EASTERN NILE TECHNICAL REGIONAL OFFICE, ADDIS ABABA

PROJECT PREPARATION

FLOOD PREPAREDNESS AND EARLY WARNING

INCEPTION REPORT

March 2006

SMEC INTERNATIONAL PTY LTD

Snowy Mountains Engineering Corporation SMEC INTERNATIONAL

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ACRONYMS

CBO	Community Based Organization
CCC	Cold cloud cover
CDO	Civil Defence Organ (Sudan)
CMU	Crisis Management Unit (Ethiopia)
DPFSC	Regional Disaster Prevention & Food Security Commissions (Ethiopia)
DPPA	Disaster Prevention & Preparedness Agency (Ethiopia)
DR	Democratic Republic
DSS	Decision support system
ECMWF	European Centre for Medium-Range Weather Forecasting
EEPCo	Ethiopian Electricity & Power Corporation
EMF	Environmental Management Framework
ENCOM	Eastern Nile Council of Ministers
ENSAP	Eastern Nile Subsidiary Action Program
ENTRO	Eastern Nile Technical Regional Office
FEWS	Flood Early Warning System
FEWS-NET	Famine Early Warning System Network (USAID)
FFC	Flood Forecast Center (Egypt)
FPEW	Flood Preparedness & Early Warning
GFFS	Galway Flood Forecasting System
HAC	Humanitarian Affairs Commission (Sudan)
HAD	High Aswan Dam
HADA	High Aswan Dam Authority
ITCZ	Inter-tropical convergence zone
MIWR	Ministry of Irrigation & Water Resources (Sudan)
MWR	Ministry of Water Resources (Ethiopia)
MWRI	Ministry of Water Resources & Irrigation (Egypt)
NBI	Nile Basin Initiative
NCCD	National Council of Civil Defense (Sudan)
NCOM	Nile Council of Ministers
NFC	National Flood Coordinator (for FPEW Project)
NFC	Nile Forecast Center (Sudan)
NGO	Non Government Organization
NMA	National Meteorological Agency (Ethiopia)
NOAA	National Oceanic & Atmospheric Administration (USA)
NRI	Nile Research Institute (Cairo)
NWD	Nile Waters Department (Khartoum)
PI	Project Implementation
PIP	Project Implementation Plan
PP	Project Preparation
RBA	River Basin Authority
RFC	Regional Flood Coordinator (for FPEW Project, from ENTRO)
RPF	Resettlement Policy Framework
RWG	Regional Working Group
SMA	Sudan Meteorological Authority
SMEC	Snowy Mountains Engineering Corporation
SNNPR	Southern Nations, Nationalities and Peoples Region (Ethiopia)
TBP	Technical Background Paper
ToR	Terms of Reference
UNESCO	United Nations Educational Scientific & Cultural Organization
WB	The World Bank

EXECUTIVE SUMMARY

This is the Inception Report for the Project Preparation of the Flood Preparedness and Early Warning (FPEW) Project.

FPEW Project

The development objective of the FPEW Project is to reduce human suffering and damages from, and to capture the benefits of, flooding in the Eastern Nile. The project focuses on flood risk management and non-structural approaches to managing the impacts of floods: including floodplain management and flood mitigation planning; flood forecasting and warning; and emergency response and preparedness at regional, national, local and community levels. This will contribute to the longer term goal of establishing a comprehensive regional approach to flood management that integrates watershed, river and floodplain management, and incorporates a suite of structural and non-structural flood mitigation measures within a broad multipurpose framework.

Project Preparation

The project was conceived as a number of proposed components, to be fully defined or modified during Project Preparation.

(1) Flood Mitigation Planning

This component was envisaged as proactive measures to manage the risk of floods while enhancing beneficial effects.

(2) Flood Forecasting and Warning

Development of flood forecasting systems for the Eastern Nile countries is an important measure that should build upon existing forecasting systems and capacity.

(3) Emergency Response and Preparedness

To be most effective, response to a natural disaster warning should be rapid, comprehensive and with clear lines of authority. Because each country has existing organizations and procedures for emergency response, this component was envisaged as strengthening national capacities and developing trans-boundary aspects of emergency response and preparedness.

(4) Regional Component

This component is intended to enhance regional cooperation and collaboration through exchange of expertise and information/data, sharing of experience, professional development and institutional capacity building, and technology transfer regionally and internationally.

During the preceding phase of project conceptualization, ENTRO organized several work components in advance of the Project Preparation. These substantial contributions were intended to facilitate the work of the Consultant during the PP, and in particular recognized that the time available for the PP did not allow sufficient

time for adequate treatment of the social issues in a large number of affected communities.

There are three steps required to complete the PP.

1. Inception Step (completed)

   The Consultant mobilized in Addis Ababa on January 9, 2006, met with ENTRO at a Project Launch for a technical briefing and exchange of information and advice, prepared a more detailed WorkPlan, undertook initial consultations and reviews of readily available information and data to obtain greater depth of understanding of the background and context of the Project, developed a preliminary flood risk management strategy, formulated a consultation and communications plan, and prepared an Inception Report.

2. Project Definition

   The Consultant will undertake technical, social, environmental and economic analyses to enable elements of the flood risk management strategy to be developed and defined. Key outputs of the Project Definition Step will be drafts of the TBP and the PIP. To comply with World Bank guidelines and for subsequent public consultations, an Environmental Management Framework (EMF) and a Resettlement Policy Framework (RPF) will be prepared. Draft Terms of Reference (ToR) will also be prepared to facilitate Project implementation.

3. Finalization of Documents

   After a pre-appraisal mission by the World Bank, review by ENSAP and ENCOM and possible amendment to the project definition, the PIP and ToRs will be finalized to reflect the needs, priorities and capacities of the respective riparian nations and provide ENTRO with the necessary documentation to initiate implementation of the FPEW Project.

Report Structure

After an introductory chapter, the following three chapters undertake a review of existing flood risk management practice in the three Eastern Nile riparian countries of Ethiopia, Sudan and Egypt; including description of the consultations undertaken, and gap analysis to identify where future action can best be directed. Chapter 5 reviews existing regional coordination for flood risk management in the Eastern Nile region, considers the benefits to be achieved through improved regional coordination, and identifies the types of activities to be included in the FPEW Project to promote future coordination. The next three chapters, chapters 6 to 8, undertake a preliminary analysis of needs in each country, and formulate proposed national flood risk management strategies. The strategies are preliminary, and are targeted at the design of the FPEW Project rather than attempting to be comprehensive management strategies.

The final chapter, chapter 9, reviews the ToR for the PP in light of the reviews completed in the Inception step, and then proceeds to present a detailed methodology and work plan for the remainder of the PP.

Comments

In general terms, after the Inception reviews, key practical benefits to be derived from the FPEW Project include:

- Capacity building in Ethiopia, with development of a flood forecasting capability and improvements to the hydrometeorological data acquisition network.
- Institutional strengthening in Sudan for effective delivery of services for emergency response and post-flood relief and recovery.
- Improved flood forecasting for the High Aswan Dam in Egypt, based on improved data acquisition networks in upstream countries.

Improvements to the hydrometeorological data acquisition network will benefit all three countries, although most of this work needs to be done in Ethiopia.

The FPEW Project will also strengthen future regional coordination, and together with greater data transfer and information exchange that will benefit flood management in all three countries. Both Sudan and Egypt have relatively advanced flood forecasting systems, and there would be good value to be derived from conducting forums to exchange experiences and share knowledge.

Recommendations

Some minor modification to how the Project Definition step of the PP should be structured is suggested in chapter 8. This would entail certain rearrangement of the content of proposed components and the separation of 'community preparedness' under a new component.

It is also proposed that the Project embrace certain preliminary work to combat river bank erosion in Sudan and Egypt. Damage from bank erosion, termed *haddam* in Sudan, is of at least as great concern to villagers as damage from inundation when floods overtop river banks, and causes loss of productive land, destruction of housing, and damage to infrastructure such as pumping stations.

These matters were discussed when the RWG met to review the draft report at the end of February 2006. The proposed restructuring of the Project Definition step was not accepted by the RWG, and so will not be implemented. On the other hand, the RWG did accept the need for preliminary work to combat river bank erosion in both Sudan and Egypt, so the detailed methodology for Project Definition has been modified to accommodate this.

1. INTRODUCTION

1.1 NILE BASIN INITIATIVE

The Nile River Basin covers territory in 10 African countries: Burundi, DR of Congo, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Tanzania and Uganda. In 1997, the Nile riparian countries initiated a dialogue on a framework for long-term cooperation, and in 1999 NCOM (Nile Council of Ministers), a Council of Ministers of Water Affairs in the Nile Basin States, launched the Nile Basin Initiative (NBI) to jointly pursue sustainable development and management of the water resources of the Nile River Basin. The ministers agreed on policy guidelines for the NBI and a shared vision to "achieve sustainable socioeconomic development through the equitable utilization of, and benefit from, the common Nile Basin water resources". An NBI Secretariat was established in Entebbe, Uganda.

Subsequently, NCOM approved a broad basin-wide program of collaborative action, exchange of experience, and capacity building (the Shared Vision Program). In parallel, they supported the preparation of sub-basin action programs aimed at physical investments in the Nile Equatorial Lakes region and the Eastern Nile Region – the latter is the Eastern Nile Subsidiary Action Program (ENSAP).

1.2 EASTERN NILE SUBSIDIARY ACTION PROGRAM

Preparation of ENSAP is managed from the Eastern Nile Technical Regional Office (ENTRO) in Addis Ababa, Ethiopia. The Eastern Nile region comprises Ethiopia, Sudan and Egypt. See Figure 1-1. It includes three major tributaries of the Nile: the Blue Nile (Abbay in Ethiopia); the Tekeze (Atbara in Sudan); and the Baro-Akobo (Sobat in Sudan) – as well as the White Nile in southern Sudan, and the Main Nile downstream of Khartoum.

Rainfall is highly variable across the region, varying from moderate to high in the Ethiopian highlands, to very low in the deserts of northern Sudan and southern Egypt. It is also seasonally variable, exhibiting a pronounced summer bias in most areas. The high climatic variability renders the region subject to droughts and floods. Through a cooperative and integrated approach, there is significant opportunity to enhance food production and energy production, mitigate floods and droughts, arrest watershed degradation, reduce erosion and sediment transport, and nurture the environment.

ENSAP is an investment-oriented program for sustainable and equitable development of the water resources of the Eastern Nile to enhance prosperity, security and peace for the countries of the region and their people. Initially the program focuses on identified areas of cooperation, including: irrigation and drainage, hydropower development and trade, watershed management and management of lakes and wetlands, river regulation, management of flood and drought, water quality management, improved water use efficiency, and integrated water resources management.

Guidance for development of investment programs is provided by the following long-term program objectives:

Figure 1-1: Eastern Nile Region

- Ensure efficient water management and optimal use of the resources through equitable utilization and no significant harm;
- Ensure cooperation and joint action between the Eastern Nile countries seeking win-win goals;
- Target poverty eradication and promote economic integration;
- Ensure that ENSAP results in a move from planning to action.

The challenge of developing a strategic framework and implementing projects within a complex major multipurpose investment program requires both thorough examination of the full range of longer term cooperative multipurpose investment opportunities and their potential benefits, costs and impacts; and addressing pressing needs that deserve more urgent attention. The countries have therefore adopted a two-track approach to this development challenge:

- A fast track to select a small but strategic sub-set of sectoral projects that can be readily identified for accelerated preparation, appraisal and implementation;
- A multipurpose track to prepare a multi-country, multipurpose program of investment by developing a strategic approach, undertaking essential baseline studies and very broad consultations, organizing project financing, and preparing the next round of investment projects.

The fast track will enable the early implementation of a few investment projects that will tangibly demonstrate the benefits of cooperation. The following projects have been identified as fast-track:

- Flood Preparedness & Early Warning Project
- Ethiopia-Sudan Transmission Interconnection Project
- Irrigation & Drainage Project
- Eastern Nile Planning Model
- Watershed Management Project

1.3 FLOOD PREPAREDNESS AND EARLY WARNING PROJECT

The FPEW project is one of the fast-track projects identified for priority action under ENSAP.

1.3.1 Objectives and Expected Outcomes

The development objective of the FPEW project is to reduce human suffering and damages from, and capture the benefits of, flooding in the Eastern Nile. The project focuses on flood risk management and non-structural approaches to managing the impacts of floods: including floodplain management and flood mitigation planning; flood forecasting and warning; and emergency response and preparedness at regional, national, local and community levels. This will contribute to the longer term goal of establishing a comprehensive regional approach to flood management that integrates watershed, river and floodplain management, and incorporates a suite of structural and non-structural flood mitigation measures within a broad multipurpose framework.

Outcomes expected from the FPEW project will be refined during the Project Preparation, but are likely to include:

- Assessment of the flood risk in the Eastern Nile region to support flood management planning and ENSAP investment planning.
- Improved floodplain management for major urban centers vulnerable to flood damage, and for flood-prone rural communities.
- Operational flood forecasting systems in Eastern Nile countries with appropriate compatibility and mechanisms for exchange of information and data.
- Improved emergency response by governments at all levels, and enhanced community preparedness.
- Enhanced regional collaboration and cooperation during flood events.

1.3.2 Project Concept

Flooding in the region includes flooding from major rivers (riverine floods), flash flooding from localized rainfall, and seasonal inundation from wetlands. The extent and severity of flooding, and responses to flooding, also vary by country.

During the preceding conceptualization phase, it was determined that project preparation will include formulation of national and regional flood risk management strategies, and development of project implementation plans for priority actions. It was further agreed that forecasting activities to be included in the PP would focus on riverine flooding. Flood mitigation planning, and emergency response and community preparedness activities would focus on selected riverine areas in each country, namely:

- in Ethiopia, selected flood-prone areas, particularly in the Lake Tana area;
- in Sudan, major urban areas and selected rural communities at risk from flooding along the Blue Nile and Main Nile;
- in Egypt, primarily related to operations of High Aswan Dam (HAD) to improve flood protection and mitigate downstream flood risk.

The project was conceived as a number of proposed components, to be fully defined or modified during Project Preparation.

(1) Flood Mitigation Planning

This component was envisaged as proactive measures to manage the risk of floods while enhancing beneficial effects. It was intended to embrace practical measures to identify flood risk and implement community-based plans to manage flood risk. A preliminary step in risk assessment is the mapping of flood-prone areas using topographic, hydrological and hydraulic analyses, followed by determination of the exposure to flood hazard, and assessment of the vulnerability of people, property and infrastructure exposed. This information is essential not only to identify practical flood mitigation options, but also to design flood forecasting and warning systems, planning of emergency response and community preparedness, and for long-term investment planning by ENSAP. This component was envisaged as work required to identify and implement a range of cost-effective measures to reduce flood damages, such as floodplain and land use management; small-scale structural measures; voluntary resettlement; improved communication of flood warnings; amended reservoir operations; design standards for structures in flood

risk areas; public education programs. Other important elements for sustainability of flood mitigation planning are: institutional capacity building; training of professional staff; and participation and mobilization of stakeholders, where key stakeholders include communities at risk from flooding, public service providers, and other organizations that provide assistance and aid.

(2) Flood Forecasting and Warning

Development of flood forecasting systems for the Eastern Nile countries is an important measure that should build upon existing forecasting systems and capacity. Key elements of flood forecasting and warning systems include: data acquisition networks and data transmission; data processing and archiving; operational forecast modeling systems; flood warning, dissemination and communications. With respect to flood warnings, effective delivery of relevant information in a form readily understood by and useful to intended users, from government agencies to floodplain dwellers, is essential. Supporting measures may include strengthening of existing institutions, quality assurance procedures, professional development programs, and community education programs.

(3) Emergency Response and Preparedness

To be most effective, response to a natural disaster warning should be rapid, comprehensive and with clear lines of authority. Because each country has existing organizations and procedures for emergency response, this component was envisaged as strengthening national capacities and developing trans-boundary aspects of emergency response and preparedness. A key focus would be on providing appropriate services to stakeholders whose lives or property are at risk from flooding, which might entail, for example: institutional strengthening; review of emergency response plans; supporting communities to prepare and improve capacity for self-help; improved organization of post-flood recovery services; and coordinating information exchange among the countries in the region and with the international community during and after flood disasters.

(4) Regional Component

This component is intended to enhance regional cooperation and collaboration through exchange of expertise and information/data, sharing of experience, professional development and institutional capacity building, and technology transfer regionally and internationally. These aims might be achieved by developing compatible technology and information data-bases; establishing formal mechanisms and organizational linkages for information exchange; coordination of emergency response efforts; organization of regular fora; joint activities to support national capacity building, technical initiatives and good practice guidelines; and facilitating regional studies and analyses.

1.3.3 Pre-Preparation Work

During the preceding phase of project conceptualization, ENTRO organized several work components in advance of the Project Preparation.

- National Flood Coordinators in Sudan and Ethiopia prepared background reports on flood management in their countries (Bakhiet, 2004; Golla, 2004);
- The Regional Flood Coordinator for ENTRO prepared a detailed background paper covering issues in all three countries (Seid, 2004);

- Consultants were engaged to conduct baseline social surveys in Sudan (Abdelati, 2005) and in Ethiopia (Teshome, 2005);
- An international consultant was engaged to consolidate the two baseline social surveys and provide operational guidelines for the social assessment work to be undertaken during the PP (Bush, 2005);
- Another international consultant was engaged to undertake a preliminary review of flood hydrology and make a rapid assessment of flood damages in Sudan (Cawood, 2005).

These substantial contributions were intended to facilitate the work of the Consultant during the PP, and in particular recognized that the time available for the PP did not allow sufficient time for adequate treatment of the social issues in a large number of affected communities. The pre-preparation work listed above provides a very sound foundation for the investigations which are to follow.

1.4 PROJECT PREPARATION

The current phase of work that is the subject of this report is the Project Preparation.

The PP requires an iterative process of consultation and analysis to refine the project concept and components, identify and prioritize tasks and activities, prepare a project budget, conduct technical, economic and financial analyses, identify social and environmental issues, determine implementation and institutional arrangements, define monitoring and evaluation activities, and prepare necessary documentation.

1.4.1 Organization

There are three steps required to complete the PP.

4. Inception Step

   The Consultant mobilizes in Addis Ababa, meets with ENTRO at a Project Launch for a technical briefing and exchange of information and advice, prepares a more detailed WorkPlan, undertakes initial consultations and reviews readily available information and data to obtain greater depth of understanding of the background and context of the Project, develops a preliminary flood risk management strategy, formulates a consultation and communications plan, and prepares an Inception Report and outlines of a Technical Background Paper (TBP) and Project Implementation Plan (PIP).

5. Project Definition

   The Consultant undertakes technical, social, environmental and economic analyses. Through the analyses and further consultations, elements of the flood risk management strategy will be developed and defined. Key outputs of the Project Definition Step will be drafts of the TBP and the PIP. To comply with World Bank guidelines and for subsequent public consultations, an Environmental Management Framework (EMF) and a Resettlement Policy Framework (RPF) will be prepared. Draft Terms of Reference (ToR) will also be prepared to facilitate Project implementation.

6. Finalization of Documents
   After a pre-appraisal mission by the World Bank, review by ENSAP and ENCOM and possible amendment to the project definition, the PIP and ToRs will be finalized to reflect the needs, priorities and capacities of the respective riparian nations and provide ENTRO with the necessary documentation to initiate implementation of the FPEW Project.

The organization of the PP is depicted in Figure 1-2.

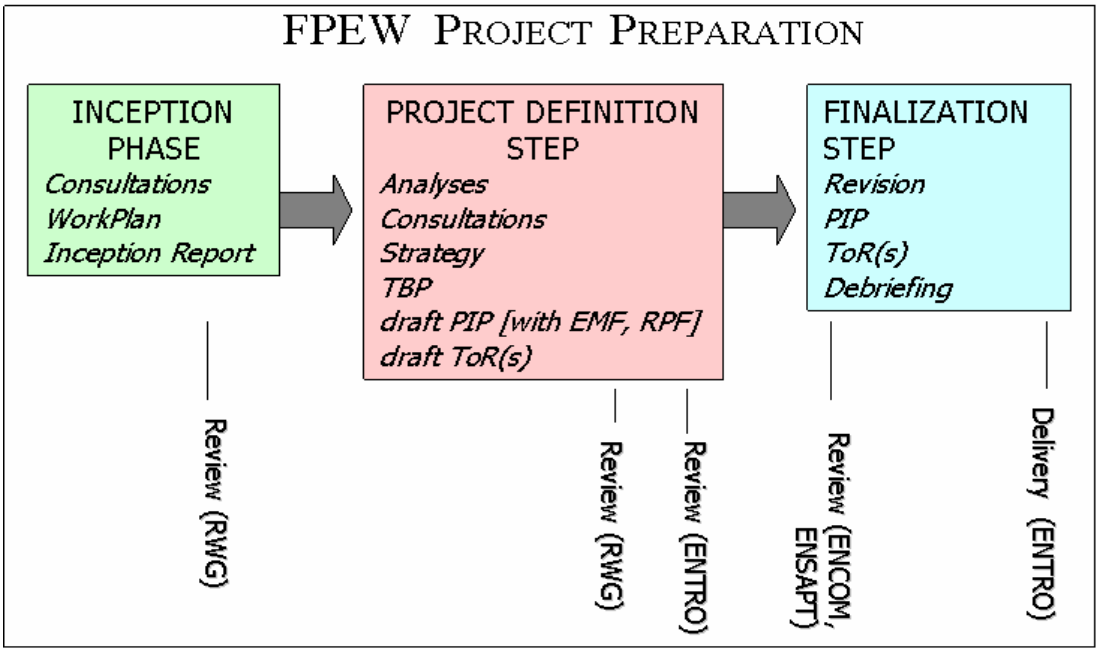


Figure 1-2: Organization of Project Preparation

ENTRO has appointed a Regional Flood Coordinator to manage the FPEW Project and assist the Consultant, and each country has nominated a National Flood Coordinator (NFC).

A Regional Working Group (RWG) has been set up by ENTRO to plan the FPEW Project and to review the work of the Consultant. The RWG comprises three government representatives from each of the three participating countries, and members from the ENSAP Team, as well as the RFC and the three NFCs.

1.4.2 Key Deliverables

The final products of the PP include the following:

- Technical Background Paper (TBP), that reports on the analyses undertaken, the decision-making processes, options considered, and recommendations. A record of all consultations will be appended to the TBP. The TBP will be reviewed at national and regional levels, including review by the RWG and ENTRO.
- Project Implementation Plan (PIP), that includes: detailed description of components, tasks and activities; detailed budget for implementation; financial and economic analyses; identification of risks, and financing plan; implementation and institutional arrangements; plan for implementation, including schedule, procurement and financial management arrangements, and disbursement schedule; proposed monitoring and

feedback, including indicators and results framework; summary of consultations; and, integrated EMF and RPF.

- Environmental Management Framework (EMF) and Resettlement Policy Framework (RPF) as stand-alone documents, extracted from the PIP for public disclosure.
- Terms of Reference (ToR) for initiating Project implementation. There may be more than one ToR if it is appropriate for the Project to be implemented as a set of sub-projects.

1.4.3 Activity to Date

The Consultant's Team Leader commenced work in Addis Ababa on January 9, 2006. After a preliminary meeting with ENTRO, the Project Launch took place over two days on January 16 and 17. The Project Launch included discussions with and presentations from officials of ENTRO and the World Bank, author of the baseline social study report for Ethiopia and a surrogate for the author of the baseline social study report for Sudan, the Ethiopian NFC, and by tele-conference with international advisors to the World Bank on flood management (Mr Michael Cawood) and social assessment (Ms Jennifer Bush).

Consultations were undertaken with stakeholders in Egypt during a visit to Cairo from January 28 to 31. Consultations were undertaken with stakeholders in Sudan during a visit to that country from February 4 to 8. The latter visit included site visits for field inspections and/or community consultations to three sites on the Blue Nile and Main Nile. Consultations were undertaken with stakeholders in Ethiopia (Addis Ababa) between January 23 and February 10. A summary of the consultations is presented in Appendix A.

In addition to the Team Leader, the international Team Institutional Specialist has been working on the PP from January 26 to February 13. He accompanied the TL and RFC on the visit to Sudan. Local specialists have also been engaged by the Consultant and were briefed on the requirements of the PP. There are two local specialists from each of Ethiopia and Sudan on the team, and one from Egypt.

A meeting of the RWG was convened on 28th February and 1st March of 2006 to review and discuss the draft Inception Report, and advise the Consultant prior to the Project Definition step. The RWG meeting comprised a workshop on the draft Inception Report, followed by another workshop on the ToR proposed by ENTRO for a separate but related project for a first phase of implementation of the FPEW Project (outlined in chapter 5 of this report).

The draft report was revised based on advice and comment received from the meeting participants. An outline or description of the principle issues raised at the RWG workshop on the draft Inception Report is presented in Appendix F. A more detailed record of the draft Inception Report workshop is under preparation for ENTRO.

1.5 REPORT ORGANIZATION

The Inception Report is organized as follows. Following this introductory chapter, there are three chapters that report on the existing arrangements for flood management in the three riparian countries of the East Nile region. Chapter 2 is an account of flood management in Ethiopia. Chapter 3 is an account of flood management in Sudan. Chapter 4 is an account

of flood management in Egypt, with a focus on the operations of the HAD. Each chapter contains analysis of existing gaps and constraints.

Chapter 5 reviews regional coordination in flood risk management in the Eastern Nile region and develops a strategic framework for improved future coordination. It also reviews current regional activity relevant to future implementation of the FPEW Project.

The next three chapters, chapters 6 to 8, identify the needs for future flood management in each of the three riparian countries. A preliminary national flood management strategy is proposed for consideration by each country. At this stage it remains a strategic framework, and may be modified after review or be supplemented by the contributions of international specialists yet to work on the PP.

Chapter 8 comments on the organization of the PP, and proposes a detailed plan of work activity for the completion of the PP. It is proposed that the work of the Consultant on the PP be completed by October 2006, however this will be subject to timing of reviews which are outside the control of the Consultant.

1.6 MANAGING FLOOD RISK

Terminology related to flood management varies considerably, and there are different conceptual approaches. The conceptual approach conditions the way we think about the problem, and how we proceed to deal with the problem. For discussion purposes, the conceptual approach favored by the Consultant is outlined below for consideration by the RWG.

Flood management is concerned with managing the risk of adverse impacts arising from floods. It can therefore be termed "flood risk management". This requires definition of flood risk, and also of risk management in the context of flooding. A useful definition of risk is offered in the box below. According to that definition, there are three essential elements of flood risk: flood **hazard**, **exposure** (of people, property or infrastructure) to the hazard, and **vulnerability** to the danger and/or damage because of exposure to the hazard. Without all three of the elements of hazard, exposure and vulnerability there would be no risk[1]. It is a useful definition of flood risk because all of the measures we adopt in flood risk management attempt to modify one or other of these three elements of flood risk.

It is important to recognize that risk management is not only (or not always) directed at risk reduction. Management of flood risk may have other objectives too. More generally, management aims at deriving the greatest net benefit to society. This entails assessment of the positive and adverse impacts of flood management activities in economic, social and environmental terms.

[1] While there may be a flood hazard without exposure, it is very unlikely that there would be exposure to a flood hazard without some vulnerability to danger or damage

DEFINITION OF FLOOD RISK

Risk = Hazard x Exposure x Vulnerability

Hazard exists where land is subject to inundation by floods (*i.e.* flood-prone land). Level of hazard depends upon flood depth, frequency, velocity, duration, *etc*.

Exposure refers to people living or using land where hazard exists, and private property or public infrastructure (assets) located in land where hazard exists.

Vulnerability relates to the degree of danger to people exposed to flood hazard, and the level of damages incurred by assets exposed to flood hazard.

MODIFYING HAZARD	MODIFYING EXPOSURE	MODIFYING VULNERABILITY
Structural Works: storages diversions levees/dikes channel enlargement *etc*.	Land Use Management: flood hazard zoning development controls property acquisition resettlement raising building floor levels	Community Preparedness awareness; practical advice/support Flood Forecasting: hydrologic/hydraulic modeling flood risk maps data acquisition networks
Watershed Management: reforestation soil conservation upland land use management		Flood Warning & Emergency Response: communications systems decision support systems rescue & evacuation Post-Flood Recovery Services: support services: health material assistance: food, shelter infrastructure rehabilitation, *etc*. Land Use Management: building regulations

BOX 1

Floodplains have always been desirable sites for human development. The most arable lands are in floodplains, their fertility and soils replenished by a succession of floods, and so floodplains are favored for agriculture. Flatter slopes also favor ease of construction, ease of access, and efficient supply of water and other services. It is unrealistic to exclude development from floodplains because a flood hazard exists. In the interests of national and social development, some development on floodplains must be permitted (*eg*. Jarraud,

2005), however it must be managed wisely to achieve the trade-off that maximizes the margin between development benefits and flood risk disbenefits[2].

[2] Green *et al*. (2000), reporting for the World Commission on Dams (WCD), state: "In the case of flooding, the appropriate economic objective is to maximize the efficiency of use of the catchment and not to minimize flood losses. Trends in national flood losses need not provide any guide to the success or failure of the national flood ... management strategy adopted: it can be readily shown that efficient flood ... management policy can be accompanied by a rise in both flood losses and the costs of flood management." The implication is that the costs incurred by increased flood losses and costs of flood management may be acceptable, if they are outweighed by the positive value of development benefits (*ie*. if the benefits significantly exceed the dis-benefits). This is perfectly logical, and especially in developing countries and in circumstances of rapid national development, even though it runs counter to a popular expectation that increased expenditure in flood management should be accompanied by a decrease in flood losses.

2. FLOOD RISK MANAGEMENT IN ETHIOPIA

2.1 GEOGRAPHY AND CLIMATE

2.1.1 General

Ethiopia is part of the East African region commonly referred to as the Horn of Africa. The country is situated between 3° 30' and 15° N latitude and between 33° and 48° E longitude, and covers an area of approximately 1.13 million km^2. Ethiopia is bordered by Somalia and Djibouti to the east, the Sudan to the west, Eritrea to the north and Kenya to the south.

A prominent feature of the Ethiopian topography is its rugged landscape, with the Great Rift Valley which runs from north to south, dividing the country into the Central Highlands and the Eastern Highlands. Ethiopia's landscape generally comprises mountain chains, plateaus, deep canyons, river valleys and rolling plains. Elevation varies from 110m below sea level in Dallol Depression to more than 4600m in the Semien Mountains. There are also extensive lowland areas with elevations under 1000 m on the western, eastern and southern margins of the country.

