

Mapping, Assessment & Management of Transboundary Water Resources in the IGAD Sub-Region Project



OVERVIEW AND GENERAL RECOMMENDATIONS



INTERGOVERNMENTAL
AUTHORITY ON DEVELOPMENT



AFRICAN WATER FACILITY



SAHARA AND SAHEL OBSERVATORY

Mapping, Assessment & Management of Transboundary
Water Resources in the IGAD Sub-Region Project



INTRODUCTION, OVERVIEW
AND GENERAL RECOMMENDATIONS

December 2011

Study conducted with the support of:



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and Sahara and Sahel Observatory

ISBN: 978-9973-856-64-7



PREFACE

The IGAD sub-region represents one of the marginal regions of the world in terms of rainfall available for natural vegetation growth and crop production. About 80% of the IGAD sub-region is arid and semi arid with low level of water use. It has a population estimated at **206 million in 2010** and projected to reach **462 million in 2050** in an area of **5.2 million km²**.

The most obvious manifestation has been periodic droughts and desertification that have consigned millions to perpetual poverty and deaths. The populations derive their livelihoods from water and land based primary production activities such as nomadic pastoralism and subsistence agriculture in a region where rainfall variability is high. The sub-region is the home of the greatest numbers of pastoral communities estimated to be about **17 million**. Dependable water availability is therefore vital to the development of the region.

The mounting concerns over water scarcity in the IGAD sub-region have focused attention to several socioeconomic challenges of water resource management.

Firstly, as the sub-region expects to advance economically and socially, the demand for water will increase as a result of population growth, rising incomes, changing dietary patterns, urbanization and industrial development. While demand will increase in all sectors, agriculture will account for the bulk of the water and will therefore be the focal point for adjustment of demand pressure.

Secondly, there are concerns as to whether the IGAD sub-region

will have enough water to meet the food security needs of a rapidly growing population. Along with food security, water security has also become a fundamental issue for human development in the sub-region

While it is a fact that water occupies pivotal position in development in the IGAD sub-region, none of the **member countries has adequate information** to manage their water resources for the attainment of economic efficiency and equity in water allocation for different uses. Yet, four IGAD countries namely **Eritrea, Kenya, Djibouti and Somalia** are in the category of those experiencing water scarcity i.e. with **less than 1000 m³ per person per year** or less.

Indeed by the year 2025 even Ethiopia and Uganda which are presently with adequate water will be water stressed (1000-2000 m³/person/year) while Djibouti, Eritrea, Kenya, Somalia and Sudan will be in water barrier situation «500 m³/person/year » and therefore water will be limiting any sustainable development.

None of the IGAD Member States has at the present time water per capita necessary for industrial development (2400 m³/day). This lack of water will severely constrain food production, ecosystem maintenance and economic development among other needs and uses.

Water resources link the IGAD Member states internally and externally with adjacent regions. Six transboundary river basins and six transboundary aquifer systems have been identified in this stage of the IGAD sub-region study. **The ratio of water demands to available supply averages which is 9% in 2011 will increase to 15% in 2031** as projected by this study which is known as “*Mapping, Assessment and Management of Transboundary Water Resources in the IGAD Sub-region Project*”. However, there are specific problems that call the need for adequate knowledge of surface and ground water resources.

This Study (the first sub-regional study) has provided a platform for refocusing efforts within the sub-region towards better quantification and understanding of the extent of water scarcity

and other water related factors that impact socioeconomic development in the sub-region. The most significant of the drivers of water demand in all sectors is population, which in the sub-region is projected to increase by 165% between 2010 and 2030, and by 136% between 2030 and 2050. This study demonstrates that these increases will create significant increases in water withdrawals for domestic supply and for industry.

The other significant sector is agriculture, which combines irrigation and livestock. Again here population is the most important parameter of change, driving the demand for food and hence the need to raise agricultural productivity through irrigation development.

The regional process has highlighted the **low level of water use** and hence of water security currently estimated as about 3% of the annually renewable water resources as a basic indicator of the overall lack of water infrastructure development to ensure water security for the social and economy and environmental use. The IGAD sub-region is one of the most vulnerable areas to climate variability and recurrent droughts.

Hence, there is need to further understand in depth the environmental situation and consolidate IGAD capacities to monitor the linkages between climate and the water system along with identification and mapping of the water resources and the major risks associated with degradation, pollution and water quality deterioration. Policies, strategies, and objectives of cooperation and how to achieve them should be set out in a second stage of the IGAD project study.

It is important to note that the IGAD project was implemented at national and sub-regional levels with active participation of the focal national institutions by employing national and regional consultants. The project coordination is done by OSS with the establishment of national coordination units in the focal national water institutions of the IGAD Member States. Steering Committee

of the project was in place and the regional coordination and facilitation was done by IGAD.

We would like to thank everyone who contributed to the success of this project: the Ministries in charge of Water and national institutions, the IGAD and OSS cooperation partners (particularly the African Water Facility), the national teams, national and international consultants, the project team within the Executive Secretariat of OSS and The IGAD Secretariat.

Our satisfaction was to pass the ownership of all project results by national teams and the establishment within the Executive Secretary of IGAD powerful tools to ensure the continuity of the project.

This final project report is made up of 7 individual documents namely

- Introduction, Overview and General Recommendations
- Volume 1: Institutional Framework Component Report
- Volume 2: Socioeconomic Component Report
- Volume 3: Environment Component Report
- Volume 4: GIS/Database Component Report
- Volume 5: Water Resources Modelling/Hydrology Component Report
- Volume 6: IWRM Component Report

We also thank SEREFACO Consultants Limited and its team for the excellent work carried out despite all the difficulties encountered particularly the lack of reliable data.

The Executive Secretary of OSS
Dr. Ing. Chedli FEZZANI

The Executive Secretary of IGAD
Eng. Mahboub Mohamed MAALIM



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LIST OF ACRONYMS

ASAL	Arid and semi-arid land
COMESA	Common Market for Eastern and Southern Africa
DB	Database
EIA	Environmental Impact Assessment
FAO	Food and Agricultural Organisation
GEF	Global Environment Facility
GWP	Global Water Partnership
IGAD	Inter-government Authority on Development
IGRAC	International Groundwater Resources Assessment Centre
IWMI	International Water Management Institute
IWRM	Integrated Water Resources Management
NAPA	National Adaptation Programme of Action
NBCU	National Basin Coordination Units
RBCU	Regional Basin Coordination Unit
RPSC	Regional project steering committee
RTBCS	Regional Transboundary Basin Coordination Secretariat
OSS	Sahara and Sahel Observatory
SWALIM	Somalia Water and Land Information Management
SWAT	Soil Water and Assessment Tool
ToR	Terms of Reference
TRBO	Transboundary River Basin Organization
UNCBD	United Nations Convention on Biodiversity

UNCCD	United Nations Convention for Combating Desertification
UNCED	UN Conference on Environment and Development (Rio Summit)
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
WEAP	Water Evaluation and Planning System
WSSD	World Summit on Sustainable Development

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INTRODUCTION

1. BACKGROUND TO THE ASSIGNMENT

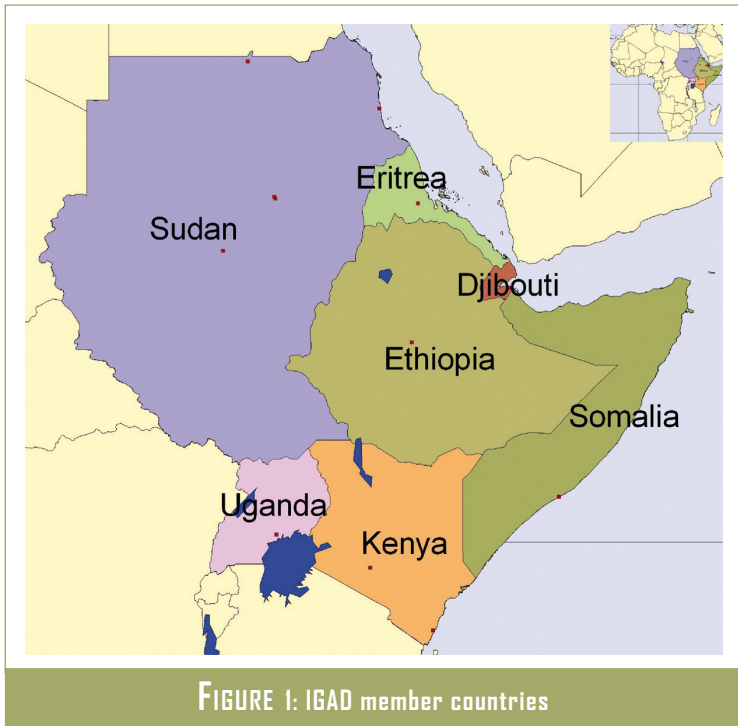
Following an international competitive bidding process by Sahara and Sahel Observatory (SSO), SEREFACO Consultants Limited was contracted to undertake this assignment on “Mapping, Assessment and Management of Transboundary Water Resources in the IGAD Sub-region Project Covering Djibouti, Eritrea, Ethiopia, Kenya, Somalia, Sudan and Uganda” (Fig.1). The main objective of this consultancy service was to assess and analyze the water resources, socio-economic and environmental condition of the sub region and come-up with a set of strategy, recommendations, and action plans to enable member states to implement and operate an integrated trans-boundary water resources management process. The project focused on acquiring data, information and knowledge to support more sustainable shared water resources management policies and strategies at national and sub-regional levels. The project was organised in three phases, namely;

- **Phase I:** Review, assessment, complementary data acquisition and analysis, and conceptualization;
- **Phase II:** Synthesis of the various components;
- **Phase III:** Planning and Implementation.

This Phase 3 report incorporates the outputs of the three phases.

It aims at presenting the major findings of the assignment and the proposed strategic recommendations and action plans thereof for moving forward with the implementation and operation of IWRM processes in the IGAD Sub-region. In particular, the report includes:

- A formulation of strategies for enhancing regional cooperation;
- A framework and guidelines for regional procedures and coordination mechanisms for information production, dissemination and sharing;
- An assessment of water resources in the IGAD Sub-region;



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- A socioeconomic assessment of water demand and use in the IGAD Sub-region;
 - An assessment of the key environmental issues affecting the IGAD countries;
 - Development of a regional database and GIS;
 - An elaboration of medium and long term capacity building strategies for planning and managing trans-boundary programmes;
 - The development of a road map for establishing a Transboundary River Basin Organization.

2. PROJECT DESCRIPTION

The Sahara and Sahel Observatory (SSO) is an independent international organisation composed of 21 African countries, four European countries, Canada, four sub regional African organisations (including IGAD), United Nations specialised organisations and NGOs. The Members States of SSO are: Algeria (AMU); Burkina Faso (CILSS); Canada; Cape-Verde (CILSS); Chad (CILSS); Côte d'Ivoire; Djibouti (IGAD); Egypt; Eritrea (IGAD); Ethiopia (IGAD); France; Germany; Guinea Bissau (CILSS); Italy; Kenya (IGAD); Libya (AMU); Mali (CILSS) and Mauritania (CILSS/AMU). Others are: Morocco (AMU); Niger (CILSS); Senegal (CILSS); Somalia (IGAD); Sudan (IGAD); Switzerland; The Gambia (CILSS); Tunisia (AMU) and Uganda (IGAD).

This project was financed by African Water Facility grant made available to IGAD for undertaking the study of the trans-boundary water resources of the sub-region excluding the Nile basin which is currently covered by the program of Nile Basin Initiative. SSO was the Client on behalf of IGAD in this assignment.

3. PROJECT RELEVANCE TO IGAD

The Inter-government Authority on Development (IGAD), founded in 1996, replaced the Inter-government Authority on Drought and Development (IGADD) founded by six African countries: Djibouti, Ethiopia, Kenya, Somalia, Sudan and Uganda in 1986. Eritrea became a member of IGADD (and now IGAD) in 1993 after attaining independence. The Executive Secretariat is located in Djibouti, where the organisation is headquartered.

The objectives of IGAD are to:

- Promote joint development strategies and gradually harmonize macro-economic policies and programmes in the social, technological and scientific fields;
- Harmonize policies with regard to trade, customs, transport, communications, agriculture, and natural resources, and promote free movement of goods, services, and people within the region;
- Create an enabling environment for foreign, cross-border and domestic trade and investment;
- Achieve regional food security and encourage and assist efforts of Member States to collectively combat drought and other natural and man-made disasters and their natural consequences;
- Initiate and promote programmes and projects to achieve regional food security and sustainable development of natural resources and environment protection, and encourage and assist efforts of Member States to collectively combat drought and other natural and man-made disasters and their consequences;
- Develop and improve a coordinated and complementary infrastructure, in the areas of transport, telecommunications and energy in the region;

-
- Promote peace and stability in the region and create mechanisms within the region for the prevention, management and resolution of inter-State and intra-State conflicts through dialogue;
 - Mobilize resources for the implementation of emergency, short-term, medium-term and long-term programmes within the framework of regional cooperation;
 - Promote and realize the objectives of the Common Market for Eastern and Southern Africa (COMESA) and the African Economic Community;
 - Facilitate, promote and strengthen cooperation in research development and application in science and technology.

4. SOCIOECONOMIC CONTEXT OF THE STUDY

The IGAD sub-region stretches over an area of 5.2 million km² and has a population of about 194 million people (2005) which is growing at an annual rate of 2.5% (1990-2007). About 80% of the sub-region is arid and semi-arid lowlands, receiving less than 400mm of rainfall per year. Global land use statistics indicate that farmlands constitute 7% of total land area, forests 19%, permanent pastures 28%, and other lands which apparently are not under productive use 46%.

