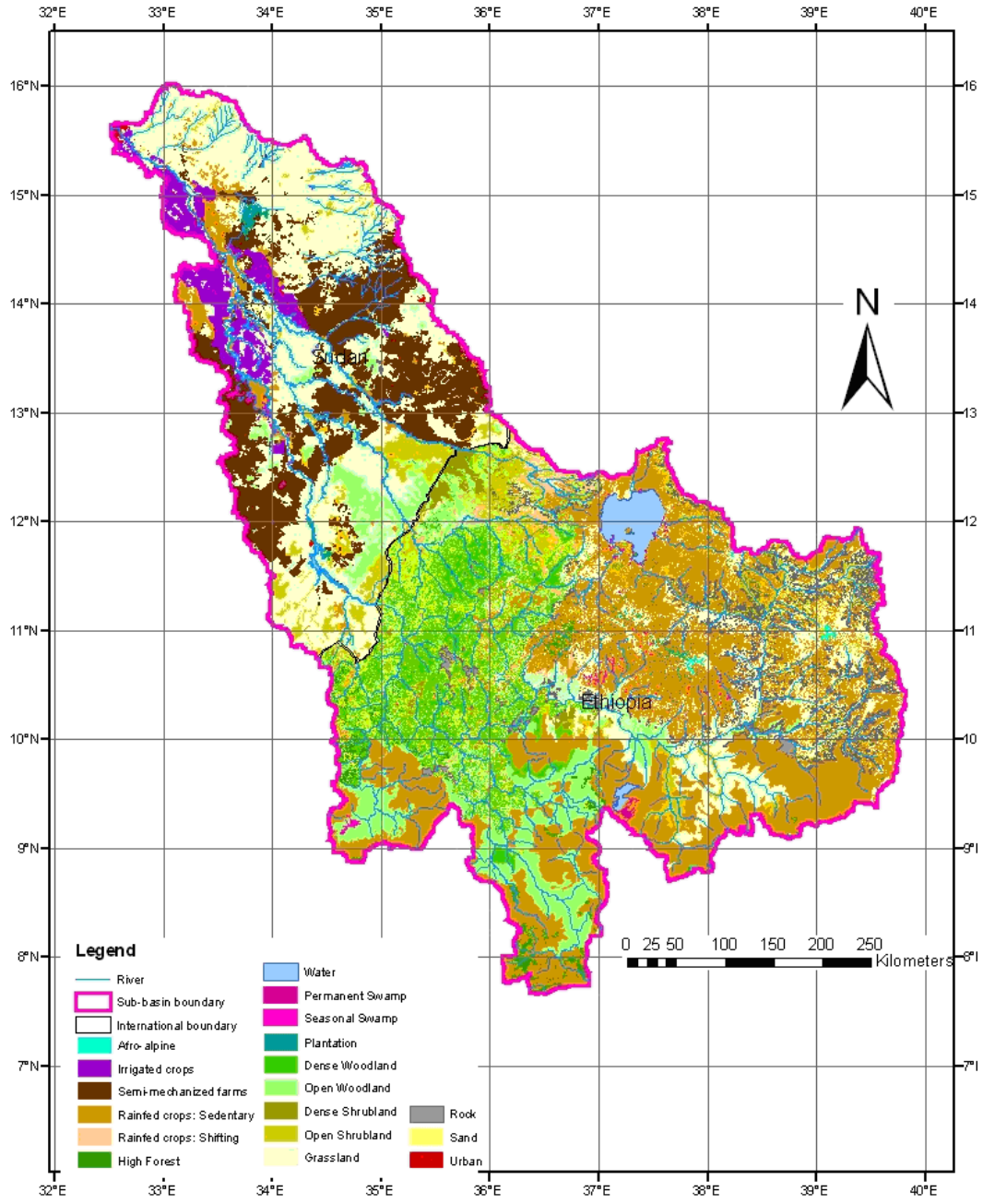
In addition, removal of wood in excess of the sustainable yield (after accounting for removal of dead wood and fallen branches, leaves and twigs) leads to declining stocks, which in turn leads to declining yields and so to progressive degradation of woody biomass.

In Sudan, the patterns of natural vegetation closely follow those of mean annual rainfall, although local conditions can provide a stronger influence where water is sometimes found. Below the 100 mm isohyet limit, which represents about 95 % of the total Sub-basin, desert or semi-desert conditions usually prevail (OSI Water Synthesis Report, 2009). Semi-desert scrubs is the most prevailing vegetation type in Sudan and it comprises a mixture of grasses and herbs up to 4 meters high, interspersed with bare earth.

Of all the Sub-basins, the Blue Nile Sub-basin in Sudan has experienced the greatest removal of the original vegetation, first from the large scale development of irrigation, then from the large expansion of semi-mechanized farms. These now cover some 1.32 million ha that were formerly woodland and shrub land. The clearing has been particularly severe in the west of the Blue Nile and towards the Ingessena Hills. An undetermined area of semi-mechanized farms is abandoned each year because of falling crop yields.

Because the land is totally cleared of all tree cover and combined with years of constant harrowing and disking the tree seed bank in the soil has been completely destroyed. The abandoned areas are a waste land with no tree cover. The quality of the grass cover is very poor because of the very low levels of soil fertility. The remaining woodland is under severe threat from fuel wood harvesting and charcoal production. The latter is mainly for export to the urban centers as far away as Khartoum. This would indicate some 224,180 ha of woodland are being cleared annually in the Blue Nile Sub-basin.

Figure 2-9 Abbay-Blue Nile Sub-basin: Dominant Land Cover



Source: Hydrosult *et al.* – Transboundary Analysis – Abbay – Blue Nile Sub-basin

Overgrazing is also an important cause of land degradation and it is reported that the areas where it occurs are also the areas with high soil erosion hazard (OSI, 2009). In Sudan, the loss of pasture land due to the expansion of the semi-mechanized farms has put additional grazing pressure on the remaining rangelands. These have become severely degraded due to overgrazing. This has also been exacerbated over the past two decades by declining rainfall. The Ministry of Agriculture now estimates that 50 percent of the rangeland is degraded.

Because grasses are mainly annual, heavy grazing and low rainfall often result in an almost complete failure of annual plant growth in the Main Nile Sub-basin, which in turn affects the movement of sand dunes as on very sandy soils *Panicum turgidum* is likely to be the dominant grass and plays an important role in stabilizing the dunes in addition to providing adequate browse (Figure 2-10). It is

now believed that the biotic factors (grazing, cutting, burning and cultivation) are of almost equal importance than the physical environment in determining the exact composition of vegetation communities.

In Egypt, the area around Lake Nasser is typically a desert and is characterized by its very dry and hot climate, with very rare rainfall. For these reasons, the natural vegetation cover is almost absent except for the very narrow strip parallel to the lake banks and its extensions which narrow and widen according to the topography and the seasonal flood height. The woody vegetation in the area is mainly desert scrub and the tree cutting for charcoal production in the hills has been reported to be sustainable for over a decade.

In North Sudan and Egypt, areas with less than 500 mm of annual rainfall have been said to be at "disequilibrium". Considering that in the Main Nile Sub-basin, most of the area receives less than 500 mm of annual rainfall, there is no stable or constant "carrying capacity" because rainfall variability is so great that forage production fluctuates widely from year to year and from place to place. Rangelands in the Main Nile Sub-basin are reported to have degraded over the past two decades with increased presence of species of poor forage quality.

A comparison of floristic composition from past studies with recent annual field observations of the Khartoum State range department have revealed no drastic change in floristic composition, but rather a change in the species density. It is thought that this is an indication of movement or shift to the south for all subdivisions in this ecological zone, which would be consistent with changing conditions and desertification. The problem is accentuated by increased gazing pressure caused by the loss of rangeland to the large expansion of the semi-mechanized farms.

2.2.1.2 Soil Degradation and Loss of Agricultural Productivity

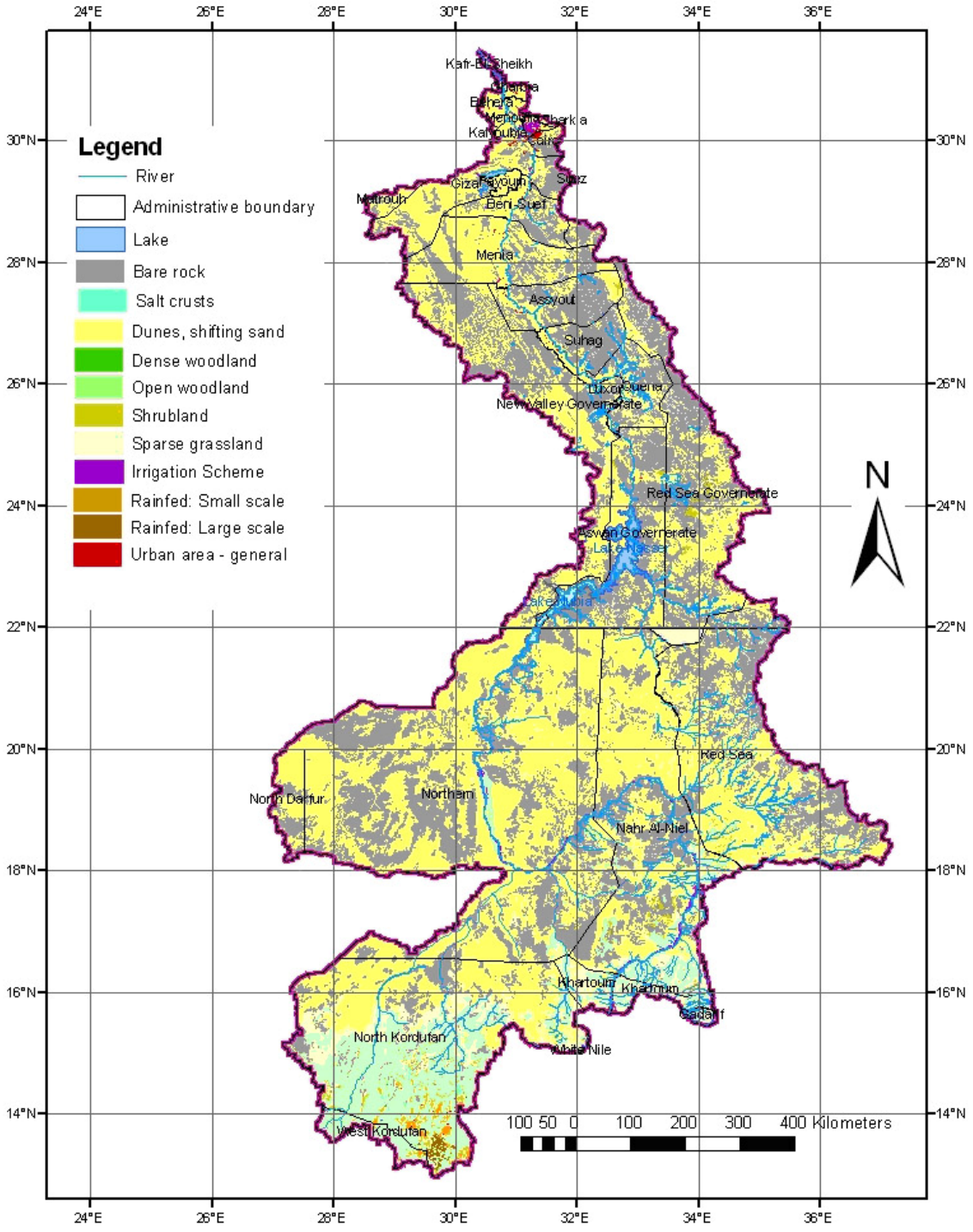
A key issue of soil degradation within the Abbay/Blue Nile Sub-basin is declining soil fertility, the immediate cause of which is soil nutrient "mining".

In the Ethiopian Highlands the immediate causes are the burning of dung (for fuel, rather than using it for fertilizer) and soil erosion. According to information found in OSI, there is a net annual loss of available Nitrogen (N) from cultivated land of approximately 37,640 tons or 5.1 kg/ha of available N. This tends to confirm the statement that soil nutrient decline in soil is a major problem in the higher rainfall areas. It is estimated that losses from grain removal make the largest contribution to total losses in the Abbay sub-basin.

The loss of woody biomass identified in the previous section also has a perverse consequence and is particularly acute in the Abbay Sub-basin, mostly in the Eastern part where the proportion of unsustainable annual woody biomass yield consumed as fuel wood by woreda encompasses over 50% of the total watershed area (Figure 2-11).

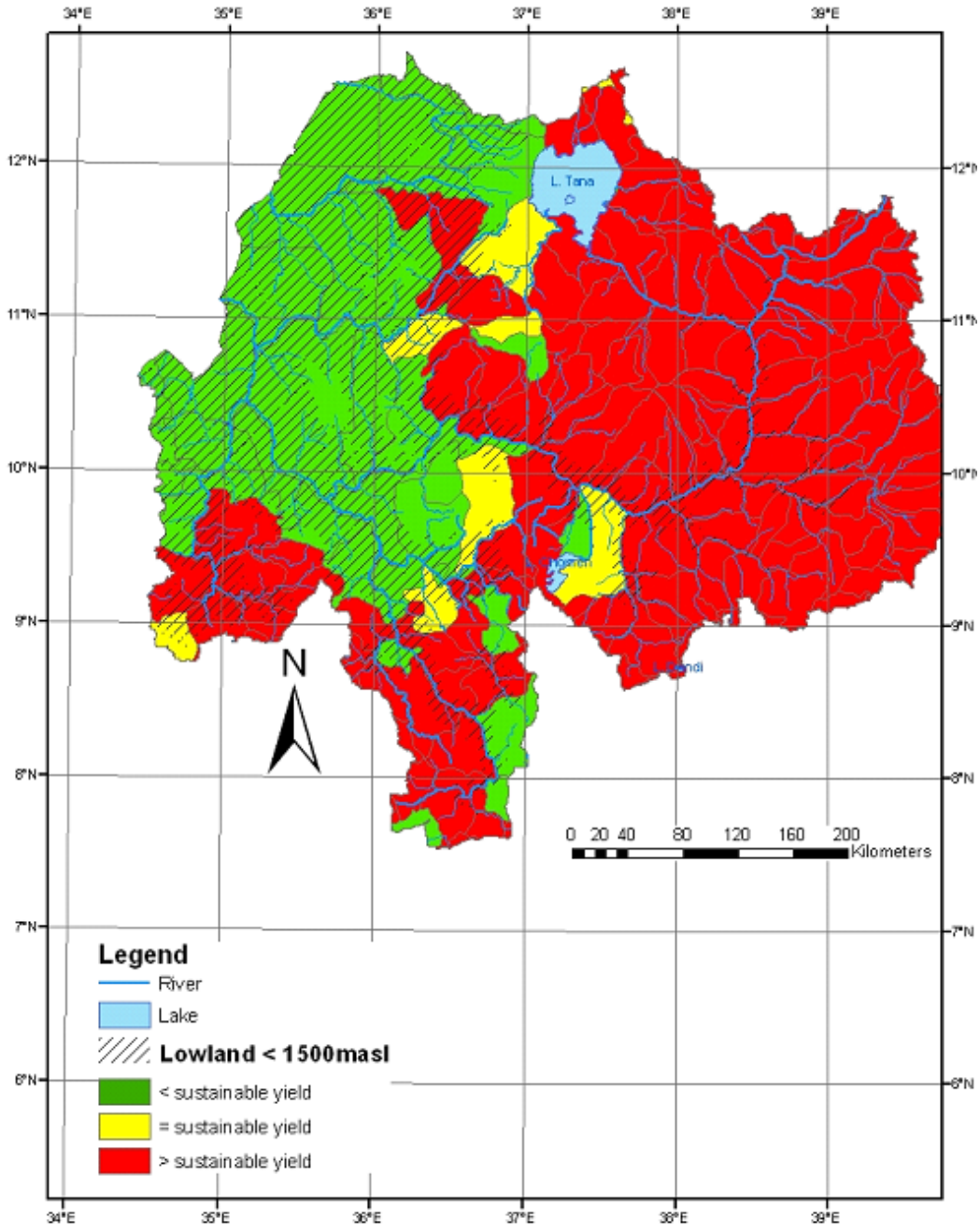
It is important to note that conversion of forest land to crop land and then grazing land has important implications for the quantity of water available in the water bodies of the watershed and the accumulation of sediment due to soil erosion. Indeed, data from the woredas on woody biomass consumption show a strong correlation between overconsumption of woody biomass and high rates of soil erosion (Figure 2-12).

Figure 2-10 Main Nile Sub-basin Land Cover and Land Use



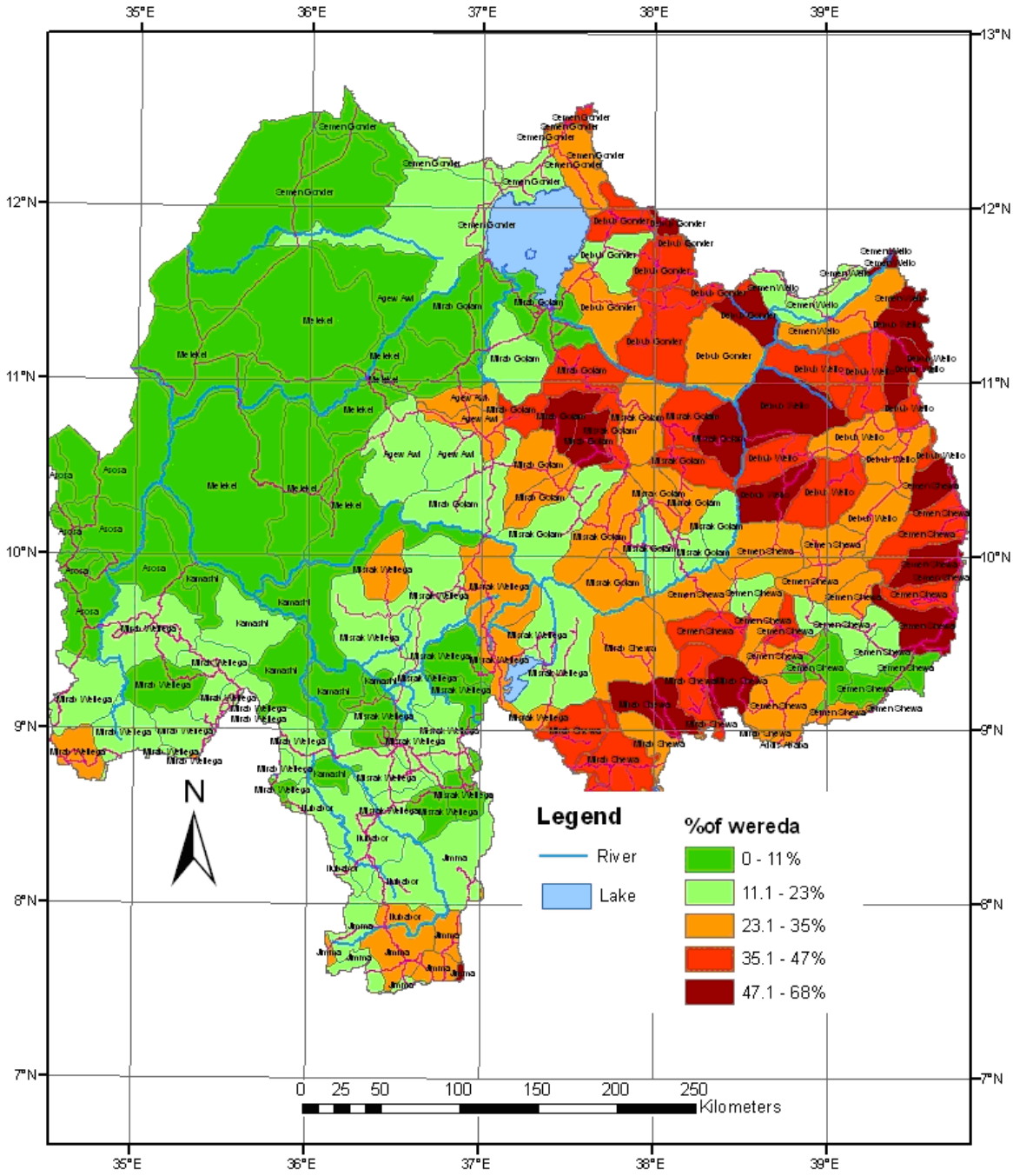
Source: Hydrosult *et al.* – Transboundary Analysis: Main Nile Sub-basin

Figure 2-11 Ethiopia – Abbay Sub-basin: Annual woody biomass consumption as fuel in relation to annual sustainable yield



Hydrosult *et al.* – Ethiopia Country Paper. 2007

Figure 2-12 Ethiopia – Abbay Sub-basin: % Area with Moderate to Severe Erosion Hazard by Woreda



Hydrosult *et al.* – Ethiopia Country Paper. 2007

In Sudan on the Blue Nile Sub-basin, the Africover mapping of rain fed cropping with large to medium size fields suggest that there are approximately 7.454 million feddans (3.131 million ha) of large to medium semi-mechanized farms. However, a proportion of this land has gone out of production and in some cases has been abandoned because of declining yields. These reductions in yield are partly due to a decline in soil fertility in the absence of fallowing or fertilizer application. There has also been a decline in productivity partly due to the build-up of weeds and partly to an expansion onto marginal land resulting in destruction of soil structure, soil erosion and soil fertility. The removal of natural predators (snakes and cats) has led to an increase in rats and other vermin. Insect eating birds have disappeared leading to a big increase in the use of insecticides and insect damage. With

only approximately 50 percent of the land being cropped and yields declining at just over 5 percent per annum it represents a substantial waste of natural resources and causes further problems of soil and water contamination.

In the Main Nile Sub-basin, land degradation is also observed, but for different reasons than in the Abbay Blue/Nile Sub-basin. The degradation is mostly related to groundwater depletion and soil contamination as opposed to soil erosion.

According to the OSI Summary, the use of inefficient traditional irrigation techniques and the inadequacy of drainage systems in the Sub-basin have led to the increase in water logging and increased salinization. It appears that over-exploitation of water for irrigation has led to the depletion of groundwater resources, which has resulted in excessive intrusion of salt water from sea into groundwater aquifers. This phenomenon is particularly noticeable in Egypt.

Also, pollutants carried by irrigation water are a major source of soil pollution, resulting into an estimated 50% loss of productivity of agricultural land, as recorded at Helwan and Shoubrah El-Kheima. Severe damage to plants has been reported in areas close to the industry in Kafr El-Zayat, Edfu, Abu Za'abal and others. Toxic heavy metals accumulate in the tissues of vegetation grown adjacent to sources of air pollution, such as lead smelters, and near traffic roads.

Also, it has been demonstrated recently that vehicle emissions have affected the soil of the agricultural land around traffic roads (OSI Appendix Main Nile Sub-basin). However, this phenomenon seems to be encountered mostly on a strip of at least 40 meters parallel to the Cairo-Alexandria Agricultural Road which receives air pollutants, mainly lead, carbon monoxide, nitrogen oxides and sulphur dioxide. These pollutants fall on the plants or pass directly into the soil. The same is not reported for the rest of the Sub-basin upstream of AHD.

2.2.2 Wetlands

Wetlands resources in the Eastern Nile region are not fully documented. It is known that they represent a significant micro-environment in many parts of the three countries. They include swamps, marshes, shallow lakes, margins of the rivers, valley and lakes, as well as flood plains and swamp forests.

Wetlands are an important part of the environmental resource base in the region. They produce several ecological and socio-economic benefits in their natural state that contribute to the well-being of rural communities. Unfortunately, wetlands are often considered as wasteland of little value and are converted by drainage into agricultural or grazing areas. This generally offers some new benefits such as increased food production and grazing, but results in the loss of other benefits such as flow regulation, recharge of groundwater, and maintenance of habitats preserving biodiversity.

There are few policies which specifically address wetlands in Ethiopia. The Ramsar Convention has not been signed by Ethiopia and so there is no related legislation. The Conservation Strategy of Ethiopia and the Water Resources Management Policy are the only formal government policy statements that mention wetlands. They address them indirectly focusing them as regulators of water quality in the Conservation Strategy and for their biodiversity protection and assimilative capacity against pollution in the Water Resource Management policy. A Wetlands Proclamation was drafted in 2001, but was never approved.

Sudan (2005) and Egypt (1988) have both signed the Ramsar Convention, but lack formal wetlands national strategies. Wetlands are also addressed as part of protected areas or biodiversity conservation. Hence it is clear that at the national level wetlands are not on the policy agenda in their own right. Indeed it might be said that there is a policy vacuum when it come to the consideration of wetlands in their own right (UN 2006).

2.2.2.1 Permanent Wetlands

Wetlands are vital natural resources in terms of environmental functions and in terms of products and services, which are extensively used by local communities. Wood *et al.* (1998) have attempted to quantify these benefits

Table 2-9 Uses and Benefits Provided by Wetlands

Uses	Estimate of Households Benefiting
Social ceremonial uses of sedges	100% (including urban dwellers)
Thatching reeds	85% (most rural households)
Sedges used for crops guarding huts	30%
Dry season grazing	30% (most cattle owners)
Water for Stock	30% (most cattle owners)
Cultivation	25%
Domestic water from springs	20-100%
Craft materials	5%
Medicinal plants	100% (mostly indirectly by purchase from collectors / traditional doctors)

Source: in Dixon and Wood, 2001.

In Ethiopia, the total area of wetlands may exceed 2% of the country area (McKee, 2007). Ethiopia possesses a great diversity of wetlands ecosystem (swamps, marshes, flood plains, natural or artificial ponds, high mountains lake and micro-dams) as a result of formation of diverse landscape subjected to various tectonic movements, a continuous process of erosion, and human activities.

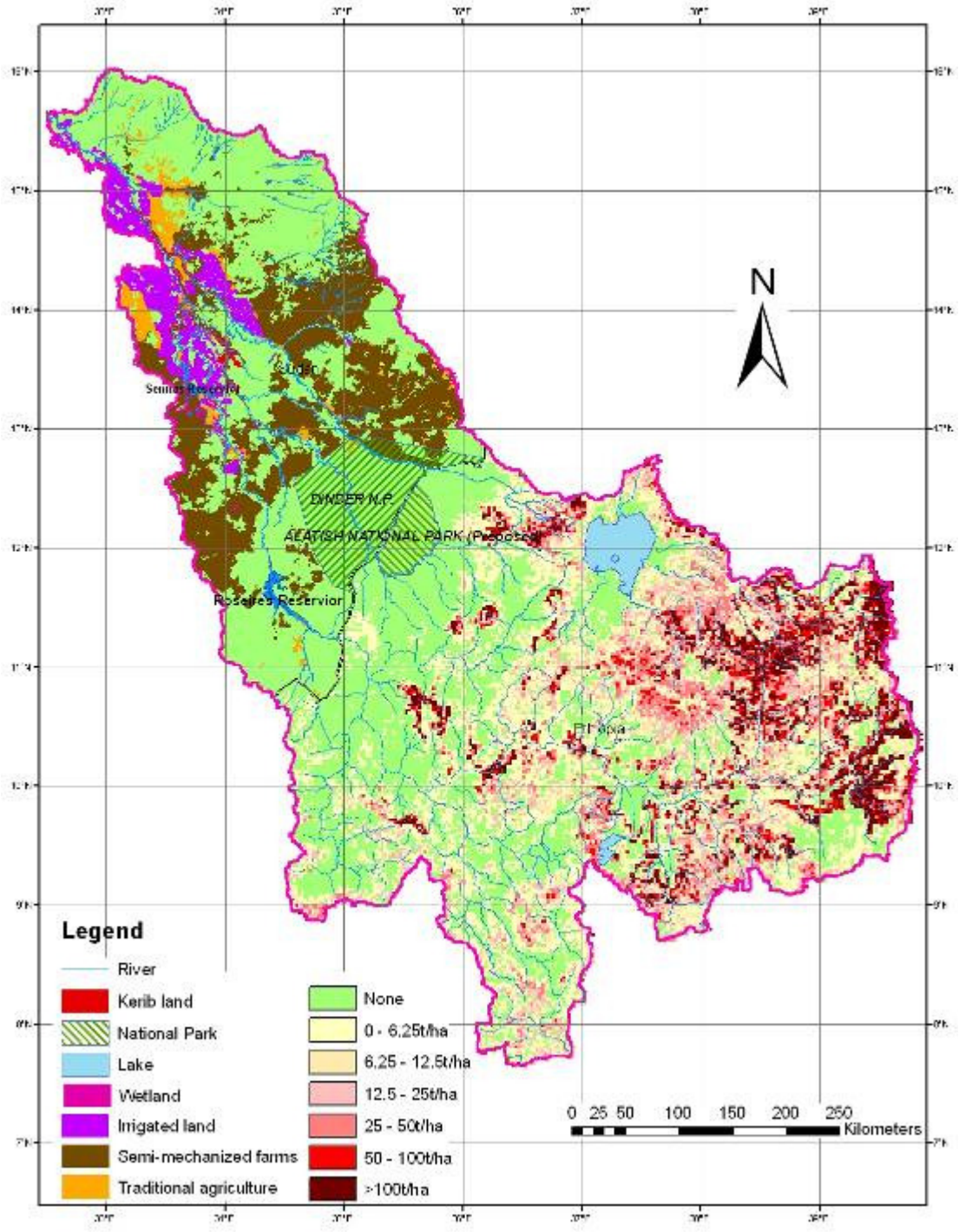
Two types of permanent wetlands dominate in Ethiopia:

- Swamps – which are permanently flooded areas with herbaceous vegetation (usually greater than one meter in depth) , and
- Marshes - which are also permanently flooded areas with herbaceous vegetation (usually less than one meter).

The Woody Biomass Inventory and Strategic Planning Project (WBISPP) land cover map of the Abbay Sub-basin estimates the area of permanent swamp at 49,943 ha. Much of these wetlands are located in the highlands (Figure 2-13). The most extensive are found around the shores of Lake Tana, around the shore of Fincha reservoir and in the headwaters of the Dabus River. There are also several other wetlands in Ethiopia that have never been listed (Institute of Biodiversity Conservation, 2010).

In a wetland ecosystem water is the primary factor controlling both plant and animal life. It favors particular type of trees, shrubby species and associated herbs and grasses. Typical characteristic species of wetlands ecosystem include those of aquatic macrophytes such as *Cyperus, Eleocharis, Scirpus, Echinochloa, Panicum, Alisma plantago-aquatica, Nymphaea, Typha, Paspalidium, Potamogoton, Wolffia, Aeschynomene, Phragmites, Urochloa, Veronica, Hydrocotyle, Polygonium, kyllinga* etc., and tree species include *Ficus sychomorus, Tamarindus indica, Celtis africana, Mimusops kummel, Syzygium guineense, Terminalia brownii, Acacia polyacantha, Kigelia abyssinica, Phoenix sp., Trichilia sp., Diospyros sp.*

Figure 2-13 Wetlands of the Abbay/Blue Nile Sub-basin Ethiopia and Dabus Valley



Source: OSI, 2009

A survey and inventory of wetlands in the Amhara Region (Enyew Adgo, 2005 in Hydrosult *et al,* 2007d) found that many of these wetlands were under threat due to a number of reasons:

- Draining for agriculture use
- Grazing
- Over exploitation of wetlands resources
- Deforestation, siltation, soil erosion and land degradation

- Urbanization, settlement, pollution from urban centers and industrialization

The conversion of swamps to agricultural land with drainage or their degradation reduce the diversity of the fauna and flora, tree cover, and generally these species are replaced with non-wetland species (Hughes and Hughes, 1992).

Wetlands are reported in the area of the proposed Karadobi reservoir where there are, on average, 5.2 ha/km of vegetated wetlands compared to an average of 0.4 ha/km for the rest of the river section between the reservoir and the Sudanese border. The river surface area is approximately 7,000 ha whilst the total area of vegetated wetlands is between 800 and 900 ha. Wetlands within the proposed reservoir area are not used for recession agriculture. No wetland area is reported in the proposed Mandaya and Border reservoir areas.

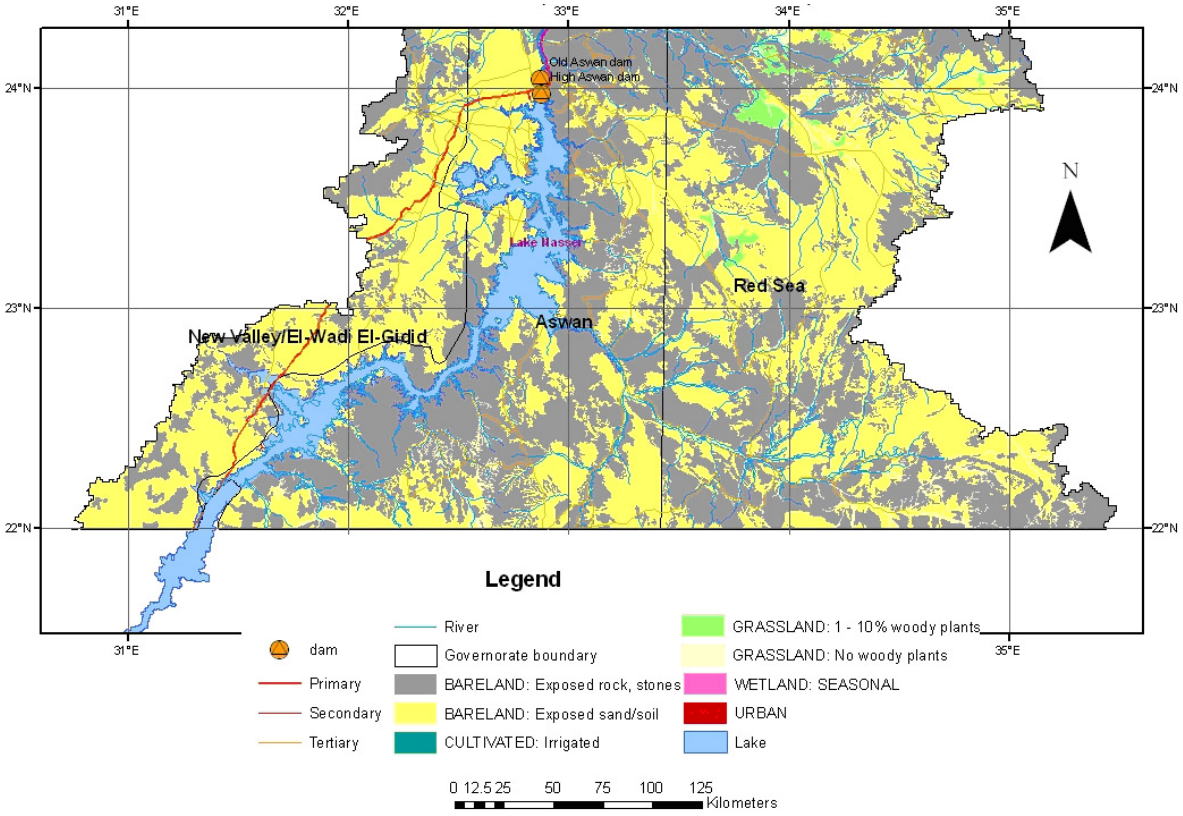
As mentioned earlier, Ethiopia is not yet signatory to the Ramsar Convention but is considering signing the convention. There has been some documentation of major wetlands that have identified a number of wetlands that would qualify for Ethiopia's Ramsar wetlands. Although none of the proposed wetlands are within the impacted areas of the proposed project, wetlands are important to Ethiopia.

Sudan boasts a significant number of diverse and relatively pristine wetlands that support a wide range of plants and animals and provide extensive ecosystem services to local populations. The main wetlands are the Sudd – which is a source of livelihood for hundreds of thousands of pastoralists and fishermen – Bahr el Ghazal, Dinder, and other Blue Nile *maya*s, the Machar marshes, Lake Abiad and the coastal mangroves. In addition, there are a large number of smaller and seasonal wetlands that host livestock in the dry season and are important for migrating birds.

More particularly in the Blue Nile Sub-basin, the main wetlands are located on and between the Dinder and Rahad rivers and are locally known as "*mayas*" (depressions or swamps along and between the rivers dominated by *Acacia nilotica*). The vast majority of these wetlands is found just outside the Dinder National park and most are within large to medium semi-mechanized farms. The Sudan Post-conflict Environmental Assessment carried out by UNEP (2007) has found that most of Sudan's major wetlands are currently facing significant conservation threats, particularly these mayas ecosystems of the Blue Nile that are badly degraded and in continuing decline. The study reports that seven mayas along the Blue Nile were visited and all of them were degraded by accelerated siltation. Several, such as Um Sunut and Kab in Gezira state and El Azaza in Sennar state, were effectively disconnected from the main river. The main causes of this decline are upstream dam construction and catchment changes. Other issues include extensive felling of riverine forests, damage from overgrazing and wildlife poaching.

Egyptian wetlands are classified into two broad categories: coastal and inland wetlands. Depressions along the Nile valley can be further classified as either natural wetlands (Wadi el Natrun depression) or man-made wetlands (Siwa oasis). There are presently two wetlands designated as Ramsar Sites. They are the Lake Bardawil and Lake Burullus and both are saline lagoons. There are several other wetlands in Egypt and all are far from the area of interest of the project. Figure 2-14 does not indicate any wetland in the area of Lake Nasser/Nubia with the exception of the lake itself.

Figure 2-14 Egypt – Wetlands of the Lake Nasser Area



Source: Hydrosult *et al.* – Transboundary Analysis: Country Report Egypt, 2006.

2.2.2.2 Flood Plains and Seasonal Wetlands

Flood plain can be defined as land adjacent to an active river channel which is occasionally flooded by those bodies of water and which remain dry for varying portion of the growing season. In most cases, flood plains are conspicuous features of the landscape in contrast with the surrounding vegetation. The flood plain ecosystem supports a variety of plant species with a succession from those adapted to a humid environment to a dryer environment. Moving from the interior of the swamps, the ecological zones grade from the open-water and submerged vegetation of a river-lake, to floating fringe vegetation, to seasonally flooded grassland, to rain-fed wetlands and, finally, to flood plain woodlands.

As a result, this habitat attracts wildlife, which seeks the refuge of the diversified habitat types. Wetlands ecosystems are considered to be more productive than the areas adjacent to them because of the periodic inflow of nutrients. Flood plains are also an essential feature of the life cycle and spawning habits of a number of fish living in the Abbay/Blue-Main Nile watershed, several of them having a significant importance in economic and livelihood terms such as Tilapia.

Strictly speaking, defining wetlands ecosystems in the Ethiopian context is difficult because of frequent and significant changes in hydrological properties (seasonal and long-term) and vegetation composition over time, plus the absence of clear boundaries between the wetlands and adjacent aquatic and terrestrial land (Institute of Biodiversity Conservation, 2010). The Woody Biomass Inventory and Strategic Planning Project (WBISPP) land cover map covering the Abbay sub-basin estimates the area of seasonal swamp at 59,250 ha.

Flood plains are found in the Abbay Sub-basin, mostly around Lake Tana and along the Rahad and Dinder Rivers and flooding occurs mostly between July and September, with a peak in August.

In Sudan, flood plains are predominantly found along the Blue Nile, with classic characteristics of low energy flood plains. The general topography and soils of the flood plains of the Blue Nile can be

classified into five geomorphic units; Recent Terrace, Upper Terrace, Sand Bars, Abandoned Channels, Ox-bow Lake and Central Clay Plain (Riverside and Unesco, 2009). Table 2-10 drawn from Riverside and Unesco (2009) lists these classifications and their associated description.

Table 2-10 Geomorphic units of the Blue Nile

Geomorphic Unit	Description
Recent Terrace	The recent terraces are narrow strips along the Blue Nile. The topography is almost flat. The soils are mainly silt loam (Entisols). The recent terraces are narrow strips that appear at lower levels with the sand bars. The recent terraces are sown with vegetables and, together with the sand bars are subject to complete disappearance as a result of high flows.
Upper Terrace	The upper terraces occupy higher positions up the recent terraces with vertical slope. It varies in its extent with almost flat to gently undulating. The soils are mainly silty clay loam (Entisols). The upper terraces are about 2 meters above the low water level. These terraces include agricultural activities such as horticulture (Citrus, Mangoes, Guava and Bananas) and fodder (Alf Alfa and Abu Sabein). The land use is irrigated agriculture pumped by gas or electric pumps. Diary and chicken farms are also located in the upper terraces. The vegetables are also grown is these terraces near large towns.
Sand Bar	The sand bars occur on the inner curves adjacent to the recent terrace. The topography is gentle slope to slightly undulating. The soils are sand to loamy sand (Entisols).
Abandoned Channel	The abandoned channels occur as elongated concave shape along the Blue Nile. The topography is generally sloping concave. The soils are generally expansive clays more than 60 % clay (Vertisols). The sunt (Acacia nilotica) occur mainly in abandoned flood channels. On the elevated areas they are planted with Banana plantations.
Ox-bow Lake	The ox-bow lake has a semi circular shape occurring near the Blue Nile. The soils are mainly expansive clays with less that 60 % clay (Vertisols).
Central Clay Plain	They have flat topography with steep slopes to the Blue Nile. The soils are clay with high clay percentage (Vertisols). These clay plains have no relation with the present flood plains of the Blue Nile. They occur on high positions of about 5 to 6 meters above the low water level in the Blue Nile. There are two kinds of agricultural activities, irrigated and rain fed agriculture. All major irrigated agricultural schemes and the rain fed schemes are located on the clay plains. The main irrigated crops are cotton, sorghum, wheat, groundnuts, sugar cane and vegetables. The main crops under rain fed agriculture are sorghum and Sesame. All these crops are of high value but are seldom subjected to flooding.

Key characteristics of flood plains are the formation of various structures of plant communities, which have a distinct composition from the adjacent dry lands, in terms of both flora and fauna. Six plant community types were described in the swamps of the Awash valley in Ethiopia (Mitiku, 2001) with a total record of 83 vascular plants from the area.

As indicated in the previous sections, wetlands in Sudan are facing significant conservation threats, particularly the mayas ecosystems of the Blue Nile that are badly degraded and in continuing decline. Some of these mayas were considered exceptionally rich (Van Noordwijk, 1984).

The mayas are inundated during the flooding season and the water can stay up to six months. These mayas are important for the conservation of *Acacia nilotica* which is considered a priority species in Sudan for its products and environmental role along the Nile River banks and its tributaries (Warrag *et al*. 2002).

Acacia nilotica is only one of about 135 species of thorny African Acacia species, and the species is further divided into 9 sub-species, of which 6 occur in Africa. Each of the sub-species had very different habitat requirements. Subspecies *subalata, leiocarpa* and *adstringens* occur in wooded grassland, savanna and dry scrub forests, while subspecies *nilotica* and *tomentosa* are restricted to riverine habitats and seasonally flooded areas. The last subspecies present in Africa, *kraussiana,* prefers dry grassland and savannas, especially on compacted sandy loam, shallow granite or clay soils along drainages and rivers, but away from flooding.

Acacia nilotica nilotica and also possibly *Acacia nilotica tomentosa,* frequently form dense belts around permanent or semi-permanent wetlands. According to Le Houérou (FAO, 2000), subspecies *tomentosa* would be the one closely tied to regularly flooded areas, 4 to 5 months per year along the Nile while subspecies *nilotica* occurs in well drained situations along water courses such as on the river banks of the White and Blue Niles and Atbara.

In addition to tree cover, the six subspecies of *Acacia nilotica* provide a range benefits from Arabic gum to fuel wood, furniture, building material for boats and railway sleepers and tannins. Some sub-species are also known for production of ink and various local medicinal products.

Acacia nilotica is also under other threats such as from the Dieback of Sunt, an insect, considered the most serious epidemic affecting many riverine forests (Sudan Higher Council for Environment and Natural Resources, 2009).

2.2.3 Aquatic Fauna and Flora

2.2.3.1 Fish

Inventory

Lake Tana is a hot spot for fish diversity. The fish families Cichlidae and Clariidae are represented by only one species each, *Oreochromis niloticus* and *Clarias gariepinus*, respectively. *Nemacheilus abyssinicus* is an endemic species belonging to the family Balitoridae and inhabits the littoral areas of Lake Tana. The largest fish family in the lake is Cyprinidae, represented by four genera, *Barbus*, *Garra*, *Varicorhinus* and *Labeobarbus*. The genus *Barbus* includes the "small" barbs and is represented by three species, namely, *B. humilis*, *B. pleurograma* and *B. tanapelagius* (de Graff *et al.*, 2000). *Varicorhinus* is represented by a single species, *V. beso*. The genus *Garra* is represented by four species, *G. dembecha, G. dembeensis, G. regressus* and *G. tana* (Stiassny and Getahun, 2007).

The most significant genus of the family Cyprinidae in Lake Tana is *Labeobarbus*. The *Labeobarbus* species of Lake Tana have previously been classified under the genus *Barbus*. However, large, hexaploid African *Barbus* are renamed as *Labeobarbus* (Skelton, 2001, Berrebi and Tsigenpoulos, 2003, Snoeks, 2004). The new genus name better reflects their phylogenetic distance from other members of the overly lumped genus *Barbus*. *Labeobarbus spp*. differs not only in their resource partitioning (feeding) but also in their reproductive strategies (de Graff *et al.*, 2005). There are 15 species of *Labeobarbus* forming a unique species flock in Lake Tana, the only cyprinid species flock in the world, after the ones in Lake Lanao vanished because of overexploitation.

Only the Blue Nile and the Abbay Rivers themselves and a few of the larger tributaries constitute a permanent river habitat for fish. Many of the tributaries are seasonal habitats, where most fish may have to migrate from the tributary to the main river during the dry season. In the Abbay/Blue Nile tributaries, although thorough and recent surveys are lacking, it appears that about 40 species of fish have been recorded (Mishrigi, 1970). Getahun (2003) mentioned 23 fish species as occurring in the Abbay between the Blue Nile Falls ("Tis Issat") and the Ethio-Sudan border.

Twenty nine species belonging to 10 families have been recorded from Roseires Reservoir by Mishrigi (1970). The main genera of fish that are found in this reservoir include *Alestes* (Characidae), *Oreochromis* (Cichlidae) *Labeo* and *Barbus* (Cyprinidae), *Schilbe* (Schilbeidae), *Lates* (Centropomidae), *Bagrus* (Bagridae), *Clarias* (Clariidae), *Synodontis* (Mochokidae), *Mormyrus* (Mormyridae), *Distichodus* (Citharinidae).

About 128 species belonging to 27 families occur in the Main Nile River (besides those recorded from Lake Victoria and its satellite lakes—that would bring the total species in the Nile to more than 800 species (Witte *et al*., 2009). The families Cyprinidae, Cichlidae, Mormyridae and Mochokidae comprise the majority of the fish species in the Nile drainage sub-basin. Mormyridae and Mochokidae have more representatives in the rivers than in the lakes. The same appears true for Cyprinidae except in the case of Lake Tana, where there are almost equal number of species of cyprinids as that of the rivers.

According to Abu-Gideiri and Ali (1975) there are about 30 species of fishes in Lake Nubia and there are about 57 fish species that belong to 16 families recorded from Lake Nasser (Bishai *et al*., 2000). Some species are very rare (e.g. *Protopterus aethiopicus* and *Polyptreus bichir*). Only two species (*Sarotherodon galilaeus* and *Oreochromis niloticus*) are currently dominating the fish catch contributing about 90-95 % of the total fish production from Lake Nasser.

Fish Biology

The biology of most of the species in the Nile and its associated lakes is not well known. However, we know that most of the *Labeobarbus* spp. that is found in Lake Tana migrates to tributary rivers to spawn during the rainy season. Although all the tributaries of the lake are not well surveyed, and the temporal and spatial variations in their spawning migrations is not well established, it has been confirmed that the fishes migrate to Ribb and Gumara Rivers for spawning (Anteneh *et al*., 2007 and 2008; Getahun *et al*., 2008).

It is the migratory species that would be very much affected by the construction of dams. The well known migratory species of fishes are found in the family Cyprinidae (*Labeobarbus* spp., *Labeo* spp.) and *Varicorhinus* spp. *Alestes* spp. in the family Characidae are also known to migrate certain distances upstream for spawning. However, without detailed studies, it is not possible to determine which tributaries these fishes go to and use for spawning. However, the OSI documentation considers that some or all of the local tributaries in the 25 km of the Abbay between Boka and Mandaya dam site could serve as breeding grounds during the rainy season. More detailed studies are needed to fully assess this.

The biology of various commercially important species has been studied in Lake Nasser by several investigators (Bishai *et al.*, 2000). They distinguished three main groups of fishes based on their reproductive behavior:

a. Fishes which have prolonged spawning season mainly with two peaks during spring and autumn (*Oreochromis niloticus, Sarotherodon galilaeus, Brycinus nurse and Lates niloticus*).
b. Summer spawners (*Alestes baremoze, Eutropius niloticus*, *Labeo coubie, Labeo horie, Barbus bynni, Mormyrus kannume* and *Mormyrus caschive*).
c. Winter spawners such as *Labeo niloticus*.

There are certain species of fish that conduct horizontal migrations within river channels and lateral migrations onto and off flood plains. Species that are adapted to the latter include *Protopterus aethiopicus, Polypterus senegalus, Heterotis niloticus, Xenomystus nigri, Clarias gariepinus, Ctenopoma muriei, and Parachanna obscura* that are well adapted to flood plains. Tilapia species are also known to migrate to flood plains for spawning. *Clarias* and Nile tilapia (*Oreochromis niloticus*) have great importance in terms of fisheries.

The construction of reservoirs could increase the potential for some species. It would be appropriate to use indigenous species of fishes to stock these reservoirs to avoid unwanted consequences that could potentially emanate from exotic species. Those species that are well adapted to standing waters as well as running waters will take advantage of these reservoirs. These include species such as Nile tilapia (*Oreochromis niloticus*) and cat fish (*Clarias gariepinus*). The Cyprinid species can adapt to the standing water environment as far as there are running waters connected to the reservoirs as most of the species of the genus need running water for spawning. *Alestes* spp. within the family

Characidae and *Bagrus* spp. of the family Bagridae can also easily adapt to the reservoir situation depending whether or not they are available in the respective rivers.

2.2.3.2 Amphibians and Reptiles

Amphibians, especially anurans, are present in Lake Tana and all along the Nile and tributary rivers, particularly in the marshy shore areas. Nile Monitor (*Varanus niloticus*) is the largest reptile in the Nile and some farmers claim (Getahum, personal observation) that there are also pythons (*Phyton sebae*). Crocodiles are very common in the Blue Nile and other tributaries of the Nile especially at places with altitudes lower than 1500 meters.

2.2.3.3 Mammals

Hippopotamuses are present in Lake Tana and the Blue Nile River in good numbers and otters are also claimed to have been seen in some water bodies (Getahum, personal communication). During surveys made in March 2007 in the Abbay reach near Mandaya, hippos were observed to be abundant and crocodiles present in various locations.

2.2.3.4 Birds

Green (2009) has recorded 205 species of non-passerine birds that are found associated with the Nile. The major families include Anatidae that includes Geese and Ducks; Scolopacidae that includes the Waders; Laridae that includes Gulls and Terns; Ardeidae that includes Herons and Egrets and Rallidae that includes Rails.

In Ethiopia, the important bird areas are found around Lake Tana, and along the Blue Nile. The Dabus River is one of the main tributaries of the Blue Nile and there is an important bird area along this river at the border between Ethiopia and the Sudan. The aquatic birds around Lake Tana are numerous. A total of 215 bird species have been documented (Aynalem, 2000). This constitutes about 25% of the total number of bird species in Ethiopia (832). Piscivorous bird species include residents such as little grebe (*Tachybaptus ruficollis*), Great white pelican (*Pelecanus onocrotalus*), Great and long tailed cormorants (*Phalacrocorax carbo* and *P. africanus*), Darter (*anhinga rufa*), many species of heron (*Ardeola* spp., *Egretta* spp., and *Ardea* spp.) Hammerkop (*Scoppus umbretta*), and African fish eagle (*Haliaeetus vocifer*). Egyptian goose (*Alpochen aegyptiaca*), spur winged goose (*Plectropterus gambensis*) and Pygmy goose (*Nettapus auritus*) are the most conspicuous non-piscivorous aquatic birds. Palearctic migrants that depend on the lake include Osprey (*Pandion haliaetus*), Great black headed, Lesser black headed, and Herring gulls (*Larus ichthyaetus, L. fuscus*, and *L. argentatus*), and whiskered and white-winged black terns (*Chlidonias hybridus* and *C. leucopterus*).

2.2.4 Biodiversity

2.2.4.1 Wildlife

Ethiopia occupies a unique position in the world with regard to plant and animal diversity. There is a high level of endemism within the country with 99 endemic animals and about 800 endemic plants. In fact, Ethiopia possesses some of the richest endemic fauna and flora in the African continent. This occurs as a result of the immense topographic and climatic diversity in the country. Ethiopia's biodiversity is illustrated in Table 2-11.

Table 2-11 Biodiversity in Ethiopia, Sudan and Egypt

Biodiversity Characteristics in Ethiopia, Sudan and Egypt	Qty
Ethiopia	
Total known higher plants species / threatened (2002)	6,603 / 22
Total known mammals / threatened (2002)	277 / 35
Total known birds / threatened (2002)	262 / 46
Total known reptiles / threatened (2002)	208 / 1

Biodiversity Characteristics in Ethiopia, Sudan and Egypt	Qty
Total known amphibians / threatened (2002)	71 / ?
Total known fish / threatened (2002) (likely underestimated)	13 / ?
Sudan	
Total known higher plants species / threatened (2002)	3,137 / 13
Total known mammals / threatened (2002)	267 / 23
Total known birds / threatened (2002)	280 / 6
Total known reptiles / threatened (2002)	161 / 2
Total known amphibians / threatened (2002)	9 / ?
Total known fish / threatened (2002)	130 / ?
Egypt	
Total known higher plants species / threatened (2002)	2,076 / 2
Total known mammals / threatened (2002)	98 / 13
Total known birds / threatened (2002)	123 / 7
Total known reptiles / threatened (2002)	108 / 6
Total known amphibians / threatened (2002)	11 / ?
Total known fish / threatened (2002)	284 / ?

Source: Earth Trends, 2003.

As is evident from Table 2-11 above, the ability of Ethiopia to maintain this high degree of inherent biodiversity is under threat as humans move into the few remaining habitat areas. According to the National Biodiversity Action Plan of Ethiopia (Institute of Biodiversity Conservation, 2005), uncontrolled population growth has increased pressure on the country's natural resource base and inadequate economic policies have deepened poverty and widened inequalities and forced rural people and others to exploit natural resources at non-sustainable rates. As a result, deforestation, overgrazing, soil erosion and desertification have become major threats to the remaining biodiversity in Ethiopia.

The Ethiopian Wildlife and Natural History Society (Deselegn and Wondafrash, 2001) has identified that, of the 16 endemic bird species within Ethiopia, half of these are still found in the Abbay Sub-basin, of these two (the Ankober Serin and Harwood's Francolin) are categorized as "vulnerable" in the list of globally threatened species. Eleven of the endemic species and a further 20 others are recognized as globally threatened. A large number of these birds have breeding populations in Ethiopia. The biology of many common endemic bird species remains poorly known. In general, the ecology, behavior and breeding biology of these species have not been fully documented, or there is no information.

Wild habitats are shrinking and apart from those savannah woodland areas in the northwest part of the sub-basin, or those areas that have tsetse fly infestation few habitats remain intact. Urgent action is needed to address this problem of shrinking habitat and biodiversity loss before extinctions occur (OSI Environmental Assessment, 2009).

The Mandaya, Karadobi and Border EIA studies did not report any endemic aquatic species, nor any species of mammals and birds as being endemic to the project area and none would be critically threatened either at the dam sites, the reservoirs or downstream in Ethiopia. However, it is noted that this assertion was based on very sketchy and incomplete baseline data. It is also known that Lake Tana is unique for its *Barbus* flock. Apparently, this is the only remaining stock in the world (Institute of Biodiversity Conservation, 2005), thus the lake takes an international significance.

The Abbay river sub-basin is regarded as an important area for a wide variety of resident and migratory water birds. The area is particularly important for water birds and watering grounds of large number of migrants. Very many Palaeoarctic migrant birds cross the Sahara desert from Europe

and Asia using the area for feeding and wintering. As the area is significant in the national and international contexts, and because Ethiopia is a signatory state to the African-Eurasian Waterbird Agreement (AEWA), particular care is required to ensure the protection of these species throughout their natural range.

Information on insects, reptiles and other fauna in the Abbay Sub-basin is also similarly severely limited.

In Sudan, the ecological diversity is reflected in the richness of biodiversity; out of 13 mammalian orders in Africa, 12 occur in Sudan. Cave and Macdonald (1958) recorded 971 species of birds. Ninety-one genera and 224 species and sub-species of mammals other than bats were reported in the late fifties. The Nile is the home of over a hundred species of fish and the swamps are considered as a major gene reserve (Moghraby 1982). The World Research Institution Annual Report 1995 recorded 3,112 flowering plants in Sudan.

Even though Sudan is rich in its diversity of ecosystems, habitats, species and genetic resources, no coordinated, comprehensive surveys or assessments have been carried out. Most surveys and studies on biodiversity components were fragmented and were tailored for limited academic or research and scientific purposes. Data collected or information gathered has most of the time been site-specific, local and at the particular institutional levels (Higher Council for Environment and Natural Resources, 2009).

Unfortunately, this diversity is under much pressure as the annual rate of deforestation is close to 504,000 ha (UNEP, 2002). Only 30,000 ha are reforested. Over the last two decades, a number of wild life species have been lost and many more are endangered or vulnerable. This is mostly due to habitat destruction. Several grasses and herbs have disappeared due to overgrazing, repeated droughts and fires. Fires are responsible for the annual loss of 30% of dry fodder otherwise available to wild life and the 103 million head of livestock. Awareness and sensitivity to environmental issues is weak among the public and the policy makers. Table 2-11 presents some of the key data on Sudan's biodiversity.

Along the Blue Nile, the reservoirs created by dams (Sennar, Roseires) are considered important wildlife sites for resident and migratory birds.

One would expect that Egypt, as part of the Sahara of North Africa with harsh geographical and bio-climatic conditions, would not only be poor in term of biodiversity, but that it would also be sparse and widely scattered. It is estimated however that Egypt has a rich biodiversity with 18,000 species of flora and fauna. The natural flora and botanic cover of the areas of and around Lake Nasser encompasses a vast range of genetic resources both natural and improved by careful human management. Medicine and aromatic plants are of major importance. Lake Nasser/Nubia and the Main Nile River between Khartoum and Aswan provide important habitat for aquatic flora and fauna and support an important fishery industry.

Egypt's biodiversity is facing threats from intensive agriculture systems, widespread use of agricultural chemicals in the form of fertilizers and pesticides, and industrialization that has accelerated enormously in the second half of the 20th century. Moreover, excessive hunting of animals and destruction of plant life have endangered the existence of several species of resident and migratory birds, as well as a number of hoofed animals (e.g. gazelles and antelopes).

2.2.4.2 Protected Areas

Ethiopia has issued a number of regulations aimed at conserving and protecting the remaining natural ecosystems of the country. These protected areas have been divided into four categories according to management objectives: National Parks, Game reserves, Sanctuaries and Controlled hunting areas. Many of the species of plants and animals are found in the protected area system (Table 2-12).