Ethiopia is divided into nine federal regional states and two administrative councils. In alphabetical order, the regional states are: Affar; Amhara; Benishangule-Gumuz; Gambella; Harari; Oromia; Somali; Southern Nations, Nationalities and Peoples Region (SNNPR); and Tigray. Addis Ababa and Dire Dawa are the two administrative councils.

The Ethiopian economy is dominated by subsistence smallholder agriculture, which accounts for about 46% of GDP and 85% of employment. The contribution to GDP of other sectors of the economy is as follows: industries 12%, distribution and other services 42%. Given the huge rural population, the contribution of agriculture to GDP is relatively small. This implies that the income level and standard of living of the rural population is low. The per capita income of the country is said to be less than US$110, which is one of the lowest in sub-Saharan Africa.

The population of Ethiopia reached 75 million in 2006. The proportion of the population that is less than 15 years of age is 42 %, indicating that much of the population is dependent. According to the Human Resources Development Report of the UNDP, published in 2002, life expectancy at birth was 43.9. About 31% of the population earned less than US$1 per day. Infant mortality was 117 per 1000 live births. Only 24% of the population had access to safe water; 15% of the population had access to sanitation services. All economic and social indicators demonstrate that Ethiopia is at a very low level of development.

2.1.2 Nile River Basin

The Eastern Nile river basin is restricted to the western and northern parts of the country, primarily draining the Central Highlands and a part of the southern lowlands in the southwest. See Figure 2-1. Regions wholly or partly included in the river basin are Gambella, Amhara, Benishangule-Gumuz, Tigray and Oromia.

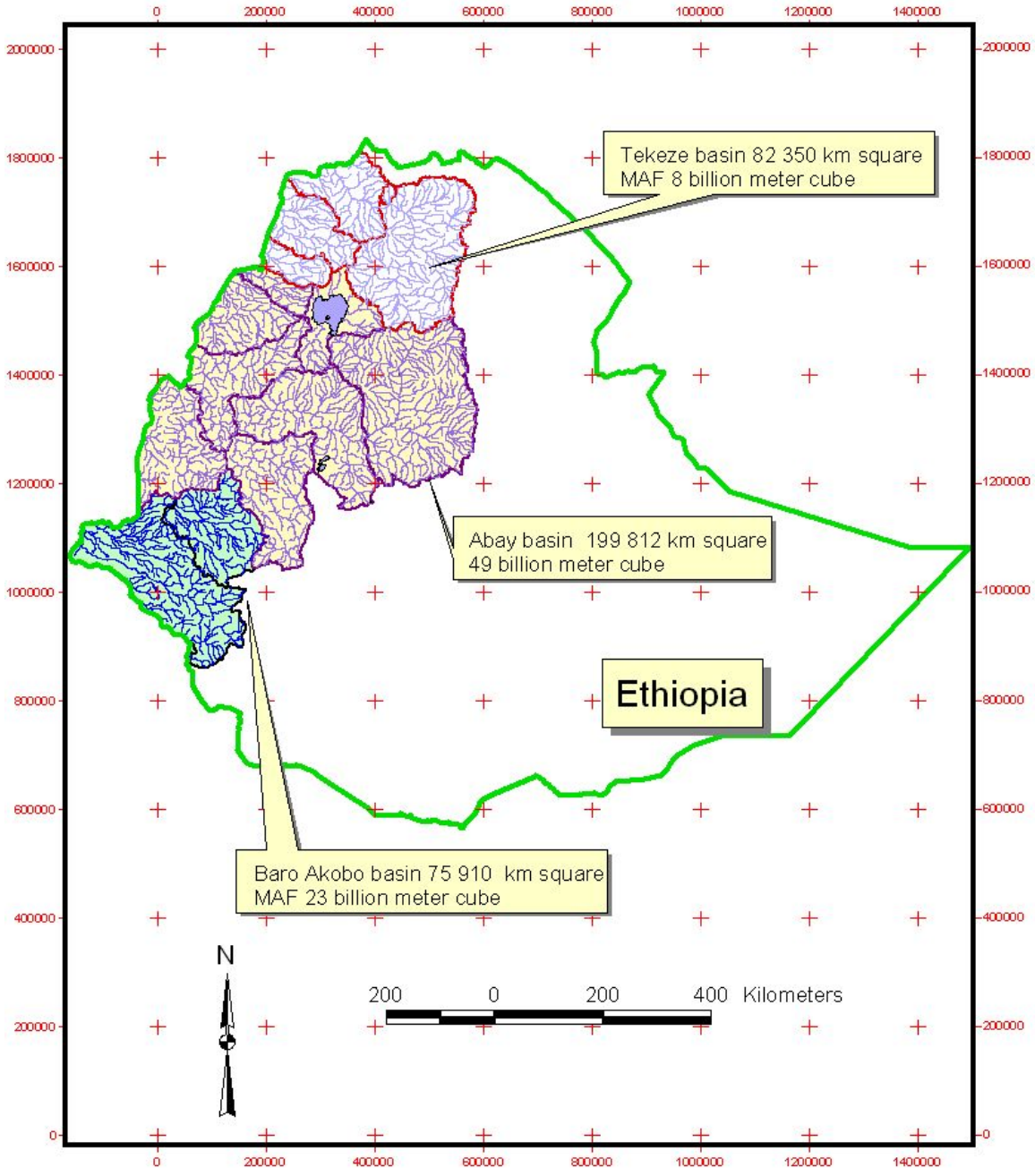


Figure 2-1: Nile River Basin in Ethiopia

There are three main river sub-basins draining west or north-west to the White Nile or Nile:

- Baro-Akobo is the river basin farthest south, draining from the south-west flanks of the Central Highlands to join the White Nile in southern Sudan (where it is known as the Sobat River).

- Abbay river basin drains from the central parts of the Central Highlands in Ethiopia: there is natural regulation of the river flow from a small fraction of the river basin area by Lake Tana in the north; as the river uncoils through the plateaus and gorges of the highlands downstream of Lake Tana it is joined by several large tributaries before draining north-west into Sudan (where it is known as the Blue Nile), and joins the White Nile at Khartoum to form the Main Nile.
- Tekeze river basin is located to the north of the Abbay, adjoining the Eritrean border; it drains north-west into Sudan, where it is known as the Atbara River, before joining the Main Nile in northern Sudan.

Average annual rainfall in the Central Highlands generally ranges from around 900 mm to well over 2000 mm, but is highly seasonal, with most rainfall occurring in the months of June to August. Consequently, river flows typically peak in July or August, and are also highly seasonal.

Baro-Akobo river basin has the highest frequency of flooding in Ethiopia. It receives more rainfall than any other river basin in the country, and features steeper river bed gradients. Almost every year, over 35% of the Gambella plain is subject to inundation. Main damage centers are Gambella city, and Itang, Abobo, Gog and Jor, Jikao and Akobo woredas in Gambella Region due to flooding from the Gilo, Baro and Akobo rivers.

In the Abbay river basin, Fogera plain on the eastern shores of Lake Tana experiences inundation in years when the Ribb and Gumera rivers have high flows, which can be aggravated by seasonally high lake levels in Lake Tana. The major damage centers in this basin are Fogera and Libo Kemkem in South Gonder district, Dembia woreda in North Gonder, Zuria woreda in Bahir Dar, Achefer woreda in West Gojjam, and Albuko and Dessie woredas in South Wello district. Urban flooding occurs in the city of Bahir Dar both from local runoff and from elevated lake levels. Since construction in 1999 of Chara-Chara Weir at the outlet from Lake Tana for hydropower purposes, lake levels have been partially regulated.

Flooding is generally not a major problem in the Tekeze river basin within Ethiopia. Minor flood damages occurred due to heavy rains in 1995 in some localities such as Adewa, Keya-Teki, Ambera and Meteka in central Tigray Region. There were also isolated flash floods in 2001 in Humera and Alamata woredas in western and southern zones of the region.

There is little river regulation of the rivers in Ethiopia. There is one dam in the Baro-Akobo basin (Alwero Dam). The natural regulation afforded by Lake Tana has been slightly enhanced by construction of Chara-Chara Weir at the lake outlet, and there is one dam (Finchaa Dam) on the Finchaa River which is a southern tributary of the Abbay. Another small dam is under construction on the Koga River which flows into Lake Tana. There are currently no dams in the Tekeze river basin, however the Tekeze Dam is under construction for hydropower purposes on the Tekeze River. Some details of these storages are presented in Table 2-1.

2.2 CONSULTATIONS

Consultations were facilitated by the NFC, and were undertaken with officials in MWR, NMA and DPPA. A summary of the consultations may be found in Appendix A.

Table 2-1: River Regulation in Ethiopia

Name	River	Capacity (m^3x10^6)	Catchment Area (km^2)	Year Commissioned
Abobo	Alwero (Baro-Akobo basin)	74	1 043	c. 1995
Chara-Chara Weir (L. Tana)	Abbay	9 000 [1]	15 300	1999
Finchaa	Finchaa (Abbay tributary)	900	2 500	1973
Koga	Koga (tributary to L Tana)	77	164	under construction
Tekeze	Tekeze	9 293	30 390	under construction

1. Capacity of Lake Tana

2.2.1 Preliminary Findings

The findings of the first round of consultations with stakeholders are summarized below. Table 2-2 is intended to provide a rapid review of the current institutional arrangements and shortcomings in flood preparedness and early warning in Ethiopia.

Ethiopia

1. Ethiopia is yet to develop a flood forecasting model for its rivers or establish a dedicated group with the responsibility for flood forecasting and warning. Flood warnings are therefore based on monitoring the flood and weather situation and not on scientific forecasting using mathematical models. The meteorological agency (NMA) and the Hydrology Department of the Ministry of Water Resources (MWR) have complementary obligations for early warning:
   - The NMA provides 10-day forecasts during the flood season and 2-3 day forecasts on request for vulnerable areas (Tana, Gambella, Awash).
   - MWR endeavors to get near real-time river stage data to make the monitoring more realistic, such as through high frequency radio communications with observers.
2. Resource limitations for flood forecasting and warning exist in the full range of tasks from data collection and processing to modeling and information dissemination. Staff numbers and skills, hydrometric equipment, telecommunication systems and reliable means of access to gauging stations will all need to be reviewed and improved if a reliable flood forecasting and warning system is to be established.
3. Dissemination of flood warnings by the High Dams Technical Committee is limited to the areas affected by releases from EEPCo (hydropower) dams. Arrangements for timely warnings are not institutionalized outside the areas of the Committee's responsibility.
4. The DPPA[3] has quite comprehensive arrangements at national, regional, woreda and kebele levels for coordinating emergency response activities to combat drought. However, its arrangements for flood situations, which of course have much shorter lead times, are much less organized due to the absence of a credible flood warning system.
5. The NGOs, which are important service providers of non-food emergency supplies during flood, are similarly inexperienced in early warning and flood preparedness activities.

[3] The DPPA (Disaster Prevention and Protection Agency) was known as the DPPC (Disaster Prevention and Protection Commission) until December 2006, when its name was changed by Government Proclamation No. 471/05.

Table 2-2: Summary Table (Ethiopia)

Key Activities	Key Stakeholders	Current Institutional Arrangements	Shortcomings
Flood forecasting and warning • Data collection and processing o Rainfall o Runoff	• MWR (Hydrology), NMA, DPPA and their Regional & Woreda bureaus. o Rainfall – NMA o River stage – MWR (Hydrology)	River level data are collected by the Regional Offices of MWR (Hydrology) and sent to HQ for data entry, quality checking and processing. Rainfall data are obtained from the NMA.	• Resource limitations (equipment and vehicles) for data collection; limited skills to maintain modern equipment. • In essence, flood warnings are based on monitoring the flood situation and not on flood forecasting.
• Flood modeling	• MWR (limited capability)		• There is no focal group dedicated to flood forecasting.
• Flood forecasting	• MWR (Hydrology), NMA, DPPA, communities affected by floods.	High frequency radio used to communicate selected river levels to MWR (Hydrology) for flood monitoring during the wet season.	• Arrangements for timely warnings are not institutionalized outside the areas of the Committee's responsibility.
• Dissemination of flood warnings	• MWR (Hydrology), NMA, DPPA, High Dams Technical Committee	Dissemination of flood warnings is limited to the areas affected by releases from EEPCo dams	• The DPPA has good experience in early warning and preparedness for drought, but less capacity for similar activity in relation to floods.
Flood mitigation planning,	MWR	Included in other planning, design and contract administration tasks as the need arises.	No unit within MWR that deals specifically with flood mitigation planning.
Emergency response and recovery	DPPA	Quite comprehensive arrangements at national, regional, woreda and kebele levels for coordinating emergency response activities to combat drought.	No credible early warning information to trigger DPPA systems. DPPA systems need to be adapted to special needs of flood emergency response with short lead times.

2.3 INSTITUTIONAL ROLES AND RESPONSIBILITIES

2.3.1 Administrative System of Government

Ethiopia has an elected system of government with line Ministries operating under Ministers appointed by the Prime Minister to conduct the affairs of the State. The line ministries are largely replicated at regional level by regional government departments, although there may be some minor variations depending on the circumstances and needs of particular regions. As noted in section 2.1.2 above, there are five Regions that are wholly or partly within the

boundaries of the Eastern Nile river basin in Ethiopia: Gambella, Amhara, Benishangule-Gumuz, Tigray and Oromia. Areas identified for focus in the FPEW Project at this stage include the Lake Tana area in Amhara Region, and areas of the Baro-Akobo sub-basin in the Gambella Region.

Each region is subdivided into districts, and further subdivided into many administrative areas named woredas (similar to counties). Woredas provide a broad range of government services at a more local level. Each woreda is further subdivided into several kebeles, which is typically a cluster of villages. Kebeles have councils appointed by the woreda, and the kebele councils play an important role in communicating government initiatives to local communities, advising woredas of local community needs, and undertaking and organizing community activities.

Federal Ministries are intended to have primarily policy and technical guidance functions, with more practical implementation of policies and delivery of public services at both regional and woreda levels. In practice, the technical capabilities at regional level and particularly at woreda level are often limited, and because of lack of resources and/or skills some of the technical work that arguably should be undertaken at regional level is sometimes performed at federal level, thereby stretching the resources at the federal level too.

2.3.2 Roles and Responsibilities in Flood Risk Management

In the Inception step of the PP there has as yet been inadequate time to confidently identify all the roles and responsibilities relevant to flood management. To consider the relevant roles, the reader can refer to the activities identified in Box 1 of section 1.6. The activities identified in relation to modifying the three aspects of flood risk are roles for government (and/or other stakeholders) in managing flood risk. For certain activities there may be identifiable subsidiary activities that may or may not be done by the same institution. For example, if we consider structural works that modify flood hazard, there may be separate activities of planning, design and implementation which could be undertaken by a single institution, but not necessarily.

Table 2-3 summarizes the preliminary findings with respect to roles and responsibilities in flood risk management in Ethiopia.

A key stakeholder is the Ministry of Water Resources (MWR) which, among other things, operates the hydrometric network of river gauging stations in Ethiopia. Preliminary efforts have been made in the Hydrological Services Department of MWR to undertake or prepare for a role in flood forecasting, but those efforts have been thwarted by resource limitations.

The National Meteorological Agency (NMA) undertakes weather forecasting, including short-term rainfall forecasting using cold cloud cover information. The NMA have facilities for receiving satellite data using a PUMA system. They also use atmospheric pressure and wind data transmitted from the European Center for Medium Weather Forecasting (ECMWF), and their network of synoptic stations in Ethiopia to make forecasts.

Table 2-3: Institutional Activities in Flood Management, Ethiopia

Activity	Primary Responsibility	Preliminary Remarks (to be confirmed)
Structural Works	MWR	MWR undertakes a planning role (eg. feasibility studies), and administers contracts for design & construction. Possible future role for RBAs [1] (?).
Watershed Management	M.of Agriculture	System of land ownership make practical measures difficult.
Land Use Management	Woreda administration, M.of Agriculture	In urban areas, provisions for land use management exist, however are little used for flood management. MoA undertakes general planning for rural areas.
Community Preparedness	DPPA	Policy at federal level, implemented at regional and sub-region level by DPFSC [2], relying on kebeles for effective action at community level.
Flood Forecasting	NMA; MWR	Weather forecasting by NMA. Tentative action to forecast floods by MWR in Awash River (outside Nile river basin) with support from universities, however methods not yet effective. Data acquisition networks operated by NMA and MWR. NMA receives near-real-time satellite data. No flood risk mapping attempted.
Flood Warning	undetermined	Apparently, no clear role established. In Awash basin, occasional warnings of releases from Koka Dam issued by MWR.
Emergency Response	DPPA, CMU	Planning & preparedness by DPPA, which mainly coordinates and monitors actions by NGOs and aid agencies during emergencies. In the case of floods, without effective flood forecasting and warning, little can be done until after flood disasters. CMU is an executive unit of government that coordinates actions & planning by Ministries.
Post-Flood Recovery Services	DPPA, CMU	DPPA undertakes post-disaster evaluation missions to assess needs, then coordinates and monitors actions by NGOs and aid agencies, and mobilizes Task Forces targeting specific needs (*eg*. food & shelter, health, water & sanitation, agriculture, education). Appeals for international assistance as required. Task Forces report to CMU.

NOTES: 1. A RBA is proposed for Abbay river basin as a pilot project.

2. DPFSCs (Disaster Prevention & Food Security Commissions) operate at regional and sub-regional levels to implement policy and programs of DPPA. The name reflects the heavy emphasis on drought management in Ethiopia.

MWR River Gauge Network:

24 gauges on rivers in Baro-Akobo RB, including 6 automatic-recording stations.
122 gauges on rivers in Abbay RB, including 17 automatic-recording stations.
26 gauges on rivers in Tekeze RB, including 10 automatic-recording stations.

See also Appendix C for gauge network diagrams. Most stations have staff gauges observed twice-daily, and observations are collected monthly. Charts from automatic-recording stations are retrieved only every 3 to 4 months. There are no stations that relay data automatically, and because of poor access and telecommunications relatively few are able to telephone data to MWR Regional Offices even on request.

Discharge measurements can be made at most stations using fixed or portable cable-ways or from bridges; however some equipment is not functional or in poor condition, and some stations are inaccessible after rain.

Both NMA and MWR participate with dam operators in a Technical Committee which meets at the beginning of the rainy season each year to consider the operations of major dams, and thereafter as frequently as required during the rainy season only. This Committee considers the likelihood of floodplain inundation downstream of dams. NMA and MWR also participate in a Standing Committee at a senior executive level which generally meets twice-weekly to review the weather and weather forecasts and its broader impacts, particularly in relation to droughts.

NMA Meteorological Gauge Network, Ethiopia:

Nationally there are:

- 17 synoptic stations that relay data to AA at 3-hr intervals;
- > 100 rain gauges that report daily during the wet season by radio or telephone.

See also Appendix C for gauge locations.

Numbers in the Tekeze, Abbay and Baro-Akobo river basins are not known precisely, but may be expected to be approx one-third of the national totals. For weather forecasting, stations outside the watershed boundaries are also useful. Data from selected synoptic stations are transmitted to ECMWF (European Centre for Medium-Range Weather Forecasting) for integration with wider regional data sets.

Another key stakeholder in Ethiopia is the Disaster Prevention & Preparedness Agency (DPPA), formerly known as the DPPC (Commission). While the DPPA has been preoccupied with drought disasters in the past, it is within its mandate to manage flood preparedness, emergency response and post-flood recovery services. An important role of DPPA is to coordinate activities by NGOs and aid agencies, and to monitor their activities. It also coordinates post-disaster evaluation missions to identify community needs and mobilize government and non-government assistance.

While DPPA has effective early warning systems for drought disasters, in the case of flood disasters the lead times in Ethiopia are relatively short, and there exist no reliable flood forecasting services. Activities are reactive only, relying on communities to advise woreda administrations of their plight. Woredas would then pass requests for post-flood assistance through regional offices to be forwarded to DPPA in Addis Ababa for mobilization of multi-sectoral evaluation teams.

Rudimentary flood risk mapping has been attempted by Bekele (1997), however the maps are sketches based on anecdotal advice and topography. Nor do they cover all the areas at risk to be reviewed in this study. Selkhozpromexport (1990) also mapped approximate extents of flooding on the Gambella Plains of the Baro-Akobo river basin.

2.4 FOCUS AREAS

As noted in section 2.1.2, riverine flooding does not create major problems along the full length of major rivers in the Eastern Nile basin within Ethiopia. In the **Tekeze river basin**, problems are mainly restricted to flash flooding. It has been agreed at the project conceptualization phase that the FPEW Project will initially focus on riverine flooding.

In the **Abbay river basin**, there are localities around Lake Tana that are seriously subject to flooding, either from the lake or from flows of tributary rivers in years of high runoff (*eg*. Ribb, Gumera, Megech Rivers). The frequency of flooding that causes serious problems is nowhere greater than about 1 in 4 years – although this assessment remains subjective at this stage. The areas of greatest concern were identified in the baseline social study (Teshome, 2005). See Figure 2-2. Teshome also described various coping mechanisms of the communities affected by the flooding. These included, for example, moving stock to higher ground, placing food stocks on raised platforms, *etc*. In the subsequent integrating study (Bush, 2005) a number of kebeles were recommended for focus in the PP. These are listed in Table 2-4.

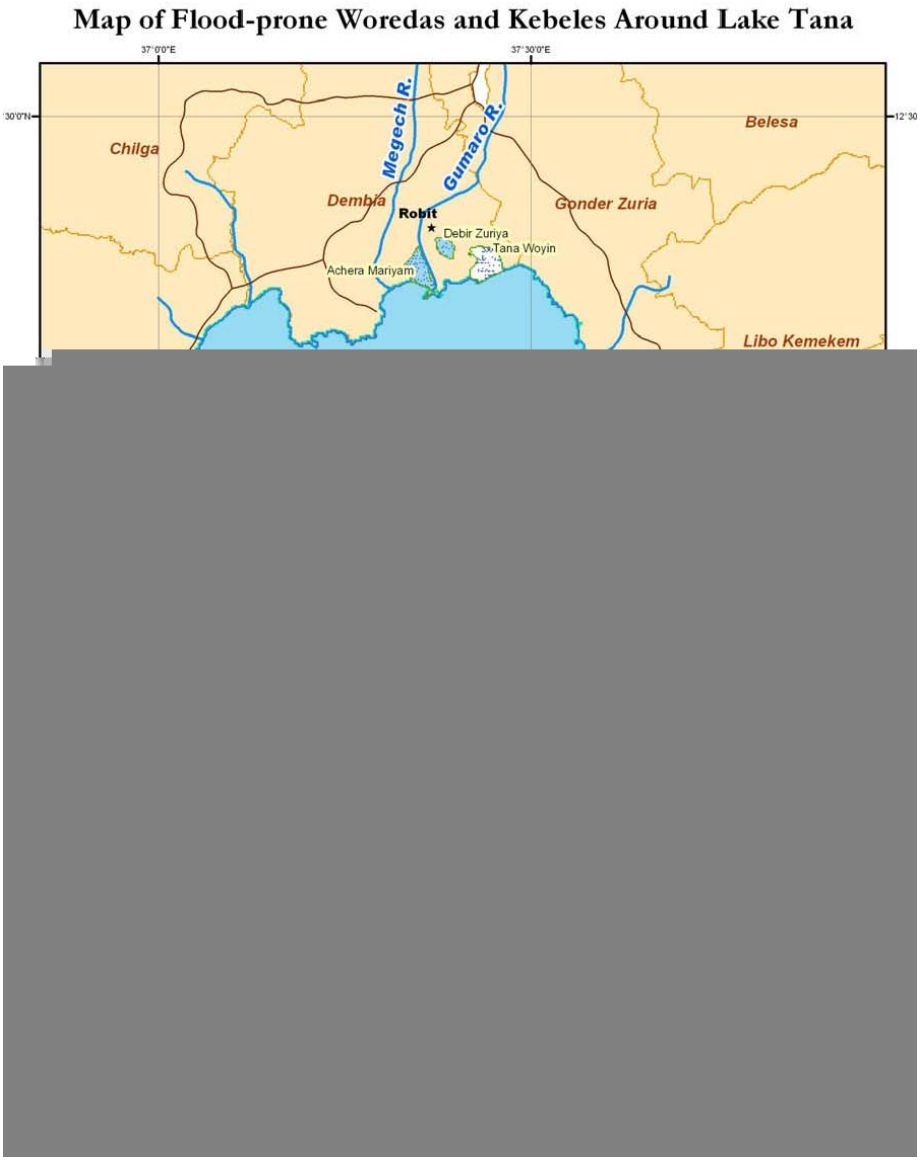
Table 2-4: Areas Proposed as Target Areas in the *Operational Guidelines*

Kebele	Woreda
RURAL	
Debre Zuria Asige	Dembiya
Shina Tsion	Libo KemKem
all kebeles	Fogera
Estumit	Achefer
URBAN	
Shimbit, Tana	Bahir Dar

based on recommendations of Bush (2005)

There has been no opportunity to visit these areas in the Inception step of PP. Nevertheless, some possible adjustment to the target areas is proposed, as follows:

- focusing on no more than 5 (five) representative kebeles in the Fogera woreda that are affected by flooding from the Ribb and Gumera Rivers and high levels in Lake Tana, rather than 'all kebeles';



from Bush (2005)

Figure 2-2: Flood-Prone Areas Around Lake Tana

- omission of Estumit kebele in Achefer woreda: the flooding problems are reportedly not as severe in this area, the woreda is more isolated and distant from the other problem areas, and greater efficiency will be achieved by directing more effort at the other areas.

A final decision on the kebele (or kebeles) to be targeted in the Megech River area north of the lake can be made, in consultation with local authorities and with ENTRO, in the initial parts of the social assessment inputs commencing in April. We need to check that the Debre Zuria Asige kebele in Dembiya woreda north of Lake Tana adjoins the Megech River, which has aggravated flooding problems after a recent avulsion (Teshome 2005). Final

selection of the kebeles to be targeted adjoining the Ribb and Gumera Rivers can also be deferred until then, selecting the worst affected, or a range of kebeles that are representative of the conditions encountered. No change to the kebeles to be targeted in the urban area of Bahir Dar is proposed.

In the **Baro-Akobo river basin**, very extensive flooding of rural areas in the Gambella Plain occurs every year (Selkhozpromexport, 1990; TAMS/ULG, 1997). These are, in effect, seasonal wetlands. Many local inhabitants have adapted to the seasonal pattern of flooding, and rural inhabitants make use of seasonal inundation of land in their agricultural practices. It is only in years of unusually high floods that great hardship is endured. In years of high flood, inundation of parts of Gambella City and other townships can also occur. Tentative plans have been devised (Selkhozpromexport, 1990) for flood mitigation of affected urban areas in Gambella City, with construction proposed of flood protection levees and diversion drains.

It is proposed that the PP undertakes a desk-top study of both the urban and rural areas, based on information available from previous studies. For the rural areas, a concept will be developed for flood management. A visit will be made to the urban area of Gambella City during the Project Definition step for consultations with local officials and, depending on assessment of the severity of the problem, a flood management strategy would be developed and prepared for subsequent implementation under the FPEW Project.

With respect to regional flood forecasting for downstream areas affected by flooding in Sudan and for operations of HAD, scope of work will be defined for the Abbay (Blue Nile) and Tekeze (Atbara) river basins in the Project Definition step. More discussion of forecasting and other requirements is provided in chapters 5 and 9.

2.5 GAP ANALYSIS

The following analysis identifies gaps in information, resources and institutional capacity that adversely affect current policy and practice for flood risk management in Ethiopia, and is based upon consultations undertaken during the Inception step of PP, and preliminary research.

2.5.1 Information and Data Gaps

There is a reasonably good network of stations gauging both river levels and rainfall, at least in terms of numbers of gauging stations. The distribution of gauging stations is not ideal, mainly because of difficult access to some parts of the Ethiopian Nile river basin catchments. For example, as can be seen from the network maps in Appendix C, gauges are limited in some areas. In the Tekeze river basin, rain gauges are sparse in the southern and western parts of the basin, and there are no river gauges in the south-east. There are no operational river gauges or rain gauges in the Ethiopian parts of the Dinder and Rahad tributary catchments that are nominally within the Abbay river basin in Appendix C; and mainly because the Abbay River downstream of Lake Tana is largely incised in a deep gorge there are too few gauges on the main river stem of the Abbay. There are also very few river gauges or rain gauges in the southern parts of the Baro-Akobo river basin, with no gauges operating on the Akobo River which forms the border between Ethiopia and Sudan.

Important limitations apply to the river gauges that do exist. Most stations rely on staff gauge observations, which are normally limited to two observations per day. This gives inadequate definition of flood hydrographs and inaccurate flood peaks. There are no stations that provide real-time or near real-time data because there are no provisions for electronic data transmission. Observation sheets and recorder charts must be transported to the MWR head office in Addis Ababa for processing.

Information and data on historical flooding is very limited. Any quantitative data that does exist on flood impacts is approximate, apparently based on anecdotal reports, and is generally non-specific concerning dates. The limited documentation that does exist is oriented to post-disaster relief, and is inevitably too general and descriptive to be of great value for flood hydrology investigations or definition of the impacts of past flooding. Some valuable attempts have been made to delineate areas affected by flooding (eg. Bekele, 1997; Selkhozpromexport, 1990) but these are not readily related to flood frequencies and they do not show the exposure of property (and population) to flood risk. No satellite imagery or aerial photography of historical flood extents have been compiled, although it is probable that some satellite imagery of past floods could be acquired.

It remains unclear what information could be provided to flood-affected communities that would assist them by raising awareness of flood risk and improving community preparedness.

2.5.2 Institutional Capacity and Resource Limitations

There is very little experience in Ethiopia in flood risk management planning. The MWR has no unit that routinely undertakes flood mitigation planning and design, or undertakes contingency planning for flood events. The only effective planning that has been undertaken was for the Awash river basin, and that was quite limited. There has been no effective flood mitigation planning for the Eastern Nile river basins in Ethiopia. This is mainly due to resource limitations, with activities related to water supply, irrigation and hydropower development taking priority in allocation of the limited resources within the MWR. With adequate training and staff development, the skills potentially reside within the Hydrological Department of MWR, however staff numbers are currently inadequate to properly manage routine data processing, data management and hydrological investigation tasks.