The sub-region is one of the most vulnerable areas to climate variability and recurrent droughts, and suffers some of the worst effects of these environmental conditions that are exacerbated by its also being prone to conflict. These include high levels of poverty and food insecurity; low levels of human development; and social, economic and political inequalities among the people as well as among regions within the individual countries.

The shortage of renewable water resources is a serious threat to sustainable and balanced socio-economic development and environmental protection in the sub-region. Rapid population growth in the sub-region and the consequent encroachment of environmentally sensitive areas for crop and livestock production has set in motion a vicious cycle of:

- Declining fuel-wood supplies and increasing use of crop residues for fuel;
- Progressive land degradation and consequent reduction of soil fertility and crop yields;
- Worsening animal feed balance;
- Reduction of areas under fallow and greater exploitation of marginal areas;
- Disastrous floods.

The increasing demand for water and the rapid population growth necessitates a search for more reliable sources of water for crop production and for human and animal consumption. There is optimism in this direction. While the sub-region is one of the most vulnerable areas to climate variability and drought, it is endowed with potential water resources found in a number of trans-boundary river basins and aquifer systems, which are yet to be developed and exploited for socio-economic development and environment management purposes.

5. PROJECT OBJECTIVES

The main objective of this assignment service was to assess and analyze the water resources, socio-economic and environmental condition of the sub region and come-up with a set of strategy,

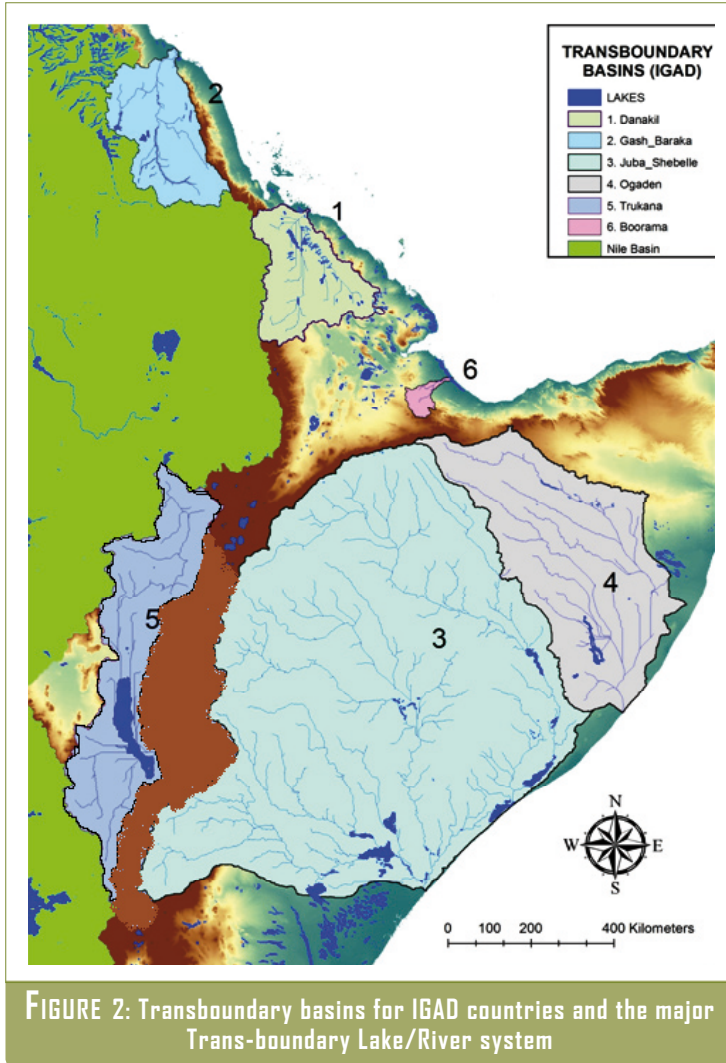
recommendations, and action plans to enable member states to implement and operate an integrated trans-boundary water resources management process. More specifically the Project outputs were aimed at contributing towards:

- Promoting IWRM principles in trans-boundary water resources (Fig. 2&3) within the IGAD Sub-Region;
- Producing reliable and easily accessible data and information for each shared water system that will serve as a basis for joint management of the water resources;
- Planning joint development of major priority trans-boundary aquifer basins that offer noticeable potential for water based development activities;
- Initiating arrangements for joint planning and implementation of trans-boundary water development activities within major trans-boundary water systems.

6. PROJECT COMPONENTS

In line with the above project objectives, the following were the main project components:

- Assessment and analysis of data, information and knowledge on water resources;
- Establishment of regional database and GIS;
- Socio-economic assessment and analysis;
- Environmental assessment and analysis;
- National and sub-regional capacity building for trans-boundary water resources management.



Code	Name of Aquifer	Sharing Countries
AF35	Upper Nile basin	Ethiopia and Sudan
AF36	Awash Valley Aquifer	Djibouti and Ethiopia
AF37	Rift Valley Aquifer	Uganda, Kenya and Sudan
AF38	Ogaden-Juba Aquifer	Ethiopia and Somalia
AF39	Mt. Elgon Aquifer	Kenya and Uganda
AF40	Merti Aquifer	Kenya and Somalia

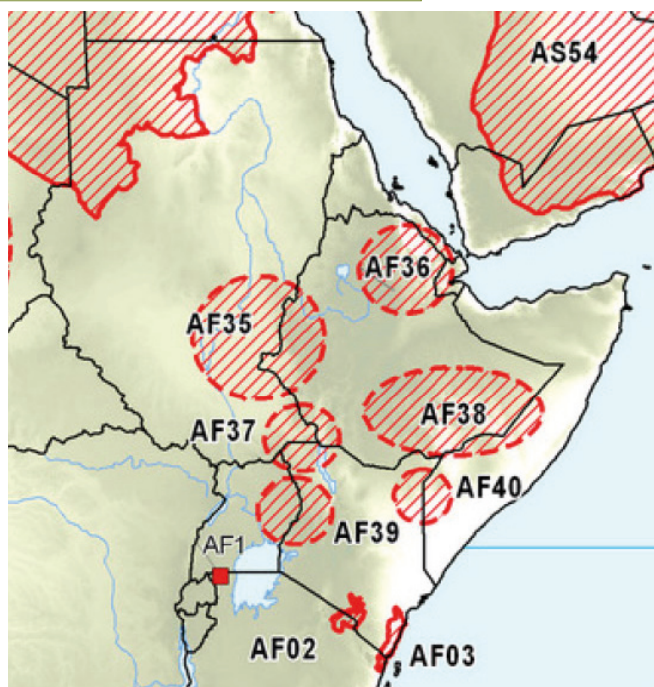


FIGURE 3: Major transboundary aquifers in IGAD sub-region
(Extracted from IGRAC, 2009)

COMPONENT SUMMARIES

1. SUMMARY FOR THE INSTITUTIONAL FRAMEWORK COMPONENT

The objectives of the Institutional Capacity Building Component of this Project are to develop a sustainable institutional framework for joint management of the shared water resources of IGAD Sub-Region, identify key management issues and development opportunities, develop a joint management strategy, and elaborate the medium and long term capacity building for implementation of the strategy, in order reduce poverty and conserve the environment on sustainable basis.

Information gathered from National Study Reports (2010), lessons learned from literature on international River Basin Organizations, and reference made to the relevant findings of other Components of this Project were made use of in understanding the characteristics of the river basins, the key development areas for regional cooperation, the disadvantages of non-cooperation, and the benefits that can accrue because of joint sub-regional actions.

National studies reviewed did not include specific studies on national institutional frameworks for water resources development and management of the seven countries of IGAD apart from the inclusion of scattered information and data under the studies targeting water resources, socio-economic, and environment. No

information and data were available on Eritrea and Somalia except those obtained from regional and international literature.

All the five countries have well established water resources development and management institutions with national policies, strategies, laws, and water master plans which have been undergoing regular reforms. They updated their old national policies and legal frameworks as well as their strategies and master plans for water resources development and management in late 1990s and in 2000s because water issues by then became the subject of increasing international concerns and debate. Besides environmental concerns and commitment to regional and international organizations to which each country subscribes, the member states appear willing and ready to collaborate on the development and management of their transboundary water resources.

The proposed legal instrument to be signed by the Member States agreeing on joint actions on the shared river basin will operationalize the monitoring, collection, generation, and sharing and exchange of data and information. Information and data for compilation, analysis, consolidation, and entry into database will flow from the Field Stations, through the National Basin Coordination Units (NBCU) to the Regional Basin Coordination Unit (RBCU) for transmission to the Regional Transboundary Basin Coordination Secretariat (RTBCS) located in IGAD Secretariat, before they can be disseminated to the clients and third parties. Flow of information and directives at policy level will move from the Summit of the Heads of State, through the Council of Ministers to the Commissioners and down through the RTBCS in IGAD Secretariat to the RBCU and to the NBRU and then to the Field Stations. All agents operating in the river basin shall report to the Field Stations. Categories of information and data for transmission

include those on water resources, climate and atmosphere, ecology and environment, land use and cover, socio-economy, recreation and tourism, infrastructure, natural resources, and agriculture and farming.

The policies of the Governments in the IGAD Sub-Region to promote industrial development including irrigation and to increase access to safe drinking water to majority of the population make freshwater, whether surface or underground, a focal issue in government strategies. This project has proposed measures to be undertaken and investments to be targeted to reduce the problems in the deficit areas of Ethiopia, Kenya, Somalia, Djibouti, Eritrea, Sudan, and Uganda. The private sector will become a key player in the water sector as realistic values are attached to freshwater.

Common vision, mission, broad objectives, policies, and strategies for the development and management of areas of common interest have been developed so that the following issues can be overcome or avoided altogether: (i) lack of a coordinated cross-sectoral and integrated approaches to problems and solutions at individual governments levels, (ii) increased conflict of interest among institutions and states, and (iii) duplication of efforts and waste of resources both at domestic and sub-regional levels.

The Shared Vision: *“Economically prosperous, socially just and environmentally sound transboundary basins for the benefits of the present and future generations.”*

The Mission: *“To promote and coordinate sustainable development, conservation, utilization, and management of water and related resources of the transboundary water basins for the mutual benefits of the people of the Sub-Region by implementing strategic programmes, projects and activities, and generating scientific data and information to guide policy decision making*

and implementation of any development programmes.”

The following **Strategic Elements were identified for the harmonization of strategies:**

- To ensure sustainable use of each of the shared river basin resources
- To preserve species of the shared river basins and the environment that are pristine or of ecological, social, and cultural significance
- To protect ecosystems, human health, and society from risks which occur as a consequence of human activity
- To develop areas and opportunities in the shared river basins and their environment that contribute to economic prosperity and social well-being while safeguarding ecological values
- To implement international instruments relevant to the management of the shared river basins and their environment.
- To communicate with stakeholders to raise public awareness, strengthen multisectoral participation and obtain scientific support for the sustainable development of the shared river basins and their environment
- To improve policy, institutions and legal processes
- To build human capacity to improve community livelihoods and responsible resource management

Capacity building is a continuous process reflecting the need of the society to respond to new ideas and technologies and changing social and political realities. The lack of adequate institutional capacities in the water sector in the IGAD countries, for joint development and management of shared water resources, is imposing severe limitation to water resources development and management.

Lessons learned indicate that capacity building programmes are more successful and are more likely to be sustainable when they respond to an internal initiative and when they are approached through a process approach and not as single one-time events. Capacity building must be provided to institutions and individuals taking on new roles and to improve awareness and knowledge.

The proposed capacity building strategic plans for water resources development and management will help the member states of IGAD to redefine their capacity building strategies, detailed programs, and required funding. The strategic plan must cover a sufficiently long period of implementation to deliver meaningful benefits. It will be designed as a medium-term action plan, broken down into annual action agendas and investment and recurrent budgets.

Sometimes in a regional set up like IGAD where there are seven (7) countries and six (6) shared river basin resources among them in the Sub-Region, the riparian countries of one or more river basins could decide to strike cooperative arrangements while others might not have the desire to cooperate. Under such circumstances, contingency plans of preparing separate institutional arrangements for the riparian countries of different shared river basins are in order.

The policy, legal, and institutional frameworks as well as, the common strategies and their key elements, the protocol for information and data sharing and exchange, and the plans for human and institutional capacity building are similar to that for the joint TRBO, and can be applied to a single or more shared river basin resources in the IGAD Sub-Region.

Development of a road map for establishing Transboundary River Basin Organization(s) (TRBO) includes the setting up of a

transboundary consultative mechanism, the RPSC and the Working Group, at IGAD level to implement the preliminary aspects for the establishment of the mechanism. Preparing the detailed action plan, negotiating and preparing the legal and implementation framework, and initiating the implementation process will be the major task of the Working Group under the supervision of the RPSC.

The proposed framework will be implemented in two stages. Initially, its Coordinating Secretariat will be housed within IGAD Secretariat as a dedicated mechanism for the development and management of the shared river basin resources. The Directorate will gradually be transformed into an independent functioning body, the “Commission” or “Organization” outside of IGAD Secretariat but within IGAD framework, after a period of five years.

The evolutionary process of the institutional framework will also aim at having one single Sectoral Council of Ministers for the TRBO to deal with all projects and programmes in any of the shared river basins.