Table 2-12 Protected and Managed Protected Areas in Ethiopia, Sudan and Egypt

Protected areas in Ethiopia, Sudan and Egypt	Qty
Ethiopia	
Total area protected all IUCN categories (000 ha)	18,620
Protected area as % of total land	16.4%
Number of Protected areas	40
Wetlands of international importance (Ramsar)	0
Biosphere reserves	0
Sudan	
Total area protected all IUCN categories (000 ha)	13,299
Protected area as % of total land	4.9%
Number of Protected areas	27
Wetlands of international importance (Ramsar)	4
Biosphere reserves	2 (12,510 km^2)
Egypt	
Total area protected all IUCN categories (000 ha)	5,598
Protected area as % of total land	5.7%
Number of Protected areas	26
Wetlands of international importance (Ramsar)	2
Biosphere reserves	2 (24,560 km^2)

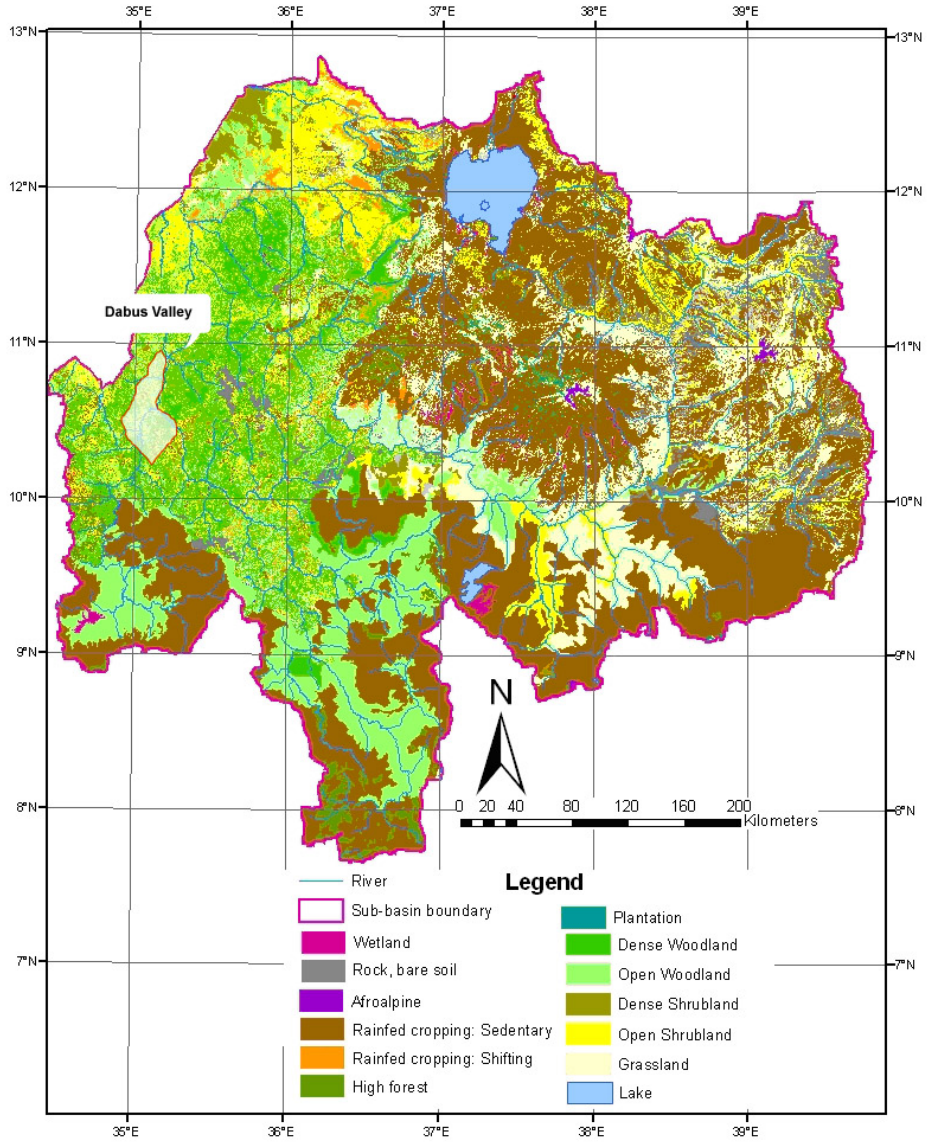
Source: Earth Trends, 2003.

Similarly, Sudan signed two protocols on biodiversity in 2005:

- The Protocol Concerning the Conservation of Biological Diversity and the Establishment of Protected Areas
- The Protocol Concerning the Protection of the Marine Environment from Land-Based Activities in the Red Sea and Gulf of Aden

In Ethiopia, the **Dabus Valley** controlled hunting area, in the Dabus River, downstream of proposed Mandaya dam site (Figure 3-15), is the only protected area directly along the Abbay River. It has been registered as a controlled hunting area by Ethiopia with the World Commission on Protected Areas (WCPA) which maintains a world database of protected areas. The Dabus Valley area is 1,227 km^2. There is not much information available on the fauna and flora present, but the presence of elephants and lions has been reported. The Dabus Valley was also listed in 1996 as a tentative candidate to become designated as an Important Bird Area of Ethiopia. Apparently, this is still the intent, but a decision on promoting Dabus Valley as a designated Important Bird Area continues to be deferred until such time as surveys are conducted and a proper assessment is made.

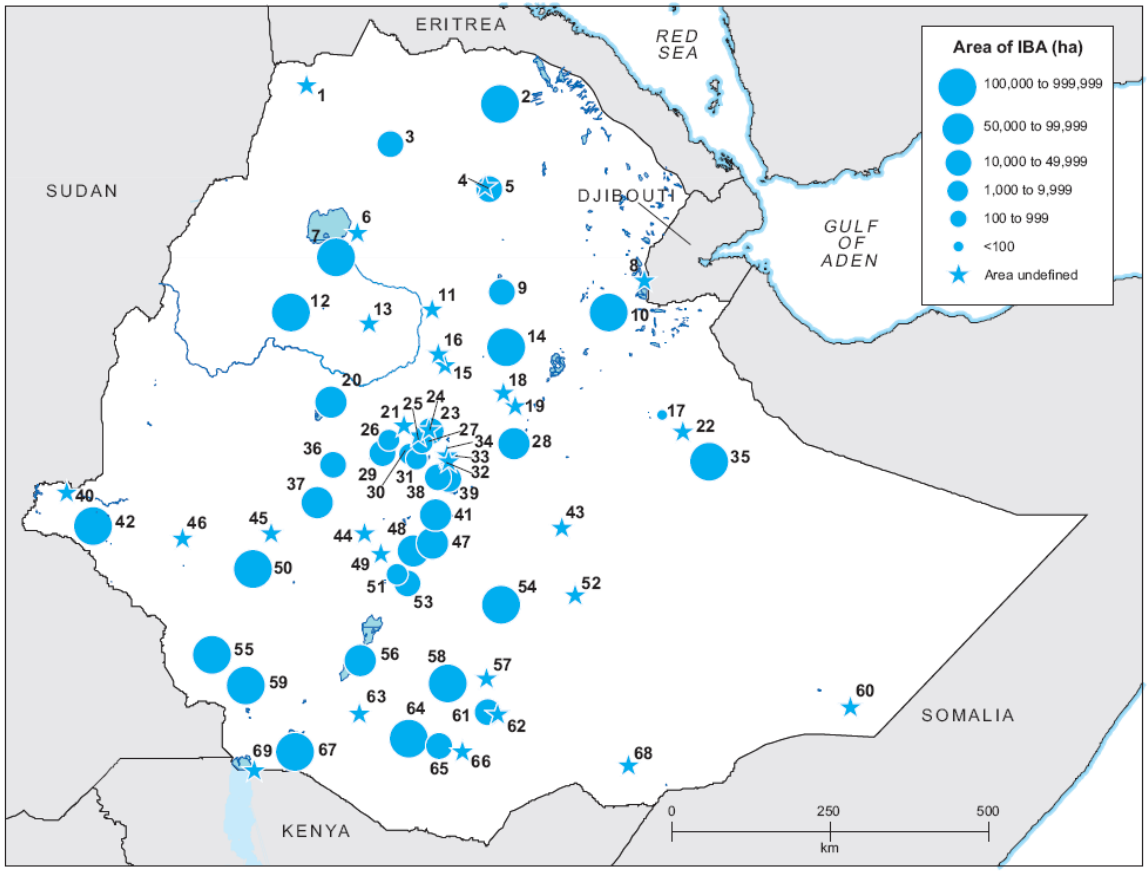
Figure 2-15 Location of Dabus Valley in Ethiopia



According to BirdLife International, there are also 69 Important Bird Areas (IBAs) in Ethiopia, several of them located in the Abbay Sub-basin (Figure 2-16). A site is recognized as an IBA only if it meets certain criteria, based on the occurrence of key bird species that are vulnerable to global extinction or whose populations are otherwise irreplaceable. An IBA must be amenable to conservation action and management. The IBA criteria are internationally agreed, standardized, quantitative and scientifically defensible. Ideally, each IBA should be large enough to support self-sustaining populations of as many as possible of the key bird species for which it was identified or, in the case of migrants, fulfill their requirements for the duration of their presence. By definition, an IBA is an internationally agreed priority for conservation action.

Of the 69 IBAs found in Ethiopia, covering an area of approximately 47,757 km^2, 29 IBA sites are still undefined. Several of the IBAs are located in the Abbay Sub-basin. The Karadobi EIA indicates that the planned Karadobi reservoir would fall within the IBA ET 016. It is also likely that other IBAs would intersect with other planned reservoirs at Beko Abo, Mandaya and Border also located near other IBAs.

Figure 2-16 Localization and Size of Important Bird Areas of Ethiopia



IBA code	National code [1]	Site name	Administrative region	Criteria (see p. 11; for A2/3 codes, see Tables 2/3) A1	A2 113	A2 114	A2 115	A2 s063	A3 A04	A3 A07	A3 A08	A4i	A4iii
ET001	58	Shire lowlands in the Tekeze valley	Tigray						✓				
ET002	28	Dessa'a forest	Tigray	✓						✓			
ET003	59	Simen Mountains National Park	Amhara	✓			✓			✓			
ET004	9	Lake Ashenge	Tigray	✓								✓	
ET005	41	Hugumburda and Grat-Kahsu forests	Tigray							✓			
ET006	34	Fogera plains	Amhara	✓									
ET007	15	Bahir Dar–Lake Tana	Amhara	✓						✓			✓
ET008	1	Lake Abe wetland system	Afar	✓									✓
ET009	66	Yegof forest	Amhara							✓			
ET010	65	Yangudi-Rassa National Park	Afar	✓							✓		
ET011	—	Denkoro forest	Amhara							✓			
ET012	13	Awi Zone	Amhara	✓						✓			
ET013	26	Choke mountains	Amhara	✓						✓			
ET014	40	Guassa (Menz)	Amhara	✓						✓		✓	
ET015	42	Iemma and Jara valleys	Amhara	✓			✓		✓	✓			
ET016	53	Mid-Abbay (Blue Nile) river basin	Amhara, Oromiya	✓			✓						
ET017	4	Lakes Alemaya and Adele	Oromiya									✓	
ET018	7	Ankober–Debre Sina escarpment	Amhara	✓			✓			✓			
ET019	5	Aliyu Amba–Dulecha	Amhara, Afar	✓			✓						
ET020	33	Finchaa and Chomen swamps	Oromiya	✓						✓			
ET021	—	Berga flood-plain	Oromiya	✓						✓		✓	
ET022	20	Bisidimo	Oromiya	✓									
ET023	32	Entoto Natural Park and escarpment	Addis Ababa							✓			
ET024	61	Sululta plain	Oromiya	✓						✓		✓	
ET025	—	Gudo plain	Oromiya	✓						✓		✓	
ET026	—	Chilimo forest	Oromiya							✓			

Source: BirdLife.org

In Sudan, the **Dinder National Park,** which was proclaimed in 1935, is located within three States: Sennar, Blue Nile and Gaderif. Its boundaries follow the Rahad River in the north, the Dinder in the south and the Ethiopian border to the east. The park covers an area of 8,960 km^2. It is also a designated Biosphere Reserve and has been designated under the Ramsar Convention as an international Wetland of importance. Immediately across the border within Ethiopia the Amhara regional State has designated an area as the **Alatish National Park** in 2006, with an area of 2,665 km^2 (Figure 2-17).

In recent years the human population has been increasing and there is now unplanned and uncontrolled expansion of mechanized rain-fed agriculture, especially in the Dinder River area. Land degradation has become a major environmental problem. Large tracts of marginal land around the park have been converted to agriculture. These marginal areas are prone to declining yields after a few years of cultivation because of their fragile soils and a thin nutrient base. After a few years the fields are abandoned and the farmers move to a new area. Such large scale agricultural practices have resulted in the displacement of traditional grazing, woodlot keeping and traditional farming patterns which assured sustained production and development.

There are three groups of people who have an interest in the Dinder National Park. The first is the original inhabitants of the areas - a small group of Maganu people who continue to live in the south-eastern part. This community has a unique culture that needs to be preserved. They depend on subsistence farming in the rainy season and supplement their diet by collecting fruits and wild honey. In the dry season they move to the Dinder for fishing.

The second group is constituted of pastoralists and agro-pastoralists who enter the Park in the Dry Season looking for forage and water because much of their rangeland has been converted into semi-mechanized farms. Included in this group are the Um Barrarow or Falata who use the Park in the dry season along the Dinder River and move into Ethiopia during the wet season. They burn the tall grasses in the dry season to make green grass available, but in doing so eliminate susceptible herbs and shrubs.

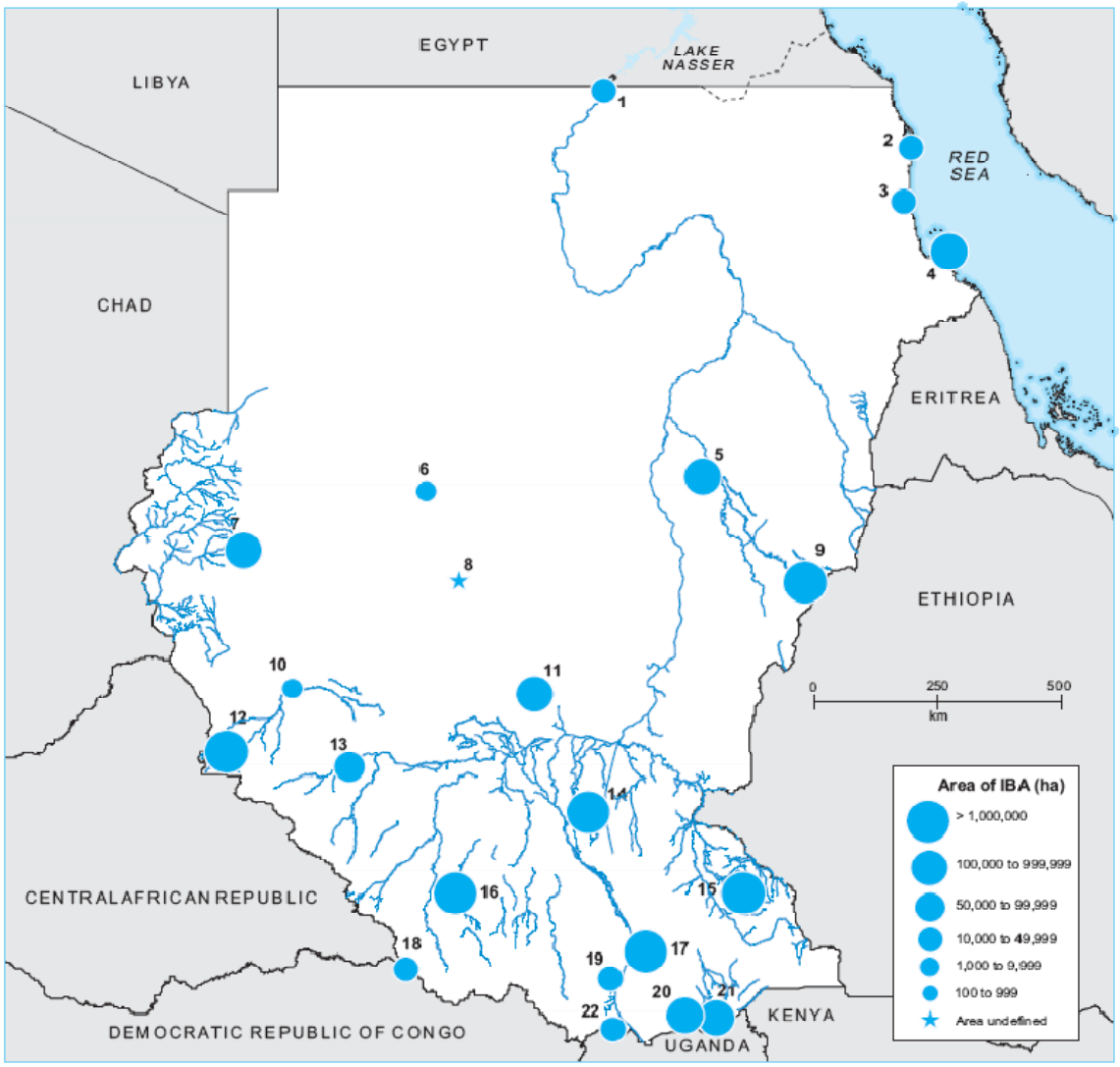
Figure 2-17 Localization of Dinder (Sudan) and Alatish (Ethiopia) National Parks

The Gumuz people have settled to the south of the Park and practice poaching and fishing along the Dinder River. Around the Park are a considerable number of Internally Displaced Peoples taking refuge from the war in Darfur in the 1970's and are settled along the Dinder and Rahad rivers and enter the Park for fishing, fuel wood and honey collection but also for illegal hunting and present the most serious threat to the wildlife. It is estimated that 100,000 people live around the park in 36 villages

Sudan also comprises several important bird areas (IBAs). Only two are located in the Blue Nile Sub-basin (Figure 2-18).

Although there are several areas in Sudan other than the Dinder Park, that are important for biodiversity or are wetlands, none is located in the Main Nile Sub-basin between Khartoum and the border with Egypt.

Figure 2-18 Localization and Size of Important Bird Areas of Sudan



IBA code	Site name	Administrative region	A1	A3						A4i	A4iii
				A02	A03	A04	A05	A07	A08		
SD001	Wadi Halfa	Northern		✓							
SD002	Mukawwar island and Dunganab Bay	Red Sea	✓	✓						✓	
SD003	Khor Arba'at	Red Sea		✓							
SD004	Suakin archipelago	Red Sea								✓	
SD005	Gezira	El Gezira								✓	✓
SD006	Um Badr	Northern Kordofan	✓	✓	✓						
SD007	Jebel Marra	Northern Darfur, Southern Darfur	✓		✓						
SD008	En Nahud	Northern Kordofan	✓		✓						
SD009	Dinder	Blue Nile, Kassala				✓					
SD010	Lake Kundi	Southern Darfur			✓	✓				✓	✓
SD011	Lake Abiad	Southern Kordofan								✓	✓
SD012	Radom	Southern Darfur				✓					
SD013	Ashana	Bahr el Ghazal				✓					
SD014	Sudd (Bahr-el-Jebel system)	Jonglei, El Buheyrat	✓			✓				✓	✓
SD015	Boma	Jonglei	✓						✓		
SD016	Southern National Park	El Buheyrat, Western Equatoria				✓					
SD017	Bandingilo	Eastern Equatoria				✓			✓		
SD018	Bengangai	Western Equatoria	✓			✓	✓				
SD019	Juba	Eastern Equatoria				✓					
SD020	Imatong mountains	Eastern Equatoria	✓			✓	✓	✓	✓		
SD021	Kidepo	Eastern Equatoria				✓		✓	✓		
SD022	Nimule	Eastern Equatoria				✓					
	Total number of IBAs qualifying:		8	4	4	12	2	2	4	6	4

Source: BirdLife.org

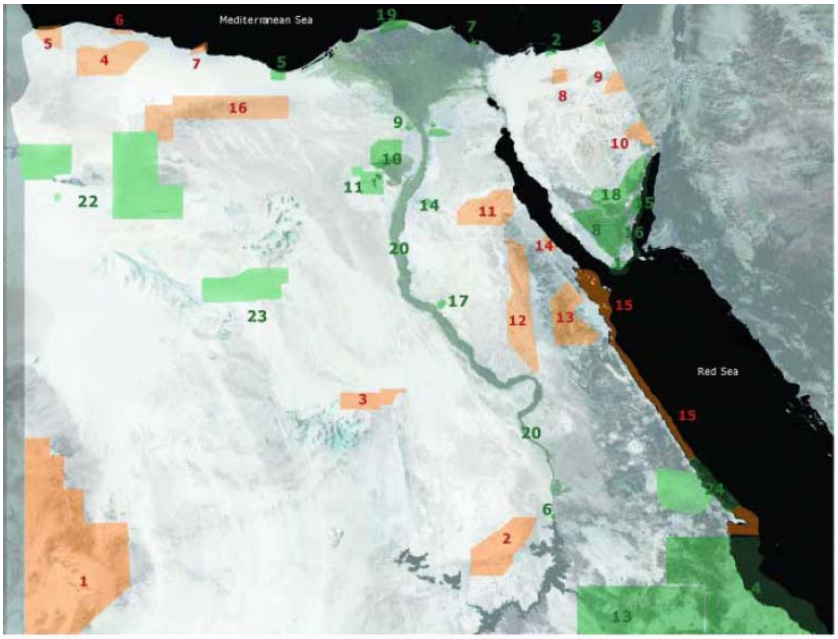
In Egypt, Figure 2-19 indicates that in 2006, there were 24 protected areas while another 16 were proposed. Several of them are located along the Main Nile.

Part of the Wadi Allaqi, one of the largest protected areas in Egypt, covering almost all the distance from Lake Nasser to the Red Sea, was declared a Protected Area in 1989 under the auspices of the EEAA and a "Man and the Biosphere" (MAB) Biosphere Reserve later in 1993. It has a core area of 63,850 ha, buffers zones of 131,095 ha and a transition zone of 2,184,200ha.

There are also several important bird areas (IBAs) in Egypt, many of them along the Main Nile between Lake Nasser and the mouth of the Nile in the Mediterranean Sea (Figure 2-20).

According to the National Water Research Center, Ministry of Water Resources and Irrigation, the wetlands of Egypt are basically the same as the IBAs reported in Figure 2-20 (Sustainable Development for the Southern Valley Area, National Water Research Center, Ministry of Water Resources and Irrigation, on-going). Several Important Bird Areas are reported along the Main Nile and in Lake Nasser/Nubia, but it is not very clear if they are really wetlands (marshes) as opposed to a water body by the Land Cover information in Lake Nasser/Nubia area.

Figure 2-19 Protected Areas in Egypt



Current protected areas

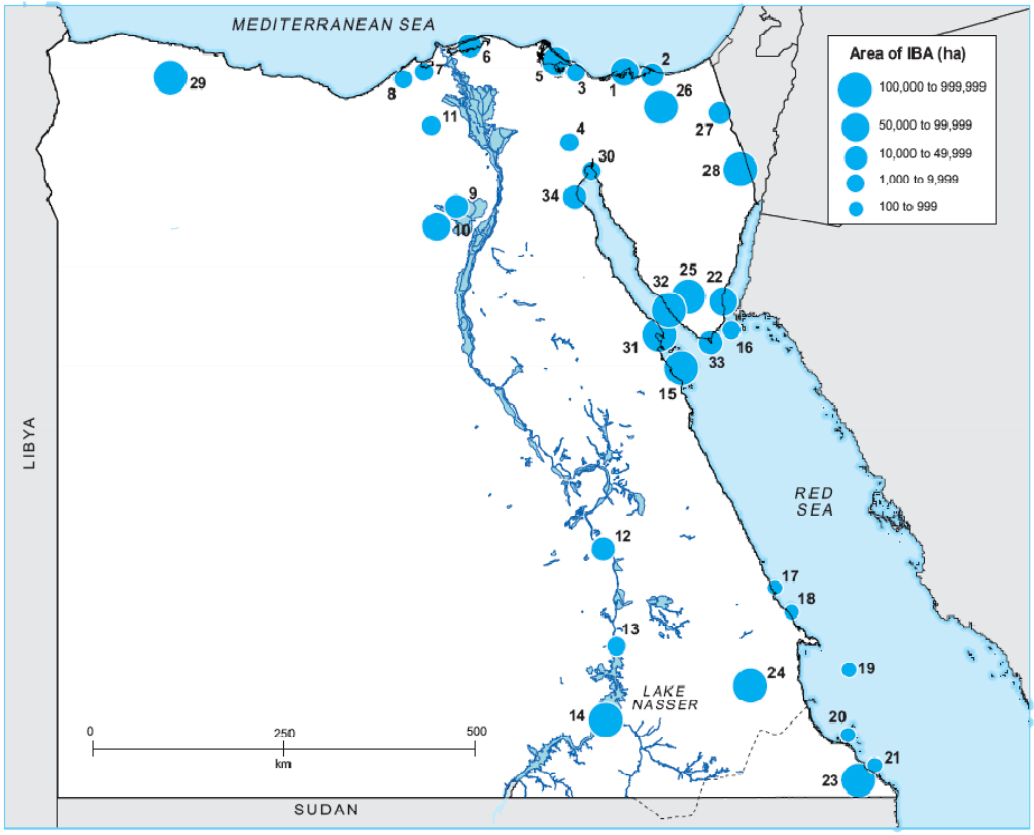
1. Ras Muhammad	9. El Hassana Dome	17. Wadi El Assiuti
2. Zaranik	10. Lake Qarun	18. Taba
3. El Ahrash	11. Wadi El Rayan	19. Lake Burullus
4. Elba	12. Maadi Petrified Forest	20. Nile River Islands
5. El Omayed	13. Wadi El Allaqi	21. Wadi Digla
6. Saluga and Ghazal	14. Sannur Cave	22. Siwa
7. Ashtum El Gamil	15. Abu Galum	23. White Desert
8. St. Katherine	16. Nabq	24. Wadi El Gemal

List of proposed areas

1. El Gilf El Kebir	7. Ras El Hekema	13. Gebel Shayeb El Banat
2. Kurkur and Dungul	8. Gebel El Maghara	14. Malahet Ras Shukair
3. Um El Dabadib	9. El Quseima	15. Red Sea Reef
4. El Qasr	10. Wadi El Gerafi	16. Qattara Depression
5. El Salum	11. Gebel El Geleala El Qebleya	
6. El Shuwaila	12. Wadi Qena	

Source: Ministry of State for Environmental Affairs, 2006. Protected Areas of Egypt – Towards the Future.

Figure 2-20 Localization and Size of Important Bird Areas of Egypt



IBA code	Site name	Administrative region	A1	A3		A4i	A4ii	A4iii	A4iv
				A01	A02				
EG001	Lake Bardawil	North Sinai	✓			✓		✓	
EG002	Zaranik Protected Area	North Sinai	✓			✓			
EG003	El Malahe	Port Said				✓		✓	
EG004	Bitter Lakes	Ismailiya				✓			
EG005	Lake Manzala	Port Said, Damietta, Daqahliya, Sharqiya, Ismailiya	✓			✓		✓	
EG006	Lake Burullus Protected Area	Kafr El Sheikh	✓			✓		✓	
EG007	Lake Idku	Beheira				✓			
EG008	Lake Maryut	Alexandria				✓			
EG009	Lake Qarun Protected Area	El Fayoum				✓		✓	
EG010	Wadi El Rayan Protected Area	El Fayoum	✓			✓			
EG011	Wadi El Natrun	Beheira				✓			
EG012	Upper Nile	Qena, Luxor, Aswan	✓			✓		✓	
EG013	Aswan reservoir	Aswan	✓						
EG014	Lake Nasser	Aswan	✓			✓		✓	
EG015	Hurghada archipelago	Red Sea	✓			✓	✓		
EG016	Tiran island	South Sinai	✓			✓			
EG017	Wadi Gimal island	Red Sea	✓			✓	✓		
EG018	Qulân islands	Red Sea	✓			✓	✓		
EG019	Zabargad island	Red Sea	✓			✓	✓		
EG020	Siyal islands	Red Sea	✓			✓			
EG021	Rawabel islands	Red Sea	✓						
EG022	Nabq Protected Area	South Sinai			✓				
EG023	Gebel Elba	Red Sea			✓				
EG024	The Abraq area	Red Sea			✓				
EG025	St Katherine National Park	South Sinai			✓				
EG026	Gebel Maghara	North Sinai	✓		✓				
EG027	Quseima	North Sinai			✓				
EG028	Wadi Gerafi	North Sinai			✓				
EG029	El Qasr desert	Matruh		✓					
EG030	Suez	Suez	✓						✓
EG031	Gebel Zeit	Red Sea	✓						✓
EG032	El Qa plain	South Sinai	✓						✓
EG033	Ras Mohammed National Park	South Sinai	✓						✓
EG034	Ain Sukhna	Suez	✓		✓				✓
	Total number of IBAs qualifying:		21	1	8	19	4	7	5

Source: BirdLife

2.2.5 Invasive Species

Poor agricultural practices and lack of sanitation have resulted in eutrophication of several water bodies, and compounded with the introduction of alien species have resulted in aquatic weed infestation.

Water Hyacinth

The water hyacinth (*Eichhornia crassipes*) is the most common aquatic weed. It was introduced into Africa through Egypt sometimes between 1879 and 1882. It was first seen on the White Nile in March 1958 and has subsequently spread both by flooding assisted by wind and by boats. Water hyacinth forms dense plant mats which degrade water quality by lowering light penetration and dissolved oxygen levels, with direct consequences for primary aquatic life. The weed also leads to increased water loss through evapotranspiration, interferes with navigation and fishing activities, and provides a breeding ground for disease vectors such as mosquitoes and the vector snails of schistosomiasis.

The northern limit of hyacinth infestation is now reportedly between Kosti and Duweim, although its presence was cited in the Jebel Aulia dam reservoir in June 2006, for the first time in seven years (Sudan Post-Conflict Environmental Assessment). A 1,750 km stretch of the White Nile, from its upper reaches near Juba to Duweim (some 70 km south of Khartoum) is infested. The water hyacinth spread used to extend to the Jebel Aulia dam, but a causeway at Duweim is apparently acting as a precarious barrier to downstream propagation.

In Ethiopia, the Institute of Biodiversity Conservation (2005) has reported the presence of water hyacinth, but there is not much detailed information available on its distribution and the severity of the infestations. At present, it is known that it has appeared in the north in Ethiopia, where it was first reported in 1965 at the Koka Reservoir and in the Awash River, where the Ethiopian Electric Light and Power Authority has managed to bring it under moderate control at the considerable cost of human labor. Other infestations in Ethiopia include many bodies of water in the Gambela Region, the Abbay from just below Lake Tana into Sudan, and Lake Ellen near Alem Tena (Fessehaie, 2005). It is also reported that the Akaki Wetland near Addis Ababa has already been totally infested by water hyacinth and the surrounding mudflats, once heavily populated by waders, no longer attract these birds. It has been recognized as the most damaging aquatic weed in Ethiopia since its fist presence in 1965 (Fessehaie, 2005).

In Sudan, control measures initially relied on large-scale applications of chemicals. An estimated 500 tons of the herbicide 2, 4-D were applied to the White Nile annually. This practice has now ceased, but it may have had significant long-term impacts on aquatic life and human health; these have not yet been assessed (Sudan Post-Conflict Environmental Assessment). More recently, biological control methods using two *Neochetina* weevils (*Neochetina bruchi* and *N. eichhorniae)* gave excellent results. About 350 km of the infested area are permanently free of water hyacinth. Moths and Fungi were also used, and since the early nineties the water hyacinth has not reached Jebel-Aulia dam; that is why sharing the Sudanese experience in its biological control was considered a true cooperation between the Nile Basin countries (NBI, 2005a).

Today, there are apparently no control operations underway at all. The role of the Plant Protection Department of the Ministry of Agriculture, which is responsible for water hyacinth control in Sudan, is currently limited to monitoring infestations, and it has no capacity to respond to the spread. In the south, the impact of water hyacinth on the Sudd is unknown, although it is anticipated to be considerable, given that these wetlands comprise a large number of oxbow lakes and slow-moving channels which are ideal conditions for weed growth. The scale of infestation can be gauged every wet season, when up to 100 meter-long rafts of detached weed float down the White Nile downstream of the Sudd (Sudan Post-Conflict Environmental Assessment, 2007).

Though the water hyacinth has been introduced in Egypt since the 1890s, it did not reach the plague proportion exhibited in the Nile until recent times. Since the construction of AHD, the Nile system has been subjected to several ecological changes: silt free water running downstream and the consequent excessive use of fertilization, permanent presence of water throughout the year, low

current velocity in the Nile and stopping the water flow to the Mediterranean. These factors have encouraged fast growth of *Eichhornia crassipes* within the Egyptian Nile River even at the end of the growing season, which extends from the end of March to October. The situation was qualified as alarming by el-Shinnawy *et al*. (2000).

According the Ministry of State for Environmental Affairs (2008), weeds like the water hyacinth cause several problems in water streams. The infected areas in Egypt amounted to 487 km^2 covering most of the canals, and about 151 km^2 in lakes. Water loss resulting from evapotranspiration in the infected areas amounts to 3.5 billion m^3 annually. This quantity is considered adequate to irrigate an extra 432 km^2 annually.

Egypt initially relied on chemicals to control water hyacinth. It stopped chemical control in about 1990–91, because of environmental concerns. Egypt has considered biological control but has not fully implemented it. In collaboration with the United States Department of Agriculture (USDA), it introduced exotic biological-control agents, evaluated the agents, and conducted host-specificity tests in quarantine during 1978–84. However, it never released these agents to control the weed. To date, Egypt has not adopted the use of these agents for the biological control of water hyacinth — the method is still under review.

Since 1991 Egypt has depended exclusively on physical methods to control water hyacinth. Its Ministry of Public Works and Water Resources (MPWWR) has executed mechanical harvesting and barriers, such as floating booms, in the main channel and claimed success. Farmers remove water hyacinth manually from the small canals that form the net of farm irrigation and drainage systems, but the weed remains a menace.

MPWWR is solely responsible for control of water hyacinth in Egypt but has little dialogue with other stakeholders, such as the Plant Protection Research Institute (PPRI) (under the Ministry of Agriculture and Land Reclamation) and universities (Phiri et al, 2000).

Egypt has a strong expertise on alternative methods for water-hyacinth control. Such expertise can be found at PPRI, including the knowledge of biological control that Egypt could use to develop an integrated water hyacinth management strategy. However, an integrated strategy has not developed, owing to a lack of inter-institutional collaboration and national coordination (Phiri *et al*., 2000)

Egypt just signed an agreement with Indonesia for Indonesian entrepreneurs to build a water hyacinth processing factory in Egypt that will produce furniture and handicrafts like bags, floor mats and steel. The planned factory would hire 400 workers (Viva News, 2010).

Other Invasive Species

The watercourses of Sudan are also afflicted with other invasive species, mesquite (*Propopis spp*. particularly *Propopis juliflora)*, which has infested many of the seasonal khors and canals of northern Sudan (Sudan Post-Conflict Environmental Assessment).

It is also noteworthy to mention that *Pistia stratiotes L*., and *Nymphea lotus* have been reported in the Blue Nile on the mud flats of the Sennar reservoir (El Mograby *et al*., 1986), and *Parthenium hysterophorus* a weed that can degrade natural ecosystems and can produce serious allergenic reactions in humans. Parthenium aggressively colonizes disturbed sites and has major impacts on pasture and cropping industries, spreading to and impacting new areas *(*Ethiopian Institute of Agricultural Research, 2004). *Myriophyllum spicatum* is invading Lake Nasser for over a decade and has replaced the originally dominant submerged macrophyte *Najas marina* (Ali and Soltan, 2006).

3. SOCIO-ECONOMIC BASELINE IN THE STUDY AREA

3.1 DEMOGRAPHICS

The total population living in areas of Ethiopia, Sudan and Egypt drained by the Abbay/Blue and main Nile from its source in Lake Tana to the Aswan High dam is estimated to be 45 million people. Nearly two-thirds are Ethiopians living along the Abbay River and its tributaries; just over one-quarter are Sudanese in the Blue Nile and Main Nile sub-basins; and, the remainder is Egyptians living in the Lake Nasser/Nubia watershed. This section reviews current population levels, key demographic characteristics and trends related to population movements and growth. It is estimated that about 100 million persons live in the Eastern Nile Watershed.

3.1.1 Population Levels

In 2002, the number of Ethiopians living in portions of the Amhara, Oromia and Benshagul-Gumuz (BNG) regions situated in the Abbay sub-basin was 26.3 million people. The average density in the sub-basin was 80 persons per square kilometer although it ranged from fewer than 10 persons/km^2 in parts of BNG to 250 persons/km^2 in Oromia. In the period 2002-2007, the population of the Sub-basin grew an estimated 12.8% based on the average annual growth rates in each of the regions in the Sub-basin. The estimated 2007 population of the Sub-basin is about 30 million people.

Table 3-1 Breakdown of Total Population in the Abbay/Blue – Main Nile Sub-basin

Region	Analysis by Sub-basin (portions of regions in basin)			Analysis by Regions In Sub-basin		
	Area (km^2)	Population (2002)	Density (p/km^2)	Area (km^2)	Population (2007)	Density (p/km^2)
Abbay Sub-basin	**200,719**	**26,310,029**	**131**	**562,154**	**45,043,374**	**79**
Amhara	93,565	10,256,425	110	170,150	17,214,056	101
Oromia	62,478	15,601,177	250	353,690	27,158,471	77
Benishangul-Gumuz	44,676	452,427	10	49,290	670,847	14
Blue Nile Sub-basin	**110,763**	**6,606,361**	**60**	**204,466**	**12,315,149**	**60**
Blue Nile	19,162	338,291	18	45,844	832,112	18
Sennar	30,106	1,091,640	36	37,844	1,285,058	34
Gaderif	38,929	1,151,050	30	75,263	1,348,378	18
El Gezira	15,686	1,919,580	122	23,373	3,575,280	153
Khartoum	6,880	2,105,800	306	22,142	5,274,321	238
Main Nile Sub-basin	**627,702**	**5,404,993**	**9**	**1,496,910**	**7,821,744**	**5**
Sudan						
North Kordofan	123,958	n.a.	n.a.	185,302	2,920,992	16
River Nile	105,195	701,256	7	122,123	1,120,441	9
Red Sea	98,747	2,048,041	21	218,887	1,369,110	6
Northern	230,080	1,179,399	5	348,765	699,065	2
Egypt						
Aswan	27,608	169,647	6	62,726	1,222,341	19
Red Sea	30,856	1,120,275	36	119,009	296,775	2
New Valley	11,258	186,375	17	440,098	193,020	<1
Total	**939,184**	**38,321,383**	**41**	**2,274,506**	**65,180,267**	**29**
Sub-total ETHIOPIA	*200,719*	*26,310,029*	*131*	*562,154*	*45,043,374*	*79*
Sub-total SUDAN	*434,022*	*3,928,696*	*9*	*875,077*	*6,136,608*	*7*
Sub-total EGYPT	*69,722*	*1,476,297*	*21*	*621,833*	*1,712,136*	*3*

N.A.: Data are not available from OSI or other readily available sources.

Sources: Hydrosult *et al.*, Main Nile Basin; national census stats
Hydrosult *et al.*, Abbay/Blue Nile Basin; 5th Population and Housing Census, Sudan, 2008
Hydrosult *et al.*, Abbay/Blue Nile Basin, 2006; 2007 Population and Housing Census, Ethiopia

In 2002, 6.6 million Sudanese lived in the Blue Nile Sub-basin, at an average density of 60 persons per square kilometer. Density ranged widely in the sub-basin from 18 persons/km^2 in Blue Nile State to more than 300 persons/km^2 in Khartoum. Between 2002 and 2008, the population of the Blue Nile Sub-basin grew an estimated 21.7% based on the average annual growth rates in the states in the Sub-basin. In addition to rural-urban migration to the capital, Khartoum, a significant portion of this rapid population growth included people fleeing conflict in other parts of Sudan. As a consequence, the estimated 2008 population in the sub-basin is 8 million people.

In 2002, the total population living in the Main Nile basin from Khartoum to the Aswan High Dam was 5.4 million people, of which over 70% lived in Sudan[2]. The population density ranged from under 10 persons/km^2 in the desert areas of northern Sudan and Aswan Governorate in Egypt, to 36 persons/km^2 in the urbanized Red Sea Governorate. Between 2002 and 2008, the population of the Main Nile sub-basin grew an estimated 13% based on the average annual growth rates in the states and governorates. In Egypt alone, the population increased an estimated 36.7% in that period. As a consequence, the estimated populations are 4.2 million people living in Sudan in the Main Nile sub-basin and 2 million people in Egypt in the Lake Nasser watershed.

3.1.2 Age and Sex Distribution

Throughout the Abbay/Blue - Main Nile Sub-basin, the proportion of children under the age of 15 years averages between 40 and 48%[3] of the population. As a consequence, there are high child dependency rates in most parts of the Sub-basin, meaning that most working age people are supporting 1.7 to 1.9 people including themselves.

The bias in the Sub-basin population towards youth is also reflected in the fact that 60-70% of the population of the Abbay/Blue Nile and 50% of the Main Nile is under the age of 25 years. This is significant in terms of the numbers of people entering the job market on an annual basis, as well as the availability of land and other resources to support rural livelihoods. There is, however, high youth emigration, particularly to Khartoum and, internationally, to the Gulf countries.

Overall in the Abbay/Blue Nile Sub-basin, there are slightly more men than women in the population (male/ female ratio of 1.02). The male/female ratio is significantly higher in the urban area of Khartoum (1.13), reflecting rural to urban migration of men looking for work. Overall, there are slightly more women than men in the Main Nile Sub-basin population (average male/female ratio of 0.95). The exceptions are Red Sea State in Sudan and Red Sea Governorate in Egypt where the male/female ratios are, respectively, 1.16 and 1.55, reflecting rural to urban migration of men looking for work.

3.1.3 Population Growth

Based on FAO projections, the 2030 population of the Nile Basin will exceed 200 million people[4]. Half of this population will be people living in Egypt along the length of the Nile River from Lake Nasser to the delta. The remainder will be divided approximately equally between Ethiopia and Sudan.

[2] To date, it has not been possible to ascertain the 2002 population in the portion of North Kordofan State situated in the Main Nile Sub-basin. This information, when available, may alter slightly the distribution of population within the Sub-basin, as well as the estimates of population increase in the 2002-2008 period.

[3] Equivalent data are not currently available for the Egyptian portion of the Main Nile Sub-basin.

[4] www.fao.org/nr/water/faonile/PopulationProspects.pdf

Table 3-2 Nile Basin Population Projection, 2030 (millions of people)

	Ethiopia	Sudan	Egypt
2005-2030 Prospects, Eastern Nile Basin			
Country Popn., 2005	79.0	36.9	72.9
Basin Popn., 2005	31.0	32.4	72.6
Basin Popn., 2030	50.3	53.7	101.5
2030 Prospects by Country			
Low Variant	128.6	54.5	96.2
Medium Variant	137.1	58.4	104.1
High Variant	145.5	62.5	112.0
2005-2030 Rural-Urban Prospects			
2005 Urban Popn.	12.5	14.8	31.3
2030 Urban Popn.	37.0	32.8	57.9
2030 Rural Popn. (%)	73	44	44
Note: Population data for Egypt are for the entire Nile Basin. No data are available for the Lake Nasser watershed.			
Source: www.faonile.org			

3.2 URBAN/RURAL DISTRIBUTION AND SETTLEMENT PATTERNS

In the Ethiopian regions situated in the Abbay sub-basin, almost 90% of the population lives in rural areas. The settlement pattern consists largely of dispersed homesteads or small clusters of houses surrounded by agricultural fields. Settlements are widely scattered, often located several hours walking distance from one another. Larger villages develop along roads in the vicinity at the local administrative offices. These communities will have small shops or kiosks, health and school facilities and a church. Smaller villages may only have an elementary school. In Benishangul-Gumuz, the regional government has designated 41 resettlement villages as part of a program to relocate people in order to make the provision of public services and infrastructure more efficient.

In the Blue Nile sub-basin, 70-80% of the population lives in rural areas with the exception of the State of Khartoum where 80% of the population is urban. Also in Sudan, less than 1% of the population in the Blue Nile sub-basin is classified as nomadic. The basin population is concentrated on the west side of the river, attracted by the El Gezira Irrigation Scheme and the presence of a main road; other concentrations are found near the Rahad Irrigation Scheme in the Dinder Valley and along the Sennar-El Kaferif road. Most people in the basin live in villages and towns, a direct consequence of the allocation of large tracts of land for mechanized and irrigated farming. They commute daily to their lands or, if agricultural laborers, to their employment. Small villages have minimal services in comparison to the larger towns such as Doka and El Damson.

Table 3-3 Urban-Rural Population Distribution (%)

Region	Rural	Urban	Nomadic
Abbay Sub-basin			
Amhara	87.4	12.6	-
Oromia	87.8	12.2	-
Benishangul-Gumuz	86.5	13.5	-
Abbay Sub-basin	**87.6**	**12.4**	**-**
Blue Nile Sub-basin			
Blue Nile	71.8	24.3	3.8
Sennar	76.2	21.7	2.1
Gaderif	70.2	28.5	1.4

Region	Rural	Urban	Nomadic
El Gezira	80.9	19.1	0.0
Khartoum	19.0	81.0	0.0
Blue Nile Sub-basin	**52.1**	**47.3**	**0.6**
Main Nile Sub-basin			
Sudan			
North Kordofan	67.2	19.9	12.9
River Nile	67.9	29.6	2.5
Red Sea	42.5	39.5	18.0
Northern	81.1	16.9	2.0
Egypt			
Aswan	57.5	42.5	-
Red Sea	4.5	95.5	-
New Valley	51.9	48.1	-

Source: 2007 Population and Housing Census, Ethiopia; 5th Population and Housing Census, Sudan, 2008; Egypt National Human Development Report, 2008; CAPMAS, 2009

The Sudanese portion of the Main Nile basin is predominantly rural except in the State of Red Sea. At the same time, the proportion of nomads is significantly higher in Red Sea as well as in the State of North Kordofan. The main areas of high population density in Sudan are along the river near Khartoum and in the areas around the towns of Kassala, Karima, Dondola and El Obeid.

In Egypt, however, people living in urban areas account for 40-50% of the population in the governorates of Aswan and New Valley and 95% of the population of Red Sea Governorate. Nearly all of the population living in the immediate area of Lake Nasser/Nubia lives outside the buffer zone of 6-10 km from the shoreline of the lake.

3.2.1 Population Movements

Population movements within the Abbay Sub-basin occur for a variety of reasons, with the dominant trend being rural-to-rural migration. In Ethiopia, the 1980's Resettlement Campaign resulted in many people being resettled from severely drought-affected highlands to lowlands areas such as the Benishagul-Gumuz (BSG) Region. Since 2003, the Government voluntary resettlement program is limited to intra-regional movements.

- In Amhara where there are high population densities, many settlements have reached their carrying capacities. People are moving to other locations due to insufficient land and other resources to support their agricultural livelihoods. Other, local migration occurs between rural areas and towns within the region.
- In BSG, there is a net in-migration to the region. This region was a principal destination for the 1980's resettlement programs. Other people migrate spontaneously to take advantage of investment opportunities in the region, as well as trade and government employment. Sudanese temporarily migrate into the region due to drought conditions in their country.

Sudan has the largest population of displaced persons in the world today. Over five million internally displaced persons (IDPs) and international refugees currently live in rural camps, informal settlements and urban slums in Sudan (Sudan Post-Conflict Environmental Assessment – Population Displacement and the Environment). The number of displaced persons in the Blue and Main Nile Sub-basins in 2005 was estimated in Table 3-4.

Table 3-4 Number of Internally Displaced Persons in the Blue and Main Nile Sub-basins (2005)

Location (State)	Number of IDPs
Blue Nile Sub-basin	
Gedaref	42,000
Sennar	60,000
Blue Nile	235,000
Khartoum	2,000,000
Sub-total	**2.337,000**
Main Nile Sub-basin	
Kordofan	189,000
Red Sea	277,000
Northern Sudan	200,000
Sub-total	**3,003,000**

Source: UNEP, 2007

The recent outbreak of hostilities between Ethiopia and Eritrea has led to the arrival in eastern Sudan of refugees from both countries. Official figures estimate the refugee population in this region to be 180,000 people (SOS Sahel, 2009).

In Sudan as elsewhere, displaced populations return to their homelands if and when it is possible. For returns to take place on a large scale, however, a number of pre-conditions must be met, including among others physical security and prospects for a livelihood in the homeland better than in the displaced location. Because these conditions are not always met, temporary displacements for any reason tend to turn into long-term processes or even permanent moves. These displacements cause of a number of environmental impacts:

- deforestation and the fuel wood crisis in dry land camp areas
- land degradation
- unsustainable groundwater extraction
- water pollution

In Sudan, the availability of work on irrigated and semi-mechanized farms has attracted internally displaced people (IDP) from Darfur to the eastern region of the country. Of the population of approximately 600,000 people associated with agricultural laborers working on the El Gezira Irrigation Scheme, 70% are estimated to be Darfur IDP (World Bank, 2000). In 2005, approximately 3 million IDPs displaced from Southern Sudan and Darfur were living in the provinces drained by the Blue Nile and Main Nile (UNEP, 2007). Many of these IDP have settled in what have become slum areas around towns and major villages.

In addition to displacements for conflicts and security reasons, government-sponsored development schemes, specifically mechanized rain-fed agricultural schemes, such as the El-Gezira, Aswan dam and the new Merowe dam are cause for movement of people looking for better conditions of living. In these cases, displacement takes the form of organized resettlements and land allocation for new agricultural schemes.

The predominant livelihood strategy for the rural majority in Sudan is agro-pastoralists. According to the 1993 census, Gaderif State, bordering Kassaka, Gezira, Blue Nile, Eritrea and Ethiopia had a population of 1.6 millions agro-pastoralists as it represented the southern destination of the nomads and pastoralists; those who moved there seasonally from the Blue Nile in the south of Sudan to the Butana area towards the north east in time of water shortage, diminishing natural pastures as a result of the expansion of the mechanized farming against the natural pastures, and increasing competition over the natural grazing.

With a grant from the Nile Basin Initiative, Practical Action Sudan has launched development innovations for Sam Turuk natural water pond in Gaderif area, which is considered as the central destination on the seasonal route of the nomads and pastoralists. Today the Sam Turuk natural water pond had become over silted and its storage capacity reduced to so that it is only capable of catching enough water for two month after the rainy season. During the rainy season, the pastoralists usually move with their herds to the Butana Plains, where they stay for two to three months before they are forced to move south to stay near the Rahad River due to a shortage of water. Their presence along the River causes them many problems as they compete with the people who live in the same area on the meager water resources available especially when the summer season advances and the river forms only small scattered ponds (Sharing, 2008).

As part of the Egyptian Government agricultural development policies, land reclaimed in the Lake Nasser watershed through the development of irrigation systems will be populated by people relocated from other parts of the country.

3.3 ETHNICITY, RELIGION AND SOCIAL ORGANIZATION

3.3.1 Abbay Sub-basin

The two largest ethnic groups in Ethiopia are the Amhara and Oromo. In the Abbay Sub-basin, although there are more than 50 ethnic groups in Amhara and Oromia regions, the Amhara and Oromo account for about 90% of the population of these regions. In BSG there is greater ethnic diversity. The principal group, Jeblawi, along with Amhara, Oromo and Gumuz account for over 80% of the regional population (Table 3-5). In the vicinity of the Mandaya and Border projects, the population is comprised primarily of Gumuz and Amhara, the latter having migrated into the region following the famines in 1978/1979 and 1984/85.

Table 3-5 Ethnic Groups, Abbay Sub-basin (%)

Region	Amhara	Oromo	Jeblawi	Gumuz
Amhara	91.5	2.6	<1.0	<1.0
Oromia	7.2	86.7	<1.0	<1.0
Benishangul-Gumuz	21.3	13.3	25.9	21.1

Source: 2007 Population and Housing Census, Ethiopia

Among the ethnic groups in the Abbay Sub-basin, there are differences in social organization. The Gumuz, Berta and other ethnic groups in BSG are clan-based societies. In these groups, land is managed collectively by the clan with the allocation of plots equally to all members. Due to the influence of the clan system, Gumuz practice marriage according to the rule of exogamy whereby a man will marry a woman from a different clan. In Amhara and Oromia, on the other hand, non-kinship forms of social organization are based more on patron-client relationships among people.

3.3.2 Blue and Main Nile Sub-basins in Sudan

Sudan has a rich ethnic history, with somewhere between 500 and 600 ethnic groups. The majority of today's Sudanese are Muslims, although due to the rich cultural history of this region there are also Christians and animists.

In the Blue Nile Sub-basin, there are a number of ethnic groups, including among others:

- The Gumuz and Berta are groups whose traditional territories bridge between the Abbay and Blue Nile sub-basins.
- The Funj were a warrior society that established a sultanate in the 1500's in what is now the state of Sennar. The sultanate was overturned in the late 18th century and, today, the Funj are largely assimilated into the general Arabic population.
- Arabic-speaking groups such as the Rufa'a al Hoi, Kenana and Fulani have traditionally practiced transhumant pastoralist livelihoods throughout the Blue Nile Sub-basin.

Progressively, these groups have become more sedentary. Many who lost their herds during the 1984 drought have not been able to restore their livestock. Moreover, the expansion of mechanized agriculture has reduced grazing lands. Others are finding benefits from living in one place and having greater access to public services. In the state of Blue Nile, the Ingessana is a group with distinct language and culture who are agriculturalists. They also raise livestock and, often, work as herders for the Rufa'a al Hoi.

The indigenous Beja are considered the dominant ethnic group in eastern Sudan, of which the largest tribe is the Hadendowa group and the second largest, the Beni Amer. The Beja are nomadic tribes that live mainly in the Red Sea Hills of the Sudan, although they are found throughout the region. This mountainous, semi-desert region lies parallel to the Red Sea coast from southeastern Egypt through northeastern Sudan into Eritrea. The Beja roam these mountains between the Red Sea and the Nile and Atbara rivers and also the plains that slope down westwards to the Nile river valley. They are a non-Arab, Hamitic people, numbering 1.8 million. They were converted to Christianity in the 6th century through the influence of the Nubians of the Nile Valley but also became Muslim at the same time adopting genealogies linking them to Arab ancestors.

Also in the Main Nile sub-basin, other ethnic groups are Nubians, Danagla, Bedirya and Rekabia. Along both banks of the Nile itself are the Gaa'lian people who have inherited the rights to use their land; being closest to water, they were able to survive the drought of 1983/84. Also living on both sides of the river are the Shaigia, Kawahla, Kababish and Hassaniya peoples, mainly pastoralists but who also cultivate sorghum along the *wadis*. As with all the pastoral/ agro-pastoral groups, wage labor is a major feature of livelihood strategies. Living mainly along the Wadi Muqadam and, more recently, along the Nile below Korti are the Hawaweer people. Their livelihoods were also devastated by the 1983/84 drought but many have returned and rebuilt their livelihoods (Haug, 2000).

The Nubians in particular consist of seven non-Arab Muslim tribes that originated in the Nubia region, an area between Aswan in southern Egypt and Dongola in northern Sudan. Although the Nubians were converted to Christianity during the sixth century, a gradual process of Islamization began taking place from the fourteenth until the seventeenth centuries, so that today, the Nubians are almost all Muslims. However traditional animistic beliefs are still mingled with Islamic practices. In the 1960's, many of the Nubian villages were flooded as a result of the construction of the Aswan High Dam. About 100,000 Nubians were forced to resettle in "New Nubia," 20 miles north of Aswan.

The numerous Baggara tribes of northern Sudan share many cultural characteristics and claim a common ancestry. These Baggara tribes live in the plains of Sudan's Darfur, North Kordofan, and South Kordofan states. The region is well suited for grazing cattle and most of the Baggara are herdsmen. Their herds are comprised primarily of cattle, although they do raise sheep and goats. Camels are kept for riding and as pack animals. Most Baggara tribes are nomadic although there are some that live in farming communities or towns. Grazing land is usually shared, but farm land is owned individually.

3.3.3 Lake Nasser Watershed in Egypt

In the Lake Nasser watershed, there are two main ethnic groups that live in the eastern part of the Main Nile sub-basin: the Ababda, and the Bishari. The Ababda are more numerous, and make up about two-thirds of the population. This group has lived in the southern part of the eastern desert for centuries, and many have migrated to the towns of the Nile Valley since the end of the 19^{th} century. The Bishari are more recent arrivals, and make up the other third of the population of the Sub-basin. Traditionally, this group lived in the Gebel Elba Region in the Red Sea Hills along the border with Sudan. Many have arrived since the 1970's to take advantage of the agricultural opportunities presented by seasonal inundation.

Originally nomadic herdsmen, both ethnic groups are becoming increasingly sedentary and share similar livelihoods with economies based on, in descending order of importance, charcoal production, sheep herding, camel herding, collecting medicinal plants and residual moisture cultivation. Charcoal production and sheep herding take place between December and April,

cultivation between May and September and camel herding and medicinal plant collection throughout the year. In the Wadi Allaqi Biosphere Reserve, loosely-related groups of 10-30 people live together in tent camps; the tents are constructed of materials that are easily dismantled and rebuilt. The most important factors in choosing a place to settle are access to water, fuelwood, grazing land and proximity to camps where relatives live; other considerations include access to social services, wage labor and trade opportunities.

3.3.4 Presence of Indigenous Peoples in Nile Basin

The World Bank policy on indigenous peoples (OP 4.10) does not specifically define the term "indigenous peoples", but uses it to refer to distinct, vulnerable, social and cultural groups that possess, in varying degrees, the following characteristics:

- Self-identification as members of a distinct indigenous cultural group and recognition of this identity by others;
- Collective attachment to geographically distinct habitats or ancestral territories in the project area and to the natural resources in these habitats and territories;
- Customary cultural, economic, social, or political institutions that are separate from those of the dominant society and culture; and
- An indigenous language, often different from the official language of the country or region.

The identities and cultures of indigenous peoples are integrally linked to their lands and the natural resources on which their livelihoods depend, thus increasing the risks and levels of impacts resulting from development. The objective of the World Bank policy is to ensure that development projects include measures to avoid potentially adverse impacts and, where that is not feasible, to minimize, mitigate or compensate for such effects.

Within the Nile Sub-basin, there is a wide diversity of ethnic groups in each of the countries. In the context of rapidly changing conditions within the Sub-basin, there are several among these groups that may be considered indigenous in the context of the objectives of the World Bank policy:

- The Gumuz and other ethnic groups in the western lowlands of the Abbay Sub-basin continue to practice extensive shifting cultivation and animal husbandry within communities that uphold traditional systems of land tenure and social and local political systems. Particularly in the event of the development of large dams on the Abbay, communities belonging to these groups will be at greater risk of adverse impacts including the potential for radical changes in their livelihoods, access to natural resources and community resources.
- In eastern Sudan, the indigenous ethnic groups that continue to engage in nomadic pastoralism and semi-nomadic agro-pastoralism represent particular cultural and livelihood systems that have evolved over thousands of years in the environmental context of the region. These groups have been under pressure for more than 60 years due to government policies, expanding large-scale agricultural development and increasing environmental degradation and desertification. They may also be further affected, albeit indirectly, by the proposed JMP 1 investments.
- In the region of Wadi Allaqi in the Lake Nasser watershed, Ababda and Bishari, while constituting the majority of the population in the immediate region, are indigenous ethnic groups that have social and livelihood systems that emanate from their cultural origins.

3.4 HEALTH CONDITIONS

Key health indicators, access to potable water and sanitation as well as the incidence of water-borne diseases are the principal health issues related to development of water resources in the Nile Basin. The differences among these characteristics reflect the levels of development and opportunities for people living in different parts of the sub-basin.

3.4.1 Key Health Indicators

Overall, key health indicators are poor throughout Ethiopia and Sudan and contrast sharply with much better conditions in Egypt. In the upstream countries of the Nile Basin, life expectancy is low; and, infant mortality rates and child malnutrition rates in the regions that drain the river are worse than national averages. Children are among the most vulnerable groups to the effects of food shortages and poverty.

In Egypt, people live, on average, 35-40% longer than people in the upstream countries. The national rates for infant mortality and child malnutrition are, respectively, 25% and 15% of the rates in Sudan. The incidence of child malnutrition is negligible in two of the three governorates in the Lake Nasser watershed.

The incidence of HIV in Ethiopia is a major public health problem. In 2005, 3.5% of the population between the ages of 15 and 49 years was HIV positive. In the Abbay Sub-basin, the situation was even worse in Amhara Region with a prevalence rate of 4.5%.The situation is potentially serious in Sudan with 2.3% of the population aged 15-49 years that test positive. In Egypt, less than 1% of the adult population is HIV positive.

Table 3-6 Health Indicators

Region	Life Expectancy (yrs, at birth)			Infant Mortality Rate (% per 1,000 births)			Child Malnutrition (% <5yrs)	HIV Prevalence (% 15-49yr)
	Total	M	F	Total	M	F		
Abbay Sub-basin								
Amhara	-	53.4	56.0	83	-	-	48.9	4.5
Oromia	-	53.0	55.5	104	-	-	34.4	2.4
Benishangul-Gumuz	-	50.1	51.1	86	-	-	44.6	2.8
Ethiopia (country)	*54.7*	*53.3*	*56.2*	*81*	*92*	*69*	*37*	*3.5*
Blue Nile Sub-basin								
Blue Nile	-	-	-	-	137	122	-	-
Sennar	-	-	-	-	121	109	-	-
Gaderif	-	-	-	-	135	122	-	-
El Gezira	-	-	-	-	101	76	-	-
Khartoum	-	-	-	-	98	85	-	-
Sudan (country)	*51.4*	*50.5*	*52.4*	*82*	*83*	*82*	*41*	*2.3*

Region	Life Expectancy (yrs, at birth)			Infant Mortality Rate (% per 1,000 births)			Child Malnutrition (% <5yrs)	HIV Prevalence (% 15-49yr)
	Total	M	F	Total	M	F		
Main Nile Sub-basin								
Sudan								
North Kordofan	-	-	-	-	125	106	49.9	-
River Nile	-	-	-	-	108	90	38.9	-
Red Sea	-	-	-	-	95	88	42.3	-
Northern	56.7	54.7	58.7	-	116	98	36.9	-
Sudan (country)	*51.4*	*50.5*	*52.4*	*82.4*	*82.5*	*82.4*	*41*	*2.3*
Egypt								
Aswan	70.8	-	-	22.9	-	-	1.5	-
Red Sea	70.8	-	-	15.9	-	-	11.4	-
New Valley	70.8	-	-	12.9	-	-	3.6	-
Egypt (country)	*72.1*	*69.6*	*74.8*	*20.5*	*28.9*	*25.5*	*6.2*	*<1*

Sources: AIDS in Ethiopia, 6th Report; www.unaids.org accessed 30 March 2010; Ethiopia National Population Office, 2003, cited in SMEC, 2006, RAP-Ethiopia, Ethiopia-Sudan Power System Interconnection Project; PASDEP; 2004 Welfare Monitoring Survey, cited in OSI Synthesis, 2007.
Blue Nile Sub-basin Data.xls; Hydrosult *et al.* Sudan Country Report, 2006.
Hydrosult *et al.* Sudan Country Report; Multiple Indicator Cluster Survey, cited in FAO, 2005; Sudan States Encyclopedia, 2000, cited in SMEC, 2006; CIA Fact book for Sudan and Egypt, 2009; Hydrosult *et al.* Egypt Country Report, Egypt Human Development Report, 2008.

