NILE BASIN INITIATIVE

4th Nile Basin Development Forum

Building Sustainable Transboundary Cooperation in a Complex River Basin

Challenges*| *Lessons*| *Prospects

6-7 October 2014
Nairobi, Kenya

Abstract Volume

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List of abbreviations

AAU	Addis Ababa University
AfDB	African Development Bank
ASARECA	Association for strengthening Agricultural Research in Eastern and Central Africa
EAC	East African Community
EAPP	Eastern Africa Power Pool
ENSAP	Eastern Nile Subsidiary Action Program (NBI)
ENTRO	Eastern Nile Technical Regional Office (NBI)
CAADP	Comprehensive Africa Agriculture Development Project
CADSWES	Center for Advanced Decision Support for Water and Environmental Systems
CEGIS	Center for Environmental and Geographic Information Services
CFA	(Nile River Basin) Cooperative Framework Agreement
CIWA	Cooperation in International Waters in Africa Trust Fund
DSS	Decision Support System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
IGAD	Intergovernmental Authority on Development
IWMI	International Water Management Institute
LVBC	Lake Victoria Basin Commission
MIT	Massachusetts Institute of Technology
NBCBN	Nile Basin Capacity Building Network
NBD	Nile Basin Discourse
NBDF	Nile Basin Development Forum
NBI	Nile Basin Initiative
NBSF	Nile Basin Sustainability Framework
NBTF	Nile Basin Trust Fund
NELSAP	Nile Equatorial Lakes Subsidiary Action Program (NBI)
NELSAP-CU	NELSAP Coordination Unit (NBI)
Nile-COM	Nile Council of Ministers (in charge of Water Affairs)
Nile-Sec	NBI Secretariat
Nile-TAC	Nile Technical Advisory Committee
RATP	Regional Agricultural Trade Project (NBI)
RPTP	Regional Power Trade Project (NBI)
SIWI	Stockholm International Water Institute
UNWC	United Nations Watercourses Convention
WEAP	Water Evaluation and Planning

Forum Brief

The Nile Basin Development Forum

The Nile Basin Development Forum (NBDF) is a high level bi-annual regional event that brings together stakeholders from within and outside of the basin to deliberate on opportunities and challenges in the sustainable management and development of the water resources of the Nile Basin. The overall objectives of the NBDF are:

- To enhance and continue building confidence and trust among countries of the basin through participation of a broader range of stakeholders including governments, private sector, civil society and NGOs, local water users and external funding agencies;
- To raise awareness of the benefit sharing of cooperative development of the Nile Basin;
- To provide a forum for open discussion of NBI projects and initiatives;
- To introduce new ideas, share knowledge and best practices.

Three Forums have been conducted to date each having their specific themes as highlighted below:

1st NBDF, Addis Ababa, Ethiopia, 2006: *The Role of the Nile River in Poverty Reduction and Economic Development in the Basin.*

2nd NBDF, Khartoum, Sudan, 2008: *Environment and Water Resources Management for Peace and regional Cooperation in the Nile Basin*

3rd NBDF, Kigali, Rwanda, 2011: *Climate Change and its Implications for Sustainable Development and Cooperation in the Nile Basin – Threats and Opportunities to Nile Basin Cooperation*

Themes of the 4th NBDF and its expected outcomes

The theme of the 4th Nile Basin Development Forum is *"Building sustainable trans-boundary cooperation in a complex River Basin"*, with opportunities for identifying lessons learnt during the last 15 years of cooperation, identifying gaps, the challenges that lie ahead requiring countries' attention, reflections into the likely directions to emerge and the mechanisms towards achieving them. The expected outcomes are:

- Shared learning on latest scientific information, knowledge as well best practices that can be replicated.
- Common understanding of the opportunities, challenges and prospects in trans-boundary water cooperation built.
- Opportunities for partnerships and networks explored and initiated.

Sub-themes

The NBDF program is built around eight sub-themes. Each session relates to one of the sub-themes:

Knowledge systems and epistemic communities

This sub-theme addresses enhancing the knowledgebase on the Nile, use of analytic tools and decision support systems for sustainable decision outcomes; fostering networks and platforms for knowledge dissemination and public understanding. See sessions I, II and IV.

Water-Energy-Food Security Nexus

This sub-theme explores the linkages of the water-, energy- and food systems in the Nile basin, and how the nexus approach can provide an avenue for increasing the efficiency of resource use and address food, energy and water security. See sessions III and VI.

Trans-boundary water governance

This sub-theme addresses institutional setups and mandates for trans-boundary co-operation, sustainability and resilience to geo-and hydro-political boundary conditions, policy and legal frameworks, stakeholder engagement and communication. See sessions V and IX.

Benefits of co-operation and risks of non-cooperation

This sub theme focuses on the role of Nile resources in catalyzing regional integration processes, promoting cooperative/joint investments, identifying trade-offs and promoting win-win solutions, risk of failure to manage adverse consequences ensuing from uncoordinated development and lack of agreed management regime. See session VIII.

Building partnerships

This sub-theme deals with providing space for stakeholders including civil society, private sector, parliamentarians, academia, media, and others in the management and development of the shared Nile resources. See session X.

Hydro-diplomacy in trans-boundary cooperation

This sub-theme explores the role of civil society and other non-governmental actors (e.g. Nile Basin countries' ex-diplomats, parliamentarians, international civil servants, influential personalities from the Nile Basin region) in mediating constructive relationships among riparians including track II/citizens' diplomacy. See session XI.