Limited training has been provided in the past in relation to flood forecasting and use of hydrological models, however effective use of that training has been constrained by limited computer resources and the workload imposed on existing staff for more routine tasks. There is no effective flood forecasting capability at the moment.

Even for the more routine tasks of data processing and data management, resources are inadequate in terms both of staffing and equipment. Resources at regional offices of MWR are so limited that basic data processing that could be done regionally has to be performed in head office, which diverts resources there from little other than data processing and data management. This means that staff have too little opportunity for hydrological analysis or investigations, which leads to poor development of technical skills and human resources.

Resource limitations also impair the effectiveness of the existing hydrometric network. Data records and data quality often suffer from equipment in poor repair or out of order (eg.

cableways, automatic recorders, access vehicles), and lack of facilities for data transmission. Facilities for data transmission do not exist for data transfer between regional offices and head office, let alone between field sites and regional offices.

There are no organized protocols or standard procedures for flood warning. That partly derives from the lack of any scientific methods of flood forecasting, however effective flood warning would also rely on other features that are lacking: including reliable communications between flood forecasting centers and flood-affected communities; and, regional and local organizations appropriately trained and prepared for effective response to flood warnings.

While Ethiopia does have effective institutional arrangements for managing response to drought disasters as noted above, those institutions lack experience of responding within the much shorter time scales of flood disasters. In relation to post-flood disaster relief and recovery, and in the absence of any real-time or near real-time flood monitoring or any regional and local organizations prepared for effective response to flood emergencies, the institutional responses are reactive, relying on advice being passed upwards from communities in dire straits through the numerous tiers of government.

3. FLOOD RISK MANAGEMENT IN SUDAN

3.1 GEOGRAPHY AND CLIMATE

3.1.1 General

The Sudan is the largest country in Africa, covering a total area of 2.5 million km^2. It is situated between latitudes 3° N and 23° N and longitudes 21° 45′ E and 38 ° 30′ E.

The physiography of the country features an extensive plain traversed throughout its length of 2000 km from north to south by the River Nile and its tributaries. On the eastern side it is bounded by the Red Sea hills rising up to altitude 2100 m. On the western side lies the Jebel Marra massif with its highest altitude reaching 3089 m.

The River Nile and its tributaries are the key physical features of the country. The Nile Basin occupies 70% of the total area of the country. The origin of the White Nile is from the Equatorial Lakes on the Lake Plateau to the south. On entering the Sudan it flows 170 km through rocky rapids, and thereafter flowing through the swampy Sudd region where huge losses occur by evaporation. After emerging from the swamps, it is joined by the Baher el-Ghazal on the west and by the Sobat on the east (Baro-Akobo in Ethiopia). At Khartoum the White Nile joins the Blue Nile, which drains north-west from the Ethiopian Plateau. The Main Nile which flows from Khartoum down to Lake Nasser and the High Aswan Dam is joined on its way by the River Atbara (the Tekeze in Ethiopia).

In the Jebel Marra area and in the central plains of the Sudan there are a number of seasonal ephemeral streams. Originating from the Ethiopian Plateau are the Gash and Baraka rivers, for example. In the central region plains considerable runoff in the form of sheet flow and streamflow finds its way to the main courses of Bahr el Jebel, Bahr el Ghazal, the Sobat and the Mashar marshes.

The renewable groundwater suitable for agriculture and other domestic use is estimated at 4.0 billion m^3. The main aquifer is the Nubian sandstone underlying about 28% of the surface of the country.

Sudan shares, bilaterally and multilaterally, several surface and ground water basins, of varying sizes and capacities, with 12 other African counties. Furthermore, the Sudan's natural environment is vulnerable and sensitive to change, particularly with respect to climate and water resources. Human activities, land use and changes in vegetation cover in neighboring countries to the south and east and in Sudan have significant potential to upset the ecological balance.

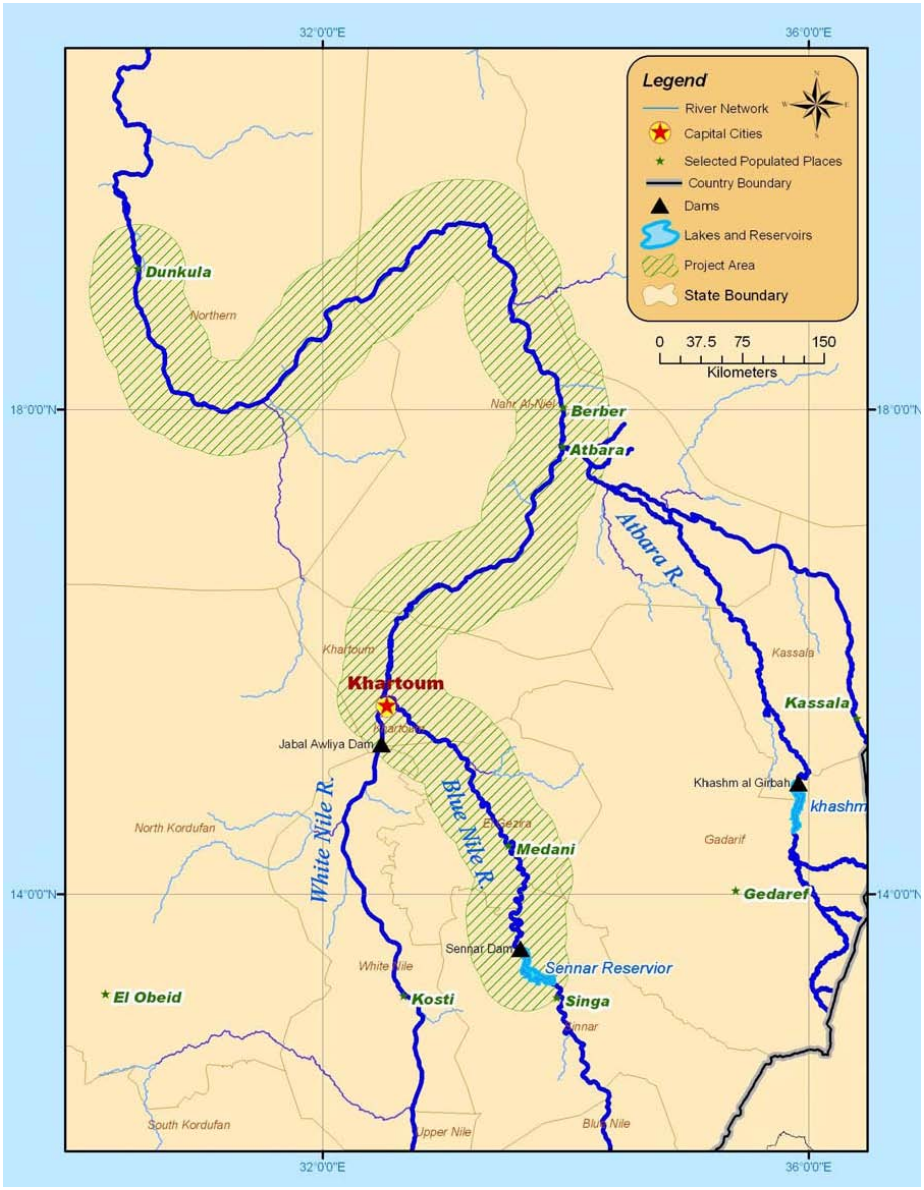
With regard to the climatic zones, the Sudan has predominantly a tropical continental climate with a maritime climate along the Red Sea coast. The climate is highly influenced by the seasonal positioning of the Inter-Tropical Convergence Zone (ITCZ). During spring and summer in the northern hemisphere, the ITCZ moves northwards, allowing the humid south-east monsoons to sweep over the country from the Indian Ocean. During the second half of the year as the ITCZ recedes southwards, the country is open to prevailing dry northeasterly winds generated by the Eurasian landmass.

The southwesterly monsoons from the Atlantic Ocean laden with moisture are another source of rainfall in the Sudan. The extent of their inland penetration helps determine the annual volume and distribution of rainfall in the country.

The northern third of the Sudan is a virtual desert with an average annual rainfall of about 20 mm. The rainfall increases steadily from north to south until it reaches 400 mm to 800 mm per annum. In the fertile central clay plains of the Sudan and in the extreme south of the country the annual rainfall varies from 1200 mm to 1500 mm.

3.1.2 The Nile Basin

The surface flow of the country is dominated by three main elements: the White Nile, the Blue Nile and the Atbara River. See Figure 3-1.



(from Bush, 2005)

Figure 3-1: River System in Sudan

Draining from the high rainfall Ethiopian highlands, the Blue Nile and Atbara contribute about 70% of the total Nile flow. See Figure 3-2. These flows are seasonally highly variable, in contrast to much less variable White Nile flows that make up the remaining 30%. The White Nile flows are much smaller than would be expected from its drainage area due to the loss of water in the swamps of the south, which also naturally regulate the flows downstream. In the area downstream of Malakal, the contribution of local runoff to the flows of the main rivers is negligible. River flows tend to decline gradually between the main tributaries. Thus, although it covers a large area, the river system of the Nile in this region is fairly simple and a dense network of gauges is not necessary.

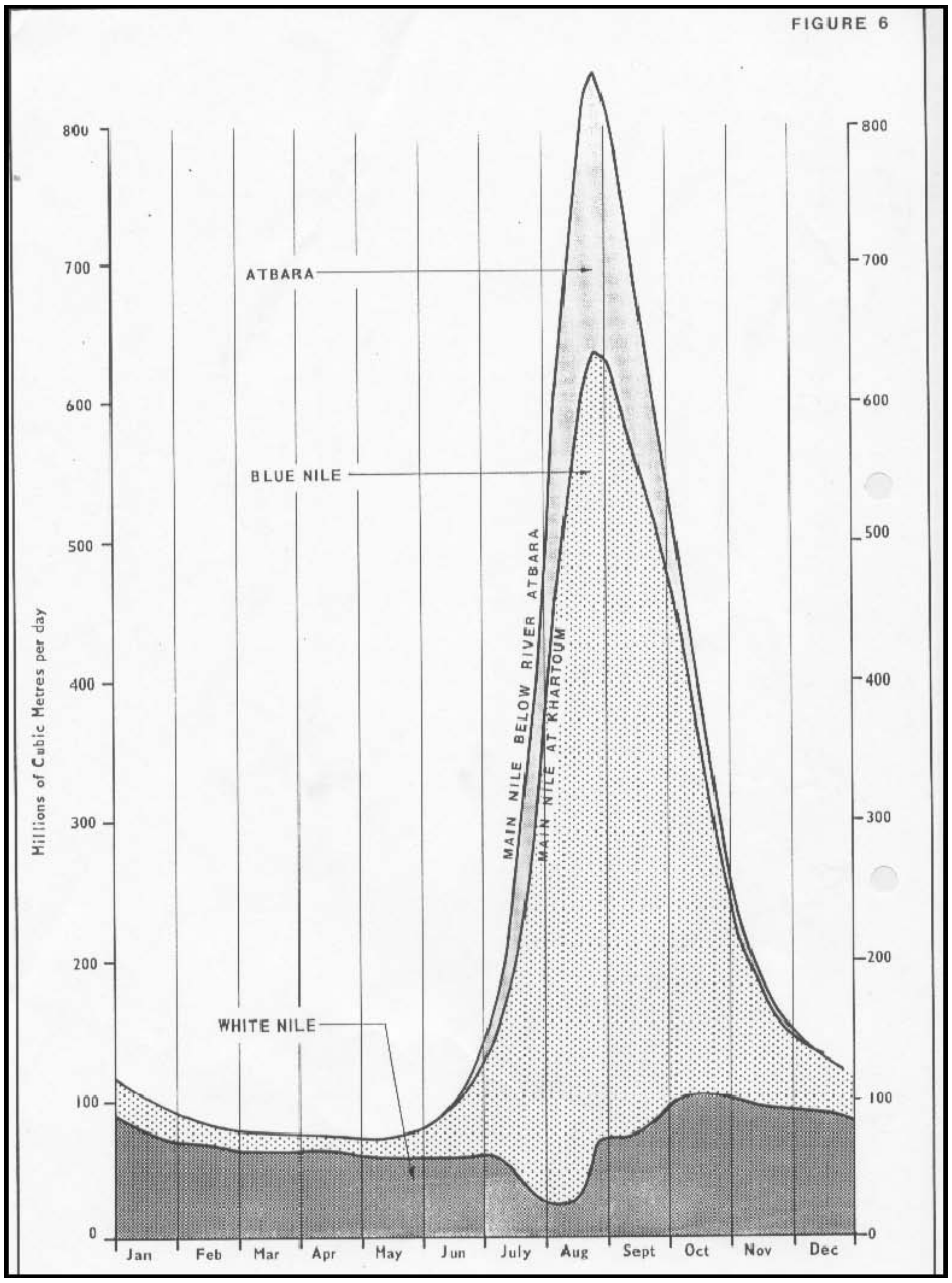


Figure 3-2: Seasonal Distribution and Derivation of Nile River Flows

In addition to the Abbay, the main source of the Blue Nile, two important tributaries draining from the Ethiopian highlands join the Blue Nile between Sennar and Wad Medani: although seasonal, the Dinder and Rahad Rivers contribute significant inflows during the wet season. The catchment area of the Blue Nile to Khartoum is 324 530 km^2.

There are several dams on the Blue Nile and White Nile in Sudan, primarily constructed for irrigation purposes. Because of the low topographic relief available, the storage capacities are small in relation to flood season river flows and have little effect on the passage of floods. A new dam is being constructed at Merowe on the Main Nile upstream of Dongola. Some details of these storages are presented in Table 3-1.

Table 3-1: River Regulation in Sudan

Name	River	Original Capacity (m^3x10^6)	Est. Current Capacity (m^3x10^6)	Year Commissioned
Rozeires	Blue Nile	3 350 *	1 900	1966
Sennar	Blue Nile	900	400	1925
Jebel Aulia	White Nile	3 500	n.a.	1938
Khashm el Girba	Atbara	1 300	600	1964
Merowe	Main Nile	12 450	---	under construction

* Rozeires: capacity after upgrading

3.2 CONSULTATIONS

Consultations were facilitated by the NFC, and were undertaken with officials in MIWR, SMA, CDO, HAC, Remote Sensing Centre of the Ministry of Science & Technology, and experts at the University of Khartoum. A summary of the consultations may be found in Appendix A.

3.2.1 Preliminary Findings

Sudan

1. Sudan has developed near real-time flood forecasting models for the Nile: (FEWS) with Dutch technical assistance; and GFFS with assistance from University of Ireland, Galway; and has several years' experience in their use. The user-friendly interfaces coupled with the need to input only three types of data (namely, river stage and discharge from its own stations and cloud cover parameters accessed via the Web as surrogates for rainfall) make them simple but satisfactory tools. This has allowed the recognition of the Nile Waters Department in the Ministry of Irrigation and Water Resources (M/I&WR) as the national centre for flood forecasting.

   The flood forecast is issued to the media for broadcasting warnings to vulnerable communities. It is also conveyed to relevant disaster prevention and mitigation bodies - the Civil Defense Organ, the Humanitarian Aid Commission (HAC) and their corresponding State organizations - to enable their preparedness plans to be deployed.

   The results of the models have been assessed recently by the University of Khartoum. These models are expected to strengthen the robustness of flood forecasts, and importantly, to maintain the trust that the community and the disaster prevention agencies have developed in the Nile Forecast Centre (NFC).
2. Resource limitations for continuing the current forecasting and warning services are not considered serious. Project assistance may be required to improve telecommunication facilities for the

NFC, for archiving of data from the key river gauging stations on the Nile, and to improve and expand the information content provided during flood warnings.

3. Unlike the DPPA in Ethiopia, which acts as the national apex body for all disaster prevention and protection activities, that responsibility is split between the Civil Defense Organ (CDO) and HAC. This is currently causing confusion in HAC's operations as it is unsure of its status as an apex body to coordinate the work of other government agencies and NGOs. Nonetheless, the coordination arrangements might improve when the apex body - National Council of Civil Defense (NCCD) – overcomes its initial problems. The Project will study the new Act on civil defense and investigate how it could provide assistance in implementing the Act and its regulations.
4. It appears from two field visits made during the Inception step - to Umbenin in Sennar State and Wawusi in Khartoum State - that the chairman of the local committee in each village is the focal person in all disaster prevention and flood protection planning activities.

   In Wawusi, the community interacts with the government via the chairman of its local committee at a weekly forum chaired by the Commissioner of the North Khartoum mahaliya. The forum is attended by the chairmen of the 40+ villages in North Khartoum. Flood related issues are dominant during the flood season, but other issues take prominence at other times of the year.

   If Wawusi is representative of other peri-urban localities that are vulnerable to flood, then there is little direct interaction between the community and service agencies (such as CDO, HAC, NGOs) in the planning stage. The Commissioner is the linchpin, with community needs conveyed to him at the weekly meetings via the village chairmen. Direct contact between the community and service providers occurs only in the implementation of disaster prevention, protection and recovery.

   In Umbenin, more remote from Khartoum, there is even less interaction with government as regular meetings are not enforced. There is less formal communication with authorities, although units do visit the village before the flood season in most years to discuss preparations, provide materials for restoring informal levees, etc.

Table 3-2: Summary Table (Sudan)

Key Activities	Key Stakeholders	Current Institutional Arrangements	Shortcomings
<u>Flood forecasting and warning</u> Data collection and processing o Rainfall o Runoff • Flood modeling • Flood forecasting • Dissemination of flood warnings	• MIWR (Nile Waters Department), SMA, HAC, CDO and their corresponding State & local arms. o Rainfall – SMA (for seasonal forecasts); daily rainfall estimation data from Reading University (UK) website o River stage – M/I&WR (Nile Waters Department) • MIWR • Communities affected by floods.	River level data are collected by the Nile Waters Department (NWD) at 15 stations and sent to the NWD's HQ for input to the flood forecasting models. Rainfall data are obtained from the SMA. Rainfall estimates for the rainfall-runoff models are obtained from satellite CCC data posted on the Reading University website. Dissemination of flood warnings by the media and CDO.	• Resource limitations relate to communications equipment: i) slow modems at the Nile Forecast Centre (NFC) at the Nile Waters Department; ii) no communications at the Nile gauging stations to upload stage and discharge data and (iii) inoperative software/hardware at SMA. • Early warnings are based primarily on MIWR forecasts.

Key Activities	Key Stakeholders	Current Institutional Arrangements	Shortcomings
Flood mitigation planning,	• MIWR (policy and studies) • Engineering Affairs Departments (State) for implementation through consultants and contractors.	Federal funding and policy framework at federal level. Detailed design, construction and O&M are the responsibility of "State Engineering Affairs".	There is a strong push by the three communities visited for bank stabilization to protect their property from flood erosion.
Emergency response and recovery	NCCD, CDO, HAC, State agencies and NGOs	CDO is responsible for emergency response and provision of early warning to communities. HAC has arrangements at Federal and State levels to coordinate post-flood relief and recovery activities.	Coordination arrangements are unclear due to the new powers of the NCCD under the new Act on civil defence and the manner in which the roles of CDO and HAC are affected by it..

3.3 INSTITUTIONAL ROLES AND RESPONSIBILITIES

3.3.1 Administrative System of Government

Under a new power-sharing Agreement finalized in 2005, the system of government administration varies in different parts of the country. In Khartoum and central and northern parts of the country there is a presidential system of government, with Ministers appointed by the President to direct the affairs of line ministries. The division of responsibilities at the central level is replicated at State level in States under the formal jurisdiction of the central government, which includes all areas along the Blue Nile and Main Nile that are of direct interest to this PP. The governors of States (termed walis in the Sudan) appoint leaders at district (mahaliya) level who administer the policies of the government departments/ ministries with the assistance of appointed local councils (village clusters) and informal councils of elders in each village. Concerns of the villagers are communicated to government through the councils and particularly through the agency of the leaders at local council and mahaliya levels.

The chain of communication between central government and rural communities in particular, and between rural communities and government therefore consists of many links, any one of which may sometimes fail or be relatively ineffective. There is also a top-down approach to administration, particularly as many of the leaders who are crucial to the flow of information are not elected and thereby not directly accountable to the communities they serve. In the baseline social study, AbdelAti (2005) noted that the provision of services in relation to emergency response and post-flood assistance declines for communities more remote from Khartoum.

3.3.2 Roles and Responsibilities in Flood Management

A key role in flood management lies with the Ministry of Irrigation & Water Resources (MIWR). The Ministry contains a Nile Waters Department which has water resources management responsibility for the water resources of the main rivers, and operates a Nile Forecast Center. The Nile Forecast Center receives good technical support from the University of Khartoum Civil Engineering Department which has applied and calibrated hydrological models that provide accurate flood forecasts and acceptable lead times for flood warning. Because local rainfall and runoff in Sudan is not a major factor in floods, relatively simple models can produce good results.

FLOOD FORECASTING, SUDAN

Two main systems are used for flood forecasting in Sudan:

(1) **FEWS** (Flood Early Warning System) using a distributed hydrological model adapted from the Delft Hydraulics model SAMFIL for real-time forecasting of flows from catchments in Ethiopia, and a river flow routing procedure along main river channels (Delft Hydraulics NETFIL model).

(2) A suite of programs known as **GFFS** (Galway Flood Forecast System). Some features of GFSS include: a soil moisture accounting & routing model (SMAR) that is applied to upstream catchments in Ethiopia using precipitation estimates; a simple linear model that is used primarily for river routing; and procedures that enable forecasts to be improved as observed data time series are updated. GFSS also includes a module for training and application of neural network algorithms, however this has not yet been used by the Nile Forecast Center in MIWR.

The Nile Forecast Center applies the models using seasonal rainfall forecasts in advance of the flood season, in May and June, and then daily during the flood season using updated river flow data and rainfall estimates supplied by the Sudan Meteorological Authority (SMA) that are based primarily on cold cloud cover (CCC) data from the Meteosat satellite. These models provide warning lead times of approximately 2 to 3 days for Sennar State, 6 to 7 days for Khartoum, and 10 days or more for northern Sudan along the Main Nile.

MIWR operates a network of river gauges along the main rivers that provide adequate information for the Nile Rivers. Figure 3-3 depicts the network of river gauges. One additional gauge along the Atbara River could be useful to improve the network.

SMA develops long-term seasonal forecasts of rainfall. These are reviewed after each wet season and have been found to be reliable. SMA also estimates short-term rainfall over the Ethiopian highlands using CCC data from Meteosat, which is received at half-hour intervals, and provides 3-day rainfall forecasts. The accuracy of short-term forecasting is constrained by two main limitations at present:

- SMA receives no real-time rainfall data from Ethiopia;
- receiving stations for ECMWF weather data are not operational, apparently due to software problems.

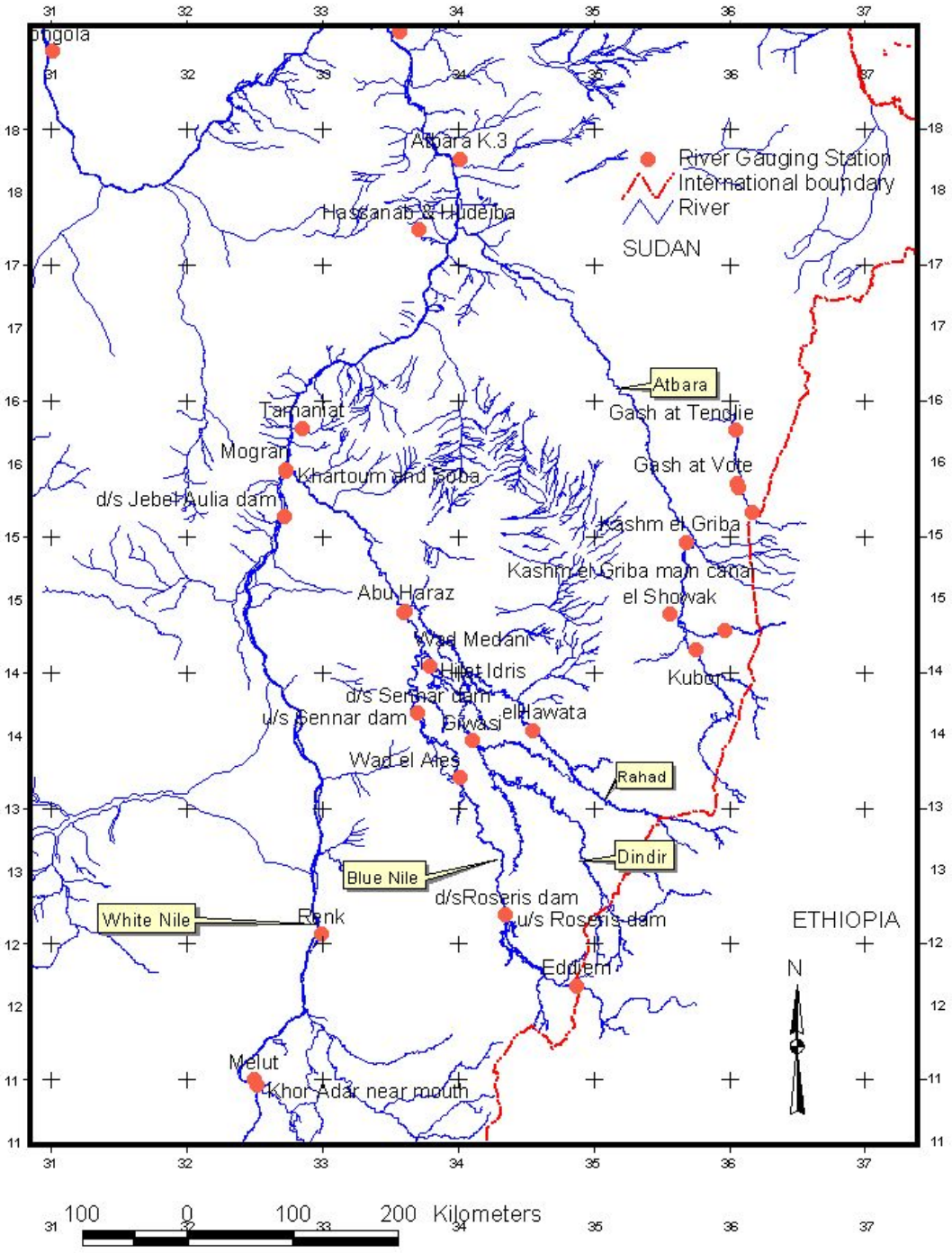


Figure 3-3: River Gauge Network in Sudan

SMA operates approximately 30 synoptic stations in Sudan. The number has declined since the 1970s due to natural attrition. There are approximately 200 rain gauges, of which only 10 report daily on a regular basis. There are only 5 automatic recording rain gauges. SMA have only recently begun computer data entry of their substantial hard-copy archives.

Emergency response is the responsibility of the Civil Defence Organ (CDO), which is an arm of the police force. CDO receives rainfall bulletins from SMA and flood forecasts from MIWR on a daily basis during the flood season. CDO organizes evacuations as necessary and monitors conditions during floods, and preceding floods can provide some material assistance for village flood defenses (eg. informal levees). Response is largely reactive, however, relying on calls for assistance through the chain of communications described above (section 3.3.1). The logistics of attending to the needs of 197 villages located beside the Blue Nile and Main Nile over a length of more than 1500 km is considerable given limitations of access and communications, particularly for communities more remote from Khartoum. CDO maintains stocks of non-food supplies (eg. tents, blankets, sand-bags) in readiness for emergencies.

A National Committee for Civil Defence meets prior to the flood season, and regularly during the flood season, as frequently as daily if circumstances dictate. The NCCD is a senior executive body to coordinate management of activities necessary to mitigate the impacts of floods. The Committee is to be chaired by the Vice-President, reflecting the importance of disaster management to the Sudan. CDO and HAC are represented on the Committee, as is MIWR, SMA and other relevant government agencies.

The Humanitarian Affairs Commission (HAC) is responsible for coordination of all activities for post-disaster assistance and recovery, including coordination and monitoring of NGOs and aid agencies. HAC maintains stores of food and non-food materials to assist after floods, and coordinates supplies provided by other government agencies and NGOs. On receiving requests for assistance, HAC organizes evaluation teams to visit affected areas and report on requirements, and then notifies NGOs and aid agencies, and in some instances organizes appeals for international assistance. HAC mainly relies on NGOs to distribute materials to communities in need. In practice, coordination of other government agencies is often difficult and there is some overlap and lack of definition of roles.

The Remote Sensing Unit of the Ministry of Science & Technology has facilities to acquire and analyze satellite imagery, including application of modern GIS sofware.

Some flood extent control lines have been delineated in urban areas around Khartoum, based on past experience and extents of historical floods and limited use of satellite imagery. No delineation of flood extents has been done outside Khartoum. MIWR have a plan to produce contour maps from satellite imagery of the entire Blue Nile-Main Nile valley, subject to resources being available.

3.4 FOCUS AREAS

The social baseline studies of AbdelAti (2005) and Bush (2005) did not recommend specific villages or communities to target, however Bush recommended that rural areas be targeted within the Northern, River Nile and Sennar States, and urban areas in both Khartoum and Dongola.

A distinct difference was noted in the responses and coping measures of rural and urban communities. Rural communities generally regard the annual flood as a blessing, have informal strategies for dealing with high river levels, and it is only in the occasional high floods that serious inconvenience or hardship is likely to arise (varies, but typically averaging 1 in 10 years or thereabouts). Urban areas are more likely to regard flooding as a nuisance, and are less cohesive and less prepared to deal with the impacts of high floods when they occur. A partial exception is Tuti, which because of its peri-urban character and its situation (isolation) on an island of the Blue Nile within greater Khartoum, has better community cohesion and coping mechanisms than other urban communities.

In his estimation of flood damages using a rapid assessment method, Cawood (2005) identified very high damages in Dongola, a northern city remote from Khartoum. If those estimates are not highly inaccurate, urban communities within the city of Dongola deserve priority attention in the FPEW Project. It was also noted by both Abdel Ati and Cawood (*ibid*) that rural areas in Gezira State, which features large irrigation project development, is relatively little affected by riverine flooding.

For most rural communities, the impacts of floods are not limited to property damage and immediate danger to life. In fact, partly because the difference in river levels between normal and high floods is typically around 2 m or less, and partly because floods occur every year and the communities have adapted to them, loss of life is typically low even in high floods. Serious effects of flooding that demand attention also include:

- epidemics of water-related diseases, including but not limited to surges in the incidence of malaria – this is how the greatest loss of life is incurred;
- loss of property and productive land by river bank erosion (*haddam*).