3.4.2 Access to Potable Water and Sanitation

In Ethiopia and Sudan, the national averages for the population with access to improved water sources were in 2000, respectively, 36% and 70% (World Bank, 2000). Since then, Ethiopia has made significant gains with about 68.5% of the population facing access to safe water in June 2010 (Water Aid, 2011). In Sudan, in 2011, about 16% of the population still did not have access to safe water (Aqua Africa Clean Water for Sudan, 2011). Safe water sources include public and private taps and deep wells as well as piped water to the house. In Egypt, nearly the entire population is connected to reticulated water supply systems providing them with piped water to their houses (World Bank, 2000).

In the Abbay Sub-basin, there is no piped water to houses and the proportions of households with access to safe water are generally below the national average of 25% for rural areas. In fact, the majority of households rely on unsafe sources such as shallow wells and water from rivers and streams. In Sudanese states in the Blue and Main Nile Sub-basins, the proportions of households with access to safe water vary widely from low levels in states such as Blue Nile and conditions equal to or better than the national average nearer to Khartoum. In the case of El Gezira State, for example, the high proportion of people with access to piped water is due, in large part, to the fact that within the Gezira Irrigation Scheme 75% of the residents are connected the reticulated water supply systems (World Bank, 2000).

Table 3-7 Main Sources of Drinking Water (%)

Region	Safe/Improved Sources				Other Sources			
	Piped into house	Private tap	Public tap	Deep well	Shallow well	Rain harvest	River, stream, lake	Other
Abbay Sub-basin								
Amhara		9.1		12.3	41.6	-	36.3	0.3
Oromia	-	11.2		11.2	34.2	-	43.1	0.3
Benishangul-Gumuz	-	12.5		5.7	0.1	-	63.1	0.4
Blue Nile Sub-basin								
Blue Nile	12.3		2.1	9.3	2.1	27.9	33.2	13
Sennar	30.2		11.3	32.4	0.6	9.3	8.1	8
Gaderif	12.6		18.8	27.7	13.9	9.4	13.8	3.6
El Gezira	47.2		14.1	16.6	6.6	0.2	12	3.3
Khartoum	59.8		3.5	29.5	2.4	1.6	0.2	2.9
Blue Nile Sub-basin	*50.8*		*4.3*	*15.8*	*9.8*	-	*12.8*	*6.5*
Main Nile Sub-basin								
Sudan								
North Kordofan	16.3		5.3	20.5	25.4	13.2	2.2	17.2
River Nile	42.3		3.7	12.2	13.5	-	24.7	3.6
Red Sea	25.6		18.3	28.3	25.8		-	0.5
Northern	50.8		4.3	15.8	9.8	-	12.8	6.5
Egypt								
Aswan	99.0		-	-	-	-	-	-
Red Sea	89.4		-	-	-	-	-	-
New Valley	99.0		-	-	-	-	-	-

Source: Blue Nile Sub-basin Data.xls; Hydrosult *et al.* Sudan Country Report, 2006; Hydrosult *et al.* Sudan Report, 2006, CRA

Sanitation conditions are poor to non-existent throughout the Abbay and Blue Nile Sub-basin. The most common type of sanitary facility is a traditional pit latrine. However, up to 60% of households in some parts of these sub-basins have no sanitary facilities. . In Egypt, in comparison to the availability of safe water, far fewer people have access to improved sanitary facilities, particularly in the rural areas.

3.4.3 Water-Borne Diseases

Schistosomiasis and malaria are serious public health risks that are endemic throughout the Abbay/Blue-Main Nile Sub-basin. The conditions that are conducive for the vectors of these diseases are similar: non- or slow-moving, shallow water bodies that characterize irrigation systems and can be found around the periphery of dam reservoirs. Other water-borne diseases include Onchocerciasis (river blindness) and Trypanosomiasis (human sleeping sickness), as well as acute dysentery and diarrheas, intestinal parasites, scabies, etc; due to poor water supply and sanitation conditions.

In Ethiopia, 68% of the population lives in malaria-prone areas. Some of the highest-risk areas are located in the lowlands of the Abbay Sub-basin. Recent initiatives such as distribution of bed nets and DDT spraying have contributed significantly to a decline in the overall malaria burden. Nonetheless, it is a major cause of mortality and engenders serious economic losses. Peak malaria transmission coincides with the major growing and harvest season, and the incidence of the disease can seriously diminish agricultural productivity.

Studies conducted at the Koka Reservoir in 2007 and recently in the Gilbel Gibe III reservoirs confirmed that the transmission of malaria is highly correlated with proximity to the reservoir, and this is particularly true for children (Yewhalaw *et al.*, 2009). The risk is compounded when people are relocated in the vicinity of the reservoir site or migrants arrive spontaneously to take advantage of dam construction or other economic opportunities. The impact of the reservoir is to increase malaria risk during the rainy season when transmission is most intense and, also, to extend the malaria transmission into the dry season.

In Sudan, malaria is the major public health issue. On an annual basis, there are 7-8 million cases that result in 35,000-40,000 deaths (Nile Basin Research Initiative, 2007). However, health experts believe that the problem is far more serious than reported, particularly in rural areas. The annual Nile floods are a primary contributing factor to the incidence of malaria, creating conditions favorable to the number of breeding sites and the density of mosquitoes.

Schistosomiasis, a potentially debilitating disease caused by parasitic flatworms, infects more than 200 million people mostly in sub-Saharan Africa (Steinmann, *et al.*, 2006). It is endemic in areas of slow-moving waters and submerged vegetation that are favorable for the propagation of the aquatic snails that are the intermediary hosts in the lifecycle of these worms. Specifically, the worms multiply inside these snails from which they are released to swim free in the water. Humans contract Schistosomiasis (also known as Bilharzia) when they come into contact with the free-swimming worms. The worms burrow into a person's bloodstream and eventually infect the intestine or the bladder. In remote areas without adequate health care, chronic, untreated Schistosomiasis results in ulcers and internal bleeding and can have major health consequences such as hypertension, seizures, bacterial infections, urinary obstruction, organ damage or destruction, and death.

The fast-running rivers of Ethiopia such as the Abbay are generally not conducive habitats for the aquatic snails that host the parasitic flatworms. However, the incidence of Schistosomiasis has been reported at levels of 90% in the Lake Tana region and other areas of the Ethiopian highlands where there are small lakes and ponds; and, there is evidence of the transmission of the disease as a consequence of population migrations (WHO, 1987).

The breeding of the snails that are the vector for schistosomiasis and its transmission to humans is closely linked to the irrigation systems. Irrigation canals, in addition to their function to deliver water to agricultural fields, are extensively used by people for many daily activities such as laundry, bathing, washing household utensils, swimming, watering and bathing animals, washing grains and vegetables, making dough and, among Muslims, ablutions before prayers. With increased population density associated with the expansion of irrigation systems, the risks increase for exposure to this disease which can be highly debilitating.

3.5 LIVELIHOOD SYSTEMS

Throughout the Nile Basin, rural livelihoods depend on the access to and exploitation of land, water and other natural resources. The principal livelihood activity, agriculture, includes various types of rain-fed and irrigated farming, as well as semi-nomadic and nomadic pastoralism. A range of ecosystem services complement agricultural activities, to provide households with goods and services for home consumption and income generation.

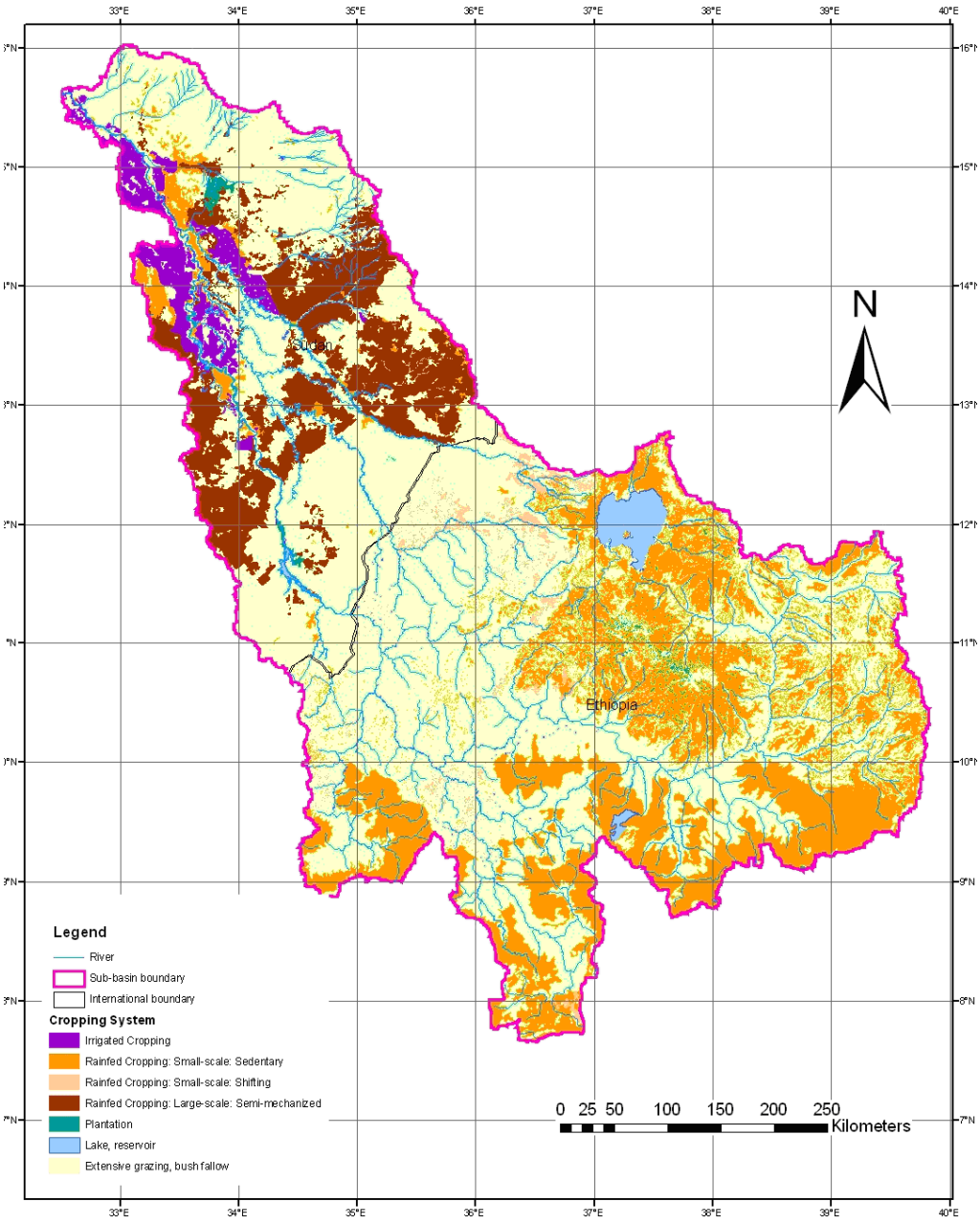
The discussion of livelihood systems is presented in this and the following section. This section reviews the principal rain-fed and irrigated farming systems in the Nile Basin. The following section looks specifically at environmental services that are integral to rural livelihoods throughout the basin, including recession agriculture and agro-pastoralism.

Table 3-8 Farming Systems, Abbay and Blue Nile Sub-basins

Main Category	Scale of operations	Tenure type	Main Components	Location
RAIN-FED CROPPING	Small-scale traditional; sedentary	State land: Individual and Communal use rights	Cropping (Cereals, pulses, oil seeds) Small Livestock holdings (Communal grazing, crop residues)	Ethiopia: Highlands
	Small-scale traditional; shifting	State land: Individual and Communal use rights	Cropping (cereals, pulses): Small livestock holdings (Communal grazing, crop residues)	Ethiopia & Sudan: Lowlands
	Large-scale: Semi-mechanized	State land: Medium-term Leases	Cropping (Sorghum, cotton, sesame)	Ethiopia & Sudan: Lowlands
IRRIGATED CROPPING	Small schemes Small-scale operations (< 1.0ha) Gravity:	State Land: Individual use rights: additional to rain-fed land	Cropping (cereals, vegetables)	Ethiopian Highlands
	Small-scale: (<20 ha) Pump	Individual Freehold	Cropping: Sorghum, wheat, Alfalfa	Blue and Main Nile; Lake Nasser
	Large schemes Small-scale (< 1.0ha) Gravity:	State Land: Individual use rights: additional to rain-fed land	Cropping (cereals, vegetables)	Ethiopian Highlands
	Large scheme: small-scale operations (<40 feddan) Gravity	State land: Individual long-term leases	Cropping: Cotton, Sorghum, wheat Small-livestock holdings	Sudan: Gezira and Rahad Schemes
	Large scheme: large-scale operations	State land	Cropping: Sugar	Ethiopia: Fincha'a Sudan: Senner and Guneid Sugar Schemes Lake Nasser
LIVESTOCK	Small-scale: Extensive Pastoral Transhumant	State land: Communal use (grazing, water) rights	Cattle, small-ruminants	Sudan
	Small-scale: Extensive Agro-pastoral Transhumant-sedentary	State land: Communal use (grazing, water) rights	Cattle, small-ruminants Small-scale cropping	Ethiopian Highlands Sudan

Source: Hydrosult et al. Abbay/Blue Nile Sub-basin, 2007.

Figure 3-1 Farming Systems, Abbay and Blue Nile Sub-basins



Source: Hydrosult et al. Abbay/Blue Nile, 2007.

3.5.1 Traditional Rain-Fed Agriculture

Traditional rain-fed agriculture is the dominant form of farming throughout the Abbay and Blue Nile sub-basins. This is the only farming system throughout much of the Abbay Sub-basin and, in Sudan, 70% of farming households practice traditional rain-fed agriculture.

In Ethiopia, rain-fed farming systems are divided into those found in the highlands and lowlands, with the dividing line being 1,500 masl.

Table 3-9 Rain-Fed Farming Systems, Abbay Sub-basin

AGRO-ECOLOGICAL ZONE	MAJOR CROPS	LIVESTOCK
NORTHERN HIGHLANDS		
Moist Dega-Wurch	Wheat+barley+peas/beans (only Barley >2900masl)	Draught oxen, cows, sheep
Wet-Moist Woina Dega	Tef+maize+sorghum+finger millet+pulses	Draught oxen, cows, sheep, goats
WESTERN HIGHLANDS		
Moist/Wet Dega	Wheat+maize+pulses	Draught oxen, cows, sheep
Wet Woina Dega	Maize+tef+coffee	Draught oxen, cows, sheep, goats
Wet Woina Dega	Enset+maize	Cows, sheep, goats
Wet Dega	Enset+Wheat	Cows, sheep
LOWLAND		
Moist Woina Dega	Tef+maize+sorghum	Cattle, sheep, goats
Moist Kolla	Millet, sorghum+maize+beans	Goats
Dry/Moist Kolla	Shifting Sorghum+maize+beans	Goats
Dry/Moist Kolla	Sorghum, maize (rice)	Cattle, sheep

Source: Hydrosult et al. Ethiopia Country Report

3.5.1.1 Landholdings

Rural Ethiopian households generally have small, fragmented land holdings. The national average for the area of cropped land per household is 0.8 ha, divided into 3.2 parcels. Within the Abbay Sub-basin, the sizes of cropped land tend to exceed the national average, although one half to two thirds of households has less than 1 ha. The proportion of holdings in the sub-basin that are rented out to generate cash or in-kind income also exceeds the national average, particularly in Amhara and BNG.

Table 3-10 Household Crop Holdings, Abbay Sub-basin

Region	Area (ha)	Number of Parcels	Rented Out (%)
Amhara	0.9-1.0	3.9-5.0	16-20
Oromia	0.9-1.0	2.6-3.2	6-10
Benishangul-Gumuz	1.1-1.3	2.6-3.2	11-15
Ethiopia	0.8	3.2	10

Source: CSA, 2006. Atlas of the Ethiopian Rural Economy

3.5.1.2 Mixed Farming in Ethiopian Highlands

Farmers engage in a combination of farming and raising livestock. Cultivation is undertaken with oxen using the tine plough (*maresha*). The main crops are teff, sorghum and maize at lower altitudes with wheat and barley taking their place at higher altitudes. Throughout much of the region, rainfall is highly variable and soils are generally of low fertility. Except in areas of sufficient rainfall, most of the farming systems produce an annual deficit. Food deficits are made up for with food aid and work for food programs.

Table 3-11 Land Holdings and Rural Occupations, Abbay Sub-basin

Region	Type of Holding (% HH)			Occupation (%HH)			Under-employed (% HH)
	Crop farming only	Live-stock only	Crop & live Stock	Agricul-ture full-time	Agricul-ture part-time	Non-agricul-ture	
Amhara	20.2	2.7	77.1	85.5	13.5	3.8	41.0
Oromia	18.4	6.2	75.4	79.2	18.8	2.0	48.8
Benishangul-Gumuz	23.6	6.6	69.8	75.9	22.5	1.6	33.2

Note: Underemployed is the proportion of employed persons who were ready and interested to work but who were not able to work.
Source: Hydrosult et al., 2007

In the Western Highlands at elevations below 2,000 masl, farmers are able to grow coffee as a cash crop. Most households except those that practice shifting cultivation grow Eucalyptus trees around their houses, to divide their fields or as small-to-medium plantations. These trees are sold for use as poles in construction projects.

Cattle, in particular, and some oxen are raised to provide draught power for agricultural activities; to a lesser degree, cattle are important to provide milk and as a "safety net" against sudden shocks such as drought, illness, etc. Other livestock include sheep and goats; the relative importance of these animals varies throughout the sub-basin. Open grazing is only possible in those parts of the sub-basin that are not already densely populated. As a result, tethered feeding is more common. Livestock feed includes grass hay that is available in some parts of the sub-basin, crop residues and leaves from indigenous trees.

In the Ethiopian Highlands, farmers are developing a series of strategies to reduce their vulnerability and risks due to climate change[5] (Oxfam, 2010):

- Increasingly, households are unable to grow sufficient food to feed themselves, as a consequence of fragmentation of landholdings and environmental degradation that affects yields. Instead of continuing to grow exclusively food crops, many people are diversifying their agricultural production to include high-value cash crops such as the spice "tena-adam". The money they earn by selling this in local markets is used to buy food.
- Increasing water scarcity means that cattle must walk farther to reach water points. In response, people are raising smaller ruminants, chickens and bees.
- Where they continue to have cattle, as noted above, they are moving from open grazing to tethered feeding. In conjunction with this, they are collecting and conserving crop residues to feed to livestock.
- In conjunction with Government initiatives, communities in the Highlands are participating in the establishment of community forests developed on the principles of agro-forestry. Communities are also establishing woodlots to grow trees for construction materials and fire wood, to compensate for the rapidly declining forest resources.
- Since firewood and other biomass used to generate energy is becoming scarcer, communities are also participating in initiatives to use biogas and solar power, as well as improved cooking stoves.

3.5.1.3 Shifting cultivation in Ethiopian Lowlands

Shifting cultivation is practiced by the Gumuz, Berta and other ethnic groups that live in the western lowlands. The principal crops are sorghum, maize and beans. Although households frequently have sheep and goats, most households do not have cattle or oxen as the western lowlands include areas

[5] This information comes from a recent publication (Oxfam, 2010) including a case study of mixed farming in the Ethiopian Highlands in Tigray Region. Although this is not in the Abbay Sub-basin, the conditions are similar and, therefore, relevant to the SSEA.

of high concentrations of tsetse and, therefore, risks of trypanosomiasis. As a consequence, people clear land and cultivate their fields using hand tools; some farmers use manure as fertilizer.

Communal lands are found on the extensive margins to the main village area; households rely on these areas to supply wood and other biomass that is used as fuel. The main croplands are often found on or close to streams and rivers on flat slopes and deep soils. Beyond the intensively cropped areas are more extensive lands on steeper slopes and shallower soils. These lands may be cropped using a bush fallowing system. They also provide the main grazing and browsing areas for livestock, and the main sources of fuel wood.

3.5.1.4 Rain-fed agriculture in Sudan

In Sudan, there are several systems of rain-fed agriculture. In the Blue Nile sub-basin, this includes sedentary agriculture and shifting cultivation, both of which also involve raising livestock. The rain-fed sector is responsible for 100% of the production of millet in Sudan, 11% of sorghum, 48% of groundnuts and 28% of sesame (UNEP, 2007).

Land resources are under individual use rights for cropping and communal use rights for grazing and fuel wood collection. Households have small landholdings ranging from 2 ha to 30 ha that they cultivate using labor-intensive methods with hand tools. The household economy relies on mixed cropping and livestock production, and is basically oriented towards subsistence production and food security.

Population pressures are leading to land degradation with lower crop yields and decreased food security. In areas where rotational shifting cultivation is practiced, the fallow periods have been reduced from an average of 20 years to five years or less. Increasingly, large areas of land remain permanently deforested and are cultivated on a continuous basis until the soils are completely depleted.

3.5.2 Mechanized Rain-Fed Farming

Within the Nile Basin, semi-mechanized rain-fed agriculture is a farming system that is unique to the Blue Nile sub-basin. Overall in Sudan, about 10,000 farmers are involved in semi-mechanized rain-fed agriculture that covers a total area of 5 million ha. The area of semi-mechanized farming in the Blue Nile Sub-basin is 1.32 million ha, located primarily in the states of Sennar and Gaderif and, to lesser degrees, Blue Nile and El Gezira. In general, farm sizes are 400-850 ha, although there are some large companies with holdings of more than 10,000 ha.

The semi-mechanized rain-fed agriculture system was adopted by the Government in the mid-1940's, to cultivate soils that were not amenable for cultivation by hand or with oxen. Land is leased by the State to individual investors under 25-year leasehold tenure. Schemes are managed by both private and government sectors. The principal crops are sorghum and cash crops such as cotton and sesame. Activities such as land preparation, seeding and harrowing are mechanized; weeding and harvesting are done by seasonal labor. The use of improved inputs such as fertilizer and improved seeds is minimal; organized crop rotation and fallow periods are very limited.

The 2006 "Green Program" of the Ministry of Agriculture and Forestry calls for further investment in large-scale expansion of mechanized agriculture (UNEP, 2007). Notwithstanding, there are a number of issues related to the impacts and viability of this farming system:

- Crop yields from semi-mechanized farming have declined dramatically. For example, it is estimated that 2002 yields in Gaderif for sorghum and sesame were, respectively 70% and 64% below 1980 levels (UNEP, 2007). As a result, unknown areas of semi-mechanized farming are abandoned yearly by farmers whose yields drop below economic limits (OSI; UNEP, 2007).
- This farming system has been criticized as being a major cause of environmental degradation, contributing to the deterioration of grazing resources, forest resources and soil fertility and the expansion of desertification. Government measures to address adverse impacts such as shelter

belts are not being enforced and, in the view of experts, are not sufficient to slow or reverse the changes (UNEP, 2007).

- The evolution of mechanized rain-fed agriculture has focused on horizontal expansion – it has been described as a crude form of extensive shifting cultivation with a tractor (UNEP, 2007). In the Blue Nile sub-basin, the area has expanded from 34,000 feddan in the early 1950's to more than 3 million feddan. This expansion has not, in general, complied with government plans, leading to clashes between private semi-mechanized farms that engage in illegal land grabbing and local traditional rain-fed farmers and pastoralists. In some instances, the expansion of mechanized farming has encroached on protected areas such as Dinder National Park (UNEP, 2007).
- Mechanized rain-fed agriculture has been a major factor in the decline of transhumance in the Blue Nile sub-basin. There has been a dramatic reduction in the grazing lands available to nomadic herders. They are also confronted with the disruption of traditional transhumance routes, with the necessity to find new routes that increase the time and make the coordination of the migration patterns of different animals difficult.

3.5.3 Traditional and Small-Scale Irrigation

Traditional and small-scale irrigation schemes are generally developed by individual farms or small community groups. They are common in the Abbay and Blue Nile sub-basins and constitute the principal farming system along the Main Nile in Sudan downstream of Khartoum.

Within the Abbay sub-basin, there is a total of 60,000 ha of small-scale, traditional irrigation schemes that range in area from 1 ha to 100 ha. In the Highlands, they are constructed using local materials (wood and stone). Water control systems fed by groundwater are common in the foothills and valley bottoms. Smallholders have, on average, less than 1 ha of irrigated land to which they have land use rights similar to those for rain-fed land. Most irrigated land irrigated is used to grow food crops (cereals and pulses) and vegetables for household consumption, with sales of small surpluses in local markets. Traditional water committees, "water fathers", administer the water distribution and coordinate maintenance activities. Most households that cultivate land in a small-scale traditional irrigation scheme also have other, rain-fed land in their total landholding; that is, small-scale irrigation does not replace, but complements rain-fed agriculture.

In Sudan, small-scale farmers living along the Blue Nile and, in particular, the Main Nile River irrigate their land using a variety of methods. Many farmers pump water directly from the river. The use of pumps has almost entirely replaced more traditional methods based on hand-operated water levers (*shaduf*) and animal-driven water wheels (*saqia*) (UNEP, 2007). Public and private small-scale pump schemes irrigate 153,000 ha along the Blue Nile and 88,000 ha along the Main Nile (BRL, 2008). In the 1970's, the Government of Sudan acquired many small pump schemes that were in bad condition, including 324 along the Blue Nile and 100 on the Main Nile downstream of Khartoum.

Along the Main Nile downstream of Khartoum, the topographic conditions of the flood plain also permit spate irrigation, that is, the collection of seasonal run-off water in basins and redirection to agricultural fields. On upper terraces beyond the floodplain but within 15 km of the river, farmers are increasingly relying on irrigation wells (*mataras*) to abstract from the shallow groundwater. The basic food crops grown in the Blue and Main Nile sub-basins include maize, grown in the summer; and, the winter crops of wheat and vegetables. Dates along with sorghum which is grown in the summer are the principal cash crops. Large areas of alfalfa are also grown as livestock fodder, with up to ten cuts per year.

Raising livestock is also an integral part of the livelihood strategies of these farmers. The animals are an additional source of income as well as a "safety net" against shocks such as droughts, high medical expenses, etc. In the Highlands, animals are also a valuable source of soil nutrients and, in fuelwood-scare areas, of fuel.

3.5.4 Medium-Scale and Large-Scale Modern Irrigation

Farming systems based on the development of medium- and large-scale modern irrigation occurs in different regions of the Nile Basin. In the Abbay Sub-basin, development is presently limited to several medium-scale schemes, although the Government has a number of proposed medium- and large-scale schemes. In Sudan, there are currently a total of six public large-scale irrigation schemes in the Blue Nile Sub-basin providing water to over 1 million hectares. In the Lake Nasser watershed in Egypt, all agriculture relies on irrigation. Section 4.2 on water resource development provides further details about existing and proposed irrigation schemes. The remainder of this section reviews the Gezira Scheme in the Blue Nile Sub-basin, as an example of agricultural livelihoods associated with irrigation.

The Gezira Scheme is Sudan's oldest and largest gravity irrigation system, located between the Blue Nile and the White Nile. It started in 1925 and progressively expanded until it now irrigates about 924,000 ha (including the Managil extension. The Government owns 60% of the land in the scheme. However, the remainder is still held in freehold by the original farmers (or their families), although this land is compulsorily rented from them at a fixed rate.

The Gezira Scheme is farmed by tenant farmers. It is the model for all public large-scale schemes in Sudan, namely a tenant farmer (i) is allowed to own only one tenancy, although other members of the immediate family (e.g., sons, wife) can own tenancies in their own rights; (ii) cannot sell or rent the tenancy without government consent; and, (iii) can bequeath the tenancy to an heir, but the tenancy can only be fragmented to half of the designated full size. In 2000, only 13% of tenancies were owned by women (World Bank, 2000).

At present, there are 114,000 tenancies at Gezira. A full tenancy is 40 feddans; the minimum tenancy is a half-tenancy or 20 feddans. In 2000, about half of the tenancies were, in fact, 20 feddans and 5% were 40 feddans. However, 45% of all tenancies were less than 20 feddans, a size that is generally considered not to be economically viable (World Bank, 2000).

The 114,000 tenancies represent an estimated population of 798,000 people (7 persons per family). Fewer than 20% of the tenant farmers rely primarily on family labor to farm their tenancies. More than 30% of farmers rent some of their land to owners and 15% of the tenancies are farmed under the *wakeel* system where a designated person farms the land for the absentee tenant farmer.

As a consequence, there is an estimated population of 600,000 migrant workers and their families living in about 1,000 ill-equipped camps situated in and around the Gezira Scheme. Although traditionally, these migrant workers came from Central and West Africa, at present nearly 70% are internally displaced people from Darfur. Tenant farmers and their families have access to a well-developed network of schools, health facilities, water supply and sanitation provided by the Scheme; these facilities are not available to migrants.

Each tenancy consists of four plots that are farmed according to a prescribed rotation of cotton, sorghum, groundnuts, wheat and fallow land. The major crop in terms of area is sorghum that is grown as a fodder as well as a subsistence grain. The dominant cash crop is cotton although it accounts for only one-quarter of the cultivated area of the Scheme. Tenants are required to sell the cotton to the Scheme ginneries although they often do not receive payment for up to twelve months. Other crops can be sold on the private market via traders. Raising livestock is an integral part of the livelihood strategies of 90% of the tenant farmers and migrant workers.

As noted, a very large proportion of the tenancies are not considered to be large enough to be economically viable. The income from livestock sales, for instance, is increasingly important to supplement farming income in order to meet household consumption needs. Although there are no reliable data, the perception is that food insecurity and poverty levels are rising among tenant farmers as well as the migrant workers on large-scale irrigation schemes.

In Egypt, soils in the Lake Nasser watershed are generally of poor quality, with low water-holding capacity and highly susceptible to erosion by wind and water. Throughout this region, agriculture is

not possible without irrigation. Therefore, the Egyptian Government has proposed a major land reclamation program, introduction of major irrigation schemes and the resettlement of up to 1.5 million people. The Lake Nasser Development Authority is responsible for the development of the watershed.

The significant increase in population in the watershed will require development of settlements and supporting social, economic and physical infrastructure. Some newcomers will be permanent settlers including farmers, laborers and support staff on large-scale developments. Others will be seasonal migrants from the middle Nile Valley who will come to cultivate vegetables on the land developed below the full supply level along the Lake.

A key issue will be adequate waste disposal facilities to prevent pollution of both the Lake and the groundwater. The Government of Egypt has established strict regulations on the use of fertilizers and agro-chemicals. The Bio-organic Control Project at Aswan has developed a number of biological controls of plant pests that reduce the need to use insecticides and fungicides

3.6 ECOSYSTEM SERVICES FOR LIVELIHOODS

Recession agriculture, pastoralism and agro-pastoralism are distinct livelihood systems in the Nile Basin that are integrally based on the ecosystem services of the watershed. In addition, livelihoods throughout the basin rely on a range of natural resources that provide goods and services for direct household consumption as well as sources of cash income.

3.6.1 Recession Agriculture

People living in the Abbay, Blue Nile and Main Nile sub-basins practice different forms of recession agriculture, relying on the soil moisture that follows annual floods to cultivate crops.

In Ethiopia, the discussion of the principal farming methods does not always include recession agriculture, however the analysis of the impacts of the major dams proposed on the Abbay main stream demonstrates that rural livelihoods in these areas benefit from the annual floods. For example, the EIA for the Border project estimates that the value of 2,400 hectares of recession agriculture that would be inundated by the reservoir is ETB 64,836 million, based on compensation for ten years of lost production.

In Sudan, people living along the Blue Nile and, particularly, the Main Nile rely on annual floods to grow crops. The most common method is based on the cultivation of rapidly maturing crops on highly fertile lands (*gerouf*) of the lower terraces along the river; with widths of 50-200 m, these terraces are farmed after the annual flood recedes.

In northern Sudan, the prevailing agricultural system combines small-scale subsistence farming with commercial crop production. The agricultural cycle involves the *gerouf* season, plus two irrigation seasons (DAL EIA, Scott Wilson, 2007). The main irrigated crops include wheat, vegetables, legumes and spices that are grown in the winter; and sorghum and maize in the summer. The *gerouf* crop is primarily fodder. Throughout this region, date palms are the main cash crop. In the region of the Dal project, households own, on average, 30 date palms. In addition to being a source of cash income, they are highly valued as a symbol of wealth.

Table 3-12 Recession Agriculture, Blue/Main Nile Sub-basin

	Riverside agricultural area (feddan)	Riverside area, assumed dev'd irrigation (feddan)	Balance of area, vulnerable to reduced flooding (feddan)	Water demand to convert vulnerable area to irrigation (Mm^3/year)
Blue Nile	200,700	0	200,700	1260
Main Nile	666,000	432,000	234,000	1722
Total	866,700	432,000	434,700	2,982

Source: EDF *et al.*; 2007 Mandaya EIA

The table above assesses the potential to convert the land currently cultivated under recession agriculture into irrigated land, following the construction of the Mandaya dam. In order to obtain an estimate of these areas, the riverside "agricultural areas" derived from remote sensing are provisionally adopted as gross areas which benefit from the annual flood, and existing irrigation areas subtracted to provide the estimated balance

In the context of the regularization of the river, pumped irrigation could be developed to make it possible to cultivate two crops per year. The water demand is based on delivering 1750 mm per year. The estimated capital and annual energy costs are, respectively, US$ 1.74 million and US$ 2.9 million.

3.6.2 Pastoralism and Agro-pastoralism

Ethiopia and Sudan have, respectively, the largest and second largest livestock herds on the African continent (UNEP, 2007). There are three principal systems of pastoralism that apply in different ways in the Nile Basin, namely, sedentary, transhumant and nomadic.

3.6.2.1 Sedentary pastoralism

As noted previously, 70-80% of households in the Abbay sub-basin raises livestock as well as grows crops. In Sudan, it is estimated that 80-90% of rural households own some livestock, of which 50-65% also grows crops (Fahey, 2007). Throughout the Abbay and Blue Nile sub-basins, households that engage in sedentary pastoralism include traditional rain-fed farmers in Ethiopia and Sudan, as well as tenant farmers on large-scale rain-fed and irrigated schemes in Sudan.

The sedentary production system has low productivity. Grazing land for these animals is limited. Some households in the Ethiopian lowlands and the Blue Nile sub-basin may have some opportunities to move their herds to different areas nearby their villages depending on the season and the availability of water. However, the area available to graze animals owned by tenant farmers is limited to fallow land and canal sides. And, as mentioned, animals are increasingly tethered in the Ethiopian Highlands. Therefore, crop residues and, in the large-scale schemes, industrial by-products are important sources of animal fodder. Traditional farmers raise animals primarily as a source of food; larger animals such as cattle represent a forms of savings, but may be sold to meet large or unexpected household expenses. Tenant farmers on large schemes sell livestock as a source of income to hire agricultural laborers for their farms (Fahey, 2007).

3.6.2.2 Transhumant agro-pastoralism

Transhumant or semi-nomadic agro-pastoralism is a production system in which households depend primarily on livestock herding; however, seasonally, households return to a home base to graze animals and grow crops (Fahey, 2007). In the Blue Nile sub-basin, groups such as the Baggars move their livestock (cattle, sheep and goats) north to grazing areas during the dry season and return south in the rainy season to their permanent homesteads; during the rainy season, they cultivate subsistence crops and/or engage in wage labor.

The social and economic significance of livestock varies across and within tribal groups, as well as geographically and temporally (Fahey, 2007). Cattle and cattle products serve a variety of important social and economic purposes. For poor herders, cattle function as a bank, allowing households to sell them when they need money and buy more cattle as an investment when they have extra money. For household consumption, they produce milk, meat and hides that can also be sold; they are sometimes used as draught animals. In some ethnic groups, cattle are used for ritual sacrifice, as currency, to pay bride price or as compensation to settle disputes. Sheep are the principal livestock export of Sudan, including live sheep and sheep meat that is sold to Saudi Arabia and other Arab countries. Households raise sheep to produce meat and milk and, to a lesser extent, skins. Rural households also rely on donkeys for short-range transportation, herding and to carry water, food and other goods; as with cattle, they are sometimes used to pull ploughs. In rural areas, people who do not own donkeys are usually the poorest of the poor, including the elderly, disabled and displaced (Fahey, 2007).

The drought in the 1980's caused many households to lose most if not all of their livestock and, even today, many of these people have not been able to restore their herds. Despite this, data available for Sudan indicate that the stock of livestock has increased sixfold in the past half century (UNEP, 2007).

At the same time, due to government policies as well as climatic conditions, there are increasing pressures on pastoral and agro-pastoral livelihood systems that have resulted in a growing number of people who are "voluntarily" abandoning livestock production as their main source of subsistence. Some have pursued wage labor in cities or on large-scale rain-fed and irrigated farms; others have adopted sedentary pastoralism, engaging in small-scale agriculture or trade as well as raising animals.

3.6.2.3 Nomadic pastoralism

Nomads move continuously between seasonal pastures with their animals. The Beja are camel herders throughout eastern Sudan; the Abbala herd camels, sheep and goats in the arid northern region of the country. As with transhumant pastoralists, nomads have been severely affected by drought (the Beja lost up to 80% of their livestock during the 1980's), as well as government policies and expanding agricultural development. At present, there are relatively few purely nomadic groups left in Sudan that depend exclusively on livestock production for their livelihoods (Fahey, 2007). However, nomadic groups typically own the largest herds.

Camels are used to transport people and packs and, to a lesser degree, for herding, as draught animals and for oil milling. Camel milk is consumed locally, and live camels and camel meat are exported to Saudi Arabia and Egypt (Fahey, 2007). Two ethnic groups of eastern Sudan, the Rashayda who are camel breeders and the Beni Amer, a Beja tribe, who are camel herders, have collaborated to produce racing camels for Persian Gulf buyers (Ikeya and Fratkin, 2005). Traditionally, these groups competed for pasture and occasionally engaged in hostilities. However, commercial demand for camels led to joint ventures although the two groups remain separate and do not intermarry. Top quality racing camels are sold, on average, for $80,000, and, in some instances, for up to $800,000.

3.6.3 Subsistence and Artisanal Fisheries

Subsistence and artisanal capture fisheries help to sustain communities throughout the Nile Basin. In Ethiopia, these activities are not well developed. Nationally, 15,000 fishers fish from 2,350 boats, the majority of which are reed or raft vessels. They use basic gear and the annual per capita fish production is less that 240g (USAID, 2009). There are no data currently available regarding fisheries activities along the Abbay main stream and tributaries, although it is probable that some households living on or near the water engage in subsistence fishing, primarily as a source of animal protein for household consumption, but with some potential to generate small amounts of cash income.

Farther downstream, subsistence and artisanal fishing are important sources of animal protein for riverside communities along the Blue and Main Nile sub-basins in Sudan, and in Egypt. In Sudan, 95% of the annual catch comes from the Nile River and its tributaries and swamplands. Over 100 fish species have been reported. Reservoir fisheries are important sources of livelihoods, including: Roseires Reservoir with a potential of 1,700 tons/year and fish landings of 1,500 tons/year; Sennar Reservoir with an estimated fish capacity of 1,100 tons/year and actual yields of 1,000 tons/year; Lake Nubia with a potential of 5,100 tons/year and current production of 1,000 tons/year; and, other locations with an estimated production of 4,000 tons/year (FAO, n.d.). It is expected that the Merowe Reservoir will also support fisheries activities when it is operational.

Subsistence fishing nets 10-11,000 tons annually. Fishers work from shore or small canoes and papyrus rafts using a range of gear. Artisanal fishing which concentrates in the lower reaches of the White Nile involves several ethnic groups and Arab fishers who use, respectively, dugout canoes and traditional one-oar boats. The majority of the catch is consumed fresh (63%); the remainder is sun-dried (28%) or wet salted (9%). Most of the fresh catch is transported to Khartoum for sale; sun-dried fish is mostly marketed in areas of rain-fed and mechanized agriculture (FAO, n.d.).

The contribution of fisheries to the economy is marginal. Fishing is generally regarded as an occupation of low social status, making it difficult to attract people beyond subsistence and artisanal activities. Notwithstanding, there is a steady increase in market-oriented activities particularly in the White Nile and Lake Nubia.

The fishery on Lake Nasser/Nubia is primarily commercial (see Section 3.3.8.2), although in the *khors* and near the shoreline, local ethnic groups and communities carry out subsistence fishing activities.

3.6.4 Production of Gum Arabic and Other Resins

Gum Arabic is an oleo-gum resin produced by *Acacia senegal* that produces *hashab* gum, the best quality; and, *Acacia seyal* that produces *talh* gum of inferior quality. These species are found in the Abbay and Blue Nile sub-basins, although due to extensive land degradation, *A. senegal* is no longer found in the Blue Nile sub-basin north of 13^{o} 45', that is north of Sennar and the southern part of Gaderif (UNEP, 2007). In Ethiopia, species of *Boswellia* and *Commiphora* produce other oleo-gum resins such as frankincense and myrrh (Lemineh, n.d.).

The resins produced by these trees provide households with a number of goods and services that are useful in their livelihoods. Fodder for livestock, traditional medicines for human and livestock disease treatments, incense for fumigation, cultural and religious rituals, and emergency foods during droughts are among the most common. The resins also have important commercial uses and represent significant sources of cash income for households.

Gum Arabic is edible and is used extensively in the food industry as a stabilizer. It is also a key ingredient used in printing, paint production, glue, cosmetics and various industrial applications. Gum Arabic is Sudan's most imported non-wood forest product, with an annual exported crop of approximately 45,000 tons (UNEP, 2007). In a study in southeast Ethiopia, the annual household production of gum Arabic, frankincense and myrrh generates cash incomes that represent nearly one-third of the annual household income; as a source of household income, it is second only to income from livestock and nearly three times the value of income earned from cultivation of crops (Lemineh, n.d.).

The acacia trees and other species grow naturally and are also cultivated by farmers. In Sudan, gum Arabic trees were first integrated into the bush fallow system that characterized traditional rain-fed farming systems, whereby agricultural cultivation and forest regeneration are practiced in sequence. Over long rotation periods, the nitrogen-fixing acacia fertilized soils at the same time that they produced resins. However, with population pressures and increased fragmentation of landholdings, farmers have been forced to shorten fallow periods. Today, *A. senegal* is more commonly intercropped with food crops such as millet, sorghum, fava beans, sesame and groundnuts. The trees are tapped in the late fall (October/November) by the farmer and, in some instances, laborers who work under a sharecropping system; a tree can produce about 300 grams of resin per season (FAO, n.d.). However, as noted above, the growing area is being pushed farther south due desertification and mechanized agriculture; also, farmers' interests in planting *A. senegal* shelterbelts fluctuates with market prices (UNEP, 2007).

3.6.5 Fuel Wood and Other Forest Services

Much of the forest cover has disappeared in the Nile Basin due to the combination of population pressures and land degradation (Table 3-13). Nonetheless, what remains in terms of riverine forests, savannah woodlands and semi-desert shrub lands are important sources of natural resources that are used by local people to meet their subsistence needs, to generate cash incomes and, in times of crisis, as a last resort for survival.

Table 3-13 Deforestation, Blue Nile Sub-basin

Location	% Total Land Area Deforested		Comments
	1972-1973	1999-2002	
Ed Damson, Blue Nile	7.5	0.1	Wooded grassland replaced by rain-fed agriculture.
El Obeid, N. Kordofan	12.0	8.7	Wooded grassland replaced by rain-fed agriculture.

Source: UNEP, 2007

Fuel wood and the production of charcoal are major services provided by forest areas, to supply fuel for household uses and, increasingly, for brick making. In Ethiopia, 23.4 million m^3 of wood fuel and charcoal are consumed annually, accounting for 65% of the total energy consumption in the Abbay sub-basin. In the western lowlands, most of this fuel wood is harvested from communal lands that belong to the Gumuz and other ethnic groups living in the area. In the highlands where deforestation is extensive, households collect branches, leaves and twigs, as well as using firewood. In Sudan, it is increasingly difficult for households particularly in arid northern regions to identify secure sources of fuel wood. Forest authorities attempt without much success to control commercial logging that supplies fuel wood and charcoal to Khartoum and other urban centers; in riverine forests, wood is supposed to be extracted by thinning branches of *A. senegal* while *A. seyal* and other species can be cleared from agricultural areas.

Acacia nilotica is common throughout the riverine forests in Ethiopia and Sudan. It is widely harvested because the termite-resistant wood is ideal for construction and making tools and other equipment. The tree also produces edible pods and leaves that are important sources of livestock fodder. The tannins in the tree bark are used to cure leather as well as a medicinal astringent. In Sudan, fruits from the trees are added to ponds where they kill the snail that carries schistosomiasis without affecting fish (Winrock, 1992).

The dom palm (*Hyphaene thebaica*) is found along the Nile in Sudan and Egypt. Like the *A. nilotica*, the wood is very strong and used for construction. It can also be carved for handicrafts that have the appearance of ivory. In Sudan, dom nuts are sliced and used as button blanks; an average of 1,500 tons is exported annually (UNEP, 2007). The fronds are used for thatching and curtain rings are made from the seed of the fruit. The fruit of the tree is edible and is relied on by households in times of food shortage.

Hunting is traditionally part of the livelihood system of the indigenous and other communities in the Abbay sub-basin. Bush meat is a key source of animal protein. Hunting is also practiced as a coping mechanism to fill seasonal food gaps. And, hunting conveys high status within the community among groups such as the Gumuz. However, since hunting has been declared illegal by the State, hunting is now forbidden. Moreover, most of the wild animals have disappeared or retreated to inaccessible areas due to encroachment on their former territory by agriculture, forest fire or other related factors.

A wide range of other goods and services are available in forested areas throughout the Nile Basin. Woodlands and shrub lands are important grazing areas for livestock. The swamps along the river area a source of reeds, papyrus and other materials that are used in house construction, making boats, handicrafts and other purposes. Other products include bamboo and rattan, also used for construction and handicrafts; honey, palm oil, other edible oils (shea oil and butter), tubers, herbs, mushrooms and other edible products that supplement other sources of food; herbs and other plants that are used as medicines; and, bees was, dyes (e.g., henna), fibers and latex.

3.6.6 Brick-Making

In Ethiopia, brick-making activities are often located in degraded wetlands that are sources of clay and fuel wood to support brick production, particularly when these resources are located in proximity to communities that function as a market for the product.

In Sudan, 83% of brick production occurs along the Blue Nile River, with 9% located on the banks of the Main Nile. The riverbank locations facilitate access to clays used to make bricks, as well as river transport of the product. Brick making is mostly a seasonal activity during the dry season and it represents an important source of cash income. In Sudan, nearly 50,000 people are employed in brick making during the dry season.

3.6.7 Artisanal Mining

Gold panning is practiced by households and communities along the Abbay main stream and tributaries from the Mandaya dam site to the Sudan border, particularly during the three-month dry season. It is also practiced in Sudan between Atbara and Abu Hamed about 500 km north of Khartoum (Lavalée, 2010). It constitutes a key aspect of the livelihoods of Gumuz and other ethnic groups living in the western lowlands of the Abbay Sub-basin. The estimated value of gold panning in the main Abbay channel that would cease following construction of the Mandaya dam is ETB 21.6 million.

3.6.8 Hunting

Bush meat is a key source of animal protein for the diets of people living in the Abbay and some areas of the Blue Nile Sub-basin. Although it is not legal without a license, hunting for antelope, monkeys, porcupine and other small animals is known to be a traditional practice in area. Among groups such as the Gumuz, hunting conveys high status within the community. Unfortunately, some of this hunting is carried out in protected areas such as the Dabus River Hunting Controlled area or the Dinder and Alatish parks.

3.6.9 Non-Timber Forest Products

A wide range of non-timber forest products (NTFP) are collected by households throughout the Abbay Sub-basin. These include, among others, bamboo, rattan, wood and other materials that are used to construct houses and other facilities; herbs, mushrooms and other edible products that supplement other sources of food; and, herbs and other plants that are used as medicines. Gum Arabic production and collection is also common throughout the Abbay/Blue Nile Sub-basin.

In Ethiopia, 23.4 million m^3 of wood fuel and charcoal are consumed annually, accounting for 65% of the total energy consumption in the Abbay Sub-basin. In the western lowlands, most of this fuel wood is harvested from communal land that belongs to the Gumuz and other ethnic groups living in the area. In the highlands where deforestation is extensive, households collect branches, leaves and twigs, as well as using firewood.

3.6.10 Ecotourism

Ecotourism promotes travel to natural, cultural and historic resources in a country in a manner that conserves the environmental integrity of these resources and improves the well-being of local people. This is a relatively new activity in Ethiopia and Sudan, which as yet do not benefit from strong networks of infrastructure and services. In Egypt, a more dynamic ecotourism market is building on the longer history of tourism to archaeological and cultural sites and supported by more extensive infrastructure.

The Tourism Strategy of the Government of Ethiopia has as its primary objective to make the country one of the top ten African destinations by 2020 with an emphasis on sustained socio-economic development and poverty reduction, namely tourism that improves the well-being of local people (WB, 2006). At present, there are seven UNESCO World Heritage Sites and four important national parks in Ethiopia that constitute major attractions. The Northern Historical Route includes the World Heritage Sites at Lalibela, Gondar and Axum, the Lake Tana and the Blue Nile Falls national park and

other sites associated with the source of the Nile River, and is one of the top tourist destinations in Ethiopia. The Strategy also highlights community involvement in tourism through approaches such as the "One Village One Product" concept that was first developed in Japan and successfully implemented in Thailand.

Table 3-14 Major Tourism Attractions, Ethiopia

UNESCO World Heritage Sites	Important National Parks
Abbay Sub-basin: Monolithic Churches of Lalibela The Castles of Gondar	Abbay Sub-basin: Lake Tana and the Blue Nile Falls
Elsewhere in Ethiopia: Axum's Obelisks Lower Omo Valley Hadar Jugol, Fortified Historic Town (where the skeleton of Lucy was discovered) Tiya - carved standing stones Semien National Park	Elsewhere in Ethiopia: Bale Mountains National Park Awash National Park Nechisar National Park

Source: WB, 2006

In 2005, there were 227,000 international tourist visits to Ethiopia, of which 63,000 were related to vacations. The estimated direct receipts from tourists to the Ethiopian economy in that year are US$ 130 million, making tourism the third largest export earner in Ethiopia after coffee and oilseeds. Based on evaluating of these earnings, studies have found that every dollar of direct earnings generates US$0.30 of indirect expenditures; for every US$2,765 of earnings, one job is created; and, every direct job in tourism can be expected to generate more than US$1,500 in induced spending[6] (WB, 2006).

The Nile River holds tremendous allure as a tourist attraction and the Blue Nile and Main Nile sub-basins in Sudan and southern Egypt have been at the crossroads of dynamic and highly significant cultural forces and exchanges. Throughout these basins, there are a number of important bird sanctuaries including Sennar Reservoir, Roseires Reservoir, Lake Nubia/Nasser and the wetlands of Dinder National Park. The Park is designated as a RAMSAR site and a UNESCO-MAB biodiversity reserve, and provides habitat for a range of large and small mammals. The main problem with wildlife tourism in Sudan is that it does not exist on a commercial scale; in 2005, the total number of foreign visitors to Dinder National Park was less than 1,000 (UNEP, 2007).

At the same time, however, Sudan has a rich cultural and historical heritage particularly along the Main Nile downstream of Khartoum. Gebel Barkal and the sites of the Napatan Region are designated as a UNESCO World Heritage Site. Located downstream of the Merowe Dam, five archaeological sites stretch over more than 60 km along the Nile River dating from the Napatan (900-270 BC) and Meroitic (270 BC – 350 AD) cultures, of the second kingdom of Kush (Nubia). Tombs, with and without pyramids, temples, living complexes and palaces, are to be found on the site. Since Antiquity, the hill of Gebel Barkal has been strongly associated with religious traditions and folklore. The largest temples are still considered by the local people as sacred places. A multitude of other sites are testimony to the Napatan, Meroitic, Pharaonic, Islamic and Christian influences in this region.

[6] Induced expenditures are the increased consumer spending resulting from additional personal income generated by the direct expenditures, e.g., hotel workers using their wages for the purchase of goods and services.

In Egypt, Wadi Allaqi is also designated a UNESCO-MAB biodiversity reserve based on its importance for bird migrations as well as the presence of indigenous groups such as the Ababda, and Bishari with their traditional lifestyles and crafts. The Nubian Monuments from Abu Simbel to Philae are designated as UNESCO World Heritage Sites. As noted previously, ecotourism is more developed in Egypt and, in and around the Lake Nasser region, includes fishing, lake cruises, caves and cave paintings and desert safaris, as well as bird watching and wildlife such as the giant Nile crocodiles.

3.7 SOCIO-ECONOMIC PROFILE

Following on the previous discussion, it is clear that the majority of people living in the Nile Basin rely on agriculture as their principal economic activity, although rural livelihoods are highly diversified. This section presents a socio-economic profile of people in the Nile Basin in terms of their economic activities and levels of employment, the informal sector, sources of household income and the income and non-income dimensions of poverty.

3.7.1 Economic Activities and Employment

The labor force participation rates are high in Ethiopia and among men in Sudan and Egypt. While Ethiopian women are economically active, women in Muslim societies in Sudan and Egypt are significantly less economically active. However, because Muslim women tend to work within their household compounds, the available data may underreport the level of their economic activities.

Table 3-15 Labor Force and Employment Data, Nile Basin

	Ethiopia	Sudan	Egypt
Labor force participation rate (%)			
Men	91	71	72
Women	80	31	16
Employment by sector (%)			
Agriculture	80	80	30
Industry	7	7	23
Services	13	13	57
Unemployment			
National	5	18.7	9
Nile Basin	5-8	17	6-18

Sources: http://data.un.org/CountryProfile.aspx?crName=Ethiopia; OSI Synthesis, 2007; CIA Factbook, 2009;

The majority of economically active people in Ethiopia and Sudan are engaged in agricultural activities. In some parts of the Abbay and Blue Nile sub-basins, the proportions of farmers is higher than national averages, for example, in Amhara Region where 90% of working people are in agriculture. In Egypt, however, the services and industrial sectors employ more than two-thirds of the labor force compared to only 30% of economically active people working in agriculture.

In the Abbay sub-basin, rural unemployment is low as the majority of people are active working on their own land. In the Blue and Main Nile sub-basins, however, there are higher levels of unemployment. In Sudan, this may be related to the importance of agricultural laborers in the

workforce. In the Lake Nasser watershed, the highest unemployment is reported in Aswan Governorate (19%). It should also be noted that unemployment in Egypt tends to affect young people disproportionately (OSI, 2009).

Underemployment is a widespread problem throughout the Nile Basin. Owing to overpopulation, land fragmentation and traditional farming technologies, a large proportion of the economically active population that is willing and able to stay additional hours at work, is nonetheless not fully engaged. In the Abbay sub-basin, the levels of underemployment are estimated to be 40-50% in Amhara and Oromia and 33% in Benishangul-Gumuz (Hydrosult et al., 2007)[7].

3.7.2 Informal Sector

The majority of people living in the Nile Basin pursue non-farm activities jointly with their agricultural activities, as part of a livelihood strategy that includes multiple activities to meet household consumption needs, generate cash income and, in general, to reduce food security and other risks. Most of this work is conducted in the informal sector which is defined as self-employment and small-scale household enterprises that have fewer than 10 workers. People who work in the informal sector generally have low incomes and lack safe working conditions and job security.

In the Abbay sub-basin, informal sector activities include trading, a range of cottage or home-based industries and sale of firewood and other forest products. As the primary household occupation, the proportion of people engaged in non-farm activities is low, namely less than 4%. Nonetheless, although data are not available, it is likely that one or more members of most households work in the informal sector on a permanent or seasonal basis. Moreover, according to 1999 data, more economically active women than men in the Abbay sub-basin are engaged in informal sector activities.

Table 3-16 Employment in Informal Sector, Abbay Sub-basin (% economically active people)

Region	Women	Men
Amhara	78	48
Oromia	76	49
Benishangul-Gumuz	64	35

Source: CSA, 1999. National Labour Force Survey

In Egypt, 45% of the labor force works in the informal sector, meaning that there is a wide range of self-employment and small-scale businesses in the industrial and services sectors. And, again, the informal sector is dominated by women.

3.7.3 Sources and Levels of Household Income

A study conducted in Blue Nile State (Gaafar, 1994, cited in SMEC 2006a) found that farming contributes 49% to household incomes, with 51% coming from a variety of off-farm economic activities. Farming income was divided between crops and livestock that accounted for, respectively, 43% and 6% of the total. The non-farm activities included commerce, handicrafts, wood cutting, charcoal making and wage labor.

[7] No data are available for the Blue and Main Nile basins.

Table 3-17 Household Income Sources, Eastern Roseires Reservoir Area, Blue Nile Sub-basin

Income Source	% Income
Farming only	29.3
Farming & artisanship	20.0
Farming & commerce	12.1
Farming & fishing	5.1
Farming & forestry	14.0
Farming & wage labor	5.7
Farming & others	4.8

Source: Gaafar, 1994, cited in SMEC 2006a.

National-level data are indicative of the variations in income levels across the Nile Basin. People living in the Abbay sub-basin have, generally, very low income levels. In Sudan, per capita income levels in the Blue and Main Nile sub-basins are higher, but remain significantly below levels in Egypt. Data for the governorates in the Lake Nasser watershed confirm that GDP per capita levels are equal to or above the national average (UNDP, 2002).

Table 3-18 Income Levels, Nile Basin Countries (US$)

	GDP/cap. 2009 CIA Factbook	GNI/cap. 2008 UNICEF	GNP/cap. n.d. CARE
Ethiopia	900	280	100
Sudan	2,300	1,130	330
Egypt	6,000	1,800	1,530
GDP (Gross domestic product): The total market value of all final goods and services produced in a country in a given year, equal to total consumer, investment and government spending, plus the value of exports, minus the value of imports. *(www.investorwords.com)*			
GNI (Gross national income): The sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad. (*www.unicef.org*)			
GNP (Gross national product): Gross National Product. GNP is the total value of all final goods and services produced within a nation in a particular year, plus income earned by its citizens (including income of those located abroad), minus income of non-residents located in that country. Basically, GNP measures the value of goods and services that the country's citizens produced regardless of their location. (*www.investorwords.com*).			

Sources: CIA Factbook (*www.cia.gov*); CARE Country Profiles (*www.care.org*); UNICEF Statistics (*www.unicef.org*)

In BNG, 2004 data confirm very low levels of cash income from such as activities as traditional mining, sale of fuel wood and charcoal, daily labor, pottery and other similar activities, as well as sale of food crops, cash crops and livestock. The annual per capita cash income from these sources ranged from a low of US$ 20 to a high of US$ 173 across seven woredas (CIDA, 2005).

3.7.4 Poverty Analysis

Poverty is endemic and widespread throughout many parts of the Nile Basin in Ethiopia and Sudan. At the national levels, 40-50% of the population lives in poverty in these countries. Within the basin, severe poverty occurs in the western lowlands of the Abbay sub-basin and large areas of the Blue and

Main Nile sub-basins in Sudan. In Khartoum and El Gezira, respectively, the urban context and the Gezira Irrigation Scheme are contributing factors to the lower poverty levels. In Egypt, the levels of poverty are significantly lower, at the national level and within the Lake Nasser watershed.

Table 3-19 Income Poverty Levels, Nile Basin Countries

	Population living in poverty (%)
Ethiopia	48
Amhara	32
Oromia	38
Benishangul-Gumuz	55
Sudan	40
Blue Nile	21-40
Sennar	41-60
Gaderif	41-60
El Gezira	21-40
Khartoum	21-40
North Kordofan	61-70
River Nile	21-40
Red Sea	61-70
Northern	21-40
Egypt	20
Aswan	24
Red Sea	n/a
New Valley	n/a
In Ethiopia, the definition of the poverty line is ETB 1,070 per capita per year (or US$ 0.34 per capita per day), based on the costs in 1995/1996 prices for a basket of food and essential non-food goods. In Sudan, poverty is defined as the proportion of the population living on U$1 per capita per day or less	

Source: CRA Abbay/Blue Nile; CRA Sudan Country Report; UNDP, 2008

Income poverty is one dimension of how people are vulnerable to moving in and out of poverty and what the longer-term trends are. Food security, literacy and education levels, health conditions, the age structure of the population and economic activities are important non-income dimensions of poverty that are relevant to understanding the situation in the Nile Basin.