Despite the gaps in data and information obtained from the national studies on existing national and regional collaborative frameworks, the data and information derived from other sources complemented them in facilitating the development, design, and elaboration of the frameworks for (a) information and data collection, generation, and dissemination, (b) strategies and the corresponding key elements for sub-regional cooperation and coordination, (c) institutional capacity building, (d) sub-regional coordination of development and management of transboundary river basin resources (e) a road map for establishing transboundary river basin organization in IGAD Sub-Region.

Policies, strategies, and objectives of cooperation and how to achieve them shall be set out in the proposed enabling legal instruments to be signed by the riparian Member States of IGAD to the agreement. This will include agreements on (a) the Status of the water resources, (b) exchange and sharing of information and data, (c) investment policies, (d) establishment of transboundary organization(s) for water resources development and management, (e) service providers and IWRM, (f) regulations for water quality, (g) regulations for water quantity, and (h) regulations on environmental standards.

The success of the proposed institutional framework will depend upon the Member States' enactment of legislative and policy changes, approval and refining the frameworks, provision of political support, involvement of stakeholders, and guiding the provision of support by development partners.

2. SUMMARY FOR THE SOCIOECONOMIC COMPONENT

2.1. Objective and scope

The overall goal of the socioeconomic component was to establish a better understanding of: (i) the socioeconomic condition of the sub-region with specific regard to factors that drive the pressures on water resources; and (ii) the demand and uses of water for various socioeconomic purposes, including a preliminary quantified assessment of water use for domestic supply, industry, and agriculture. The component provided the necessary path-way for an in-depth investigation of the factors that impact on water resources and their uses. This included a review of the existing information on water resources of the sub-region vis-à-vis uses and demands in current and future scenarios.

Several socioeconomic challenges have underscored the analysis of the water resources of the IGAD Sub-region and their uses. The sub-region's march on the path of economic, political and social progress is constrained by many pit falls, in particular: poverty and food insecurity; accelerated degradation of natural resources; environmental hazards that manifest themselves in frequent and severe droughts; and conflicts of various kinds - political, social, economic and religious. The countries of the sub-region have entered, or are entering, an era of serious water shortages, which raises the prospect of intensified competition for water in the future.

In addressing these underlying constraints, the socioeconomic component envisaged a two-way causal relationship between water resources (supply and demand) on the one hand, and the processes of socioeconomic development on the other. Thus, depending on the situation of abundance or scarcity, the current supply and access to water resources may positively or negatively impact on the socioeconomic processes in the sub-region. On the other hand, uncontrollable trends in the key socioeconomic parameters (e.g. population and economic growth) can place unsustainable demands on water resources through over-exploitation. The implied competition for a finite supply requires that a balance be struck between supply and the rate of exploitation (demand) to avoid undue limitations on human and socioeconomic progress of the sub-region. An evaluation of demand management strategies was therefore an important aspect of the component, and this has been achieved by way of a concept note which may form the basis of a more detailed proposal in future projects.

2.2. Component concept and strategy

The component used national reports as the building blocks for

the core tasks of sub-regional assessments, analyses and synthesis of data and information. These were significantly complemented and where necessary upgraded with complementary data and information from regional and international sources. To achieve the desired results more effectively, the study focused the assessment and analysis of water use in the most important water-using sectors (this was largely dictated by lack or inadequacy of data for the other sectors), namely water uses in the domestic, agriculture and industrial sectors.

Two models (Water Use Model and PODIUMSIM Model) were examined for potential application in the quantification, assessment and projection of water use. Both models provide tools for simulation of alternative scenarios of future water demand with respect to the variations of the key demand drivers. While the full application of the models was proscribed by insufficient data, they nonetheless provided the conceptual framework used in this study to work projections and scenarios of future water demand.

2.3. Key findings

Key results of the socioeconomic component included, firstly the detailed assessment of the key drivers of water demand in the sub-region, and secondly the projections of future water needs in various scenarios. The Table below summarises the results of the preliminary quantification of total current and future water withdrawals in various scenarios. Though based on a limited set of scenarios (principally irrigation water use scenarios), the Table offers “a vision” of an emerging future competition for water and how this might be managed through adjustment in agriculture water use.

Sector	2010 Withdrawals		2030 Withdrawals				2050 Withdrawals			
	Qty	%	SC 1		SC 2		SC 1		SC 2	
			Qty	%	Qty	%	Qty	%	Qty	%
Domestic	2.29	4.50	5.25	6.93	5.25	9.71	10.32	11.22	10.32	18.42
Industry	0.63	1.30	2.01	2.65	2.01	3.72	3.84	4.18	3.84	6.86
Agriculture	47.90	94.20	68.45	90.42	46.79	86.57	77.80	84.60	41.85	74.72
- Irrigation	46.13	90.70	65.57	86.61	43.91	81.24	73.94	80.40	37.99	67.83
- Livestock	1.77	3.50	2.88	3.81	2.88	5.33	3.86	4.20	3.86	6.89
Total	50.82	100.00	75.71	100.00	54.05	100.00	91.96	100.00	56.01	100.00
% total AWR	16.7%		24.9%		17.8%		30.2%		18.4%	

TABLE I. Summary of current and future water withdrawals by sector – 2010, 2030 and 2050.

The findings of the component reveal that:

- Overall water withdrawals are expected to increase substantially in the medium term (2030) and long-term (2050). The share of domestic supply will increase from 4.5% in 2010 to 9.7% in 2030 and to 18.4% in 2050. This is expected to reflect: (i) deliberate efforts by governments to accelerate access to potable water, and (ii) efforts to raise the level of household water security.
- The share of industry and livestock will also increase, reflecting efforts of governments to accelerate industrialisation and better targeting of improved water supply for livestock as a strategy for livestock development in the sub-region.
- The overall share of agriculture will decline, principally due to the declining share of irrigation withdrawals. This is predicated upon raising efficiency in irrigation water use (to 50% in 2030 and 60% in 2050) through improvements in irrigation technology and management.
- Water scarcity is looming over the sub-region and is a serious threat to any future plans for economic and social development. Countries of the sub-region will be critically water stressed by

2030, and the situation will reach life-threatening levels by 2050.

2.4. Main conclusions

While several factors will drive the pressures on water resources, population and its dynamics will be the primary driver of all demands, including water demand. High population growth is outstripping the pace at which water resources are being developed to meet the various socioeconomic needs of the sub-region. Associated with this is the low and unbalanced funding of the water and sanitation sector, with the tendency to concentrate water infrastructure in the urban centres and giving lower priority to rural areas.

The water issues of the sub-region are exacerbated by the fact that over 75% of the sub-region is classified as ASAL – these areas which are mostly water stressed and have low agricultural potential.

The impact of population on water resources will be at two levels:

- At the level of domestic water supply where pressure will be exerted to provide more water from both existing and new water sources as governments accelerate the achievement of the MDG goals for access to clean drinking-water in quantities that meet domestic water security needs; and
- At the level of agricultural water withdrawals, primarily for irrigation but also for livestock – the increased demand for food will put pressure on agricultural resources including land and water. The imperative to raise agricultural productivity to meet increased food demand will call for expansion of irrigated agriculture areas.

But as rain-fed agriculture continues to occupy a commanding place in the overall production system of the sub-region and cannot

be wholly replaced with irrigation, it will be equally imperative to continue to accord the priority it deserves as it will continue to account for over 50% of cereal production. However, the focus should change from area expansion to improved management of “green water” in rain-fed agriculture.

2.5. Main recommendations

(1) On population and its impacts on water demand:

Institute the collection and sharing of data and information on the impacts of population growth on water resources of the transboundary basins in the sub-region; and advise member states and share data and information on population movements in transboundary basins including cross-border ASAL zones. Other measures are: (i) accelerate the MDG targets and quantitative access targets to realise household water security; (ii) invest in new water resources development, focusing in rural areas and the ASAL zones; including new technologies for securing water supply and sanitation such as water harvesting, storage and purification suited to poor households.

(2) On adjustment of water demand and food security:

(i) Specific surveys should be undertaken to update information on irrigation schemes in transboundary basins; (ii) Improved water use and management technologies be prioritised in existing and planned irrigation programmes; (iii) Emphasis should be given to promoting technologies to improve water management in rain-fed agriculture; and (iii) Irrigation policies and programmes must be underpinned by effective and active research and extension support.

(3) On data and data sharing:

(i) The conceptual framework and

findings of the socioeconomic component could form the basis of comprehensive baseline surveys of transboundary basins and sub-basins; (ii) the surveys should focus on an exhaustive collection of data on water users and their appropriate characterisation including domestic, agriculture, livestock, industry, environment, infrastructure, tourism & wildlife, etc; and (iii) the benefits of data and information sharing should be actively promoted: such benefits include empowerment and improved negotiation capacity; enhanced inter-state relationships; and improved administrative routines – for instance planning and decision making, improved communications among linked groups, etc.

3. SUMMARY FOR THE ENVIRONMENTAL COMPONENT

This Phase 3 Environmental Component Report is the culmination of the assignment that took a team of six Specialists to prepare. The Report is a self-contained document i.e. all the information in the other reports – Phase 1 and Phase 2 – is fully reflected in this report; one does not need to refer to the other reports in order to use this Report. The Report includes coverage and analysis of Eritrea and Somalia on top of the other IGAD countries.

The report is built out of three key environmental thematic areas: 1) drought and desertification; 2) flooding and erosion risk and 3) water quality and pollution. These three areas were covered at national and sub-regional levels, meaning that the volume contains analysis of each of the 7 IGAD Member States and a general sub-regional analysis for each thematic area.

The basic documents for study were the national reports prepared for the SSO Project by consultant; the National Adaptation Programmes of Action prepared by each State for the UNCCD; the Initial National Communications to the UNCCD prepared by each

State and a raft of general information obtained from a number of portals.

Eritrea and Somalia were only included in the Study at the Validation Workshop for Phase 2 and it was a challenge to prepare an analysis that reached the levels for the other IGAD countries. We were however not able to obtain full information and data on some of the areas that were critical for the progress: both Eritrea and Somalia did not have National Environmental Reports in the three thematic areas. The available information inadequately covered the thematic areas. Somalia has not prepared a NAPA or even the Initial Communication documents. However, the SWALIM website proved to be a valuable source of information on Somalia.

The depth and breadth of the information in this report, being largely one of literature review, can only be as good as the sources that are quoted herein. The transboundary aspects of the Study were not dealt with to the required depth since there was a shortage of information on the basins from the National Focal Point Offices. There is virtually no transboundary analysis in the reports so far studied, much less modelling of the effects of the three scenarios over the next few decades. The models given in the reports are those for greenhouse gases and climate change and variability; even this is not consistent in quality and quantity.

Large areas of the IGAD sub region are arid, semi-arid or desert with more than 50% of their land mass regarded as arid or semi-arid in some of the countries. The impacts of climate change and variability are therefore felt directly by these countries, especially the most vulnerable rural populations. The arid and semi-arid lands (ASALs) are mainly inhabited by the itinerant pastoralists and nomads, some of who combine pastoralism with agriculture.

However their habitats are being denuded of vegetation – especially the forests – leading to wider environmental impacts such as land degradation, reduction in ground and surface water resources, pollution of the soils and waters, increased soil erosion and failure by the ecosystems to perform their roles in a sustainable manner.

The rapid population growth and poor socioeconomic structures in these countries make the future bleak for the vulnerable populations. In the case of Somalia, the extended civil conflict and the devastating flash floods combine to wreak havoc on the helpless population in the rural areas. Even the more peaceful north suffers from the flash floods which strike even after little rains due to the inability of the soils and terrain to absorb and retain rainwater.

The mitigation actions for these flash floods include the setting up of storage facilities for the rainwater in dams, rainwater harvesting tanks and by reducing the slopes of the hillsides.

Pollution of water is increasing in all the IGAD countries at an alarming rate. For countries such as Eritrea, Somalia, Djibouti, Sudan and Kenya, where the exploitation of groundwater to sustain life in the ASALs is practised on a large scale, salinisation of water sources has been experienced. The same effects are also felt in the large irrigation projects in Sudan, Kenya and Ethiopia – the methods used for much of the irrigation easily create water logging and salinisation of the soils.

The IGAD region is experiencing a surge in oil discoveries and will face the problems of increased pollution from exploration and exploitation of oil from the countries. Sudan is already experiencing severe problems with produced water during the exploitation of oil while Uganda is soon moving to the stage of producing oil in the Albertine Graben of Western Uganda.

4. SUMMARY FOR THE GIS/DATABASE COMPONENT

The objective of the sub-component was to create the DB that will facilitate easy information access and exchange between the IGAD member countries.

The major activities of the component have been to carry out the analysis of required entities and attributes for DB development, defining entity relationship model at Conceptual level and thereafter to carry out DB installation and testing, data conversion and semantic translation, data input into the database and data output generation.

In addition, assessment of the suitability of the available data in the national reports has been made. Since the database cuts across all the sub-disciplines, the summary has been restricted to the quality aspects of the data in the reports. It is assumed that the adequacy and relevance aspects of the data will be addressed in the specific sub-discipline assessment reports.

By the end of the project, all the activities have been accomplished, with a regional DB built. The DB built included both identification and variable data/information on borehole, shallow wells, Meteorological, hydrological and river gauging stations. In total, 83,064 (Eighty three thousand and sixty four) water points have been input the regional DB.

Data provided were quite heterogeneous, different formats and semantics. The variation in data semantics was minimised greatly, but some still exist due to lack of basic meaning of those water points, example is “Source” of Djibouti and 1st class water points of Eritrea. This requires the intervention of coordinators in those countries.

Heterogeneous of the data was eliminated completely by converting all the data to Microsoft excel and thereafter importing it in Microsoft access. However, in the process of harmonizing it, some of the data fields were left out as they could not fit in the data structure.