Bank erosion and flood-induced disease are generally of much greater concern to the riparian communities than the inundation of land when the river level exceeds bank height. Pest such as spiders and snakes are also attendant upon the seasonal inundation of land.

AbdelAti (2005) visited 26 communities in his baseline study, and three of those (Um Beneen in Sennar State, and Tuti and Wawusi in Khartoum State) were again visited by the Consultant in the Inception step of the PP. It would be sensible to include these three communities for further assessment in the Project Definition step of the PP for purposes of continuity, plus two urban flood-affected communities in Dongola, plus a selection of others from those listed as visited by AbdelAti. It is proposed that the remainder include two rural communities from each of Northern and River Nile States, plus one other from Sennar State. That would make two communities from each State (excluding Gezira State, which is relatively less affected by floods), plus two urban communities in Dongola. Within Khartoum State, Tuti is urban and Wawusi is rural. This selection would provide a total of seven rural villages plus three urban communities. The selection of specific communities (apart from the three noted at the start of this paragraph) can await the arrival of the international social assessment specialist in April, and can be made in consultation with ENTRO, the Sudanese community specialist in the Consultant team, and possibly with the author of the baseline social study for Sudan.

Flood forecasting is well developed in Sudan – which is not to say that it could not benefit from additional support. More support is required in relation to weather forecasting, and

there appear to be serious problems in the delivery of effective services in both emergency response and in post-flood recovery and assistance to the communities in need. Further study and analysis is necessary to clarify why these services are failing the communities despite the organizations and administrative procedures that exist to provide them.

More discussion of forecasting and other requirements is provided in chapter 8.

3.5 GAP ANALYSIS

The following analysis identifies gaps in information, resources and institutional capacity that adversely affect current policy and practice for flood risk management in Sudan, and is based upon consultations undertaken during the Inception step of PP, and preliminary research.

3.5.1 Information and Data Gaps

The network of river gauges on the main rivers of interest to this study is generally adequate in Sudan. As noted above, lateral inflows to the main rivers are minor – with the exception of the Dinder and Rahad Rivers that join the Blue Nile, both of which are gauged. Other changes to river flows are due to losses in transmission or by attenuation, which are also minor. In these circumstances, a relatively simple network of river gauges is sufficient to characterize the hydrology. The system could be improved by communications to telemeter river level data to the Nile Forecast Center in Khartoum.

On the Atbara River, the one gauge on the lower reaches of the river (Atbara at K.3) is affected by Main Nile backwater and does not provide reliable gauging of high flows. An additional gauge (or alternative site) on the lower Atbara would be useful if a suitable site with reasonable access can be located.

Unofficial sites equipped with staff gauges located in villages subject to flood damage may also assist villagers interpret flood warnings better in relation to their local conditions. The potential value of this measure can be investigated during subsequent community consultations, however one community visited during the Inception step (Umbenin) agreed that such a facility might be useful to them.

As lateral inflows to the main rivers are usually minor compared to flows in the main rivers themselves, a relatively low density of rain gauges is tolerable from the perspective of river flow forecasting. Flash flooding is also significant in Sudan from the perspective of flood damages, and there is a role for short-term weather forecasting in managing this problem that would benefit from an improved rain gauge network targeted at areas where flash flooding is most severe. In particular, numbers of automatic rain gauges are inadequate for this purpose, and there are too few stations with facilities for real time (or near real time) data communications. There are currently no facilities in Sudan for upper atmosphere monitoring to identify atmospheric instability and moisture movements, which would also complement short-term forecasting for flash flooding.

The lead time and accuracy of flood forecasts for the main rivers could be improved with access to real-time data or near real-time data from rain gauges and river gauges in upper catchment areas of Ethiopia.

Seasonal weather forecasting and short-term rainfall forecasting related to river floods in Sudan currently lacks information from synoptic stations and forecasts available from ECMWF because of communications software problems that could readily be resolved with appropriate support. Similarly, seasonal weather forecasting would benefit from sea surface temperature data that were intended to be available through systems provided by IGAD that are not functioning properly.

Information on flood extents is much too general: while the number of villages potentially affected by seasonal river floods is known, specific impacts of flooding from rivers in those villages is poorly documented; and this is a contributing factor to the poor emergency response reported in the baseline study for Sudan (AbdelAti, 2005). Because floods occur every year (though with varying severity) and floodplain inundation is generally linear, it should be possible to delineate extents of land liable to riverine flooding with differing frequencies of inundation reasonably accurately – the main problem being the great length of river(s) for which flood risk mapping is desired. The task should be commenced with priority areas, including urban areas at risk and selected rural areas with highest flood risk.

Better information on damages caused by floods is necessary for more targeted flood risk management. What has been documented from past floods has been oriented to post-disaster relief and appeals for international assistance. Estimates are often made in relation to the value of food, materials and medicines required, for example, but that is not directly related to the value of flood damages. Documented information is very non-specific concerning the spatial distribution of damages, and estimation of damages do not appear consistent from year to year given what is known of flood magnitudes from river gauging records. Different methods of estimation or different criteria for damages have been applied, different sources typically present different estimates, and so past estimates are unreliable.

It remains unclear what information could be provided to flood-affected riparian communities that would assist them by raising awareness of flood risk and improving community preparedness.

3.5.2 Institutional Capacity and Resource Limitations

Training in short-term weather forecasting procedures would improve capacity in SMA to assist flood forecasting efforts in relation to both main river flooding and flash flooding, ideally complemented by actions to address the relevant information/data gaps identified above and to update and modernize computer and IT facilities used for data processing, storage and communications.

The Nile Forecast Center at MIWR has received good technical support from the specialist group at the University of Khartoum in the past, and that support should be encouraged in the future to maintain capacity. The Center will also need to update and modernize computer and IT facilities for data processing and communications.

While the Nile Forecasting Center is effective at providing flood warnings in terms of predicted flood peak levels and times to peak at official river gauging stations, one reason the emergency response system fails is that technical skills available in local authorities are inadequate to accurately interpret the detailed local impacts of flooding. The flood warnings

could contain much more information relevant to communities at risk from flooding if the flood peak levels could be interpreted clearly in relation to impacts at community scale. This is possible if the information on flood extents can be made more specific through flood risk mapping (refer to section 3.5.1). Apart from the task of mapping itself, which is a necessary prerequisite, this interpretation could best be achieved by a central unit trained and equipped for GIS spatial data analysis that could analyze extents of inundation and exposure to flood risk. There is adequate warning lead time for quite specific identification of flood extents and impacts in advance of flood peaks. To be fully effective, communications with State authorities and mahaliyas would need to be made capable of receiving the spatial information analysis, and appropriate computer hardware and software would be required at the remote locations for data display.

From past experience, there are major shortcomings in relation to emergency response and delivery of post-flood relief and recovery services. This is partly due to the large spatial scale of flood emergencies when they arise, and the rapid sequential development of local emergencies as floods progress down the main streams in Sudan. These circumstances will strain resources and communications, regardless of how well advance planning is undertaken to increase preparedness. From the limited consultation possible in the Inception step of the PP, and considering that most relevant documents were unavailable to the Consultant in English, and that institutional arrangements are in transition as a consequence of recent legislation in Sudan, it remains unclear what are the key problems. These will be further investigated during the next step of Project Definition, and particularly after arrival of the emergency response specialist in the consulting team. It can be stated with reasonable certainty that institutional capacity and limited resources are very likely to be important constraints, and the provision of additional resources, training and capacity building will be a part of any future management strategy.

There is little capacity in government for dealing with the ongoing problem of *haddam*, or river bank erosion, which is a serious problem for riparian villages and urban centers. This is partly a response conditioned by limited available resources, and partly a deficiency of skills from lack of institutional experience in waterway management.

4. FLOOD RISK MANAGEMENT IN EGYPT

4.1 THE NILE RIVER

Egypt is almost entirely dependent on the Nile River for its current prosperity. One of the earliest of the great human civilizations was founded and sustained for millennia along its banks and adjoining its great delta, where the Nile eventually reaches its outfall to the Mediterranean Sea. The country is divided by the river, flowing from south to north, with mostly arid lands to both sides along most of its length in Egypt.

Through the centuries the river has been both a blessing and a curse. Because of its near total dependency on the Nile for fresh water, the vagaries of the river in years of high and low floods determined the fortunes of the nation. Given the aridity of the climate, on balance it was overwhelmingly a benefit. In the 20th century, with modern water management and engineering, and particularly with the commissioning of the High Aswan Dam (HAD) in 1968, the great benefits of the river have been enhanced and the regulation afforded by HAD has greatly reduced the risks associated with the annual flood and increased the supply of water for irrigation and national development.

4.1.1 High Aswan Dam

The High Aswan Dam in located in Upper Egypt, and the lake it forms (Lake Nasser) extends more than 500 km upstream into the northern limits of the Sudan.

As indicated in Table 4-1, the storage is divided into three zones: dead storage; active storage; and flood storage. According to the design, the dead storage was sufficient to accommodate the sediment inflow over a period of 500 years. In practice, virtually all of the sediment is being deposited in the headwaters of the storage as the river waters slow down on entering the lake. The flood storage is intended to accommodate the annual flood, and the current operating rules aim to have the lake level at (or below) 175 m by July 1, before the annual flood inflow. Above around 178 m, water also begins to spill laterally from the lake to the Western Desert through a depression known as Toshka Spillway. Any water above dead storage is available for release for irrigation, hydropower generation and to sustain minimum environmentally acceptable flows down the river and through the delta.

Table 4-1: Lake Nasser Storage Zones

Zone	Up to lake level (m)	Cumulative Storage Volume (m^3x10^9)	Surface Area (km^2)
Dead storage	147	31.6	1 737
Active storage	175	122	5 168
Flood storage	182	163	6 540

Thus, the flood storage zone has a volume of approximately 41 m^3x10^9.

6.5 km downstream of HAD, the Old Aswan Dam serves to re-regulate hydropower releases and generate additional power. See Figure 4-1.

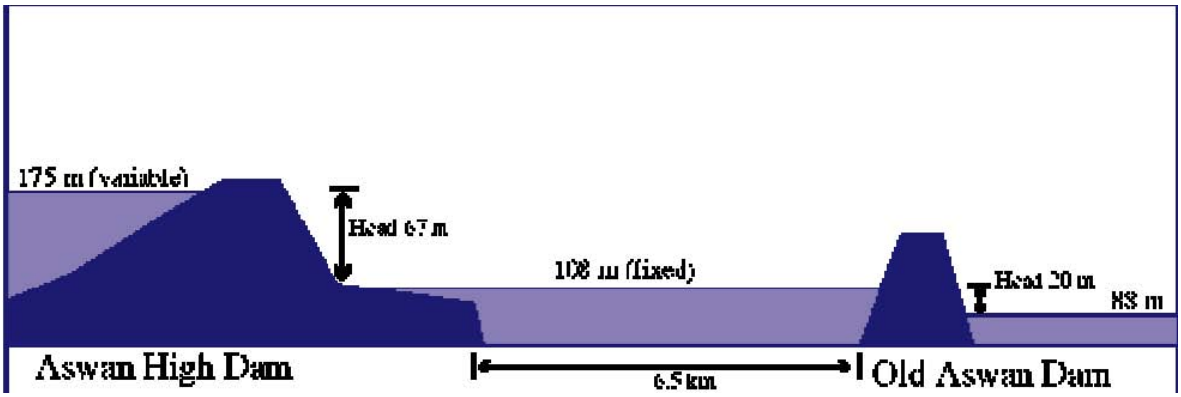


Figure 4-1: Regulation by High Aswan Dam and Old Aswan Dam

A series of barrages downstream further regulate and distribute the water released.

After commissioning, the storage filled over a period of almost 10 years, and annual releases were relatively stable for many years. During the severe droughts in the Ethiopian highlands during the 1980s, the lake levels declined progressively, remaining well below the flood storage pool for many years before beginning to recover commencing with the very large flood in 1988. See Figure 4-2. A sequence of generally above-average floods, commencing in 1998 and culminating in 2001, pushed lake storage well into the flood storage zone with releases of unprecedented magnitude since dam commissioning, and a record high lake level of approximately 181.6 m was reached in 2001.

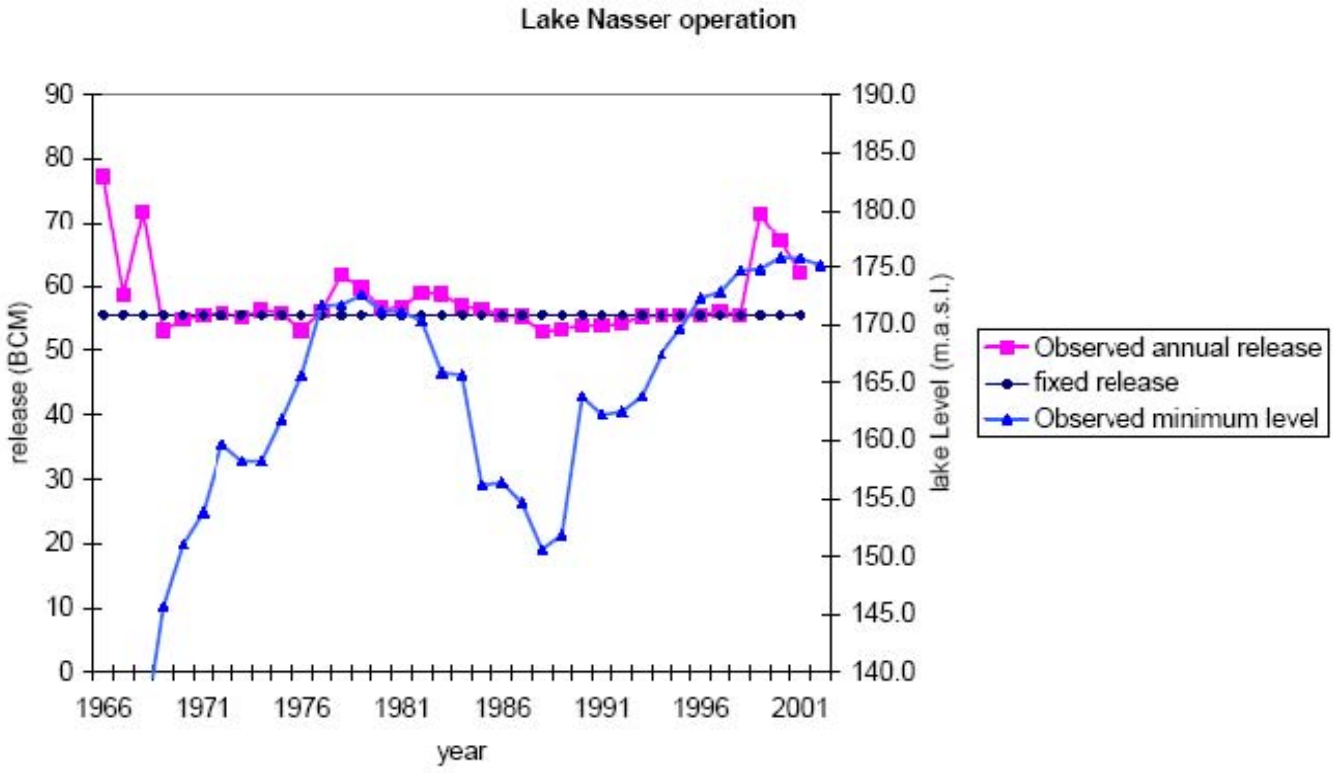


Figure 4-2: HAD Storage and Release Time Series

4.1.2 Downstream of HAD

In both 1998 and 2001, high rates of release had to be made from HAD. While much larger release discharges are possible using the main and subsidiary spillway gates at the dam, flood discharges of up to 350 m^3x10^6/d were assumed to be possible without significant downstream damage at the time of dam design. The necessity to release high flows for the first time in decades during 1998 and 2001 demonstrated that any flows above approximately 250 m^3x10^6/d to 260 m^3x10^6/d caused significant damages downstream, including the inundation of islands that were either occupied or intensively used for agriculture. Encroachment on floodplain lands had occurred over the intervening decades since commissioning of HAD, partly due to unauthorized land use and partly because of inadequate land use controls. High river flows also caused scouring at river structures (bridges and barrages), a problem aggravated by the low sediment loads downstream of the dams, leaving river flows with greater potential to degrade river beds and transport material.

4.2 CONSULTATIONS

Consultations were undertaken with several operational and research units in the Egyptian Ministry of Water Resources & Irrigation (MWRI) in Cairo. These included:

- the Nile Water Sector,
- the Nile Protection Sector,
- the Nile Research Institute,
- FRIEND Nile Project,
- The Nile Forecasting Center.

A summary of consultations undertaken is provided in Appendix A.

Another key stakeholder is the High Aswan Dam Authority (HADA), which is responsible for operations of HAD. HADA has no office in Cairo, and a visit to Aswan could not be accommodated in the Inception step visit.

4.3 KEY ACTIVITIES AND RESEARCH

Several important activities and research projects are in progress in relation to flood preparedness, flood forecasting and flood mitigation. This account is necessarily selective and summarizes some important projects. More details are available in the background paper by Seid (2004).

4.3.1 Flood Forecasting

The Nile Forecasting Center was set up in the Planning Sector of MWRI in 1990 with assistance from NOAA (US National Oceanic & Atmospheric Agency), and is well-equipped and skilled. It has developed models for short and medium term forecasting of inflows to HAD, and long-term simulation models for investigations of reservoir operations.

It has facilities to receive satellite data, including half-hourly CCC information and imagery from Meteosat. It also receives meteorological observations and weather forecasts from the ECMWF, which provides, *inter alia*, recent rainfall observations from five or six synoptic stations in the Ethiopian highlands. The Center is therefore able to make near real-time estimates of rainfall in the upper Blue Nile basin from CCC data using established techniques that have been calibrated to the ground observations available.

Data from selected river gauging stations upstream of HAD (in Sudan and Uganda) are also transmitted to the Forecasting Center.

A variety of techniques are also used to make seasonal streamflow estimates of inflows to Lake Nasser, and these are refined every 10 days as data from observation stations become available.

The USGS flood forecasting model associated with FEWS-NET is used for short-term and medium term streamflow forecasting, starting with the calibrated CCC estimates of rainfall at a current resolution of 5 km x 5 km pixels, soil moisture accounting rainfall-runoff simulation for each cell, then kinematic wave routing between model cells and Muskingum-style routing along main river channels. Forecasts are refined as updated data becomes available from ground observation stations and satellite imagery.

The Nile Water Sector also makes estimates of inflows to Lake Nasser for short-term operational decisions using simple regression techniques. The lead time from the monitored river station at Eddeim on the Blue Nile is of the order of 17 days.

A Standing Committee with representatives from the Nile Water Sector, the Nile Forecasting Center, HADA, the Irrigation Sector and other sectors and research institutions of MWRI meets two-weekly, or more frequently as circumstances demand, to review the flood forecasts and adjudicate on operational decisions.

4.3.2 Flood Risk Mapping Project

The Nile Research Institute is undertaking a floodplain mapping project of the Nile River valley. The mapping covers Reaches 3 and 4, which are between Naga Hammadi and Delta Barrages, a river distance of approximately 600 km (excluding river branches). With assistance of the government survey department, topographic survey has been completed and contours prepared at 0.5 m elevation intervals. NRI have also delineated three 'training lines', which are for channel extent, terrace lines and flood extents. The channel extent is essentially delimited by the banks of the active river channel, or the extents inundated during 'normal' floods. The terrace lines are taken from 1979 maps produced by the Canadian Earth Science Company, and were delineated to define the conveyance capacity required to pass a release from HAD of 350 m^3x10^6/d; although this is higher than the current threshold limit for damages, the intention is to control future development and land use within the terrace lines and encourage reversal of past encroachment. The flood lines are proposed as the likely upper limit of flood inundation. Development will not be controlled beyond the terrace lines.

After verification of the 'training lines' using new hydrographic survey data, the intention is to proceed with land use mapping and mapping of features (infrastructure, buildings) within

the flood lines, and then undertake flood risk mapping with the aid of hydraulic modeling. These maps are in digital format, and value would be added if they are incorporated in a GIS system.

There are plans to extend the mapping further upstream.

4.3.3 Lake Nasser Flood and Drought Control

This project commenced in 2002 (WL/Delft Hydraulics, 2002) to examine modes of operation of HAD to better cope with droughts and floods. It is being managed through the Nile Forecasting Center with the assistance of WL/Delft Hydraulics and others. The project will investigate the effects on downstream benefits and disbenefits of releases from HAD and the Toshka spillway under a range of operating scenarios. The scope of the project is quite comprehensive, and will include application of:

- downscaling models to improve precipitation estimates and forecasting, and downscale estimates from general circulation models to match the inputs required of existing streamflow forecasting models;
- a decision support system, or reservoir operations simulation model linked to benefits and costs, for HAD;
- hydraulic models of the Nile downstream of HAD;
- models of water distribution and water management in areas upstream of Delta Barrage, and in the main river delta;
- cost-benefit assessment analyses.

Some of the many alternatives being considered include engineering modifications of the Toshka spillway, new irrigation development on the shores of Lake Nasser, and modifications to dam operating rules and target reservoir levels. A primary objective of the study is to ensure the greatest net benefits of water stored in Lake Nasser. As far as practicable, losses to evaporation and the Toshka spillway should be minimized, consistent with appropriate management of flood damage downstream of HAD and dam safety.

The implications of climate change are also being examined in the study.

NRI are also involved in reviewing reservoir operations in view of the proposed development of a barrage at Toshka spillway (Aziz & Sadek, 2003; Sadek & Aziz, 2005).

4.4 FOCUS AREAS

The main focus areas for the benefit of Egypt are to complement existing programs such as those identified above. For example, improved flood forecasting has the potential to enable Egypt to gain greater benefit from the water stored in Lake Nasser. The value of water that can be released from the HAD can be derived from the cost-benefit analyses of the Lake Nasser Flood and Drought Control Project when these become available. Future forecasting will also need to consider operations of new storages being constructed upstream, or other storages being assessed in water resources development planning.

The FPEW Project will also consider providing assistance to NRI efforts to develop flood risk mapping downstream of HAD if that is considered desirable.

4.5 GAP ANALYSIS

The following analysis identifies gaps in information, resources and institutional capacity that adversely affect current policy and practice for flood risk management in Egypt, and is based upon consultations undertaken during the Inception step of PP, and preliminary research.

4.5.1 Information and Data Gaps

Any improved access to river flow data and rainfall data from upstream (Sudan or Ethiopia) will assist advance forecasting of inflows to Lake Nasser, and as operation of High Aswan Dam is a main focus area for flood risk management in Egypt, improvements to the regional data acquisition networks and improvements in data communications from remote sites to Cairo and Aswan will be important.

The current lack of flood risk mapping downstream of HAD is an important deficiency in information. Although this information gap is being addressed by Egyptian authorities, the measures completed to date remain only a beginning. Delineation of training lines has to date been completed only for the highest priority reaches. Furthermore, flood risk mapping properly requires identification of locations of the property and people exposed to flood risk, and should identify exposure to risk under different flood magnitudes. These are essential elements for effective floodplain management planning in the future.

If assistance under the FPEW Project is to be provided or facilitated by The World Bank, it is essential to undertake work consistent with WB environmental guidelines. When large dams are involved (such as HAD) the guidelines include dam safety requirements. To this end, access will be required to documentation on dam surveillance procedures, most recent dam safety review by an accredited panel of experts, operations and maintenance manuals, and trends in sediment deposition.

In relation to deposition of sediment in HAD, it is understood that regular monitoring of reservoir depth has been undertaken, however there are some limitations of current monitoring procedures. New three-dimensional hydrometric survey technology is available that would improve the accuracy of estimation of loss of storage and distribution of deposited sediments.

It is understood that past exchange of information has occurred between Sudan and Egypt on the new development of Merowe Dam on the Main Nile, but it remains unclear how frequently information exchange occurs, what protocols are to be observed, and how close the cooperation is. This is potentially an area where the FPEW Project could make a positive contribution under the regional component of the Project, particularly as the development moves from its construction phase to its operational phase.

4.5.2 Institutional Capacity and Resource Limitations

In general, resourcing constraints are not as severe in Egypt as they often are in Ethiopia or as limiting as they can be in Sudan. Institutional capacity is also relatively high. Despite these advantages, Egypt will benefit from opportunities for increasing knowledge of new technologies or new procedures that are related to the tasks of flood risk management.

Egyptian authorities may also participate in regional transfer of knowledge for mutual benefit.

The Nile Forecasting Center in Cairo has developed admirable skills and capabilities for flood forecasting of inflows to HAD. Nevertheless, as with any advanced technology, there is a current and ongoing need for modernization and updating to new generation equipment for data processing and information display.

The replication of forecasting in several sectors of the MWRI was noted during the visit to Cairo in the Inception step of PP. Although the objectives of the separate forecasting activities that occur may vary, there appears to be some danger of duplication of effort and inefficiency in these practices. While it is not the role of this Project to resolve such issues, the MWRI might well consider whether this situation has just developed through historical practice and lack of coordination, or whether the multiple forecasting approach is valid for its purposes and its operations. If rationalization of the efforts does prove to be justified, the well developed skills in the Nile Forecasting Center could perhaps be expanded to meet the requirements of multiple users within the Ministry.

In relation to equipment resources, the observation was made in the preceding section that accuracy of estimation of loss of storage due to sediment deposition and knowledge of the distribution of deposition in HAD could be improved with new technology hydrometric survey equipment, plus relevant training in the technology and its application, operations and maintenance.

There is insufficient capacity in government for, and lack of experience in, dealing with the problem of river bank erosion and scour, which is significant downstream of HAD when high releases must be made.

5. REGIONAL ASPECTS OF FLOOD RISK MANAGEMENT

5.1 PRELIMINARY

The purpose of this chapter is to briefly review past regional cooperation in management of flood risk, and current activities that are relevant to regional flood risk management, and then to identify how greater regional coordination would be of mutual benefit. Finally, a program for future progress towards better regional cooperation and coordination is proposed.

5.2 REGIONAL COORDINATION

5.2.1 Past and Current Coordination

Regional coordination in flood risk management arguably began after the commissioning of HAD with the need for forecasting of flood inflows to Lake Nasser. Management of HAD also entails an international agreement between Egypt and Sudan, although that agreement is primarily related to the allocation of water resources. The need to forecast flood inflows led to development of monitoring stations located in upstream countries relaying data to Egypt, and the exchange of rainfall data with the advent of modern computer and satellite communications technology. With those exceptions, there remain no formal protocols or agreements for data exchange between the three Eastern Nile riparian countries. Only limited informal or *ad hoc* exchange of data has occurred in the past. This has been a constraint on good flood risk management practice, particularly for the downstream States of Sudan in particular, and Egypt.

The political and economic climate has recently become more conducive to cooperation than in the past, and the needs for and benefits of greater coordination have been recognized by ENCOM. The NBI, and particularly ENSAP and the establishment of ENTRO within the past five years promise a new era of regional coordination in water resources management, including flood risk management – however, as explained in section 1.2, the FPEW program is one of several fast-track projects identified under ENSAP and is therefore at the forefront of what will be the new wave of regional coordination.

Within ENSAP, a project with especial relevance to the FPEW Project is the Joint Multi-purpose Project (JMP), which aims to develop water resources jointly in an equitable and sustainable manner for the shared prosperity and security of the peoples and nations in the Nile river basin. For example, within its likely agenda will be the development of hydro-power facilities from storages located within the Abbay river basin in Ethiopia. Several sites for major storages are being considered in prefeasibility planning. At this early stage a favored site is at Karidobe on the Abbay River. Any of the developments being considered could make very significant changes to future flood risk scenarios downstream, particularly in relation to riparian communities along the Blue Nile and Main Nile in Sudan. Benefits would accrue from reduced flood damages downstream; however, riparian communities depend on seasonal flooding for water resources and replenishment of soil fertility, have adapted their land management practices to the current flood regime, and so substantial mitigating measures may be necessary to offset benefits potentially foregone. The JMP is

currently at the conceptual or launch phase, an earlier phase of development than the current preparation phase of the FPEW Project. Interchange of information is essential to derive the best project outcomes. As it proceeds, the FPEW Project can advise on down-stream flood risk for JMP proposals, and the JMP can advise on changes to downstream flood regimes that will be relevant to flood risk management under the FPEW Project.

Other fast-track projects nominated under ENSAP that have linkages with the FPEW Project are the Watershed Management Project, and the Irrigation & Drainage Project, both of which remain in the conceptual phase of project development and therefore lag behind development of the FPEW Project. Effective watershed management would reduce land erosion and sediment loads in rivers, influencing the dynamic fluvial morphology of main rivers such as the Blue Nile, Atbara and Main Nile and modifying flood hazard and exposure. Irrigation projects may involve development of water storages that would directly modify downstream flood hazard. Current planning for irrigation projects in the Lake Tana area that may be supported by WB, and therefore potentially by ENTRO, entails development of water storages that would modify flood hazard in some of the localities already identified as priority flood risk focus areas under the FPEW Project.

Apart from the importance of ready exchange of information between projects, there is also scope for the FPEW Project to identify measures desired for future management of flood risk that would be more appropriately implemented under other related projects.

5.2.2 Benefits of Regional Coordination

In large transnational river basins such as the Nile river basin there are always benefits to downstream riparian States from regional coordination. Data exchange provides better information for water resources management, and in the case of flood risk management provides earlier warning of impending floods and improved accuracy of flood forecasting. In the Eastern Nile region the benefits of data exchange are clear to Sudan and Egypt, for example.

Regional coordination concerns much more than simple exchange of data. It embraces knowledge transfer and information sharing, and joint management and technical activities, from which benefits are derived for all participants. In the Eastern Nile region, this is particularly relevant. Because of historical experience over recent decades, Ethiopia has focused on drought management with very little attention to flood risk management, and therefore has little experience and poorly developed skills in most aspects of flood manage-ment. Ethiopia has much to learn from consultation and cooperation with Sudan and Egypt, both of which have greater depth of experience and more developed skills in flood manage-ment. On the other hand, Ethiopia has a relatively well developed system for disaster management related to drought risk (Sinage, 2002), particularly in relation to preparedness and delivery of post-disaster relief and recovery services. There are aspects that may be adaptable to management of flood risk, and useful lessons may be applicable to emergency response and post-flood relief and recovery for Sudan and Egypt.