3.7.4.1 Food security

Food insecurity is a persistent and serious problem throughout parts of the Nile Basin in Ethiopia and Sudan. The problem of food security is the lack of agricultural development and extreme vulnerability to drought. In Ethiopia, this is compounded by the lack of irrigation including water harvesting and small-scale irrigation schemes, as well as poor post-harvest storage facilities and the lack of veterinary services for animals.

According to data in the Famine Early Warning System (FEWS) for the first quarter of 2010 (www.fews.net), accessed 30 March 2010), there are areas of Amhara region within the Abbay sub-basin where the population is extremely or highly food insecure. On the other hand, the Benishangul-Gumuz region is generally food stable and, in Oromia, the situation ranges from moderately food insecure to food stable. The months of July and August are the primary hunger season throughout most of the sub-basin, although this season begins as early as May in Benishangul-Gumuz. The problem persists through September in some parts of the sub-basin.

Notwithstanding the recent FEWS evaluation, food security has been identified as a systemic and chronic problem in Benishangul-Gumuz (CIDA, 2005). The level of food demand and supply analysis conducted during a baseline survey in seven woredas in 2004 showed an average -13% food gap for all woredas, with gaps as high as -59% in several woredas. Woredas with large food gaps experience food shortages throughout the year. The reasons for lack of food security in this region are diverse, compounded by the fact that this region has been marginalized by national governments. The socio-economic conditions are poor; crop productivity is limited by the use of rudimentary labor-intensive tools, as well as declining soil fertility, erratic rainfall and limited use of improved inputs; crops disease, pests and weeds are widespread; infrastructure such as roads and markets is poor; there is an absence of credit services; and, many people suffer from malaria and other diseases (CIDA, 2005).

In the Blue and Main Nile sub-basins in Sudan, the month of August is the peak of the lean season. The current projections are that most of the areas in these sub-basins will remain generally food secure during this time, but people living in the states of North Kordofan, Red Sea and Blue Nile will be more vulnerable to food shortages (www.fews.net, accessed 28 June 2010). In parts of these sub-basins such as Gaderif, there were droughts and poor agricultural seasons with widespread failure of the sorghum harvests in 2008 and 2009; this resulted in high levels of food security within pastoralist communities (SOS Sahel, 1009).

3.7.4.2 Literacy and education achievement

Literacy and educational achievement are key determinants of the capacity of people to move out of poverty on a long-term, permanent basis. The current situation regarding literacy in the Nile Basin countries reflects poverty conditions, with very low levels of literacy in the Abbay sub-basin and literacy levels below the national average throughout much of the Blue and Main Nile sub-basins in Sudan. The gender dimension of poverty is also evident in the fact that females have consistently and often significantly lower literacy levels compared with men, including in the Lake Nasser watershed.

Table 3-20 Literacy Rates, Nile Basin Countries

Region	Literacy (%)		
	Total	Female	Male
Abbay Sub-basin			
Amhara	17.8	12.1	23.5
Oromia	22.4	15.6	29.3
Benishangul-Gumuz	17.7	10.5	24.9
Ethiopia (country)	*35.2*	*22.8*	*50.0*
Blue Nile Sub-basin			
Blue Nile	31.3	20.4	41.8
Sennar	52.0	40.0	64.5
Gaderif	55.6	38.4	72.9
El Gezira	65.2	55.8	75.5
Khartoum	73.6	65.0	81.1
Blue Nile Sub-basin (North Sudan)	*54.5*	*42.4*	*66.6*
Main Nile Sub-basin			

Region	Literacy (%)		
	Total	Female	Male
North Kordofan	39.1	29.4	52.0
River Nile	64.5	56.5	73.6
Red Sea	47.9	40.1	54.5
Northern	65.2	56.6	75.0
North Sudan	*54.5*	*42.4*	*66.6*
Sudan (country)	*60.9*	*51.8*	*71.1*
Egypt			
Aswan	76.0	46.0	-
Red Sea	86.1	59.9	-
New Valley	78.9	58.3	-

Sources: Hydrosult *et al.* Transboundary Analysis, Abbay/Blue Nile Sub-basin, 2007
Hydrosult *et al.* Sudan Country Report, 2006, Egypt National Human Development Report, 2008
Hydrosult *et al.* Transboundary Analysis, Abbay/Blue Nile Sub-basin, 2007; Hydrosult *et al.* Sudan Country Report, 2006

Attending secondary school as well as completing primary school are important achievements that increase the capacity and opportunities for people to gain wage employment requiring semi-skilled and skilled workers. The diversification of household incomes to include non-agriculture wage income contributes significantly to increasing and stabilizing income levels. As reflected in school enrolment rates, the situation in the Nile Basin is not good particularly in Ethiopia and Sudan. Although increasing numbers of children are enrolled in primary school, very few continue to the secondary level. In Egypt, on the other hand, there are high levels of primary and secondary school enrolment.

Table 3-21 School Enrolment Rates, 2000-2001

Region	Primary (%)			Secondary (%)		
	Total	Male	Female	Total	Male	Female
Abbay Sub-basin						
Amhara	58.5	62.9	53.9	12.6	15.3	9.9
Oromia	66.9	82.6	51.0	19.1	25.5	12.4
Benishangul-Gumuz	98.4	121.2	74.5	19.5	26.8	12.0
Ethiopia (country)	*79.8*	*87.3*	*70.9*	*29.2*	*36.6*	*21.6*
Blue Nile Sub-basin						
Blue Nile	42.0	46.8	36.8	8.5	9.2	7.8
Sennar	63.5	72.5	54.2	19.4	18.0	20.9
Gaderif	50.7	56.4	45.0	12.1	12.9	11.3
El Gezira	83.1	85.6	80.5	29.7	28.1	31.3
Khartoum	87.5	88.3	85.6	32.9	32.9	32.9
Sudan (country)	*57.7*	*61.9*	*53.4*	*15.3*	*15.1*	*15.5*
Main Nile Sub-basin						
Sudan						

Region	Primary (%)			Secondary (%)		
	Total	Male	Female	Total	Male	Female
North Kordofan	64.7	69.2	60.0	9.5	4.1	18.6
River Nile	87.3	88.9	85.6	36.6	31.8	43.8
Red Sea	59.9	65.6	54.0	25.8	24.9	26.6
Northern	103.5	106.0	100.8	38.8	33.9	43.8
Egypt						
Aswan	86.9	-	86.4	78.3	-	73.3
Red Sea	102.2	-	105.5	82.1	-	87.0
New Valley	89.4	-	88.1	87.2	-	82.3

Note: Data represent gross enrolment rates. For Sudan, data are reported for 2000-2001; data for Egypt are for 2006.

Sources: Ministry of Education, cited in SMEC, 2006, RAP-Ethiopia, Ethiopia-Sudan Power System Interconnection Project; PASDEP, Ethiopia-Sudan Power System Interconnection Project; Sudan Gender Profile, WFP, 2004; Egypt Human Development Report, 2008

3.7.4.3 Other non-income dimensions of poverty

Other non-income dimensions of poverty are fundamental to understanding how people living in the Nile Basin are vulnerable to poverty. As discussed above, some of these include:

- The **poor health status** of many people living in rural areas of Ethiopia, combined with poor access to health care services, is reflected in increased risks of falling into poverty. This may be associated with lower productivity due to poor health as well as the forced sales of land, livestock and other key assets to pay for medical costs.
- Households with **high proportions of dependent children and elderly** are more vulnerable to falling into poverty. Similarly, female-headed households are more likely to be poor due to lack of assets such as secure land tenure as well as lack of available labor.
- Households in the Abbay sub-basin that practice **rain-fed subsistence agriculture** are more vulnerable than households that cultivate exportable crops such as coffee.

3.8 ECONOMIC DEVELOPMENT

3.8.1 Commercial Agriculture

In Ethiopia, agriculture accounts for more than 80% of the country's exports. Coffee is the principal export crop. It is grown largely by smallholders at elevations of 1,000-2,000 m, with the majority of production outside the Abbay sub-basin in the regions of Oromia and SNNPR. Livestock including live animals, leather and leather products represent about 10% of exports.

In Sudan, commercial agricultural activities are concentrated in a belt in the center of the country, between latitudes 10^{o} and 14^{o} north, in the semi-arid savannah zone. Although estimates suggest that oil now constitutes 80-90% of Sudan's total exports, agricultural products such as cotton, sesame, peanuts, gum Arabic and livestock constitute the majority of the remainder of exports. Notwithstanding, Sudan is a net importer of food to feed the country.

3.8.2 Commercial Fisheries

3.8.2.1 Lake Tana

The potential yield from the Abbay River sub-basin in Ethiopia has been estimated at 18,200 tons per year (Ministry of Water Resources, 1998). Of this, Lake Tana accounts for 15,000 tons, existing reservoirs 1,200 tons and the rivers 2,000 tons. The main catches from rivers are from inflowing rivers to Lake Tana and the fishery in the gorge section of Abbay is considered to be insignificant (Ministry of Water Resources, 1998).

The main fish species fished in Lake Tana are the *Labeobarbus* spp. that consists of about 17 different species, the Nile tilapia (*Oreochromis niloticus*) and cat fish (*Clarias gariepinus).* The commercial gill net fishery on *Labeobarbus* spp. is highly seasonal and mainly targets the spawning aggregations, as more than 50% of the annual catch is obtained at the river mouths during August and September. Nile perch (Lates niloticus) Nile tilapia (Oreochromis niloticus), Catsish (Clarias sp), Bargrus, Barbus and Labeo species are known to be important both in ecological and commercial terms.

The annual maximum sustainable yield of Lake Tana was estimated to be about 7,000-15,000 tons. This prediction is based on the assumption that the reproduction of fish is not affected by anthropogenic factors.

Currently, there are four major types of fisheries characterized by specific combination of gears and fishing crafts. These are:

1) the motorized gillnet (mesh sizes 10-12 cm) fishery based in Bahir Dar (the provincial town adjacent to Lake Tana) and now expanding in 10 bordering woredas
2) the traditional reed-rafts-gillnet (mesh size 6 to 10 cm) around the lake,
3) the traditional reed-rafts-gillnet (mesh size 10 to 12 cm), and
4) the chase and trap fishery (mesh size 6 to 9 cm) based in the southern part of the lake; whereas gears such as long line, cast net and traps are occasionally used but contribute very insignificant amount to the total fish catch.

The traditional reed boat fishery is still important for remote areas of the lake. Reed boats carry normally only one fisherman. Catches are collected in early morning. The catch from this fishery is used for selling at small markets in the villages and for household consumption and they target mainly *Oreochromis niloticus* (Nile tilapia).

Traditional reed boats use local gillnets, hooks, line traps and sometime spears for catfish. The reed boats are 3-4 m long and 60-80 cm wide and have a life span of 2 years. They are made by the fishers themselves using locally available materials like papyrus. The boat can carry 5 nets of each 50 m long. The total number of reed boats is estimated to be about 400 (about 400 fishers). Reed boat fishers are not organized under an association or cooperative.

The motorized fisheries mainly target bigger markets. This fishery uses motorized boats with 100 m long gillnets of 10 to 14 cm stretched mesh size. The program of motorization was accompanied by the organization of the fishers into an association accompanied by technical training in net making, processing and engine maintenance. These are mainly steel hulled boats. There are about 25 motorized fishing boats on the lake, most of which land their catch at Bahir Dar, either directly or via collector boats.

The majority of the catch comes from the traditional reed boat fishery. The introduction of commercial gillnet fishery did not have a significant changes to traditional fishing practices because it focused mainly on fish collection from fishers rather than fishing itself. The total fish catch from Lake Tana was estimated by the Regional Bureau of Agriculture and Rural Development, as presented in Table 3-22.

Table 3-22 Annual Fish Catches for Lake Tana

Year	Annual Catch (tons)
2003	1,068
2004	1,231
2005	1,281
2006	3,003

These reported catches appear to be far below the maximum sustainable yield, which is estimated at 7,000 to 15,000 tons/y (Dejen, 2007). This potential is expected to remain unexploited for a considerable number of years for a number of reasons:

Difficulty in accessing the deep gorge and the presence of crocodiles make the resource difficult to exploit.

There is critical shortage of skilled manpower in the fisheries and aquaculture sector in the regions as well as at Federal level, and there are no fishery experts at Zone, Woreda and Kebele level.

- Fish from Lake Tana is caught and transported by reed boat and motorized vessels. These boats are old, inefficient and few in numbers. Furthermore, motors for boats, wether in-board or out-board, are not readily available in Ethiopia. It is also difficult to obtain some spare parts
- There is a critical shortage of landing, cooling and processing facilities around the lake. There is no also ice on board for preserving fish
- The fish are transported from Lake Tana to Addis Ababa and Sudan by road in refrigerated trucks. There are not many trucks available and there is no air transport for fish from Bahir Dar.

Fish prices vary and are generally affected by the locality at which they are sold. Table 2-35 shows the price in 2007 at Bahir Dar.

Table 3-23 Fish prices at Bahir Dar (ETB/kg)

Type	Tilapia		Catfish		Labeobarbus	
	Producer	Retailer	Producer	Retailer	Producer	Retailer
Wet whole fish	5	21	3	17	3	11
Dried fish			2	12.5	2	6.5

Source: Fish Production and Marketing Enterprise, in Dejen, 2007.

Fishers are organized in associations for credit and technical provisions. The “Tana Haik 1” fishing cooperative was established 20 years ago in the Southern Gulf of the lake and was the first such organization. “Georgis”, “Zege” and “Fish for All” associations are recently organized associations and are currently functional. Other associations are now emerging across the 10 woredas surrounding the lake. Each woreda has at least one association with 80-120 members. In general it is estimated that 1,300 fishers will be organized in associations with modern fishing methods.

Many cooperatives remain; some of them little more than producer groups not currently engaged in any cooperative enterprise, and some still heavily supported by government or by projects. Others, such as “Tana Haik 1” fishing cooperative, appear to be well managed as producer cooperative enterprises. It has sought to incorporate smaller producer groups operating at Kebele level, in a bid to improve efficiency and realize economies of scale.

The “Tana Haik 1” fishing co-operative has a net making facility mainly run by women. Women members of the cooperative are engaged in net making and fish processing, whereas, men are involved in fishing and engine/boat maintenance. This cooperative rents out motorized boats to its members on a full cost recovery basis.

In general, the lake fishery has employed more than 3,000 people who are directly dependent on the major activities of fishing, marketing, and processing for their livelihood. It is also contributing in giving employment opportunity to women and other landless people like ex-soldiers other than the fishers (Table 3-24).

The following, although not recent data, are dependents on the fishery sector that are directly involved in fishing and post harvest processing (Demisse, 2003).

Table 3-24 Number of People Depending on the Fisheries Sector around Lake Tana

Activities	Households	Dependents	Total
Fishing	596	2384	2980
Fish trading (self-employed)	26	-	26
Fish processing employed in FPME and the cooperatives	52	208	260
Others (in other activities, net, gear, fishmeal, etc)	33	132	165
Total	**707**	**2750**	**3431**

3.8.2.2 Abbay/Blue Nile and Tributaries

The fish fauna and fishery activities that are presumed to be taking place along the Abbay/Blue Nile tributaries are not well researched and not well understood and it is unclear how much fishery activity takes place. However, sporadic information and personal observation suggest that there is only small scale traditional fishery activity in the Abbay/Blue Nile tributaries using hooks and lines, as well as traps made of local materials.

The Abbay, Beles, Dabus and some other tributary rivers of the Blue Nile are suitable for fishing, at least in some segments of the rivers, but the fishery potential of them is not known. The catch is mainly used for household consumption with some limited, local marketing. Fish do not have great commercial value in the area, but in a few cases it is reported that some fishermen take dried (smoked) fish to nearby towns for sale.

In the upper course of the Blue Nile Sub-basin the potential is limited and fishing is carried out on a subsistence basis only. Virtually, every family that lives near water fishes to supplement its diet. Roseires Reservoir has a potential of 1,700 tons/year and reported fish landings of 1,500 tons/year. Sennar Reservoir has an estimated fish capacity of 1,100 tons/year and an actual fish yield of 1,000 tons/year.

Table 3-25 Fish Landings in main water Bodies on the Blue Nile and Main Nile in Sudan (2003)

Water Body	Surface (km^2)	Fish landings (t/y)	Potential (t/y)	No of Fishermen
Sennar	160	1,000	1,100[2]	800
Roseires	280	1,500	1,700[2]	1,200
Lake Nubia	1,140	1,000	5,100[1]	
Gebel Aulia	1,500	13,000	-	

1) Witte *et al.*, 2009
2) FAO, 2000

3.8.2.3 Main Nile

In central and northern Sudan, several lakes and reservoirs have been formed by the damming of the river and its branches: the 180-kilometer section of Lake Nubia on the main Nile in Sudan and the Jabal al Awliya Dam on the White Nile, and the Khashm al Qirbah Dam on the Atbara River tributary of the Main Nile. These bodies of water account for about 11,000 tons of fish against a calculated potential of about 29,000 tons (Chapin Metz, 1991).

According to the FAO Fisheries Country Profile, production from Nile River localities within Sudan, other than from the reservoirs, is estimated at 4,000 tons/year. Moreover, the Sudd region has an

estimated fish potential of 75,000 tons/year. However, the civil war disturbances, the dense cover of aquatic macrophytes and the rudimentary fishing gear and techniques has a negative impact on fish production, which does not exceed 30,000 tons annually.

There is no data available yet for the newly built Merowe Dam and reservoir, though it was expected that fishing potential could be developed within the reservoir.

Table 3-25 also reports fish catches in Lake Nubia, and the Gebel Aulia reservoir (Witte et al., 2009).

In the northern states near the major cities, resources are reportedly fished to saturation, with stable or dropping catches (UNEP, 2007). In the absence of hard water quality monitoring data, the reason for such catch reductions cannot be accurately determined, but localized overfishing and sedimentation are likely causes.

The contribution of the Nile River to fisheries is very much lower than that of the associated lakes. The Baro River, which is a tributary of the Main Nile system from Ethiopia, is known to be well utilized as a fishery by the local people as a source of income (small scale commercial exploitation) as well as for household purposes.

3.8.2.4 Lake Nasser/Nubia

Lake Nubia is that part of Lake Nasser within the Sudanese border which came into existence after the construction of the Aswan High Dam in 1961.

There are 25 species recorded in Witte *et al*. (2009) while twenty three fish species of commercial importance have been given in *Bishai et al*. (2000). The predominant marketable fresh fishes are *Sarotherodon galilaeus*, *Oreochromis niloticus, Lates niloticus, Labeo* spp., *Bagrus* spp. and *Synodontis* spp. while the salted fishes are mostly *Hydrocynus forskalii, Alestes* spp. and *Schilbe niloticus*. According to Witte *et al*. (2009), the most important species are *Labeo niloticus, Lates niloticus, Hydrocynus forskalii* and *Alestes baremoze*

According to FAO (2001), Lake Nubia's potential is 5,100 tons/year, but is able to produce currently only 1000 tons of fish annually.

Fishing is an important industry for Lake Nasser. According to Bishai *et al.* (2000) there are about 10,000 fishers organized in five associations around Lake Nasser. Many of the fishers are unqualified and use unsuitable, illegal or damaging fishing techniques to compensate for their inexperience. The maximum fish landing was recorded at 34,206 tons in 1981. However, the potential of Lake Nasser appears to be higher than that. The most important species in the fish landings are cichlidae with *Tilapia nilotica* and *Tilapia galilaea* forming about 90 % of the total catches.

The Lake was reported to be providing adequate supplies until 1981 when production started to plummet. Over the next two decades, fishers have proceeded with their work despite the steady decrease in the quantity of fish they produce - from a peak of over 34,000 tons in 1981 to only 8,000 in 2000 (Table 3-26).

Researchers have identified a number of possible causes of the low productivity of fisheries in Lake Nasser. These include:

- Fishermen use illegal fishing methods including nets with mesh smaller than the legal limit.
- Unlicensed boats.
- Smuggling of fish, up to 60,000 - 70,000 tons; (these figures appear extremely high considering the normal catches in Table 3-26, if confirmed, it would mean that smuggling is 4 to 5 times more important than regulated commercial fishing)
- Over-fishing: excessive and indiscriminate fishing occurring in the lake.

The fishing area of the lake is divided into two fishing zones. Fishing in shallow water khors around the shores, represents about 20% of the lake surface and is where the Nile Tilapia usually breeds. Fishing in deep waters represents 80% of the lake surface, but very few fish live in the deep waters.

Any significant change in the water level of the lake could significantly affect the fishing industry by completely changing the breeding habitats of the fish. More detailed studies are necessary to properly assess the impact of major water level changes.

Table 3-26 Lake Nasser Fish Production, 1966-2005

Year	Total (ton)	Year	Total (ton)
1966	751	1986	16,315
1967	1,415	1987	16,815
1968	2,662	1988	15,888
1969	4,670	1989	15,650
1970	5,676	1990	21,882
1971	6,819	1991	30,838
1972	8,343	1992	26,219
1973	10,587	1993	17,931
1974	12,255	1994	22,074
1975	14,635	1995	22,058
1976	15,791	1996	20,540
1977	18,471	1997	20,503
1978	22,725	1998	19,203
1979	27,021	1999	13,983
1980	30,216	2000	8,281
1981	34,206	2001	12,164
1982	28,667	2002	22,093
1983	31,282	2003	17,029
1984	24,534	2004	12,434
1985	26,450	2005	15,285

Source: Hydrosult *et al.* Report, Egypt (2007), from HDLDA - Fisheries Department

Because of the plummeting production figures, Egypt issued Law 324 in 2000. It reallocated fishing space, giving the fishers' associations only 60%, with 40% handed over to six private sector companies - a move that generated unrest among fishers and resulted in conflict between the associations and the governorate. The companies promised to increase production to over 40,000 tons per year by fishing at lower depths and developing breeding farms, thereby exploiting the full potential of the lake (Dena Rashed, 2005).

3.8.3 Industrial Development

Outside of Khartoum, there are no major cities in the Abbay, Blue and Main Nile sub-basins. Industrial development is not significant, and consists primarily of agro-processing (e.g., sugar factories), utilities (e.g., energy production) and construction materials (e.g., cement factories). However, the exploitation of oil reserves in central and southern Sudan is leading to the development of a wide range of industries upstream and downstream of Khartoum.

3.8.4 Transport Infrastructure

In Ethiopia, 42-48% of households in the Abbay Sub-basin live within five kilometers from the nearest all-weather road (2004 Welfare Monitoring Survey as cited in Hydrosult et al., 2007).

People living along the Abbay River cross it for many reasons: they move their animals to pasture on both sides of the river; trade is a common reason to cross the river; often, the nearest schools, clinics or other social services are on the other side of the river; and, people need to cross the river to visit relatives, go to weddings and for other personal reasons. During the dry season, people can often walk across the river. When this is not possible and during the wet season, ferry services using small boats (*feluco*) allow people to cross the river. According to the Mandaya EIA, the change in the river levels immediately below the dam will be +1.4 m in January and +1.7 m in April, compared to long-term average conditions (EDF *et al*., 2007).

As noted previously, the population in the Blue Nile Sub-basin is concentrated along the west bank of the river. An asphalt road extends from Khartoum to El Damson, the capital of the state of Blue Nile. Another asphalt road connects from Wad Medani to the Ethiopian border at El Gaderif. An all-weather road extends from El Gaderif to the south along the border for about 160 km. In addition, there is a railway from Khartoum to Sennar and El Gaderif.

In Sudan, there is a very poor road network through the desert regions in the northern part of the country. The network consists primarily of two primary roads and other, secondary roads. The primary roads are: (i) Khartoum to Atbara (312 km) and Atbara to Haiya; and, (ii) Khartoum to Abu Dom (386 km) and Abu Dom to Dongola. The principal secondary road goes from Atbara to Wadi Halfa (613 km). There is also one rail line between Khartoum and Wadi Halfa.

The highway system in Egypt is concentrated in the Nile Valley north of Aswan and throughout the Delta; paved roads also extend along the Mediterranean coast from the Libyan border in the west to the border with Israel. In the east, a surfaced road ran south from Suez along the Red Sea, and another connected areas along the southern coast of Sinai from Suez to the Israeli town of Elat. A well maintained route is also circled through several western oases and tied into the main Nile corridor of highways at Cairo in the north and Asyut in the south. Unfortunately, despite this decent road infrastructure development elsewhere in Egypt, large areas of the Western Desert, the mountainous areas near the Red Sea, and the interior of the Sinai Peninsula, remain without any permanent-surface roads. There exists however extensive boat and ferry service on Lake Nasser move cargo and passengers between Aswan and Sudan.

3.9 ARCHAEOLOGICAL AND CULTURAL RESOURCES

The historical development of the Nile Basin has left a legacy of cultures and societies with a rich archaeological record. This has ensured that the sub-basin remains one of the most distinct and visually identifiable regions of the world.

3.9.1 Ethiopia

Although archaeological investigations have been limited, the oldest human remains were found in the Rift Valley in Ethiopia. Archaeological finds have also included important fossils and traces of pre-historic stone tablets, tools and other artifacts. Since 1998, the Blue Nile Basin Survey Project has worked west of Gondor focusing on Oligocene vertebrate paleontology and paleobotany; this region is believed to contain the most extensive Acheulean record outside of the Rift Valley in Ethiopia (Todd, et al., n.d.).

Formerly known as Abyssinia, Ethiopia is the oldest state in sub-Saharan Africa and traces its roots to King Menelik I believed to be the son of King Solomon. Orthodox Christianity was introduced in the 4th century AD, giving rise to a rich physical history of churches and other religious sites. Ethiopia is home to many ethnic and cultural groups, each with its distinctive architecture and historic sites as well as the traces of people's lives and cultural systems. Trade routes crossed Ethiopia linking India to the Middle East, and competing with other trade routes through the Nile corridor. Egyptian kings and pharaohs organized expeditions to hunt in the Ethiopian highlands. As a result of all of these exchanges, there is the potential for a range of physical cultural resources throughout the country including the Abbay sub-basin.

3.9.2 Sudan

The northern reaches of the Nile River are the "cradle" of civilization in Sudan, dating back to at least 3000 BC. The Nubian kingdoms of Kerma (2500-1520 BC) and, subsequently, Kush (1070 BC – 350 AD) and Meroe (800 BC – 350) established along the banks of the river. Closely linked with Egypt through conquests and trading relations, they flourished until 350 AD when the Axum Kingdom from Ethiopia vanquished the region. By the 6th century AD, the region was converted to Coptic Christianity by missionaries. After centuries of peaceful co-existence, the influx of Muslim Arab immigrants from Egypt and other areas resulted, by the 15th century, in the conversion of Sudan to Islam.

As a consequence, the main areas of archaeological interest in Sudan are to be found along the Nile River to the north of Khartoum. As noted in the discussion of ecotourism (Section 3.6.10), Jebel El Barkal, a major metropolis and religious site in the Meroe Kingdom, has been designated a UNESCO World Heritage Site. There are numerous other sites in this region of the Nile Basin that bear witness to the history of the area.

Table 3-27 Archaeological and Cultural Resources, Main Nile Sub-basin, Sudan

Site	Location	Period	Comments
Jebel El Barkal	At foot of Jebel El Barkal (mountain) on right bank of Nile downstream of Merowe Dam.	Napatan-Meroitic	UNESCO World Heritage Site: The metropolis of the Meroe Kingdom with a large Napatan and Meoitic temple and palace complex, with pyramid cemetery; and, palace of King Natakami (12 BC – 12 AD) and temple of God Ammon.
Sanam Abu Dom	5 km downstream of Jebel El Barkal on left bank of Nile	Napatan	Important temples, storehouses and a palace.
Meroe	4 miles north of Kaboshiva station in Shendi area, on right bank of Nile	Meroitic	The royal city and capital of the Meroe Kingdom, with several temples especially for the God Ammon and largely unexcavated rubble mounds with evidence of iron working and kilns. Immediately to east lies the sun temple and three pyramid cemeteries where the great kings and queens were buried
Kerma	35 km north of Dongola on right bank of Nile	2500–1500 BC.	Western or lower Daffufa (Nubian term of or any upstanding brick ruin
Nuri	6 miles above Karima and approximately 1 mile south of river	Napatan	Large tumulus and pyramid necropolis.
El Kurru	15 km south of Karima on right bank of Nile	Napatan	Large tumulus and pyramid necropolis of the first Kings of Napata
Naqa	Wadi Awatib, 159 km northeast of Khartoum	Meroitic	Well-preserved lion temple build around 15 BC-15AD by Queen Amanitore; it was dedicated to the lion-headed god Apedamak
Muswarat Es	15 km east of Naqa (30 km	Meroitic	Massive complex of temples and

Site	Location	Period	Comments
Sufra	from Nile)		other buildings centered on the Great Enclosure
Wad Ban Naga	Right bank of Nile, 75 km south of Meroe site	Meroitic	Royal palace of Queen Amanishakhete (35BC-20AD)
Tombos	Right bank of Nile, 9 km north of Kerma	Pharaonic-Meroitic	Fortified settlement (Christian Islamic), inscriptions (Pharaonic) and other buildings
Sai Island	9 km south of Abri in Northern State	Pharaonic, Napatan, Meroitic, Christian	Large fortress dating back to Egyptian New Kingdom (1550-1080AD). Temples and buildings dating to Napatan Period.
Tabo	40 km north of Dongola on island of Argo	Pharaonic (New Kingdom)	Very large Pharaonic temple.
Kawa	5 km north of Dongola on right bank of Nile	Napatan-Meroitic	Site of major Meroitic town that includes several temples and remains of houses and domestic quarters
Sedeomga	35 km south of Abri on left bank of Nile	Meroitic	So-called tombo of Taharqa (Tiharqo) plus a temple built by the Pharaoh Amenohetep III
Soleb	Third cataract, 40 km south of Abri on left bank of Nile	Pharaonic	Magnificent temple of Amenohetep III in honor of the royal god Ra and of himself
Sesebi	23 km south of Soleb on left bank of Nile	Pharaonic	Temple founded by Akhenaton (Amenohetep IV) in 14th century BC
Old Dongola	109 km south of Dongola	Christian	Capital of Christian kingdom known as El Maquria (540-1317 AD); large town with several churches
Soba East	15 km south of Khartoum on right bank of Blue Nile	Christian	Historical capital of the Kingdom of Alwa (540-1504 AD)
Sennar	350 km southeast of Khartoum on right bank of Blue Nile	Islamic	Capital of Funj Islamic kingdom (1504-1821 AD)
Abu Fatma	9 km north of Kerma just south of Tombos on right bank of Nile	Islamic	A Qubba (domed tomb) that lies on a rocky spur measuring 110 m x 45 m; site is still visited as a religious site

Source: http://www.sudanembassy.org/index.php?page=archaeological-sites-in-sudan

3.9.3 Egypt

The global importance of the Nile valley's archaeology has generated some of the most important international efforts at protecting archaeological sites, including the huge operation undertaken in the mid-1960s to rescue sites being inundated by Lake Nasser, following construction of the Aswan High Dam. The number of sites is too considerable to list here, but the Figure to the left illustrates some of the most important sites along the Nile (British Museum).

3.10 GENDER ASSESSMENT

The roles and contributions of women in the Nile Basin to household economies and community development are undervalued and, frequently, undercounted. This section summarizes women's roles, as well as the opportunities and constraints they face within societies in the Nile Basin. Their vulnerability as a group is also discussed in the next section in the context of socio-political aspects of the Nile Basin.

3.10.1 Women's Roles in Households and Communities

Throughout the Abbay sub-basin, in particular, women contribute widely to agricultural production, as well as assuming the primary responsibilities for household management. In addition to food preparation, child rearing and domestic chores, women are responsible for land preparation, planting and weeding; they are also the principal collectors of water and firewood, often walking long distances daily. Moreover, due to intermittent droughts and deforestation, the time required for these tasks has increased fourfold in the past decade. In the Blue and Main Nile sub-basins, women's participation in agriculture is confined to their households where they are responsible for keeping poultry and fowl, as well as participating in the threshing, drying and storing of farm produce. Outside the compounds, young girls assist to pasture goats and sheep and elderly women weed or glean open fields for livestock fodder.

The economic, social and political position of women in the Nile Basin is defined by cultural and religious traditions, with the result that women often do not share equally with men in the opportunities and benefits of development. Ethiopian women depend economically on their husbands and must defer to them on basic decisions such as how many children they will have. In pastoral societies in Benishangul-Gumuz, women do not own property without a male guardian. In Muslim communities in Sudan and Egypt, women generally carry out their activities within the confines of the household compound. Under Sharia law, Muslim women are considered to be legal minors; they are regarded as household resources to be controlled by men; and, they cannot inherit camels, cattle or land.

3.10.2 Access to Land and Other Resources

In the 2003 Agricultural Census in Ethiopia, 18% of rural landowners were identified as women, although other studies suggest the proportion is lower. Less than 10-15% of rural women have access to agricultural extension services and agricultural sector credit. In rural parts of the country, 15-20% of households are headed by women; these households tend to own fewer animals, cattle in particular, and to have fewer farm implements than households headed by men. In areas such as Amhara and Oromia, female-headed households depend on men to plough fields because it is culturally inappropriate for women to do this work.

Land in many parts of north Sudan is communal, allocated by the community leaders to male heads of households. Women have usufruct rights, and in areas where the Islamic practice of wife inheritance prevails it is to ensure that the land remains within the family line making women dependants of their male relatives. The 1927 Ordinance that established the Gezira Irrigation Scheme

entitles women to own tenancies, however women owned only 13% of the tenancies in 2000 (World Bank, 2000). Moreover, the same Ordinance stipulates that because the Scheme is Government land, the Islamic Laws pertaining to wife inheritance would not apply in the event of the death of a Scheme tenant. As a consequence, the tenancies tend to be transferred to an adult male rather than to the widow of deceased tenants.

3.10.3 Women's Health and Education Status

In general, the poor health and education status of women in the Nile Basin are both cause and effect of the constraints they face. In Ethiopia, each woman gives birth, on average, to more than 5 children; the maternal mortality rate (MMR) is 870 deaths for every 100,000 live births, one of highest in the world. In Sudan, fertility rates are high, with an average of 6 children born to each woman. The maternal mortality rate (MMR) is 450 deaths for every 100,000 live births although it is 644 in the state of Gaderif. The high rates of HIV infection in Ethiopia are concentrated in the 15-34 years age group and, among them, the majority is women.

Among indigenous groups in Ethiopia, women are subject to a number of harmful traditional practices, such as female circumcision, early marriage and giving birth unassisted in the bush. Women often have a heavier workload in comparison to men, working at physical weight-bearing activities and other activities that can be risky to their health. When coupled with other common health concerns, such as poor nutrition and limited access to health care, a woman's daily workload may have an important impact on her health and the health of her children.

In rural areas of Ethiopia, tradition is often cited as the reason for low school enrolment of girls compared to boys. In Benishangul-Gumuz, for example, girls comprise 36% of school enrolment; among the Gumuz ethnic group, the proportion drops to 25%. Literacy rates and primary enrolment rates are lower for girls throughout the Abbay sub-basin, as well as in Sudan; and, very few girls receive secondary education.

Girls' participation in education is constrained by economic, socio-cultural, family and school factors. In poor households, parents will invest in the education of their sons. Girls are more often needed at home where they tend to have more chores than boys. Also, because they tend to marry at a younger age, their education is seen as less important. The lack of village schools in many communities means many children travel long distances to study; this is often considered inappropriate and/or unsafe for girls.

In Egypt, a policy promoting the education of women has paid off in terms of both human and economic development at the personal, community and social level. In urban areas, in particular, women are increasingly joining the work force. They are also participating more in family decisions. Acceptance of these changes is making it possible for more women to be breadwinners while still managing the household (Kandagor, 2005). Nevertheless, the female illiteracy rate is still at 51% and gender inequalities persist as far as access, attainment and training are concerned. Girls' access to schooling is more limited than that of boys. Once in school, girls tend to perform as well as boys if not better, as far as achievement and completion are concerned.

3.10.4 Women and Natural Resource Management

By virtue of their roles in the domestic and economic activities of rural households, women are often the primary custodian of the environmental resources, giving them responsibility for managing the use of water, energy and other natural resources. Women along with men are repositories of indigenous knowledge that is crucial to their resource-based livelihoods. Some of the linkages between women's roles and natural resource management are:

- Women and girls make a disproportionately high contribution to the provision of water compared with the men in their households. As a result, they often decide where to collect water, how to draw, transport and store it, what water sources should be used for what purposes and how to purify water for drinking.

- Women gather edible plants, herbs used for cooking and medicinal purposes, firewood and other goods and services from forests and woodlands that are essential to meet the needs of the household. Degradation and deforestation of these areas increase the time and effort, as well as the capacity of women, to fulfill these responsibilities.
- At the same time, women's indigenous knowledge of forests and forest products makes them natural environmental stewards and active participants in tree planting and other natural resource management initiatives that they organize or that are organized by government and NGOs.
- In households that have abandoned migratory or other forms of extensive grazing of livestock, women are increasingly responsible for growing the grass that is used as animal fodder.

4. WATER RESOURCES DEVELOPMENT

4.1 DAM AND POWER GENERATION

4.1.1 Abbay River

The Abbay River flows out of Lake Tana at Bahir Dar over the Chara Chara Weir. The catchment area at Chara Chara Weir is 15,320 km2. From the Lake Tana outlet, the Abbay River spirals first south, then west, and finally northwest into Sudan. On the way it is joined by many large tributaries, as shown in Table 4-1 below.

Table 4-1 Tributaries and Sub-basins of the Abbay River

Sub-basin	Abbay Bank	Area (km^2)	Mean Annual Flow (MCM)
Lake Tana		15,054	3,809
North Gojam	RB	14,389	4,389
Beshilo	LB	13,242	3,920
Welaka	LB	6,415	2,072
Jemma	LB	15,782	4,798
South Gojam	RB	16,762	5,012
Muger	LB	8,188	2,440
Guder	LB	7,011	2,187
Fincha	LB	4,089	1,719
Didessa	LB	19,630	5,673
Anger	LB	7,901	2,355
Wombera	RB	12,957	3,874
Dabus	LB	21,032	6,246
Beles	RB	14,200	4,345
Total Abbay		**176,652**	**52,839**

At present there is no regulation of the Abbay River itself, apart from Chara Chara Weir at the outlet of Lake Tana. It was completed in 1996 and is used to regulate the lake outflows from Lake Tana for hydroelectric generation at Tis Abbay, and to regulate lake levels between 1,787 m and 1,784 m and improve wet season storage in the lake. There have been some negative reactions to the weir as it has apparently exacerbated flooding problems in land adjacent to the lake.

The Tis Abbay power station was originally built in 1964 with a generating capacity of 11.4 MW. There is no dam associated with it, as it uses Lake Tana as its storage. It was upgraded to 73 MW in 2001.

The Tana / Beles power project on the Beles River has recently begun testing. With a production capacity of 460 MW, it is one of the country's major water projects. Water is transferred to the Beles River through a 12 km long tunnel from Lake Tana. An expected 2,985 MCM will be diverted from Lake Tana to the Beles River annually. A major irrigation scheme is also being developed at Beles, with the feasibility study currently ongoing. The intention is to use most of the diverted water for irrigation.

The Fincha Dam on the Fincha River was completed in 1973. It has a catchment area of 2,500 km^2, and a storage capacity of 900 MCM. A secondary reservoir, Amerti Dam, with a FSL of 2,234 masl, was constructed in 1987 to increase the overall storage volume and water supply. Power generation capacity of Fincha is now 134 MW.

The Neshe Dam and reservoir is currently under construction and is expected to begin operation in 2011. It has a catchment area of 330 km^2 at the dam site. Its power production capacity is 97 MW. At its FSL of 2,230 masl it has a gross reservoir volume of 448 MCM and a live storage of 363 MCM. At FSL the reservoir has a surface area of 29.2 km^2.

While not part of the Abbay sub-basin, the Tekeze dam and hydro project is also mentioned here. It started operating in 2009 and commands a catchment area of 30,390 km^2, with a gross storage capacity of 9,293 MCM and a live storage capacity of 5,293 MCM. It has a power production capacity of 300 MW.

4.1.2 Dinder and Rahad Rivers

The Dinder and Rahad Rivers arise in the Ethiopian highlands from watersheds abutting the Abbay sub-basin. They are two important tributaries of the Blue Nile and flow into the river downstream of the Sennar dam. These rivers contribute an average of 2,900 MCM (Dinder) and 1,100 MCM (Rahad) per year to the discharge of the Blue Nile.

There are no existing dams or power schemes identified on the Dinder and Rahad Rivers.

4.1.3 Blue Nile

The discharge of the Blue Nile has varied over the past century, with a long term average discharge of 51,700 MCM per year between 1912 and 1986. Since then, average flow has reportedly increased, with maximum annual discharges exceeding 70,000 MCM and a minimum annual discharge of 23,000 MCM. Drought in the Sahel severely affected flows in the Blue Nile during the late 1970s and in the 1980s.

There are two dams on the Blue Nile, the Roseires and the Sennar. The Roseires Dam was built in 1966, with the power generation facilities being installed in 1971. Both the water and the power were needed to implement the Rahad River irrigation project located east of the Rahad River. Roseires has a generation capacity of 280 MW and a design reservoir capacity of 3,000 MCM, though this has now been reduced to 1,900 MCM (in 2007) through rapid sedimentation. The Sennar Dam was built for flood control and irrigation of the Gezira Scheme but it also produces 15 MW of hydropower. It has a design capacity of 930 MCM, which has now been reduced to 600 MCM.

Operation of both the Roseires and Sennar dams emphasizes minimizing sediment capture. Main flood flows are allowed to pass through the reservoir on the rising limb and through the peak, capturing water only on the recession. This is because most sediment transport occurs in the upper portions of the rising limb, decreasing substantially on the descending limb. This reduces storage potential, but the storage capacity is low enough that the operation of the dam is not the deciding factor in total storage.

There are currently plans to raise Roseires by 10 meters from the present 60 meters. This is mainly for increased power production and to make up for lost storage due to sedimentation.

4.1.4 Main Nile

The Merowe Dam, 800 km downstream of Khartoum on the Main Nile, was completed in 2007, submerging the fourth cataract and creating a reservoir of 174 km in length and with a surface area of 476 km^2. It has a height of 67 m and a power production capacity of 1,250 MW, doubling the hydropower capacity of Sudan at the time. Merowe also has an irrigation component but its implementation is uncertain.

Currently, the installed power capacity in Sudan is 4,121 MW, only one quarter of the estimated required capacity by 2030. Some of the new required capacity will be derived from hydro but most from thermal and combined cycle sources.

There are only two hydro projects considered for the Main Nile in Sudan. One is the Dal hydro project, downstream of Merowe. It has a potential capacity of 780 MW, but the current

consideration is for a smaller Dal at 340 MW. Kajbar Dam is also being considered, with a potential capacity of 300 MW.

For Egypt, the Aswan Dam is the only existing hydro dam. It comprises the Aswan High Dam and the Old Aswan Dam, or Aswan Low Dam, located about 1,000 km upstream and south-southeast of Cairo, has a generating capacity of 2,100 MW. It creates Lake Nasser, which stretches 350 km in Egypt and 150 km in Sudan. It has a surface area of 5,250 km^2 (6,000 km^2 at high waters) and a total average reservoir volume of about 132 BCM, and up to 157 BCM in very rainy seasons.

Currently, the installed power capacity in Egypt is 26,382 MW, and the estimated required capacity by 2030 is 77,951 MW. Most of the new capacity requirement will be met by nuclear power development; coal and oil fired steam and combined cycle.

4.2 IRRIGATION MODERNIZATION AND DEVELOPMENT

4.2.1 Abbay River

There have been various estimates of the total irrigable land in the Abbay sub-basin. The MoWR website estimates it at 5.8 million ha (this includes the catchment area upstream of Lake Tana), based on land slope only. The Abbay River Master Plan estimated the maximum irrigable area at 2.0 million ha, based on slope and land suitability only. It also states that water is the main constraint in most Sub-basins. Water availability reduces the estimate for the Lake Tana Sub-basin to 100,000 ha of large scale irrigation, without storage, and an uncertain but possible 100,000 to 150,000 ha of small scale irrigation. Including other Sub-basins of the Abbay system the Master Plan estimates a potential area of 525,000 ha. The most recent estimation is shown in Table 4-2 by sub-basin.

Table 4-2 Total Irrigable Land in Ethiopia Abbay Sub-basin

Sub-basin	Area (ha)
Lake Tana, Beles and the Northwest Basin	369,545
Guder	8,996
Birr / Fettam	16,160
Didessa	68,338
Angar	26,563
Dabus	9,661
Other Sub-basins	55,102
Total Abbay Sub-basins	**554,365**

Source: MoER, 1999 - Abbay River Basin Integrated Resource Master Plan (1998)

The total current medium to large scale irrigation development of the Abbay sub-basin is quite limited, with only the scheme associated with Fincha Dam at 6,205 ha. There is also small scale irrigation pumping, mostly from Lake Tana, but also in other areas, estimated at around 25,000 ha. There is also the nearly constructed Koga Irrigation Scheme at 6,000 ha.

However, there are several major irrigation schemes planned for the Lake Tana sub-basin and on tributaries of the Abbay River. Table 4-3 shows the potential irrigation schemes that have been considered for development. These are derived from the Abbay River Basin Master Plan (1999) which MoWR states remains valid as their overall development plan for the sub-basin despite the length of time since its formulation.

Table 4-3 Potential Irrigation Development in the Abbay Sub-basin

Project *(with number of sub-projects)*	Type	Net Irrig. Area (ha)	Status
Lake Tana Sub-basin			
Megech Gravity (2)	Gravity	7,300	FS
Megech Pump (4)	Pump	24,510	PFS
NE Tana (4)	Pump	5,745	PFS
Ribb (4)	Gravity / Pump	19,925	PFS
Gumera (6)	Gravity Pump	13,976	MP
NW Tana (4)	Pump	6,720	PFS
SW Tana (4)	Pump	5,132	PFS
Tis Abbay (5)	RoR / Pump	11,300	MP
Jema (1)	Gravity	7,800	MP
Gilgel Abbay (8)	Gravity / Pump	12,852	PFS
Koga (1)	Gravity	5,100	FS
Total Sub-basin		**120,360**	
Beles Sub-basin with Lake Tana Transfer			
Upper Beles (1)	RoR	53,700	FS
Upper Dinder (1)	RoR	10,000	MP
Middle Beles (1)	Gravity	85,000	MP
Upper Guder (1)	Gravity	4,896	PFS
Anonu (1)	RoR	1,607	Pos. for AMP
Kale (1)	RoR	1,537	Pos. for AMP
Huluka Debis (2)	RoR	956	Pos. for AMP
Fincha-Amarti (1)	Gravity / Pump		Existing (6,200 ha)
Neshe/Nedi (2)	Gravity		MP
Middle Birr (1)	Gravity	8,500	FS
Lower Birr (1)	Gravity	7,660	MP
Total Sub-basin		**173,856**	
Didessa Sub-basin			
Arjo-Didessa (1)	Gravity	14,280	MP
Arjo-Didessa Pump (1)	Pump	4,803	MP
Didiga (1)	RoR	4,600	MP
Negeso (1)	Gravity	23,000	MP
Wam/Urg (2)	RoR	3,258	MP
Dabana (1)	Gravity	16,388	MP
Dimtu/Hida/Lugo (3)	RoR	2,009	MP
Total Sub-basin		**68,338**	
Anger Sub-basin			
Anger (1)	Gravity	14,450	MP
Nekemte (1)	Pump	11,220	MP
Anger RoR (1)	RoR	893	MP
Total Sub-basin		**26,563**	

Project *(with number of sub-projects)*	Type	Net Irrig. Area (ha)	Status
Dabus Sub-basin			
Dabus (1)	Pump Gravity	5,100	MP
Dabus RoR (2)	RoR	4,561	MP
Total Sub-basin		**9,661**	
Other Sub-basins			
Gramma/Welaka (3)	Gravity	25,628	MP
Muger (1)	Gravity	4,420	MP
Debre Markos (9)	RoR	25,054	MP
Total Sub-basin		**55,102**	
Total		**453,880**	

Notes: RoR = run of river, FS = feasibility study stage, PFS = prefeasibility study stage, MP = studied at master plan level only
Source: MoWR 1999 - Abbay River Basin Master Plan

The water requirement of the above schemes would amount to about 3,500 MCM per year if they were all developed, which represents about 7% of the flow in the Abbay River as it crosses to Sudan.

The MoWR planning for irrigation development from 2005 to 2020 includes the schemes as shown on Table 4-4.

There are several planned irrigation schemes in the Tekezi sub-basin, which are mentioned only for sake of completeness. These are: Metema (11,560 ha), Angereb (16,535 ha), Wolkayit (50,000 ha) and Humera, currently at 43,000 ha, but with a possible later expansion of 17,000 ha. The Humera scheme has been studied to feasibility and detailed design level, which suggests likely implementation in the near future.

4.2.2 Dinder and Rahad Rivers

The Dinder and Rahad rivers originate in Ethiopia, with their upper catchment boundaries adjacent to those of the Abbay sub-basin. For this reason the Ethiopian part of the sub-basins were included in the Abbay River Master Plan Study. Two irrigation schemes were put forward in the Master Plan, one of approximately 45,000 ha on the Rahad River, and one of about 50,000 ha on the Dinder River, but these have not yet been developed.

Table 4-4 Planned Irrigation Development in the Abbay Sub-basin (2005 to 2020)

Sub-basin	Area (ha)
Beles Sub-basin	
Upper Beles	53,000
Upper Dinder	10,000
Middle/Lower Beles	85,000
Sub total	**148,000**
Lake Tana Sub-basin	
Various Smaller Projects	**115,260**
Didessa Sub-basin	
Arjo	19,083
Negeso	23,000
Dabana	16,388
Sub total	**58,471**
Angar Sub-basin	

Sub-basin	Area (ha)
Angar	**26,563**
Total	**348,294**

There are existing irrigation schemes on the lower reaches of the Dinder and Rahad Rivers, closer to the Gezira scheme on the Blue Nile. Approximately 125,000 ha of irrigated agriculture were developed in the late 1970s on the east bank of the Rahad River using water pumped from the Blue Nile.

The Roseires Dam was built in 1966 to serve the Rahad scheme, both with power and water. The Rahad River itself, which joins the Blue Nile downstream from Roseires Dam, had insufficient flow for irrigation diversion during the dry season. Work on the initial 63,000 ha of the project began in the early 1970s, with the first irrigation water being delivered in 1977. By 1981, 80% of the prepared area was reported to be irrigated. Water is pumped from the Blue Nile using electric power generated by the Roseires plant, and is transported through an 80 km canal to the Rahad River (under passing the Dinder River on the way). The canal merges with the Rahad River above a barrage which diverts the combined flow into the project's main irrigation canal. Irrigation is by gravity and using furrow irrigation as it is more amenable to mechanized farming.

On the South Dinder approximately 132,329 ha is under development and the Rahad II scheme of 210,000 ha is also being considered. The Rahad project is considered as being among one of the schemes that could have a huge potential for expansion in the near future after the heightening of the Roseires Dam. The water supply sources for the Rahad scheme are the Blue Nile River and the Rahad seasonal river.

4.2.3 Blue Nile Sub-basin

Most (almost 70%) of the irrigated area of Sudan is fed by the Blue Nile. There are several irrigation schemes, as listed in Table 4-5. These are also shown on Figure 4-1.

Table 4-5 Public Large-Scale Irrigation Schemes, Blue Nile Sub-basin

Scheme	Area (ha)
Gezira & Managil	924,000
Rahad I	126,000
Suki	36,000
NW Sennar (sugar)	14,000
Guneid (sugar)	36,000
Abu Nama (jute)	13,000

Sources: BRL, 2008; Hydrosult *et al.* Sudan Country Report

The Gezira Scheme is Sudan's oldest and largest gravity irrigation system, located between the Blue Nile and the White Nile. It started in 1925 and progressively expanded until it irrigated about 880,000 ha. Combined with Managil (which is contiguous) it totals about 924,000 ha. Rahad I scheme is on the Rahad River, but flows are insufficient to support it and water is transferred by pumping through a canal from the Blue Nile.

Apart from the Gezira scheme most of the irrigation schemes were developed in the 1960s and 1970s. Since then, there have been no significant irrigation developments because the 'easier' sites have already been developed and others would be more complex and expensive to develop, and with higher risks. Secondly, the current low levels of productivity and declining yield of irrigated crops in the country make it difficult to justify further investment.

Demand for food and fiber continues to grow and priority has now been given to increasing productivity from existing irrigation schemes, rather than developing new ones. This objective has been derailed by the declining supply of water to farmers in the existing schemes, due to the reasons cited above: poor water use efficiency, losses to water distribution from sedimentation of the network and other management problems. It is evident, therefore, that investments in irrigation modernization for improving crop production and water use efficiency would have significant benefits if done correctly.

There are also several pumped irrigation projects on the Blue Nile, including the June project on the right bank of the Blue Nile east of the Gezira Scheme. This project, with an irrigated area of 36,000 ha, started operation in 1955 to provide an alternative livelihood for nomadic pastoralists in the area. It produced cotton until 1960, when about 8,400 ha were converted to sugarcane. In the early 1970s the As Suki project, also of 36,000 ha, was established upstream from Sennar to grow cotton, sorghum, and oilseeds. In the mid 1970s the government constructed a second project near Sennar of about 20,000 ha. In addition to cotton and other crops such as peanuts, about 8,400 ha of the area were devoted to sugarcane. Several smaller Blue Nile projects added more than 80,000 additional ha to Sudan's overall irrigated area during this time.

There are no plans for new irrigation developments. However, there is interest in increasing the productivity and overall production of Gezira, with water supply as the main barrier.

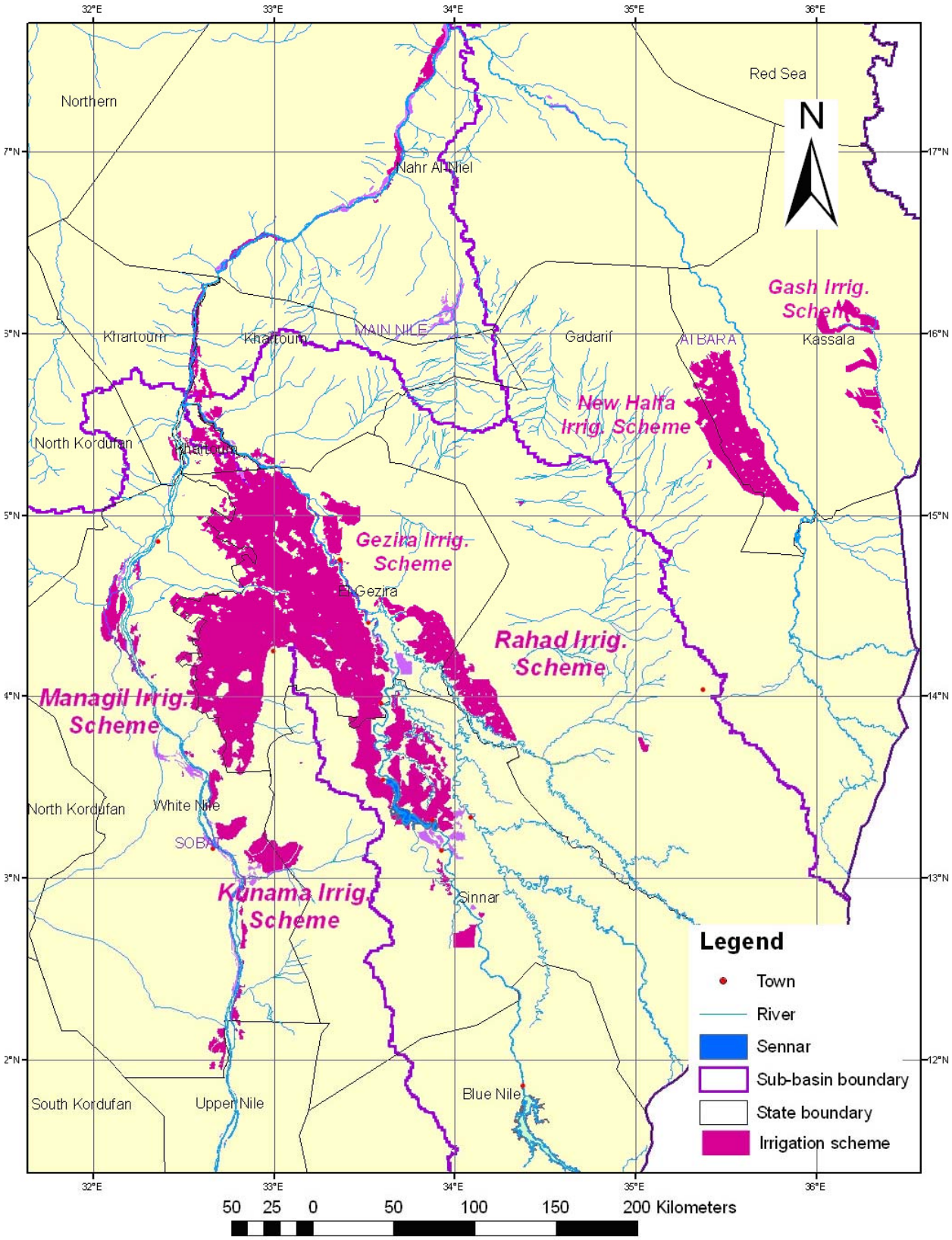
The Sudan Long Term Agricultural Strategy (2002-2007) has proposed expansion of irrigated areas in the Blue Nile Sub-basin to include an additional 420,000 ha.

4.2.4 Main Nile Sub-basin

In Sudan, the Main Nile irrigation is mostly from water pumped from the river by individual farmers. The Kasham Al Qirba scheme on the Atbara River was designed to irrigate 164,000 ha but has expanded to 200,000 ha. The dam on the Atbara River is reducing in volume due to the heavy sediment loads coming from the Ethiopian Highlands.

In the Lake Nasser/Nubia watershed, arable land accounts for 1% or less of the area of the governorates in the basin. Therefore, agricultural development is premised on expansion of the area of irrigated land. The proposed strategies include pumped irrigation of land above the high water mark and development of land below the full supply level using residual soil moisture and supplementary irrigation. The potential areas reclaimed through these strategies are estimated, in the former instance, to be between 50,000 and 1.5 million ha. In the latter case, it is estimated that there is the potential to develop up to 85,000 ha. In addition, the proposed Tushka Project situated on the left bank of the lake would irrigate 227,000 ha of land using water from Sheikh Zayed canal and groundwater resources.

Figure 4-1 Large Scale Irrigation, Sudan



Source: Hydrosult *et al.*, 2007. Sudan Country Report

In Egypt, the total proposed irrigation development is approximately 500,000 ha, with a water requirement of 9.5 BCM (BRL, 2008).

There are no CRA irrigation projects identified for the Main Nile in Sudan. Under the CRA Irrigation Studies the identified irrigation development projects in Egypt are:

- Mubarak Pumping station and Sheikh Zayed Canal, which may be developed to 220,000 ha and consume 5,000 Mm^3/year
- Tushka spillway and Land Reclamation
- West delta Water Conservation and Irrigation Rehabilitation Project

4.3 WATERSHED MANAGEMENT

4.3.1 Abbay Sub-basin

While most of the highlands area of the Abbay Sub-basin was once covered by forest, the remaining forest is now limited to small, scattered remnants. Most of the highlands area is either cultivated or used for grazing. Most (over 90%) of the land which is cultivated is also in the highlands, which indicates that expansion of land into lower areas is more difficult, primarily because of steep slopes. Expansion onto the steeper, lower areas means greater erosion hazard.

Severe forest destruction is common across Ethiopia, with a decrease in forest area from about 40% coverage in the early decades of the 20th century to less than 3% at present. This alone is responsible for severe soil erosion and land degradation. It is estimated that over 200 million tons of soil are lost from the highlands of Ethiopia annually, with the Abbay sub-basin accounting for a significant share, as most of it is highlands.

With such a magnitude of forest loss, it can now be said that soil erosion defines the Abbay Sub-basin. It threatens the productive capacity of the basin when population pressures and requirements for food are increasing. The greatest cause of erosion is human activity – the removal of forests and other natural vegetation in favor of mostly annual cropping, but exacerbated by the physical characteristics of the sub-basin: steep slopes, high and erosive rainfall.