The major shortcomings encountered during data compilation and analysis was as follows;

- Coordinates; 29% of the water do not or have wrong coordinates. This excludes them from being spatially plotted and visualised in GIS. This shortcoming is very hard and complicated to overcome without involving the Coordinators from member countries. This will be eliminated continuously when updating the DB whenever coordinates of those points are availed.

- Duplication; almost all countries had duplicates in their datasets. This was a very serious setback removing them. Duplication was in all forms (identifier, coordinates, source names, source codes) but majority were duplicated by identifier. Those which were duplicated by all forms were eliminated from the DB and those which were duplicated by identifier were given another unique identifier.

- Lack of Identifier; most data did not have identifier key. However, these were created, an example is x_Eth_1 (meaning x=No identifier key, Eth=Ethiopia, 1=water point 1). Apart from Uganda borehole identifier (WDD or DWD), other countries had normal numbers as the identifier key. This would make the water point to be duplicate basing on identifier yet they are not. And in the process the identifier key would not be made a primary key. This was overcome by creating a unique key from the normal number, an example 10000_Eth (10000= normal number which was used as identifier in the country and Eth=Ethiopia).

■ Lack of important field; for example most water points do not have the “status” field, one cannot easily identify the non functional from functional borehole in one administrative unit. This would be very misleading especially in spatial distribution of water point maps and in decision making in future if say one is following the spatial distribution.

The data conceptual model was adopted from OSS 2007, and involves the inputting all the data available and developing the data structure. It also required understanding of the following: Information sets (entities), the nature of the existing links between these sets, the management guidelines associated with these entities

The following planned rules were set which synthesises the entities and the relations:

- A borehole can pick up 1 or many aquifers.
- A borehole at a given date provides a given yield.
- A borehole can serve many users.
- A user can be supplied by many boreholes.

All water points with coordinates were plotted in ARCGIS 9.3, projection GCS-WGS 84 and for demonstration purposes most maps have been inserted in this document.

5. SUMMARY FOR THE WATER RESOURCES MODELLING COMPONENT

The work involved data collection, hydrological model set-up, identification of the most sensitive model parameter, model calibration and sensitivity analysis for the IGAD trans-boundary basins. The main output of the strategy was a clearer understanding

of the hydrological response of several IGAD catchments and the potential use in terms of solving controversies surrounding fluctuating stream flows and Lake water levels, sustainable agriculture, rural development, hydropower generation and environmental stewardship.

The Water Resources Modelling section conceptualized and developed of a hydrologic model for water resources assessment of the identified transboundary basins in the IGAD region. This involved close collaboration with the GIS/Database expert for effective preparation, presentation and archiving of water resources and hydrologic data in the agreed format. Substantial knowledge of GIS was required by the potential participant of the water resources modelling modules. In terms of software requirements, ArcGIS was also required for hydrological models setup/simulation of the water resources modelling component. Several meteorological datasets were acquired for effective modelling; however, the continued lack of daily stream flows still limited the effective calibration of the delineated hydrological IGAD basins. Several attempts were carried out to ensure effective estimation of the Water resources for the IGAD basins.

A basin-wide summary of the simulated water resources components was presented to give a general insight into the water resources components for IGAD transboundary basins. Additional data especially daily stream flows at several locations in the basin, are required to improve the water resources simulation. The available hydrological and climatological data from the IGAD databases revealed large deficiencies, especially regarding daily observations - a number of observations are missing. Furthermore the available data from other sources were sparse and not free of errors. The climate in the IGAD basin is rather complex and for accurate use of hydrological models, representative precipitation

sequences may be required. For the IGAD hydrological basins, evaluation of the hydrological performance of the SWAT model on a daily/monthly time resolution should reveal the hydrological patterns and the sensitivity of hydrological variables to input rainfall datasets and parameter estimates. A simple sensitivity study helped reduce the dimensionality of the calibration challenge.

The results of the Water Resources Modelling/Hydrology component of this study represent a first attempt to comprehensively model the water resources of the 6 transboundary river basins in the IGAD Sub-region. For most of the basins, the estimated available annual water resources were in good agreement with results from other studies (for example those by the FAO Water Resources Project). This was the case for Danakil, Gash-Baraka, Turkana-Omo and Ayesha. The estimates for Juba-Shebelle and Ogaden exhibited wider discrepancies with the FAO estimates. However, the estimates were based on data available to the consultant at the time of the study. As noted in the report and elsewhere, the datasets were limited in both temporal and spatial terms. In particular, model calibration requires the availability of reliable flow data for major rivers within the basins. These data were not available for the current study. As such the estimates for all basins need further investigations before they can be used as a basis for comprehensive decisions about the basins. There is need for collection of additional data from the member countries as soon as a mechanism for data sharing can be implemented. The absence of an IGAD level data sharing protocol may be one of the reasons why some countries could not avail their data to the consultant.

There is also a need for installation of new data collection stations in the transboundary basins. At present, the IGAD basins have limited capacity in terms of gauge network for hydrometeorological monitoring and operations and each country should have

additional capacity for effective operation of the designed hydrometeorological networks. Once the networks are setup, it should be ensured that all stations have complete installation of equipment to

Basin	Surface water	Groundwater
Danakil	1.0	0.6
Gash-Barka	2.8	1.4
Juba-Shebelle	64.6	43.7
Ogaden	14.1	6.5
Turkana-Omo	28.7	19.3
Ayasha	0.1	-
Total	111.3	71.5

TABLE 2. Simulated estimates of available water resources (km³) for the IGAD transboundary basins.

guarantee effective monitoring of hydrological events. New equipment for measuring both climatic and hydrologic variables is needed to complement the limited data available in the countries. The proposed coordination mechanisms for data collection, transmission and storage are documented in the Institution Component report. IGAD should establish a capacity building component especially in fields related to water resource modelling and this should be done in a way that member countries create opportunities for cooperation in water resources assessment at sub-regional levels. To ensure effective data collection for all the IGAD member countries, several programmes that support effective data collection and monitoring should be implemented and these should as well ensure mechanism for data achieving and sharing among IGAD member countries.

6. SUMMARY FOR THE IWRM COMPONENT

The water resources management challenges of IGAD countries are many and tend to have cross-border implications. They include; endemic poverty, rapidly growing populations, desertification, highly variable rains that affect rainfall and frequently cause droughts, famine and starvation, land degradation due to

deforestation, civil strife. Implementing IWRM in transboundary basins provides a viable mechanism for addressing the challenges. The concept of IWRM is represented by its principles which provide a backbone to the process of preparing transboundary water management plans. They define the need for conserving the water resources, importance of a participatory approach to water resources development and management, the role of women in water resources provision and management and the economic value of water.

The modelling of water resources management in the IGAD region is challenging. Water resources are sparsely distributed in space and highly variable in time. Additionally, data on water demand and usage are scarce and can be unreliable in areas where they exist. The WEAP model was used for modelling water resources management in many regions around the world. It provides a means of analysing the effect of policies interventions (both structural and non-structural) on water resources availability and demand in a region. The model was successfully developed for 6 transboundary basins in the IGAD region. The demand and supply data used were based on the socioeconomic and water resources modelling studies (see table below). The possible use of the models in testing the effect of alternative water management scenarios was investigated. The main idea behind the development of the models was the models will evolve over time as more information about water resources, demand and other policy issues becomes available.

The model was set up for a base year of 2011 while simulations were carried out for 20 years ending in 2031. Initial water resources scenario assessments showed that all basins have considerable water resources which, if well managed, can serve the needs of the basin inhabitants. The annual water resources and

water demand estimates for 2011 and 2031 are shown the table below. It is generally clear from the table that the available water resources in the basins are sufficient to meet current and future demands. The ratio of water demands to available supply averages only 9% in 2011 to 15% in 2031. The problem is one of spatial and temporal variation in water availability. The rivers mainly flow during the wet season which lasts only 4-5 months between June and October annually. The other 7-8 months are generally dry with many of the rivers drying up. This generally implies that, to meet the projected demands, investment in water storage (in form of dams and reservoirs) is inevitable. Some preliminary estimates of required storage were computed. The estimates need further refining as more data becomes available.

Basin	Available water resources (x 10 ⁶ m ³)		Domestic demand (x 10 ⁶ m ³)		Agriculture demand (x 10 ⁶ m ³) - 2011	Total demand (x 10 ⁶ m ³)	
	Surface water	Ground water	2011	2031		2011	2031**
Juba-Shebelle	64,600	43,700	578	1,054	1,192	1,770	2,824
Turkana-Omo	28,700	19,300	707	1,293	680	1,387	2,680
Gash-Barka	2,800	1,400	53	225	225	278	503
Danakil	1,000	600	52	99	60	112	211
Ogaden	14,100	6,500	91	165	310	401	566
Ayasha	123	-	4	7	0	4	11
Total	111,323	71,500	1,485	2,843	2,467	3,952	6,795

** Irrigation demands assumed at 2011 values. For total demands including irrigation demand projections, see the specific scenarios in the main report.

The following recommendations can be drawn from the IWRM modelling study

- a) The implementation of IWRM is complicated by lack of political will, lack of institutional and legal tools and also lack of human resources capacity. There are many international organisations with experience in supporting developing countries to start the process of IWRM implementation. These include Global

Water Partnership, UNESCO, UNDP, Cap-Net, IWMI, UNEP and others. These organisations should be brought on board as early as possible to share their experiences and also support the implementation of IWRM in the transboundary basins of IGAD.

- b)** The IWRM models were built from the data available at the time of analysis. More detailed analysis will require further data collection concerning water demands and demand growth rates including specific information about planned future developments in the water sectors of the IGAD sub-region. In particular, livestock water demands represent a significant water user in the IGAD countries but data on this were not available.
- c)** The IWRM models were built in such a that further refinements can be made by users. WEAP model can be used for a range of applications including scenario assessment, impacts of climate change, irrigation management, water supply modelling, etc. Training of model users will help in ensuring that the use of the model is integrated in their daily work and a critical mass of professionals can be built to implement the model at Transboundary basin level.

3

OVERALL CONCLUSION

The major conclusions and recommendations from each of the project components are listed below

1. INSTITUTIONAL FRAMEWORK COMPONENT

Despite the gaps in data and information obtained from the national studies on existing national and regional collaborative frameworks, the data and information derived from regional and international literature on transnational shared water resources development and management complemented them in facilitating the development, design, and elaboration of the required frameworks for creating and establishing Transboundary River Basin Organization for the Member States of IGAD. These include the frameworks for (a) information and data collection, generation, and dissemination, (b) strategies and the corresponding key elements for sub-regional cooperation and coordination, (c) institutional capacity building, (d) sub-regional coordination of development and management of transboundary river basin resources (e) a road map for establishing transboundary river basin organization in IGAD Sub-Region. Refinement of the frameworks will entail visits to the Member States of IGAD for more detail consultation with senior officials in the concerned national institutions.

Policies, strategies, and objectives of cooperation and how to achieve them shall be set out in the proposed enabling legal

instruments to be prepared and signed by the riparian Member States of IGAD to the agreement. This will include agreements on (a) the Status of the water resources, (b) exchange and sharing of information and data, (c) investment policies, (d) establishment of transboundary organization(s) for water resources development and management, (e) service providers and IWRM, (f) regulations for water quality, (g) regulations for water quantity, and (h) regulations on environmental standards. A technical drafting committee will be appointed to prepare the final protocols under the supervision of the RPSC for approval by senior officials, Council of Ministers, and the Heads of State of the member countries.

The success of the proposed institutional framework will depend upon the Member States' enactment of legislative and policy changes, approval and refining the frameworks, provision of political support, involvement of stakeholders, and guiding the provision of support by development partners.

2. SOCIOECONOMIC COMPONENT

The socioeconomic component of the MAM-TWR project has focused on creating an understanding of the water demand for various socioeconomic needs including quantified assessment of water use for domestic supply, agriculture, livestock, industry, recreation, ecology, etc. This was achieved, firstly, by detailed assessment of the key drivers of water demand in the sub-region, and secondly by projecting future water needs in various scenarios (principally assumptions on irrigation efficiencies).

The table below summarises the results of the preliminary quantification of total current and future water withdrawals in various scenarios.

Sector	2010 Withdrawals		2030 Withdrawals				2050 Withdrawals			
	Qty	%	SC 1		SC 2		SC 1		SC 2	
			Qty	%	Qty	%	Qty	%	Qty	%
Domestic	2.29	4.50	5.25	6.93	5.25	9.71	10.32	11.22	10.32	18.42
Industry	0.63	1.30	2.01	2.65	2.01	3.72	3.84	4.18	3.84	6.86
Agriculture	47.90	94.20	68.45	90.42	46.79	86.57	77.80	84.60	41.85	74.72
- Irrigation	46.13	90.70	65.57	86.61	43.91	81.24	73.94	80.40	37.99	67.83
- Livestock	1.77	3.50	2.88	3.81	2.88	5.33	3.86	4.20	3.86	6.89
Total	50.82	100.00	75.71	100.00	54.05	100.00	91.96	100.00	56.01	100.00
% increase	0.0		149%		106%		121%		104%	

TABLE 3. Summary of current and future water withdrawals.