More generally, but no less importantly, regional coordination and joint activities build confidence and promote understanding so that sharing of information and exchange of data by technical specialists and managers becomes the norm. Modern management relies on good information and ready access to information, so regional cooperation in water

resources and flood risk management within shared river basins leads to better management and benefits all participants. A regional approach will also assist all participating countries by attracting more funding and technical support from outside the region, *eg.* through the auspices of international donor/aid bodies.

5.3 REGIONAL PROGRAM

5.3.1 Analysis of Needs

A major need is for a better integrated regional data acquisition network and data transmission system to support flood forecasting, and flood risk management more generally. There are other flood risk management tasks that will benefit from a regional approach (*eg*. flood warning, mitigation of bank erosion, flood risk mapping, flood emergency response, *etc*.), however while there are commonalities in these tasks, in most cases there are also important differences in circumstances between the countries such that varied approaches will be necessary. Even the tasks of flood forecasting will vary in approach between the three countries because of different lead times and different circumstances (*eg*. scattered communities in Ethiopia, linear development of communities along banks of main rivers in Sudan, communities downstream of HAD in Egypt). Despite differences, because of common objectives sharing of experience and technical skills will benefit all participants by broadening their knowledge base.

Another important need is therefore to provide the opportunities for sharing of experience and technical knowledge, to promote shared learning. These opportunities should take several forms, including regular technical forums, joint post-flood reviews of operations, joint study tours, *etc*., and will require funding and organizational support.

An effective way of providing organizational support would be to have a small permanent unit, appropriately staffed and equipped, whose role would be to maintain communications with interested parties in all regional countries, organize the opportunities for shared learning, and develop a technical framework for joint activities such as integration of the data network and data transmission system, joint technical studies, *etc*.

5.3.2 Framework for Action

Based on this synopsis, Table 5-1 provides a basic framework for a regional program that will be further developed in the Project Definition step of the PP. This addresses the Regional Component in the ToR.

Table 5-1: Requirements for Regional Component of Flood Risk Management

Category	Needs	Remarks
Regional Data Networks/ Systems	Extend real-time reporting rain gauge network	Establish target network density (PP). Additional reporting rain gauges in the Tekeze and Abbay sub-basins in western Ethiopia.
	Introduce real-time reporting river gauges	Identify requirements, locations (PP). Additional reporting river gauges on the Tekeze and Abbay Rivers in western Ethiopia, and possibly Atbara R in northern Sudan.
	Data acquisition equipment	Evaluate alternatives, training (PP, PI)
	Communications for data transmission	Evaluate alternatives, training (PP, PI)
	Regional relay stations	Evaluate need, eg. at Bahir Dar, other sites (PP) – capacity building
	Development of discharge ratings at new sites	Equipment needs (eg. current meters, cableways, vehicles, etc.), training (PP, PI)
	Review non-transmitting sites to strengthen wider gauge network, database, planning information.	Facilities, equipment, IT, training (PP, possibly under another Project).
	Laboratory facilities for calibration of current meters, etc. in conjunction with other hydraulic research needs.	Possibly joint project by university/ government. Training (PP, possibly under another Project).
Shared Learning	Regional conferences, seminars	Develop proposals (PP)
	Regular (annual) post-flood reviews of technical operations	Consult with stakeholders (PP)
	Joint study tours	Identify possibilities (PP, PI)
	Joint technical studies	Identify possibilities (PP, PI)
Funding & Organizational Support	Standing unit and/or committee for administration & technical liaison	Establishment, location, structure, detailed role to be determined (PP)
	Funding of regional activities	Identify sustainable sources of funding (PP, PI)

NOTE: PP is Project Preparation; PI is Project Implementation.

6. PROPOSED FLOOD RISK MANAGEMENT STRATEGY FOR ETHIOPIA

6.1 ASSESSMENT OF NEEDS

6.1.1 General

The current capabilities for flood management in Ethiopia are limited. There are a number of reasons why this is the case. Drought management has always been a greater priority in the field of disaster management in Ethiopia, and with limited government resources most effort has been directed to the management of drought. Flooding problems are spatially isolated in Ethiopia. In the Abbay sub-basin in particular, downstream of Lake Tana the river is generally deeply incised and floodplains are either absent or of very limited extent, or are sparsely populated. In other words, the exposure to flood hazard is very limited. This is quite different to Sudan and Egypt where the majority of the population reside near the rivers, and large numbers are (or were) exposed to flood hazard. Where exposure to flood hazard does exist in Ethiopia, floods are occasional hazards, not annual hazards. In other words, the flood hazard is relatively low compared to areas where large variations in river levels occur every year, as in Sudan. Another important aspect is that the response times between storm rainfall and flood peaks are relatively short in Ethiopia, making flood management more difficult.

Despite the foregoing synopsis, floods do occur in Ethiopia that can result in loss of life or incur damages affecting and causing hardship to many thousands of people, and better flood risk management is possible and would benefit many communities.

The following section attempts to identify certain technical, resourcing and skills requirements that are needed in Ethiopia to provide a sound foundation for flood risk management. In the context of the Eastern Nile FPEW Project, attention is directed to the Lake Tana area and Gambella region (see section 2.4), however development of a sound foundation for flood risk management for these regions would clearly benefit other regions or river basins where flood risk is substantial (eg. Awash river basin).

6.1.2 Basic Requirements

The requirements follow logically from the gap analysis presented in section 2.5, and are listed under the following categories: information requirements; flood forecasting requirements; flood warning and emergency response; post-flood recovery and assistance; community preparedness; flood mitigation measures. See Table 6-1.

Table 6-1: Requirements for Flood Risk Management in Ethiopia

Category	Needs	Remarks
Information	Clarify identification of damages/impacts in target areas (qualitative)	Social survey will provide more info (PP)
	Preliminary assessment of damages (quantitative)	Apply Rapid Assessment Method as in Cawood (2005) - PP
	Estimate flood response times in different river systems	Hydrological analysis (PP)

Category	Needs	Remarks
	Preliminary mapping of flood extents	Extend work of Bekele (1997) based on topography, anecdotal advice from social survey, satellite imagery (PI).
Flood Forecasting	Develop and support new Forecasting Center. Proposed functions:	Identify most appropriate location, resourcing (PP)
	- receive, analyze satellite imagery, global synoptic & rainfall data, weather forecasts;	NMA already do this
	- receive, analyze local data from transmitting rainfall & river gauges;	
	-develop flood forecasting models for L Tana flood risk areas (initially);	Assess model requirements, compatibility with forecasting procedures in Sudan & Egypt (PP).
	- improve data acquisition network & communications around L Tana	Preliminary network/system design (PP).
	- exchange data, forecasts directly with E Nile countries, submit to ECMWF;	Method of communication (PP).
	- real-time forecasting during flood alerts.	
	Consider:	
	- addition of GIS capabilities to comprise a center of expertise for remote sensing & forecasting.	To broaden skill base, and complement capabilities for drought forecasting/management, agricultural/ economic planning, transportation/ comms planning, etc.
	Improve data acquisition network	New rain/river gauging stations where network is sparse eg. upper Dinder and Rahad, Tekeze river basin in S and E (PI)
		Upgrade facilities at existing stations where necessary (PI)
		New equipment eg. vehicles, current meters, cableways, etc. (PI)
	Modernize data transmission for key stations	Identify most appropriate methods for data transmission from remote sites. (PP, PI)
	Upgrade facilities at regional centers to develop data processing capacity	Provide facilities, training for data processing, regional flood warning tasks, upgrade data communications (PI)
	Develop capacity in MWR for data processing & analysis	Upgrade equipment, facilities, provide training (PI)
Flood Warning & Emergency Response	Clarify roles, responsibility	Flood warning by new Forecasting Center? or an existing committee or agency? (PP)
	Clear, reliable lines of communication	
	-communications to regional centers;	eg. Bahir Dar, other sites? (PP)

Category	Needs	Remarks
	- comms. from regional centers to observers, local authorities;	role for DPFSCs (?) (PP)
	- preparation of general guidelines for flood contingency plans;	through DPPA (PI)
	- local authorities to develop specific flood contingency plans;	with assistance of FPEW PI
	- review of operational/capacity requirements.	review for DPPA (PP, PI); identify training requirements
Post-Flood Services	Review existing resources, capacity in view of much more rapid response times required for flood cf. drought.	Basics already exist in DPPA oriented to drought management. Specify needs in PP.
	Prepare guidelines for provision of post-flood recovery services.	Preliminary in PP, detailed in PI.
	Identify practical assistance measures for remote communities.	
Community Preparedness	Confirm findings of baseline study.	Social survey (PP).
	Identify/evaluate appropriate support for risk avoidance measures.	To modify flood hazard, or exposure, or vulnerability – eg. small-scale structural measures, refuges, stores for damageable goods, relocations, etc. (PP).
	Pilot project to support establishment of community management groups to manage group activities in advance of floods, post-flood self-help, liaison with government agencies.	Emulate successful models elsewhere (PI).
	Identify what information could be of use to communities, and how it could be provided and related to their circum-stances.	Social survey (PP). eg. u/s river levels, flood warnings
Flood Mitigation Measures	Resettlement in urban areas – i.e. Bahir Dar, Gambella City	Review potential (PP) for implementation (PI).
	Gambella City – review existing proposals, identify other practical measures to manage flood risk.	eg. land use controls, forecasting, advance contingency planning
	L Tana: review flood mitigation effects of proposed dams	Links with proposed irrigation and hydro projects, incl. WB L Tana Project
	Review of flood risk management proposals for Gambella Plains	Concept (PP)
	NOTE: PP is Project Preparation; PI is Project Implementation.	

A number of comments are necessary to supplement Table 6-1.

- Satellite imagery may assist delineation of flooded areas. It was noticed that the earth observation image in GoogleEarth© shows some inundation of areas in the lower river basins of Ribb and Gumera. The date of that imagery is not stated. However, it shows

that, if the dates of past flooding can be established in the PP, there are prospects that satellite imagery may be available to assist delineation during PI.

- An appropriate target network density for the reporting rain gauge network in Abbay and Tekeze sub-basins should ideally be around one per 1000 km^2, however a lower density may be acceptable given the size of the areas to be monitored.
- Relatively few reporting river gauges would add great value to regional forecasting systems: perhaps up to seven or eight in the Abbay sub-basin and up to four or five in the Tekeze sub-basin; however a rational basis for site selection will be established in the Project Definition step of the PP.
- The concept of regional relay stations (with a central station in Addis Ababa) would add value to the proposals for several reasons. One reason is that regional offices of MWR are currently under-resourced, and do not even possess computer facilities for data storage processing and communications. That shifts the data processing load on to the main office of MWR in Addis Ababa, which has to attend to all routine DP tasks, diverting resources from added-value analytical tasks. Placing relay stations in regional centers like Bahir Dar, Makale, etc., would not only build their capacity to support regional and national water resources in Ethiopia, but would also provide a valuable conduit or link for flood warning purposes, to help bridge the gap between Addis Ababa and the communities that need to be alerted. Of course, this would require developing adequate resources and skills at the regional centers to accept the new role, including new facilities, equipment and training. The flow-on benefits could be considerable.
- The existing river gauge network in Ethiopia is in great need of assistance. Apart from limited resources, much of the field equipment is now very old or not operational, and renewal and modernization of parts of the network is required. The existing network serves important roles in providing basic data for investigations and planning of all water resources projects, including flood mitigation projects and any projects that benefit flood risk management. It is proposed that the PP undertake additional review to identify a preliminary plan for rehabilitation of the river gauge network and institutional support for MWR, particularly the Hydrological Department. Whether development of the preliminary plan and implementation should be undertaken by the FPEW Project or by some other avenue will need to be determined.
- Hydrographic work in Ethiopia (and other regional States) has to work around the difficulty of having no facilities available in country to accurately calibrate measurement equipment and being far remote from countries that do. Laboratory facilities should be developed in Addis Ababa (or one of the other capitals in the region) with the capability to perform this function. Appropriate hydraulic facilities should also find application in many hydraulic investigations for public and private developments, and for hydraulic research. Such a unit may be appropriate for joint university and government development, with calibration of hydrographic equipment just one of many applications. It does not seem appropriate that this be part of the FPEW Project implementation, however it could be allocated to some other Project for assistance.
- The proposed Forecasting Centre could be an example of regional cooperation, as Forecasting Centers are well established in Khartoum and Cairo and similar approaches may be applicable in Addis Ababa. Past experience in the other Centers would be very useful information for a new Forecasting Center in Ethiopia.

- The location of the new Center needs to be determined in consultation with the Ethiopian Government. Current resources and skills in relation to satellite and international weather data capture reside in NMA, however flood forecasting logically belongs with MWR. If the broader concept of a specialist center for remote sensing, GIS applications and forecasting is accepted, then several other Ministries or government agencies would also have an interest in being stakeholders. Alternatives include: locating the Forecasting Center in MWR; building on the existing capacity in NMA; developing a joint unit with NMA and MWR as key stakeholders; developing a semi-autonomous specialist unit to service the needs of MWR, NMA, DPPA and others; etc.
- One agency should have sole responsibility for issuing flood warnings. It could be the new Forecasting Center or specialist applications center, it could be MWR. It could also be a committee with representation from several agencies such as the existing technical committee on dams or the executive Crisis Management Unit, however awarding the responsibility for flood warning to a multi-sectoral group risks (a) delays in issuing warnings when delays are unacceptable, and (b) diluting the message.
- As noted above, development of regional relay centers to transmit field data to Addis Ababa would also provide a line of communications for transmitting flood warnings and emergency response commands to the field. Communications could be directed from relay sites through regional DPFSC offices to take appropriate action. Guidelines for flood emergency response would need to be developed for DPPA and DPFSCs, and training provided in order for them to undertake this new role. Other links in the chain of communications need to be strengthened, with flood contingency plans developed for local authorities in flood risk areas, followed by capacity building and training in emergency response procedures.
- In other parts of the world there have been successful examples of communities organizing to help themselves and prepare for the impacts of floods. Communities are typically not able to organize without some external impetus, such as support from a social worker (government or NGO) and perhaps some seeding money for initiatives such as refuges, platforms, cooperative funds, etc. To be sustainable community organization requires development of good self-management skills and is predicated on the presence of a genuine need in the community and clear perception of benefits. A pilot study in one of the worst-affected kebeles is suggested in PI, preferably linked to some method of flood warning even if only an informal one.
- There are several development proposals around Lake Tana currently being investigated by MWR, including a pre-feasibility study of irrigation areas with prioritization of approximately 20 000 ha, and feasibility study of a further 80 000 ha proposed this year with WB support. Up to five dams are proposed within a possible nine projects, including projects on the Ribb, Gumera and Megech rivers which are responsible for some of the worst flooding in the region. There is also a hydropower project being studied for diversions from Lake Tana to the Beles (tributary to the Abbay downstream, and west of Lake Tana). Any of these schemes are likely to have significant flood mitigation benefits if implemented. Their potential mitigation effects will be reviewed in PP, and recommendations made for how the FPEW Project could have an input if appropriate.

6.2 PRELIMINARY STRATEGIC FRAMEWORK

An appropriate strategy for Ethiopia can therefore be summarized.

Clarify and delineate flood risk areas.

Build and support a flood forecasting capability – eg. Forecasting Center.

Assign a clear responsibility for issuing of flood warnings.

Establish clear, reliable lines of communications to/from local communities at risk.

Prepare guidelines for emergency response procedures and for post-flood recovery assistance. Specify roles and responsibilities, and build institutional capacity.

Support local authorities (woreda/kebele) with development of specific flood contingency plans, adequate training and capacity building for effective delivery of services as needed.

In a pilot program, work with a community or communities to promote self-organization and self-help, including liaison with government services and implementation of community-based plans.

Prepare proposals to mitigate the adverse impacts of urban flooding in Bahir Dar and Gambella City.

Derive flood mitigation benefits from proposed irrigation and hydropower developments in Lake Tana area.

Develop data acquisition networks (rainfall and river gauging) with real-time reporting to support in-country and regional flood forecasting needs.

Regional cooperation in technology transfer, data exchange, joint technical activities and research, regular forums, etc.

These tasks or activities provide a framework for further development in the next Project Definition step. Each one requires substantial elaboration and more detailed development, including definition of associated resourcing and capacity building.

7. PROPOSED FLOOD RISK MANAGEMENT STRATEGY FOR SUDAN

7.1 ASSESSMENT OF NEEDS

7.1.1 General

The Sudan has a tradition of coping with floods, and a range of government services have been developed that are designed to support communities in areas of flood risk along the main rivers. This tradition is the natural outcome of the situation in Sudan where, at least in central and northern parts of the country, a large proportion of the population live on land near large rivers and some are exposed to flood risk. Furthermore, floods occur every year during the seasonal rains. As noted previously, 70% of the Nile flow is derived from the Blue Nile and Atbara rivers which rise in the Ethiopian highlands.

Because of the regularity of floods on the Blue Nile and Main Nile, rural communities situated along the river banks have adapted well to the temporary inconvenience of seasonal high river levels and have coping mechanisms that are at least partly effective. The benefits of the seasonal floods bringing soil moisture for agriculture and a reliable supply of water through the remainder of each year are well understood by villagers. It is only the occasional higher floods that greatly disrupt village affairs, but despite their knowledge of flooding communities still seem to be ill-prepared for the higher floods (such as in 1998) that are outside their usual experience.

Flash flooding from sudden storms is another problem experienced in rural areas of Sudan, and for riparian communities it is most damaging when it coincides with river levels exceeding bank height. It has been accepted that the focus of this PP will be on riverine floods, however it is recognized that preparation of some mitigation measures – eg. community levees – needs to consider the impacts of flash flooding.

The development and application of flood forecasting is well advanced in Sudan, largely by virtue of collaboration by a group within the University of Khartoum Department of Civil Engineering with the MIWR, and in particular the Nile Waters Department which operates a Nile Forecast Center. Unlike the Nile Forecasting Center in Cairo, which undertakes weather forecasting and model development internally, the Center in Khartoum relies on external cooperation with the Sudan Meteorological Authority (SMA) for weather forecasting and with the University of Khartoum for model development and testing. The arrangement generally functions well, although aspects of the weather forecasting require additional support. The relatively simple hydrological situation – with virtually all river flow derived from upstream – has permitted accurate flood forecasts with adequate lead times: although the lead times for Sennar State are shorter (2 to 3 days). Warning lead times could be extended if real-time data on rainfall and river flows in Ethiopia were available.

As described in section 3.3.2, emergency response relies primarily on the CDO, while the CDO, HAC, NGOs and others become involved in post-flood recovery. Despite the organization that exists, a clear message from the baseline social survey was that communities do not perceive that assistance is being delivered effectively, and this perception strengthens with distance from Khartoum. It was not clear from the short visit made during the Incept-

ion step why that is so, and there are probably many contributing factors. The fact that, when floods occur, they occur sequentially along the river so that a large number of communities are impacted over a short time, presents difficult resourcing issues. The length of the rivers and remote locations of some communities aggravates that problem, with access and telecommunications often difficult. The plethora of organizations that become involved in relief operations may be another issue: while HAC nominally has the responsibility for coordinating these operations, it lacks authority to direct and has limited resources. Current arrangements are also in transition after new legislation was enacted in 2005. Further analysis is essential by the social assessment specialist, institutional specialist and emergency response specialist to diagnose the symptoms and propose a remedy.

It is clear that there is a lack of planning information. While good forecasts are made with adequate lead times, that advantage is not being translated into effective action because the flood risk areas are poorly defined. A priority is therefore to build a spatial information base of flood risk mapping. Because of the great length of the rivers affected, it will be best to begin with reaches selected because of greatest need. Unless very substantial funding can be organized at short notice, this will have to be staged over many years.

Resettlement is a measure used in Sudan to modify exposure to flood hazard. Typically, new village land is allocated more remote from the river. The measure has only been partially successful. Villagers are reluctant to relocate to areas without equivalent services (eg. water supply, schools, sanitation, shade). Provision of services to new areas has been too slow.

Apart from the direct impacts of inundation from floods, there are two very serious side-effects: river bank erosion (*haddam*); and disease.

Whether river bank erosion should be treated under the FPEW project is a vexed question. To some extent, the river channels are naturally unstable due to the combination of varying flows and high sediment loads. Like floods, river bank erosion cannot be entirely eliminated. Instability of river morphology is also undoubtedly aggravated by land use change, both in Sudan and particularly in the Ethiopian highlands where a reduction in vegetation cover and agricultural practices elevate rates of erosion. On the other hand, river bank erosion occurs predominantly during floods, and it contributes directly to the damage done by floods: loss of productive land, damage to infrastructure (eg. pumping stations), and destruction of housing. In the Consultant's view, the issues of land use change and upland erosion are a separate problem that requires treatment under another Project: ideally the Watershed Management Project. However, treatment of the river bank erosion along the river in Sudan should ideally be made under the FPEW Project, or it stands in danger of remaining untreated. The difficulty with this suggestion is that the PP team does not include the specialist expertise to propose management of the problem.

The annual floods are inevitably followed by a surge in incidence of several water-related diseases, particularly malaria. In terms of human welfare, and in terms of loss of life, this is clearly the most important consequence of floods in Sudan, and cannot be ignored. There are very urgent needs to address this problem. Again, the PP team does not have the expertise to propose management treatment of this problem. It is a national health issue, and treatment properly belongs under a health improvement program. Arguably, it does not even fall within the mandate of ENSAP. The PP should highlight the problem to alert

other aid and support programs to the need. In development of project implementation measures, the PP should also identify opportunities to alleviate the physical conditions that lead to post-flood epidemics – such as standing water, contamination of village water supplies and sanitation.

7.1.2 Basic Requirements

The requirements follow logically from the gap analysis presented in section 3.5, and are listed under the following categories: information requirements; flood forecasting requirements; flood warning and emergency response; post-flood recovery and assistance; community preparedness; flood mitigation measures. See Table 7-1.

Table 7-1: Requirements for Flood Risk Management in Sudan

Category	Needs	Remarks
Information	Clarify identification of damages/impacts in target areas (qualitative)	Social survey will provide some info (PP)
	Preliminary assessment of damages (quantitative)	Refine Rapid Assessment Method as in Cawood (2005), particularly assumed unit rates, and areas impacted - PP
	Acquire detailed topographic data of Blue Nile and main Nile valleys: GIS DTM layer and preparation of contours; river channel cross-sections.	Select pilot areas (eg. Dongola, Khartoum, rural reach in Nile State). Compare costs, accuracy of different methods. (PP)
	Hydrological analysis to determine design flood discharges at selected locations.	
	Hydraulic analysis to estimate flood profiles. GIS layers of flood extents.	Establish what flood level data and satellite imagery exists for calibration, apart from gauging station data.
	Analysis of features and land use from satellite imagery.	Identify capabilities of existing agencies, need for capacity building or consulting services. (PP)
	Preparation and distribution of flood risk maps.	
Flood Forecasting	Extend real-time reporting rain gauge network in Ethiopia	See Table 5-1.
	Introduce real-time reporting river gauges in Ethiopia.	See Table 5-1.
	New river gauging station on Atbara R.	Discuss requirement with MIWR (PP).
	Provide support to Univ.of Khartoum for updating calibration/validation of flood forecasting models, future research.	Consult to define tasks (PP).
	Provide support to SMA to overcome data receival software problem to enhance weather forecasting capability.	Identify supplier for receival of ECMWF data (PP). Training.
	Supplement rain gauge network, esp. automatic recording/reporting stations.	Propose sites to complement existing network in consultation with SMA (PP).
	Standing Committee for liaison on forecasting: MIWR, SMA, others (?)	Two-way communication on needs, links, exchange of information.

Category	Needs	Remarks
Flood Warning & Emergency Response	Develop GIS capacity so that warnings can have more information content, linking flood forecasts to flood risk mapping. Capacity building, training.	Establish management agency: Nile Forecast Center, CDO? with adequate skills base. Remote Sensing Authority to support. Establish other assistance necessary. (PP)
	Link flood risk mapping to flood contingency plans.	Capacity building, training needs in CDO. (PP)
	Improved pre-season preparedness, shorter response times, better capacity to serve remote communities.	Organization study of CDO. (PP, PI). Review implications of new legislation & role of NCCD (PP).
	Improved communications.	Review of communications systems for disseminating flood warnings and operational commands during emergencies. (PP)
Post-Flood Services	Improved delivery of post-flood assistance (food, shelter).	Organization study of HAC, relief operations. (PP, PI).
	Improved post-flood recovery services: health, education, water/sanitation, etc.	
	Clarify lines of authority. Roles and responsibilities must be clear, with little or no overlap. Adequate authority must reside with one agency to direct post-flood operations.	Consider need for institutional restructuring, capacity building, training needs. (PP)
	Prepare guidelines for provision of post-flood recovery services.	
	Identify practical assistance measures for remote communities.	
Community Preparedness	Confirm findings of baseline study.	Social survey (PP).
	Identify/evaluate appropriate support for risk avoidance measures.	To modify flood hazard, or exposure, or vulnerability – eg. small-scale structural measures, refuges, stores for damageable goods, relocations, etc. (PP).
	Pilot project to support establishment of community management groups to manage group activities in advance of floods, post-flood self-help, liaison with government agencies.	Emulate successful models elsewhere (PI).
	Identify what information could be of use to communities, and how it could be provided and related to their circumstances.	Social survey (PP). eg. u/s river levels, flood warnings
Flood Mitigation Measures	Dikes constructed to engineering design standards in urban areas.	eg. Tuti Island, elsewhere in Khartoum, Dongola(?). Review requirements with Khartoum and Northern States (PP).
	Minor levees, bunds in rural villages, with provision for drainage for local runoff.	Investigate options for improving standards.

Category	Needs	Remarks
	River bank protection in urban areas.	Review requirements with Khartoum and Northern States (PP).
	River bank protection in rural villages.	Pilot low-technology/ appropriate technology measures. (PI)
	Better provision of preventive health methods.	Consult with health authorities. (PP) Implementation under other programs. Incorporate simple risk reduction methods in management guidelines.
NOTE: PP is Project Preparation; PI is Project Implementation.		

A number of comments are necessary to supplement Table 7-1.

- For flood risk management purposes, elevation contours of 0.2 m are desirable, with vertical accuracy of less than 0.2 m. Lower vertical resolution is acceptable in rural areas – say, 0.5 m. That accuracy could not be achieved from satellite imagery a few years ago, but with advances in technology and new satellite launches it may be now. This needs to be established, because if satellite imagery can be used successfully it could achieve substantial cost savings. MIWR recently received quotes in expressions of interest from local providers, indicating satellite image analysis would be less than half the cost of photogrammetry. LIDAR (air-borne lasar) is of the same order of cost as photogrammetry. Further investigation of options and capabilities will be undertaken during Project Definition.
- Selection of pilot areas for commencement of topographic data acquisition needs to consider priority areas. Based on the damages estimates of Cawood (2005), the urban areas of Dongola (say, reach length 25 km, to be confirmed) and Khartoum (say, reach length of 60 km) should be included. It is proposed that at least one longer rural reach be included in the first set of pilot areas. On the basis of damages, a reach in Nile State (assume 150 km) may be included, though this selection remains open at this stage. Options will be reviewed.
- The Remote Sensing Authority has the skills to assist with interpretation of satellite imagery in flood risk mapping. Whether it has the capacity to undertake the workload required, considering that flood risk mapping may be staged over many years, or whether it would be more appropriate to outsource the task using consultants, will be discussed in the Project Definition step. Similarly, the government survey agency may have the capacity to prepare the flood risk maps for distribution, but it may be more appropriate to outsource this task.
- SMA are receiving Meteosat data using the PUMA system. They also have hardware intended for receiving transmissions from ECMWF of weather data and weather forecasts, however it is not operational apparently due to software problems. This restricts their weather forecasting capability. It should be possible to rehabilitate the system with assistance from the French supplier Corobor, and this will be investigated.
- SMA expressed a desire for a regular forum with the Nile Forecast Center for information exchange about weather forecasting and flood forecasting.

- Those who prepare and issue flood warnings should be equipped with GIS analysis tools after the flood risk mapping has been completed. This would enable them to provide much more information content to users who must know how to react to warnings issued. That would mean expanding the role of the Flood Forecasting Center in MIWR, accompanied by capacity building and technical training. An alternative would be to place the GIS installation in the CDO, which is the agency that must be able to interpret the warnings in terms of their effects – however, better technical skills reside in MIWR, and the link between modeling and displaying flood extents and exposure to flood hazard would be intact. Ideally, the forecasting group, the emergency response group and local authorities should work together during flood alerts to review and visually interpret forecast results and implications. Leaving interpretive tasks to local authorities is likely to be an ineffective option. Local authorities should not be relied on to accurately interpret flood warning messages despite whatever advantage of local knowledge they may have. They lack adequate technical skills and can least afford the time to undertake detailed interpretation during flood emergencies, however they would need access to transmitted spatial data sets and the equipment for visual display of spatial information. The Remote Sensing Authority may be able to assist in establishing the GIS installation.
- After production of the flood risk mapping, flood contingency plans for emergency response should be revised to make best use of the new tools available.
- Organizational reviews and analysis of the emergency response procedures and guide-lines for emergency response and post-flood relief and recovery services should be undertaken to identify which are the root causes of the inadequacy of the current system to deliver services to rural communities. The root causes may not necessarily be organizational problems, but the organizational reviews and analysis should be able to identify the causes, whatever they are.
- In other parts of the world there have been successful examples of communities organizing to help themselves and prepare for the impacts of floods. Communities are typically not able to organize without some external impetus, such as support from a social worker (government or NGO) and perhaps some seeding money for initiatives such as refuges, platforms, cooperative funds, etc. To be sustainable community organization requires development of good self-management skills and is predicated on the presence of a genuine need in the community and clear perception of benefits. A pilot study in a few of the worst-affected villages is suggested in PI.
- The assets at risk from flood inundation or bank collapse in urban areas justifies investment in design and construction of dikes and river bank protection to high engineering standards. Tuti Island is one example inspected during the Inception step where such investment appears justified.
- In rural villages where bank erosion is relentlessly advancing and threatening houses and/or livelihoods, some action is needed to tackle the problem. Bank protection works to high engineering standards are not economically justified in most circum-stances, however the use of appropriate technology may be able to arrest the damage. Much has been learned in the discipline of waterway management over recent decades, and there are manuals of good practice available in countries like Australia. Some of these lower-cost approaches should be trialed along the banks of the Blue Nile and Main Nile for evaluation purposes. If outcomes from a pilot program

are successful, the methods could provide a basis for a sustained future program to improve river bank stability in Sudan.