Steep slopes are one of the most important factors in erosion and soil loss. The Abbay sub-basin features a relatively flat upland plateau, but is generally a steep watershed. Table 4-6 shows the slope classifications for the Abbay sub-basin.

Table 4-6 Slope Classes in the Abbay Sub-basin

Slope (%)	Area (ha)	Area (%)
0-5	9,417,058	47.1
5-10	2,774,791	13.9
10-15	534,159	2.7
15-30	5,317,587	26.6
>30	1,937,619	9.7

More than 36% of the sub-basin has slopes over 15%, indicating the steep, and therefore highly potentially erosive, nature of the Abbay sub-basin.

There have been many estimates made of sediment transport in the Abbay River, with equally varying quantities. While measurements of sediment in rivers and estimation of sediment loads and erosion rates are often contentious, no one disagrees that erosion and soil loss in the Abbay sub-basin is a major problem, perhaps the single biggest in terms of economic and social development in the Abbay Sub-basin, with far-reaching consequences down to the Aswan High Dam.

It can be argued that the immediate cause is related to management practices, but these are driven by poverty and the lack of alternatives for livelihoods that poverty creates. For effective watershed management it is therefore necessary to identify solutions to the root cause as well as the perhaps more immediate physical aspects of land degradation.

From a watershed management perspective, there are two main considerations for the JMP 1 analysis. There is the reduction of sediment in the reservoirs, which has an impact on the functional life of the project. Perhaps more important is the reversal of the degradation of land, which has impacts on poverty, livelihoods, food security, overall agricultural productivity and, thereby, the economy of the region.

Ethiopia has been putting efforts in to soil and water conservation measures in recent years, with some impressive successes. In areas of Tigray the rate of adoption of soil and water conservation measures exceeds 40% of farmers. This has been mainly due to the visible impacts of the increase in soil and water conservation, risk reduction and significant crop yield increases. Communal grazing land management systems are in place in 80% of the villages. On-farm tree planting has also been promoted and has had some success, though it has had greater uptake in the Amhara Region.

Several feasibility studies have been undertaken in recent years for watershed management. MoWR has recently completed two in the Rift Valley Lakes Basin. For the Abbay sub-basin, ENTRO completed a Project Implementation Plan in 2007 for areas of Ribb, Gumera and Jema Sub-basins under their Fast Track Projects. Initially looking at a gross study area of 444,000 ha in these Sub-basins, the selected areas totaled just over 80,000 ha.

In the Cooperative Regional Assessment studies for watershed management there are seven watershed management projects (direct interventions) that have been defined in the CRA for Ethiopia. These are:

- Soil conservation and improved soil husbandry
- Crop diversification and intensification
- On-farm tree production and domestic energy
- On-farm forage production
- Improved animal health
- Area closure: communal land and community woodlots
- Water conservation and improved utilization

4.3.2 Rahad and Dinder Sub-basin

The Rahad and Dinder rivers are the largest tributaries of the Blue Nile, draining parts of the Ethiopian highlands adjacent to the Abbay Sub-basin. They flow from the Ethiopian highlands above 3,000 masl, and flow northwesterly across the flat plains of Sudan to meet the Blue Nile upstream of Khartoum, at an elevation of only some 120 masl. The River Rahad flows through the northern boundary of Dinder National Park while the Dinder River flows through the center of the park. The catchment area of River Dinder is around 16,000km^2 and has average annual discharge of about 3,000 MCM, while it is 1,100 fro Rahad.

Both rivers are seasonal, beginning the flow season in mid-June and peaking around the middle of August each year, with flow ceasing in November. The sandy riverbed tends to be pooled after flow stops and some of these may retain water throughout the dry season and into the next rainy season.

A defining feature of the Rahad and Dinder rivers is the wetland which contain '*mayas*' or water meadows which vary in area from less than 0.2 km^2 to 4.5 km^2. These are a typical feature of rivers which flow from elevated areas through steep channels which rapidly transform to flat lands. Meandering channels are formed with many oxbows and other low energy characteristics.

- The seven watershed management projects defined in the CRA also apply to Rahad and Dinder Rivers. There are also eight watershed management projects (direct interventions) that have been defined in the CRA for the Sudanese portion of these rivers, which are:
- Arresting soil degradation
- Improving crop production
- Support to rain fed traditional water harvesting systems
- Reducing degradation
- Improving rangeland productivity
- Halting shifting sand dunes reducing drifting sand on to cropland
- Reducing river bank erosion
- Human-induced salinity in irrigated lands

These interventions are not specific to the Dinder or Rahad Rivers, but there are also a series of Supporting Interventions developed through the CRA which are more area specific. For the Dinder and Rahad sub-basins there are two: the 'Sustainable Management and Development: Dinder-Rahad Wetlands' project and 'Support to the Establishment of Dinder-Alatish Transboundary Park'.

4.3.3 Blue Nile Sub-basin

For the Blue Nile, most of the watershed management issues are related to the Abbay Sub-basin and the sediment loads deriving from it, rather than issues on the Blue Nile itself. However, the Gezira irrigation scheme has some significant watershed management or land management related problems.

Under the CRA, there are ten watershed management projects (direct interventions) that have been defined for Sudan:

- Arresting soil degradation
- Improving crop production
- Support to rain-fed traditional water harvesting systems
- Reducing degradation
- Improving rangeland productivity
- Halting shifting sand dunes reducing drifting sand on to cropland
- Reducing river bank erosion
- Human-induced salinity in irrigated lands

These interventions are not specific to the Blue Nile, but there are also a series of Supporting Interventions which are more area specific, including one for the Blue Nile, 'Sustainable Management and Development: Blue Nile Wetlands'.

4.3.4 Main Nile Sub-basin

Most of the watershed management issues in Sudan, with respect to the JMP 1 project area, are on the Blue Nile and the Dinder and Rahad rivers. The CRA does not put forward any specific projects on the Main Nile for watershed management. There are two watershed management projects (direct interventions) that have been defined in the CRA for the Main Nile in Egypt:

- Livelihood support for resettlement around Lake Nasser
- Livelihood support for the Ababda and Bishari communities

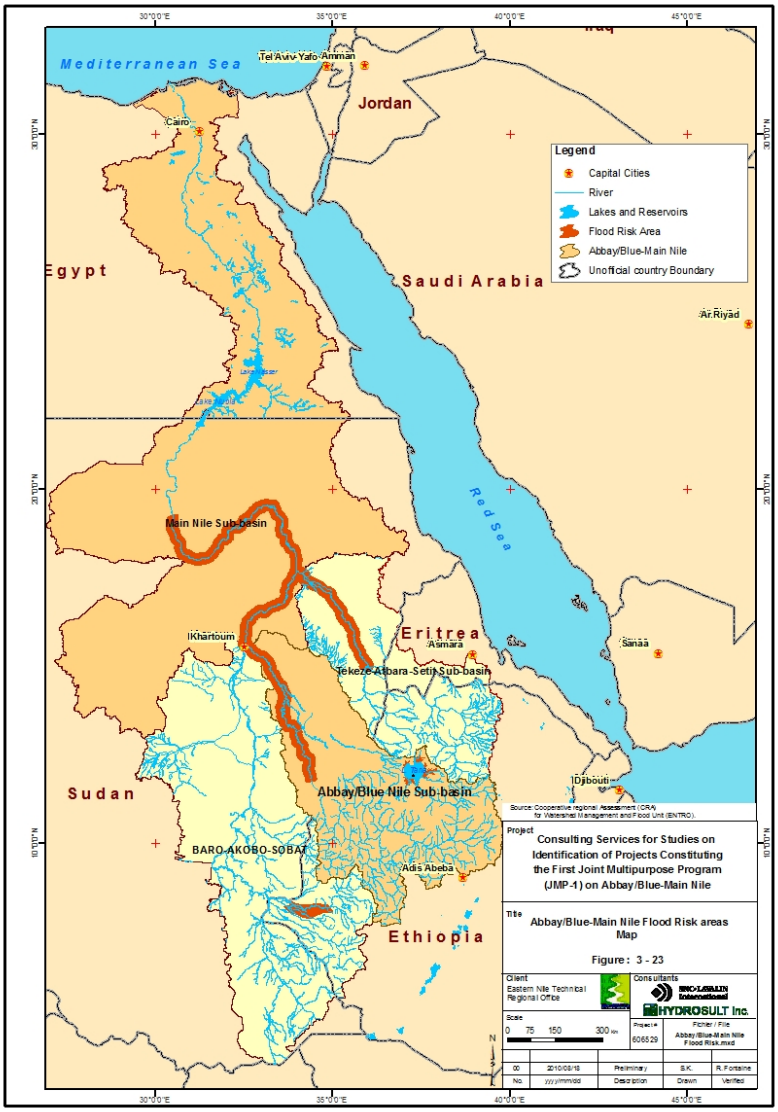
4.4 FLOOD PLAIN MANAGEMENT

Flooding is a mixed blessing as it brings both positive and negative impacts. The negative impacts of flooding are economic, social and environmental. They are mainly related to loss of life of humans and animals, economic costs of damage to assets, costs of desilting the irrigation canals of irrigation schemes, soil erosion and land degradation, damages on plants, change in landscape, and damage to water habitats.

Flood has also a positive impact in supplying siltation as free fertilizers, and also on seasonal wetlands, and support of semi-aquatic habitats that are critical for many species of animals and plants that in turn provide environmental services, for example by supporting spawning areas for fish reproduction.

A large area along the Blue Nile and the Main Nile between Roseires and Dongola is subject to flooding. Figure 4-2 illustrates the area at risk.

Figure 4-2 Location of Flood Prone Areas in the Eastern Nile Region



Adapted from ENTRO GIS database

4.4.1 Abbay Sub-basin

In the Abbay Sub-basin the impacts of flooding are generally minor because most of the population lives on elevated plateaus and not in the deep river valleys, though sporadic flash flooding has been

noted in some areas. The exception to this is around Lake Tana, particularly where flat plains adjoin the lake. Some flooding also occurs on Abbay River tributaries. This also appears to be limited but is locally important as damages affect people of limited means for recovery.

During the project preparation for the FPEW study, recent flooding around Lake Tana was analyzed through surveys of the people. Table 4-7 shows the results of that analysis.

Table 4-7 Recent Flooding in Abbay Sub-basin around Lake Tana

Area (Kebele, Woreda)	People Affected	Event Type	Recent Flood Events
Nabega, Fogera	9,465 (100%) of population (2005 data)	Ribb River and Lake Tana, annual flooding. Flooding has a positive effect for rice production but negative on people's health and access to services	1994, 1995, 1996, 2001
Achere, Dembiya	Several villages, but no population numbers available	Megech river floods annually through the Nededit River.	1998, 1999, moderate flooding
Debir Zebir Adisge, Dembiya	6,450 (2000 data)	Megech River floods annually, sometimes severe	1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005 (severe). River changed course in 1998 and flooding is now severs in most years.
Shina Tsion, Libo Kemkem	16,480 (2005 data)	Ribb River and Shineti River flood annually. Moderate but with severe episodes (1997).	1997, severe
Fasilo, Bahir Dar	300 households in 1998	Annual flooding, mainly due to high rainfall and poor drainage on low lying, swampy ground	1995,1997, 1998, moderate
Sefen Selam, Bahir Dar	2,640 households, 13,200 people in 2001		1995,1997, 1998, moderate
Shimbit, Bahir Dar	270 households, 1,350 people in 2001	Similar to above, located near Gudo Bahir Swamp	2001 Severe
Tana, Bahir Dar	290 households, 1,450 people in 2001		2001 Severe

Source: SMEC, FPEW Project Preparation, Vol. 2 Appendices, July 2006

Some cost figures were also estimated for the 1:100, 1:20 and annual floods for some of the areas affected by flooding, specifically Fogera and Dembiya woredas, as shown in Table 4-8. The report does not discuss how these costs were arrived at. It is not known how many people would be affected at each return period level, but estimating from Table 4-7 above, it is likely to be above 25,000.

Table 4-8 Estimated Flood Damages for Selected Areas in Abbay Sub-basin

Type of Cost	Cost by Flood Magnitude ($US)	
	1:100 yr	1:20 yr
Direct Costs		
Agriculture	9,102,273	3,146,591
Farm residences	1	0
Loss of permanent production through scouring	91,023	31,466

Type of Cost	Cost by Flood Magnitude ($US)	
	1:100 yr	1:20 yr
Direct Costs		
Industry	8,100	1,800
Commercial	115,604	11,344
Housing	10,560,000	3,520,000
Public Facility	155,000	74,000
Recreational	1	0
Vehicle losses	1	0
Total Direct Costs	20,032,003	6,785,201
Indirect Costs		
Temporary accommodation	1,143,000	284,625
Temporary water supply	171,360	64,260
Medical supplies, sanitation, etc.	76,500	38,250
Recovery assistance - food, seeds, etc.	91,800	45,900
Temporary electricity supply	5,040	378
Deployment of emergency services	4,445,000	2,213,750
Gathering food, fuel, water	495,300	123,338
Total Indirect Costs	6,428,000	2,770,501
Total Costs	26,460,003	9,555,702

Source: SMEC, FPEW Project Preparation, Vol. 2 Appendices, July 2006

Floods occurred across Ethiopia in 2006 and were devastating in some areas of the country. The year 2006 has also been cited as a major flood in parts of Sudan. However, no information on flood damages in the Abbay Sub-basin has been located. A paper produced on the 2006 flooding in Ethiopia (Moges, *et al*., 2010) suggests only minor flooding in the Lake Tana area, possibly partly due to the relatively low water levels in the lake since 2001.

Flood Protection and Management

There are no comprehensive flood plain management programs for the Abbay Sub-basin at this time. However, there are some flood protection works included in the currently ongoing feasibility studies for irrigation projects, such as Megech, to protect agricultural land and populated areas from flooding.

Some flood mitigation will also derive from the irrigation projects in the Lake Tana watershed and downstream of Lake Tana. These projects include small storage dams on the Megech, Ribb and Gumera rivers and are upstream of the area of greatest flood risk (Fogera and Dembiya Woredas adjoining the lake). It is uncertain how much impact these projects would have on flooding.

Communities in Ethiopia tend to respond to floods as they occur, doing such things as moving livestock off the lowest flood plain areas at the start of the flood season. Community flood preparedness and response is tied to the more frequent and smaller floods. Larger floods will exceed the experiential capacity of these communities as they are relatively rare, which suggests a need for an outside agency to bring experience to communities in the form of flood preparedness plans.

The Early Warning Department of The Disaster Prevention and Preparedness Agency of Ethiopia is the one organization with experience in dealing with the impact of natural hazards, including recovery from floods, but their planning efforts have so far been mainly directed at the disasters of drought and famine. However, the DPPA did issue flood warnings in 2007 in response to the major floods of 2006.

There is no formal process for recording the impact of previous floods or for estimating and recording what the consequences of future floods of different severity might be. There is no dedicated flood emergency management agency in Ethiopia, and no formal flood emergency planning is undertaken.

At present, no practical flood forecasting capability exists in Ethiopia given the current network. There are few weather stations that can report in real time to the National Meteorological Agency in Addis Ababa. There are no river gauging stations equipped to report in real or near real time to MoWR.

In the Abbay Sub-basin, flood forecasting is more difficult than in the other areas of Ethiopia and in the other Eastern Nile countries because of the shorter lead times following major storms. This is particularly so for the flood risk areas around Lake Tana.

The Ethiopian government has not undertaken any specific structural works to modify flood hazards within the Abbay Sub-basin. The aggravating effects of high lake levels have already been mitigated by recent redevelopment of Chara Chara Weir on the outlet of Lake Tana, and diversions from the lake for the Tana-Beles hydropower project currently under construction should further mitigate the impact of high lake levels on inundation of adjoining flood plains. Future dams being investigated for irrigation developments would modify but not eliminate the immediate downstream flood risk if they proceed.

The Flood Preparedness and Early Warning (FPEW) Project is one of the fast-track projects identified for priority action under the Eastern Nile Subsidiary Action Program (ENSAP) as part of the Nile Basin Initiative (NBI). Flood forecasting models have been developed under the Flood Protection and Early Warning I (FPEW I).

Most actual flood management interventions proposed by FPEW are at country level (though there is a regional subprogram as well). Proposed FPEW interventions are specifically non-structural. Proposals for structural interventions should now await the outcome of the JMP 1 studies, as the flood regime will change dramatically with the dams involved in JMP 1. Table 4-9 shows the FPEW Subprogram Summary for Ethiopia. The implementation of these FPEW flood management programs will be the most comprehensive flood mitigation interventions for the Abbay River sub-basin.

There has been no information identified for flood events of flood damages on the Dinder or Rahad Rivers and they were not included in the FPEW studies. No specific flood plain management interventions have been identified for them.

As for PFEW II, implementation of some activities described in Table 4-9 below is being funded through the Tana and Beles Integrated Water resources Development Project. The activities described for Sudan (Table 4-11), Egypt (Table 4-14) and regional (Table 4-15) have not yet been funded.

Table 4-9 FPEW Ethiopia Subprogram Summary

Item No.	Type of Works	Description
1-E	Flood risk mapping	Lake Tana district. Acquire, analyze satellite imagery for digital topographic data and exposure to flood hazard. Develop DEMs in selected areas, including hydrological and hydraulic analysis. Review Baro-Akobo mapping.
2-E	Network of river gauging and rain gauge stations	>50 rain gauges, almost 30 river gauging stations, assumed rehabilitation of ~15 stations, ~8 new stations, and satellite data transmission. All sites require digital data logging and data transmission equipment.
3-E	Establishment of flood forecasting center in Addis Ababa	Building renovation, IT equipment, communications, development of forecasting models for Ribb, Gumera, Megech and Baro Rivers, training, specialist supervision for 2 years
4-E	Capacity building at DPPA	Guideline procedures and training, new unit for flood emergency response planning

Item No.	Type of Works	Description
5-E	Capacity building at regional and woreda levels	Guideline procedures and training for woreda staff, Lake Tana area (Fogera, Libo Kamkem, Dembiya), NGOs to assist
6-E	Capacity building at MoWR	Training, equipment at H.O. to increase productivity of hydrological data management services, field equipment.
7-E	Capacity building in NMA / MoWR regional offices	Staff training, computers, equipment, communications
8-E	Community education and training for awareness and preparedness	Guidelines for developing community self reliance, training trainers, support for community driven action plans for flood preparedness and self management
9a-E	Flood protection works, Gambella	Preliminary survey and investigations
9b-E		Design and construction of levees, drainage works for urban flood risk areas
10-E	Land management planning	Technical assistance, Bahir Dar

4.4.2 Blue Nile Sub-basin

Flows from the White Nile at Khartoum are relatively stable throughout the year, compared with flows from the Blue Nile, which vary substantially. Flooding at Khartoum and downstream on the Main Nile is therefore generally attributed to Blue Nile flows.

Over the last ten years, heavy flooding was experienced in Sudan in 1998, 1999, 2001, 2002, 2003 and again in 2006. Prior to this period are the severe historic floods of 1878, 1946, and 1988.

Information on flood damages specific to the Blue Nile upstream of and including Khartoum has not been identified. However, Table 4-10 shows a summary of costs of flood damages for the 1:100 year and 1:20 year floods for a total of 196 villages on the Blue and Main Nile.

Table 4-10 Flood Damages for Riparian Villages on Blue and Main Nile

Type of Cost	Cost by Flood Magnitude ($US)	
	1:100 yr	1:20 yr
Direct Costs		
Agriculture	133,750,000	88,275,000
Farm residences	1	0
Loss of permanent production through scouring	1,337,500	882,750
Industry	0	0
Commercial	400,404	40,954
Housing	23,400,000	13,325,000
Public Facility	13,970,000	6,732,500
Recreational	1	0
Vehicle losses	1,137,500	0
Total Direct Costs	173,995,406	109,256,204

Type of Cost	Cost by Flood Magnitude ($US)	
Indirect Costs		
Temporary accommodation	7,137,000	3,568,500
Temporary water supply	6,182,400	2,318,400
Medical supplies, sanitation, etc.	2,760,000	1,380,000
Recovery assistance - food, seeds, etc.	3,312,000	1,656,000
Temporary electricity supply	13,000	1,950
Deployment of emergency services	19,500,000	13,000,000
Gathering food, fuel, water	2,340,000	1,170,000
Total Indirect Costs	41,244,400	23,094,850
Total Costs	215,239,806	132,351,054

Source: SMEC, FPEW Project Preparation, Vol. 2 Appendices, July 2006

It is also understood that there are significant flood damages, especially around the Gezira irrigation area, which is heavily populated and where there is potential for flood damages to crops. Official statistics indicate many homes are damaged or destroyed in larger than average floods. Other impacts include agricultural and livestock losses, increased health problems, damage to water supply and sanitation systems leading to further health problems, bank erosion and others.

Approximately 6 million people reside in greater Khartoum at the confluence of the Blue and White Niles. The annual flood from the Blue Nile impacts Khartoum to some extent almost every year. Hundreds of villages line the banks of the Blue Nile and Main Nile, and because of their proximity to the river banks are adversely affected in years of above average floods. In large floods, lower lying riparian land in Khartoum may also be inundated.

In Sudan the main government organization responsible for flood management are: MoIWR, which looks after river monitoring and flood warning. It is also a member of the National Flood Control Committee. The civil defense department of the Ministry of Interior trains people how to protect themselves and their property from flooding.

They participate with local councils and villages in flood protection works. The State Ministry of Planning works in collaboration with Civil Defense, MoIWR and local councils to prepare for rural protection. It also investigates and develops programs for moving settlements out of the flood plain. The State Ministry of Agriculture, Animals and Irrigation (SMOAAI) is also involved in monitoring losses in agriculture and animals. In Sudan, the Civil Defense Office (CDO) assumes the role of a flood emergency management agency, and the Humanitarian Aid Commission (HAC) coordinate post flood recovery and relief. However, there is no formal process for recording the impact of previous floods or for estimating and recording what the consequences of future floods of different severity might be.

In terms of flood damage mitigation, there are only a few existing interventions. Many riparian villages have developed systems of low levees to provide a degree of protection from flooding during low to average floods. Some villages receive assistance from government or NGOs in these efforts. More formal levees exist in certain urban areas in Khartoum and strategic town levees also exist in Dongola.

One cost estimate for mitigating flood damages along the Blue and Main Niles for a 100-year flood is $US 527 million, and the average annual damage is estimated at $US 52 million (EDF, Scott Wilson, 2007, Border EIA).

The long-planned raising of Roseires Dam appears to be proceeding, but there is no planned change to operating rules, which are aimed at reducing sediment capture and which allow the flood waters to pass up to and through the peak, therefore impact on flooding will be negligible.

Table 4-11 shows the FPEW Subprogram Summary for Sudan (not specific to the Blue Nile, but combined Blue and Main Nile).

Table 4-11 FPEW Sudan Subprogram Summary

Item No.	Type of Works	Description
1-S	Flood risk mapping	Acquire and analyze satellite imagery. Undertake pilot tests. Acquire accurate topographic data. Delineation f inundation extents. Identify exposure to flood hazard.
2-S	Hydrology and Hydraulic Modeling	Hydrology and hydraulics of planning floods to determine planning flood levels.
3-S	New reporting river gauging stations	Assume 3 new stations on Atbara, + 1 replacement cableway + AWLR; 2 new stations on Dinder and Rahad
4-S	New reporting weather stations	15 stations, with new data transmission + 2 laptops to download data from on-site digital data loggers
5-S	Capacity building at MIWR	Reinstate flood forecasting system. Upgrade computer hardware, GIS software, rehabilitate materials testing laboratory.
6-S	Community education and training for awareness and preparedness	Guidelines for developing community self reliance + training trainers, who will then educate / train communities for self reliance and self organization. Support for community driven action plans for flood preparedness and self-management.
7-S	General capacity building for MIWR	Equipment and training to support regional offices and field programs of data measurements. Data management.
8-S	Capacity building at Sudan Meteorological Authority (SMA)	Upgrading SMA facilities – PCs, mass storage devices, software upgrade, training: assume 1 month on site training by 2 specialists.
9-S	Capacity building for CDO	Guideline procedures for CDO + training, at national and state levels. New unit for flood emergency response planning.
10-S	General capacity building at CDO	Equipment, vehicles, communications.
11-S	Capacity building for HAC	Guideline procedures for HAC + training at national and state levels.
12-S	General capacity building at HAC	Equipment, communications. Establish office in Dongola.
13a-S	Flood protection levees, Dongola	Preliminary survey and investigations. Undertake structural, geotechnical audit.
13b-S		Design and construction. Reconstruct flood protection works where necessary.
14-S	Land Management Planning, Khartoum	Technical assistance.
15-S	Investigations of river hydraulics, sediment transport and channel morphology	Program of field sampling, Khartoum rivers – bathymetry, sediment sampling, velocity profiles, materials sampling, etc. Hydraulic modeling of flows and sediment transport, Khartoum.

Item No.	Type of Works	Description
16-S	Pilot study on bank erosion	Investigate and trial appropriate waterway management techniques.

4.4.2.1 Main Nile Sub-basin

Hundreds of villages line the banks of the Main Nile, and because of their proximity to the river banks are adversely affected in years of above average floods.

Flooding on the Main Nile at Dongola will be reduced now that Merowe Dam is in place upstream, though it is expected that the flood mitigation effect of the dam will be minor. This is especially so as, like other dams in Sudan, it is operated to pass the main flood peak so as to minimize sediment deposition, capturing water on the flood recession.

While the annual volume of flows from the Atbara are comparatively minor, the flood peak from the Atbara aggravates flooding along the Nile downstream if they coincide with high flows from Khartoum.

Table 4-12 below shows the estimated costs of flooding for the 1:100 and 1:20 year flood events for Dongola City on the Main Nile in Sudan.

Table 4-13 shows estimated costs for a specific flood event (2006) for Wawassi, a village downstream of Khartoum on the Main Nile. No return period for the 2006 flood was suggested in the report from which this information was derived, but it did state that the damage was similar to estimates for the 1:5 year flood event. The population of the village was 7,000 people, with 1,200 permanent buildings. It was also noted that 97.5% of crops were damaged. It can be seen on Table 2-52 that almost half the total value of damage is attributed to "disruption of commercial and public buildings", which seems unlikely in a small agricultural village. However, the analysis and the table presented here do show that flooding on the Main Nile is disruptive and costly.

Table 4-12 Estimated Flooding Costs for Dongola City, Sudan

Type of Cost	Cost by Flood Magnitude ($US)	
	1:100 yr	1:20 yr
Direct Costs		
Agriculture	1,629,450	725,359
Farm residences	1	1
Loss of permanent production through scouring	16,295	0
Industry	1	1
Commercial	1,900,625	323,438
Housing	7,809,375	1,250,156
Public Facility	3,564,000	877,600
Recreational	0	0
Vehicle losses	1,023,750	170,625
Total Direct Costs	15,943,497	3,347,180
Indirect Costs		
Temporary accommodation	2,882,250	360,281
Temporary water supply	116,480	19,413

Type of Cost	Cost by Flood Magnitude ($US)	
	1:100 yr	1:20 yr
Medical supplies, sanitation, etc.	78,000	13,000
Recovery assistance - food, seeds, etc.	93,600	15,600
Temporary electricity supply	32,080	4,010
Deployment of emergency services	5,250,000	656,250
Gathering food, fuel, water	840,000	105,000
Total Indirect Costs	9,292,410	1,173,554
Total Costs	25,235,907	4,520,734

Source: SMEC, FPEW Project Preparation, Vol. 2 Appendices, July 2006

Table 4-13 Estimated Flooding Costs at Wawassi Village, 2006

Flood Impact	Damage Type	Damage Extent	No.	Unit	Value ($US)
Buildings	Structural	Complete destruction	30	House	41,860
		Recoverable, repair	400	House	41,860
	Contents	Complete destruction	500	House	46,512
	Latrines	recoverable, reinvest	300	House	16,279
	Cleanup		100	Days	41,860
Persons	Injured				
	Dead				
	Disease	Treated	2000	Person	41,860
	Displaced	Temporary	30	Person	41,860
Animals	Dead				13,958
	Disease	Treated	2100	animals	23,256
Commercial & Public Buildings	Disruption			Days	465,120
Farms	Loss of crop	Complete destruction	774	feddans	
		Partial recovery	2000	feddans	93,024
	Cleanup		90	days	
Infrastructure (roads, irrigation)	Structural	Complete destruction	1	km	46,510
		Recoverable, repair	2.5	km	13,954
	Cleanup		15	days	
	Disruption				
Seasonal delay	Shifting of planting time	Complete	30	days	
Total Cost Estimate					**927,913**

Source: adapted from SMEC, FPEW Project Preparation, Vol. 2 Appendices, July 2006

In Sudan, many riparian villages have developed systems of low levees (terraces) to provide a degree of protection from flood hazard during low to average floods. Some villages receive assistance from government or NGOs in these efforts. More formal levees exist in certain urban areas in the Sudan, particularly in Khartoum. Strategic town levees also exist in Dongola.

The Flood Preparedness and Early Warning (FPEW) Project has identified specific programs for the Main Nile in Sudan. These are presented above in Table 4-11, combined with the same for the Blue Nile.

In Egypt, although flash flooding still presents problems in some areas, the existence of the Aswan High Dam has reduced flooding problems. However, it has not eradicated them entirely. A series of high flood years between 1998 and 2001 required high rates of release from the dam and it was found that rates of release in excess of about 250 MCM/d to 260 MCM/d did cause problems, including inundation of island used for agriculture and of other encroaching development on the flood plain.

Table 4-14 shows the FPEW Subprogram Summary for Egypt. The FPEW also has a Regional Component. The proposed programs with a regional outlook are shown in Table 4-15.

Table 4-14 FPEW Egypt Subprogram Summary

Item No.	Type of Works	Description
1-EG	Upgrade NFC	Upgrade computer equipment, software, training
2-EG	Studies related to flood forecasting	Studies to determine effectiveness of improved flood forecasting procedures, related to AHD operations.
3-EG	Revise flood forecasting procedures	When expanded data network comes on line.
4-EG	Assistance with flood risk mapping	Technical assistance and study tour.
5-EG	Sediment transport modeling of pilot reach	Technical assistance for field sampling program and sediment transport modeling.
6-EG	Land use management	Technical assistance for pilot Land Use Management Plan in flood risk area, and study tours.

Table 4-15 FPEW Regional Subprogram Summary

Item No.	Type of Works	Description
1-R	Management unit support for ENTRO	Capacity building, funding support for RFCU
2-R	EN flood management interest group in NBCBN	Facilities, management, travel budget over 5 years, website establishment.
3-R	Annual conferences	Annual post flood conferences, biennial technical conferences – travel, accommodation, venues, etc.
4-R	Special topic seminars	Travel, accommodation, venues, etc. over 4 years for 3 seminars with 8 participants from each country.
5-R	Joint study tours	Assume 20 persons: fees for institutions providing time / services.
6-R	Visiting specialists	Assume 6 persons.
7-R	Joint studies	Assume 4 joint projects.

4.5 SUMMARY OF WATER RESOURCES DEVELOPMENT

The Eastern Nile has a significant water resource in the Nile River and its tributaries, but increasing regional population and industrializing economies are placing ever greater demands on it.

The water resource and water use vary widely across the Eastern Nile basin. Ethiopia has by far the greatest input to the water resource, with an annual average flow of some 52,839 MCM from the Abbay River alone. There are also significant contributions from the Tekeze River and the Baro-Akobo River system, as well as the Dinder and Rahad rivers.

Consumptive water demands in Ethiopia are comparatively low, with limited irrigation development compared to the other two countries. Current large scale irrigated area in the Abbay sub-basin is only just over 6,000 ha, with the development of a further 6,000 soon to be completed. Small scale irrigation around Lake Tana may be as high as 25,000. There are plans for expansion of irrigation by as much as 350,000 ha, but even if this was fully developed it is small compared with the irrigation development in Egypt and Sudan.

The Blue Nile has irrigation developments totaling over 1 million ha at present and proposes an expansion of some 420,000 ha. On the Sudan Main Nile, there are about 200,000 ha of irrigation on the Atbara tributary and the Merowe irrigation area.

The area around Lake Nasser / Nubia expansion plans for irrigation total more than 1.5 million ha. On the Egyptian Main Nile there are currently about 1.8 million ha of irrigated land.

Hydropower development remains limited on the Nile. On the Ethiopian Nile, the total is only just over 600 MW of production on the Abbay and its tributaries, and a further 300 MW on the Tekeze, On the Blue Nile in Sudan there is currently less than 300 MW of production. On the Sudanese Main Nile, Merowe Dam recently came on line with a production capacity of 1250 MW. Several other developments are being considered with a possible near future increase of 640 MW. The largest development is the High Aswan Dam with a capacity of 2,100 MW. This makes a current total for the JMP 1 area of study of just over 4,000 MW. The JMP 1 project could more than double this total.

Flooding is a relatively frequent event on the Nile. In Ethiopia flooding causes only limited damage and is not considered a major issue. The Blue Nile in Sudan is the area of main concern, especially around Gezira and in Khartoum. Many towns and villages downstream of Khartoum on the Main Nile experience frequent, damaging flooding. Downstream of Aswan, flooding has been essentially eliminated by the construction of Aswan High Dam. So far an accurate quantification of flood damages has been elusive, but it is known to be damaging and disruptive to agriculture, commerce and other forms of livelihood and economic activity.

Another main issue regarding water resources is the transport and deposition of sediment. In short, deforestation and poor land management practices in the Ethiopian highland area of the Abbay sub-basin cause massive soil loss which ends up as sediments in existing reservoirs and in irrigation schemes in Sudan and in Lake Nasser / Nubia. Part of the JMP 1 program is to tackle this problem through watershed management, focused in the Abbay sub-basin. The proposed dams themselves will also act as sediment traps, reducing the problems associated with sediments downstream. While it can be argued that this merely moves the problem to Ethiopia, the configuration of the reservoirs have a greater capacity for capture, with less economic impact, than do Roseires, Sennar, Merowe and other such structures.

5. STRATEGIC LEGISLATIVE AND INSTITUTIONAL BASELINE

5.1 ROLE OF INSTITUTIONAL ASSESSMENT FOR SSEA

The SSEA team has identified a series of national and transboundary institutional issues that will impact and be impacted by the development and implementation of JMP 1. A clear set of institutional parameters with appropriate national institutions for this project will be a key element in the successful development and sustainable implementation and operation of the JMP 1. *To date, there are only nascent existing transboundary institutional structures specifically to guide JMP 1 development, implementation and operation, and therefore the countries must address this need within the context of sustainable transboundary institutional cooperation.*

At the national level, the baseline of existing national and sub national structures, institutions, and legal instruments will serve to guide the formation of an institutional body for JMP 1, in concert with the existing transboundary institutions and organizations. Section 5-2 outlines the baseline of the primary contact institutions within each government, and will address other related institutions, policies, plans and programs affiliated with the potential development of JMP 1. While this list will not be exhaustive, it is intended to present the institutional context within each country as it most directly pertains to management of the Nile Basin and Eastern Nile in particular.

Within the Eastern Nile Basin exists a long and thriving tradition of bilateral transboundary agreements and efforts that can set the precedent for JMP 1. There is a long history of transboundary cooperation ranging from shared natural resources to economic development and energy trade. Section 5-3 will provide a summary of these bi-lateral agreements within the context of broader regional cooperation and intersectoral development efforts. This section will place the potential institutional development of the JMP 1 arrangements within the existing historical tradition and existing baseline of transboundary collaboration. The baseline foundation of multi-sector Egyptian-Ethiopian, Ethiopian-Sudanese, and Egyptian-Sudanese bi-lateral cooperation provides the linkages for building and strengthening the institutional structures for potential JMP 1.

The Eastern Nile countries have expanded the tradition of bilateral cooperation to include broader regional institutions. Section 5-4 examines the existing baseline regional organizations, as they currently exist. The organizations examined here have existing institutional structures specifically related to the potential JMP 1. These include the Nile Basin Initiative, Eastern Nile Technical Regional Office, East African Power Pool, and Common Market for East and South Africa. These will be examined within the baseline context to identify current functions.

The broader existing international agreements for environmental management, transboundary cooperation and sustainable development are outlined in Section 5-5. These international agreements provide a wider international context for cooperation between the Eastern Nile countries, and will be relevant to the potential implementation of JMP 1.

The international safeguard policies for funding organizations are reviewed in Section 5-6. These are intended to provide a summary of the requirements of the donor community, and to identify the specific triggers within the JMP 1 of the various safeguards.

5.2 NATIONAL POLICIES AND INSTITUTIONS

The baseline national institutional structures and policy mechanisms exist currently and provide national level management of existing Nile issues. In each country there is a primary institution charged with management of Nile issues, these organizations coordinate with other institutions in order to optimize policy coordination and multi-sector uses of the Eastern Nile/Nile Basin. This section describes the primary national institutions, coordinating sectors, including those related to transboundary management of resource, and development policies which are dependent on Nile issues. A more detailed review and assessment of the capacity of national level institutions is needed in subsequent phases of for planning for JMP 1.

5.2.1 Ethiopian National Policies and Institutions related to JMP

The primary institution in Ethiopia pertaining to the Nile River (referred to as the Abbay River in Ethiopia) is the Ministry of Water Resources. Within the Ministry of Water Resources several offices deal specifically with issues pertaining to JMP 1. The Basin Development and Implementation Supervision Department oversees the development schemes for the Abbay sub-basin. The Boundary and Transboundary River Affairs Department within the Ministry of Water Resources provides diplomatic government representation for agreements between countries within the basin.

The Ministry of Water Resources has the mandate to undertake studies pertaining to the utilization of the waters of transboundary rivers and upon approval, follow up the implementation of same; and to sign international agreements relating to transboundary Rivers in accordance with the law.

The management of water resources at the national level is carried out by the Ministry of Water Resources (MWR) and is responsible for:

- Formulating policies, long-term strategies and generic standards.
- Coordinating projects and their funding together with leasing with foreign donor agencies.
- Legislating for the utilization and protection of water resources.
- Allocating water between regional governments.
- Providing technical assistance and advice to the regional governments within Ethiopia.

The 2001 National Water Strategy of the Ministry of Water Resources emphasizes the Shared Vision Program of the NBI, with a strong emphasis on the development of hydropower capacity within Ethiopia in collaboration with downstream countries of Egypt and Sudan. Within the Strategy there is the objective to:

- Develop and enhance capacity in trans-boundary negotiations and conflict resolution.
- Actively participate in the Nile Basin Initiative.
- Assess and identify trans-boundary issues that require co-operation, and develop strategies to address these issues.
- Establish a National Consultative Group on trans-boundary issues.
- Raise public awareness about trans-boundary issues. (Ethiopian National Water Strategy, 2001, *http://www.mowr.gov.et/index.php?pagenum=10&pagehgt=1000px)*

Planning is done at the River Basin level, of which Ethiopia has 8 functional (non-dry) River Basins. It is believed that there is potential for irrigation development within Ethiopia, though this is at the earliest stages and irrigation efforts remain at the project level within the Ministry of Water Resources.

Also, critical to the JMP 1 is the Ministry of Electricity and specifically the State Enterprise for power The Ethiopian Energy and Power Company (EEPCO). This organization is responsible for investments, reports to the Minister and a Board of Directors, and provides studies and annual reports on activities to the government, but is largely independent as a functional body. EEPCO provides support to the government for the creation of electricity including meeting the increase in demand for energy and implementation of projects, including hydro electric management. The mandate of the EEPCO stems from the Prime Minister's declaration that Ethiopia will become a source of significant amount of electricity in Eastern Africa as part of the regional organization the East African Power Pool.

Pertaining to issues for JMP 1, the Prime Minister plays an active role, meeting with government representatives from other Eastern Nile Countries, as does the Minister of Water Resources.

The legal basis for national legislation related to the JMP 1 and to Transboundary water management in the Eastern Nile Basin, is based on the following legislation:

- Ethiopian Constitution

- All federal and regional laws originate from the Constitution of the Federal Democratic Republic of Ethiopia, issued in August 1995
- Water Resources Development and Management
- Energy Policy issued in 1994
- The Ethiopian Water Resources Management Policy
- Water Sector Strategy
- Water Sector Development Program (2006-2016)
- National Proclamation on Water Resources Management
- Water Resources Management Regulation
- Basin Organization Proclamation
- Water Resource Management Policy in 1999
- Socio-economic Development and Land legislation
- Agricultural Development Led Industrialization (ADLI)
- Plan for Accelerated and Sustainable Development to End Poverty (PASDEP)
- Food Security Strategy
- Millennium Development Goals
- Legislation on Expropriation of Land and Compensation - Proclamation No. 455/2005 on Expropriation of Land for Public Purposes & Compensation
- Legislation on the Preservation of Culture - Proclamation No. 209/2000-The Research and Conservation of Cultural Heritage of Ethiopia
- National Agricultural Resource Policy and Strategy issued in 1993
- Rural Development Policy and Strategy issued in 2002
- Sustainable Development and Poverty Reduction program issued in 2002
- Sectoral Policies and Strategies
- National Population Policy issued in April 1993
- National Policy on Women issued in March 1993
- Environment
- Environmental Policy of Ethiopia
- Environmental Impact Assessment Proclamation
- Environmental Pollution Control Proclamation
- Establishment of Environmental Proclamation
- Conservation of Wildlife Proclamation (Proc. No. 541/2007)
- Policy on Biodiversity Conservation and Research issued in April 1998
- Environmental Guidelines
- National Biodiversity Strategy and Action Plan
- Wildlife Policy

For a detailed treatment of the legislation listed here please refer to the Appendices.

5.2.2 Sudanese National Policies and Institutions related to JMP 1

In Sudan the primary institution related to JMP 1 is the Ministry of Irrigation and Water Resources. Within the Ministry exists an office of Nile Basin Affairs, though the Nile activities are spread

throughout the Ministry, much as it is throughout the other countries. The representation for Sudan to NBI and ENTRO stems from the Ministry of Irrigation and Water Resources.

The Nile Water Department within the Ministry of Irrigation and Water Resources has the following objectives: co-operation with Nile Basin countries and regional, national organization in order to develop water resources and efficient utilization without prejudice to another basin countries and helping in developing schemes of increasing surface water resources. This office is responsible for co-operation with regional, national organization in order to develop and renew of monitoring methods and increasing of yield and decreasing of losses, and setting up of budget proposal and expend from approval budget according to financial principles.

The Nile Water Department Directorate conducts monitoring of Nile water resources and its tributaries and working on developing and renewing of monitoring methods as main resources to develop agriculture, navigation and generating energy and provides support for efficient utilization and optimum benefit of water resources to supply agriculture needs and increasing of electric generation; providing of other water resources to full fill the development needs in its different fields. They also establish and operate hydraulic stations to monitor discharges and level for River Nile and its tributaries and collect and analyze wedged silt in water and operate hydraulic stations to monitors the losses; analyze hydraulic data in order to estimate Nile yields and its different, seasonal, annual tributaries the quantities and losses; provide forecasts and flood management; determine increasing Nile river yield schemes and its tributaries and other river, and storage schemes for irrigation and generating energy and determination the ways of exploitation of water resources.

Within the Ministry of Irrigation and Water Resources, the Office of the General Directorate of Planning has the mission to contribute to the strategic planning in international, regional, and bilateral cooperation projects in the field of water resource uses and its development. This includes support for environmental standards for new projects to ensure international standards are adhered to. This body also coordinates with federal ministries departments, conducts economic and technical feasibility studies, and coordinates with state departments.

The General Directorate for Irrigation Operations is closely linked to the JMP 1 development, as they are responsible for the oversight, coordination, expansion and efficient utilization of irrigation schemes with the Ministry of Agriculture.

The General Directorate of Dams also closely links the Nile issues and JMP 1 in particular, as they oversee the hydroelectric production for Sudan, as well as work to manage flooding concerns and support irrigation.

Additional sectors active in Nile management include the Ministry of Agriculture, Civil Defense management for flood control and mitigation, Ministry of Transportation, and Ministry of Social Development.

The legal basis for Nile management, are based on the following legislation:

- Sudanese Constitution
- The 2005 Interim National Constitution (INC) of the Republic of the Sudan aims to address issues of environmental and social justice, wherein Chapter II: Guiding Principles and Directives, Section 11 on Environment and Natural Resources
- Water Resources Development and Management
- Ministry of Health Act (1975) which prevented the drainage or throwing any substances (solid or liquid harmful or likely to be harmful to human and animal's health into any drinking water source
- Criminal Act 1991. According to article 70 (1&2), people who cause pollution to any source of water shall be punished with imprisonment for a term not exceeding three years
- Water Resources Act 1995
- National water corporation Act 1995

- Environmental Health Act 1997
- Groundwater Act 1997
- Environment protection Act 2001
- Sudan constitution 2005, which provides the right to a safe and hygienic environment
- Consumer protection court
- The National Comprehensive Strategy 1993/2002
- Environmental Health Act 1997
- Socio-economic Development and Land legislation
- Land Acquisition Ordinance 1930
- Unregistered Land Act 1970
- Legislation on Preservation of Cultural Heritage -The Antiquities Ordinance of 1905, 1952 and the Antiquities Protection Act 1999
- Environment
- National Plan for Environmental Management (NPEM) in post-conflict Sudan, developed by the Higher Council for Environment and Natural Resources (HCENR)
- The Sudan Environmental Protection Act is the basic environmental law in Sudan.
- Environmental Impact Assessment - Sudan Environmental Protection Policy Act
- Environmental Health Act 1975, the Public Health Act 1975
- Electricity Act 2001
- Wildlife Protection and National Parks Act 1986
- Forestry Act 1989, Forests and Renewable Natural Resources Act 2002

For a detailed treatment of the legislation listed here please refer to the Appendices.

5.2.3 Egyptian National Policies and Institutions related to JMP 1

The primary institution for Nile Basin issues is the Ministry of Water Resources and Irrigation. Within this Ministry exists the Nile Water Sector that houses the Central Department for Nile Control, and the Central Department of Egyptian Irrigation in Sudan. The Nile Water Sector is the institutional location of the Nile Basin Initiative National Focal Point.

Within the Ministry of Water Resources and Irrigation is also the National Water Research Center, which houses the Nile Research Institute formerly the Institute for the Study of Impacts of the High Aswan Dam. The coordination between these organizations represents the Egyptian Government for Nile issues in technical matters. The Focal Point for the JMP 1 is located within the Nile Sector Office with close ties to the National Water Research Institute.

For capacity building nationally and throughout the region the Regional Center for Training and Water Studies that contributes to different programs of capacity building in the field of integrated water resources management, water engineering, environment and water-related sciences that meets the needs of professionals, engineers and technicians, in Egypt, as well as the Arid and Semi-arid zones and African countries. Within this organization, the Nile Basin Training Program of the NBI exists, with initial support from UNESCO.

The Ministry of Water Resources and Irrigation has the Public Authority for Aswan High Dam and Aswan Reservoir. This Authority has the responsibilities of: operating and maintaining the High Dam and Aswan Dam; monitoring water levels upstream and downstream the High Dam; monitoring water levels in Lake Nasser; studying and executing all supplementary projects necessary for the High Dam and Aswan Dam; and, monitoring and studying earthquakes in Aswan region.

The Mechanical and Electrical Authority of the Ministry of Water Resources and Irrigation coordinates with the Ministry of Electricity for the management of releases of water within the hydropower dams on the Nile to meet both electrical and water needs throughout the country.

The Irrigation Authority within the Ministry of Water Resources and Irrigation coordinates with the Ministry of Agriculture, and houses the Nile Protection Sector, which monitors water quality used for irrigation purposes. Within the Ministry of Environment, Egyptian Environmental Affairs Agency There is a Central Department for Water Quality Monitoring that monitors Nile Waters to enforce compliance with national pollution laws. The Ministry of Health monitors potable water quality.

The Ministry of Water Resources and Irrigation coordinates with other relevant Ministry sectors for the development of long terms planning. These include (*inter alia*) Ministry of Agriculture and Land Reclamation, Ministry of Electricity and Energy, Ministry of Environmental Affairs and Ministry of Health, Ministry for Economic Development, and Ministry of Finance. The coordination spans long-term planning for water dependent development based on the Egyptians very high level of dependence on the Nile.

For transboundary management issues the Ministry of Foreign Affairs often plays a critical role through the Office for Nile Basin Country Affairs. This office provides critical support with regards to transboundary agreements and creation of formal bilateral, transboundary institutions.

The high sensitivity and dependence on Nile water in Egypt leads to the Office of the Prime Minister, Cabinet of Ministers, Office of the President and the Ministry of Defense and Military Production to actively monitor developments pertaining to the Nile River.

The legal basis for Nile management, are based on the following legislation:

- Water Resources Development and Management
- Law 12 for the year 1984 for the Irrigation and drainage, and
- Law 213 for the year 1994 for farmer participation and cost sharing.

Among the laws and decrees for environmental protection are:

- Law 93 for the year 1962 for the discharge to open streams and its modifications for the years 1962, 1982, and 1989,
- Law 27 for the year 1978 for the regulation of water resources and treatment of wastewater,
- Law 48 for the year 1982 Regarding the protection of the River Nile and waterways from pollution,
- Law 4 for the year 1994 for Environment Protection
- National Water Policy
- Law 48/1982 and Decree 8/1983 - specifically deals with discharges to water bodies.

Laws specific to Environmental Impact Assessment are under the Egyptian Environmental Affairs Agency of the Ministry of Environment. These include:

- Environment
- Law 4/1994 Through Law 4 of 1994, the EEAA is the authority responsible for preparing legislation and decrees to protect the environment in Egypt.
- Environmental Impact Assessment Measures concerning the assessment of Environmental Impacts are stipulated in articles no. 19, 20, 21, 22, 23, 70, 71 and 73 of the environmental protection law 4/1994.
- Biodiversity National Legislation Law 53 of 1966 (also known as “The Law of Agriculture”).
- Ministerial decree 28 of 1967
- Ministerial decree 349 of 1979
- Ministerial decree 66 of 1982;

- Law 48 of 1982
- Law 102 of 1983
- Law 101 of 1985
- Law 4 of 1994

For a detailed treatment of the legislation listed here please refer to the appendices.

5.2.4 National Institutional Water Quality Monitoring Frameworks

Although all the countries of the Nile Basin have put in place some kind of institutional and policy arrangements to address water issues, water quality management in the Eastern Nile basin and in the Nile basin as a whole faces numerous difficulties they lack the adequate instruments, such as standards and regulations, to translate into concrete actions and outcomes the policies and Strategies. Egypt, Ethiopia and Sudan have designated similar ministries, policies, strategies and regulations in place. They also have varying technical know-how to draw up programs and other implementation and enforcement instruments, but their efforts are hampered often by lack of funds and weak enforcement (NBI-NTEAP, 2007).

Enforcement

According to NBI-NTEAP (2007) all the countries have the legislation to enforce waste water treatment water, standards and regulations although the quality of this legislation varies from one country to another.

In Ethiopia, the Environmental Protection Authority (EPA) is also responsible for the development of policies and laws among other necessary to prevent pollution of water bodies. EPA is also responsible for overall inspection of the implementation of the water quality laws and standards and to prepare the state of environment, which include the quality of the country water resources, in collaboration with other key stakeholders (proc.295/2002). Similarly, regional environmental agencies undertake the same task in their respective regions. The Environmental Policy of Ethiopia provides a comprehensive guidance to water resources management and pollution control. In Ethiopia, Environmental Impact Assessment proclamation (proc.299/2002), Pollution control Proclamation (proc, 300/2002), Solid waste Management Proclamation (proc. 513/2007), pollution control regulation and draft industrial effluents standard are key legal instruments pertaining to water quality management.

The management of water resources at the regional level is carried out by sector institutions such as: Energy Resources Development, Mines, and Water Resources Development Bureaus.

According to NBI 2005, there are no central government laboratories responsible for monitoring the Nile, though there are five regional laboratories, which can undertake limited analysis. Additionally, there was no water quality monitoring program for the Nile Basin in the past. However, according to Mr. Solomon, Head of the Laboratory service of at Water Works Design Enterprise, its Laboratory is currently a nationally designated laboratory for water quality monitoring in Ethiopia.

In Sudan, there are over 16 acts covering Water Management. The Natural Water Directorate reports to The Ministry of Irrigation and Water Resources (MoIER) and is responsible for:

- Groundwater and Wadis Directorate (GWWD),
- The Nile Water Directorate

The main laboratory is the Groundwater and Wadis Directorate (GWWCL) Central Laboratories established in 1989. According to NBI (2005) the GWWCL takes regular water quality monitoring samples, three times a year from three sites along the Nile:

- Blue Nile (Soba),
- White Nile (Malakal),
- Nile (Dongola).

In Egypt, the first comprehensive environmental legislation controlling disposal of wastewater in the Nile and canals is Law 93, which was put into force in 1962. In addition, Law 48 of 1982 on the "Protection of the River Nile and Water Ways from Pollution" established stringent effluent standards for various organic and inorganic pollutants. Lack of proper funds for treatment of industrial wastes and for providing adequate municipal wastewater treatment plants, has hindered, so far, the full enforcement of the law (NBI, 2005). The protection of the water environment from pollution represents one of the important priorities of Ministry of State for Environmental affairs (MSEA) and its executive institution the Egyptian Environmental Affairs Agency (EEAA). The Ministry of Water Resources and Irrigation (MWRI) is the central institution for water quality management and for formulating the national water policy for resolving the problems of water scarcity and water quality deterioration. The Nile Research Institute (NRI) which has been responsible for maintaining a national water quality monitoring network since 1976 including the River Nile and Nasser Lake and contracts portions of the monitoring activity to other institutes but reports to the MWRI. The main reference laboratory for MWRI is the Central Laboratory for Environmental Quality Monitoring (CLEQM), which and performs the analysis for main parameters in water together with algae, heavy metals and pesticides.

5.3 BILATERAL INSTITUTIONS – TRANSBOUNDARY INSTITUTIONS

It should be recognized that that some of these bilateral agreements are controversial as they may be not recognized by the countries not having signed them.

The current baseline of bilateral and transboundary institutions in the Eastern Nile pertain to a wide array of topics. Bilateral agreements related to co-management of the Nile exist historically, and continue to develop. The presence of bilateral agreements, memoranda of understanding and joint cooperation activities reflects an increasing interdependence and economic integration across the region emphasizing cooperation between countries. These bilateral agreements are enhanced by tripartite and regional agreements focusing on increasing trade mechanisms, investments, infrastructure development, and social linkages between the countries.

Table 5.1 provides an overview of sample historical and current bilateral agreements between Egypt – Ethiopia, Ethiopia – Sudan, and Egypt – Sudan. These agreements reflect the tone and cooperative institutional traditions emerging in the region, as they pertain to co-management of the Eastern Nile, and realization the economic importance of establishing ties between countries. This list is not exhaustive, but rather reflects the nature of these ties.

Table 5-1 Some Bilateral Agreements

Sample bilateral agreements	
Egypt - Ethiopia	
Framework for General Cooperation between Egypt and Ethiopia in 1993	The first bilateral framework for cooperation signed between Egypt and Ethiopia regarding the Nile issues, after the colonial period. It stipulated that future negotiations between Ethiopia and Egypt, with respect to the utilization of the water of the Nile, would be based on the rules and principles of international law. The agreement was catalytic to improving relations between the two countries. With respect to Nile waters, the Framework underlines the following: • Neither country should engage in activities detrimental to the other's interests. • Nile waters should be protected. • International laws should be respected. • Both countries should consult and cooperate on implementing projects to increase the flow and reduce the waste of Nile waters. This non-binding framework agreement was signed under the Ethiopian transitional government.
Memorandum of	Bilateral commitment to enhance the trade and investment ties between the

Sample bilateral agreements	
Understanding creating Ethiopia-Egypt Council of Commerce December 2009	two countries, including agriculture, industrial development and trade (protecting and encouraging investments); new agreements were signed to address double taxation avoidance and removing obstacles to trade. The agreement includes multiplying the amount of frozen meat and living cattle imported from Ethiopia. This Memorandum of Understanding was agreed under the terms that include the construction of three medium sized dams on the Eastern Nile Basin to generate electricity for industry as long as it does not affect Egypt's Nile water quota.
Memorandum of Understanding on 20 sectoral points, March 2010	The Ethio-Egyptian Joint Ministerial Commission signed cooperation agreements in the areas of agriculture, trade, health, transit of live animals and beef meat, economic development, information science, technology, education, air service, media and communications among others. The agreement increased trade partnership projects with Egyptian investors significantly boosting the economic relations of the two nations and enhancing trade relations of the two countries by encouraging Egyptian investors to Ethiopia.
Ethiopia - Sudan	
Treaty between Britain and Ethiopia in 1902	This was signed on May 15, 1902, between Britain, representing the Sudan, and Ethiopia, to determine the boundary between Ethiopia and the Sudan. It also contained a provision relating to the water of the Nile. Ethiopia agreed, under Article III of the agreement, not to construct or permit construction on the Blue Nile and its tributaries, of any works that would arrest their flow, without the prior agreement of the government of Britain. (Interpretation of the treaty, and translation concerns not fully resolved)
Memorandum of Understanding on General Cooperation, Communications and Transportation, 2003	This agreement builds on prior un-specified agreements and MoUs between Sudan and Ethiopia, including those on general cooperation, communications and transportation, and specific to power trade agreements
Memorandum of Understanding on Free Trade Area between Ethiopia and Sudan, 2010	Relations between Ethiopia and Sudan continue to emerge as strong interrelated partnerships. There has been a recent series of Memoranda of Understanding pertaining to economic, social and infrastructure development, diplomatic ties, and measurement standards. The intention is to increase the work toward creation of a "free trade area" between Ethiopia and Sudan. (Redi, 2010)
Ethiopia-Sudan Transmission Interconnection	Facilitate, through high voltage transmission line, cross-border power trade between Ethiopia and Sudan, and thus optimize utilization of existing and planned generation capacity
Egypt - Sudan	
Nile Water Agreement in 1929	This was concluded between Egypt's then Prime Minister Mohammad Mahmud and the British High Commissioner Lord George Lloyd. The agreement took the form of two letters dated May 7, 1929 and a report by the Water Committee. Britain signed the agreement on behalf of Sudan, Uganda and Tanganyika (present Tanzania), the three of which were countries under British occupation. The most prominent stipulations were that: • Without the prior agreement of the Egyptian government, no works, either for irrigation or power generation purposes, and no arrangements of any kind should be attempted affecting the Nile, its tributaries or the lakes where it originates in Sudan, or in the other countries under British occupation.

Sample bilateral agreements	
	• No works and/or arrangements were allowed that could reduce the amount of water reaching Egypt, change the date on which it was due or lower its levels in any way that would be harmful to Egypt. • Egypt's natural and historical rights to waters of the Nile were protected under the agreement.
Egypt and the Sudan Nile Agreement in 1959 (*Also referred to as the Nile Water Treaty of 1959, or the '59 Agreement*)	Signed by Egypt and Sudan in November 1959, it ensures Egypt's right to 55.5 billion meters^3 of water a year as well as Sudan's right to 18.5 billion meters^3. The two countries also agreed to the establishment in Egypt of the Aswan High Dam and in Sudan of Roseires reservoir on the Blue Nile. Egypt and Sudan moreover agreed to a number of projects which aim at reducing water wasted in Bahr al-Jabal, Bahr al-Zaraf, Bahr al-Ghazal, the Sobat and the White Nile. Any losses from upstream developments would be split 50/50, as would any net gains in water quantity. Under the Agreement, an organization (The Nile Water Authority) was established jointly by Egypt and Sudan to handle Nile water issues, both operate within each country Ministry of Water Resources and Irrigation (Egypt) and Ministry of Irrigation and Water Resources (Sudan) Established the Permanent Joint Technical Commission for Nile Waters (PJTC)
Agreement promoting political and economic integration, 1974	Signed by both Presidents to support integration between countries and enhance trade
Egyptian Sudan Integration Scheme, 1982	Established: • The Supreme Council for Integration, • The Nile Valley Parliament, and • The Egypt-Sudan Integration Fund
Multiple Trade Agreements (1993 - 2003	A trade exchange protocol (signed March 1993) An agreement (signed November 2003) whereby Egypt would import frozen meat from Sudan; Agreement on facilitating the purchase of Sudanese camels by Egypt; and, Agreement on the establishment of a free trade zone in Juba
Joint Projects (ongoing)	A number of joint projects are being implemented in the fields of transport, roads and irrigation. The most important are: • The Coastal Egypt-Sudan Highway. • The Aswan-Wadi-Halfa-Dongola Highway. • Developing and restructuring railroads to facilitate the movement of individuals and commodities. • Extending the electricity grid to north Sudan. • Cooperating in the area of water resources and reviving the Jonglei Canal project. • Clearing the southern part of the River Nile. • Developing Sudan's irrigation and sewage network.

This is only a sample of the bilateral agreements in place. Further exploration of these and other bi-lateral agreements will enable the countries to more accurately place the institutional arrangements for the JMP, as it evolves, within the existing context of ongoing regional cooperation.