The following conclusions may be made from this Table:

- a) Total water withdrawals are expected to increase from about 50.8 Km³ in 2010 to about 75.7 Km³ in 2030 and to 92 Km³ in 2050 under irrigation scenario 1 for both years. Under the second irrigation scenario total withdrawals will increase to 54 Km³ in 2030 and 56 Km³ in 2050. The lower figures in the second scenario are due to implementation of improved technologies and efficient management of water in irrigation schemes.
- b) While several factors will drive the pressures on water resources, population and its dynamics will be the primary driver of all demands, including water demand. The impact of population on water resources will be at two levels: (i) at the level of domestic water supply where pressure will be exerted to provide more water from both existing and new water sources; and (ii) at the level of agricultural withdrawals, primary for irrigation but also for livestock – the increased demand for food will put pressure on agricultural resources including land and water.
- c) The overall share of agriculture water will decline over the years under all scenarios, on account of the rapidly increasing share of domestic supply and industry. This will result from a

combination of: (i) measures to achieve the MDG goals for access to clean drinking-water in quantities that meet domestic water security needs; (ii) measures for accelerated industrialisation in the sub-region; and (iii) measures to improve water use efficiency in irrigation schemes.

Data limitations were paramount in achieving the aims of the socioeconomic component. For instance, this prevented effective assessment of water use in the different components and sub-components of water-using sectors, which was the initial objective of the TOR. The separate assessment of the sectors revealed serious gaps in the level and availability of data on such key sectors as industry, livestock, environment, energy, tourism and wildlife, amongst others.

Despite the data and other limitations, the overriding conclusion is that, following these assessments the MAM-TWR project is now in a better position to initiate a strategy and action plan for developing and building a comprehensive socioeconomic database on the transboundary water resources of the sub-region. This would improve the conceptual and empirical basis for planning and managing the water transboundary water resources of the sub-region.

3. ENVIRONMENTAL COMPONENT

The key conclusions from the Environmental Component are:

1. Drought, desertification and land degradation are serious threats to nation states in all the IGAD countries. Although these impacts are caused by the global effect of climate change, there are many activities that the individual countries can do individually and collectively to combat these threats. The

main vehicle for collective action is IGAD and the international environment conventions to which most of the countries are signatory to.

The countries must therefore join the environmental conventions which are beneficial to them under the IGAD umbrella.

2. Coping with drought, desertification and land degradation is critical to the survival of the nomads and pastoralists of the region; they are the most affected of the communities since their options for survival are limited.

The pastoralists and nomads are the most vulnerable people and urgent actions should be carried out to enable them cope with the severe impacts of climate change.

3. Water dependent agriculture is important in the region; however the potential for irrigation needs to be exploited to create more opportunities for efficiency of water use. However, the lessons from the failed and inefficient irrigation schemes in the region should be taken up by the regional and national bodies so that the known problems can be avoided in the design of the new schemes.

Irrigation should be adopted in the IGAD region but IGAD should coordinate studies to ensure that the lessons learned from the failed or inefficient irrigation schemes in the region are not repeated.

4. Wetlands occur along the coastal areas of Kenya, Somalia, Eritrea and Sudan and also inland in Kenya, Uganda and Ethiopia. Conservation of these wetlands is critical for the environment since they provide environmental services and are refuges for many endangered species. Encroachment and

degradation of wetlands needs to be addressed nationally and in a transboundary manner to ensure that actions are acceptable to all the transboundary states. International agreements such as the Ramsar Convention provide a platform for concerted conservation actions.

Protection of wetlands should be a major focus of IGAD since these wetlands are refuges for endangered species and are unable to provide services if they are not sustainably managed. All the countries should join the Ramsar Convention and ensure that they get the available technical support from the organisation.

5. The IGAD countries have all prepared national action plans to combat environmental impacts; funding of these NAPAs is to be provided through international bodies such as the UNCCD. However, national efforts are critical in planning and implementing the projects that are approved. These require national capacity to carry out the interventions as well as improved policy, legal and institutional frameworks.

IGAD should coordinate the financial and technical support to the countries from UNCCD and other international bodies. Where there are transboundary environmentally sensitive areas, IGAD should be more involved to increase cooperation and build synergies.

6. Water and environmental pollution is a significant problem in all the countries. Significant actions are required in order to contain pollution from urban centres: most of the large towns do not have centralised sewerage systems and rely on on-site methods such as septic tanks and pit latrines which pollute the environment, especially the groundwater. However, sewerage systems are costly to construct and also to maintain. Most of

the even the existing ones are now failing. There is a significant issue of pollution from the exploration and exploitation of oil in some of the countries. This is still a growing sector, but its impacts can be large and widespread.

There should be concerted actions to improve on the sewerage and sanitation systems in the urban centres in IGAD countries. The pollution problem from oil exploration and exploitation should be handled at an early stage since more of the IGAD countries are starting to exploit oil reserves.

4. GIS AND DATABASE COMPONENT

The setting up of an IGAD common DB made it possible to bring in the set of all available regarding water resources management and make them more homogeneous and coherent.

However, given that the source of this data being heterogeneous (word document, excel, pdf, maps etc), this required was diversely analysed and processed before adapting them to a common structure. Thus a harmonised DB with a standard structure was made for the IGAD sub-region.

The shortcomings which were encountered during the data capture were as follows:

- About 29% of the water points input in the DB are still without coordinates and wrong coordinates, this requires the attention of coordinators from IGAD member countries;
- There was much duplication however, these were deleted except for those which were not easy to eliminate because of some indifferences from some of the fields; So duplication was minimised greatly.

■ There are still many uninformed fields; this uninformed could have been neglected when they were compiling country reports thinking that they were not necessary. This create gaps in the BD, however, this can continuously be fielded/updated as one gets the information

■ Some very important field like status are missing yet these would help in spatial distribution analysis.

■ Variation in semantics was greatly reduced, though not removed completely, due to lack of the local knowledge of the meanings of some water points, especially water points from Djibouti and Eritrea. This surely requires the intervention the coordinators in the IGAD member countries.

■ Lack of identifier keys; Special identify keys were created for all water points which did not have them.

The regional DB made will require continuous updating to fill in the gaps and with ne data to eliminate completely the above mentioned shortcomings so that it can fully be a functional and sustainable DB.

With continuous collection of data and updating this DB, there will be a need to upgrade this DB. This is because at present, Microsoft Access which is easily accessible and available to all countries, have been used. But with the collection and input of more data this DB might be small, as in Access you can only input 2GB size, beyond which a new one has to be developed.

There were no specific requirements for the DB for the member countries apart from storage, but with continuous sensitisation and filling in the gaps, the DB will be useful for modelling the water coverage, water needs/shortage and excess and for planning purposes in the member countries.

In addition, the DB will facilitate easy information access and exchange between the IGAD member countries.

Capacity building is the requirement for the sustainability of this great work for the personnel who is going to handle and help in disseminating the information in GIS and DB. The training requirements will be basics of DB and GIS in relation to water resources management. The trained personnel will also help in routine updating of the DB and GIS. In addition he/she should be trained in basics of software and hardware for GIS and DB.

To be able to collect, store, archive and retrieve all the data collected in the IGAD secretariat, a GIS and BD section should be established at IGAD Secretariat, with well equipped GIS software and high speed computer.

5. WATER RESOURCES MODELLING COMPONENT

The work involved data collection, hydrological model set-up, identification of the most sensitive model parameter, model calibration and sensitivity analysis for the IGAD trans-boundary basins. The main output of the strategy was a clearer understanding of the hydrological response of several IGAD catchments and the potential use in terms of solving controversies surrounding fluctuating stream flows and Lake water levels, sustainable agriculture, rural development, hydropower generation and environmental stewardship.

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resources and hydrologic data in the agreed format. Substantial knowledge of GIS was required by the potential participant of the water resources modelling modules. In terms of software requirements, ArcGIS was also required for hydrological models setup/simulation of the water resources modelling component. Several meteorological datasets were acquired for effective modelling; however, the continued lack of daily stream flows still limited the effective calibration of the delineated hydrological IGAD basins. Several attempts were carried out to ensure effective estimation of the Water resources for the IGAD basins. A basin-wide summary of the simulated water resources' components was presented to give a general insight into the water resources components for IGAD transboundary basins.

Additional data especially daily stream flows at several locations in the basin, are required to improve the water resources simulation. The available hydrological and climatological data from the IGAD databases revealed large deficiencies, especially regarding daily observations - a number of observations are missing. Furthermore the available data from other sources were sparse and not free of errors. The climate in the IGAD basin is rather complex and for accurate use of hydrological models, representative precipitation sequences may be required. For the IGAD hydrological basins, evaluation of the hydrological performance of the SWAT model on a daily/monthly time resolution should reveal the hydrological patterns and the sensitivity of hydrological variables to input rainfall datasets and parameter estimates. A simple sensitivity study helped reduce the dimensionality of the calibration challenge.

Given the significant lack of hydrological and Meteorological data required for water resources monitoring and modelling, it is recommended that through out the entire IGAD trans-boundary basins, weather stations should be deployed after an appropriate

study of where each station should be installed. A recommended source of such hydro-meteorological equipment can be attained from <http://www.geonica.com/index.php>, However, a separate study is recommended to show explicitly where to install such systems.

6. IWRM COMPONENT

The model was set up for a base year of 2011 while simulations were carried out for 20 years ending in 2031. Initial water resources scenario assessments showed that all basins have considerable water resources which, if well managed, can serve the needs of the basin inhabitants. The ratio of water demands to available supply averages only 9% in 2011 to 15% in 2031. The problem is one of spatial and temporal variation in water availability. The rivers mainly flow during the wet season which lasts only 4-5 months between June and October annually. The other 7-8 months are generally dry with many of the rivers drying up. This implies that, to meet the projected demands, investment in water storage is inevitable. Some preliminary estimates of required storage were computed.

More detailed analysis will require further data collection concerning water demands and demand growth rates including specific information about planned future developments in the water sectors of the IGAD sub-region. In particular, livestock water demands represent a significant water user in the IGAD countries but data on this were not available.

The IWRM models were built in such a that further refinements can be made by users. WEAP model can be used for a range of applications including scenario assessment, impacts of climate change, irrigation management, water supply modelling, etc. Training of model users will help in ensuring that the use of the model is integrated in

their daily work and a critical mass of professionals can be built to implement the model at Transboundary basin level.

4

KEY AREAS ADDRESSED, KEY FINDINGS, LESSONS LEARNED AND STRATEGY RECOMMENDATIONS

Based on the project terms of reference, the main findings and recommendations of the assignment are summarised in the table below.

These are related to the key areas/issues addressed which are grouped as follow, covering the different thematic for Water resources management in the IGAD sub-region:

1. Establishment of transboundary river basin organization
2. Road map for establishing transboundary river basin organization.
3. Develop Common monitoring and information sharing network at sub-regional level; Procedure and mechanisms for coordination of information production and dissemination; Protocol for exchange and sharing of information/data
4. Harmonisation of water sector strategies between riparian countries; key elements of the strategy
5. Medium and long term capacity building strategies for planning and managing trans-boundary programmes
6. Key socioeconomic processes and trends that drive the pressures on water resources (demand and supply)

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7. Scenarios of water demand and use in the sub-region
 8. Demand management strategies
 9. Identification of the major trans-boundary river basins and aquifers systems of the sub-region
 10. Assessment of surface and groundwater resources potential
 11. Identification of key data collection points and hydrological equipments
 12. Identification of sources and formats of information available for database formation
 13. Establishment of a database structure, database and GIS development
 14. Water resources management issues in IGAD sub-region
 15. Capacity for planning for water resources management
 16. Elaboration of IWRM model and its components in light of the transboundary basins
 17. IWRM model for transboundary basins
 18. Impact of drought and desertification in the region
 19. Impact of flooding and erosion
 20. Water pollution

No.	Key areas/issues addressed	Key findings/ results	Lessons learned	Policy and strategy recommendations	Action plan
1.	Establishment of transboundary river basin organization	Sub-Regional framework developed with National Committee reporting to a Commission based in IGAD Secretariat that reports to Sectoral Council of Ministers which is advisory to the IGAD Council of Ministers that reports to the Heads of State.	<ul style="list-style-type: none"> The need for joint action in the development and management of water resources in the IGAD countries exists. This is in accordance with the cooperative arrangements being promoted by IGAD in its strategies for the development and management of natural resources. Many other river basin organizations exist with useful experiences that can be drawn upon. 	<ul style="list-style-type: none"> The road map developed for the proposed framework should be operationalized. The benefits accruing from establishing the framework are greater than if no management framework existed. 	<ul style="list-style-type: none"> Set up a consultation mechanism for establishing the transboundary river basin organisation. The Protocol for establishing the framework should be prepared. The structure should be set up. Development plans should be prepared. Implementation should start.
2.	Road map for establishing transboundary river basin organization.	A road map covering five years has been developed involving the setting up of a Consultative Mechanism to oversee the preparation and initial implementation of the recommended activities: Appoint Coordinator to carry out initial activities of finalizing legal issues before recruiting the Commission, and later the Executive Secretary and Project Officer(s).	<p>Lessons from existing river basin organizations in Africa and elsewhere were valuable: Great Lakes of North America, Mekong River Commission, Lake Victoria Basin Commission, Niger River Basin, Lake Chad Basin Commission, and LVFO provided useful experiences.</p>	<ul style="list-style-type: none"> The proposed protocol should be adopted so that the Organization(s) could be established. Develop management structures & initiate activities. 	<ul style="list-style-type: none"> Put in place a transitional mechanism to oversee the preparation and initial implementation of the recommended activities. IGAD and the Member States to follow up and implement the recommended road map