7.2 PRELIMINARY STRATEGY

An appropriate strategy for the Sudan can therefore be summarized.

Acquire digital topographic data, analyze satellite imagery and undertake technical studies to prepare flood risk mapping along the main river valleys.

Revise flood contingency plans to relate to the flood risk mapping as it becomes available.

Develop GIS capabilities to facilitate the interpretation of flood warnings in terms of spatial extents of inundation and people and assets expose to flood hazard.

Develop better cooperative mechanisms for sharing and interpreting information during flood alerts.

Diagnose the symptoms of the failure to deliver effective or adequate assistance to rural communities at risk from flooding, and take appropriate steps to remedy the problems.

Improve communications systems for operational command during flood emergencies and for coordination of post-flood relief and recovery services.

Prepare guidelines for emergency response procedures and for post-flood recovery assistance. Specify roles and responsibilities. Provide support for essential capacity building and training.

In a pilot program, work with a community or communities to promote self-organization and self-help, including liaison with government services and implementation of community-based plans.

Undertake engineering works in selected urban areas to provide flood protection dikes and river bank protection.

Trial appropriate technology approaches to stabilize river banks in rural communities as a pilot program.

Strengthen existing arrangements for weather forecasting and flood forecasting.

Regional cooperation in technology transfer, data exchange, joint technical activities and research, regular forums, etc.

These tasks or activities provide a framework for further development in the next Project Definition step. Each one requires substantial elaboration and more detailed development, including definition of associated resourcing and capacity building.

8. PROPOSED FLOOD RISK MANAGEMENT STRATEGY FOR EGYPT

8.1 ASSESSMENT OF NEEDS

8.1.1 General

The High Aswan Dam (HAD) provides a high level of flood protection to the Nile Valley in Egypt. Nevertheless, with the high value of development along the valley, in part encouraged by the protection of HAD, losses in very rare floods could still be high. However, very rare floods are not the main issue. Because the value of the water in HAD for hydropower generation, and for irrigation and industrial production is high, optimum use of the water available must be sought through carefully planned operation of the HAD.

As noted in section 4, there are several factors that are of special interest to future operation of the dam. These include, but are not limited to:

- control of encroachment on the river floodplain downstream to avoid aggravated damage during the passage of large floods;
- modification to the Toshka spillway to provide greater flexibility in the passage of large and rare floods;
- reduction of losses to evaporation;
- reduction of storage capacity loss due to sediment deposition;
- future operations of the Merowe Dam under construction in northern Sudan;
- effects of climate change.

Any improvement in water management, either in water conservation through dam operations or in water distribution and water use efficiency downstream, is of great value for Egypt.

Improved accuracy of forecasting of reservoir inflows is one way in which dam operations can be refined. Egypt already has well developed weather and streamflow forecasting capabilities centered in the Nile Forecasting Center in Cairo, but with advances in technology and improved monitoring of weather and river flows the accuracy and lead times can be further improved, which in turn should lead to more refinement of HAD reservoir operations, and improved water conservation.

The monetary value of the water should be estimated during the current Lake Nasser Flood and Drought Control / Climate Change Project. In the absence of that data, for purposes of speculation let us assume a very conservative value of US$10 per ML (US$10,000 per m^3x10^6). The average planned releases from HAD each year are approximately 55 m^3x10^9. If we conjecture that refinements to reservoir operations available through improved weather and flow forecasting could achieve a 1% increase in useable water resources from HAD, the annual value of that improved forecasting would be US$5.5 M.

8.1.2 Basic Requirements

The requirements follow logically from the gap analysis presented in section 4.5, and are listed under the following categories: information requirements; flood forecasting requirements; flood mitigation measures. See Table 8-1.

Table 8-1: Requirements for Flood Risk Management in Egypt

Category	Needs	Remarks
Information	Additional reporting rain gauges in the Tekeze and Abbay sub-basins in western Ethiopia.	Refer to Table 5-1.
	Additional reporting river gauges on the Tekeze and Abbay Rivers in western Ethiopia, and possibly Atbara R in northern Sudan.	Refer to Table 5-1.
	Preparation of flood risk maps.	Support future development of work by NRI, including estimation of hydro-logical planning floods, hydraulic modeling, flood extent delineation, identification of land use/exposure to flood hazard, GIS development, etc.
	Review of dam safety.	Compliance with WB guidelines (PP).
	More accurate determination of the distribution of sediment deposited in HAD.	Consider resourcing support (PP).
Regional Forecasting	Recalibration and validation of flood forecasting model(s) using data from new sites.	Historical data from non-reporting stations is available for most stations. Existing forecasting model(s) can be retained. (PI)
	Error analysis to determine differences between forecast inflows using current limited data set and forecast inflows using proposed expanded data set.	Including use of existing forecast updating methods. (PI)
	Application of HAD DSS model with forecast inflows using current limited data set and forecast inflows using proposed expanded data set to determine volumes of water conserved, changes to releases through HAD and Toshka spillway, etc; and cost-benefit analysis.	
	Hydrological studies of the passage of rare and extreme floods to establish dam safety criteria and preferred modes of operation during major floods.	Review would be timely given the number of years since dam design and construction.
	Modernization/ upgrading of facilities at NFC in Cairo.	Improved IT & visual display equipment (PI).
	Information exchange for joint flood operations of Merowe Dam & HAD.	Protocols, procedures (PP, PI).
Flood Mitigation Measures	Flood risk mapping downstream of HAD	Prepare program of assistance to develop current NRI mapping initiatives into flood risk mapping (PP).

Category	Needs	Remarks
NOTE: PP is Project Preparation; PI is Project Implementation.		

A number of comments are necessary to supplement Table 8-1.

- The forecasting methods currently employed are sound and provide very good forecasts given the data limitations (particularly in the Ethiopian highlands). One option would be to review methods currently available for streamflow forecasting to compare capabilities. If such a review demonstrated clear benefits of alternative forecasting methods, then selection of a new technique might be considered. On the assumption that demonstration of clear benefits would be unlikely from such a review, the proposed activities in Table 8-1 propose that the existing forecasting techniques be retained, however model(s) should be recalibrated and revalidated to the new data sets which will be available. Rainfall data from existing daily observations in NMA archives and streamflow data from existing MWR archives in Ethiopia (some site transposition of data would be necessary for new sites) will be suitable for the task.
- Given that mathematical methods for progressively refining forecasts as real-time data is updated are currently used, it may prove difficult to demonstrate advantages of using the expanded data set. This can only be determined after undertaking an error analysis (i.e. comparison of forecast results with old and new data sets, including application of the forecast updating methods, and with observed data. This might entail a re-simulation of forecasts, updated daily, over a number of years of historical record (eg. 1997 to 2005), to establish the difference in forecasts, followed by use of the two forecast streams to re-simulate operations of the HAD with the DSS model.
- Consideration of adjustment of operating rules should be accompanied by a review of dam safety. This is, in fact, a condition of assistance by WB. Given that it is 40 years since design of HAD and original determination of dam safety, if it has not already been done recently, a review of very rare and extreme events and of operational procedures to pass them safely, would be very timely.
- Collaborative studies on the joint operations of the future Merowe Dam in northern Sudan and the HAD in southern Egypt would be a fine example of regional coordination. It would provide Egypt with information essential for ongoing refinement of operating rules to optimize water conservation, and it would provide Sudan with a better understanding of the implications of future operations of Merowe Dam for downstream water users and riparian land use.

8.2 PRELIMINARY STRATEGY

An appropriate strategy for Egypt can therefore be summarized.

Support regional initiatives to upgrade data instrumentation and develop a better reporting gauge network upstream of HAD.

Undertake studies to determine the improved margin of forecasting error available with an expanded reporting data network.

Analyze outcomes for operations of HAD, including cost-benefit analysis, and possible adjustment of operating rules to take advantage of improved forecasts.

Review implications for dam safety, if any.

Develop flood risk mapping for the Nile River downstream of HAD.

Upgrade facilities for data processing and visual information display at the Nile Forecast Center.

Liaise with Sudanese authorities on future joint operations of HAD and Merowe Dam.

Regional cooperation in technology transfer, data exchange, joint technical activities and research, regular forums, etc.

These tasks or activities provide a framework for further development in the next Project Definition step. Each one requires substantial elaboration and more detailed development, including definition of associated resourcing and capacity building.

9. FPEW PROJECT PREPARATION

9.1 COMMENT ON TERMS OF REFERENCE

9.1.1 General

The proposed organization of the Project Preparation is a sound approach. The Inception step has allowed a preliminary familiarization with the flood management practices in each country, and has enabled the Consultant to review the project objectives and methodology from a more informed perspective.

The Project Definition step which follows the finalization of this Inception Report will be the most important phase of the Project. The scope of the subject to be investigated is broad, and this is complicated by the regional character of the Project, with strategies for enhancement of current arrangements being required in three countries. A number of disciplines will be brought to bear on the issues facing future flood management so that a comprehensive and practical program of activities can be developed for Project Implementation.

The last step of Finalization of Documents is deceptively simple, involving review of draft documents such as the TBP, PIP, EMF, RPF and ToRs. The reviews must be undertaken by the RWG, ENTRO and the three national governments through ENSAPT and ENCOM, and in this period The World Bank will also undertake a pre-appraisal of the proposed Project. All of this will take time, and there will be a progressive refinement of the proposals before the documents are finalized and presented to ENTRO at a debriefing session.

One thing the Consultant has learned is that communications between the three countries have their limitations, and can be slow or unreliable. This is a reality that must be managed, and the Consultant is developing strategies to deal with this difficulty.

The time permitted for the Inception step was limited, given (a) the need to mobilize a consulting team in the three countries and internationally (but this has been satisfactorily resolved); (b) the need to undertake fact-finding missions to the two other countries outside the Consultant's office base in Ethiopia; and (c) the requirement to prepare a draft report on the Inception step two weeks in advance of review. Although the time allowed appeared generous enough at the outset, the fact-finding missions were brief and draft reporting was rushed. However, revisions have been made since the review by the RWG and WB advisers at the workshop on February 28, 2006. Many helpful suggestions were made. The time permitted for the Project Definition step is also tight, particularly as deadlines were advanced at the Project Launch in January to accommodate a pre-appraisal mission by The World Bank before August. If the PP is managed efficiently, it will be possible to accommodate this without compromising the standard of the PP outcomes and deliverables.

All bar one of the 12-person consulting team proposed in the Proposal of June 2005 have confirmed their availability to participate in the PP, and to participate on schedule. The single exception is the international Social Assessment Specialist. A replacement with similar or better qualifications and experience has been proposed, awaiting approval by ENTRO.

9.1.2 Project Definition Step

Under the Terms of Reference, the Project Definition step includes four components, paraphrased below:

(1) **Flood Mitigation Planning**. Approximate assessment of flood-related damages; development of a sustainable flood risk reduction strategy including non-structural and small-scale structural approaches.

(2) **Flood Forecasting, Warning and Communication**. Conceptual design of a flood forecasting, warning and communication system, building on existing forecasting capacity; strengthening of data networks and communication systems, data acquisition, processing, storage and dissemination, models for hydrologic and weather forecasting, support technologies such as database, GIS, data display and other decision-making aids, linkages to community-based organizations (CBOs), and general technical capacity; specification of software and hardware requirements to support the concept system design.

(3) **Emergency Preparedness and Response**. Formulation of a program to strengthen existing emergency preparedness and response plans in the riparian countries to make them more effective and proactive, including official response mechanisms and community-based mechanisms.

(4) **Regional**. Identification and assessment of opportunities for cooperative actions related to reducing negative impacts of floods, and to strengthen development of a cooperative regional agenda in flood management.

Of course, there are many ways in which the numerous and multi-disciplinary activities of flood management can be divided into components. The categorization described above and in the ToR is appropriate, and covers all the key aspects of flood management.

The term 'flood mitigation' is often associated with structural measures that modify flood hazard, but it does not have to be limited to structural measures, and logically includes all measures and activities that will mitigate the impacts of floods. However, if we include <u>all</u> measures and activities that mitigate the impacts of floods the definition is too broad for our purposes, and does not match well with the definitions of flood risk presented in section 1.6. We need to clarify which types of measures and activities we intend to include – and by inference which we do not. Before proceeding to that clarification, let us consider the other categories (or components) in the ToR.

Flood forecasting is primarily a technical issue, as is evident from the array of technological innovations used to describe its activities: mathematical modeling, GIS, data acquisition networks, database, *etc*. By distinction, flood warning is the important link between the highly technical activity of forecasting and the socially-oriented emergency response to flood alerts. Flood warning is not highly technical, and an important aspect of flood warning is the information content of warnings so that people and institutions know how to react appropriately in the face of an impending flood hazard. It could either be grouped with the highly technical activities of flood and weather forecasting as in the ToR, or it could be grouped with emergency response. The Consultant recommends the latter, because, as with emergency response, flood warning has more to do with the interface between institutional response and community response: it is a service provided directly to the public.

Communications are not confined to the activities of flood forecasting and flood warning. In fact, flood forecasting and data acquisition networks require data communications, whereas flood warning, emergency response and post-flood recovery require communications of information. So there is a key distinction that can be made between **data communications** and **information communications**. Again, data communications is involved in flood forecasting and is a purely technical issue, whereas the information communications involved in flood warning and emergency response is more complex and demanding.

Another distinction can usually be made between emergency response activity (i.e rescue, public safety, evacuations and other precautionary measures in advance of or during a flood) and post-flood relief and recovery services – although in Sudan the distinction may be blurred by the long duration of flooding often experienced.

Even without government provision (or coordination) of emergency response and post-flood recovery services, communities can help themselves, particularly if they are organized in advance. We can term this **community preparedness**. It benefits from assistance in organizing during non-flood periods so that communities are prepared to take risk-reduction measures in advance of impending floods, and measures that enable them to recover more rapidly after floods. There are some good examples of how this has been applied successfully in other countries. It is not clear where this fits in the categorization of components described in the ToR. It could be under either the Flood Mitigation component, or the Emergency Preparedness and Response component, although the ToR seems to suggest the former.

The Regional component is clearly a separate issue, deriving from the others opportunities for regional cooperation and coordination, and seeking new initiatives such as regular technical forums for information exchange and sharing of knowledge.

Based on the discussion above, the Consultant proposed an alternative grouping of components that were considered by the RWG and ENTRO during the workshops on February 28 and March 1. The alternative was:

(1) Flood Mitigation Planning
(2) Flood Forecasting
(3) Flood Warning, Emergency Response and Communications: or alternatively, just Flood Warning and Emergency Response
(4) Community Preparedness
(5) Regional

This is not a major departure from the categorization of components in the ToR. In fact, it embraces the same range of issues, arranged in a different way. The Flood Mitigation component will deal with planning of structural measures (mainly small-scale structural measures; although recognizing and integrating flood mitigation benefits of large structures such as dams being developed primarily for other purposes) and non-structural measures such as flood risk mapping, land use management controls, resettlement, *etc*. The Flood Forecasting component is a more highly technical component; as distinct from the Flood Warning and Emergency Response component which has a strong social dimension, although it is primarily associated with activities by government institutions (and NGOs and CBOs). The Community Preparedness component is dealing directly with the communities

being served, and their self-organization. Obviously, there are close links between all components, as they are all part of an integrated approach to flood risk management.

The alternative selection of components for Project Definition was a suggestion only, and was not accepted by the RWG and ENTRO at the Inception step workshops. The methodology that follows is therefore based on the selection in the ToR.

9.1.3 River Bank Erosion

Following on from earlier discussion, another suggestion of the Consultant is that the serious problem of river bank erosion (*haddam* in Sudan) be addressed under the FPEW Project. Please refer to section 7.1.2.

This suggestion was accepted, and will be accommodated within the Flood Mitigation Planning component.

The consulting team for the PP does not have specialist knowledge of waterway management issues; however a proposal for the PIP will be developed by the Consultant's Team Leader, who has managed multi-disciplinary projects including waterway management specialists in the past, and by reference to available manuals on good practice for waterway management.

9.2 METHODOLOGY

The methodology for the Project Definition step, as elaborated in the Consultant's Proposal, is now revised based on the findings of the Inception step. The methodology now proposed is described below.

PROJECT DEFINITION PHASE

The Project Definition phase will define the project adequately for ENTRO and the three riparian countries to reach agreement on, and approve, the organization, scope, cost and other attributes of the Project proposed.

The definition and analysis of each of the components in this step will, when integrated, define the PIP (Project Implementation Plan) that emerges at the end of the step. The analyses required will be based on available data and information, although in some instances it may be necessary to infer data to give some relativities and scope to an issue. This implies that in most cases, analysis will tend towards high level analysis rather than detailed analysis; however, analyses will be sufficiently robust and rigorous to be quantitative (when possible), objective, repeatable, and appropriate to the task, and will use approaches that reflect currently accepted good practice. Likely strengths and weaknesses will be identified and commentary provided. Background analyses required for PIP preparation, the decision-making processes followed, options considered, and recommendations made will be documented in the TBP (Technical Background Paper) that is to be delivered with the draft PIP.

1 Flood Mitigation Planning Component

Key Consultant Inputs:

Team Leader, Deputy Team Leader, Social Assessment Specialist, Environmental Planning Specialist, Project Economist and the Institutional Specialist will undertake this task.

Objective:

The objective of this component is to determine the status of existing and planned flood mitigation activities and treatments of flood risk, and to undertake a first approximation of flood-related damages to identify priority flood impact areas and develop a sustainable flood risk reduction strategy.

Key Activities:

The Consultant will:

- Undertake the analyses on an individual country basis, but within the context of regional coordination and associated partnership opportunities.
- Assess existing flood mitigation issues by undertaking a detailed review and evaluation of existing or planned approaches to flood mitigation (i.e. practice and policy). This sub-task will build upon the information obtained and lessons learned during the Inception step including the review of reports, documents and data, and the consultations undertaken. More detailed review of reports will be required, and some critical analysis of data will be undertaken to examine the assumptions underlying policies and planned flood mitigation actions in target areas. The assessment will be supported by consultations at national levels when sufficient information or data is unavailable from documented or electronic sources. It is envisaged that two visits to Khartoum will be required. Site visits will also be undertaken when this is necessary to acquire adequate understanding of physical, social and development conditions. It is envisaged that site visits will be required to Gambella city and to Lake Tana region on the Abbay-Blue Nile river system in Ethiopia, and locations on the Main Nile in Sudan. A final decision on which sites need to be visited must be agreed in consultation with ENTRO and National Flood Coordinators.
- Undertake a gap analysis in conjunction with the assessment of existing flood mitigation approaches and policies. It will draw upon the findings of the ENTRO-implemented base-line analyses completed in 2005, and the preliminary gap analysis of the Inception step. This gap analysis is important to identify where necessary information is lacking or unreliable, and will help determine tasks or studies to be included in the PIP so that the FPEW Project will be sustainable and founded on sound assumptions, scientific analysis and socially-appropriate approaches.
- Identify priority flood risk areas, and quantify flood damages and social impacts based on existing information, local knowledge and best professional judgment. As complete information and data is not anticipated, this flood impact assessment will be a high-level assessment rather than a detailed analysis, however best endeavors will be made to obtain estimates that are as accurate and reliable as possible. The assessment will provide input to essential benefit-cost analyses by the Project Economics Specialist (PES) – see section 9.3 – and assist in prioritization of flood mitigation options. Criteria for subsequent, more detailed estimates of flood damages and impacts and more rigorous assessments will be documented, having due regard for data availability and national capacities. This will serve to help determine tasks to be included in the PIP so that the FPEW Project will be founded on sound assumptions and scientific analysis.
- Mitigation Options and Flood Risk Reduction Strategy for Ethiopia. A range of feasible flood mitigation options will be identified and defined for the flood risk areas in Ethiopia. Options will be selected in the context of prevailing social, institutional and economic constraints. While these will primarily include non-structural and small-scale structural measures

because of the constraints, larger-scale initiatives will also be identified if appropriate, and particularly in the context of any current development plans for irrigation and hydropower (eg. Lake Tana area developments), and other Projects under the NBI (eg. JMP).

- A risk management strategy will be developed based on the options identified above and the management needs identified in the Inception step.
- The environmental and social issues, and potential beneficial and adverse effects of the risk management strategy and its associated mitigation options will be evaluated by the Social Assessment Specialist (SAS) and the Environmental Management Specialist (EMS) in the Consultant Team, supported by inputs from the local country specialists in the Consultant Team and taking into account the baseline social analysis. The SAS and the EMS will consult with local specialists and NGOs, as well as with ENTRO and the RWG, to identify all relevant issues that may prove relevant to the risk management strategy being devised. Opportunities will be sought to enhance social outcomes and to secure environmental benefits where possible. All project proposals will incorporate management measures that mitigate existing environmental and social security hazards. Where adverse impacts are inevitable, means will be sought to minimize and mitigate such impacts, and mitigation and consultation activities required during Project Implementation will be determined for integration into the PIP.
- An Environmental Management Framework (EMF) will be developed for inclusion in the draft PIP, and as a stand-alone document. If the risk management strategy for Ethiopia involves resettlement, a Resettlement Policy Framework (RPF) will also be developed.
- The risk management strategy (generic strategy) will be used with the EMF (and the RPF if applicable) to develop flood mitigation proposals and plans for implementation for selected rural areas near Lake Tana.
- Develop a flood risk reduction strategy for the city of Gambella, based on a review of existing information, site visits and consultations. The risk reduction strategy will identify appropriate measures, studies necessary to prove their feasibility and estimate costs and benefits.
- Flood risk management measures identified in the generic risk management strategy will be prioritized, and preliminary cost estimates made for their implementation.
- A conceptual plan for flood management will be prepared for the Baro-Akobo river basin based upon readily available data and review of previous studies.
- Mitigation Options and Flood Risk Reduction Strategy for Sudan. A range of feasible flood mitigation options will be identified and defined for flood risk areas in Sudan. Options will be selected in the context of operating social, institutional and economic constraints. Flood risk mapping will be a central element of the risk management strategy in Sudan. While options will primarily include non-structural and small-scale structural measures (eg. community levees, drainage facilities) because of the constraints, larger-scale initiatives may also be identified if appropriate, particularly in urban areas of greater Khartoum and Dongola (eg. river bank protection works, levees to good practice engineering standards).
- Identify and plan a pilot project to trial low-technology river bank stability measures in rural areas; and identify and plan projects for river engineering works to protect river banks in selected urban areas where property is at risk.
- A risk management strategy will be developed based on the options identified above and the management needs identified in the Inception Phase.
- The environmental and social issues, and potential beneficial and adverse effects of the risk management strategy and its associated mitigation options will be evaluated by the Social Assessment Specialist (SAS) and the Environmental Management Specialist (EMS) in the Consultant Team, supported by inputs from the local country specialists in the Consultant Team and taking into account the baseline social analysis. The SAS and the EMS will consult with local specialists and NGOs, as well as with ENTRO and the RWG, to identify all relevant issues that may prove relevant to the risk management strategy being devised.

Opportunities will be sought to enhance social outcomes and to secure environmental benefits where possible. Where adverse impacts are inevitable, means will be sought to minimize and mitigate such impacts, and mitigation and consultation activities required during Project Implementation will be determined for integration into the PIP.

- An Environmental Management Framework (RMF) and a Resettlement Policy Framework (RPF) will be developed for inclusion in the draft PIP, and as stand-alone documents.
- The risk management strategy (generic strategy) will be used with the EMF and the RPF to develop flood mitigation proposals and plans for implementation, for a selection of urban areas and rural areas. We will be guided by Sudanese members of the RWG in the selection of these pilot areas. The implementation plans developed will provide examples of how flood mitigation options can be implemented in the FPEW Project.
- Measures in the risk management strategy for Sudan will include review of reservoir options upstream in Ethiopia that are at the planning stage. Although those reservoirs are planned primarily for hydropower, they would also modify and mitigate flood impacts in Sudan. Follow-on studies will be identified that would improve flood mitigation through reservoir operations and seek to retain the benefits currently enjoyed by riparian landholders.
- Flood risk management measures identified in the generic risk management strategy for the Blue Nile and Main Nile will be prioritized, and preliminary cost estimates made for their phased implementation.
- Mitigation Options and Flood Risk Reduction Strategy for Egypt. Potential options will be investigated at a preliminary level to modify operations of the High Aswan Dam in conjunction with improvements to the weather and flood forecasting data networks to improve flood mitigation and minimize downstream flood risk. Follow-on studies will be proposed to prove the feasibility of the options identified and evaluate the socio-economic and dam safety implications if modified operating rules were implemented.
- Requirements for flood risk mapping downstream of HAD will be reviewed, and in consultation with NRI and the Egyptian authorities a program of support and assistance will be proposed for Project implementation.
- Identify and plan a pilot project to trial low-technology river bank stability measures in rural areas; and identify and plan projects for river engineering works to protect river banks in selected urban areas where property is at risk.
- Investigations of the joint operation of dams along the main stem rivers will be proposed in order to assess the implications for water conservation in riparian countries.
- Include in the TBP (Technical Background Paper) a summary of analyses, findings, options and recommendations for the Flood Mitigation Planning Component.
- Include in the PIP descriptions of priority flood mitigation options, cost estimates and such other information as necessary to define the first phase of the flood risk management strategy devised for each of the three riparian countries. The descriptions of flood mitigation options will include not only technical, social and environmental requirements and issues, but also issues of institutional strengthening and capacity building that will be desirable to accomplish the strategy and implement the priority options in an integrated fashion. In development of the options, we will consult with management agencies and other interested parties to achieve outcomes that are socially acceptable, environmentally responsible, technically feasible and achievable within the prevailing institutional context.
- Identify potential environmental and social issues, including beneficial and adverse impacts. Determine appropriate measures to mitigate adverse impacts and identify consultations required during Project preparation and implementation to address all issues. This information will be used to inform and refine the Environmental Management Framework (EMF) and Resettlement Policy Framework (RPF). This sub-task will be undertaken by the Social Assessment Specialist (SAS) and the Environmental Management Specialist (EMS) in the Consultant Team, supported by inputs from the local country specialists in the Consultant Team and taking into account the baseline social analysis.

- Define functional requirements of flood forecasting and warning systems in the context of the integrated flood risk management strategies and proposed flood mitigation planning options.
- Identify opportunities for activities or studies in relation to flood mitigation options that will be of common concern and can be considered under Task 2.4 Regional Component.

Deliverables and key linkages to other Outputs/Tasks:

The deliverables of this Component will be EMFs and RPFs that will be delivered as stand-alone documents and integrated into the PIP. After delivery of first drafts of these documents in the 8th month of the Project Preparation consultancy, they will go through a two-step revision process, first being reviewed by national representatives and the RWG, then at a second stage by ENTRO and the World Bank.

Other deliverables will be contributions to the TBP and the PIP. The TBP and the PIP will also be subject to a two-stage review process, first being reviewed by national representatives and the RWG, then at a second stage by ENTRO and the National Flood Coordinators (NFCs). After the second review, the TBP will be finalized. The PIP will receive further scrutiny by the Eastern Nile Council of Ministers (ENCOM) and/or the ENSAP Team before being finalized in the Finalization of Documents step.

2 Flood Forecasting, Warning and Communication Component

Key Consultant Inputs:

Team Leader, Deputy Team Leader, Social Assessment Specialist, Institutional Specialist, Project Economist, the GIS-database Specialist and the Emergency Management Systems Specialist will undertake this task.

Objectives:

The objective of this component is to establish a conceptual design for a flood forecasting, warning and communication system to meet the functional requirements of the Nile riparian countries consistent with existing technical and institutional capacities. National systems should be compatible, with the capability of operating as a distributed regional forecast system when needed, with agreed mechanisms and linkages for data/information exchange during flood events.

Key Activities:

The Consultant will:

- Undertake the analyses on an individual country basis, but within the context of regional coordination and associated partnership opportunities.
- Review existing capacity for flood forecasting and assess performance. The review will consider both technical and institutional aspects of capacity in each of the riparian countries so that the conceptual system design can best build upon existing capacity. This sub-task will build upon the information obtained and lessons learned during the Inception step. The assessment will be supported by consultations at national levels when sufficient information or data is unavailable from documented or electronic sources. These consultations can be conducted in conjunction with consultations for other tasks.
- Define the functional requirements of the systems for flood forecasting, warning and communication, based on the findings of the investigations of Component 1, and in particular the assessment of flood mitigation issues. The functional requirements will be

oriented to the priority flood risk areas and social issues identified during Component 1. Functional requirements will consider desirable advance warning times, essential information content of warning messages, means of dissemination of warnings to recipient groups, and linkages to appropriate response procedures. The baseline social analysis implemented by ENTRO will be referenced.

- Compare the functional requirements with the existing capacities and resources to assess shortcomings and identify needs for strengthening the technical and institutional capacity to meet the functional requirements, and needs for increased resources. For Ethiopia, develop proposals to set up a new forecasting unit, or specialist remote sensing analysis and forecasting center,
- Evaluate forecasting system and data acquisition network options, having regard for past experience (from the review of existing capacity and resources above), cost-effectiveness, sustainability, and issues of operations and maintenance. Emphasis will be placed on options that enhance existing forecasting capacity, depend on reliable equipment and communication linkages, and utilize as far as possible public-domain software applying well-proven modeling techniques. Availability of adequate data, training and technical support will also be factors in comparison of forecasting system options.
- Develop a conceptual design for a proposed system for flood forecasting, warning and communication, and having regard to the need for effective coordination and data/ information exchange during flood events. Consult closely with the RFC (and the NFCs) during this development to ensure that the proposed system adequately meets the needs and expectations of the riparian countries. Sufficient detail will be developed in the conceptual design to facilitate cost estimation and planning for implementation, including: data acquisition networks; equipment for data capture and transmission; facilities for data storage, validation and processing; database and GIS facilities; hydrological flood forecasting procedures; procedures for short-term weather forecasting and seasonal outlooks; information display, decision support tools and other aids to data analysis; communications systems for dissemination of warnings and information; effective means for participation by communities and groups to facilitate key messages and advice getting to intended recipients; training and capacity building for system sustainability. Although the system proposed will initially focus on flooding from main rivers identified in the ToR, opportunities will be sought to adapt the system to accommodate the issues of flash flooding that also cause significant damage and loss of life in the Eastern Nile countries.
- Identify communications procedures and channels to effectively link communities and groups at risk from flooding to the flood warning system. This sub-task will be undertaken by the Social Assessment Specialist, the Institutional Specialist and local specialists in the Consultant Team.
- Include in the TBP (Technical Background Paper) a summary of analyses, findings, options and recommendations for the Flood Forecasting, Warning & Communication Component.
- Include in the PIP description of the analysis, the proposed conceptual system and data acquisition networks for flood forecasting, warning and communications, cost estimates and such other information as necessary to define the first phase of the flood risk management strategy. The descriptions will include technical issues, and issues of institutional strengthening and capacity building that will be essential to make the system sustainable.
- Identify opportunities for activities or studies that will be of common concern in relation to flood forecasting, warning and communications and which can be considered under the Regional Component 4. As the conceptual system will be designed to facilitate effective coordination and data/information exchange, there will definitely be relevant activities in this respect.