5.4 REGIONAL INSTITUTIONS

Throughout the Eastern Nile region, and beyond there are a number of key regional institutions that currently set a baseline for the region in which a potential JMP 1 would be established. These existing baseline institutions include the Nile Basin Initiative (NBI), the Eastern Nile subsidiary organizations of the NBI, including the Eastern Nile Conference of Ministers (ENCOM) Eastern Nile Technical Regional Office (ENTRO), ENSAP, JMP 1 Regional Parliamentary Committee. Also included in existing regional institutions is the ongoing Water Quality Monitoring Project established under the NBI Environment Program, and the Shared Vision Program. Broader regional institutions related specifically to a potential Eastern Nile JMP 1 include the East African Power Pool, and the Common Market for East and South Africa. Egypt, Ethiopia, and Sudan are all members of these organizations, and actively participate on a regular basis. This section will review the function of these institutions, as they currently exist. Pending challenges pertaining identified gaps and future demand on these organizations are addressed in Chapter 6 of this report.

5.4.1 The Nile Basin Initiative

The Nile Basin Initiative (NBI) is a partnership initiated and led by the riparian states of the Nile River through the Council of Ministers of Water Affairs of the Nile Basin states (Nile Council of Ministers, or NILE-COM). The NBI seeks to develop the river in a cooperative manner, share substantial socioeconomic benefits, and promote regional peace and security. The NBI started with a participatory process of dialogue among the riparians that resulted in their agreeing on a shared vision—to "achieve sustainable socioeconomic development through the equitable utilization of, and benefit from, the common Nile Basin water resources.

The current members of the Nile Basin Initiative are Burundi, D.R. Congo, Egypt, Ethiopia, Kenya, Rwanda, Sudan, Tanzania, and Uganda.

The Nile Basin Initiative was formally launched in February 1999, the initiative provides an institutional mechanism, a shared vision, and a set of agreed policy guidelines to provide a basinwide framework for cooperative action. The policy guidelines define the following as the primary objectives of the NBI:

- To develop the Nile Basin water resources in a sustainable and equitable way to ensure prosperity, security, and peace for all its peoples
- To ensure efficient water management and the optimal use of the resources
- To ensure cooperation and joint action between the riparian countries, seeking win-win gains
- To target poverty eradication and promote economic integration
- To ensure that the program results in a move from planning to action.

The Strategic Action Program represents the Nile riparians' strategic approach to achieving sustainable socioeconomic development in the sub-basin through "equitable utilization of, and benefit from, the common Nile Basin water resources." The Strategic Action Program seeks to translate this shared vision into concrete activities through a two-fold, complementary approach:

- Lay the groundwork for cooperative action through a regional program to build confidence and capacity throughout the sub-basin (the Shared Vision Program)
- Pursue, simultaneously, cooperative development opportunities to realize physical investments and tangible results through Sub-basin activities (Subsidiary action programs) in the Eastern Nile and the Nile Equatorial Lakes regions.
- The NBI has supported the development and 9 year negotiation process of the Nile Cooperative Framework Agreement, a transboundary river legal agreement based on the Helsinki Convention and emphasizing equitable use of the Nile Waters by all riparian countries, and the precedent to do no harm to other riparian countries. To date, the Framework Agreement has only been signed by five of the nine riparian states, and under consideration by others. The Framework Agreement

will require six signatories to enter in to force. Ethiopia is a signator, Egypt and Sudan consider this a draft agreement and have not signed at this time. The Framework Agreement will remain open for signature for the period of one year from 14 May 2010 to 13 May 2011, and then must be ratified by the countries to enter into force.

5.4.1.1 Nile Transboundary Water Quality Monitoring Network

An inter-laboratory comparison activity on water chemistry analysis was initiated in May 1997 (GWW –laboratory). The objective is to improve the analytical quality of the eleven laboratories involved in the IAEA regional project for Africa (RAF/8/002). In this initiative Egypt, Ethiopia and Sudan are involved (Sudan country report, 2006).

According to Omwenga (2006), the ultimate objective of the Component is to establish and make operational a Nile Transboundary Water Quality Monitoring Network, of selected and agreed upon water quality sampling stations. The results from the transboundary stations are to form a basis on which to initiate and enhance transboundary water quality monitoring information exchanges and sharing.

A total of 44 Geo-referenced transboundary stations were selected of which 5, 5, and 2 stations are locate respectively in Ethiopia, Sudan and Egypt (Table 5-2).

Table 5-2 Transboundary Water Quality Sampling Stations

No.	River	Station	Lat.	Long.
Ethiopia				
1	Baro	Itang Town	8.11N	34.16E
2	Abbey river	Sudan Border	11.14N	34.59E
3	Tekeze river	Near Siraro town		
4	Gilo river	Near Pinudo	7.37N	34.16E
5	Akobo river	Near Dima	6.30N	35.15E
Sudan				
1	Main Nile	Dongola	19.20N	30.60E
2	White Nile	Juba	04.55N	31.74E
3	Blue Nile	Eddeium	11.04N	34.94E
4	Sobat, White Nile	Malakal	09.57N	31.60E
5	Atbara	Kashm Algirba		
Egypt				
1	Nile	Lake Nasser		
2	Nile	Nile Delta		

Source: Omwenga (2006)

It was also agreed that annual sampling frequency would be four with seasonal bias in addition piloting of the Biological water quality monitoring reported as one of the achievement of NTEAP (Omwenga, 2006; NBI-NTEAP, 2008). However, for lack of financial support and consistency, sampling was carried out only once in 2005 and countries were advised to reduce their number of sampling stations (personal communication, Mr. Solomon, Head of Laboratory Service of the Water Works Design Enterprise). He further indicated that the sampling of Biological Indicators (phytoplancton, phytobentos, macrophytes, benthic macro-invertebrates, and fish has been initiated in some countries but has not been actualized in Ethiopia. (NBI-NTEAP, 2006).

Each country has facilities to monitor and analyze water but the quality of these facilities is unequal. Egypt is one of the countries in the Nile Basin that has fairly advanced equipment while the rest have minimal facilities. For a baseline study to be undertaken it is vital that the quality of the data be reliable and consistent. Ideally, each country should have similar laboratory quality equipment, and use the same methods, but at this time this is not the case.

The following are the names of the NTEAP Focal Laboratories in the Sub-basin:

- Central Water Quality Testing Unit, Cairo; and the High Dam Laboratories, Aswan
- Groundwater and Wadis Laboratory, Khartoum, Sudan
- Ministry of Water Resources Laboratory, Addis Ababa, Ethiopia

Further training would be useful for several laboratories, and above all it would be useful for comparison purpose that the methods and protocols be uniformized.

5.4.2 The Eastern Nile Subsidary Action Program and Eastern Nile Council of Ministers

The Eastern Nile Subsidiary Action Program (ENSAP) is an investment program by the Governments of Egypt, Ethiopia and the Sudan under the umbrella of the NBI. The Eastern Nile Council of Ministers (ENCOM) comprised of the Water Ministers in the three Eastern Nile countries leads the ENSAP Team (ENSAPT) formed of three technical country teams. The objective of ENSAP is to achieve joint action on the ground to promote poverty alleviation, economic growth and reversal of environmental degradation.

5.4.3 The Eastern Nile Technical Regional Office

The Eastern Nile Technical Regional Office (ENTRO) was established by an ENCOM decision in 2001, started operation in June 2002 in Addis Ababa, Ethiopia, and was restructured in 2004/2005. ENTRO manages and coordinates the preparation of ENSAP projects, capacitate and strengthen institutions and provides secretariat support to ENCOM/ENSAPT. ENTRO has a Social Development Office that supports all ENSAP projects through: capacity building in social development, input to project design, formulation of guidelines, initiation of pilot and background studies and analysis; and networking.

Eastern Nile Subsidiary Action Program (ENSAP) objectives and guiding principles has established the Integrated Development of the Easter Nile (IDEN). The purpose of the IDEN projects is to initiate a regional, integrated, multipurpose development program through a first set of investments which confer tangible, win-win gains and demonstrate joint action between the Eastern Nile Countries. The preparation of five fast track projects has been completed in readiness for investments. The launch phase of the first Joint Multipurpose Project (JMP 1) has made significant strides during the year in accomplishing its key objective of conducting key consultative and analytical work to build consensus on the broad outlines of the first set of investments within the Joint Multipurpose Program, in a manner that demonstrates good practice in economic, social and environmental issues. The Eastern Nile Power Trade study (to promote regional power trade) was launched and the inception reports were reviewed by the technical committee from ENTRO and the EN power, environment, socioeconomic, water and electricity sector experts. Study on watershed management studies dealing with transboundary analysis and public good financing was finalized.

Complimentary to this is the Shared Vision Project Regional Power Trade Project. It is anticipated that by 2014, the power networks of NBI member countries will be integrated into one grid system – a culmination of the many transmission interconnector projects under implementation. The development objective for establishing the institutional means to coordinate the development of regional power markets among the Nile Basin countries to facilitating the development of regional power markets by concentrating on the delivery of technical assistance and supporting the development of required power trade infrastructure.

5.4.4 Eastern Africa Power Pool

To support operational and planning decisions of the integrated grid system, the Eastern Africa Power Pool (EAPP) commissioned a Regional Power System Master Plan study in October 2009 which focuses on the short to medium-term horizon. The EAPP Master Plan and the Comprehensive Basin-wide Study (CBWS) are complementary and reinforcing, allowing for efficient utilization of available resources. As part of the CBWS, the findings and recommendations of the EAPP Study as it progresses will be reviewed and incorporated into the CBWS.

This is closely linked to both the Eastern Nile Power Trade Program Study. This seeks to support Power trade and the co-operative development of hydropower and transmission interconnection among the three countries is considered a viable strategy to address these linkages. Additionally it is also linked to the Ethiopia-Sudan Transmission Interconnection Project that seeks to provide support for low-cost electricity critical for industrial development, employment and poverty alleviation. Shortage of electricity is also proving to be severe constraint on economic growth of, particularly, Ethiopia and Sudan. One way to increase access to electricity is through power trade between the two countries. Support for enhancing the transmission connections will enable power trade between these two countries, with future interconnection of the grids to Egypt, thus optimize utilization of existing and planned generation capacity in the Eastern Nile.

The Easter African Power Pool (EAPP) was formed by an agreement between the member countries, through an inter-governmental Memorandum of Understanding as well as an inter – utility Memorandum of Understanding. EAPP is processing a legal instrument for a binding agreement between the countries and the utilities. The EAPP brings together the member countries and utilities in negotiating the cooperation agreements. It is not a supranational body that decides for the countries; rather, it is the means to achieve agreements among the countries on different issues.

EAPP works through “projects”; these projects are approved at the level of Ministers and then the actual implementation is overseen by the Steering Committee. The actual execution of the projects is carried out by the utilities within the countries. The EAPP is funded by contributions from the member utilities and collaborates with the NBI Activities including capacity building, needs assessment and standardization of bilateral agreements to facilitate regional power trade.

5.4.5 Common Market for East and South Africa

In 1981 the Common Market for East and South Africa (COMESA) was formed. Egypt, Ethiopia and Sudan are all members of this organization that seeks to form an African Economic Community. The objectives of the common market are: to attain sustainable growth and development of member countries by promoting a more balanced production and marketing structure; to promote joint development in all fields of economic activity, in addition to jointly adopting macroeconomic policies and its programs to improve the welfare of the citizens and encourage close relations between member countries; to co-operate in the creation of suitable environment for domestic, foreign, and cross border investment; to collaborate in strengthening the relations between the common market and the rest of the world; to cooperate in driving peace and security process between member countries so as to strengthen the economic development ties in the region. COMESA also plays a role in identifying and supporting financing sources for investments in member states.

5.5 RELEVANT INTERNATIONAL AGREEMENTS

Ethiopia, Sudan and Egypt are all signatories to a number of international and regional treaties addressing environmental conservation. The implications of these treaties for the hydropower projects are discussed below. Global and regional treaties are, in principle, binding in the first instance on national governments, which are obliged to implement such arrangements through national legislation. In Ethiopia, Sudan and in Egypt often the speed and timing of implementation of international conventions and treaties has been slow and not all international treaties have a local legislation to support their implementation. However, it is prudent and environmentally desirable for the proponents of hydropower projects to ensure that the intent of such treaties is respected. A summary of the relevant international conventions is provided below in Table 5-3.

5.6 INTERNATIONAL SAFEGUARDS POLICIES

This section briefly introduces the main international safeguards that are at risk be triggered by one or another key issues or element of the JMP 1. The scoping analysis follows in the next Chapter where the safeguards triggered will be identified and their consequences determined.

5.6.1 World Bank's International Safeguard Policies

The World Bank has developed a series of safeguard policies to help promote socially and environmentally sustainable approaches to development as well as to ensure that Bank operations do not harm people and the environment. These safeguard policies include the Bank's policy on Environmental Assessment (EA) and those policies that fall within the scope of EA. These have been considered in relation to JMP 1 ID and their applicability is summarized as follows:

Safeguard policies on Environmental Assessment, International Waterways, Involuntary Resettlement, Natural Habitats and Safety of Dams all apply to JMP 1 in additon to the safeguard policies on Physical Cultural Resources, indigenous Peoples and Forestry, which may apply as well. The Bank's safeguard policies on Pest Management and Disputed Areas are not considered applicable to JMP 1.

Table 5-3 International Agreements and Conventions

Agreement Name	Comments	Status		
		Ethiopia	Sudan	Egypt
Convention on Conservation of Migratory Species of Wild Animals , 1979	Prohibits the hunting, fishing, capturing, harassing and deliberate killing of the species; and the projects activities do not seriously hinder migration of the species.	Entry into force of CMS: 01/01/2010 Party to: Agreement on the Conservation of African-Eurasian Migratory Waterbirds (1.11.1999) (AEWA)	AM Status: Signatory to an Agreement or MoU but not CMS; Party to: AEWA Signatory to: MoU on the Conservation of Migratory Birds of Prey in Africa and Eurasia (01.11.2008)	Entry into force of CMS: 01/11/1983 Party to: AEWA, Agreement on the Conservation of Cetaceans of the Black Seas, Mediterranean and Contiguous Atlantic Area (01.06.2001) (ACCOBAMS) Signatory to: MoU concerning Conservation Measures for the Slender-billed Curlew (10.09.1994)
Convention of International Trade in Endangered Species (CITES), 1973	Requires the signatories to impose strict regulation (including penalization, confiscation of the specimen etc.) regarding trade of all species threatened with extinction or that may become so, in order not to endanger further their survival.	Date of Accession: 05/04/1989 Date of Entry into Force: 04/07/1989	Date of Ratification: 26/10/1982 Date of Entry into Force: 24/01/1983	Date of Accession: 04/01/1978 Date of Entry into Force: 04/04/1978
Climate Change Convention 1992	Aims at stabilizing greenhouse gas concentration in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. To achieve the objective of the convention, all parties are	Date of Signature: 10/06/1992 Date of Ratification:	Date of Signature: 09/06/1992 Date of Ratification:	Date of Signature: 09/06/1992 Date of Ratification:

Agreement Name	Comments	Status		
		Ethiopia	Sudan	Egypt
	generally required to develop national inventories of emission and formulate and implement national and regional programs of mitigation measures.	05/04/1994 Date of Entry into Force: 04/07/1994 Date of Ratification of Kyoto Protocol: 14/04/2005	19/11/1993 Date of Entry into Force: 21/03/1994 Date of Ratification of Kyoto Protocol: 02/11/2004	05/12/1994 Date of Entry into Force: 05/03/1995 Date of Ratification of Kyoto Protocol: 12/01/2005
Convention of Biological Diversity 1992	Deals with issues such as the monitoring and assessment of biodiversity, practical approaches to taxonomy, economic valuation of biodiversity, access to genetic resources, agricultural biodiversity, terrestrial biodiversity, marine and coastal biodiversity and bio-safety	Date of Signature:10/06/1992 Date of Ratification: 05/04/1994	Date of Signature:09/06/1992 Date of Ratification: 30/10/1995	Date of Signature:09/06/1992 Date of Ratification: 02/06/1994
The Rio Declaration	Comprises twenty seven principles which address such important issues as: sustainable development to integrate environmental protection into the development process; common but differentiated responsibilities to conserve, protect and restore the earth's ecosystems; public participation and information access at the national level, reduce and eliminate unsustainable	Signatory	Signatory	Signatory

Agreement Name	Comments	Status		
		Ethiopia	Sudan	Egypt
	patterns of production and consumption.			
Agenda 21	A blueprint and action plan for international cooperation towards sustainable development	Signatory	Signatory	Signatory
Convention on Wetlands (Ramsar Convention)	Aims to halt the worldwide loss of wetlands and to conserve those that remain through wise use and management. This requires international cooperation, policymaking, capacity building and technology transfer. Egypt and Sudan are contracting parties, but not Ethiopia	Not a contracting party	Date of Entry into Force: 07/05/20055 Ramsar Sites: 4 Area Covered: 8,189,600 ha	Date of Entry into Force: 09/09/1988 Ramsar Sites: 2 Area Covered: 105,700 ha
Convention to Combat Desertification and Drought (CCDD)	Seeks to combat desertification and mitigate the effects of drought in countries experiencing serious drought and/or desertification, particularly in Africa	Date of Signature: 15/10/1994 Date of Ratification: 27/06/1997 Date of Entry into Force: 25/09/1997	Date of Signature: 15/10/1994 Date of Ratification:09/09/1995 Date of Entry into Force: 26/12/1996	Date of Signature: 14/10/1994 Date of Ratification: 07/07/1995 Date of Entry into Force: 26/12/1996
African Convention on the Conservation of Nature and Natural Resources (Algiers Convention)	Contracting States promise to adopt measures necessary to ensure conservation, utilization and development of soil, water, flora and faunal resources in accordance with scientific principles and with due	Date of Signature:15/09/1968 Not Ratified	Date of Signature: 15/09/1968 Date of Ratification:09/10/1973	Date of Signature:15/09/1968 Date of Ratification: 06/03/1972

Agreement Name	Comments	Status		
		Ethiopia	Sudan	Egypt
	regard to the best interests of the people.		Date Deposited: 21/10/1973	Date Deposited: 12/04/1972
Basel Convention on Hazardous Wastes	Goal of the convention is "environmentally sound management" (ESM), the aim of which is to protect human health and the environment by minimizing hazardous waste production whenever possible. It aims for strong controls over the generation of a hazardous waste to its storage, transport, treatment, reuse, recycling, recovery and final disposal and in particular aims to halt the transport of waste to developing countries with sometimes less robust environmental standards.	Date of Accession: 12/04/2000	Date of Accession: 09/01/06	Date of Accession: 08/01/1993

The 10 safeguard policies mentioned above are outlined in more detail below. The examination of these safegaurds in relation to JMP 1 at the Strategic Social and Environmental Assessment level it is intended to build confidence and trust in all stakeholders that these important issues will be addressed in detail in future phases of study.

5.6.1.1 Environmental Assessment (OP 4.01)

Environmental Assessment is one of the 10 environmental, social, and legal safeguard policies of the World Bank. Environmental Assessment is used in the World Bank to identify, avoid, and mitigate the potential negative environmental impacts associated with Bank lending operations. This policy is considered to be the umbrella policy for the Bank's environmental 'safeguard policies'.

The Operational Policy (OP) and Bank Procedure (BP) 4.01 on Environmental Assessment (EA) published in January 1999, applies to JMP 1. The Anchor project identified in subsequent phases of JMP 1 will likely be determined as a Category 'A' project, requiring a full EIA in the future.

Appendixes of the OP define the required structure of the EIA report and the structure of the Environmental Management Plan (EMP) with which the future EIA report must comply.

OP 4.01 states that for Category 'A' projects that are highly risky or contentious or that involve serious and multidimensional environmental concerns, the developer should normally engage an advisory panel of independent, internationally recognized environmental specialists to advise on all aspects of the project relevant to the EA.

In relation to public consultation, OP 4.01 requires a two-stage process:

a) shortly after environmental screening and before the terms of reference for the full EIA are finalised, and
b) once a draft EIA report is prepared.

In addition, the borrower is required to consult with stakeholder groups throughout project implementation as necessary to address EIA-related issues that affect them.

5.6.1.2 Projects on International Waterways (OP 7.50)

This policy directly applies to JMP 1 because the Abbay/Blue Nile/Main Nile flows through two or more states.

The Bank recognizes that the cooperation and goodwill of riparians is essential for the efficient use and protection of international waterways. Therefore, it attaches great importance to riparians' making appropriate agreements or arrangements for these purposes for the entire waterway or any part thereof. The Bank stand ready to assist riparians in achieving this end. In cases where differences remain unresolved between the state proposing the project (beneficiary state) and the other riparians, prior to financing the project the Bank normally urges the beneficiary state to offer to negotiate in good faith with the other riparians to reach appropriate agreements or arrangements.

It is noted that this process has effectively begun by World Bank already being a stakeholder in promoting NBI and ENTRO's pursuit of viable projects including these relating to power trading. There are future plans for an indepth institutional assessment for JMP, to be implemented through ENTRO and funded by the World Bank. This will draw on this and earlier assessments, and is intended to serve as the basis for the tripartite agreement between the Egypt, Ethiopia and Sudan pertaining to JMP development, implementation and management.

5.6.1.3 Involuntary Resettlement (OP 4.12)

This policy applies to the JMP 1 because involuntary resettlement will likely be required, depending on Anchor Project and ultimate Cascade sequencing.

The World Bank Policy on Involuntary Resettlement (OP 4.12) has as its objective to assist the people and communities affected directly and indirectly by physical and economic displacement caused by development investments. The overarching goal is to assist project-affected people to improve or at least

to restore their living conditions, livelihoods and income levels to the existing conditions prior to the project. The key principles underlying the approach to resettlement programs are that (i) resettlement planning and implementation is a participatory process, involving project-affected people and other stakeholders and including activities to inform and consult them, as well as procedures for public disclosure and grievance redress; (ii) compensation for lost or affected assets is equal to the replacement cost or value based on current market prices; (iii) the lack of formal title to affected assets does not preclude affected people from being assisted; and, (iv) the needs of vulnerable groups such as ethnic minorities, the very poor, women or disabled must be explicitly addressed through relocation, income restoration and other rehabilitation strategies.

The implementation of the World Bank policy is based on the development and implementation of two tools, the Resettlement Policy Framework and the Resettlement Action Plan.

- The Resettlement Policy Framework (RPF) is prepared when an investment program includes projects that may involve land acquisition and physical or economic displacement of people. It encompasses a gap analysis and proposals to harmonize national legislation and regulations with the requirements of the World Bank policy; and, based on this, establishes the compensation and entitlement policies and procedures for all projects developed under the program. The RPF includes an assessment of the institutional capacity and procedures of the national and sub-national authorities with responsibilities for land acquisition, compensation and resettlement, as well as the potential for NGOs and other organizations to contribute to resettlement. And, the RPF defines the components of a participatory resettlement process, including the policies and procedures for information dissemination, consultations, disclosure and grievance redress.
- The Resettlement Action Plan (RAP) is prepared for specific investments (projects). It incorporates and complies with the RPF, and identifies the specific scope of resettlement impacts, as well as compensation, relocation, income restoration and other rehabilitation strategies for the project. As required, special initiatives and action plans are incorporated into the RAP to address the needs of vulnerable project-affected people such as women, ethnic minorities, very poor households, host communities, etc. The RAP is based on extensive fieldwork to document the land acquisition and resettlement impacts including a complete census of project-affected people and an inventory of their affected assets, socio-economic surveys of project-affected people and communities and community consultations. The RAP sets out a time-bound, fully costed program for compensating and assisting project-affected people.

5.6.1.4 Natural Habitat (OP 4.04)

This policy may be triggered by JMP 1. It states that wherever feasible, Bank-financed projects are sited on land already converted (excluding any land that in the Bank's opinion were converted in anticipation of the project). The Bank does not support projects involving the significant conversion of natural habitats unless there are no feasible alternatives for the project and its siting, and comprehensive analysis demonstrates that overall benefits from the project substantially outweigh the environmental costs. If the environmental assessment indicates that a project would significantly convert or degrade natural habitats, the project should include mitigation measures acceptable to the Bank. Such mitigation measures include, as appropriate, minimizing habitat loss (e.g., strategic habitat retention and post-development restoration) and establishing and maintaining an ecologically similar protected area. The Bank accepts other forms of mitigation measures only when they are technically justified.

The Bank encourages borrowers to incorporate into their development and environmental strategies, analyses of any major natural habitat issues, including the identification of important natural habitat sites, the ecological functions they perform, the degree of threat to the sites, priorities for conservation, and associated recurrent-funding.

The World Bank definition of critical natural habitat is as follows:

- Existing protected areas and areas officially proposed by governments as protected areas (e.g., reserves that meet the criteria of IUCN classifications), areas initially recognized as protected by traditional local communities (e.g., sacred groves), and sites that maintain conditions vital for the

viability of these protected areas (as determined by the environmental assessment process);or sites identified on supplementary lists prepared by the Bank or other authoritative sources. Such sites may include areas recognized by traditional local communities (e.g. sacred groves); areas with known high suitability for biodiversity conservation; and sites that are critical for rare, vulnerable, migratory, or endangered species. Listings are based on systematic evaluations of such factors as species richness; the degree of endemism, rarity, and vulnerability of component species; representativeness; and integrity of ecosystem processes.

- If an EIA indicates that a project would significantly convert or degrade natural habitats, the project must include mitigation measures acceptable to the Bank. Such mitigation measures may include, as appropriate, minimizing habitat loss (e.g., strategic habitat retention and post-development restoration) and the establishment and maintenance of an ecologically similar protected area. The Bank accepts other forms of mitigation measures only when they are technically justified.
- The Bank takes into account the borrower's ability to implement the appropriate conservation and mitigation measures. If there are potential institutional capacity problems, the project must include components that develop the capacity of national and local institutions for effective environmental planning and management.

5.6.1.5 Dam Safety (OP 4.37)

This policy will be triggered by JMP 1. For the life of any dam, the owner is responsible for ensuring that appropriate measures are taken and sufficient resources provided for the safety of the dam, irrespective of its funding sources or construction status. Because there are serious consequences if a dam does not function properly or fails, the Bank is concerned about the safety of new dams it finances and existing dams on which a Bank-financed project is directly dependent.

When the Bank finances a project that includes the construction of a new dam, it requires that the dam be designed and its construction supervised by experienced and competent professionals. It also requires that the borrower adopt and implement certain dam safety measures for the design, bid tendering, construction, operation, and maintenance of the dam and associated works.

The Bank distinguishes between small and large dams. The dam(s) likely proposed under JMP 1 will likely be large dams “15 metres or more in height”. For large dams, the Bank requires

a) reviews by an independent panel of experts (the Panel) of the investigation, design, and construction of the dam and the start of operations;

b) preparation and implementation of detailed plans: a plan for construction supervision and quality assurance, an instrumentation plan, an operation and maintenance plan, and an emergency preparedness plan;

c) pre-qualification of bidders during procurement and bid tendering, and

d) periodic safety inspections of the dam after completion.

The Panel consists of three or more experts, appointed by the borrower and acceptable to the Bank, with expertise in the various technical fields relevant to the safety aspects of the particular dam. The primary purpose of the Panel is to review and advise the borrower on matters relative to dam safety and other critical aspects of the dam, its appurtenant structures, the catchment area, the area surrounding the reservoir, and downstream areas. However, the borrower normally extends the Panel’s composition and terms of reference beyond dam safety to cover such areas as project formulation; technical design; construction procedures; and, for water storage dams, associated works such as power facilities and river diversion during construction.

The borrower contracts the services of the Panel and provides administrative support for the Panel’s activities. Beginning as early in project preparation as possible, the borrower arranges for periodic Panel meetings and reviews, which continue through the investigation, design, construction, and initial filling and start-up phases of the dam. The borrower informs the Bank in advance of the Panel meetings, and the Bank normally sends an observer to these meetings. After each meeting, the Panel provides the

borrower a written report of its conclusions and recommendations, signed by each participating member; the borrower provides a copy of that report to the Bank. Following the filling of the reservoir and start-up of the dam, the Bank reviews the Panel's findings and recommendations. If no significant difficulties are encountered in the filling and start-up of the dam, the borrower may disband the Panel.

5.6.1.6 Physical Cultural Resources OP/BP 4.11

This policy may be triggered JMP 1. Cultural resources are important as sources of valuable historical and scientific information, as assets for economic and social development, and as integral parts of a people's cultural identity and practices. The loss of such resources is irreversible, but fortunately, it is often avoidable. The objective of OP/BP 4.11 on Physical Cultural Resources is to avoid, or mitigate, adverse impacts on cultural resources from development projects that the World Bank finances.

The United Nations term "cultural property" includes sites having archaeological (prehistoric), palaeological, historical, religious, and unique natural values. Cultural property, therefore, encompasses both remains left by previous human inhabitants (including middens, shrines, and battlegrounds), and unique natural environmental features such as canyons and waterfalls. The World Bank requires that, before proceeding with a project that may risk damaging cultural property (e.g., any project that includes large scale excavations, movement of earth, superficial environmental changes or demolition), the cultural property aspects of the project site must be determined. If there is any question of cultural property in the area, a reconnaissance survey should be undertaken in the field by specialists.

5.6.1.7 Forests (OP 4.36)

This policy will likely be triggered by JMP 1. Whilst this policy is principally related to World Bank activities in the forestry sector, it includes policies on the conservation of forest biodiversity, the sustainable management of forest areas, and the participation of local people particularly in the management of the surrounding forests. The policy emphasizes that the management, conservation, and sustainable development of forest ecosystems and their associated resources are essential for lasting poverty reduction and sustainable development.

The policy states that:

- The Bank does not finance projects that, in its opinion, would involve significant conversion or degradation of critical forest areas or related critical natural habitats;
- If a project involves the significant conversion or degradation of natural forests or related natural habitats that the Bank determines are not critical, and the Bank determines that there are no feasible alternatives to the project and its siting, and comprehensive analysis demonstrates that the overall benefits from the project substantially outweigh the environmental costs, the Bank may finance the project provided that it incorporates appropriate mitigation measures.

This policy overlaps with that on Natural Habitat (OP 4.04) to a great extent. In the case of JMP 1, if woodland issues are not considered covered by Natural Habitat (OP 4.04), it would cover roads, reservoir sub-basin clearance/inundation and transmission lines through woodland (if indeed concerned Combretum woodland and open woodland are regarded as forests).

5.6.1.8 Indigenous Peoples (OP 4.10)

This Operational Policy provides policy guidance to ensure that indigenous people benefit from development projects, and to avoid or mitigate potentially adverse effects on indigenous people caused by Bank-assisted activities. Special action is required where Bank investments affect indigenous peoples, tribes, ethnic minorities, or other groups whose social and economic status restricts their capacity to assert their interests and rights in land and other productive resources. The Bank defines "indigenous peoples," "indigenous ethnic minorities," "tribal groups," and "scheduled tribes" as social groups with a social and cultural identity distinct from the dominant society that makes them vulnerable to being disadvantaged in the development process.

Whilst the people living in Sub-basins affected by JMP 1 are from more than one recognisable ethnic group, and are extremely poor, vulnerable and in need of great care concerning resettlement and

restoring/improving livelihoods, none can be described as indigenous peoples under the above definition. Currently, this policy may be triggered by the project.

5.6.1.9 Pest Management (OP 4.09)

Rural development and health sector projects have to avoid using harmful pesticides. A preferred solution is to use Integrated Pest Management techniques and encourage their use in the whole of the sectors concerned.

If pesticides are considered necessary at full EIA stage, either for crop protection at resettlement sites or in the fight against water-related vector-borne diseases, a Bank-funded project should include a Pest Management Plan (PMP), prepared by the borrower, either as a stand-alone document or as part of the Environmental Assessment. Currently, this policy is not expected to be triggered by the project.

5.6.1.10 Projects in Disputed Areas (OP 7.60)

The projects proposed under JMP 1 will not be in a disputed area and hence the Bank's policy on disputed areas will not be triggered by the project.

5.6.2 African Development Bank's International Safeguard Policies

The African Development Bank's (AfDB) environmental policy was approved in 1990 and its environmental assessment guideline followed in 1992. The Bank has continually updated its environmental policy and its social and environmental study guidelines. AfDB's updated policy on environment was issued 2004, incorporating and redefining environmentally sustainable development. The Bank's development plan seeks to ensure that environmental management tools like strategic impact assessment and project level environmental and social assessment will be used systematically to monitor environmental performance and encourage community involvement. With regard to sustainable energy development, the Bank has identified the need to refocus its instruments and policy to deliver sustainable, reliable and environmentally friendly energy resource development. The proposed hydropower project under study is in line with the Bank's policy in relation to sustainable and environmentally friendly energy resource development.

In line with the updated policy, two relevant guidelines, namely the Strategic Impact Assessment Guideline and the Integrated Environmental and Social Assessment Guideline that were produced in 2004, were used for guiding the present pre-feasibility study and preparation of TOR for a future feasibility study. Based on the nature, scale and identified impacts the project can be categorized as Category 1. According to the AfDB, Category 1 projects that proceed to full feasibility study and implementation require a full Environmental and Social Impact Assessment (ESIA), including the preparation of an Environmental and Social Management Plan (ESMP). The ESIA examines the project's potential beneficial and adverse impacts in detail and recommends any measures needed to prevent, minimize, mitigate or compensate for adverse impacts and to enhance environmental and social project benefits. The Bank provides special attention to public participation in the environmental study process through conducting meaningful consultations with relevant stakeholders, including potential beneficiaries, affected groups, Civil Society Organizations (CSOs) and local authorities, about the project's environmental and social aspects and take their views into account.

5.6.3 Equator Principles and the IFC

The Equator Principles Financial Institutions (EPFIs) have adopted the following Principles, summarized below, in order to ensure that the projects financed are developed in a manner that is socially responsible and reflect sound environmental management practices. The Principles apply to all new project financings globally with total project capital costs of US$10 million or more, and across all industry sectors and hence will be applicable to the JMP 1. EPFIs will only provide loans to projects that conform to Principles 1-9 summarized below:

Principle 1: Review and Categorisation

When a project is proposed for financing, the EPFI will, as part of its internal social and environmental review and due diligence, categorise such project based on the magnitude of its potential impacts and

risks in accordance with the environmental and social screening criteria of the International Finance Corporation (IFC)

Principle 2: Social and Environmental Assessment

For each project assessed as being either Category A or Category B, the borrower has conducted a Social and Environmental Assessment ("Assessment") process to address, as appropriate and to the EPFI's satisfaction, the relevant social and environmental impacts and risks of the proposed project. The Assessment should also propose mitigation and management measures relevant and appropriate to the nature and scale of the proposed project.

Principle 3: Applicable Social and Environmental Standards

For projects located in non-OECD countries the Assessment will refer to the then applicable IFC Performance Standards and the then applicable Industry Specific EHS Guidelines ("EHS Guidelines"). The Assessment will establish to a participating EPFI's satisfaction the project's overall compliance with, or justified deviation from, the respective Performance Standards and EHS Guidelines. The Assessment process should address compliance with relevant host country laws, regulations and permits that pertain to social and environmental matters.

Principle 4: Action Plan and Management System

For all Category A and Category B projects located in non-OECD countries, the borrower has prepared an Action Plan (AP)3 which addresses the relevant findings, and draws on the conclusions of the Assessment. The AP will describe and prioritise the actions needed to implement mitigation measures, corrective actions and monitoring measures necessary to manage the impacts and risks identified in the Assessment. Borrowers will build on, maintain or establish a Social and Environmental Management System that addresses the management of these impacts, risks, and corrective actions required to comply with applicable host country social and environmental laws and regulations, and requirements of the applicable Performance Standards and EHS Guidelines, as defined in the AP.

Principle 5: Consultation and Disclosure

For all Category A and, as appropriate, Category B projects the government, borrower or third party expert has consulted with project affected communities in a structured and culturally appropriate manner.For projects with significant adverse impacts on affected communities, the process will ensure their free, prior and informed consultation and facilitate their informed participation as a means to establish, to the satisfaction of the EPFI, whether a project has adequately incorporated affected communities' concerns.

In order to accomplish this, the Assessment documentation and AP, or non-technical summaries thereof, will be made available to the public by the borrower for a reasonable minimum period in the relevant local language and in a culturally appropriate manner. The borrower will take account of and document the process and results of the consultation, including any actions agreed resulting from the consultation. For projects with adverse social or environmental impacts, disclosure should occur early in the Assessment process and in any event before the project construction commences, and on an ongoing basis.

Principle 6: Grievance Mechanism

For all Category A and, as appropriate, Category B projects to ensure that consultation, disclosure and community engagement continues throughout construction and operation of the project, the borrower will, scaled to the risks and adverse impacts of the project, establish a grievance mechanism as part of the management system. This will allow the borrower to receive and facilitate resolution of concerns and grievances about the project's social and environmental performance raised by individuals or groups from among project-affected communities. The borrower will inform the affected communities about the mechanism in the course of its community engagement process and ensure that the mechanism addresses concerns promptly and transparently, in a culturally appropriate manner, and is readily accessible to all segments of the affected communities.

Principle 7: Independent Review

For all Category A projects and, as appropriate, for Category B projects, an independent social or environmental expert not directly associated with the borrower will review the Assessment, AP and consultation process documentation in order to assist EPFI's due diligence, and assess Equator Principles compliance.

Principle 8: Covenants

An important strength of the Principles is the incorporation of covenants linked to compliance. For Category A and B projects, the borrower will covenant in financing documentation:

a) to comply with all relevant host country social and environmental laws, regulations and permits in all material respects;

b) to comply with the AP (where applicable) during the construction and operation of the project in all material respects;

c) to provide periodic reports in a format agreed with EPFIs (with the frequency of these reports proportionate to the severity of impacts, or as required by law, but not less than annually), prepared by in-house staff or third party experts, that i) document compliance with the AP (where applicable), and ii) provide representation of compliance with relevant local, state and host country social and environmental laws, regulations and permits; and

d) to decommission the facilities, where applicable and appropriate, in accordance with an agreed decommissioning plan.Where a borrower is not in compliance with its social and environmental covenants, EPFIs will work with the borrower to bring it back into compliance to the extent feasible, and if the borrower fails to re-establish compliance within an agreed grace period, EPFIs reserve the right to exercise remedies, as they consider appropriate.

Principle 9: Independent Monitoring and Reporting

To ensure ongoing monitoring and reporting over the life of the loan, EPFIs will, for all Category A projects, and as appropriate, for Category B projects, require appointment of an independent environmental and/or social expert, or require that the borrower retain qualified and experienced external experts to verify its monitoring information which would be shared with EPFIs.

Principle 10: EPFI Reporting

Each EPFI adopting the Equator Principles commits to report publicly at least annually about its Equator Principles implementation processes and experience, taking into account appropriate confidentiality considerations.

It is important to note that the International Finance Corporation (IFC) recently launched the process to review and update its Performance Standards. The process is expected to last until October 2010 and the updated framework to be released by January 2011. The IFC Performance Standards Review Process is extremely important for the Equator Principles and all EPFIs as it will define the Standards applied by the Equator Principles in the coming years. The IFC is currently in the process of meeting with key stakeholders, the EPFI Steering Committee and other active EPFIs in order to solicit input on the key issues and challenges for the upcoming IFC Performance Standards Review Process. The EPFIs are closely engaged with the IFC, civil society, clients, and other stakeholders during the Performance Standards Review Process.

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Appendix A

National Legislative Frameworks

TABLE OF CONTENTS

1 ETHIOPIAN CONSTITUTION

All federal and regional laws originate from the Constitution of the Federal Democratic Republic of Ethiopia, issued in August 1995. The constitution therefore forms the fundamental basis for the other laws of the country including water resources development and environmental matters at the national as well as regional level. Articles 51, 43, 44 and 92 of the Constitution specifically deal with water resources and environmental issues.

The major provision of the Constitution regarding water resources development and management states that "the federal government shall determine and administer the utilization of the waters or rivers or lakes linking two or more States or crossing the boundaries of the national territorial jurisdiction" (Art. 51(11). This implies that the regional governments implicated in the project (Amhara, Benishangul Gumuz, and Oromiya) have no direct responsibility related to the Abbay River, but rather that administration takes place at the federal level.

The elements of the constitution with direct bearing on JMP1, and specifically with bearing in regards to strategic environmental and social issues are the following:

- [Article 40 (7)]: The Constitution recognizes that "Every Ethiopian shall have the full right to the immovable property he builds and to the permanent improvements he brings about on the land by his labour or capital. This right shall include the right to alienate, to bequeath, and where the right to use expires to remove his property, transfer his title, or claim compensation for it."
- [Article 43 (1)] and [Article 43 (2)]: The Constitution also gives broad rights to the peoples of Ethiopia to improved living standards and to sustainable development. It also acknowledges the rights of the people to be consulted with respect to policies and projects affecting their community
- [Article 43 (3)]. According to this provision in the Constitution, all international agreements and relations by the State must protect and ensure Ethiopia's right to sustainable development
- [Article 44]: With regard to environmental rights, this article guarantees the right to a clean and healthy environment.
- [Article 92]: sets out the Federal policy principles and significant environmental objectives, including (1) the commitment of the Government to ensure that all Ethiopians live in a clean and healthy environment, (2) the design and implementation of development programs and projects should not damage or destroy the environment, (3) right of people to full consultation and their expression of views in the planning and implementation of environmental policies on projects that affect them directly, and (4) imposes the duty on Government and citizens to protect the environment. Clauses (2) and (3) are most relevant to JMP1 and have a direct bearing on the design of the project and the consultation strategy, both during this phase and future phases.
- In the context of land ownership and holding rights the Constitution vests the right to ownership of rural and urban land, as well as of all natural resources, in the government and in the peoples of Ethiopia. It recognizes land as a common property of the Nations, Nationalities of and peoples of Ethiopia and prohibits sale or any other exchange of land. At the same time it guarantees the right of farmers to obtain land without payment and protection against eviction from their possession.
- [Article 40 (7)]: While recognizing the above people's right to acquire property, the Constitution empowers the Government to expropriate private property for public purposes subject to payment in advance of compensation commensurate to the value of the property."

- [Article 41 (9)]:The constitutional provision that deals with economic, social and cultural rights, declares that State is responsible to protect and preserve historical and cultural legacies

In regard to Regional Constitutions, with the exception of Benishangul Gumuz, both of the other Regional States in the study zone (Amhara and Oromiya) have issued their own Regional Constitutions based on the Federal Constitution. Both have more or less similar provisions as the Federal Constitution pertaining to the management and administration of water resources. According to these constitutions, the ownership of rural and urban land, as well as all natural resources, is 'exclusively vested' in the State and the people of the respective Regions.

1.1 WATER RESOURCES DEVELOPMENT AND MANAGEMENT

1.1.1 The Ethiopian Water Resources Management Policy

The Ethiopian Water Resources Management Policy (EWRMP) issued in 1999 is not only one of Ethiopia's most important policy documents, but also one of the policies most relevant to JMP1, containing provisions affecting the natural and water resources development throughout the country and in the Abbay Basin. The EWRMP covers issues crucial to sustainable water resources management, including integrated water resources management, institutional arrangements and other cross cutting issues.

The main goal of EWRMP is to enhance and promote efforts towards an efficient, equitable, and optimum utilization of the available water resources and to contribute to the country's socioeconomic development on a sustainable basis, reflecting the overall vision of the Nile Basin Initiative on a smaller scale. It states that allocation of water should be based on integrated planning and on the optimum allocation of water that incorporates efficiency of use, equity of access and sustainability of the resource. It covers many issues relating to land, aquatic resources and the environment as well as technical and engineering aspects of the water and natural resources development.

The key policy provisions of the EWRMP can be summarized as follows:

With regard to institutional setup: Establish a Basin Authority for efficient, successful and joint sustainable management of the water resources of the basin through concerted efforts of relevant stakeholders. Additionally, establish water resources management institutions for sustainable development and management of the water sector. Avoid or minimize institutional instability in order to maintain sufficiently skilled manpower, and as appropriate, to enhance a coherent institutional framework that allows the necessary flexibility and accommodate continuity in times of change.

With regard to coordination: Promote appropriate linkage mechanisms for the coordination of water resources management activities between federal and regional governments

Relating to stakeholders: Water resources development must ensure the participation of the user communities and other stakeholders in water resources management; It should also ensure that an appropriate participatory framework is established at all levels.

1.1.2 Water Sector Strategy

The Water Sector Strategy of Ethiopia translates the intentions of the aforementioned EWRMP into action in order to enhance the contribution of water resources in attaining national development priorities. It also promotes the improvement of the living standards of the Ethiopian people.

The strategy sets out the water resources development priorities, stating that domestic water supply is the number one priority, followed by water requirements for livestock. Water is then allocated to the uses yielding the highest socioeconomic benefits.

The strategy calls for the establishment, at the basin level, of effective institutions for the sustainable development and management of water resources and the development of appropriate linkage mechanisms among stakeholders.

1.1.3 Water Sector Development Program (2006-2016)

The Water Sector Development Program (WSDP) outlines concrete interventions in the water resources sector in terms of projects and programs to achieve the water policy objectives, using the guidelines set under the national strategy within a 15-year time horizon. The WSDP includes priority projects for river basin master-plan studies, as well as those identified by various stakeholders, especially at the regional government level. The Development Program also considers projects as discussed and agreed to by the Nile Basin Initiative (NBI). Key components include:

Water supply and sewerage development: The coverage of urban water supply will grow from 74 to 98 per cent of the urban population by 2016. The works that will be undertaken are (1) Completion of study and design work for 391 towns, (2) Implementation of construction works for 402 towns, (3) Rehabilitation for 112 towns.

The rural water supply coverage will grow from 23 to 71 per cent by the end of the WSDP planning horizon. This would entail the execution of the following works (1) 4,255 deep wells, (2) 9,329 shallow wells, (3) 27,338 hand-dug wells & 18,908 springs [developed], (4) 222 subsurface dams, surface-water harvesting, river intakes, and similar projects, (5) 2,857 rehabilitation works, and (6) the WSDP will provide for 10,761 ponds, cisterns, ground catchments and livestock watering facilities.

With regard to sewerage the WSDP will undertake studies and design work for 109 cities and towns, while construction work will be carried out for 110 sewerage projects.

Irrigation development: New irrigation works will be undertaken to develop a total of 274,612 ha of farmland under the Irrigation Development Plan (IDP). Of that total, the Federal Government under the Large- and Medium-Scale Irrigation Development Plan will develop 147,474 ha, while the Regional Governments under the Small-Scale Irrigation Development Plan will develop 127,138 ha. By the end of the WSDP in 2016, the total area under irrigation will be 471,862 ha.

Hydropower development: A total of 6 medium-scale hydroelectric power plants with an aggregate installed capacity of 950 MW will be constructed under the WSDP. In addition, a total of 15 medium-scale and 37 small-scale hydropower sites will be developed to the level of feasibility study during the program period.

Water resources development: Studies for integrated water-resources master plans will be conducted on the Wabi Shebelle, Genale-Dawa, Ougaden, Awash and Danakil-Aysha basins, and Rift Valley lakes. Therefore, by the end of the WSDP, master-plan

studies will be completed for all major basins in Ethiopia. A total of 274 river-flow measuring stations and 745 meteorological stations will be installed under the WSDP.

Institution- and capacity building development: In the institutional aspects, human resources development plans in the form of long-term and short-term training for the staff of Federal institutions and Regional bureaus will be implemented. Other features of institution and capacity building program are:

1. Federal institutional structure will be strengthened, especially with the reorganization of the MoWR.
2. In addition to seven Basin Authorities, three new centers/institutes will be established: Water Resources Information Center; Water Resources Research Center; and a Water Resources Training Institute.
3. Capacities of Regional institutions will be strengthened through training of their staff, and by the provision of required equipment and facilities. The WSDP will promote the involvement of important stakeholders such as women, NGOs, private sector, local communities and water user associations in implementing various components of the WSDP.

Indicative financial requirements: Total financial requirements for the WSDP over the entire planning period of 2002-2016 is estimated to be $US 7,444.8 million. Water supply and sewerage takes about 39 per cent of the total investment needs followed by for hydropower 26 per cent, irrigation 23 per cent, water resources 9 per cent, and institutional development and capacity building 3 per cent.

1.1.3.1 National Proclamation on Water Resources Management

Following the aforementioned Ethiopian Water Resource Management Policy (EWRMP), the Ministry of Water Resources Development (MoWR) has drafted water resources management legislation that was approved by the Government in 2000 as Proclamation No 197/2000-Water Resources Management.

The Proclamation clearly articulates the following issues:

1. The water resources management and administration in the country should be based on the water resources laws of the country
2. The Ministry of Water Resources is entrusted with broad powers of 'planning, management, utilization administration and protection of water resources'. This includes promoting the implementation of medium and large multipurpose dam projects.
3. The MoWR have the duties of inventory of water resources, allocation of water resources, establishing standards for design and construction of waterworks (including hydropower dams), issuing guidelines and directives for the prevention of pollution of water resources, as well as for water quality and health standards, establishing water users' associations, and settlement of disputes.

1.1.4 Water Resources Management Regulation

The regulation provides the mechanism for implementation of the National Proclamation on Water Resources Management. It provides details for such aspects as the issuance of permits, the conditions for issuance of permits, levels of water charges and procedures for licensing water operators. As with the Proclamation, most of the responsibilities of water management are given to the MoWR.

1.1.5 Basin Organization Proclamation

Proclamation No. 534/2007 was enacted in 2007 by the Government of Ethiopia. The Proclamation sets the legal framework for the establishment of River Basin Authorities in all the 12 River Basins in the Country. The main purpose of the establishment of this organization is to ensure the development of the basins according to the principles of integrated water resource management. This process aims at using the water resources for the socio-economic welfare of the people in an equitable, participatory and sustainable manner.

The Proclamation mandates each River Basin Authority to (1) undertake activities necessary for, and facilitate, the implementation of integrated water resources management in the basin, (2) ensure that projects, activities and interventions related to water in the basin are, in their content, schedule, impacts and management, in line with the integrated water resources management process and other duties specified in the proclamation. Currently the Abbay River Basin Authority has been established and the rest will follow in coming few years.

1.2 ENVIRONMENT

1.2.1 Environmental Policy of Ethiopia

The Environmental Policy of Ethiopian issued in 1997 provides several provisions relating to the social and environmental assessment at a strategic level.

These are emphasized in the key guiding principles of the policy which targets at determining all policies, strategies, and programs as well as their implementation to sound development efforts at national and international levels. This calls for the need of Strategic Environmental Assessment (SEA) undertakings in hydropower, watershed, irrigation and flood control developments.

One of the key issues of the policy is sustainability of policies, and programmes (also plans by inference) in line with SEA concepts.

The policy further repeatedly states the development of resources and all development in a sustainable manner which is a concept fundamental to the SEA engagement.

Specific sectoral policies applicable to the SEA during the development of Hydropower and related activities, among others, are the following.

Sustainable Agriculture: the policy requires to promote effective ground cover as one of the most important factors in soil erosion control, taking advantage of the wide range of sustainable agronomic, pastoral and silvicultural approaches used in various areas of Ethiopia as potentially flexible alternatives to mechanical soil conservation systems;

Promote in drought-prone and low rainfall areas water conservation this is as important as physical soil conservation for more secure and increased biomass production, including crop production.

Vegetation of the area: the policy ensures that forestry development strategies integrate the development, management and conservation of forest resources with those of land and water resources, energy resources, ecosystems and genetic resources, as well as with crop and livestock production;

The policy requires pursuing agricultural and other policies and programmes that will reduce pressure on fragile ecosystem.

Genetic, Species and Ecosystem Biodiversity: the policy states that certain animal and plant species are vermin or pests or may be a reservoir of disease to humans, crops and livestock, and calls for devising mechanisms to control them.

Water Resources: the policy requires to subject all major water conservation, development and management projects to the environmental impact assessment process and to include the costs and benefits of protecting watershed forests, wetlands and other relevant key ecosystems in the economic analysis of such water projects;

Hydropower Development: the policy aims at ensuring that feasibility studies for hydroelectricity facilities and other significant generating facilities include rigorous environmental impact assessments to allow informed decision-making that maximizes benefits to the community and to the country at large and eliminates or at least minimizes damage to the natural resources base and/or to environmental well-being.

The policy also recognizes that water resources play an important role to meet Ethiopia's energy demand and that, by generating power cause no pollution on the environment.

Human Settlements, Urban Environment and Environmental Health Policy provisions recognize that Ethiopia's environmental and long-term economic interests and its energy prospect coincide with the need to minimize atmospheric inputs of greenhouse gases as it has a large potential for harnessing hydro-, geothermal and solar energy, none of which produce pollutant gases in significant amounts and to develop its energy sector accordingly;

Cultural and Natural Heritage, the policy promotes the perception of heritage conservation as part of, and integrated with, Ethiopia's general social and economic development.

1.2.2 Environmental Impact Assessment Proclamation

The Proclamation No 299/2002, issued in 2002, imposes mandatory environmental impact assessment (EIA) for development projects that may adversely affect society and the environment, whether such projects belong to public or private bodies. Following the above Proclamation, the EPA issued several directives subjecting categories of projects to environmental impact assessment. In addition, the Proclamation also includes provisions to conduct *Strategic Environmental Assessment* to identify the potential impacts of the proposed public instruments and the design of their containment.

The Proclamation requires, among others:

- Specified categories of projects to be subjected to EIA and receive an authorization from the Authority or the relevant regional environmental agency prior to commencing implementation of the project.
- Licensing agencies to ensure that the requisite authorization has been duly received prior to issuing an investment permit, a trade or operating license or a work permit to a business organization.
- The EPA or the relevant regional environmental agencies may exempt from environmental impact assessment projects with insignificant environmental impact.

- A licensing agency may suspend or cancel a license that has already been issued where the EPA or the relevant regional environmental agency suspends or cancels environmental authorization.

According to this Proclamation, the proponent of any project must:

- Undertake a timely environmental impact assessment, identifying the likely adverse impacts, incorporate the means of their prevention, and submit the environmental impact study report accompanied by the necessary documents to the Authority or the relevant regional environmental agency.
- Ensure that an environmental impact assessment is conducted and an environmental impact study report prepared by an expert who meets the requirements set forth by the directive issued by the Authority.
- Submit an environmental impact study report to the Authority or the relevant Regional environmental agency for review.

After the submission of the EIA report by the owner of the project, EPA evaluates the report by taking into account any public comment and expert opinion. Based on the evaluation result, the EPA or the relevant Regional environmental agency will either (1) approve the project without condition and issue authorization if the EIA report is satisfactory and the project does not cause negative impact, or (2) approve the project and issue authorization with condition that must be met in order to reduce adverse impacts to insignificant impacts, or (3) refuse approval of the project if the negative impact cannot be satisfactorily avoided.

In the event of a project having likely trans-national impacts within Ethiopia, the national EPA will handle the matter without delegation to the regional Authorities.

1.2.3 Environmental Pollution Control Proclamation

This Proclamation *No. 300/2002* was issued in 2002 to ensure the right of citizens to a healthy environment and to impose obligations to protect the environment of the country. In this connection, the Proclamation provides a basis from which the relevant environmental standards applicable to Ethiopia can be developed and sanctions violation of these standards as criminally punishable offences.

In order to ensure implementation of environmental standards and related requirements, inspectors of the Authority or of the relevant Regional environmental agency are empowered by the Proclamation to enter, without prior notice or court order, any land or premises at any time as deemed necessary by the competent authority.

1.2.4 Establishment of Environmental Proclamation

The Proclamation No. 295/2002 is a very important part of the institutional framework for environmental protection. It establishes the institutional arm of the Federal EPA to ensure the realization of the objectives of the Constitution and the Environmental Policy, with respect to the environmentally sustainable management of economic and social development.

The Proclamation directs every sectoral agency of the Federal Government to set up an environment unit as part of its organizational structure and also for each Regional State to establish a Regional autonomous environmental agency. Apart from assigning specific responsibilities to the EPA, the Proclamation links the efforts of Regional States with those of the EPA by instructing the Regional States to prepare and submit reports on the state of the environment and on sustainable development plans and submit them to the EPA.

1.2.5 Conservation of Wildlife Proclamation (Proc. No. 541/2007)

The wildlife conservation and utilization Proclamation was enacted in 2007 by the Federal Government to stop unplanned and inappropriate utilization of wildlife in Ethiopia. The objectives of the proclamation are (1) to conserve, manage, develop and properly utilize the wildlife resources in Ethiopia, (2) to promote wildlife based tourism and encourage private investors, and others.

The proclamation designates area of administration by the Federal, Regional and private investors. The proclamation further imposes conditions for wildlife hunting and scientific work and also specifies permit requirement to engage in such activities.

1.2.6 Environmental Guidelines

In addition to the above policy and legal frameworks, there are other guidelines applicable to the JMP1 in particular and environmental and social impact assessment (ESIA) in Ethiopia in general. The most important one the ones issued by the Environmental Protection Authority of Ethiopia and the World Bank.

These guidelines deal with specific procedures that a development project must be subjected to and follow. These regard screening of a project, consultation, and mechanism to ensure compliance with the law. These guidelines also describe the surveillance of a project to see if environmental quality criteria are met by the proponent of the project.

The guidelines require the project proponents to submit initial environmental management report to help the competent authority to decide on the additional requirement for screening and further ESIA needs. The main guidelines of Ethiopia are the following:

- Guidelines for Dam and Reservoirs, 2004
- Guidelines on Irrigation, 2004
- Guidelines for Mineral and Petroleum Operation Projects, 2003
- Guidelines for Roads and Railway, 2004
- Guidelines for Hydropower Production, Transmission and Distribution, 2004
- Guidelines on Ambient Water Quality of Domestic, Agriculture and Industrial Wastes
- Environmental Impact Procedural EIA Guideline, 2003
- Guideline Series Documents for Reviewing Environmental Impact Study Reports, 2003
- Guidelines on Strategic Environmental Assessment, 2002.

1.2.7 National Biodiversity Strategy and Action Plan

Ethiopia possesses valuable animals and plants which are reported to have been endangered and disappearing because of overuse and loss of natural habitat. High population growth is the main reason for the ever-dwindling natural resources base. In addition, poverty has forced people to overuse the biodiversity beyond its sustainable limits. As a result, deforestation, overgrazing, soil erosion and desertification have become major threats to the biodiversity of Ethiopia.

The Ethiopian Biodiversity Strategy and Action Plan (EBSAP) was issued in December 2005 to arrest the threats and protect and manage the biodiversity for the wellbeing of the people of Ethiopia. The overall goal of the EBSAP is to establish “effective systems that ensure the conservation and sustainable use of Ethiopia’s biodiversity, that provide for the equitable sharing of the costs and benefits arising there from, and that contribute

to the wellbeing and security of the nation". The document established four Strategic Priorities:

1. Representative examples of Ethiopia's remaining ecosystems are conserved through a network of effectively managed protected areas.
2. By 2020 all remaining natural ecosystems outside protected areas are under suitable use management.
3. The cost and benefits of biodiversity conservation are equitably shared through a range of public, private, community/CBO and NGO partnerships for PA management and for sustainable use and marketing of biodiversity.
4. The rich agro-biodiversity of Ethiopia is effectively conserved through a mix of in situ and ex situ programs

1.2.8 Fishery Development and Utilization Proclamation

The Fishery Development and Utilization Proclamation was enacted in February 2003 by the FDRE for the sustainable development and rational utilization of the resource; it is applicable to all water bodies such as lakes, rivers, streams, reservoirs, ponds and marshy area. Any person who wishes to undertake subsistence fishing, or commercial fishing or recreational fishing on a fisheries resource must obtain concession from the concessionaire, as well as a written permit from the responsible national or regional authorities.

With regard to trans-boundary and trans-regional fisheries resources, (1) the Ministry of Agriculture will negotiate and enter into agreements about the development of trans-boundary fisheries resources, (2) Regional Administrations shall cooperate to ensure that trans-regional fisheries are managed according to the principles set out in the Proclamation.

Proclamation No. 92/2003- A Proclamation to Provide for the Determination of Fisheries Development, Prevention and its Utilization was issued by the Amhara Region in December 2003. The Proclamation contains similar provisions to that of FDRE Proc. No. 315/2003

1.2.9 Wildlife Policy

The policy describes that the main threats of the country's wildlife emerge from improper land use, which includes destruction of wildlife habitat due to illegal land expansion activities, unbalanced population growth, illegal settlement and poaching. The major objective of the policy is to create conducive environment whereby the country's wildlife and their corresponding habitats are protected and developed in a sustainable manner, and enable the sector to play an important role in the economic development of the country.

1.3 SOCIO-ECONOMIC DEVELOPMENT AND LAND LEGISLATION

1.3.1 Agricultural Development Led Industrialization (ADLI)

Agricultural Development Led Industrialization (ADLI) was developed by the FDRE in 1992. This development policy and strategy uses agricultural development as an engine for economic diversification and industrialization. The policy underlines that for a country like Ethiopia where agriculture is the dominant economic activity (for more than 85 % of the population), rural development as well as overall economic development based on agriculture is the core development strategy.