No.	Key areas/issues addressed	Key findings/ results	Lessons learned	Policy and strategy recommendations	Action plan
3.	Develop Common monitoring and information sharing network at sub-regional level; Procedure and mechanisms for coordination of information production and dissemination; Protocol for exchange and sharing of information/ data	<ul style="list-style-type: none"> • A framework of common monitoring and information sharing network at Sub-Regional Level was developed. • Procedures and Mechanism for Coordination of Information and Dissemination was developed. • Road Map and outlines for an Agreement for Exchange/Sharing of Information/Data was formulated. 	<ul style="list-style-type: none"> • The network will facilitate the exchange/sharing of collected and processed Data & information among the Member States of IGAD • Trained nationals of the Member States will collect the Data/Information and process them before channeling them to the Commission. • The Protocol will provide for smooth exchange and sharing of data/information among the Member States 	<ul style="list-style-type: none"> • The Member States should approve the protocol to enable the setting up of the network and the mechanism to enforce the procedures for the data/information exchange/sharing. • Each Member State adhere to the Protocol so that all in the Sub-Region can begin to realize the benefits of sharing/exchanging data and information 	<ul style="list-style-type: none"> • Data collection should start as soon as the monitoring network and the mechanism have been established • Data/information exchange and sharing can commence to facilitate development planning in the Sub-Region • Establish the necessary human resource capacity for data/ information collection/analysis • Establish the necessary infrastructure (hardware and software) for data/information collection, transmission, archiving, analysis and exchange
4.	Harmonisation of water sector strategies between riparian countries; key elements of the strategy	<ul style="list-style-type: none"> • Proposals for the harmonization of water sector-between riparian countries were formulated • Key elements of the strategies were identified together with the principles and supporting activities. 	<ul style="list-style-type: none"> • Lessons learned from other institutions sharing water resources assisted in the formulation of strategies for harmonization. • The key elements of the strategies should enable the Member States to kick-start action plans • The member states have strategic plans for IWRM development that are at different levels of development which can be used as a basis for harmonization of water-sector strategies 	<ul style="list-style-type: none"> • These key elements were derived from lessons learned and should be useful. 	<ul style="list-style-type: none"> • Development of joint multipurpose projects for socioeconomic development, regional cooperation and economic integration • Support should be given to countries complete their national strategies/IWRM plans

No.	Key areas/issues addressed	Key findings/ results	Lessons learned	Policy and strategy recommendations	Action plan
5.	<p>Medium and long term capacity building strategies for planning and managing trans-boundary programmes</p>	<p>Strategies for capacity development in all sectors of water resources development and management were developed.</p>	<ul style="list-style-type: none"> The human & institutional capacities in all the seven countries were weak, hence the need for the medium and long term strategies. The strategies will enable the countries to work together in developing & managing the resources of the shared water basins. 	<ul style="list-style-type: none"> There is need to identify capacity requirements in the region and opportunities for bridging the gap Institutional capacity should be strengthened by availing the needed infrastructure and facilities 	<ul style="list-style-type: none"> Approve the strategies, and amend where necessary before implementing them in the medium and long term. Carry out country-level capacity needs assessments Train and procure the needed facilities Partner with regional and international organisations which have experience in water resources management in Africa (e.g. FAO, UNESCO, UNDP, UNEP, GWP, WMO)
6.	<p>Key socioeconomic processes and trends that drive the pressures on water resources (demand and supply)</p>	<ul style="list-style-type: none"> High population growth is outstripping the pace at which water resources are being developed to meet various socioeconomic needs. The majority of the people are trapped in a vicious cycle of poverty high and pervasive poverty is reducing the capacity of the majority households to create real demand for goods and services, including access to better education and technological advancement, and to potable water. 	<ul style="list-style-type: none"> Progress towards accelerating access to potable water and improved sanitation services is very slow in the region. There are major discrepancies as well as inequalities in access to potable water between urban and rural areas, and between different classes of communities. Prospects for achieving a wide range of MDGs in the sub-region hinge on attainment of effective water security. Equitable economic growth & growth in per capita incomes is highly correlated with indicators 	<ul style="list-style-type: none"> Substantial investments are needed in new water resources, especially in the ASAL zones and the rural areas generally. The investments in water supply and sanitation should be directed not only at the infrastructure for water delivery systems but also at new technologies for securing water supply and sanitation, such as water harvesting techniques and storage methods as well as affordable sanitation technologies. 	<ul style="list-style-type: none"> Institute the collection (sector by sector) and sharing of data on impacts of population growth on water resources at basin, national and sub-regional level. Advise member states and share information on population movements in water stressed regions. Identify and promote water use efficiency techniques, including establishment of suitable storage systems, both at the level of households but also at the level of delivery.

No.	Key areas/issues addressed	Key findings/ results	Lessons learned	Policy and strategy recommendations	Action plan
7.	<p>Scenarios of water demand and use in the sub-region</p> <ul style="list-style-type: none"> Over 75% of the sub-region is classified as ASAL and these are areas that are highly water stressed and with relatively low agriculture potential. There is low and unbalanced funding of water and sanitation sector, with tendency to concentrate infrastructure in urban areas. Agriculture sector dominates overall water use – with 94.2%, of which irrigation accounts for 90.7% and livestock 3.5%. The domestic and industrial sectors are relatively small users: with domestic at 4.5% and industry at 1.3%. The overall share of agriculture will, however, decline over the years under all scenarios on account of the increasing share of domestic supply and industry supply. 	<p>of development such as access to education, health services and water & sanitation.</p> <ul style="list-style-type: none"> Countries of the sub-region are therefore rightly targeting poverty reduction in their development plans. <ul style="list-style-type: none"> The imperative to raise agricultural productivity to meet the growing demand for food will call for expansion of irrigated agriculture as well as improved management of rain-fed agriculture. The share for agriculture can decline overtime through a combination of measures to: (i) achieve the MDG goals for access to potable water in quantities that meet domestic water security needs; (ii) accelerate industrialisation in the sub-region; and (iii) improve water use efficiency in irrigation. 	<ul style="list-style-type: none"> Besides targeting access goals in terms of population coverage, quantitative targets in terms of meeting optimal household water security needs should be set and monitored by all countries. Expansion of irrigation should be weighed against increased irrigated yields, which must rise substantially above current levels. Rain-fed agriculture should continue to be given high priority as it still accounts for more than 50% of cereal production. This highlights the need to boost the productivity of “green water” through enhanced moisture retention and improved cultivation practices. 	<ul style="list-style-type: none"> Undertake special studies in the ASAL zones to identify socioeconomic constraints and opportunities for developing existing and new water resources in the sub-region. Prioritise improved water management technologies in existing and new irrigation programmes. Boost the productivity of “green water” through enhanced moisture retention and improved cultivation practices in small holder farms Undertake specific surveys of irrigation projects in the sub-region. 	

No.	Key areas/issues addressed	Key findings/ results	Lessons learned	Policy and strategy recommendations	Action plan
8.	Demand management strategies	<ul style="list-style-type: none"> The IGAD sub-region faces the prospect of intensified competition for water. While population growth will be the principal driver of demand for water, agriculture will account for the bulk of the water and will therefore be the focal point for adjustment of demand pressure. Developing new water sources and expanding and increasing abstractions from existing ones has been the traditional supply-driven response to the pressures on water availability. This approach is being replaced by IWRM approaches which are more efficient and equitable. 	<ul style="list-style-type: none"> A large share of water needed to meet new or increased demand can come from water saved from existing uses through: comprehensive reform of water policies; changing consumer attitudes and behaviour towards wasteful uses of water; removing or preventing water losses in the current access and delivery systems; and improving overall irrigation efficiencies. Promoted within IWRM principles, water demand management ensures cross-sectoral cooperation, coordinated management and development of land, water and other related resources, and maximise the resulting social and economic benefits in an equitable manner, without compromising ecosystem sustainability. 	<ul style="list-style-type: none"> Strategies for water demand management should be designed to take full account of human concerns by including, among others, stakeholders participation in water resources management, and especially by recognising and ensuring representation of the interests of women, the youth and the poor; and recognising multiple uses of water and the range of people's needs. 	<ul style="list-style-type: none"> IGAD should undertake a specific survey of women's situation with regard to access and utilisation of water in the sub-region so as to improve the data and information on the role played by women and the youth in water resources management. Identify specific constraints, existing household technologies and knowledge which can aid practical designs of intervention.

No.	Key areas/issues addressed	Key findings/ results	Lessons learned	Policy and strategy recommendations	Action plan
9.	<p>Identification of the major trans-boundary river basins and aquifers systems of the sub-region</p>	<ul style="list-style-type: none"> Six transboundary river basins were delineated and mapped The data available at this stage could not support a detailed delineation and mapping of aquifer systems. However, the major aquifer systems in the Sub-region were identified and their reported storages, productivities, classifications and flow types documented 	<ul style="list-style-type: none"> Identification and delineation of transboundary basins was partly based on consensus arrived at through consultations with experts from the member states 	<ul style="list-style-type: none"> Further data will be needed for better characterisation of the transboundary river basins Delineation and mapping of aquifer systems should be carried out 	<ul style="list-style-type: none"> Establishment of a framework for collection of necessary data Studies on groundwater systems in the sub-region including yields and storage
10.	<p>Assessment of surface and groundwater resources potential</p>	<ul style="list-style-type: none"> In total, the 6 transboundary river basins receive 620km³/year of rainfall while simulated runoff is 111km³/year or 18% of rainfall. Potential groundwater yields were estimated at 71km³/year 	<ul style="list-style-type: none"> More detailed assessments can be carried out with more detailed datasets The water resources modelling challenges are significantly affected by lack of data to support detailed and informative modelling. Additionally the region has a variable climate that complicates this further. 	<ul style="list-style-type: none"> Additional datasets and studies are required to improve the estimates of surface and groundwater resources potential Develop a data collection programme , especially for the primary data sets that are required for water resources assessment and modelling. 	<ul style="list-style-type: none"> Routine strategic evaluation of the existing hydro-meteorological networks in the different countries Enhance/ Set-up a reliable hydro-meteorological network that can support continuous water resources assessment at sub-regional level Intergovernmental cooperation to allow data exchange between the different IGAD countries.

No.	Key areas/issues addressed	Key findings/ results	Lessons learned	Policy and strategy recommendations	Action plan
11.	<p>Identification of key data collection points and hydrological equipments</p>	<ul style="list-style-type: none"> The existing hydro-meteorological networks are highly limited to support detailed hydrological modelling The required equipment for sustainable data collection have been identified Key data collection points in the Sub-region have been proposed for water resources assessment and water quality monitoring (surface and groundwater) 	<ul style="list-style-type: none"> Improvement of the network would greatly improve water resources assessment in the sub-region. 	<ul style="list-style-type: none"> Establishment of the proposed additional data collection points Implement the data and information exchange and sharing protocol. 	<ul style="list-style-type: none"> Solicit funding for establishment and sustainable management of the proposed hydro-meteorological stations Establishment of the proposed key data collection points Institutional and human resource capacity building.
12.	<p>Identification of sources and formats of information available for database formation.</p>	<ul style="list-style-type: none"> High variation in data formats and information levels and scales Variation of data formats provided by member countries. Variation in data semantics. The information level differs from one country to another. High variations in datum/ coordinates systems of the data and information provided. 	<ul style="list-style-type: none"> Although national reports contained some unique and context specific information at a more detailed level, the regional database was developed contain cross-cutting spatially/thematically aggregated data which was developed by consistently defined uniform standard. 	<ul style="list-style-type: none"> Data collection formats should be harmonized among member countries. Standardisation of data collection levels. Adoption of common coordinate system (e.g. Geographic Coordinate System -GCS). 	<ul style="list-style-type: none"> Establishment of common data collection format Training on data capture, storage and retrieve The member countries should adopt the recommended coordinate system.

No.	Key areas/issues addressed	Key findings/ results	Lessons learned	Policy and strategy recommendations	Action plan
13.	<p>Establishment of a database structure, database and GIS development</p>	<ul style="list-style-type: none"> The Concept Model was developed and the DB structure was defined that include data surface and groundwater resources, Climatology, Administrative units, Social and Economic aspect and natural resources in sub-region. Many uninformed fields like status of the wells, coordinate, completion data and water withdraws were identified. Water points are still without coordinates and wrong coordinates. This excludes them from being put in GIS and carry out spatial analysis Duplications in the DB, there are duplicates by coordinates: Water points with different characteristics (identifier, name, etc) but with similar coordinates or even without coordinates. 	<ul style="list-style-type: none"> The developed database would improve access, exchange and sharing of data and information in the sub-region Some datasets were incomplete because of the absence/loss of the data There are still some reservations about sharing of data by member countries but with ongoing efforts at cooperation, this situation will improve. 	<ul style="list-style-type: none"> Future upgrading/Updating necessary for sustainability of the database Capacity building for users 	<ul style="list-style-type: none"> DB and GIS hardware should be provided to the member countries. Continuous updating of the data base required. Training on basics data bases. Upgrading will be required to guarantee the sustainability of the database at sub-regional level including recent acquired data and information. Standardized data capture should be encouraged by IGAD.