Deliverables and key linkages to other Outputs/Tasks:

The deliverables of Component 2 will be contributions to the TBP and the PIP. The TBP and the PIP will be subject to a two-stage review process, first being reviewed by national representatives

and the RWG, then at a second stage by ENTRO and the National Flood Coordinators (NFCs). After the second review, the TBP will be finalized. The PIP will receive further scrutiny by the Eastern Nile Council of Ministers (ENCOM) and/or the ENSAP Team before being finalized in Step 3 Finalization of Documents.

3 Emergency Preparedness and Response Component

Key Consultant Inputs:

Team Leader, Deputy Team Leader, the Emergency Management Systems Specialist, Institutional Specialist, Project Economist and Social Assessment Specialist will undertake this task.

Objectives:

The objective of the Emergency Preparedness and Response Component is to define a program that will strengthen existing preparedness for flood emergencies and improve emergency response planning. As effectiveness of existing mechanisms for coordinating response is variable, and approaches tend to be reactive rather than proactive, this component will need to strengthen national capacities to achieve accepted good practice by institutional planning and improved coordination between agencies, with community-based groups and in trans-boundary cooperation.

Key Activities:

The Consultant will:

- Undertake the analyses on an individual country basis, but within the context of regional coordination and associated partnership opportunities.
- Review existing arrangements and planning for preparedness and emergency response in each of the riparian countries. Aspects that will be reviewed will include institutional capacity, institutional planning, established partnerships and mechanisms for coordination, communications between key urban centers and remote communities, and integrating the capacity of community-based organizations. The baseline social analysis implemented by ENTRO will be referenced. This sub-task will build upon the information obtained and lessons learned during the Inception step. The review will be supported by consultations at national levels when sufficient information or data is unavailable from documented or electronic sources. These consultations can be conducted in conjunction with consultations undertaken for other Components. Existing policy and practice will be compared to accepted international good practice to identify gaps between current and desired future policy and practice.
- Based on the review above, identify options to remedy the discrepancies between current and desired future policy and practice in emergency preparedness and response. Emphasis will be placed on opportunities to build on existing capacity, strengthen institut-ions and institutional planning, and build productive partnerships between organizations and agencies so that communities and agencies will be better prepared to respond appropriately when flood alerts are issued and take advance actions to reduce exposure of lives and assets to flood hazard and their vulnerability to flood risk.
- Identify social issues that may constrain effectiveness of preparedness in advance of emergencies and response during emergencies. The Social Assessment Specialist will determine mitigation and consultation activities needed during Project preparation and implementation to address these issues.

- Consult with selected rural communities to define their current coping mechanisms. Identify measures that could be introduced to assist community preparedness and awareness of flood risk. Evaluate the potential for village-level organization to manage community response during flood alerts and to manage self-help for post-flood recovery, and to liaise with government agencies and other service providers. Identify support that may be needed to sustain self-help and village organization.
- Include in the TBP (Technical Background Paper) a summary of analyses, findings, options and recommendations for the Emergency Preparedness & Response Component.
- Include in the PIP description of the review, the proposed options to improve preparedness and emergency response, cost estimates and such other information as necessary to define the first phase of the flood risk management strategy. The description will include issues of institutional strengthening and capacity building, community self-help, building of effective partnerships and regional cooperation.
- Identify opportunities for activities or studies that will be of common concern in relation to emergency preparedness and response and which can be considered under the Regional Component 4.

Deliverables and key linkages to other Outputs/Tasks:

The deliverables of Component 3 will be contributions to the TBP and the PIP. The TBP and the PIP will be subject to a two-stage review process, first being reviewed by national representatives and the RWG, then at a second stage by ENTRO and the National Flood Coordinators (NFCs). After the second review, the TBP will be finalized. The PIP will receive further scrutiny by the Eastern Nile Council of Ministers (ENCOM) and/or the ENSAP Team before being finalized in Step 3 Finalization of Documents.

4 Regional Component

Key Consultant Inputs:

Team Leader, Deputy Team Leader, and the Institutional Specialist will undertake this task.

Objectives:

The main objectives of this component are to identify, assess and foster opportunities for cooperative actions between Eastern Nile countries to reduce the adverse impacts of flood risk. Regional activities will help to merge national perspectives, increase mutual trust and confidence, and ultimately lead towards a cooperative regional agenda.

Key Activities:

The Consultant will:

- Identify potential regional activities that will strengthen trans-boundary cooperation and partnerships. This will be derived from the national and regional consultations that occur during the course of Project Preparation. Several excellent ideas were proposed in the ToR and in the preliminary proposal by ENTRO for a Phase 1 of Project implementation to be funded from EU sources; including regular conferences, joint technical committees, seasonal outlook forecasting, joint research programs, special purpose studies, data and information exchange during flood forecasting, and development of compatible technical support systems to facilitate data/ information exchange. During the Project Definition Phase specific proposals will be developed in conjunction with the RWG, RFC and NFCs, and in consultation with interested potential partners.

- Administration and organization of a regional program will require institutional development as this is a new role not currently being performed. Proposals for future institutional arrangements that will adequately support the regional program will be prepared.
- Reliable sources of funding are key to sustaining many of these activities that involve time commitments and travel by specialist agency staff. Estimates will be made of the costs involved, and potential sources of funding to support these activities will be investigated.
- The regional weather and flood forecasting is one example of a task in which future joint activities could be developed and sustained, as the data acquisition networks on which the systems depend are not confined by international boundaries. Another example is studies of the joint operation of dams along the main stem rivers for mutual benefit.
- Review the experience and successes of regional cooperation in flood management in transnational river basins elsewhere. The ToR notes initiatives adopted by the Mekong River Commission for the Lower Mekong River Basin. Within Africa, another example from which to learn is SARDC (Southern Africa Research & Documentation Centre). Transnational river basins abound in Africa, and there are also excellent examples of transnational cooperation in flood management to be found in Europe (eg. Rhine, Danube river basins).
- Include in the TBP (Technical Background Paper) a summary of analyses, findings, options and recommendations for the Regional Component.
- Include in the PIP description of the review, the proposed options to improve regional cooperative actions, cost estimates and such other information as necessary to define the first phase of the flood risk management strategy. The description will include technology transfer, information exchange, joint institutional strengthening and capacity building, and the building of effective partnerships and regional cooperation.

Deliverables and key linkages to other Outputs/Tasks:

The deliverables of Component 4 will be contributions to the TBP and the PIP. The TBP and the PIP will be subject to a two-stage review process, first being reviewed by national representatives and the RWG, then at a second stage by ENTRO and the National Flood Coordinators (NFCs). After the second review, the TBP will be finalized. The PIP will receive further scrutiny by the Eastern Nile Council of Ministers (ENCOM) and/or the ENSAP Team before being finalized in Step 3 Finalization of Documents.

5 Preparation of Integrated Final Draft PIP (Project Implementation Plan)

Key Consultant Inputs:

Team Leader, Deputy Team Leader, the Institutional Specialist, Environmental Planning Specialist, Social Assessment Specialist, Emergency Management Systems Specialist, Project Economist and support staff from the Consultant's country office in Addis Ababa will undertake this task.

Objectives:

The PIP is to describe the proposed first phase of the FPEW Project in sufficient detail for its implementation by ENTRO and riparian country agencies, and a ToR is required to initiate project implementation after conclusion of the Project Preparation.

Key Activities:

The Consultant will:

- Include in the PIP detailed description of Project components, institutional arrangements, tasks and activities, with preliminary budget, financial and cost-benefit analyses, and financing plan (see also section 9.3).
- Describe the risks associated with Project implementation and risk minimization strategy. Propose monitoring programs including performance indicators and framework for remedial actions if necessary.
- Provide a plan for implementation, including a task schedule, procurement and financial management arrangements, and disbursement schedule.
- Integrate the EMF and RPF in the PIP, and produce the EMF and RPF as stand-alone documents for public disclosure and WB review.
- Prepare Terms of Reference (ToR) for the first phase of the FPEW Project, so that when the Consultant has completed Project Preparation, ENTRO will have adequate documentation to independently initiate implementation of the first phase of the FPEW Project.

Key activities of the third step in the PP, Finalization of Documents, are:

- Make any revisions to the PIP and ToR(s) that may be necessary after the review by ENCOM and submit to ENTRO for final approval.
- Prepare and deliver to ENTRO 50 (fifty) bound copies of the TBP, the approved PIP and ToR(s). In addition, five electronic versions will be provided on CD, or other approved medium, of all report files in print-ready formats (eg. MS Word, Adobe Acrobat) and other documents, maps or products of the Consultancy.
- Prepare and deliver to ENTRO a project critique of the Project Preparation to highlight lessons learned that may be useful for future reference, and develop recommendations that might be used to inform and improve future projects.
- Attend a one-day debriefing session with the ENTRO team in Addis Ababa. It is proposed that the handover of the deliverables of Task 3.1 be made at the debriefing session.
- The Team Leader will provide a critique of the Project Preparation, recounting experiences, and recommending constructive lessons to be learned from the experience that might be used to inform and improve future projects.

9.3 ECONOMIC AND FINANCIAL ANALYSIS

9.3.1 Methodology

The proposed FPEW project investments will be subjected to financial, economic, distributive, sensitive and risk analyses. The project financial costs will include both the incremental investment costs as well as incremental recurring costs needed for sustaining the project impacts during and beyond the project implementation period. The expected project financial net benefits will be assessed as the difference between the incremental benefits and costs under 'with' and 'without' project scenarios. While the 'with project' scenario considers the designed flood preparedness and early warning related investment activities and their expected impacts, the 'without project' scenario represents no interventions and hence, flood damage continues to occur undiminished. Economic analysis will be conducted

after netting out the taxes and subsidies from the financial cost and benefit flows for which appropriate conversion factors based on the import/export parity prices for the internationally traded inputs and outputs and standard conversion factors for others will be used. The analysis will be done for 20-year project period at 2006 prices using the opportunity cost of capital as the discount rate.

9.3.2 Estimation of Benefits

The expected project benefits will come from reduced damage costs and reduced potential losses of farm income following the implementation of the FPEW project as highlighted below:

Avoided Damage Costs:
The benefit stream to be estimated through the reduced damage cost will measure the cost of direct flood damage, which the project would reduce. This will correspond to the difference between damage costs under 'with' and 'without' project scenarios. The associated damage costs will vary with the intensity of the flood, extents of flooded areas, return period and annual growth in damage costs, however average annual damages will be estimated. The reduced damage costs will be estimated for (i) residential sector; (ii) public sector (school, roads, irrigation, hospital, buildings and other public infrastructure); and (iii) industrial and commercial sectors. The primary source of information for this will be historical data available from recent past flood histories and other relevant literature to be compiled and comprehensively supplemented by appropriately designed surveys, rapid appraisals and focus group discussions planned during the PP phase. The social baseline surveys conducted in Ethiopia and Sudan will be a useful starting point.

Avoided Potential Losses of Farm Income: The benefit stream will capture the loss of future farm income due to floods that is avoided by reduced flood damage risks and vulnerability following project interventions. Specifically, the benefits would come from: (i) land area saved; (ii) cropped area saved; (iii) agricultural productivity saved; (iv) livestock saved; and (v) fish production saved. For quantifying the saved farm income, crop/activity models would be developed for target areas through appropriately designed rapid appraisals and focus group discussions during the PP by the consultant team.

Other Benefits: Several other important project benefits, difficult to quantify, include avoidance of water-borne diseases, loss of human life, loss of biodiversity, diversion of scarce resources, and disruption in social and economic services. However, if required, potential implicit value of the intangible project impacts will be estimated using contingency calculations and applied for assessing the viability of the project.

9.3.3 Analytical Framework

Economic and financial analysis will estimate economic rate of return and financial rate of return, along with NPVs, by comparing the stream of incremental costs and benefits over a 20-year project life.

Sensitivity analysis will be performed to test the robustness of the project investments and to identify the critical risk variables. For instance, avoided damage costs, annual growth in damage costs, return period of the floods, or area saved from flooding could be a relevant set of risk variables in this case. Using the Monte Carlo simulation model, the distribution of

incremental benefits and costs can be analyzed by modeling the likely distribution for each of the identified risk variables.

Risk analysis will estimate the confidence limit for realizing the estimated economic rate of return for the proposed project investments. Distributive analysis will evaluate the deviation between economic and financial cash flows for different groups to determine who benefits from and who should pay for the project.

9.4 CONSULTATION AND COMMUNICATION

The Project will depend for its success on the participation of stakeholders, particularly the communities to be served, but also stakeholders in the public and private sector. Development of Project proposals therefore needs to built around consultation and information-sharing, and mechanisms or procedures need to be established to seek information and advice from stakeholders, and to keep stakeholders informed of preparation and progress.

Appendix A summarizes the scope of consultations undertaken in the Inception step. Fuller accounts of each consultation have been provided progressively to ENTRO.

Appendix B sets out the Consultation and Communication Plan proposed for Project Preparation. This is a framework for consultation procedures and communications methods, not a list of stakeholders to be consulted.

9.5 INSTITUTIONAL AND CAPACITY BUILDING

9.5.1 Scope

This section describes the approach proposed for formulating institutional and capacity development aspects of the Project. It is based on consultations with the project's major stakeholders in the period 27 January to 13 February 2006 and data gathered from reference material, chiefly from the conceptualization stage (2004-05) of the FPEW Project .

9.5.2 Consultations

Consultations with stakeholder agencies were designed to determine: their existing capacity in terms of expertise; information sharing and exchange within the organization and with others; coordination mechanisms with other stakeholders; and resource availability for flood mitigation planning, flood forecasting and early warning, and emergency preparedness and response for riverine flooding in the Eastern Nile.

Appendix A summarizes the scope of consultations.

The consultations were open and productive and it was possible to:

- identify key stakeholders and institutions involved in the different aspects of flood management;
- ascertain the current institutional status, existing capacity and key needs in each country in sufficient detail to determine the major gaps in institutional capabilities and coordination arrangements;
- formulate a framework in which institutional strengthening proposals could be set; and

- develop a plan to identify each organization's capacity building needs and resource requirements in a participatory fashion.

9.5.3 Analysis and Proposed Approach

Institutional arrangements comprise policies, organizational mandates, regulations and other work procedures which together sanction, control and direct the actions of officials and organizations in achieving a desired objective: such as, for example, flood forecasting and dissemination of early warnings to communities and service providers.

As this project involves coordination across jurisdictional boundaries within each country (particularly in Ethiopia and Sudan) as well as between nations, the national and inter-national issues will be analyzed separately, as described below.

National Issues

Institutional arrangements for flood related activities within each country can be investigated at three levels:

- Institutional arrangements required **within each organization** ("intra-organizational") to successfully carry out its mandated functions in respect of flood mitigation planning, flood forecasting and warning, and emergency response and recovery.
- Institutional arrangements required for information exchange and coordination of activities **between organizations** (i.e., "inter-organizational protocols") to ensure smooth communication and action across organizational boundaries.
- Institutional arrangements required nationally **across sectors** ("inter-sectoral") and across levels of government (federal-regional-local in Ethiopia, federal-state -local in Sudan) to ensure smooth communication and action across political boundaries.

The challenges at each of the above three levels are:

- Intra-organizational – too little staff, lack of expertise, poorly defined procedures and insufficient resources (e.g., equipment, vehicles)
- *Inter*-organizational – poorly defined mandates, inefficient coordination procedures and lack of protocols
- Inter-sectoral – lack of agreed protocols.

International (EN Regional) Issues

Regional cooperation can be expected to enhance flood management in all Eastern Nile countries, particularly in Sudan which is affected by flood runoff from the Ethiopian high-lands. The establishment and implementation of regional coordination mechanisms for flood management will also provide useful experience in joint river management. This will be valuable for regional cooperation eventually in achieving the broader objective of integrated water resources management in the sub-basins of the Nile.

The challenges here are similar to those associated with "inter sectoral" coordination in the national context, above. Therefore key activities will include: exchange of expertise, experience, and information/data; coordination and facilitation of human and institutional capacity development; and technology transfer within the basin and internationally.

9.5.4 Preliminary Identification of Capacity Building Needs

Table 9-1 sets out the objectives, activities and targets for capacity building at the four institutional levels, namely, intra-organizational, inter-organizational, inter-sectoral and inter-EN Regional, as identified at this Inception step of the PP.

These will be tested and modified as the PP proceeds.

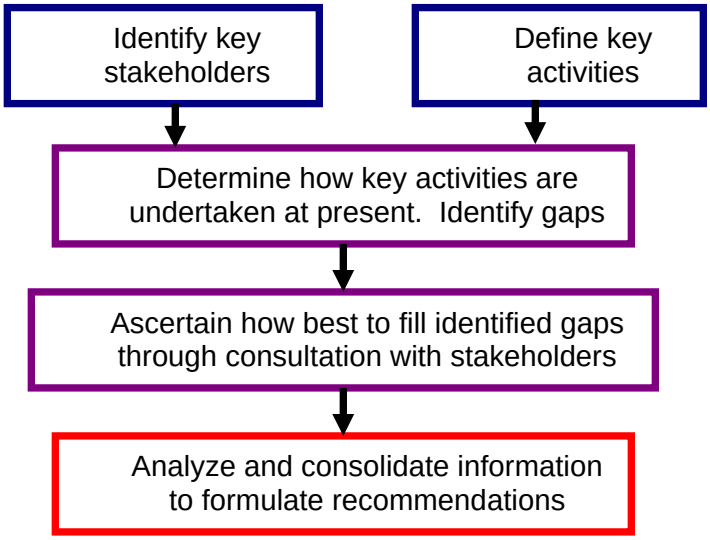
Table 9-1: Capacity Building

Institutional level	Objective	Associated activities and outputs	Target for capacity building
Intra-agency needs	Development of: • flood forecasting system(s); • plans to reduce flood damage and capture environmental benefits	• Forecasting systems; • Communication of flood warnings; • Improved reservoir operations; • Floodplain and land use management guidelines; • Design of small scale structural measures; development of standards for flood-prone structures • Relocation of flood-prone communities.	Professional development programs and training for staff in: - ***data collection*** and transmission - ***data*** archiving and ***processing*** - ***modelling*** (an operational forecasting system) - flood ***warning and communication*** Building capacity of relevant agencies - ***Systems*** (clearly understood procedures) - Necessary ***equipment and software***
Inter-agency Links	Delivery of flood information in a form and manner needed by other agencies with a role in any aspect of disaster prevention, preparedness, rescue and recovery.	Clear understanding of the roles of agencies and the interfaces between them.	***Strengthening*** of existing links and developing new arrangements where there is agreement on their value to achieving each agency's mandate in regard to flood disaster prevention and management.
Agency – Community Links	Identifying flood risk and implementing community-based plans to reduce flood damages and capture environmental benefits.	Identification and implementation of a range of cost-effective options at the community level to reduce flood damages: • floodplain and land use management; • small scale structural approaches; • communication of flood warnings; • relocation of flood-prone communities.	Strengthening or establishing flood management committees, affected communities and civil society groups building on existing programs for - ***public education programs*** - ***community warning mechanisms***
Regional, Federal and international	Enhance regional cooperation and collaboration to	Activities will include: • building compatible technology and information/data;	- Exchange of expertise, experience and information/data;

Institutional level	Objective	Associated activities and outputs	Target for capacity building
(Eastern Nile countries) links	create a strong Eastern Nile (EN) group.	• establishing mechanisms to exchange information and coordinate emergency preparedness and response efforts during critical events; • organizing regular forums (e.g., regular flood meeting, technical committees); • establishing mechanisms to exchange expertise and experience (e.g., national and regional linkages between government, universities and research institutes); • providing capacity building and technical support to national activities; • facilitating regional analyses and studies	- Human and institutional capacity development; - ***technology transfer*** within the Basin and internationally

9.5.5 Proposed Methodology

The methodology proposed to frame institutional and capacity development activities is described below:



1. Identify the key stakeholders in each country for the three aspects of flood management, namely: i) flood mitigation and planning; ii) flood forecasting, warning, and communication; and iii) emergency preparedness and response.
2. Define the key activities (or processes) associated with the three aspects.
3. Determine the manner in which the key stakeholders carry out these activities at present.
4. Identify key gaps and ascertain from each stakeholder their views on how best to fill the gaps.

5. Analyze and consolidate the information obtained from consultations to formulate recommendations for institutional and capacity development.

9.5.6 Tasks

Figure 9-2: Task Schedule for Institutional Input

Task	Work Plan		
	Jan-Feb	***March-May***	***June-July***
1. Identify the key stakeholders in each country for the three aspects of flood management, namely: i) flood mitigation and planning; ii) flood forecasting, warning, and communication; and iii) emergency preparedness and response.	First round of consultation to determine stakeholder needs	Confirmation of key stakeholders	N/A
2. Define the key activities (or processes) associated with the three aspects.	Preliminary identification of key activities	Confirmation of key activities	N/A
3. Determine the manner in which the key stakeholders carry out these activities at present.	Rapid appraisal of stakeholder functions	Development of detailed understanding	Discussion and confirmation of key stakeholder roles
4. Identify key gaps and ascertain from each stakeholder their views on how best to fill the gaps.	Preliminary identification of gaps	Investigation of the significance of gaps	Confirm key gaps that need to be addressed
5. Analyze and consolidate the information obtained from consultations to formulate recommendations for institutional and capacity development.	First round of consultation to determine stakeholder needs.	Dialogue and analysis to formulate recommendations	Refinement and finalization of recommendations

9.6 WORK PLAN

The Work Plan has been compressed to complete the work within 10 months, at the request of The World Bank during Project Launch. The schedule of work and the staffing schedule are shown on the following pages.

No.	RFP Section no:	Methodology/ Section No:	ACTIVITY / TASK	MONTHS
	5.2	**1.0**	**PROJECT INCEPTION PHASE**	1 2 3 4 5 6 7 8 9 10 11 12
	5.2.2	1.1	PROJECT LAUNCH & ORIENTATION	
	5.2.3	1.2	GENERAL ASESSMENT OF CURRENT STATUS, FLOOD MANAGEMENT NEEDS, AND EXISTING CAPACITY	
		1.2.1	SITE VISITS STAKEHOLDER CONSULTATIONS & WORKIG MEETINGS	
		1.2.2	REVIEW FLOOD RISK PROBLEMS, EXTENTS & IMPACTS OF FLOODING	
		1.2.3	IDENTIFY FLOOD MANAGEMENT NEEDS & PRIORITIES	
		1.2.4	DEVELOP CONSULTATION & COMMUNICATIONS PLAN	
		1.3	PREPARE INCEPTION REPORT	
	5.3	**2**	**PROJECT DEFINITION PHASE**	
	5.3.2	2.1	FLOOD MITIGATION PLANNING COMPONENT	
		2.1.1	ASSESSMENT & GAP ANALYSIS OF EXISTING FLOOD MITIGATION ISSUES	
		2.1.2	HIGH-LEVEL FLOOD IMPACT ASSESSMENT	
		2.1.3	FLOOD MITIGATION OPTIONS & RISK REDUCTION STRATEGY FOR ETHIOPIA	
		2.1.4	FLOOD MITIGATION OPTIONS & RISK REDUCTION STRATEGY FOR SUDAN	
		2.1.5	FLOOD MITIGATION OPTIONS & RISK REDUCTION STRATEGY FOR EGYPT	
		2.1.6	SUMMARIZE ANALYSES, FINDINGS, OPTIONS & RECOMMENDATIONS FOR TBP (Technical Background Paper)	
		2.1.7	DEFINE COMPONENT INPUT TO PIP (Project Implementation Plan)	
		2.1.8	IDENTIFY BENEFICIAL & ADVERSE ENVIRONMENTAL & SOCIAL ISSUES	
		2.1.9	FUNCTIONAL REQUIREMENTS FOR FLOOD FORECASTING & WARNING	
		2.1.10	IDENTIFY POTENTIAL REGIONAL ACTIVITIES & PROJECT OPPORTUNITIES	
	5.3.3	2.2	FLOOD FORECASTING, WARNING & COMMUNICATION COMPONENT	
		2.2.1	ASSESSMENT & GAP ANALYSIS OFEXISTING FLOOD FORECASTING, WARNING & COMMUNICATION SYSTEMS	
		2.2.2	FORECASTING SYSTEM OPTIONS	
		2.2.3	CONCEPTUAL DESIGN OF FORECASTING SYSTEM	
		2.2.4	IDENTIFY APPROPRIATE COMMUNICATION PROCEDURES	
		2.2.5	SUMMARIZE ANALYSES, FINDINGS, OPTIONS & RECOMMENDATIONS FOR TBP (Technical Background Paper)	
		2.2.6	DEFINE COMPONENT INPUT TO PIP (Project Implementation Plan)	
		2.2.7	IDENTIFY POTENTIAL REGIONAL ACTIVITIES	
	5.3.4	2.3	EMERGENCY PREPAREDNESS AND RESPONSE	
		2.3.1	ASSESSMENT& GAP ANALYSIS OF EXISTING EMERGENCY PREPAREDNESS & RESPONSE PLANS	
		2.3.2	EMERGENCY PREPAREDNESS & RESPONSE OPTIONS	
		2.3.3	IDENTIFY POTENTIAL SOCIAL ISSUES AND CONSTRAINTS	
		2.3.4	SUMMARIZE ANALYSES, FINDINGS, OPTIONS & RECOMMENDATIONS FOR TBP (Technical Background Paper)	
		2.3.5	DEFINE COMPONENT INPUT TO PIP (Project Implementation Plan)	
		2.3.6	IDENTIFY POTENTIAL REGIONAL ACTIVITIES	
	5.3.5	2.4	REGIONAL COMPONENT	
		2.4.1	IDENTIFY POTENTIAL REGIONAL ACTIVITIES	
		2.4.2	REVIEW PRACTICE IN OTHER INTERNATIONAL RIVER BASINS	
		2.4.3	SUMMARIZE ANALYSES, FINDINGS, DECISION PROCESSES & OUTCOMES FOR TBP (Technical Background Paper)	
		2.4.4	DEFINE COMPONENT INPUT TO PIP (Project Implementation Plan)	
	5.3.6	2.5	PREPARATION OF IINTEGRATED FINAL DRAFT PIP & LINKED EMF & RPF	
			PREPARATION OF IINTEGRATED FINAL DRAFT PIP & LINKED EMF & RPF	
	5.4	3.0	**FINALISATION OF DOCUMENTS**	
		3.1	PREPARATION & DELIVERY OF FINAL DOCUMENTS	
		3.2	PROJECT DEBRIEFING	
	7.0	4.3	**DELIVERABLES**	
			PROJECT PREPARATION WORKPLAN	
			DRAFT INCEPTION REPORT & REINED WORKPLAN	
			FINAL INCEPTION REPORT	
			DRAFT TBP & DRAFT PIP WITH INTEGRATED DRAFT EMF & RPF	
			DRAFT PIP (integrated with Draft EMF/RPF), FINAL DRAFT TBP, SEPARATE EMF & RPF FOR DISCLOSURE, & DRAFT TORs	
			FINAL DRAFT PIP (integrated with EMF/RPF), FINAL TBP & FINAL DRAFT TORs	
			FINAL PIP (with integrated EMF/RPF) & TORs	
			FINAL DOCUMENTS AND PROJECT CRITIQUE	
			ADMINISTRATIVE REPORTS	
			BRIEF PROGRESS REPORTS EMAILED WEEKLY	
			PROGRESS REPORT EMAILED MONTHLY	
			FINAL PROJECT NOTE	

STAFFING SCHEDULE Revised January 2006

No.	Name of Staff	Months												Total Staff - month input		
		1	2	3	4	5	6	7	8	9	10	11	12	Home	Field	Total
Foreign																
														1		1
1	Dr John Porter (Team Leader)														6	6
														0.25		0.25
2	Mr Duleep Danton (IS)														1.75	1.75
														0.25		0.25
3	Dr Tyson- Taylor (SAS)														1.75	1.75
														0.25		0.25
4	Mr Steve Opper (EMSS)														0.75	0.75
5	Dr Mekuria Beyene (GIS - DBS)														1	1
														0.25		
6	Mr Ian Milwood Brown (PES)														0.75	1
														0.25		0.25
7	Mr Brett Loney (EPS)														0.75	0.75
												Subtotal		**2.25**	**12.75**	**15**
Local																
1	Mr Yousif Fadlalla Ahmed (SHS)														4	4
2	Mr Assefa Addisu (ECS)														2	2
3	Dr Yilma Seleshi Shiferaw (EHS/DTL)														4	4
4	Dr Mustafa Babiker Ahmed (SCS)														3	3
5	Mr Ahmed Fahmy Abdalla (EWMS)														1	1
												Subtotal			15	15
												Total		2	28	30

LEGEND:

International Staff Inputs (Full-time in Field)

International Staff Inputs (Full-Time Home)

Domestic Staff Inputs (Full-time in Field)

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Appendix A: Summary of Consultations During Inception

Note that this is a summary only. More comprehensive notes of consultations have been prepared by the Consultant and copied to ENTRO.