Implementation of this policy has focused on provision of agricultural inputs including labor, fertilizers and improved seeds. The expansion in the volume of real agricultural output over 1992-2002 was driven by this policy supported by the liberalization of input and output markets leading to increased use of inputs. The increased utilization of fertilizers and improved seeds has allowed turning some areas previously in food deficit into food exporters.

1.3.2 Plan for Accelerated and Sustainable Development to End Poverty (PASDEP)

The Plan for Accelerated and Sustainable Development to End Poverty (PASDEP) represents the second phase of the PRSP process (2005-2010) that began under SDPRP. PASDEP pursues initiatives under SDPRP and ADLI but with important enhancements to capture the private initiative of farmers and support the shift to diversification and commercialization of agriculture. The Plan has eight broad initiatives listed below.

- Building all-inclusive implementation capacity;
- A massive push to accelerate growth;
- Creating the balance between economic development and population growth;
- Unleashing the potential of Ethiopia's women;
- Strengthening the infrastructure backbone of the country;
- Strengthening human resource development;
- Managing risk and volatility; and,
- Creating employment opportunities.

The main emphasis of the Plan revolves around rural growth, accelerating private sector growth in the modern economy to create employment and incomes, and strengthening of public institutions to deliver services. It is also emphasized in PASDEP that, “parallel to this shift to commercialized agriculture, improvement of pro-poor subsistence farming still needs to take place as the main welfare improvement for several million households that still depend on achieving higher yields of basic food grains.

This orientation will be pursued through a combination of intensified extension support at the Kebele level, establishment of a network of demonstration centers, increased low-level veterinary services, support for small-scale irrigation, better use of ground water, complemented by productive safety net and off-farm income generating initiatives supported under the Food Security Program. Both approaches need to be pursued with measures to manage the natural resource base and protect the environment.”

The PASDEP development strategies are improving the infrastructure (roads, telecommunication, electric power supply, etc.), strengthening financial and administrative development capacity, and reducing public health problems (malaria and tsetse) and special effort is also being put towards pastoral areas. Watershed management related elements are mentioned under the sectors of water management and irrigation (water harvesting) and crop production (water harvesting, soil and water conservation). Notably, an update of the PASDEP is presently in preparation and should be made public shortly.

1.3.3 Food Security Strategy

The Food security strategy equally underlines the importance of sustainable use and management of natural resources, mentioning more or less the same fields of attention as the SDPRS.

1.3.4 Millennium Development Goals

The Millennium Development Goals (MDG) was endorsed by Ethiopia in June 2002. The goal of the MDG in Ethiopia is poverty reduction and has the following detailed objectives:

- Eradicate extreme poverty and hunger
- Achieve universal primary education
- Promote gender equality and empower women reduce child mortality
- Improve maternal health
- Combat HIV/AIDS, malaria and other diseases
- Ensure environmental sustain develop a global partnership for development
- Eradicate extreme poverty and hunger
- Reduce child mortality • improve maternal health • combat HIV/AIDS, malaria.

The MDGs are closely linked with the Government's program known as PASDEP both aiming at reducing poverty. The achievement so far as evaluated in 2009 is summarized as follows (from Department for International Development: Annual Report 2009).

Eradicating of extreme poverty and hunger: As a result of the Productive Safety Net Program a million chronically food-insecure people, who previously depended on emergency relief for their survival, have secured improved livelihoods through direct employment in public works and through other support measures. Through the program, recipients have gained better access to health and education facilities.

Achieving universal primary education: The number of children in primary school increased from 14 million in 2006/07 to 15.3 million in 2007/08. The net primary enrolment rate now stands at 83%.

Promote gender equality and empower women: Water, sanitation and hygiene program implemented in the country have reduced the amount of time that women and girls spend collecting household water, thus allowing them to spend their time on a more productive, income-earning opportunities.

Reduce child mortality: Even though not adequate, Ethiopia has made encouraging progress in reducing child mortality.

Improve maternal health: The Protection of Basic Services program has doubled spending on basic services at the district level. In general, the Health Extension Program is having a real impact on the health of communities.

Combat HIV/ AIDS, malaria and other diseases: Ethiopia has made some real progress in preventing and treating malaria and HIV/AIDS in recent years, supported by robust government plans and partnership with donors.

Ensure environmental sustainability: National data indicates 53% of the population has access to drinking water and 54% have access to sanitation now.

1.3.5 Legislation on Expropriation of Land and Compensation

The Federal Government of Ethiopia issued Proclamation No. 455/2005 on Expropriation of Land for Public Purposes & Compensation in 2005 provides the detailed procedures of using public land and property for the development of projects that are national interest. The Proclamation sets the time limits within which land could be acquired after a request is received from a proponent and, principles for assessment of compensation for

properties on the land as well as for displacement compensation. In addition to that, the Proclamation authorizes the Woreda administration to establish valuation committees to value private properties. In the case of public-owned infrastructures to be removed from the right-of-way, the owners of the structures would assess the value of the properties to be removed.

Additionally, the legislation provides the mechanism for appeals on valuation decisions but such action would not delay transfer of possession of land to the proponent or contractor appointed by the proponent.

This legislation has removed the barriers for planned land acquisition, substantially raised the amount of compensation payable to expropriated owners of properties and displaced people. The provision states that financial compensation should be sufficient to reinstate the displaced people to the economic position prior to displacement. The relevant Regional administration is required to give replacement land to any person who has lost land in favor of a public project.

1.3.6 Legislation on the Preservation of Culture

Ethiopia has issued a proclamation on the conservation of cultural heritage. This proclamation is known as Proclamation No. 209/2000-The Research and Conservation of Cultural Heritage of Ethiopia. The Proclamation defines cultural heritage broadly as "anything tangible or intangible which is the product of creativity and labor of man in the pre-history and history times, that describes and witnesses to the evolution of nature and which has a major value in its scientific, historical, cultural, artistic and handcraft content."

One of the most important articles of the Proclamation (Art. 21/1) states the conditions required to remove immovable cultural heritage from its original site. Art. 21/2 states that whenever a registered movable cultural heritage is encountered during the execution of the project, it is possible to remove such property by notifying the Authority in advance.

Art. 45/2 states that any person who destroys or damages cultural heritage intentionally shall be punished with gregarious imprisonment not less than 10 years and not exceeding 20 years

1.3.7 Sectoral Policies and Strategies

Finally, several specific sectoral policies have been issued by the governmental authorities (Federal and Regional) of Ethiopia that are relevant to JMP1. These include:

- National Population Policy issued in April 1993
- National Policy on Women issued in March 1993
- National Agricultural Resource Policy and Strategy issued in 1993
- Energy Policy issued in 1994
- Water Resource Management Policy in 1999
- Policy on Biodiversity Conservation and Research issued in April 1998
- Rural Development Policy and Strategy issued in 2002
- Sustainable Development and Poverty Reduction program issued in 2002

2 SUDAN

2.1 SUDANESE CONSTITUTION

The 2005 Interim National Constitution (INC) of the Republic of the Sudan, which came shortly after the signing of the Comprehensive Peace Agreement (CPA) between the ruling National Congress Party (NCP) and the Sudan People's Liberation Movement (SPLM), was the first in the history of Sudan to formally recognize the subject of "Environmental Pollution and Ecology" and placed the topic on the Concurrent Legislative List. The INC aims to address issues of environmental and social justice, wherein Chapter II: Guiding Principles and Directives, Section 11 on Environment and Natural Resources:

- Guarantees the right of the Sudanese's people to clean and diverse environment while imposing a duty on the citizens to preserve and promote the country's biodiversity;
- Precludes the State from pursuing any policy, or taking or permitting any action, which may adversely affect the existence of any special animals or vegetative life or their natural or adopted habitat; and
- Guarantees that the State shall promote, through legislation, sustainable utilization of natural resources and best practices with respect to their management.

The Interim Constitution provides for the creation of commissions, particularly on land to assume among others planning and division of lands and forests between federal and state authorities. Section 12 requires the State:

- To develop policies and strategies to ensure social justice through ensuring means of livelihood and opportunities of employment.
- To encourage mutual assistance, self-help, cooperation and charity.

Section 24 describes Sudan as a decentralized State with three levels of government:

- The national level of government with the power to protect national sovereignty, and territorial integrity of the entire Sudan and to promote the welfare of its people,
- The State level of government with the power to exercise authority at the State level throughout the Sudan, and render public services through the level closest to the people, and
- The local level of government, which shall be throughout the Sudan.

The Interim Constitution has five Schedules (Schedules A-F), which more specifically state the powers of the various level of government in respect of, among others, environment, land acquisition and conservation of cultural heritage. Such powers include:

1. Exclusive legislative and executive powers of the national level as stated under Schedule A:
   - Natural lands and national natural resources (item no. 15),
   - Meteorology (item no. 19),
   - Signing of International Treaties on behalf of the Republic of Sudan (item no. 25),
   - National Public Utilities (item no. 30),
   - National Museums and National heritage Sites (item no. 31),
   - National Economic Policy and Planning (item no. 32), and

- Nile Water Commission, the management of the Nile Waters and trans-boundary waters and disputes arising from the management of interstate waters (item no. 31).

2. Exclusive legislative and executive powers of a State of the Sudan as stated under Schedule C:
   - State Land and State Natural Resources (item no. 8),
   - Cultural matters within the state (item no. 9),
   - Enforcement of state laws (item no. 19),
   - The development, conservation and management of state natural resources and state natural resources and state forestry resources (item no. 21),
   - Laws relating to Agriculture within the state (item no. 23),
   - Pollution control (item no. 27),
   - Quarrying regulations (item no. 31),
   - Town and rural planning (item no. 32),
   - State cultural and heritage sites… and other historical sites (item no. 33),
   - Traditional and customary law (item no. 34),
   - State irrigation and embankments (item no. 36),
   - State archives, antiquities and monuments (item no. 38), and
   - State public utilities (item no. 40).

Schedule E provides for residual powers exercised by the relevant level of government depending on the nature of the issue and Schedule F deals with the resolution of disputes in relation to concurrent powers at various levels of government. New legislations expounding the broad principles of the Interim Constitution may be enacted while revision or repeal of some of the existing laws might be considered in order to conform to the provisions of the Constitution.

Article 43(2) of the Interim Constitution gives the federal government the right to expropriate land for development purposes and to compensate owners. There are a number of articles related to natural resource management, protection of cultural heritage sites and respect of traditional and customary regulations related to land ownership.

The Interim Constitution also specifies land issues which are under national powers (federal level) and those under the control of states as well as joint powers (concurrent powers) shared by federal and states. The States manage issues related to State lands which are not under national control. These include: management, lease and utilization of lands belonging to States, town and rural planning and agricultural lands within the State boundaries. The concurrent powers include matters related to urban development, planning and housing, electricity generation, waste management, consumer safety and protection, water resources other than inter-state waters and regulation of land tenure and the rights on land.

2.2 WATER RESOURCES DEVELOPMENT AND MANAGEMENT

Water resources management is fragmented in Sudan. In an attempt to address this problem, the Water Resources Act (1995) gave responsibility for managing freshwater resources to the Ministry of Irrigation and Water Resources. Four years later, a National Council for Water Resources was formed. It is headed by the ministry, with participation by central and state government representatives. Its objective is to formulate general policies and the outline of water resources development and management for the whole country, and to coordinate actions between the state and central levels. The main laws concerning water resources and their protection are the Environmental and Natural Resources Act (1991), the Water Resources Act (1995) and the Groundwater and Wadis

Directorate Act (1998). They cover the entire spectrum of development, management and protection of freshwater resources.

These efforts have not been successful, however, as various dimensions of water resources management are still spread among different ministries and dealt with by many government organizations without integration or coordination. Thus, many aspects of the legislation are not enforced, with ill-defined responsibilities and coordination lacking. Moreover, major gaps in the laws exist. For example, in irrigation development projects, protection of groundwater resources from agricultural pollution is not taken into consideration. Nor do mining projects or the newly introduced oil development include any provision for groundwater protection. Efforts to produce a national water policy are continuing.

Currently, the water sector in the Sudan is governed by three overlapping and, sometimes contradicting legal regimes. These are the legal regime established by the Irrigation and Drainage Act 1990 which complements the first legal regimes and, therefore, has not repealed the Nile pumps Control Act 1939. The two major developments introduced by the second legal regime were that it broadened the scope of the 1939 legal regime to include drainage activities, and it has also made of Minister of Irrigation and Water Resources ((Minister of IWR)) the concerned authority under the Nile pumps Control Act 1939. The legal regime which is currently in force established by the Water Resources Act 1995 however, repealed the Nile Pumps Control Act of 1939, but it has retained the 1951 Regulations. Also it has not repealed the Irrigation and Drainage Act 1990.

Legislation relevant to water resources includes:

- Ministry of Health Act (1975) which prevented the drainage or throwing any substances (solid or liquid harmful or likely to be harmful to human and animal's health into any drinking water source
- Criminal Act 1991. According to article 70 (1&2), people who cause pollution to any source of water shall be punished with imprisonment for a term not exceeding three years
- Water Resources Act 1995
- National water corporation Act 1995
- Environmental Health Act 1997
- Ground Water Act 1997
- Environment protection Act 2001
- Sudan constitution 2005, which provides the right to a safe and hygienic environment
- Consumer protection court

2.3 THE NATIONAL COMPREHENSIVE STRATEGY 1993/2002

The National Comprehensive Strategy 1993/2002 aimed at decentralization of water services, provision of 18 and 90 liter pre capita/day in rural ad urban areas respectively. Due to the lack of finance, enforcement of laws, infrastructure and lack of trained staff the strategy was not adopted as planned. Subsequently a 25 year strategy for drinking water was established. It aimed at the provision of sustainable, safe and adequate drinking water and the realization of 50 and 150 liter/capita/day in rural and urban areas respectively by the end of the strategy. The first five years program was adopted by the government. It aimed at:

- Provision of adequate and safe water supply for rural populations from sources close to their dwellings t affordable cost to reach rate of 20 liters/ per capita /day.

- Provision of 80 liters/per capita/ day in urban areas
- Rehabilitation of deteriorating water supply sources with emphasis on replacement of low efficiency systems by simple low cost technologies particularly in rural areas to be followed by the development of new water supply sources
- The most vulnerable areas will be provided with high priority in water supply and sanitation programs
- Training and capacity building at top and medium management levels to improve the technical skills of labor force to attain higher levels of operation and maintenance.

2.3.1 Environmental Health Act 1997

In regards to water, the Environmental Health Act clearly states that "no person shall drain, throw or attempt to drain or throw any substance, whether solid, liquid or gaseous, into any drinking water source; River course, or tributaries, reservoirs, well, natural ponds or the sea in a manner harmful to human or animal health and the uses of water by human beings for other purposes. The health authority may allow the disposal of treated sewage water and industrial refuse in the sewerage under the following conditions:

- COD shall be less than 20 parts per million or water weight
- Suspended particles shall be less than 30 ppm
- No concentrated chemicals in treated water

2.4 ENVIRONMENT

The national legal framework for protection of the environment in Sudan is widely acknowledged concerned to be weak. A study carried out with the help of UNEP in 1994 discovered over 120 references to environmental legislation over a wide range of topics (e.g. soils, pesticides, wildlife, etc.) and with authority spread among over 30 government bodies. Furthermore, there was no national coordination of environmental policy.

In an effort to remedy this situation, particularly in the light of obligations taken at the1992 Rio Conference, the Higher Council of Environment and Natural Resources (HCENR) has taken the lead in drafting a new framework law for the environment. This "umbrella" law clarifies the role of the Ministry of Environment and Physical Development as the competent Ministry responsible for coordinating all matters concerning the environment. However, the new law also acknowledges that other Government Ministries with particular competence in certain fields are responsible for developing environmental measures within their areas of competence, e.g. the Ministry of Transport as the appropriate Ministry to implement measures to prevent pollution from ships.

The draft for the National Plan for Environmental Management (NPEM) in post-conflict Sudan, developed by the Higher Council for Environment and Natural Resources (HCENR) of the Ministry of Environment and Physical Development of the Government of National Unity (GONU) and the Ministry of Environment, Wildlife Conservation and Tourism (MEWCT) of the Government of Southern Sudan (GOSS) has also been developed. The Plan is supported by the development partners working in the field of environment in Sudan; the Nile Transboundary Environmental Action Project (NTEAP), the European Community (EC), and the United Nations Environment Program (UNEP).

2.4.1 Environmental Protection Act of 2001

In 2000 the federal cabinet directed the drafting of "an overall legislation for environmental protection". In the same year, the Ministry of Environment and Physical Planning was established. The most notable achievement in the 2001 was the

enactment of the Sudan Environmental Protection Act (EPA). The EPA envisaged the HCENR as a policy making body and the environmental protection agency for implementation of the Ordinance, although without executive powers and scantily staffed, the HCENR enjoyed considerable international exposure. The HCENR met irregularly, the establishment of state environment and natural resources councils was very slow, federal and state environmental conservation strategies and standards are yet to be developed. Currently, Sudan has drafted a National Environmental Action Plan (NEAP) comprising strategies for management of natural resources and the environment.

The Sudan Environmental Protection Act is the basic environmental law in Sudan. The act is first in the history of Sudan and meant to overcome the deficiencies in existing laws, which were considered narrow in scope, conflicting and fragmentary. Various regulations relating to the environment have been promulgated since colonial times and to date some are still under review. Various other laws cover different facets of environmental protection, biodiversity, cultural heritage, and natural resources.

The Environmental Protection Act of 2001 provides an umbrella law and general principles to be considered in carrying out EIA studies. This law provides definitions and several clarifications regarding natural resources management, sources of pollution and pollutants and endorses the principal of the "polluter pays". The act also make it the responsibility of the project proponents, before embarking on any development activity, to carry out an EIA study, to identify the positive and negative environmental impacts with suggestions to mitigate adverse impacts According to the Act, such studies must contain the following:

- Description of the existing environmental conditions as a baseline.
- Description of the project.
- Assessment of potential environmental impacts, both positive and negative throughout the project phases.
- Provision of recommendations to mitigate the negative environmental effects.

According to this Act all development projects outside environmentally protected areas and in environmentally sensitive areas require an EIA. Proponents of all projects are required to monitor their projects and submit reports to the HCENR.

2.4.2 Environmental Impact Assessment

As most of the developing projects in Sudan are sponsored and implemented by overseas donors, these donors usually require and supervise the implementation of particular EIAs. Sudan itself has no legislated for EIA. Instead, as mentioned above, there are over 150 natural resources laws and sectoral regulations dealing with health, water supply, land tenure, game, protected areas, fisheries and marine resources and other sectors of natural resources. More recently, the Sudan Environmental Protection Policy Act mentioned above, took a step towards establishing an official federal requirement for EIAs, stating that: ‘Any large developmental project, which construction might negatively impact the quality of the environment should undergo an Environment Feasibility Study (EFS).

Stipulated in the EFS is the requirement for the following information:

- Effect of proposed project/action on the environment;
- Any unavoidable negative environmental impact;
- Available alternatives for proposed actions.

2.4.3 Environmental Health Act 1975, the Public Health Act 1975

These Acts ensure the correct calculation, reporting and payment of pollution charges by polluting/industrial units. They require the owners, tenants or occupiers of commercial and industrial concerns to have at their own cost prepared and implement a scheme for the safe drainage and disposal of their wastes and effluents of the quality permitted under the rules or the bye-laws. Pollution units per unit of production are the basis for calculation of the pollution charge by the industrial unit.

2.4.4 Electricity Act 2001

The Act of 2001 relates to the generation, transmission, supply, and use of electricity in the Sudan.

2.4.5 Wildlife Protection and National Parks Act 1986

This Act was issued to provide protection, preservation, conservation and management of wildlife and setting up of a National Park. This Act is applicable to all areas for protection, conservation and preservation and management of wildlife.

2.4.6 Forestry Act 1989, Forests and Renewable Natural Resources Act 2002

These Acts empower provincial governments to prohibit the clearing of forest for cultivation, grazing, hunting, removing forest produce; quarrying and felling, lopping and topping of trees, branches in reserved or protected areas. Penalties for breach of regulation and payment of cash compensation are provided in these Acts.

2.5 LEGISLATION ON LAND ACQUISITION AND COMPENSATION

2.5.1 Land Acquisition Ordinance 1930

This act is the legal umbrella under which the government or private parties, subject to certain conditions and procedures, may in the interest of the public undertake compulsory acquisition of land. The land may be acquired for use in development activities or projects, which directly or indirectly promote the general welfare of the public.

2.5.2 Unregistered Land Act 1970

The 1970 Unregistered Land Act declared all unregistered land as government land. The declaration was made without recognition of the long established and existing usufruct rights communally enjoyed village or pastoral communities. The Act is an amendment to the Land Settlement and Registration Ordinance 1925, which recognizes usufruct customary rights with respect to unregistered land. Specific details and procedures on land are found in sectoral laws including:

- Land Settlement and Registration Ordinance 1925 provides rules to determine rights on land and other rights attached to it and ensure land registration.
- Land Acquisition Act 1930 gives the government the power to appropriate lands for development purposes. It also states detail formalities of acquisition and rules governing assessment and payment of compensation. The Act outlines detailed procedures to be followed in the acquisition of land and rules governing payment of compensation for land for public purposes. The procedures for land acquisition in any locality are initiated with a notification by the People's Executive Council in a Gazette stating that it appeared to the President of the Republic to authorize the acquisition of land for public purposes. It is only after such notification that it shall be lawful to enter

into, bore, set out boundaries, mark or survey the land. An appropriation officer appointed by the People's Executive Council would notify the occupant of land the declaration that a designated area of land is to be appropriated for public purposes; call upon persons claiming compensation to appear before him at a place and time (not earlier than fourteen days) and to state the particulars of their claims for compensation. He must attempt to agree on the amount of compensation for the land. The Act provides for further steps to be taken with regard to assessment of compensation if agreement is not reached.

- Unregistered Land Act 1970 deems any unregistered land, before the enactment of this law, as being registered in the name of the government.
- The Civil Transactions Act 1984 regulates the different matters related to civil transactions with respect to titles on land, means of land acquisition, easement rights and conditions to be observed by land users.
- Urban Planning and Land Disposal Act 1994 regulates designation of lands for different purposes and urban planning. With respect to land expropriation for public purposes Section13 of the Act recognizes the application of its predecessor – Land Acquisition Act, 1930.
- Central Forest Act, 1932 empowers the Minister of Agriculture, Food and Natural Resources to declare to be a central forest reserve an area of land, which is registered under the Land and Settlement and Registration Act, 1925 as a Government land (Section 5). Unless with special license or a permit has been first obtained from the Director of Forest any act, including entry upon or remaining in such forests would be an offence (Sections 9 & 10 of Central Forest Act, 1932).

Generally, these Acts provide procedures for land expropriation for development purposes and ways to specify rights in order to compensate the owner. The Urban Planning Act sets specific rules for the separation of industrial areas from residential areas.

2.5.3 Legislation on Preservation of Cultural Heritage

The Antiquities Ordinance of 1905, 1952 and the Antiquities Protection Act 1999 are the principal national legislations that deal with the protection and preservation of Sudan's archaeological heritage. These acts empower the Government to preserve and protect any premises or objects of archaeological, architectural, historical, cultural, or national interest in Sudan by declaring them protected; compulsorily purchasing them; or making arrangements to restore and maintain the object or premises.

3 EGYPT

There is a wide variety of legislation in Egypt for the control of the impact of human activity to minimize its harmful and nuisance impacts on the environment The environmental legislation is concerned with surface water contamination, soil pollution and degradation, air contamination, noise, energy consumption and effects on human beings and other living organisms. Other legislation is concerned with the impact of the human exploitation of natural resources; the visual effects of building developments and redevelopments; that may harm sites of historic/ architectural / archaeological importance.

3.1 WATER RESOURCES DEVELOPMENT AND MANAGEMENT

Although, there is no single overarching water resources law in Egypt. The main laws of relevance for water resources management include laws about irrigation and drainage

on the one hand, and laws to protect the environment on the other hand. Among the irrigation and drainage laws are:

- Law 12 for the year 1984 for the Irrigation and drainage, and
- Law 213 for the year 1994 for farmer participation and cost sharing.

Among the laws and decrees for environmental protection are:

- Law 93 for the year 1962 for the discharge to open streams and its modifications for the years 1962, 1982, and 1989,
- Law 27 for the year 1978 for the regulation of water resources and treatment of wastewater,
- Law 48 for the year 1982 Regarding the protection of the River Nile and waterways from pollution,
- Law 4 for the year 1994 for Environment Protection.

A legal basis for controlling water pollution exists through a number of laws and decrees. Law 48/1982 regarding the protection of the river Nile and other waterways from pollution, and Law 4/1994 on Environmental protection are the most important ones and are discussed below.

3.1.1 National Water Policy

The Ministry of Water Resources and Irrigation (MWRI) has prepared a National Water Policy till the year 2017 including three main themes:

- Optimal use of available water resources;
- Development of water resources; and
- Protection of water quality and pollution abatement.

At present, Egypt is addressing the issue of limited water quantity by managing the demand side. MWRI formulated a water master plan in 1981, which is currently updated. The process of updating the water master plan aims to allocate available water resources according to various needs and demands that are feasible from the economic perspective. The Water Master Plan is updated through the National Water Resources Plan (NWRP) project.

The NWRP has been operated since 1998 and jointly funded between MWRI and the Netherlands Government. This project is directed towards developing a National Water Resources Plan that describes how Egypt will safeguard its water resources both quantity and quality and how it will optimize the use these resources in response to the socio-economic and environmental conditions

3.1.2 Law 48/1982 and Decree 8/1983

Law 48 of 1982 specifically deals with discharges to water bodies. This law prohibits discharge to the river Nile, irrigation canals, drains, lakes and groundwater without a license issued by the MWRI. Licenses can be issued as long as the effluents meet the standards of the laws. The license includes both the quantity and quality that is permitted to be discharged. Discharging without a license can result in a fine. Licenses may be withdrawn in case of failure to immediately reduce discharge, in case of pollution danger, or failure to install appropriate treatment within a period of three months.

Under the law, the Ministry of Interior has police power while the Ministry of Health and Population is the organization responsible to give binding advice on water quality

standards and to monitor effluents/discharges. Law 48 does not cover ambient quality monitoring of receiving water bodies although some standards are given. Law 48 recognizes three categories of water body functions:

- Fresh water bodies for the Nile River and irrigation canals;
- Non-fresh or brackish water bodies for drains, lakes and ponds;
- Groundwater aquifers.

Ambient quality standards are given for potable resources, which are intended as raw water supplies for drinking water. The implementing Decree 8 of 1983 specifies the water quality standards for the following categories:

- The Nile river and canals into which discharges are licensed (article 60);
- Treated industrial discharges to the Nile river, canals and groundwater;
- Upstream the Delta barrages discharging more than 100 m3/day (article 61);
- Downstream the Delta barrages discharging more than 100 m3/day (article 61);
- Upstream the Delta barrages discharging less than 100 m3/day (article 62);
- Downstream the Delta barrages discharging less than 100 m3/day (article 62);
- Drain waters to be mixed with the Nile river or canal waters (article 65);
- Treated industrial and sanitary waste discharges to drains, lakes and ponds (article 66);
- The drains, lakes and ponds into which discharges are licensed (article 68);

Discharge of treated sanitary effluents to the Nile River and canals is not allowed at all (article 63) and any discharge of sanitary waste into other water bodies should be chlorinated (article 67). The water quality standards are generally based on the drinking water standards and are not linked to all other functions a water body may have. The use of agrochemicals for weed control is also regulated in the law.

3.2 ENVIRONMENT

3.2.1 Law 4/1994

Through Law 4 of 1994, the EEAA is the authority responsible for preparing legislation and decrees to protect the environment in Egypt. The agency also has the responsibility for setting standards and for carrying out compliance monitoring. It should participate in the preparation and implementation of the national program for environmental monitoring and utilization of data (including water quality). The agency is also charged with establishing an “Environmental Protection Fund” which would include water quality monitoring. With respect to the pollution of the water environment, the law states that all provisions of Law 48/1982 are not affected and further, Law 4 only covers coastal and seawater aspects.

- The MWRI remains the responsible authority for water quality and water pollution issues, although the definition of “discharge” in Law 4 specifically includes discharges to the Nile River waterways. EEAA is responsible for coordinating the pollution monitoring networks;
- In Law 4, it is stated that all facilities discharging to surface water are required to obtain a license and maintain a register indicating the impact of the establishment’s activity on the environment. The register should include data on emissions, efficiency and outflow from treatment units and periodic measurements. EEAA will inspect the facilities yearly and follow-up any non-compliance. This provision is confusing or creating duplication because Law 48/1982 also includes certain standards for effluents with MOHP as compliance monitoring organization and only MOHP

laboratory results are considered to be official; and both laws create funds where fines are collected and which are used to fund monitoring and other activities.

It should be noted that various aspects of environmental protection were addressed before Law 4/94. These were traditional regulatory measures that focused on end-of-pipe controls implemented through command-and-control regulations. The resulting legislation is piecemeal, leaving gaps and causing overlaps. Law 4/94 was a step towards introducing more flexible and more effective tools for dealing with environmental problems. The source of institutional overlap between ministries and agencies involved with environmental issues lies with the originating legislation.

3.2.2 Environmental Impact Assessment

Measures concerning the assessment of Environmental Impacts are stipulated in articles no. 19, 20, 21, 22, 23, 70, 71 and 73 of the environmental protection law 4/1994. These articles are complemented by the provisions of articles no. 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 57, 58, 59 and 60 0f the Executive regulation issued by the Prime Minister's Decree no 338/1995.

3.2.3 Biodiversity National Legislation

The legislative tools for biodiversity conservation and sustainable development in Egypt were issued as laws and ministerial decrees and can be summed up in chronological order as follows:

- Law 53 of 1966 (also known as "The Law of Agriculture"). Among the numerous articles and clauses of this law, article 117 prohibits the hunting of birds and other wild animals useful to agriculture. It also bans the trading and killing of these birds as well as the destruction of their nests. Article 118 of the same law prohibits the cultivation of plants harmful to these birds and wild animals, bans the importation of material used in their hunting and prevents the use of all forms of traps. The prevention of cruelty to animals is spelled out explicitly in article 119;
- Ministerial decree 28 of 1967 specified the species of birds and other wild animals under protection covered by article 117 of the previous law 72 of 1968 concerning the prevention of pollution of seawater by oil**.**
- Ministerial decree 349 of 1979 established the Egyptian Wildlife Service as the first governmental authority concerned with the protection of wildlife in the country;
- Ministerial decree 66 of 1982 prohibited hunting all species of birds and other wild animal in certain areas of the Sinai Peninsula, as well as fishing and catching all species of mollusks and corals in various other specified regions;
- Law 48 of 1982 for the protection of the River Nile and other water courses against pollution. It prohibits the discharge of solid, liquid and gaseous wastes with certain levels of pollutants into the Nile and all freshwater bodies; while the Ministry of Irrigation determined the maximum allowable levels of polluting elements in such wastes, the Ministry of Health is empowered to carry out the required analysis of samples of these wastes;
- Law 102 of 1983 set up the legal framework for the declaration and management of protected areas and regulates the conservation of natural resources;
- Law 101 of 1985 levied an additional tax on aeroplane tickets issued locally, in order to secure a suitable source of funding to finance programmes for developing tourism and environmental protection; and
- Law 4 of 1994 is by far the most comprehensive environmental legislation to date. It authorizes the EEAA to prepare an Environmental Contingency Plan (article 25), and forbids the hunting of specified types of wild birds and animals (article 28) as well as the destruction of their natural habitats.

3.3 SOCIO-ECONOMIC DEVELOPMENT AND LAND LEGISLATION

3.3.1 Egypt's Agricultural policy up to 2017

A Land Master Plan of Egypt was prepared in 1986. It concluded that the construction of AHD not only made the intensification of agriculture feasible in the old lands but also extended it to new "reclaimed" areas. Some 650 000 fedddans out of 805 000 feddans of land reclaimed during 1960-70 was made possible due to the increased supply of water from AHD. The total land that could be reclaimed is subject to water availability. The arable area per person declined by 75% from 0.51 feddan / person to 0.13 feddan /person during 1887-1990 (Abu Zeid and Rady 1991).

The strategy for agricultural development up to 2017 has a number of aims.

- To increase the annual rate growth in the agricultural production from 3.4% to 3.8% during the remaining period of the Fourth 5-Year Plan, and to 4.1% annually up to 2017. This goal is attainable only through vertical and horizontal expansion of plant and animal production, which will have a positive bearing on job creation, income to producers and the overall standard of living of the rural population.
- To reclaim no less than 150,000 feddans annually, within the Master Plan of Egypt's Land and water resources which assesses the reclaimable and cultivable lands in the Delta, Southern Valley, East Owaynat, the area of and round Lake Nasser and East and West of Suez Canal by the year 2017 at about 3.4 million feddans. The inhabited area would reach 25% of the total area of Egypt.
- To increase the agricultural production horizontally and vertically through the efficient allocation and use of soil and water resources. Maintenance and development of the natural resource base is an integral part of Egypt's sustainable agricultural development program.
- To form a national strategic stock of the basis food commodities by focusing on the efficient use of the available resources and redirecting investments to such areas that help fulfill the increasing food needs of the population. This shall be accompanied with rationalization of food consumption levels, reduction of post-harvest losses.

3.3.2 Legislation related to resettlement and expropriation land

In accordance with Article 34 of the Constitution: "Private ownership shall be safeguarded and may not be placed under sequestration except in the cases defined by law and in accordance with a judicial decision. It may not be expropriated except for the general good and against a fair compensation as defined by law. The right of inheritance shall be guaranteed in it." According to this article, it is understood that procedures for private property expropriation are considered to be exceptional.

Other relevant laws governing expropriation and consequent compensation procedures include Law 577/54, which was later amended by Law 252/60 and Law 13/162, lays down the provisions pertaining to the expropriation of real estate property for public benefit and improvement, Law No. 27 of 1956, which stipulates the provisions for expropriation of districts for re-planning, upgrading, and improvement, and the amended and comprehensive Law No.10 of 1990 on the expropriation of real estate for public interest.

The general provisions guiding expropriation of private property (according to Law 577/54, Law No. 27 of 1956, Law No. 252 of the year 1960), include the following:

- Property expropriation shall be only on tangible real estate property, there shall be no expropriation of movable possessions.

- Applicable only to property privately owned by individuals, thus, public property is excluded from the procedures.
- The expropriation shall include land and constructions (structures).
- The purpose of expropriation shall only be for realizing public interest.
- The administrative authority has the right to assess the circumstances related to expropriation as well as the authority for implementation of property expropriation, which is justifiable by the objective of achieving public benefit. The administrative authority may not be challenged or judged on the grounds that it could have chosen more appropriate real estate property to achieve public benefit than the one that it has already chosen.
- The administration shall estimate the area it sees necessary for the establishment of a project. This right shall not be only restricted to the real estate property required for the project; but the legislator empowered the administration to also include expropriated property. Meaning that the administration has the right to choose the needed land not limited to the real estate property but also from the private properties that can be later on expropriated.

According to Article 23 of Law 577/1954: "If the purpose of the property expropriation is the establishment of a squares, streets, or their expansion, modification, demarcation, or the establishment of a new district, or for its improvement/ upgrading or beautification, or for any health related matter; property expropriation may include, in addition to the real-estate property needed for the project, any other real-estate property which the administration in charge seems to be necessary to achieve the project's objective or any other property whose current state (whether in size or form) is not consistent with the required improvement.

Moreover, the first article of Law No. 27 of 1956 allows for the expropriation of districts for their improvement, upgrading, re-planning, and reconstruction. Article 24 of Law 577/54 also stipulates that in case only partial expropriation of real estate property is required, and the remaining un-expropriated part will not be of benefit to the owner; the owner shall be given the right to submit a request within 30 days (beginning from the date of final disclosure of the list of the expropriated property) for the purchase of the entire area. It should be noted that the new law has not restricted the right to request the purchase the remaining un-expropriated portion of real estate to buildings only, but it was also extended to include land as well.

Law No. 252 of the year 1960, amended by Law 577/54 was promulgated to equilibrate the rights and guarantees for individuals with the rights of the state in expropriating private property. Moreover, this law has stipulated that the assessment of public benefit interest, which justifies property expropriation, shall be emanated in all cases by a Presidential Decree, while previously it was made by the competent minister.

3.3.3 Legal and Administrative Procedures for Transfer of Ownership and Compensation

The procedures taken to this regard are administrative, with no judicial interference except in the assessment of the compensation amount. Article 1 of Law 252/60 (amended by Law 577/54), states that the determination of public benefit for the expropriation of private real estate property is subject to Presidential Decree. On the other hand, according to Article 2 of Law 27/1956, the determination of public interest for the expropriation of districts for re-planning and upgrading is subject to a Decree from the Cabinet. Each Minister is responsible for the disclosure of the needed lands and the expropriation in the official newspapers.

Appendix B

National Institutional Frameworks

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LIST OF FIGURES

1 ETHIOPIA

1.1 MINISTRY OF WATER RESOURCES DEVELOPMENT

The leading water resources sector player at Federal level is the Ministry of Water Resources (MoWR). It is mainly mandated to carry out tasks such as the study, design, development and management relating to the entire water resources development. According to the Ethiopia Water Resources Management Policy (EWRMP), the MoWR is also responsible for matters relating to interregional and trans-boundary waters.

The MoWR has nine technical units (directorate and process) and ten support units to discharge its duties effectively (see Figure 1.1). As seen in the figure hydropower directorate is the responsible units for hydropower and watershed studies, design and other matters relating. In addition to that the Ministry of Water Resources has significant role in irrigation and flood control study, design and implementation in the country.

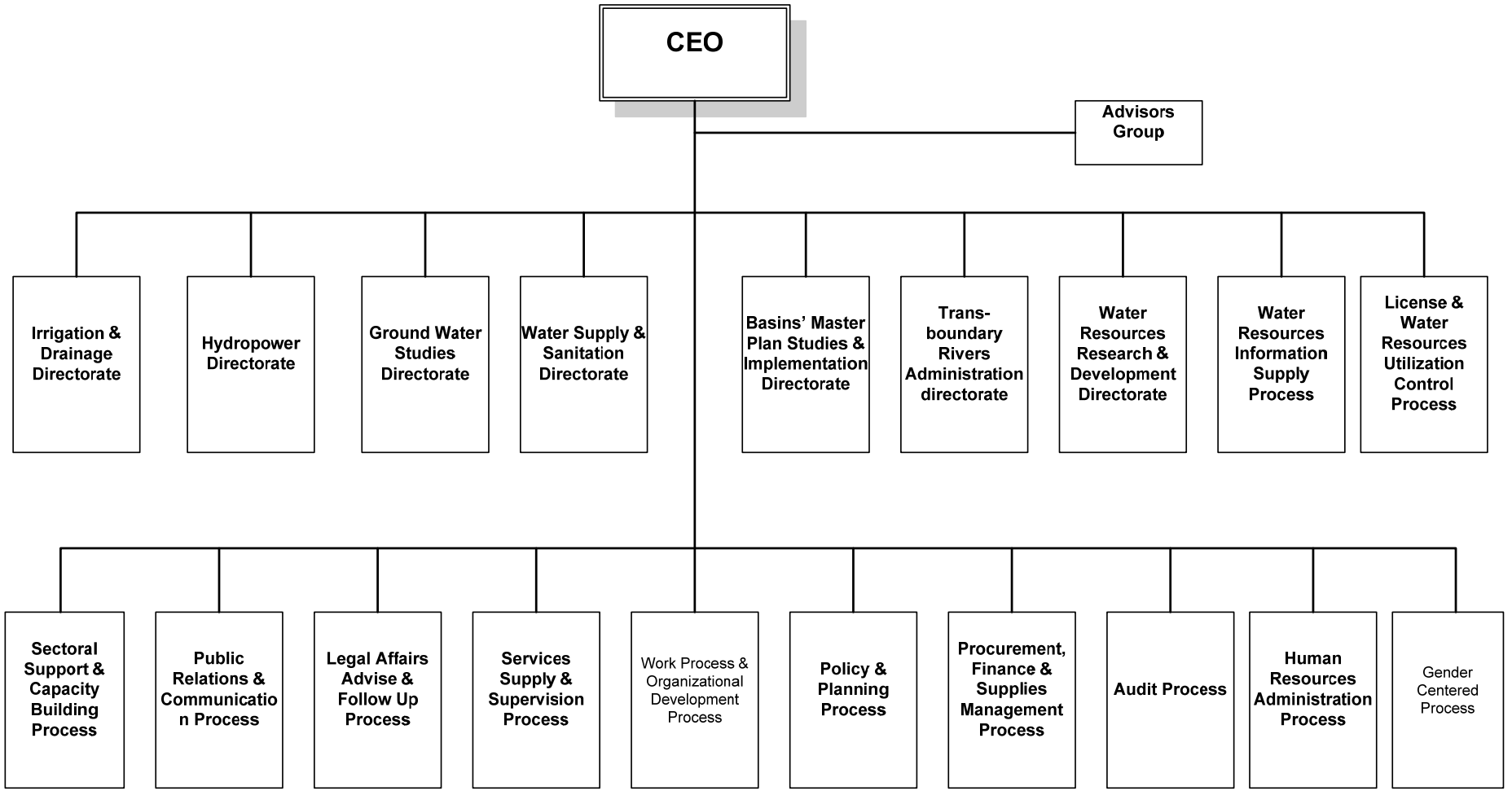
With regards to the manpower, there are about 366 employees in the Ministry in total. Out of the total about 63 % of the employees are technical and the remaining 37 % are support personnel.

The MoWR, in the past, has made substantial contribution to the development of hydropower. Major problem impeding the activities of the institution is high rate of staff loss due to low salary scale and lack of motivational mechanism in the organization to retain trained and qualified staff. Capacities in the Ministry can be developed easily but the salary scale has to be changed to keep those staff with required capacities.

The mandate of the MoWR is specified in its establishment proclamation. These are to:

- Undertake basin studies and determine the country's ground water and surface water resource potential in terms of volume and quality, and facilitate the utilization of the same
- Determine conditions and methods required for the optimum and equitable allocation and utilization of water bodies that flow across or lie between more than one Regional State, among various uses and the Regional States:
- Undertake studies and negotiate treaties pertaining to the utilization of boundary and trans-boundary water bodies, and follow up the implementation of the same
- Develop studies, designs and construction works to promote the expansion of medium and large irrigation dams
- Issue permits and regulate the construction and operation of water works relating to specified water bodies
- Manage dams and hydraulic structures constructed under federal budgets unless they are entrusted to the authority of other bodies
- Ensure the provision of meteorological services.

Figure 1.1 Organizational Chart of Ministry of Water Resources



Source: Ministry of Water Resources, 2010 (translation from the BPR Study).

1.1.1 Ministry of Agriculture and Rural Development

The Ministry of Agriculture and Rural Development (MoARD) is another major player operating in the Abbay Basin. Its mission can be described as increasing agricultural productivity and production of the 85 % of the population engaged in agriculture. The Ministry introduces modern technology and builds the capacities of regional agricultural public organs at various levels, including the farmers to who water harvesting for small-scale farming and rainfed agriculture is promoted.

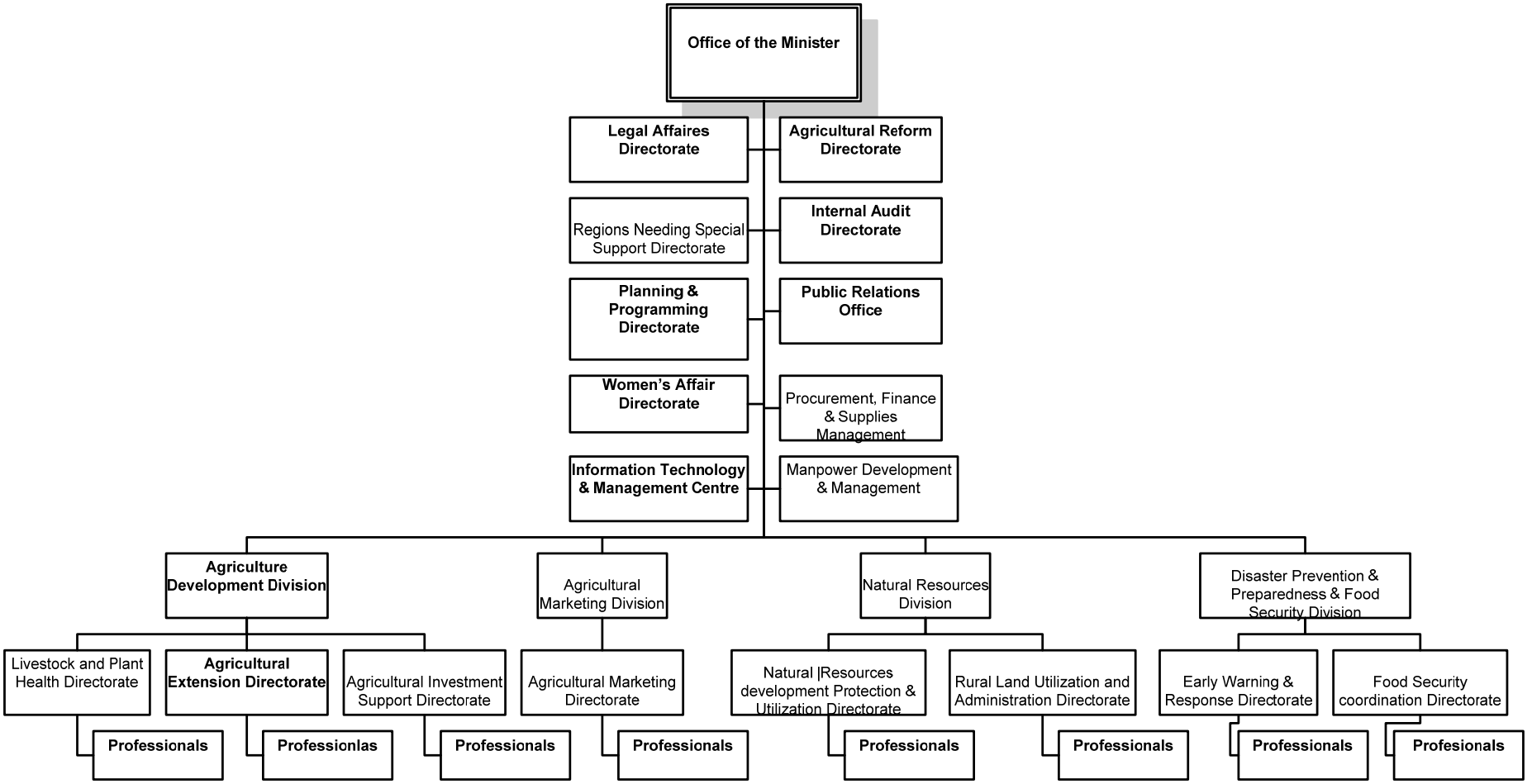
The MoARD has a wide experience in irrigation development and it provides support to farmers and investors in the irrigation activities. There exists highly qualified personnel in the Ministry but overall staffing is not adequate and there is a need for more qualified people. Several positions in the ministry cannot be filled by staff due to several reasons including lack of qualified personnel on the market and lack of motivation to attract and sustain the employees. Figure 1.2 depicts the organizational structure of the MoARD. The MoARD is also engaged in watershed and flood control development particularly supporting farmers and small scale watershed programmes.

The Ministry aims at ensuring food security and enhancing market-led agricultural development and improving the use of agricultural inputs and the quality of products as it primary tasks. The MoARD have the following powers and duties as specified in its establishment proclamation:

- Promote the expansion of rapid and sustainable agricultural and rural development
- Direct and coordinate the implementation of the Food Security Program
- Prepare land use and administration policies as well and draft laws on the conservation and utilization of forest and wildlife resources, and follow up and coordinate their implementation;
- Encourage and assist the provision of agricultural extension services to smallholder farmers and pastoralists;
- Encourage and support the expansion of water harvesting and small scale irrigation schemes;
- In cooperation with the concerned organizations, create conducive conditions for the expansion of rural development infrastructure and facilitate the provision of credit facilities to farmers and pastoralists and provide comprehensive support to private investors engaged in the agricultural sector;
- Monitor events affecting agricultural development and set up an early warning system;
- Conduct quarantine controls on plants, seeds, animals and animal products brought into or taken out of the country;
- Take the necessary measures to prevent the outbreak of animal and plant disease and migratory pests;
- With a view to enhancing market-led agricultural development and creating efficient agricultural inputs and products marketing systems, closely monitor market signals in particular those of international markets, and provide farmers, pastoralists and investors with comprehensive, up-to-date and accurate information to enable them identify those agricultural products which they can produce products market centers;
- Set criteria to be fulfilled by traders engaged in the production, supply and distribution of agricultural inputs and the processing, grading and export of agricultural products and issue import and export permit for agricultural inputs;
- Promote the expansion of out-growers schemes to secure reliable supply and market for agricultural products;

- Undertake studies and submit recommendations on measures to be taken by the government to stabilize prices for agricultural inputs and products;
- In cooperation with the concerned organs, identify bottlenecks for agricultural and rural development and contribute towards their solution;
- Establish and direct training establishments that may assist the enhancement of agriculture and the improvement or rural technology;
- Coordinate and assist regional governments in the implementation of resettlement programs.

Figure 1.2 Organizational Structure of Ministry of Agriculture and Rural Development



Source: Business Process Re-engineering Study, MoARD, 2010.

1.2 MINISTRY OF FINANCE AND ECONOMIC DEVELOPMENT

The mandate of the Ministry of Finance and Economic Development (MoFED) is to initiate policy for the country's long-term development and set development priorities and strategies in cooperation with other ministries. The MoFED undertakes economic research and develops macroeconomic and social parameters and guidelines to facilitate development plans. It also formulates strategies for managing foreign aid and loans, negotiates and signs aid and loan agreements and monitors their implementation.

1.3 MINISTRY OF HEALTH

The Ministry of Health (MoH) is given general responsibility for all public health matters and has the duty to prevent and eradicate communicable diseases. The MoH is engaged in national hygiene promotion and sanitation programs. Pertinent to water resources development, the Ministry of Health coordinates and directs the country's health sector development program and devises and follows up the implementation of strategies for preventing and eradicating communicable and non-communicable disease, devises and follows up the implementation of strategies for preventing malnutrition and other tasks.

1.4 ENVIRONMENTAL PROTECTION AUTHORITY

The Environmental Protection Authority (EPA) is the responsible body for environmental issues at the federal level, entrusted with the powers to develop policies, laws, directives and standards. The objective of EPA is to formulate policies, strategies, laws and standards, which foster social and economic development in a manner that enhances the welfare of the people and the sustainability of the environment, and to spearhead the process of their implementation.

The powers and duties given to EPA includes, but not limited, to coordinate measures to ensure that the environmental objectives, establish a system for environmental impact assessment of public and private projects, establish an environmental information system that promotes efficiency in environmental data collection, management and use and others.

Recently a new institutional arrangement has been established by the EPA where the main tasks of EPA have been given to the selected sector ministries. The power of the Environmental Protection Authority has accordingly been devolved to Ministry of Water Resources, Ministry of Mines and Energy, Ministry of Agriculture and rural Development, Ministry of Works and Urban Development, Ministry of Health, Ministry of Trade and Industry, and Ministry of Tourism and Culture.

Based on this new arrangement, the sectors ministries are required to establish Environmental Protection Units in their organizational structure responsible for environmental matters in their respective sectors. Accordingly the ministries were delegated to assess and evaluate the ESIA and RAP undertaken by the proponents of projects of different sectors. In addition, the sectoral environmental units will produce annual reports and submit the same to EPA for final decision and monitoring of performances of the units.

This system has already been implemented and functioning properly with a few other government agencies that have already developed their capacities such as the Ethiopian Road Authority (ERA). What is notable is that the EPA has delegated the EIA function to eight national institutions, without necessarily confirming whether sufficient capacity

exists to fulfill the mandate and without confirming that they developed the required system to carry it out.

This has raised an important issue: environmental specialists assigned in the specific sectoral unit may be biased and the work of those environmental professionals may be influenced by the sector institution to give exclusive priority to the development of their sectors & undermine environmental concerns and recommendations. According to EPA, this gap will be filled through critical review of periodic environmental performance reports submitted to the authority and by conducting surprise audit visits, sampling and analysis.

This institutional arrangement however is provisional and adjustments will be made following a review of results accomplishment during this period. Although this structure has already been implemented, it still requires a legal framework to affect it. The legal framework will be issued in the form of proclamation by the national government.

1.5 ETHIOPIAN ELECTRIC POWER CORPORATION

The Ethiopian Electric Power Corporation (EEPCO) was first established as the Ethiopian Electric Light and Power Authority (EELPA) in 1956. It was later restructured institutionally and organizationally and was renamed as EEPCO. EEPCO is responsible for generation, transmission, distribution and sales of electricity nationwide. It operates the entire electric power system in Ethiopia. The power system of EEPCO is categorized under interconnected systems (ICS) and self-contained systems (SCS).

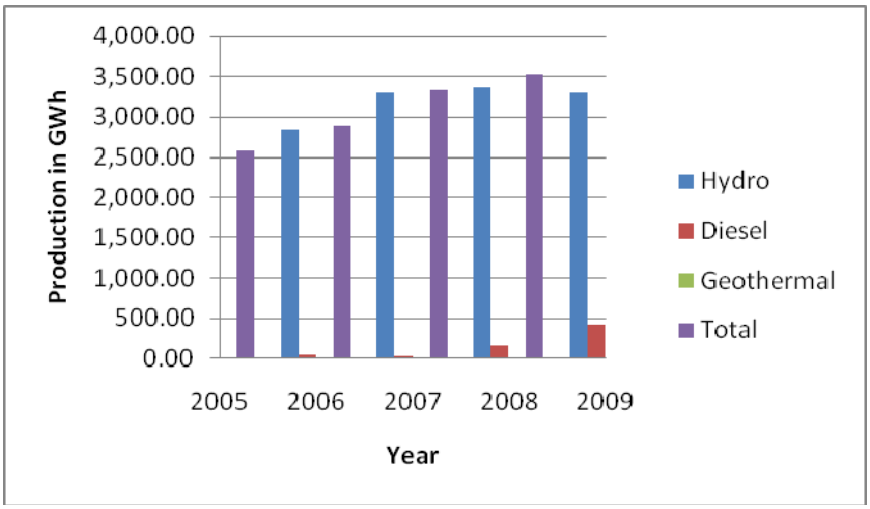
EEPCo is a profit making public enterprise engaged in the production and sales of electricity in Ethiopia. It is the only enterprise responsible for the development of large hydropower projects. EEPCo currently has about 2000 MW[1] generation capacity, comes mostly from Inter Connected System-ICS (99%). The total energy produced in 2008/2009 is reported to be 3,727.78 GWH. The production trend has increased significantly in the last 5 years (see Figure 1.3).

The company's major generation sources are hydropower. Even though there are considerable amount of geothermal, solar and wind energy that could be converted to electricity, sufficient efforts has not been made so far to tap this sources of energy. Electricity produced from diesel is less than 1 % of the total at this moment.

EEPCo has good capacity in operation and maintenance as well as management of the power sector in general. It, however require additional capacity for study, design and construction. The main problem of the institution has been that significant number of the qualified employees have left the company in the last decade due to various reasons including existence of better opportunities on the market.

[1] Includes Tekeze and Gilgel Gibe.

Figure 1.3 Annual Growth of Production of EEPCo



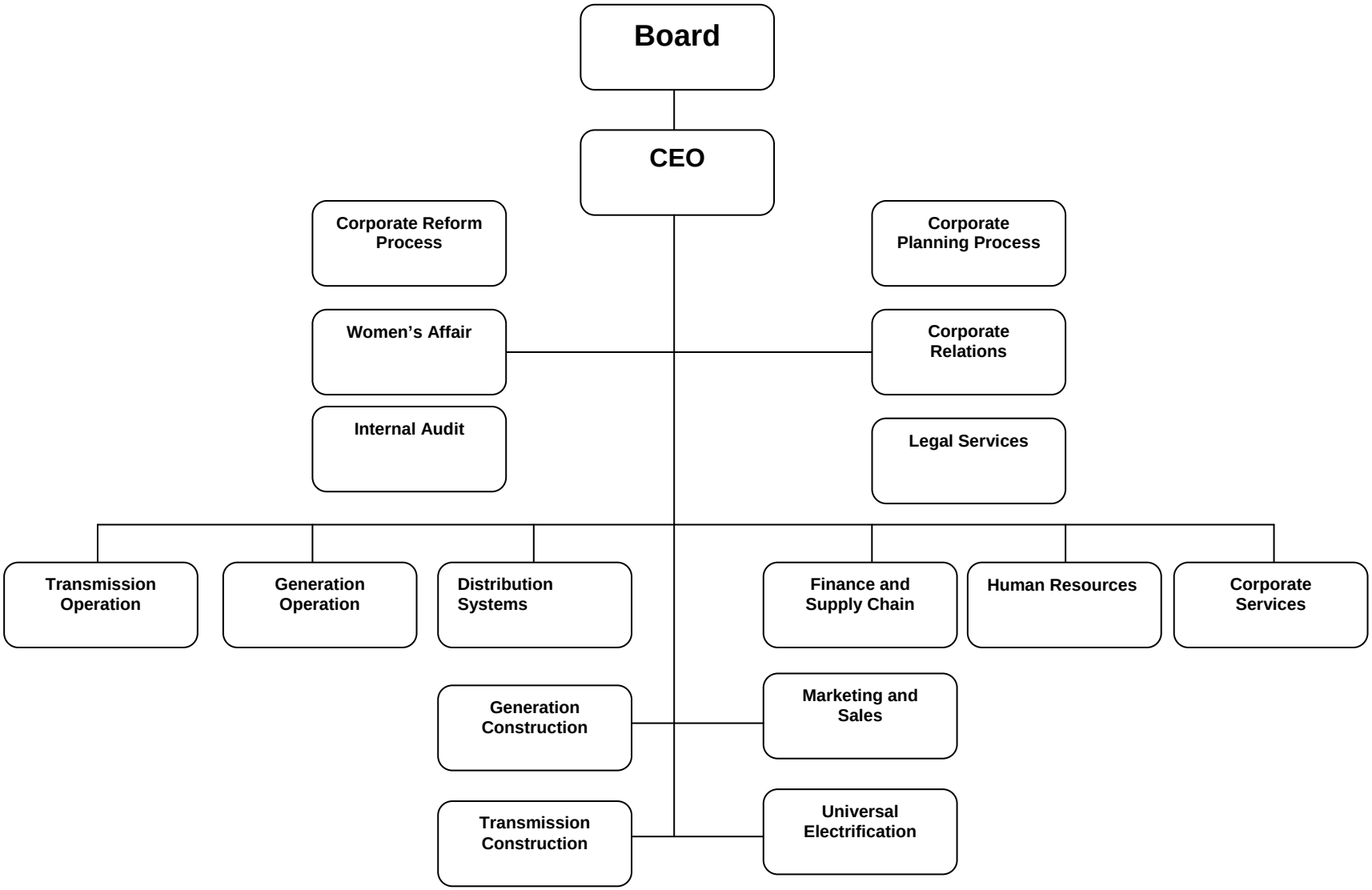
Source: Facts in brief 2009/2009, EEPCo

EEPCo has about 12,292 employees all together. 10,224 of which are male (2,064 female). The great majority of the employees are diploma holders (48.43%), followed by 12th grade or less (42 %), and degree holders are 9.57 % of all employees.

As seen in the organizational structure (Figure 1.4), the six most important units that are directly related to electricity production are Transmission, Generation, Distribution, Generation Construction, Transmission Construction and Universal Electrification (rural). The remaining ten are support units.

Large hydropower constructions including transmissions are outsourced to international and national contractors. Distributions are mostly done by the company. EEPCo has well experienced professionals who are able to manage the development of hydropower in the country but they are not in sufficient number. Like other Ethiopian institutions the employees require more training to handle large hydropower projects such as the ones intended in the JMP. The company needs training to handle the SSEA strategies and plans.

Figure 1.4 Organizational Structure of EEPCo



1.6 WATER SUPPLY AND SEWERAGE SERVICES

Major institutions working on water supply and sanitation in the country both at federal and regional as well as at lower administration level are Water Supply and Sewerage Services of towns, and the water committees of rural communities. The MoWR and Bureau of Water Resources (Regional water organ) also provide technical support to the Water Supply and Sewerage Services and Water Committees. Additionally the health sector institutions also provide support to the water supply entities in matters relating to public health and sanitation.

1.7 BASIN LEVEL INSTITUTION

The Ministry of Water Resources has established the Abbay River Basin Authority (ARBA) in line with the aforementioned Proc. 234./2007. The functions of the ARBA include:

- Decision-making, collaborative planning and programming,;
- Knowledge, monitoring & evaluation;
- Regulatory functions - Water Resources Administration;
- Financial functions (charges and collection);
- Promotion of "sustainable development" projects in the frame of the Basin program.