No.	Key areas/issues addressed	Key findings/ results	Lessons learned	Policy and strategy recommendations	Action plan
14.	Water resources management issues in IGAD sub-region	The water resources management challenges in the sub-region were identified and found to be significant for the socioeconomic development of the countries	<ul style="list-style-type: none"> Water resources management is a cross-cutting issue that has implications for all aspects of socio-economic development Data and information about water users are limited and hence a detailed assessment is hard. 	<ul style="list-style-type: none"> Encouragement of cross-sectoral discussions and collaboration in dealing with the water resources management challenges Commitment and concerted efforts to collect relevant water use data at country and sub-regional level. 	Setting-up of forums for discussing and assessing water resources problems in the region. The forums should bring together government, private sector, NGOs and other organisations <ul style="list-style-type: none"> Liaison with government agencies to collect and transmit relevant data. Setting up of a centre for data collection at IGAD to support the national agencies.
15.	Capacity for planning for water resources management.	<ul style="list-style-type: none"> All countries suffer from limited capacity for water resources management. All countries have aging, fragmented and inadequate infrastructure for resources monitoring. 	<ul style="list-style-type: none"> Several of the IGAD countries have started, or have already been through, the process of putting in place elements of the IWRM process envisaged by the WSSD Summit (Johannesburg 2002) Countries need support in further developments concerning IWRM including development of their IWRM plans. 	<ul style="list-style-type: none"> Development of IWRM plans at country level Support for the countries to start the implementation of the IWRM plans. 	<ul style="list-style-type: none"> Liaison with international agencies involved in IWRM support including Global Water Partnership, UNDP, UNESCO, IWMI, GEF, World Bank and others. Mobilisation of financial resources Capacity building (Human and Institutional) Reform of policy and legal frameworks.

No.	Key areas/issues addressed	Key findings/ results	Lessons learned	Policy and strategy recommendations	Action plan
16.	Elaboration of IWRM model and its components in light of the transboundary basins.	<ul style="list-style-type: none"> The modelling of water resources management in the IGAD region is challenging. The region mainly comprises of arid and semi arid areas where access to water resources is limited both in space and time. Additionally, data on water demand and usage are scarce and can be unreliable in areas where they exist. An IWRM modelling concept based on the WEAP system was developed for the 6 transboundary river basins. 	<ul style="list-style-type: none"> Understanding the availability and distribution of the water resources (both surface- and ground-water) is key for any successful exploitation and sustainable use. 	<ul style="list-style-type: none"> Setting up of a sub-regional water resources monitoring framework and strategy. 	<ul style="list-style-type: none"> Support of the member states to better monitor their water resources Setting up a sub-regional data collection, storage, assessment and dissemination mechanism at IGAD level Use of modern techniques (Like remote sensing) for resource monitoring.
17.	IWRM model for transboundary basins.	<p>Water resources supply and demand modelling using WEAP model showed that there are sufficient water resources to meet current and projected future demands.</p> <p>However the problem is one of variability in space and time meaning that water may not be available where and when it is needed.</p>	<ul style="list-style-type: none"> Measures have to be put in place for sustainable water supply and demand management including <ul style="list-style-type: none"> i. Water storage ii. Water conservation iii. Demand management. 	<ul style="list-style-type: none"> Implementation of mechanisms for water conservation, storage and management Refinement of the models through collection of additional data. 	<ul style="list-style-type: none"> Further studies should be carried out on measures for sustainable water resources supply and management Training of a critical mass of professionals in the use of the modelling tools Improvement of water resources data collection through installation of state-of-the-art equipments Improvement of data sharing mechanisms.

No.	Key areas/issues addressed	Key findings/ results	Lessons learned	Policy and strategy recommendations	Action plan
18.	Impact of drought and desertification in the region.	<ul style="list-style-type: none"> Drought and desertification affects all the IGAD countries to a large extent. Djibouti, Eritrea, Kenya, Somalia and Sudan have more than 50% of the land mass regarded as arid or semi-arid. The situation is exacerbated by the climate change and variability that is a global phenomenon. Human induced impacts, such as degradation of forests for fuelwood and construction materials are key to mitigating the impacts of climate change and variability. 	<ul style="list-style-type: none"> Governments have to tackle the root causes of climate change and variability, including the high levels of poverty which leads to over-dependence on fuelwood for cooking. The integration of environmental management to all aspects of management of the socioeconomy is vital. The global impact of climate change and variability means that international action is required since individual nations might not achieve meaningful mitigations on their own. All the IGAD countries should therefore become members of the multilateral environment agreements to enhance their own national efforts at combating drought and desertification. 	<ul style="list-style-type: none"> IGAD countries should implement the adaptation measures in their NAPAs and Initial National Communications to the UNFCCC. Somalia should in particular be supported to prepare its initial National Communication and the NAPA. Each country should ensure that they tackle poverty and high population growth rates. More efficient use of the limited water resources should be enhanced while wasteful uses, for example in irrigation, should be checked. 	<ul style="list-style-type: none"> For Somalia – to prepare its Initial National Communication and the NAPA by 2012. All the IGAD countries to become members of the most important MEAs by end of 2012.

No.	Key areas/issues addressed	Key findings/ results	Lessons learned	Policy and strategy recommendations	Action plan
19.	<p>Impact of flooding and erosion.</p>	<p>• Flooding and erosion are increasingly becoming serious problems for some countries in the region such as Ethiopia and Uganda. However it is a major problem for the ASALs of Djibouti, Eritrea, Kenya, Somalia and Sudan. These ASALs experience flash floods resulting from even small amounts of rainfall because the soils have low water retention capacity and the dry river beds have been taken over cultivation and livestock grazing. The flash flood gives little chance for the people who inhabit these river valleys since most early warning systems poorly developed.</p> <ul style="list-style-type: none"> • Increasing erosion is a consequence of unchecked deforestation and general degradation of the environment. Deposition on a large scale is witnessed in Sudan where the silt carried by the Nile is trapped behind the dams and barrages used for power generation and irrigation. 	<ul style="list-style-type: none"> • Communities living in the flood prone areas should be assisted to resettle elsewhere. • Reliable early warning systems must be put in place to ensure reduction in loss of life and property. • Some of the flooding and erosion is transboundary – for example, the Nile from Ethiopia flooding Sudan and the Juba and Shebelle rivers from Ethiopia flooding Somalia. 	<ul style="list-style-type: none"> • Each country should enforce population controls as much as possible. • Physical and environmental planning should be prioritised so that settlements are not allowed in the most flood prone lowlands and river valleys. • Flood mitigation and erosion hazard protection measures (physical & biological ones) should be enhanced • Integrated Water Resources Management principles should be adhered to • Watershed management plans should be prepared. 	<ul style="list-style-type: none"> • IGAD countries should coordinate the actions on their transboundary rivers by creating early warning systems to alert the downstream countries of flood situations. • National agencies should be assisted to set this up over the next 3 years. • Integrated River Basin Management should be implemented • Integrated natural resources management plans should be prepared to facilitate sustainable development • Pilot schemes development which can be replicated through time to demonstrate the efficacy of IWRM.

No.	Key areas/issues addressed	Key findings/ results	Lessons learned	Policy and strategy recommendations	Action plan
20.	Water pollution	<ul style="list-style-type: none"> Water and environmental pollution is increasing rapidly due to population pressures, especially affecting the urban centres. Most urban centres do not have sewerage systems and use on-site sanitation that pollutes the soils and water bodies. Over-extraction of groundwater in the ASALS has created salt water intrusion, leading to the abandonment of wells in some areas. Poor irrigation methods have created water logging and salinisation of water. Overuse or misuse of pesticides and herbicides may lead to long term pollution of soils and water bodies. Dumping of municipal solid wastes should be controlled. 	<ul style="list-style-type: none"> An important lesson is that the cleaning up of soil and water pollution is quite expensive and sometimes impossible, for example where pesticides are involved. Each country should try and control the proliferation of on-site sanitation systems by investing in sewerage systems. Control of pesticides and herbicides and training of their users should be done at all times. 	<ul style="list-style-type: none"> Make laws and policies that penalise the discharge of untreated wastes in to the environment. Improve irrigation methods through building the capacity of the farmers and improving the available technologies. Reward successful farmers and use them as examples of best practices. Carry out environmental impact assessments for all major potential pollution centres. Ensure that the polluter-pays-principle is applied to the high polluters. 	<ul style="list-style-type: none"> Each country to make plans for investment on sewerage systems for their large urban centres and industrial complexes over a 10 year period. This is due to the high cost of sewerage – investments need to be staggered. Improve the municipal compliance with the environmental laws and regulations over the next 5 years.



APPENDIX 1

AWARENESS CREATION WORKSHOP REPORT

AWARENESS CREATION WORKSHOP (Desalegn Hotel, Addis Ababa 20-21 June 2011)

Registration and Opening Speeches

- Opening speech given by L Tadesse, OSS Project Manager.
- Welcome speech given by Semonesh Golla, from the Host Country – Steering Committee Member.
- Opening speech given by Mohamed Moussa, Director of Agriculture and Environment in IGAD.

Introductions

- The participants introduced themselves from 10:05 am.
- Participants came from Ethiopia, Djibouti, Sudan, Serefaco Consultants, Kenya, Uganda, IGAD, OSS.

General overview of the Project presented by Micheal Kizza, Serefaco

- Gave greetings from Serefaco

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- Project started in April 2010.
 - He introduced the Consultant's Team.
 - Also gave a presentation of the general overview of the Project.

Presentation on strategies for enhancing regional cooperation by Prof. Orach Meza, Serefacó

- Presentation commenced at 11:00 am.
- Comments
 - The presentation was commended. But how do we implement the recommendations? This requires political commitment.
 - In some countries, water sector is hidden in other ministries, such as ministry of irrigation etc.
 - Response from Prof. Orach: yes, political commitment is critical to move the process forward.
 - EAC has a draft bill on ecosystems protocol. This could give inspiration to the new one proposed, esp. in harmonization.
 - The proposed strategy is problematic since there are other organizations, such as AMCOW, which could handle the some of the issues. The structure seems to suggest an unusual reporting arrangement where ministers report to fellow ministers. They should report to a higher level.
 - Issues of sharing the main river basin in IGAD – the Nile – should be given special consideration in the structure.
 - Protocol arrangements in governments should be respected. Should look at the arrangement again.

Response: The Consultant will make agreed changes in the Final Report.

- Why propose an organization that is managing all the other basins yet the Nile has its own? Each basin has its own peculiarities – why propose one management system for them? It is not practical for the management to be done at the center for these basins; they need own management systems. Response: The Nile Basin already has an agreement. The present proposals are for basins outside of River Nile. Agreed positions will be reflected in the Final Report.
- Recommends that the consultant should use the existing structures, rather than creating new structures.
- Linkages between IGAD and other regional bodies shall be addressed when the need comes. Each of these, such as EAC have their own charters.
- Response: With additional information from IGAD, the Consultant will make adjustments to the proposed institutional framework.

Challenges of the region in IWRM presented by Mr. Michael Kizza, Serefaco

- Presentation made from 12:30.
- He highlighted the challenges in all the countries. Djibouti, Ethiopia, Eritrea, Kenya, Somalia, Sudan, Uganda.
- Comments
 - Poverty is a major issue, but is missing in the list.
 - Recognition of decision makers in the system
 - Compliance to what is agreed already - is missing

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- The involuntary resettlement as a result of construction of dams is not a problem in Ethiopia
 - Water quality is not as indicated as a challenge
 - Salinity is not a big problem since there is little irrigation
 - Response: The Consultant will make the necessary adjustments in the Final Report.
 - Data monitoring problems are not mentioned in some countries
 - Ageing of infrastructure is not the main issue, it is the inadequacies of the infrastructure
 - Pollution is more than pesticides – also sewage etc.
 - Enforcement of regulations is inadequate, not that it is missing
 - Flooding is not only flash flooding, also riverine flooding
 - Quantitative assessment of the data: has been done but there are some challenges in getting the data to rely on. We try to reduce the figures where there may be doubts.
 - In reaction to whether population growth was recognized as a problem in Uganda: yes, it is a major problem.
 - Lack of recognition of water resources issues among decision makers will be included in the reports.
 - The Consultant will make changes in the Final Report.

Presentation of the sub regional database, presented by A Tumwine, Serefaco

- Issues, or comments:
 - The Consultant to give the terminology that should be used

to capture the water points – use same nomenclature.

- Data availability is still a problem and even where data is available, it is not geo-referenced.
- IGAD to ensure that information is availed in acceptable formats for all to use.

Institutional common monitoring and information sharing network presented by Prof. Drach, Serefaco

■ Comments to the presentation:

- Which of the basins can be operationalized? Uganda and Kenya and Somalia linked basins might not be practical.
- Some of the basins are dry basins, and there is a lack of information on them. How then do you monitor the basin?
- The Consultant will make recommendations on which basins may be practical in the Final Report.

Presentation on sub-regional framework and road map on transboundary organizations and related issues by Prof. Drach, Serefaco

■ Prof. Drach presented the above beginning around 17:30.

- Which should come first – the protocol or data sharing agreement?
- Cooperation should be based on basins rather than on IGAD level. The report should be accordingly aligned with this position.
- It is agreed that the information and data exchange protocol should follow the cooperation agreement.

Day two: Presentation on major project findings and recommended way forward

■ Comments:

- Report does not give figures. Consultant should put specifics as much as possible. It was however noted that the reports give the details.
- On irrigation efficiency and levels of current yields of crops, this is addressed in the Report.
- Water harvesting and conservation / recycling should be covered. These are covered in the Environmental Component.
- Population growth is a major concern. This is clearly reflected in the report.
- Countries deliberately trying to go to irrigation rather than over-reliance on rain-fed agriculture. It was clarified that the countries needed both rain-fed and irrigation agriculture. The emphasis should be on the management of water in rain-fed agriculture as given in the report.
- Page 27 on pollution is not correct. There is minimal threat of salt water intrusion in the ASALs. This will be rectified in the Final Report.