Country	Ministry/ Department	Name/ Designation	Issue discussed
Ethiopia	MWR/ Hydrology	Mr Deksios Tarekegn/ Head	Flood related information flows in and out of MWR and coordinat-ion mechanisms in Ethiopia for flood mitigation planning, flood forecasting and early warning.
	MWR/ Hydrology	Ms Semunesh Golla/ National Flood Coordinator / Team Leader	Institutional arrangements for flood planning and forecasting country-wide.
	MWR	Mr Tefera Beyene/ ENSAP Team Memeber	MWR organization; flooding around L Tana; future WR developments
	MWR/ Irrigation & Drainage	Mr Teshome Atenafe/ Head	Future irrigation developments; role of Irrigation Department. Responsibility for flood control infrastructure design, construct-ion and O&M.
	MWR/ Hydrology	Mr Dawit Teffera/ Data Processing Team Leader	Hydrometric data collection, checking, archiving and dissemination.
	MWR/ Hydrology	Mr Solomon Kebede/ Instrumentation Team Leader	Hydrometric data capture/ collection instrumentation – operation, maintenance and replacement.
	MWR/ Hydrology	Mr Mohammad/ Data Analyst and Mr Belete/ Hydrological Modeller	Data analysis and modeling for flood forecasting.
	MWR/ Dam & Hydro Design	Mr Michael Abebe/ Head	Consideration of flood aspects in the design stage of projects.
	MWR/ Boundary & Transboundary Affairs	Mr Musa Mohammad/ Head	Eastern Nile Region outlook in regard to institutional and capacity building aspects under this project.
	MWR/ Abbay Basin Institutional Development	Mr Fekahmed Negash/ Team Leader	Proposed institutional arrangements for the Abbay Basin. Capacity building in database development.
	MWR/ Administration	Mr Tamene Gossaie/ UNICEF Projects Coordinator/ TaskForce for Water Supply & Sanitation	TaskForce post-disaster activities; contingency planning; Crisis Management Committee.
	MWR/ Contract Administration	Mr Leulseged Tadesse	Responsibility for flood control infrastructure design, construction and O&M.

Country	Ministry/ Department	Name/ Designation	Issue discussed
Ethiopia	NMA	Mr Kidane Asefa/ Director General	FPEW Project and NMA data systems.
	NMA	Mr Diriba Koriche/ TL Weather Forecasting and Early Warning (WFEW), Member, RWG.	MNA organization and activities. Current WFEW systems and limitations. Possibility of extending the mandate of the High Dams Technical Committee to also include flood warnings.
	NMA/ Meteorological Analysis & Forecast	Mr Amare Babu/ Head	Weather forecasting
	NMA	Mr Seid Amedie/ Team Leader, Met. Communication Team	Satellite data reception and analysis.
	DPPA DPPA DPPA DPPA	Mr Guluma Sobokssa/ Project Evaluation & Monitoring Team/ RWG member Mr Teshome Erkeneh/ Head, Early Warning Department Mr Getachew Abate/ Engineer, Early Warning Department Ms Tiruwork/ Team Leader, Project Evaluation & Monitoring	Current institutional arrangements for disaster prevention and management for drought; and the extent to which they could be adapted to flood disasters. Possible assistance from the Project to fill gaps in current arrangements to improve preparedness, early warning and emergency response to floods.

Country	Ministry/ Department	Name/ Designation	Issue discussed
Sudan	**Civil Defense Organ**	Gen. Abdulhamid Hadj Hamad/ Director Lt.Col. Roden Loro Karlo	Current institutional arrangements and constraints to flood preparedness, early warning, response and recovery activities.
	Ministry of Irrigation and Water Resources MIWR MIWR	Mr Hayder Bakhiet/ Director Nile Waters Department/ NFCordinator Dr Salaheldien Yousef/ Chairman, WRTO Ms Tagreed Abdel Rahim, Hydrologist, Forecast Center	Institutional Arrangements Re Hydrometric Data Collection and Management; Flood Forecasting And Early Warning. Information Flow For Operations of the Flood Forecasting Centre.
	Humanitarian Aid Commission	Mr Harim Mohamedal Khalid/ Deputy Head, Emergency Unit	Current institutional arrangements and constraints to satisfactory preparedness for

Country	Ministry/ Department	Name/ Designation	Issue discussed
Sudan	HAC	Mr Yasser Mohammed/ Head, Early Warning Unit	flood, receiving early warning and undertaking response and recovery activities
	Civil Engineering Dept, University of Khartoum	Prof Gamal Abdo/ Head Dr Barsi, Dr Kamal Bashar, Dr Bhakti, Engr Hatim Eisa/ Hydrology and Water Engineering	Development of flood fore-casting models. Capability to provide training and capacity building of government institutions in flood forecasting and associated modeling.
	UNESCO Chair in Water Resources	Prof Abdalla A Ahmed/ Director Dr Kamal Bashar	Water resources development. FRIEND Nile Project.
	Sudan Meteorological Authority	Saber Ali Taho, A/Director General; Musa Ahmed Fota/ Director, Forecast Centre; Mohamed Suliman; Ismail Fudl el Moula/ Director, Finance & Admin; Haroun Abdalla/ General Director, Training, Research & Information	Current arrangements for weather forecasting and capacity to provide meteoro-logical information required for early warning of floods. Satellite data reception and analysis. National meteorological data network.

Country	Ministry/ Department	Name/ Designation	Issue discussed
Egypt	Ministry of Water Resources and Irrigation / Nile Forecasting Centre	Mohamed Abdel Aty/ Manager/ NFCoordinator Mamdouh Hasan/ GIS specialist Mamdouh Ansar/ Hydrologist	Current systems used in Egypt for flood forecasting. Satellite data reception and analysis. L Nasser Flood & Drought Management Project. Operations of HAD.
	MWRI/ Nile Water Sector, National Office of NBI	Mr Yasser Elwan/ Director of Information/ RWG member Mr Magdy Sayed Ahmed/ RWG member	Operations of HAD. Future issues: Toshka spillway, irrigation. Past floods and downstream impacts of high releases.
	MWRI/ Nile Research Institute	Dr A F Ahmed/ Director Dr Karima Attia/ Head, Erosion & Sediment-ation Dept.	Nile mapping project; impacts of high releases from HAD. Flood risk mapping proposals. Flood warning times. Sediment deposition in L Nasser.
	MWRI/ Nile Water Research Centre	Dr Mohamed Sonbel	FRIEND Nile Project; flood frequency analysis.
	MWRI/ Nile Protection Sector	Abdel Hafiz Shalaby/ Head	River bank erosion and scour caused by flood releases from HAD.

Appendix B: Proposed Consultation and Communications Plan

B.1 Objectives

Consultation and effective communication with key stakeholders is essential for Project Preparation in order to ensure that the Project design meets the real needs of stakeholders. Participatory consultations identify the priorities of all stakeholders and bring to light the multidimensional nature of flood.

Key stakeholders include government agencies with a role in flood management, flood-affected communities, and NGOs engaged in disaster relief and recovery.

Consultations need to be directed at identifying key issues, information gaps and organizational deficiencies that are relevant to the Project design. Communications should provide adequate information so that stakeholders understand the Project background and the current stage of the Project, and understand the Consultant's role in the process.

All consultations should be adequately recorded and documented for subsequent reference by all who work on Project Preparation and Project Implementation.

B.2 Consultation with Government Agencies

Consultation with officials and representatives of government agencies / institutions will primarily be through formal interview. Discussion will target identification and description of existing institutional, administrative and technical organization relevant to flood management, identification of constraints to good management practice, and identification of plans and aspirations for improved future flood management.

Consultation with local officials (woredas and kebeles in Ethiopia; mahaliyas in Sudan) will, in addition to the above, target identification of how agencies interact with flood-affected communities and identification of their perception of the issues relevant to the communities and the constraints in meeting community expectations and needs.

During the course of Project Preparation as definition of the Project advances, additional consultation and communications will take place to inform the stakeholders of measures and activities being planned, ensure that these measures and activities match the expectations of the stakeholders, and discuss how these measures and activities would be undertaken inasmuch as there is a role for the stakeholder agency or inasmuch as it affects its future operation.

Meeting notes will be maintained of all interviews and discussions, noting the date, time and place of the meeting, attendees, subject of the discussions and highlighting key information relevant to Project planning and design.

B.3 Consultation with NGOs

Consultation with officials and representatives of NGOs will primarily be through formal interview. The Consultant will communicate adequate information for a general understanding of the Project, its purpose and context, and the current stage of preparation. Discussion will target identification of the role or potential role of the NGO in post-flood relief and recovery operations, how its activities are coordinated with government operations, and identify constraints to the effective delivery of goods and services.

Meeting notes will be maintained of all interviews and discussions, noting the date, time and place of the meeting, attendees, subject of the discussions and highlighting key information relevant to Project planning and design.

B.4 Consultation with Flood-Affected Communities

Consultation with flood-affected communities will adopt a range of consultation techniques. These will include focus group meetings, formal meetings with community leaders or village elders, and interviews with individuals from different identifiable groups (eg. women, youth, ethnic groups, heads of households). Individual interviews can be more in-depth than focus group discussions and can be used to highlight specific results obtained from more general analysis.

During the public consultation process checklists and guiding questions will be prepared for community meetings; and for the use with different stakeholders and for individual interviews. The Consultant will communicate adequate information for a general understanding of the Project, its purpose, and the current stage of preparation. The Consultant will explain their advisory role in the Project Preparation, and that decisions will be made by others.

Consultations will target identification of the coping mechanisms the communities adopt to deal with the impacts of floods; their level of self-organization and independence; identification of damages, health issues and social impacts experienced in past floods; how the community interacts with government agencies and others that assist in preparations prior to floods and in post-flood relief and recovery; how effective assistance by government agencies and others has been; what information or assistance would be valuable to the community. Where past resettlement has been attempted or is in progress, consultations will target identification of issues that have impeded success of the resettlement initiatives. Where future resettlement may be considered, consultations will target identification of community and group attitudes to the prospect of resettlement and expectations were it to occur.

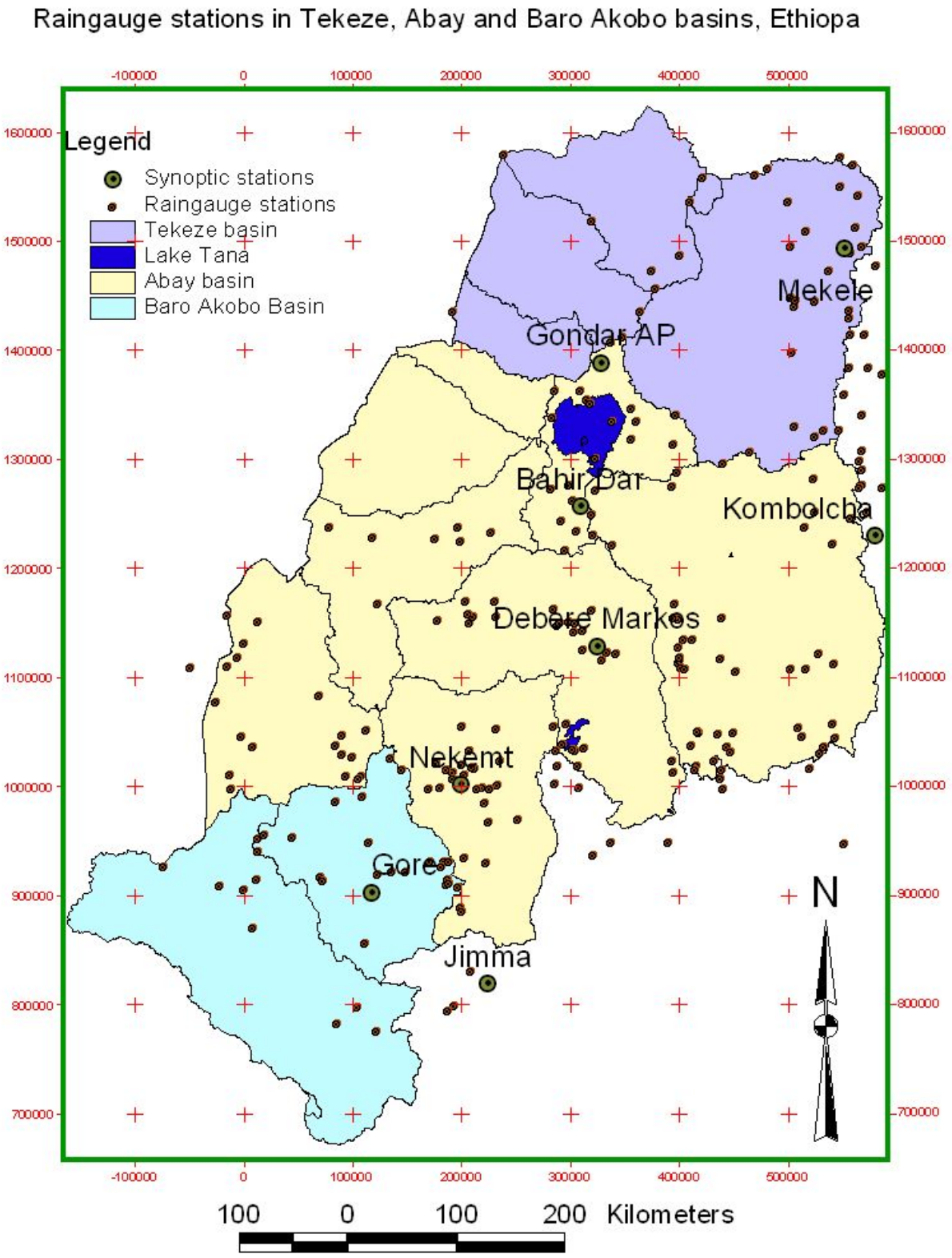
Notes will be maintained of all interviews and discussions, noting the date, time and place of the meeting or interview, names and/or descriptions of those present, type of meeting, subject of the discussions and highlighting key information of substance relevant to Project planning and design.

Appendix C: Additional Hydrometeorological Information for Ethiopia

BCEOM (1999) identified major dam sites named Karadobi, Mabil, Mendia and Border dam sites located on the Abbay river, having high potential for regional hydropower generation. Presently, the Karadobi dam site with gross storage size of 41 billion m^3 is under pre-feasibility study. Studies on Mendia and Border dam sites are expected to follow.

A major dam with gross storage about 9 billion m^3 is under construction on the middle reach of the Tekeze river for hydropower generation and also help attenuate flood peak in the Tekeze valley as well as in Humera plain near Sudan border. Irrigation in the Humera Plain will also be possible.

There are no current plans for development of major dams in the Baro-Akobo river basin in Ethiopia.


Raingauge stations in Tekeze, Abay and Baro Akobo basins, Ethiopa
Legend
Synoptic stations
Raingauge stations
Tekeze basin
Lake Tana
Abay basin
Baro Akobo Basin
Mekele
Gondar AP
Bahir Dar
Kombolcha
Debare Markos
Nekemt
Gore
Jimma
N
-100000
0
100000
200000
300000
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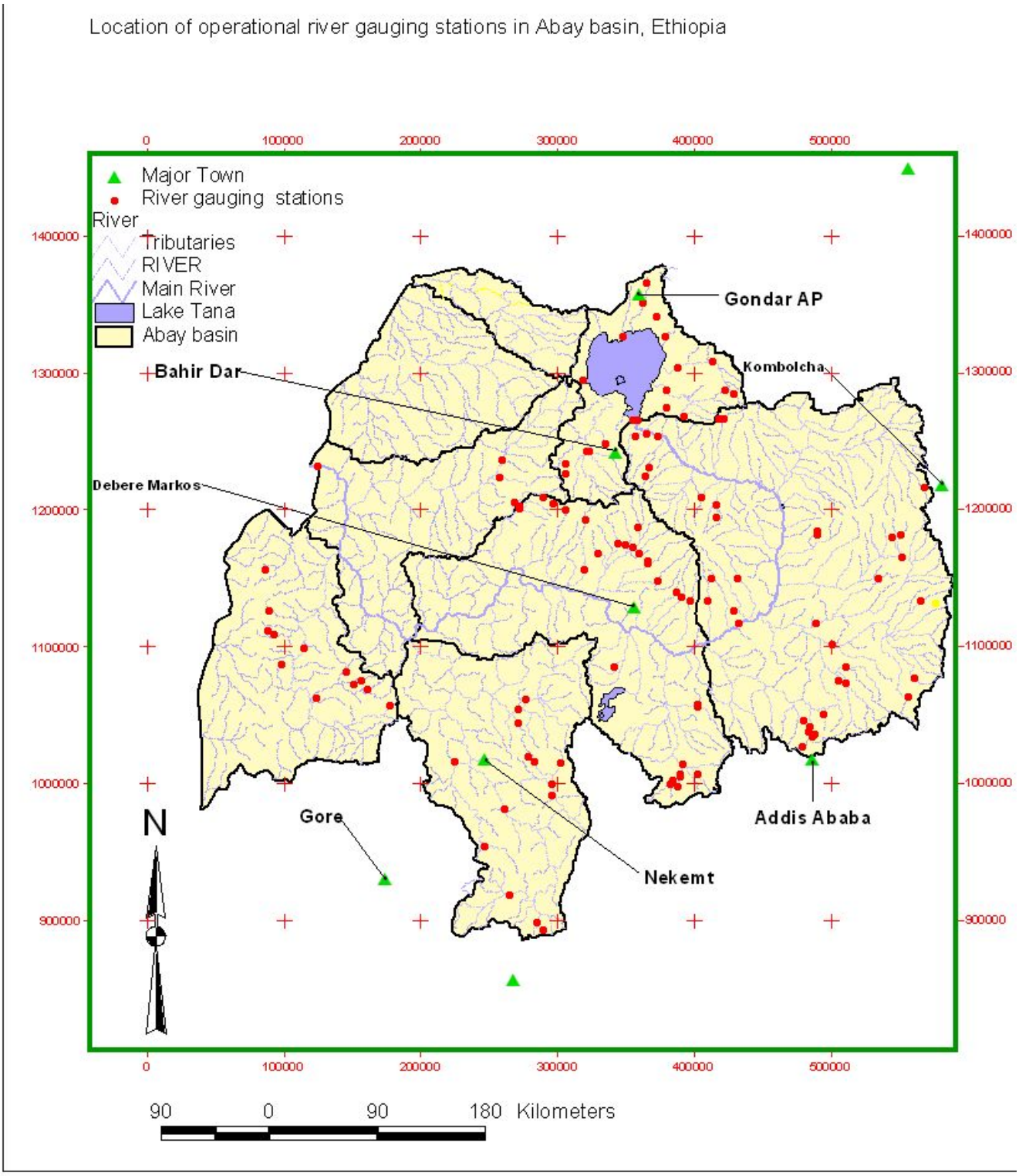
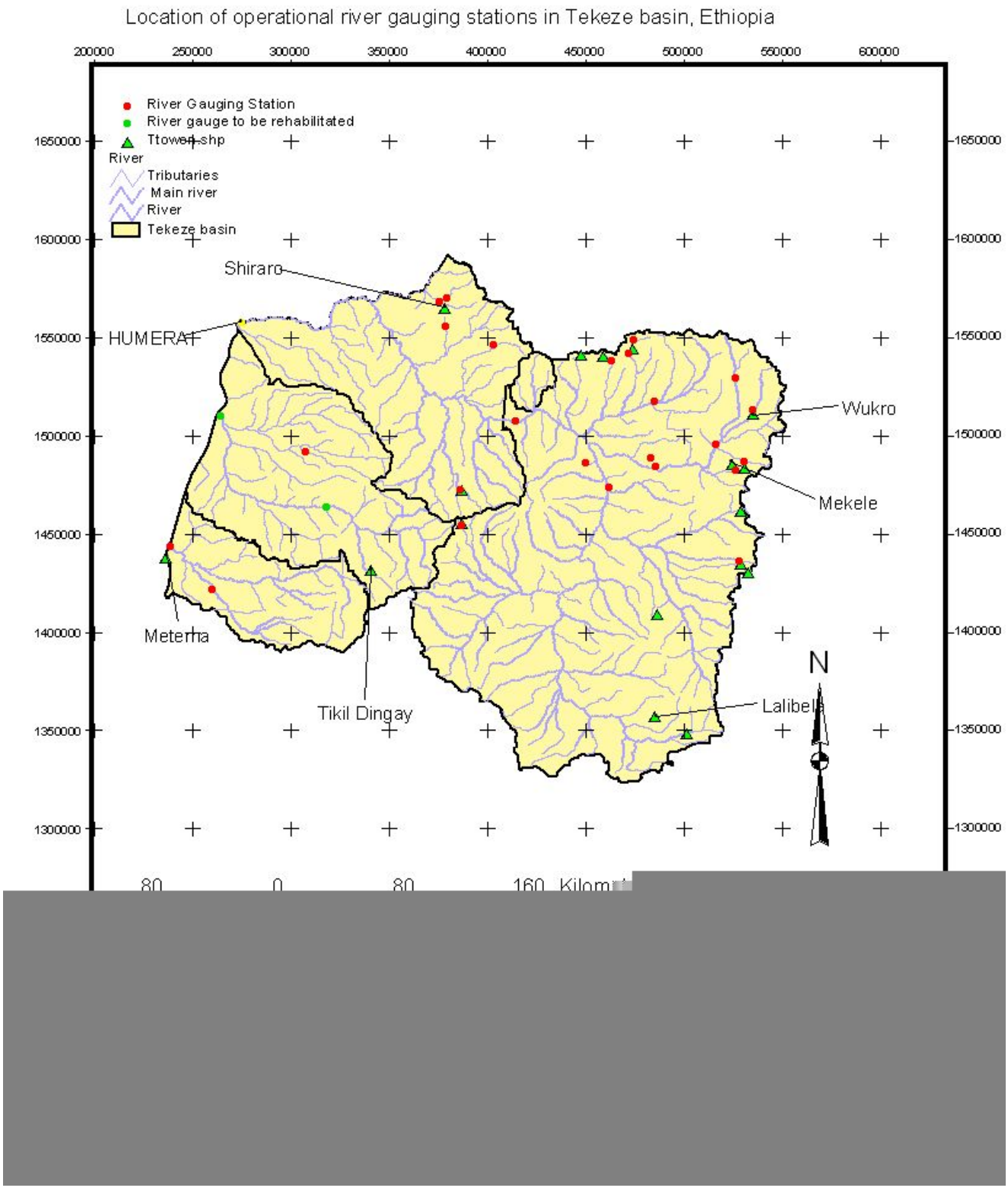
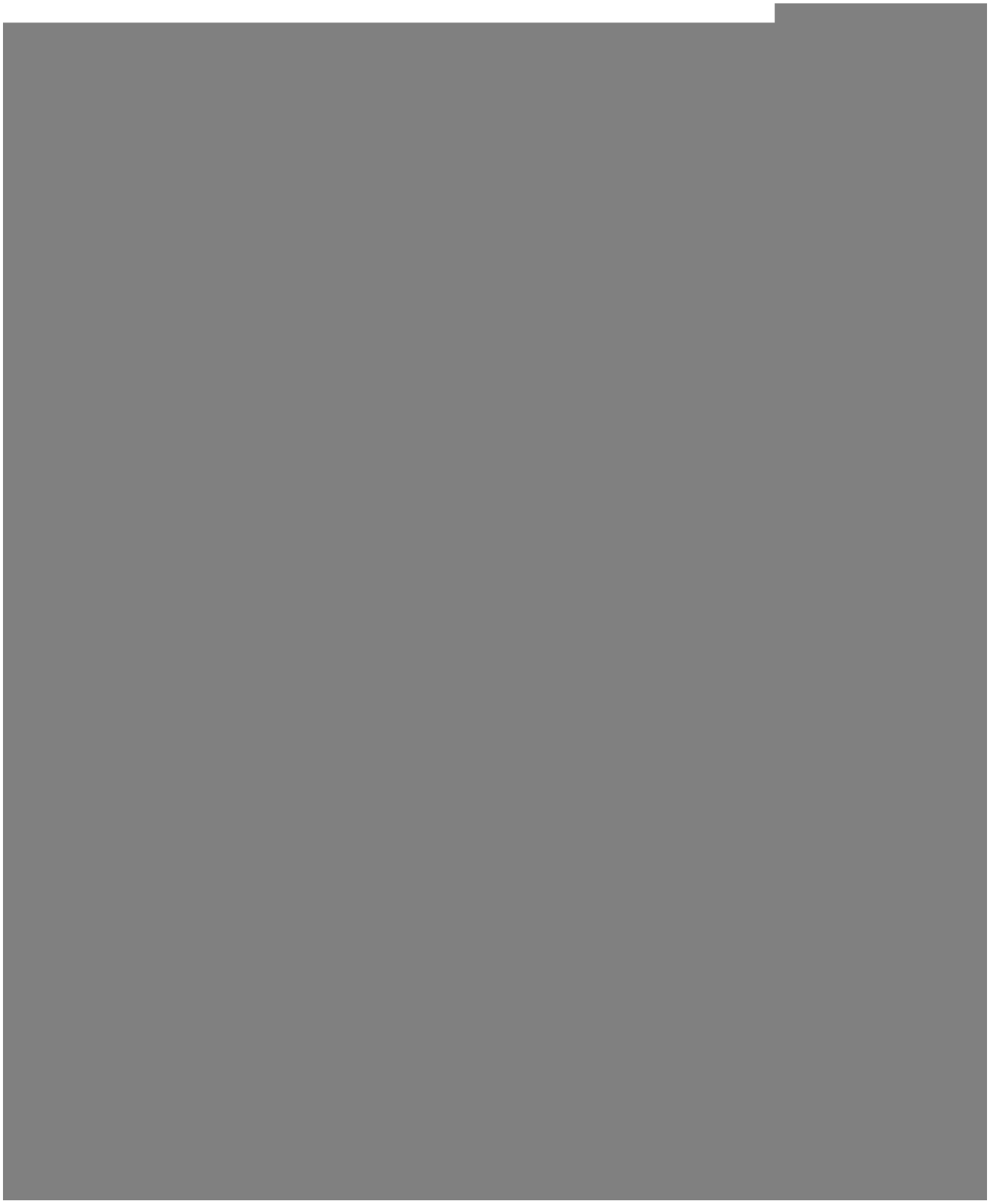
1200000
1100000
1000000
900000
800000
700000
100 0 100 200 Kilometers


Location of operational river gauging stations in Abay basin, Ethiopia
Major Town
River gauging stations
River
Tributaries
RIVER
Main River
Lake Tana
Abay basin
Gondar AP
Kombolcha
Bahir Dar
Debere Markos
Addis Ababa
Gore
Nekemt
N
0
100000
200000
300000
400000
500000
1400000
1300000
1200000
1100000
1000000
900000
90 0 90 180 Kilometers


Location of operational river gauging stations in Tekeze basin, Ethiopia
200000
250000
300000
350000
400000
450000
500000
550000
600000
1650000
1600000
1550000
1500000
1450000
1400000
1350000
1300000
River Gauging Station
River gauge to be rehabilitated
Ttowns_shp
River
Tributaries
Main river
River
Tekeze basin
Shiraro
HUMERA
Wukro
Mekele
Meterha
Tikil Dingay
Lalibela
N
80
0
80
160 Kilom



Appendix D: Preliminary Outline for TBP

TECHNICAL BACKGROUND PAPER

1. INTRODUCTION
   - 1.1 FPEW Project
     Objectives Concept
   - 2.2 Project Preparation
     Organization Inception step Project Definition step
   - 3.3 East Nile Region
     Countries, geography, governments, peoples, languages, GDPs.
   - 4.4 Climate
     Regional influences Seasonal variations Sample rainfalls Isohyetal map
   - 5.5 Hydrology
     Descriptive – river basins, MAFs, seasonal variation Flood hydrology Main areas at risk of river flooding – rural/urban, Ethiopia, Sudan, Egypt Flash flooding in Sudan
   - 6.6 Purpose of TBP
     Document analyses, assumptions, options, etc.

2. INSTITUTIONAL EVALUATION
   - 1.1 Purpose
     Objectives Background
   - 2.2 Methodology
     Approach Consultation
   - 3.3 Ethiopia
     System of govt & administration
     Analysis of constraints & limitations
     Identification of needs
     Capacity building, incl. alternatives
   - 4.4 Sudan
     System of govt & administration
     Analysis of constraints & limitations
     Identification of needs
     Capacity building, incl. alternatives
   - 5.5 Recommendations

3. COMMUNITY PREPAREDNESS
   - 1.1 Introduction
     Objectives Social baseline studies Context within FPEW Project
   - 2.2 Methodology
     Consultation & communications plan Selection of community sample Identification of coping mechanisms, community organization Description of govt service provision Analysis of needs
   - 3.3 Review of Successful Models of Community Preparedness

Appendix E: Preliminary Outline for PIP

PROJECT IMPLEMENTATION PLAN

1. INTRODUCTION
   - 1.1 Flood Risk Management in the Eastern Nile Nations
     Existing practice & policy in Ethiopia Sudan Egypt Regional coordination
   - 1.2 Important Constraints in Flood Risk Management
     Summaries of gap analysis; needs assessment
   - 1.3 Nile Basin Initiative
     NBI ENSAP Objectives Programs
   - 1.4 FPEW Project
     Objectives Concept Project Preparation
   - 1.5 Project Implementation Plan
     Purpose Link to TBP Structure of report

2. PROJECT DESIGN
   - 2.1 Background
   - 2.2 Project Objectives
   - 2.3 Project Scope
   - 2.4 Expected Outcomes and Key Performance Indicators
   - 2.5 Project Components
   - 2.6 Project Component Description
     Flood Mitigation Planning Component
     Flood Forecasting and Warning Component
     Emergency Response and Preparedness Component
     Regional Component
   - 2.7 Distinguishing Features of Project Design
   - 2.8 Project Costs and Budget
   - 2.9 Project Financing Plan

3. INSTITUTIONAL FRAMEWORK FOR PROJECT IMPLEMENTATION
   - 3.1 Background
   - 3.2 Implementing Agencies
   - 3.3 Regional Level Agencies
   - 3.4 National Level Agencies
     in Ethiopia in Sudan in Egypt
   - 3.5 Sub-National Level Agencies
     for regions, woredas, kebeles in Ethiopia for states, mahaliyas in Sudan
   - 3.6 Relevant Policies and Legislation
   - 3.7 Technical Assistance
   - 3.8 Logistical Support
   - 3.9 Human Resource Development Strategy and Capacity Building Program

9. RESETTLEMENT POLICY FRAMEWORK
   - 9.1 Introduction
     Objectives Context within FPEW Project
   - 9.2 Context of Existing National Policy and Legal Framework
   - 9.3 Assessment in Relation to World Bank Safeguard Policy
   - 9.4 Stakeholder Consultations
   - 9.5 Operational Framework
     Impacts & mitigation measures Compliance criteria Capacity building Monitoring requirements

APPENDICES:

A. Regional Strategy for Flood Risk Management

B. National Strategies for Flood Risk Management
   - Ethiopia
   - Sudan
   - Egypt

C. Detailed Project Cost Analysis

D. Terms of Reference
   - Introduction
     Packaging of tasks in sub-projects
   - Sub-Project Packaging Alternatives
   - Recommendations
     Implications for financing
   - Preparation of Terms of Reference
     ToRs documented separately