1.8 REGIONAL INSTITUTIONS

At the regional level, there are parallel institutions to those that of the Federal Ministries. Counterpart institutions described for federal government are also available at the regions and zonal and woreda level of disaggregation.

The Woreda Council plays an important role in initial identification and final decision making for water resources development projects for both small urban and rural areas. It is also responsible for the execution of sanitation programs.

Although the Zonal administration comes after the regional government in hierarchy, it plays limited roles in the implementation of projects. Its task is mainly to supervise projects and programs implemented at Woreda level. The Woreda Administration provides administrative and political support for all water resources, including irrigation, small scale hydropower and water supply and sanitation development in the Woreda.

The most important player in the development at rural level are perhaps the communities themselves, which are often mobilized for natural resources development activities. The community participates in the planning, construction and, often, operation and maintenance of Woreda water resources projects undertaken at the village level. Communities are also fully responsible for the operation and maintenance of their water supplies and sanitation activities of the villages (Kebele).

2 SUDAN

In the Sudan federal system there are three levels of authority: national level, state level and locality level. The powers over land and other natural resources are divided among the various levels as follows:

- At the national level, the federal organs exercise the power of planning, legislation and execution on federal lands, natural resources, mineral and subterranean wealth, inter – state waters, national electricity projects, epidemics and disasters.

- The state organs within the boundaries of the state exercise power on state lands, natural resources, animal resources, wildlife, non-Nile waters and electric power.
- There are concurrent powers where both federal (national) and state organs exercise power on education, health, environment, tourism, industry and meteorology.

2.1 MINISTRY OF IRRIGATION AND WATER RESOURCES (MIWR)

As of the year 1992, comprehensive review of policies and legislations has taken place, under which the MIWR embraced most of the functions, namely, policy making legislation, planning, and coordination of all the water resource activities.

The objectives of the Ministry are:

- Full utilization of Sudan's share of Nile water and the expected one of reducing wastage projects from Nile water.
- The available exploitation of khors, wadis and nonnilotic rivers water.
- Increasing of irrigated agricultural areas.
- Developing and modernizing of irrigation systems and increase its effectiveness.
- Providing of drinking water and get-red of thirsty problems for human being and animals in nomadic, rural urban areas.
- Making required balance in providing water for different consumed sectors.
- Conservation of environment and ecosystem in exploitation of different water resources and approval of scientific method and research in utilization and protection of water resources against pollution.
- Developing of regional cooperation in different water resources affairs.
- Guiding with scientific research and supporting abilities in different fields to develop our water resources management.

Functions and mission:

- According to the Decree (34, September, 2005 the function has been determined as follows:-
- Setting up of national policies and plans for irrigation and utilization of water resources and working on its development and modernization.
- Monitoring of water resources in country and collecting its information, data and its analysis and reforming.
- Designing and reforming of irrigated engineering projects and reforming of engineering designing and its approval and its supervision.
- Making scientific research in hydraulic facilities fields and irrigation canals, rivers courses sediment and flood impacts, all the concerning with development and operation of irrigation and water resources facilities.
- Putting policies, programs and projects for development of drinking water for rural, urban areas and working on providing drinking water in international standers.
- Operation of dams and its management in efficiency and effectiveness and supervised on its maintenance.
- Developing and reforming the indicators of operation and maintenance activities to irrigation services units in schemes.

In addition to this, the Ministry of Irrigation and water resources functions and missions is to providing operation and maintenance services and improvement of irrigation systems in national schemes that represents in AL Gezira, Rahad, New Halfa and Suki schemes.

2.2 MINISTRY OF IRRIGATION AND WATER RESOURCES (GOVERNMENT OF SOUTHERN SUDAN)

The Government of Southern Sudan also has its own Ministry of Irrigation and Water Resources. The Ministry performs the following functions and duties:

- Draw up and oversee the implementation of policies, guidelines, master plans and regulations for water resources development, conservation and management in Southern Sudan;
- Encourage and where appropriate, fund scientific research into the development of water resources in Southern Sudan;
- Oversee the operation of the Water Corporation of Southern Sudan to ensure it performs its functions as laid out in the relevant Act;
- Undertake or supervise the design, construction and management of dams and other surface water storage infrastructure for irrigation, human and animal consumption and hydro-electricity generation;
- Set tariffs for the sale of water for whatever purpose;
- Draw up policy on rural and urban water resource development and management;
- Implement ground-water supplies of drinking water for the rural populations and make provisions for local community management and maintenance of constructed water supplies until such times as State and local governments have the capacity to undertake such functions;
- Initiate irrigation development and management schemes;
- Inspection of rural water yards;
- Draw up and oversee the implementation of rural flood control policy;
- Protection of the Sudd and other wetlands from pollution;
- Participate in international bodies charged with management of the Nile River basin;
- Water hyacinth management and control;
- Map water resources and carry out hydrological studies and research;
- Design and implement surface water resources projects including those for irrigation schemes;
- Establish flood warning schemes and other measures to protect against floods; and
- Advise and support States and local governments in their responsibilities for water supply and build their capacity to assume all functions vested by the Constitution and GoSS policy.

The Ministry is composed of the following directorates:

- General Administration and Finance;
- Directorate of Planning and projects;
- Directorate of Hydrology and survey;
- Directorate of Water resources management;
- Directorate of Rural water supply and sanitation; and
- Directorate of Irrigation and Drainage.

Projects and Programs:

- Embankment of flood control dikes in floods prone areas of Phom el-Zeraf (Fangak County) and Twic East County, in Jonglei State, so as to protect lives, properties, farmlands and wet season grazing areas from flooding and reclaim lands for returnees;
- Water harvesting constructions (Hafiirs and Barriers), so as to increase spatial and seasonal availability of water for various uses;

- Rehabilitation and construction of rural water supply and sanitation facilities, with emphasis being on guinea worm endemic villages, schools, health centres, market places, administrative centres and other areas where communities congregate;
- In close collaboration with the Southern Sudan Urban Water Corporation (SSUWC) that was established to operate urban water facilities, improve their sustainability and expand the service coverage;
- Operation, maintenance, management, rehabilitation, and provision of Irrigation facilities, in an effort to boost food security;
- Collection and archiving of data pertaining to Water Resources;
- Preparation of Water Resources Management, Rural Water Supply and Sanitation, and Urban Water Supply and Sanitation Strategies for the implementation of the Government of Southern Sudan Water Policy;
- Projects of Investment Cooperation with some Chinese Public Companies: In 2006 the Ministry signed MOU with China Construction and Machinery Company (CCM); and in collaboration with CCM experts, surveys were carried out for the opening of blocked rivers in the Zeraf Island and for the construction of a bridge to allow navigation of the Bahr el-Ghazal at Bentiu;
- Projects of Technical and Development cooperation with Egypt: The Government of Egypt offered and pledged six projects at a value of 26.6 million US dollars, over a period of three years;
- National Projects through the Dams Implementation Unit (DIU): Since October 2006, the Ministry started coordination of DIU activities in Southern Sudan;
- The Nile Basin Initiative (NBI): In collaboration with the Nile Basin Initiative (NBI) Subsidiary Action Programmes; namely the Eastern Nile Subsidiary Action Programme (ENSAP) and the Nile Equatorial Lakes Subsidiary Action Programme (NELSAP); and Training and Capacity Building.

Publications and Policies include:

- Government of Southern Sudan Water Policy;
- National Technical Guidelines and Manuals for Water Supply and Sanitation Facilities; and
- Draft Drinking Water Quality Guidelines

2.3 HIGHER COUNCIL FOR ENVIRONMENT AND NATURAL RESOURCES (HCENR)

The Higher Council for Environment and Natural Resources was founded in 1992, as part of the Sudan's follow-up to the Rio Conference, with the task of coordinating national plans and policies on the environment. Headed by a federal minister, the Ministry of Environment and Physical Development is the main government organization responsible for the protection of environment and resource conservation. The Ministry works with the Higher Council for Environment and Natural Resources (HCENR). The HCENR is a high-level committee comprising the Minister of Environment and Physical Development as the Chairperson; the Khartoum State Governor; federal ministers; environmentalists and community representatives. The functions of the Council include policy formulation and approval of standards. The state governors chair the SCENR.

The HCENR discharges its functions through a General Secretariat with the following mandates:

- Draft general policies for natural resource inventories and development to ensure the appropriate management of the resources and their conservation and sustainable use;

- Environment conservation in coordination with the appropriate authorities in the States;
- Coordinate the work of the Council Branches and all efforts in natural resource inventories and conservation, efforts for the sustainable development of the resources, and monitor changes in the natural resources;
- Specify areas subjected to depletion, desertification and pollution and decide on priorities for surveys and studies on natural resources;
- Make long-term plans for rational and the balanced use of natural resources and environment conservation, and follow-up the execution of the plan with the appropriate authorities;
- Periodically review legislation related to natural resources and the environment, make sure that laws are effective and introduce any necessary amendments to improve the laws;
- Establishment of branches in the different States to help the Council in performing its responsibilities;
- Encourage support and coordinate scientific research in all fields of the environment and natural resources;
- Formulate a federal plan for environmental awareness and rational use of the natural resources, and try to incorporate environmental education in school curricula.

The HCENR's objectives are the sustainable utilisation, rational development and conservation of natural resources, undertaken through line Ministries and public bodies. Apart from steering through the new environment law, the HCENR has coordinated major projects on Strategic Planning (funded by UNDP, 1996-1999), on Climate Change (funded by GEF, 1998-2001) and on a Biodiversity Action Plan (funded by GEF, 1999-2003).

2.4 MINISTRY OF INTERNATIONAL COOPERATION (MIC)

The functions of the Ministry are expressed as follows:-

- Design and coordinate plans and policies of international cooperation with the purpose of construction and development.
- Attraction of foreign resources presented by countries, organizations, international financial institutions as well as regional institutions and coordinates such business.
- Follow- up the execution of international cooperation agreements with ministries responsible for the executions of such projects and the use foreign resources available through these agreements.
- Follow –up the work of ministerial joint committees with countries with the aim of supervision, execution and follow- up.
- Attraction and coordination and follow – up of grant on both bilateral and regional levels.
- Coordinate Sudan's external relation with organizations, regional and international institutions (other than financial) and related to Sudan.
- Associated Organizations include: UNDP, EU Programme, UNDP for population activities; World Food Programme; UNESCO and IGAD.

2.5 MINISTRY OF AGRICULTURE AND FORESTRY (MOAF)

In 2008, the Ministry issued its Agricultural Revitalization Programme, which will cover the period 2007-2011. One of the most important features of the programme is the call for "Investment in infrastructure to be a priority, with 39.4% of the total Investment allocated for that for that purpose"; then followed by investment in the development and protection of natural resources, which has been assigned 9.8% of the total investment;

then the building of marketing and export infrastructure that have been allocated 7.5% and 6.6%of the total investment respectively.

2.6 MINISTRY OF SOCIAL WELFARE, WOMEN AND CHILD AFFAIRS (MSWWCA)

The Ministry belongs to the service sector as indicated by the Constitutional Decree 34 issued in 2005, with the sector main objectives as "Accomplishing building of a unified, secured, civilized advanced Sudanese Nation" (Service Sector, Sector's plan for the years 2007- 2011).

In its plan for 2008 the Ministry proposes the preparation of a National Strategy for combating poverty, which aims at determining the national indicators of poverty, as well as specifying the neediest regions of the country. Moreover, the goal of the Ministry is to assist the needy families; and turning them into productive families. The strategy will be implemented by the Poverty Coordination Center at the Ministry besides other related parties (Service Sector, Sector's plan for the Year 2008.November 2007).

2.7 STATE COUNCIL FOR ENVIRONMENT AND NATURAL RESOURCES

The Environmental Protection Act 2001 empowers each state to establish its own independent State Council for Environment and Natural Resources (SCENR) with the responsibilities to coordinate and follow-up the state effort to ensure public participation in the decision making process, to play an active role in coordinating the formulation and implementation of conservation policies as well as to foster environmental monitoring, protection and regulation. However, like most other states in Sudan, the Northern State is yet to promulgate an act for the establishment of the State Council Environment and Natural Resources (SCENR)

2.8 WILDLIFE CONSERVATION GENERAL ADMINISTRATION

The Wildlife Conservation General Administration (WCGA) is responsible for formulation of national wildlife policies; co-ordination with provincial wildlife departments on the implementation of these policies; and co-ordination with international organizations on matters related to international treaties. The WCGA works under the Ministry of Interior

2.9 ANTIQUITIES AND MUSEUMS NATIONAL CORPORATION

The Antiquities and Museums National Corporation (AMNC) under the Federal Ministry of Culture is the custodian of the nation's cultural heritage. The main functions of the Department are as follows:

- Preservation and conservation of historical and archaeological monuments
- Exploration and excavation
- Collaboration with foreign archaeological missions working at various sites in Sudan
- Control of movement of cultural property
- Establishment and maintenance of museums
- Treatment and restoration of antiquities
- Administration of the Antiquities and Museums National Corporation Act, 1991
- Research on epigraphy, numismatics, and other relevant fields of archaeology
- Organisation of seminars, symposia, and workshops at the national and international level

The State governments have not yet enacted laws governing archaeological and historical sites.

2.10 DAMS IMPLEMENTATION UNIT

The Dams Implementation Unit (DIU) is an upgrading of the Merowe Dam Project Implementation Unit (MDPIU), which was headed by the State Minister for Irrigation and Water Resources. DIU is an autonomous body directly under the Office of the President of the Republic with a status of full Federal Ministry. The responsibility for the formulation and execution of resettlement and compensation policies is assigned to the Commission for Environmental and Social Affairs of the DIU.

2.11 CIVIL SOCIETY

Numerous national and local NGOs are active in the social sector in the Northern State: emergency support, rehabilitation, health, and education. Other areas include environmental conservation, income generation, poverty reduction, vocational training, nutrition and food security, and maternal, child health and family planning. The most important NGO in the Northern State is the Sudanese Red Crescent working in disaster (mainly flood) management.

The Sudanese Environment Conservation Society (SECS) is the most popular in terms of its composition and size of membership, regional coverage, and the range of environmental issues tackled. However, in the Northern State SECS branches are among the most inactive in the country.

3 EGYPT

3.1 MINISTRY OF WATER RESOURCES AND IRRIGATION (MWRI)

The MWRI has sole legal responsibility for the planning and management of all water resources in Egypt. It is responsible for providing water of suitable quality to all users. To accomplish this goal, the Ministry has to ensure that appropriate measures are undertaken to protect both the quantity and the quality of Egypt's water resources. In practice, very little attention has been given to water quality management, which represents a relatively small portion of the overall activities although priorities are now being reassessed. Law 48 for the protection of the Nile and its waterways assigns to MWRI legal responsibility over the following functions:

- Issue and cancellation of discharge permits into Egyptian waterways, which include the Nile, canals and drainage networks, lakes and groundwater reservoirs;
- Inspection of wastewater treatment facilities;
- Monitoring of intake sites for potable water treatment plants as well as municipal and industrial discharges;
- Delegating responsibility of proper sampling and analyses of discharges are carried out by the Ministry of Health; levying of fines for non-compliance;
- Setting of regulations and specifications for discharges into water bodies;
- Issue and oversee of licenses for new waste treatment units in floating vessels;
- Issue of licenses for the construction of any establishment that directly discharges into waterways;

The following authorities operate under MWRI:

- The Egyptian Public Authority for the High Dam and Aswan Reservoir is responsible for operation of the Aswan High Dam. Its functions are the following:
  - Operating and maintaining the High Dam and Aswan Dam;
  - Monitoring water levels upstream and downstream the High Dam;
  - Monitoring water levels in Lake Nasser;
  - Studying and executing all supplementary projects necessary for the High Dam and Aswan Dam;
  - Monitoring and studying earthquakes in Aswan region.
- The Egyptian Public Authority for Drainage Projects (EPADP) is a public implementing agency responsible for the construction and maintenance of drains. EPADP has the following responsibilities:
  - Creating the general plan for the EPADP;
  - Designing and executing the surface drainage network;
  - Designing and executing the sub-surface drainage network;
  - Designing and executing drainage pump stations;
  - Designing pipes required for sub-surface drainage;
  - Maintenance of surface drainage network;
  - Maintenance of sub-surface drainage network.
- The Egyptian Public Authority for Shore Protection, also called Shore Protection Authority (SPA), is responsible for the planning of shore protection activities. In 1981, the SPA (Egyptian Shore Protection Authority) was established to study and deal with the problem as a socioeconomic issue. Most of the eroded shore areas had had very successful protection works carried out.
- The National Water Research Center (NWRC) acts as the lead organization for the Water and Food in the Nile basin. The national institutions dealing with water resources in the ten riparian countries are potential stakeholders.

Through NWRC, a close collaboration with the ongoing process of cooperation or reform (e.g., Nile Basin Initiative, Nile River Basin Cooperative Framework Project, Nile Basin Water Resources Projects, and Lake Victoria Environment Management Project) is maintained.

The NWRC was established in 1975 by the Ministry of Water Resources Irrigation (MWRI). It is the organization responsible for research in water related fields. NWRC is composed of twelve research institutes. The NWRC through its different institutes is conducting researches in irrigation, drainage, water distribution, hydraulics, river engineering, water resources planning and management, hydraulic structures and shore protection. The main objectives of the NWRC are to propose and study long-term water resources policies and solve the technical and applied problems associated with general policies for irrigation, drainage, and water resources. In addition, the NWRC is responsible for research activities conducted for the extension of agriculture land and utilizing water resources of the country in the most efficient and cost-effective way. On the regional scale, NWRC acts as the Coordination unit for the African Water Resources Network and is a member of the water resources networks in Europe and Middle East countries.

- The Regional Center for Training and Water Studies had been launched in 2002, when an agreement was signed to put the Center under the auspices of UNESCO, as a Regional Center. The Center started the mission under the name of Regional Center for Training and Water Studies for Arid and Semi-arid Region (RCTWS). The RCTWS for Arid and Semi-arid Region has the goal to contribute to different programs of capacity building in the field of integrated water resources management,

water engineering, environment and water-related sciences that meets the needs of professionals, engineers and technicians, in Egypt, as well as the Arid and Semi-arid zones and African countries. It pursues the following objectives:

- To function as a vital regional center in the generation, transfer, and exchange of knowledge in the field of water resources management, water engineering, and water-related sciences;
- To conduct high-quality training and education in relevant subjects and fields of work and experience;
- To promote scientific studies, stimulate and coordinate applied research and enhance awareness creation in this field;
- To play a pivotal role in stimulating connectivity between knowledge institutions, and in establishing regional networks for scientific cooperation, knowledge management and information exchange.

The MWRI through its Water Quality Management Unit (WQMU) has delegated most of the water quality monitoring tasks of both surface and groundwater to the NWRC. NWRC and its Institutes are monitoring the water quality status on regional and national level at strategic locations. While awaiting the amended Law 12 to be ratified, MWRI has the powers to establish Water User's Organizations (WUAs, WUOs, and Water Councils) by Ministerial Decree and determine their functions. This decree is in place.

3.2 MINISTRY OF ENVIRONMENTAL AFFAIRS /EEAA

At the national level, the recently established Ministry of Environmental Affairs (MoEA) has the portfolio for environment in the Egyptian Cabinet of Ministers. Within this Ministry, the EEAA has the responsibility for setting national policy for the environment and coordinating environmental management activities within the government. The EEAA's functions, as established by law 4/1994, include:

- Conducting studies; formulating the national plan for environmental protection;
- Preparing legislation, decrees, and regulations as needed to protect the environment;
- Setting requirements for EIAs of projects;
- Monitoring compliance with standards and norms;
- Coordinating enforcement actions; managing natural protectorates;
- Promoting environmental education.

Law 4/1994, the most recent and comprehensive law gives the EEAA the authority to regulate air pollution, management of hazardous wastes, and discharges to the marine environment. Furthermore, the law gives the EEAA an array of tools for implementing and enforcing these provisions, including traditional regulatory controls (e.g.. emission standards for air pollutants), economic instruments, compliance monitoring, inspection, and enforcement (e.g., penalties, closures, and imprisonment).

Thus, the EEAA has significant authority over industry under this law, including the authority to require industries to keep records of the environmental impact of their activities, to collect and analyze samples to ensure that standards are being met, and in the case of a violation to shut down a facility within 60 days if the violation has not been corrected. The EEAA has promulgated regulations implementing the air pollution, marine discharge, and EIA provisions of the law and is in the process of completing regulations for the management of hazardous substances and wastes.

3.3 MINISTRY OF HEALTH AND POPULATION (MOHP)

The MoHP has been given a central role in water quality management, especially in setting standards for the quality of the following:

- Potable water sources (River Nile, canals and groundwater wells);
- Drain water that can be mixed with other water for drinking water;
- Industrial and sewage treatment plant discharges;
- Wastes discharged from river vessels; and

Besides developing standards, the MoHP must sample and analyze all industrial and municipal effluents and all drinking water treatment plant influents and effluents as well, which is considered a significant load of work.

3.4 MINISTRY OF HOUSING, UTILITIES AND NEW COMMUNITIES (MHUNC)

Within the Ministry of Housing, Utilities and Urban Communities (MHUNC), the National Organization for Potable Water and Sanitary Drainage (NOPWASD) has the responsibility for planning, design and construction of municipal drinking water purification plants, distribution systems, sewage collection systems, and municipal wastewater treatment plants. Once the facilities have been installed, NOPWASD organizes training, but the responsibilities for operation and maintenance are left to the regional or local authorities. NOPWASD has the intention to inspect each plant regularly, but in practice this very much depends on the cooperation of the various governorates. Many domestic wastewater treatment plants are currently in poor condition.

The Holding Company for Water and Waste established by virtue of the Presidential Decree number 135/2004, under the Minister of MUNHC, has been entrusted the general economic authorities and public sector companies for water and wastewater in Cairo, Alexandria, Beheira, Damietta, Sharqia, Gharbia, Kafr El Sheikh, Dakahlia, Fayoum, BeniSuef, Minia and Aswan. It has its judicial personality according to the provisions of Law 203/1991 and its executive regulation. The purpose of the company is treating, transporting, transmitting and selling drinking water; and collecting, treating and safely disposing wastewater by itself or by its subsidiary companies as well as establishing, managing and rotating a portfolio to ensure financing bonds, stocks and instruments and any other financial tools or instruments.

The regional wastewater authorities and other bodies affiliated that are responsible for both water and wastewater treatments include:

- The General Organization for Sanitary Drainage in Cairo (GOSDC)
- General Organization for Greater Cairo Water Supply (GOGCWS)
- The Alexandria General Organization for Sanitary Drainage (AGOSD)
- The Alexandria Water General Authority (AWGA)
- The Suez Canal Authority
- A number of private companies for wastewater treatment in Damietta, Kafr El Sheikh, Beheira and other Governorates.

3.5 MINISTRY OF INDUSTRY AND MINERAL WEALTH

Within the Ministry of Industry and Mineral Wealth (MIMW), the General Organization for Industrialization (GOFI) supervises pollution control, safety and health issues in industry through its General Department for Environmental Protection. It also ensures that new plants include industrial waste treatment units. MIMW decree No. 380 of 1982 requires

compliance with all applicable environmental laws, regulations, and standards as a condition for granting industrial licenses. A clause to this effect is written into all industrial licenses granted by the MIMW, committing the industry to taking the necessary preventive measures, such as installing necessary control equipment. However, GOFI does not perform any inspections at industries and, therefore, does not monitor whether industries are actually in compliance with these license requirements.

3.6 MINISTRY OF THE INTERIOR (MOI)

Egypt's national police force, has for some time maintained the Inland Water Police, a special police force for enforcement of Law 48 and protection of the environment in general. The Inland Water Police provide guidance to citizens and take enforcement actions for violations of environmental laws. Law 4/1994 provides additional authority for this environmental police force, specifying that the MoI shall form a police force specialized in environmental protection within the ministry and in its Security Departments in the governorates (Article 65 of the executive regulations).

3.7 MINISTRY OF AGRICULTURE AND LAND RECLAMATION (MALR)

MALR develops policies related to cropping patterns and farm production. Moreover they are in charge of water distribution at field level and reclamation of new agricultural land. With respect to water quality management issues, their policies on the use and subsidy reduction of fertilizers and pesticides is important. In addition, MALR is responsible for fisheries and fish farms (aquaculture).

The Soil, Water and Environment Research Institute is part of the MALR and is responsible for research on many subjects such as water and soil quality studies on pollution, bioconversion of agricultural wastes, reuse of sewage wastewater for irrigation, saline and saline-alkaline soils, fertilizer and pesticide use and effects.

3.8 MINISTRY OF LOCAL DEVELOPMENT (MOLD)

The MoLD co-ordinates all activities of the government’s line agencies at the governorate and local-community levels. MoLD identifies the programs needed to improve services at these levels, including drinking water, sanitation, and protection of the environment. The required funds are shared between the Government budget, the local public, the concerned communities, and donors.

3.9 MINISTRY OF ELECTRICITY AND ENERGY (MOEE)

The MoEE is responsible for power generation; hence it coordinates with MWRI regarding hydropower generation. The MOEE also operates thermal power plants that draw water from the Nile for cooling purposes. The return flows may cause thermal pollution.

3.10 MINISTRY OF TRANSPORTATION (MOT)

The River Transport Authority (RTA) of the MoT manages navigation activities along the course of the Nile and main canals downstream of the Aswan Dam, in coordination with MWRI. The activities include dredging, as there are navigational bottlenecks at the shallow sections of the Nile and the main canals.

3.11 MINISTRY OF TOURISM

The Ministry of Tourism requires that MWRI maintain a depth of water in the Nile and main canals as sufficient for commercial and recreational navigation (e.g., floating hotels and tourist vessels) as well as for aesthetic purposes. The same applies for the coastal tourist areas on the North coast and the Red Sea.

3.12 WATER USERS ASSOCIATIONS

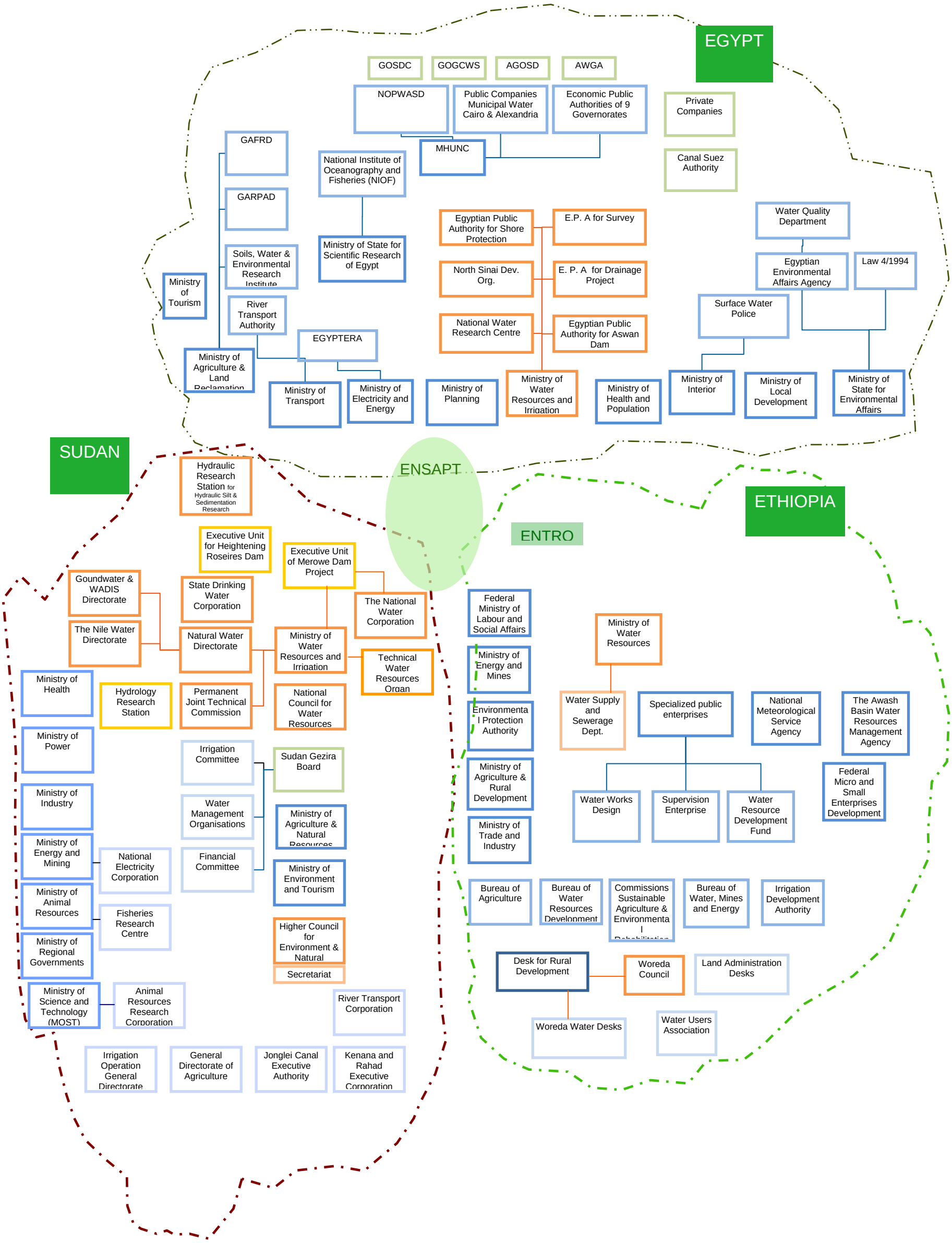
The December 1984 Law on irrigation and drainage allow the *mesqas'* management by the Water Users Association. Its amendment in 1994, defines a legal framework for those associations (functions, office composition…). This legislation attempts to protect the farmers, their right to conduct irrigation and the association's budget. It is highlighted from the legislative perspective that the farmers must organize themselves as WUA to make sure innovation is considered. Water Users Associations are local water resource management organizations.

The *mesqa* is managed by the Water User Associations at village level that report to and are managed by the *markaz* level Water Boards. Then, the *markaz* level report to the Water Board's Committee or Executive Board constituted of representatives of agriculture, industry and of residents living and operating in a given area that falls under the jurisdiction of the Water Board. Even though they are primarily concerned with equitable management of water resources, they look for alternate options of disposal when rural households evacuate their waste waters into the canals. These and other measures can also be implemented in whole or in part by civil society organizations (CSOs).

3.13 RELATED RESEARCH INSTITUTIONS

- Cairo University
- The Hydraulics Research Institute (HRI) is one of twelve research institutes within the National Water Research Center (NWRC) of the Ministry of Water Resources & Irrigation (MWRI). It was established in 1975 to take over and extend the work of the Hydraulic Research & Experiment Station founded in 1949.The Institute is one of the oldest hydraulic institutes in the Middle East and Africa. HRI was and still one of the largest specialized Institutes in the region in water related research and river hydraulics studies.
- The Consultative Group on International Agricultural Research (CGIAR) established in 1971 is a strategic partnership of diverse donors guided by a vision of reduced poverty and hunger, improved human health and nutrition, and greater ecosystem resilience, brought about through high-quality international agricultural research, partnership and leadership. CGIAR is involved is the Challenge Program on Water and Food to offer a multidisciplinary research framework for the design of transboundary solutions to the Nile basin's many challenges. The program, led by Egypt's NWRC, is complementing ongoing activities and cooperating with national and other stakeholder organizations in the region.

Figure B-1 Diagram of main Institutions related to the JMP-1



Appendix C

Threatened Species

TABLE OF CONTENTS

1 ANIMAL INFO - ETHIOPIA

Contents

Threatened Species

Threatened Species: The following list includes all mammals which occur in Ethiopia and are rated as Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) in the 2004 IUCN Red List of Threatened Animals.

- **Critically Endangered**:
  - **African Wild Ass** (*Equus africanus*).
  - **Bilen Gerbil** (*Gerbillus bilensis*). (**Endemic** to Ethiopia.)
  - **Black Rhinoceros** (*Diceros bicornis*).
  - **Ethiopian Wolf (Simien Jackal)** (*Canis simensis*). (**Endemic** to Ethiopia.)
  - **Guramba Shrew** (*Crocidura phaeura*). (**Endemic** to Ethiopia.)
  - **Harenna Shrew** (*Crocidura harenna*). (**Endemic** to Ethiopia.)
  - **MacMillan's Shrew** (*Crocidura macmillani*). (**Endemic** to Ethiopia.)
  - **Walia Ibex** (*Capra walie*). (**Endemic** to Ethiopia.)
- **Endangered**:
  - **Grevy's Zebra** (*Equus grevyi*).
  - **Mountain Nyala** (*Tragelaphus buxtoni*). (**Endemic** to Ethiopia.)
  - **Nubian Ibex** (*Capra nubiana*).
  - **Wild Dog** (*Lycaon pictus*).
- **Vulnerable**:
  - **African Elephant** (*Loxodonta africana*).
  - **Ammodile (Gerbil Family)** (*Ammodillus imbellis*).
  - **Bailey's Shrew** (*Crocidura baileyi*). (**Endemic** to Ethiopia.)
  - **Bale Shrew** (*Crocidura bottegoides*). (**Endemic** to Ethiopia.)
  - **Beira Antelope** (*Dorcatragus megalotis*).
  - **Cheetah** (*Acinonyx jubatus*).
  - **Dibatag** (*Ammodorcas clarkei*).
  - **Dorcas Gazelle** (*Gazella dorcas*).
  - **Glass's Shrew** (*Crocidura glassi*). (**Endemic** to Ethiopia.)
  - **Large-eared Free-tailed Bat** (*Otomops martiensseni*).
  - **Lesser Horseshoe Bat** (*Rhinolophus hipposideros*).
  - **Lion** (*Panthera leo*).
  - **Moorland Shrew** (*Crocidura lucina*). (**Endemic** to Ethiopia.)
  - **Morris's Bat** (*Myotis morrisi*).
  - **Mouse-tailed Bat Species** (*Rhinopoma macinnesi*).

- **Natal Free-tailed Bat** (*Mormopterus acetabulosus*).
- **Nikolaus's Mouse** (*Megadendromus nikolausi*). (**Endemic** to Ethiopia.)
- **Patrizi's Trident Leaf-nosed Bat** (*Asellia patrizii*).
- **Red-fronted Gazelle** (*Gazella rufifrons*).
- **Rupp's Mouse** (*Myomys ruppi*). (**Endemic** to Ethiopia.)
- **Scott's Mouse-eared Bat** (*Myotis scotti*). (**Endemic** to Ethiopia.)
- **Soemmerring's Gazelle** (*Gazella soemmerringii*).
- **Speke's Gazelle** (*Gazella spekei*).
- **Spotted-necked Otter** (*Lutra maculicollis*).
- **Stripe-backed Mouse** (*Muriculus imberbis*). (**Endemic** to Ethiopia.)

Environmental and Social Data

Mammals

Total number of species: 255 *(Groombridge & Jenkins 1994)*
Number of endemic species: 31 *(Groombridge & Jenkins 1994)*
Number of threatened species: 1996: 35 (14 % of total species) (*IUCN 1996*); 2000: 37 (15% of total species) *(IUCN 2000)*

Biodiversity/Ecosystems

Ethiopia contains portions of the Sudanian Savannas, East African Acacia Savannas, Sudd Flooded Grasslands & Savannas, Ethiopian Highlands, and Rift Valley Lakes
Global 200 Ecoregions *(Olson & Dinerstein 1998, Olson & Dinerstein 1999)*

Population

Population in 1995: 55,979,000 *(Natl. Geog. Soc. 1995)*
Population density in 1995: 50.9 people/sq km (131.7 people/sq mi) *(Natl. Geog. Soc. 1995)*
Population in 1998: 58,390,351 *(World Almanac 1999)*
Average population growth rate, 1980 - 1990: 3.1 % *(World Bank 1992)*

Area/Land Use

Area: 1,100,574 sq km (424,934 sq mi) *(Natl. Geog. Soc. 1995)*
Percentages of primary world ecosystem types:

- Major Wetland: 1 %
- Desert and Semi-desert: 2 %
- Grass and Shrub: 41 %
- Crop and Settlements: 4 %
- Interrupted Woods: 32 %
- Major Forests: 20 %

(Groombridge 1992)

Percent of land area classified as the following degree of human disturbance: Low: 2 %; Medium: 93 %; High: 5 % *(WRI 1994)*

Protected Lands

Area: 25,340 sq km (9,781 sq mi) *(Natl. Geog. Soc. 1995)*
Percent of land protected: 2.48 % totally protected; 0 % partially protected; 2.48 % totally or partially protected *(Groombridge 1992)*

Economy

Per capita GNP ($ U.S.) (1991): $123 *(WRI 1994)*
Per capita GDP ($ U.S.) (1996): $430 *(World Almanac 1999)*

Education

Percent of females in secondary education (1989): 12 % *(World Bank 1992)*

References and Links

References: Groombridge 1992, Groombridge & Jenkins 1994, IUCN 1994, IUCN 1996, IUCN 2000, IUCN 2004, Natl. Geog. Soc. 1995, Olson & Dinerstein 1998, Olson & Dinerstein 1999, World Almanac 1999, World Bank 1992, WRI 1994

General Links (After you get to one of these sites, click on the link for Ethiopia): CIA World Factbook, Foreign Embassies of Washington, D.C., Library of Congress - Country Studies, University of Texas - Country Maps, Washington Post - Countries, World Resources Institute - Country Profiles

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2 ANIMAL INFO - SUDAN

Contents

Threatened Species

Threatened Species: The following list includes all mammals which occur in Sudan and are rated as Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) in the 2004 IUCN Red List of Threatened Animals.

Critically Endangered:

Addax (*Addax nasomaculatus*).

African Wild Ass (*Equus africanus*).

Burton's Gerbil (*Gerbillus burtoni*). (**Endemic** to Sudan.)

Four-spotted Gerbil (*Gerbillus quadrimaculatus*). (**Endemic** to Sudan.)

Lowe's Gerbil (*Gerbillus lowei*). (**Endemic** to Sudan.)

Principal Gerbil (*Gerbillus principulus*). (**Endemic** to Sudan.)

Endangered:

Chimpanzee (*Pan troglodytes*).

Dama Gazelle (*Gazella dama*).

Giant African Water Shrew (*Potamogale velox*).

Grevy's Zebra (*Equus grevyi*).

Nubian Ibex (*Capra nubiana*).

Slender-horned Gazelle (*Gazella leptoceros*).

Wild Dog (*Lycaon pictus*).

Vulnerable:

African Elephant (*Loxodonta africana*).

Barbary Sheep (*Ammotragus lervia*).

Cheetah (*Acinonyx jubatus*).

Desert Pipistrelle (Bat) (*Pipistrellus ariel*).

Dorcas Gazelle (*Gazella dorcas*).

Dugong (*Dugong dugon*).

Large-eared Free-tailed Bat (*Otomops martiensseni*).

Lesser Horseshoe Bat (*Rhinolophus hipposideros*).

Lion (*Panthera leo*).

Red-fronted Gazelle (*Gazella rufifrons*).

Soemmerring's Gazelle (*Gazella soemmerringii*).

Spotted-necked Otter (*Lutra maculicollis*).

Tomb Bat Species (*Taphozous hamiltoni*).

Environmental and Social Data

Mammals

Total number of species: 267 *(Groombridge & Jenkins 1994)*
Number of endemic species: 11 *(Groombridge & Jenkins 1994)*
Number of threatened species: 1996: 21 (8 % of total species) (*IUCN 1996*); 2000: 26 (10 % of total species) *(IUCN 2000)*

Biodiversity/Ecosystems

Sudan contains portions of the Northeastern Congo Basin Forests, Sudanian Savannas, East African Acacia Savannas, Red Sea Fog Woodlands, Sudd Flooded Grasslands & Savannas, Ethiopian Highlands, and Red Sea Marine Ecosystems **Global 200 Ecoregions** *(Olson & Dinerstein 1998, Olson & Dinerstein 1999)*

Population

Population in 1995: 28,098,000 *(Natl. Geog. Soc. 1995)*
Population density in 1995: 11.2 people/sq km (29.0 people/sq mi) *(Natl. Geog. Soc. 1995)*
Population in 1998: 33,550,552 *(World Almanac 1999)*
Average population growth rate, 1980 - 1990: 2.7 % *(World Bank 1992)*

Area/Land Use

Area: 2,505,814 sq km (967,500 sq mi) *(Natl. Geog. Soc. 1995)*
Percentages of primary world ecosystem types:

Other Coastal Aquatic: 1 %

Major Wetland: 2 %

Desert and Semi-desert: 24 %

Grass and Shrub: 52 %

Crop and Settlements: 10 %

Interrupted Woods: 8 %

Major Forests: 2 %

(Groombridge 1992)

Percent of land area classified as the following degree of human disturbance: Low: 32 %, Medium: 59 %, High: 9 % *(WRI 1994)*

Protected Lands

Area: 93,580 sq km (36,122 sq mi) *(Groombridge 1992)*
Percent of land protected: 3.39 % totally protected, 0.34 % partially protected, 3.73 % totally or partially protected *(Groombridge 1992)*

Economy

Per capita GDP ($ U.S.) (1996): $860 *(World Almanac 1999)*

Education

Percent adult literacy: Female: 12 % (1990), 6 % (1970); Male: 43 % (1990) 28 % (1970) *(WRI 1994)*

References and Links

References: Groombridge 1992, Groombridge & Jenkins 1994, IUCN 1994, IUCN 1996, IUCN 2000, IUCN 2004, Natl. Geog. Soc. 1995, Olson & Dinerstein 1998, Olson & Dinerstein 1999, World Almanac 1999, World Bank 1992, WRI 1994

General Links (After you get to one of these sites, click on the link for Sudan): CIA World Factbook, Foreign Embassies of Washington, D.C., Library of Congress - Country Studies, University of Texas - Country Maps, Washington Post - Countries, World Resources Institute - Country Profiles; **Links for Sudan**: Sudan Net

Read more: http://www.animalinfo.org/country/sudan.htm#ixzz0tTE98AJc

3 ANIMAL INFO - EGYPT

Contents

Threatened Species

Threatened Species: The following list includes all mammals which occur in Egypt and are rated as Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) in the 2004 IUCN Red List of Threatened Animals.

Critically Endangered:

Flower's Gerbil (*Gerbillus floweri*). (**Endemic** to Egypt.)

Endangered:

Arabian Oryx (*Oryx leucoryx*).

Flower's Shrew (*Crocidura floweri*). (**Endemic** to Egypt.)

Four-toed Jerboa (*Allactaga tetradactyla*).

Nubian Ibex (*Capra nubiana*).

Slender-horned Gazelle (*Gazella leptoceros*).

Vulnerable:

Barbary Sheep (*Ammotragus lervia*).

Bonhote's Gerbil (*Gerbillus bonhotei*). (**Endemic** to Egypt.)

Desert Pipistrelle (*Pipistrellus ariel*).

Dorcas Gazelle (*Gazella dorcas*).

Dugong (*Dugong dugon*).

Lesser Horseshoe Bat (*Rhinolophus hipposideros*).

Mediterranean Horseshoe Bat (*Rhinolophus euryale*).

Mehelyi's Horseshoe Bat (*Rhinolophus mehelyi*).

Environmental and Social Data

Mammals

Total number of species: 102 *(Groombridge & Jenkins 1994)*
Number of endemic species: 7 *(Groombridge & Jenkins 1994)*
Number of threatened species: 1996: 15 (15 % of total species) (*IUCN 1996*); 2000: 14 (14 % of total species) *(IUCN 2000)*

Biodiversity/Ecosystems

Egypt contains portions of the Red Sea Fog Woodlands and the Red Sea Marine Ecosystems **Global 200 Ecoregions** *(Olson & Dinerstein 1998, Olson & Dinerstein 1999)*

Population

Population in 1995: 61,948,000 *(Natl. Geog. Soc. 1995)*
Population density in 1995: 61.9 people/sq km (160.2 people/sq mi) *(Natl. Geog. Soc. 1995)*
Population in 1998: 66,050,004 *(World Almanac 1999)*
Average population growth rate, 1980 - 1990: 2.4 % *(World Bank 1992)*

Area/Land Use

Area: 1,001,450 sq km (386,662 sq mi) *(Natl. Geog. Soc. 1995)*
Percentages of primary world ecosystem types:

Other Coastal Aquatic: 3 %

Desert and Semi-desert: 76 %

Grass and Shrub: 8 %

Crop and Settlements: 13 %

(Groombridge 1992)

Percent of land area classified as the following degree of human disturbance: Low: 79 %; Medium: 15 %; High: 6 % *(WRI 1994)*

Protected Lands

Area: 8,000 sq km (3,088 sq mi) *(Groombridge 1992)*
Percent of land protected: 0.06 % totally protected; 0.74 % partially protected; 0.8 % totally or partially protected *(Groombridge 1992)*

Economy

Per capita GNP ($ U.S.) (1991): $611 *(WRI 1994)*
Per capita GDP ($ U.S.) (1996): $2,900 *(World Almanac 1999)*

Education

Percent of females in secondary education (1989): 71 % *(World Bank 1992)*
Percent adult literacy: Female: 34 % (1990), 20 % (1970); Male: 63 % (1990), 50 % (1970) *(WRI 1994)*

References and Links

References: Groombridge 1992, Groombridge & Jenkins 1994, IUCN 1994, IUCN 1996, IUCN 2000, IUCN 2004, Natl. Geog. Soc. 1995, Olson & Dinerstein 1998, Olson & Dinerstein 1999, World Almanac 1999, World Bank 1992, WRI 1994

General Links (After you get to one of these sites, click on the link for Egypt): CIA World Factbook, Foreign Embassies of Washington, D.C., Library of Congress - Country Studies, University of Texas - Country Maps, Washington Post - Countries, World Resources Institute - Country Profiles : Egypt Tourism

Read more: http://www.animalinfo.org/country/egypt.htm#ixzz0tTEQr2ab

Appendix D

Maps of Land Use for Dams and Reservoirs Considered in JMP-1

PLATE
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Legend

- Large Dam Site
- Major River
- Kebele Boundary
- Karadobi Reservoi

Karadobi land use

- Bareland; Exposed rock
- Cultivated Land; Rainfed; Cereal Land Cover System
- Grassland
- Shrubland; Dense (>50% woody cover)
- Shrubland; Open (20-50% woody cover)
- Wetland; Open water
- Woodland; Open (20-50% tree cover)

Karadobi land use (see note)	Area_km^2
Bareland; Exposed rock	109.67
Cultivated Land; Rainfed; Cereal Land Cover System	121.77
Grassland	556.45
Shrubland; Dense (>50% woody cover)	36.56
Shrubland; Open (20-50% woody cover)	397.09
Wetland; Open water	0.24
Woodland; Open (20-50% tree cover)	13.4

1, The land use analysis includes an area up to 1 km beyond the estimated reservoir boundary to include potentially affected populations and land use.

2, Detailed land use data are not presently available for Oromia Region.

Source: Cooperative Regional Assessment (CRA) for Watershed Management

Project
Consulting Services for Studies on Identification of Projects Constituting the First Joint Multipurpose Program (JMP-1) on Abbay/BLue-Main Nile

Title
Karadobi Reservoir area land use Buffer 1 km Map

Client
Eastern Nile Technical Regional Office

Consultants
SNC-LAVALIN International
HYDROSULT Inc.

Scale
0 4 8 16 km

Project # 606529

Fichier / File: Karadobi Reservoir LuLc Buffer.mxd

No.	yyyy/mm/dd	Description	Drawn	Verified
00	2010/08/20	Preliminary	S.K.	R. Fontaine

0.0 mi 1.0 mi 2.0 mi 3.0 mi 4.0 mi 5.0 mi 6.0 mi 7.0 mi

PLATE
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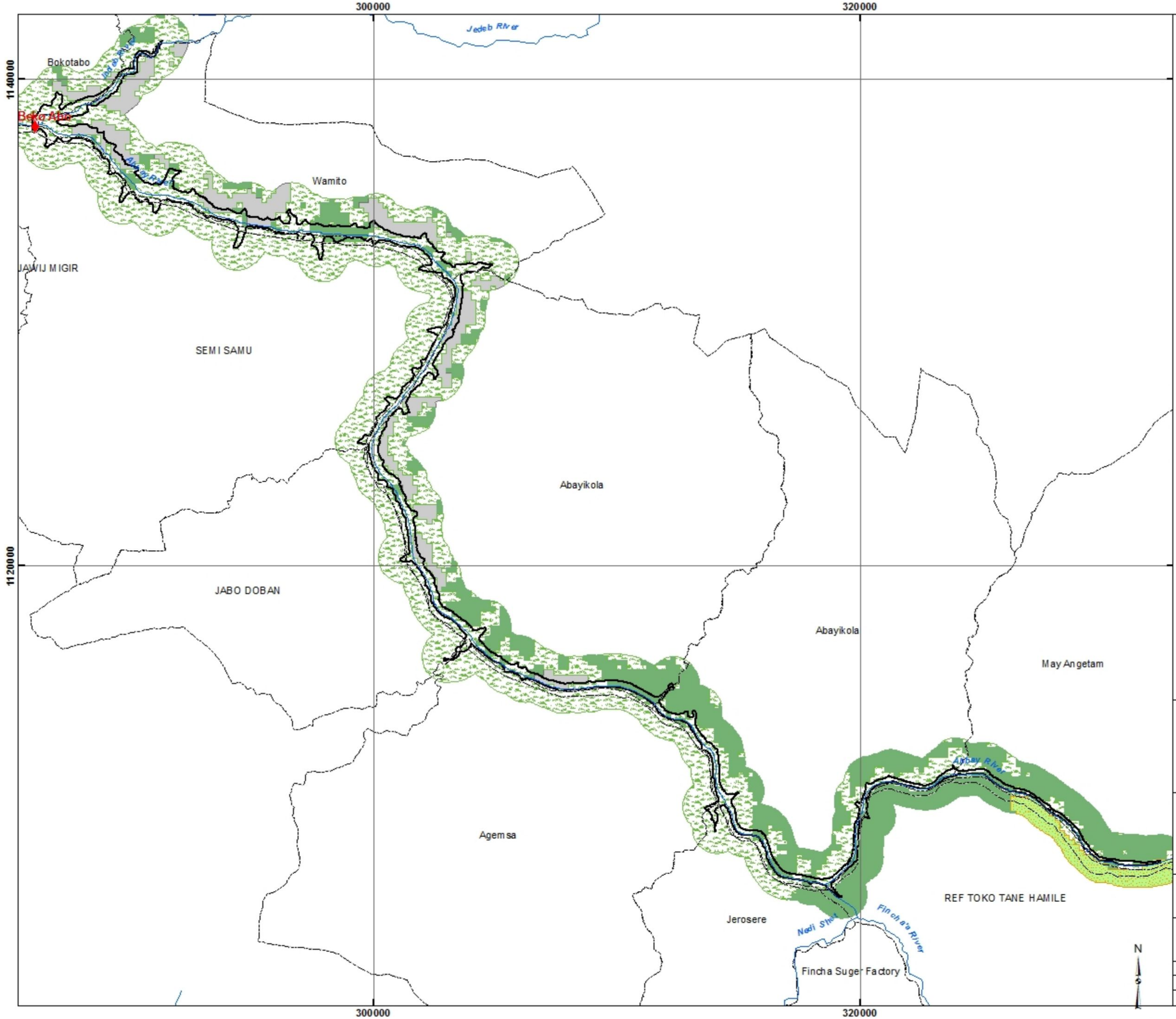

Legend

- Large Dam Site
- Major River
- Kebele Boundary
- Reservoir

Bekoabo land use

- Bareland; Exposed rock
- Grassland
- Shrubland; Open (20-50% woody cover)
- Woodland; Open (20-50% tree cover)

Beko Abo land use (see note)	Area_km2
Bareland; Exposed rock	21.13
Grassland	134.12
Shrubland; Open (20-50% woody cover)	6.38
Woodland; Open (20-50% tree cover)	54.53

1, The land use analysis includes an area up to 1 km beyond the estimated reservoir boundary to include potentially affected populations and land use.

2, Detailed land use data are not presently available for Oromia Region.

Source: Cooperative Regional Assessment (CRA) for Watershed Management

Project

Consulting Services for Studies on Identification of Projects Constituting the First Joint Multipurpose Program (JMP-1) on Abbay/BLue-Main Nile

Title

Beko Abo Reservoir area landuse Buffer Map

Client
Eastern Nile Technical Regional Office

Consultants
SNC-LAVALIN International
HYDROSULT Inc.

Scale
0 1.25 2.5 5 km

Project # 606529

Fichier / File
Beko Abo Reservoir LuLc Buffer.mxd

No.	yyyy/mm/dd	Description	Drawn	Verified
00	2010/08/20	Preliminary	S.K.	R. Fontaine

PLATE
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Legend

- Large Dam Site
- Major River
- Mandaya Reservoir

Mandaya Land use

- Bareland; Exposed rock
- Cultivated Land; Rainfed; Cereal Land Cover System
- Cultivated Land; Shifting cultivation
- Forest; Bamboo; Highland Bamboo; Dense (50-80% crown cover)
- Forest; Bamboo; Highland Bamboo; Open (20-50% crown cover)
- Forest; Riparian; Dense (50-80% crown cover)
- Grassland
- Shrubland; Dense (>50% woody cover)
- Shrubland; Open (20-50% woody cover)
- Wetland; Open water
- Wetland; Seasonal Swamp / Marsh
- Woodland; Dense (>50% tree cover)
- Woodland; Open (20-50% tree cover)

Mandaya Reservoir land use (see Note)	Area_km2
Bareland; Exposed rock	68.27
Cultivated Land; Rainfed; Cereal Land Cover System	0.76
Cultivated Land; Shifting cultivation	19.55
Forest; Bamboo; Highland Bamboo; Dense (50-80% crown cover)	1.4
Forest; Bamboo; Highland Bamboo; Open (20-50% crown cover)	0.29
Forest; Riparian; Dense (50-80% crown cover)	1.01
Grassland	257.02
Shrubland; Dense (>50% woody cover)	554.76
Shrubland; Open (20-50% woody cover)	256.26
Wetland; Open water	44.04
Wetland; Seasonal Swamp / Marsh	0.07
Woodland; Dense (>50% tree cover)	466.24
Woodland; Open (20-50% tree cover)	259.76

1, The land use analysis includes an area up to 1 km beyond the estimated reservoir boundary to include potentially affected populations and land use.

2, Detailed land use data are not presently available for Oromia Region.

Source: Cooperative Regional Assessment (CRA) for Watershed Management

Project

Consulting Services for Studies on Identification of Projects Constituting the First Joint Multipurpose Program (JMP-1) on Abbay/Blue-Main Nile

Title

Mandaya Reservoir area land use buffer 1km Map

Client
Eastern Nile Technical Regional Office

Consultants
SNC-LAVALIN International
HYDROSULT Inc.

Scale
0 4.5 9 18 km

Project # 606529

Fichier / File
Mandaya Reservoir LuLc Buffer.mxd

No.	yyyy/mm/dd	Description	Drawn	Verified
00	2010/08/20	Preliminary	S.K.	R. Fontaine

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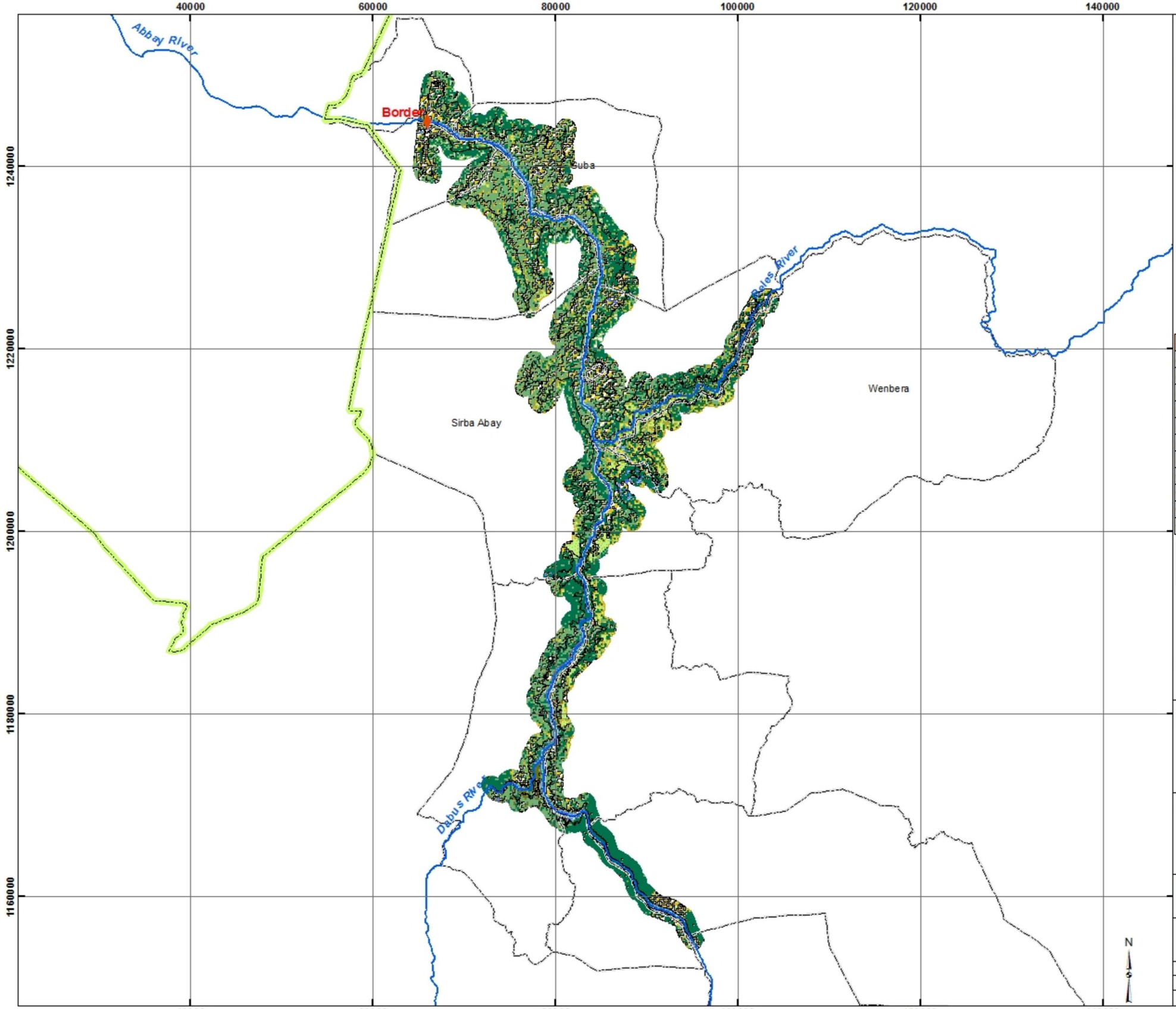

PLATE
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Legend

- Large Dam Site
- International Boundary
- Major River
- Reservoir Area
- Wereda Boundary

Border land use

- Cultivated Land; Rainfed; Cereal Land Cover System
- Cultivated Land; Shifting cultivation
- Forest; Bamboo; Highland Bamboo; Dense (50-80% crown cover)
- Forest; Riparian; Dense (50-80% crown cover)
- Grassland
- Shrubland; Dense (>50% woody cover)
- Shrubland; Open (20-50% woody cover)
- Wetland; Open water
- Wetland; Seasonal Swamp / Marsh
- Woodland; Dense (>50% tree cover)
- Woodland; Open (20-50% tree cover)

Border Reservoir land use (see note)	Area_Km²
Cultivated Land; Rainfed; Cereal Land Cover System	1.3
Cultivated Land; Shifting cultivation	6.72
Forest; Bamboo; Highland Bamboo; Dense (50-80% crown cover)	10.68
Forest; Riparian; Dense (50-80% crown cover)	1.99
Grassland	40.91
Shrubland; Dense (>50% woody cover)	87.84
Shrubland; Open (20-50% woody cover)	187.7
Wetland; Open water	37.28
Wetland; Seasonal Swamp / Marsh	1.68
Woodland; Dense (>50% tree cover)	260.79
Woodland; Open (20-50% tree cover)	199.15

1, The land use analysis includes an area up to 1 km beyond the estimated reservoir boundary to include potentially affected populations and land use.

Source: Cooperative Regional Assessment (CRA) for Watershed Management.

Project

Consulting Services for Studies on Identification of Projects Constituting the First Joint Multipurpose Program (JMP-1) on Abbay/BLue-Main Nile

Title

Border Reservoir area land use Map

Client
Eastern Nile Technical Regional Office

Consultants
SNC-LAVALIN International
HYDROSULT Inc.

Scale
0 3.5 7 14 km

Project # 606529

Fichier / File
Border Reservoir LuLc Buffer.mxd

No.	yyyy/mm/dd	Description	Drawn	Verified
00	2010/08/20	Preliminary	S.K.	R. Fontaine

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