General comments

- Repetitions noted in the report – these will be removed during editing of the Final Report.
- Some abbreviations and acronyms are not defined: this will be rectified in the Final Report
- Afforestation is not mentioned in the report; however

this was clarified since this is a major adaptation measure recommended in the report.

- Impacts of sedimentation and siltation is in the report – this was clarified.
- Sources of data: acknowledge the sources of data in the tables in the report.



APPENDIX 2

VALIDATION WORKSHOP

(Desalegn Hotel, Addis Ababa 22-24 June 2011)

Registration and Opening Speeches

- Opening speech given by L Tadesse, OSS Project Manager.
- Welcomed speech given by Semonesh Golla, from the Host Country – Steering Committee Member.
- Opening speech given by Mohamed Moussa, Director of Agriculture and Environment in IGAD.

Proceedings after speeches

- Members made self introductions.
- Adoption of the programme for the Validation Workshop: programme adopted. Chaired by Elrayah Mohamed from Sudan.

General overview of the Project, presented by the TL

- Michael Kizza, the Consultant’s Team Leader made his presentation from 09:45 am
- Peter Akari of the African Water Facility was introduced as a representative of the Funding Agency.

Presentation of the Institutional Component by Prof. Orach Meza, Serefaco Consultants

- Presentation made from 10:40 am.
- Comments:
 - Consultants should have gone round the countries of the IGAD basins. This is a lost opportunity that should have been tapped so that the Consultants get first hand information on the basins.
 - The institutional set up should be embedded in the IGAD structures, may be as tasks/duties of one of the Directors. Then they can be increased to lower levels as the workload increases.
 - Some of the issues can be approved/adopted at the lower levels, not necessarily at the Head of State level. This will lead to faster decision making.
 - Some of the statements are not correct – such as the statement that there is no capacity in the region – it is better to use ‘inadequate capacity’.
 - Use of the phrase ‘local government’ may not be correct since transboundary water resources are the preserve of national governments. Use the phrase local appropriately.
 - The structure of reporting could be changed to reduce the levels
 - The governance of transboundary basins should be based on the basins without reference to other basins. The countries should be in total control of their basins.
 - Issues that were discussed during the Awareness Creation Workshop should have been included in the present

presentation. The Consultant assures the Workshop that these are included in the final document.

- Role of IGAD is to get information from the basins so that it can be shared. IGAD should not be directly involved in the management of the basins.
- Practicality of the implementation of the basins should be discussed – with flash points such as Eritrea and Ethiopia having issues that may prevent the formation of a basin organization.
- Data sharing is constrained by the sale of data at the national levels. This issue should be discussed in the report.
- On data sharing: issues could be legal, political and technological which constrain sharing. Issues include the need to observe security in data sharing. The longevity of the OSS project comes into question where data is sharing.
- Prioritization of the types of data that should be shared in the capacity building proposals.

■ Responses:

- The Consultant proposed a regional transboundary unit, but the Validation Workshop advised the hydrological basins should be taken as the basic units for transboundary water resources management and the proposed structure should take this into account. This issue should be left to the countries sharing each basin to agree upon.
- On inclusion of the suggestions made during the Awareness Workshop: the consultant accepted to consider the suggestions when writing the final report.
- On visiting the basins: the Consultant did propose to the Client on the possibility for visits to the basins/countries.

Due to financial limitations, this was not possible.

- On the placement of the tasks for transboundary management: it is agreed that it should be embedded within the Agriculture and Environment Division in IGAD.
- Funding mechanisms, contributions by countries: this is a common predicament. There must be a policy commitment at the highest levels of the countries.

Presentation of the Socioeconomic Component by Lawrence Eтуру

■ Presentation started at 14:05 pm.

■ Comments:

- There was a recommendation to quote the sources of information and the year when the information was published. The Consultant clarified that all the tables are referenced. Where they are not referenced, these are tables generated from data from the study.
- The scenario formulations should be backed up by proposals of how water demand may be reduced or increased. Scenarios are based on population projections – meaning that increases in demand increase with the population, to a great extent.
- In some areas, data referenced as from Somalia National Report is not correct. Somalia did not prepare these reports.
- Transport over the water bodies: refer to areas where there are shared infrastructure
- Humanitarian issues: the cost of water should be analyzed to enrich the socioeconomic component

-
- Water for energy: should also be adequately discussed in a future study

Presentation of the Environmental Component by Eng. Simon Otoi

■ Comments:

- There was an issue of abbreviations in the presentation; however it was clarified that all the abbreviations and acronyms are given in the report.
- Linkages between IGAD and other bodies: what is the link? It was clarified that IGAD has links with most regional and international bodies as part of its mandate.
- It was noted that climate change was indeed a critical problem since water or the lack of it was central to all the impacts of climate change on mankind.
- Vulnerability assessments, it was agreed, should be done. A lot has already been done, but more are needed.
- Technical assistance by IGAD for those issues requiring high levels of technical ability, such as carbon trade, will be supported at the IGAD level to benefit the national bodies.
- Siltation and sedimentation are adequately dealt with in the report. However, some analysis of how countries can benefit from floods should be added – see examples of some Asian countries where floods are beneficial.

Presentation of the GIS/Database Component by Annet Tumwine

■ Comments:

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- Some countries were dissatisfied with the numbers of water points which have been geo-referenced. It was clarified that points that were not geo-referenced could not be displayed on the maps but are included in the database
 - Terminologies should be agreed and explained in the report.
 - Issues of data security are important; countries should be assured that critical national data does not land in wrong hands, if the national bodies hand it over.
 - Developing the database should be continued beyond the project lifetime. IGAD should facilitate this process.
 - Use of MS Access against MS SQL should be included in the recommendations to improve data security and related issues – technological aspects have to be considered in the report.
 - On the low number of water points in the database, countries were called upon to enrich the data by availing by availing more data.

Presentation of the Water Resources Modeling Component

- Presentation started at 17:35.
 - Comment/Question: Why did you consider the SWAT Model? Response: this would hide the detailed model components required for the hydrological modeling of surface and groundwater.
 - Comment/Question: Why not include the detailed simulations of groundwater and soil water? Response: These were considered in the modeling and are given in the

report for all the main sub basins that were set up. Additional data needed to improve the groundwater modeling outputs

- Comment/Question: Change the boundaries of Turkana-Omo to match the reality on ground. Response: The consultant will re-delineate the basin boundaries.
- Comment/Question: What is the adequacy of data and hydrology available for the study? Response: National reports and country data were used together with additional data from other agencies to provide a detailed hydrological analysis.

Day 2: Presentation of the IWRM Model Component by Michael Kizza

- The report does not mention the Sudan area for the Turkana-Omo basin. It was clarified that the SWAT model needs further fine tuning. It is a distributed model and only simulates the situation, but is not exact. The FAO website indicates that there are no irrigated areas in the Sudan part of the basin.
- The levels of Lake Turkana have created some tension between Kenya and Ethiopia, yet the presentation seems to indicate that there would be no water problem if the irrigated areas were increased.
- Gibe 3 hydropower station is planned. What is the effect on the report? Storage for hydropower was not modeled.
- Danakil seems to have runoff for the whole year round

whereas it is known as a dry basin. This was clarified as one of the shortcomings of the model – it still requires further refinement in future studies.

■ What arrangements are there for training and capacity building on the WEAP and SWAT models?

■ Is the model realistic in estimating the demand of water? For example, the region imports 1 million tons of grain annually, which requires 1 billion cu.m. of water. Is that water available in the models given? The water is available but the level of exploitation is currently limited

■ Model limitations should be clearly stated so that wrong conclusions are not reached. The consultant will do this in the final report

■ Is modelled irrigation supplementary to rainfall or full irrigation? It was clarified that the FAO figure for irrigation demand per hectare per country take this into account. If irrigation is supplementary (for example in Uganda) the irrigation water demand per hectare is lower while in countries like Somalia, where full irrigation is carried out, the figure is higher.

Group discussion

■ The formation of three groups

- Group 1: Institutional Framework (see below for the major discussions)
- Group 2: Socioeconomic and Environment Components. Issues discussed include the mention of terrestrial weeds as well and aquatic weeds. Issues of leakages and unaccounted for water should be included. Specifics on how to select tree species for restoration of denuded areas may be stated.

- Group 3: GIS/database, Water Resources Modelling and IWRM components: Issues discussed included main findings on GIS/database, Water Resources and IWRM including the main strategic recommendations and policy proposals.

Group discussions on Institutional framework component

Participants in the Working Group

Ms. S. Golla, Mr. F.C. Mwangi, Mr. P.M. Macharia, Mr. Mugisha Shillingi, Mr. K.K. Chapaa, Mr. Kamil Daoud, Mr. P. Akari, Prof. F.L. Orach-Meza

FINDINGS	CONNECTION TO OTHER REGIONAL INITIATIVES	BOTTLENECKS	RECOMMENDATIONS
Rationale: As in the Terms of Reference and in the Inception Report	N.A.	N.A.	Raised some discussions but generally accepted
Approach: Based on desk study of National Study Reports, Literature on Shared River Basin Organizations, Peer Reviewed documents and outcome of the validation workshops	NBI, LVBC, LVFO, and other River and Lake Basin Organizations in Africa, Americas, Asia, and Europe.	No opportunity for consultation with national authorities and visits to national institutions. No field visits	Provision should be made for field work for future similar studies
(a) National Institutional Status for the Development and Management of Water Resources of the Seven member states	Reform of water sector strategies in other countries in accordance with the recommendations of International Bodies (World Bank, ILC, UN Bodies, etc.)	Lack of visits by the Consultant to the member states of IGAD to observe and consult with national authorities.	The recommendations to enhance institutional capacity should be supported by all the countries
(b1) Developed a framework for Data Collection and Monitoring Networks for each river basin based on identical methods and processes for the member states of IGAD	Information network on food security in IGAD countries have been initiated by donors	No basic network for data collection and monitoring at transboundary level	The recommendations to establish information and data monitoring network should be supported by all the countries
(B2) The roadmap for the Protocol on the Framework for Data and Information Sharing and Exchange was developed.	NBI and IGAD are negotiating joint information and data sharing and exchange protocol for the respective countries. IGAD's is on food security and early warning system	Not a single bilateral arrangement has been agreed upon by any of the riparian states to any of the six river basins	Linkage to the Heads of State should be purely on issues where their attention is needed, but not on every decisions at national or regional ministerial levels. The linkage in the structure should be through dotted lines.

(c) Harmonization of strategies to enhance regional cooperation and coordination	Many riparian countries to a river basin in Africa, Asia, Europe, America, have harmonized their policies, missions, strategies for joint actions	Direct access by the Consultant to national policies, missions, strategies, and development plans of the member states was not possible.	The recommendations to harmonize strategies to enhance regional cooperation and coordination by the riparian states of a river basin should be supported by all the countries. There linkage in the structure to the Heads of State should be through dotted lines only to signify provision of information only when necessary.
(d) Developed a framework for Capacity Building at both national and regional levels	Institutions of higher learning at both professional and technical levels exist in the region	Inadequate capacity of human and facilities at all levels in all the countries. Inadequacy of funds.	Each country should build capacity for both national and transboundary activities as recommended by the Consultant
(e) Developed Sub-Regional Framework, Transboundary River Basin Organization (TRBO) based on each river basin for the development and management of the resources of the shared river basin.	Similar regional organizations have been established for river basins in Africa, Asia, Europe, and America.	Availability of funds. Commitment to the proposal by member states. Agreement on areas for joint activities.	TRBO should be river basin based to be coordinated by the riparian countries within the IGAD framework
(f) Roadmap	Similar successful roadmaps have been developed for the establishment of TRBOs in Africa, Asia, Europe, and America.	Acceptability by the member states, provision of funds, availing of human and institutional facilities.	Roadmap is acceptable provided the arrangement is based on each river basin but within the framework of IGAD to facilitate coordination by the riparian countries.

Mapping, Assessment & Management of Transboundary Water Resources in the IGAD Sub-Region Project

OVERVIEW & GENERAL RECOMMANDATIONS

Following an international competitive bidding process by Sahara and Sahel Observatory (SSO), SEREFACD Consultants Limited was contracted to undertake this assignment on "Mapping, Assessment and Management of Transboundary Water Resources in the IGAD Sub-region Project Covering Djibouti, Eritrea, Ethiopia, Kenya, Somalia, Sudan and Uganda". The main objective of this consultancy service was to assess and analyze the water resources, socio-economic and environmental condition of the sub region and come-up with a set of strategy, recommendations, and action plans to enable member states to implement and operate an integrated trans-boundary water resources management process. The project focused on acquiring data, information and knowledge to support more sustainable shared water resources management policies and strategies at national and subregional levels.

This report aims at presenting the major findings of the assignment and the proposed strategic recommendations and action plans thereof for moving forward with the implementation and operation of IWRM processes in the IGAD Sub-region. In particular, the report includes:

- A formulation of strategies for enhancing regional cooperation;
- A framework and guidelines for regional procedures and coordination mechanisms for information production, dissemination and sharing;
- An assessment of water resources in the IGAD Sub-region;
- A socioeconomic assessment of water demand and use in the IGAD Sub-region;
- An assessment of the key environmental issues affecting the IGAD countries;
- Development of a regional database and GIS;
- An elaboration of medium and long term capacity building strategies for planning and managing trans-boundary programmes;
- The development of a road map for establishing a Transboundary River Basin Organization.

This project was financed by African Water Facility grant made available to IGAD for undertaking the study of the trans-boundary water resources of the sub-region excluding the Nile basin which is currently covered by the program of Nile Basin Initiative. OSS was the Client on behalf of IGAD in this assignment ■

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