Financing trans-boundary cooperation

This sub-theme deals with the challenges of securing sustainable financing for water resources development (investment in e.g. water infrastructure), management (analytic systems, shared knowledge base) and institutional platforms for sustaining trans-boundary cooperation. See session XII.

Building resilience through transboundary cooperation

This sub-theme deals with how Nile cooperation increases riparian countries' resilience to impacts of climate change (e.g. to extreme events and increased variability), such as through identifying collective policy responses; coordinated management of water storage infrastructure; and regional monitoring systems for better preparedness. This sub-theme is addressed as a cross-cutting issue in various sessions throughout the program.

Forum Structure

The two-day program is structured based on the following three perspectives on Nile Cooperation:

1) Nile Advances: We take stock of our knowledge and experience base. We present achievements made, exchange the lessons learnt and identify the gaps of the Nile Cooperation process to date. See Opening session and sessions I-VI on day 1.
2) Nile Futures: We envisage the future(s) we want, and discuss what it takes to get there. We explore plausible scenarios of Nile Cooperation and deliberate on some major challenges that lie ahead. See sessions VII-IX on day 2 (morning).
3) Nile Prospects: We explore ways ahead to achieve our desired future. As stakeholders, we reflect on our roles and contributions to sustain our achievements and move Nile Cooperation forward. See sessions X-XIII on day 2 (afternoon).

Program Overview

Day 1, Monday 6th October		
09.00-10.30: Opening Session (plenary)		
10.30-11.30: Exhibition, group photo and coffee break		
11.30-13.30: Sessions I-III (parallel paper sessions)		
Session I – Use of analytic tools and planning frameworks in Water Resources Planning and Management *Sub-theme: Knowledge systems and epistemic communities* Co-convener: DHI	**Session II – Understanding the complex hydrology of the Nile Basin** *Sub-theme: Knowledge systems and epistemic communities* Co-convener: IWMI	**Session III – The Food-Water Nexus in the Nile Basin** *Sub-theme Water-Energy-Food Nexus* Co-convener: GIZ
13.30-14.30: Lunch		
14.30-16.30: Sessions IV-VI (parallel paper sessions)		
Session IV – Cooperative water development and management *Sub-theme: Knowledge systems and epistemic communities*	**Session V – Nile Discourses: evidence for "One Nile – One Family"?** *Sub-theme: Transboundary water governance* Co-convener: NBD	**Session VI – The Water-Energy Nexus in the Nile Basin** *Sub-theme: Water-Energy-Food Nexus* Co-convener: GIZ
16.30-17.00: Coffee		
17.00-18.00: Exhibition (continued)		
18.00: Dinner		

Day 2, Tuesday 7th October		
08.30-09.30: Session VII: Exploring Possible Futures for the Nile (plenary)		
09.30-11.00: Sessions VIII and IX (parallel panel discussions)		
Session VIII – Nile Basin Joint Development Planning: Way Forward *Sub-theme: Benefits of cooperation and risks of non-cooperation*	**Session IX – Multi-level Nile Basin Governance – what next for legal, institutional and policy frameworks?** *Sub-theme: Transboundary water governance*	
11.00-11.30: Coffee		
11.30-13.00: Sessions X-XII (parallel panel discussions)		
Session X – Regional integration and the Nile – a common agenda? *Sub-theme: Building partnerships*	**Session XI – Hydro-Diplomacy for the Nile – converging political and technical tracks of cooperation** *Sub-theme: Hydro-diplomacy in transboundary cooperation* Co-convener: SIWI	**Session XII – Sustainable financing for institutions, information and infrastructure** *Sub-theme: Financing transboundary cooperation* Co-convener: World Bank
13.00-14.00: Lunch		
14.00-14.30: Key Messages from day 1 and 2 (plenary) **14.30-15.30: Session XIII – High level panel discussion (plenary)**		
15.30-16.30: Coffee		
16.30-17.15: Closing Session: Reporting back, NBDF Declaration, Vote of Thanks and Closing (plenary)		
18.00: Press conference		
19.00: Reception		

Session co-conveners

DHI is an independent, international consulting and research organization authorized by the Danish Ministry of Science, Technology and Innovation as an Approved Technological Service Institute (GTS). We offer a wide range of research, consulting and policy services as well as leading edge technologies. DHI's activities are based on the development and application of know-how and advanced technologies within coastal, river, ports and offshore engineering as well as ecology, water resources, urban and industrial water and other areas related to the water environment. DHI is designated as Collaborating Centre for the United Nations Environmental Programme, UNEP, and furthermore as Advisory Centre for the Global Water Partnership. In collaboration with the Nile Basin Initiative (NBI), DHI has developed the Nile Basin Decision Support System (NB DSS) to support river basin planning and management over the basin. DHI together with IWA have now embarked on the GEF/UNEP Flood and Droughts project to develop planning tools and methods addressing floods and droughts under changing climate - delivering results to be used in river basin planning processes and downscaled level for urban and utility managers. See www.dhigroup.com

The International Water Management Institute (IWMI) is a non-profit, scientific research organization focusing on the sustainable use of water and land resources in developing countries. It is headquartered in Colombo, Sri Lanka, with regional offices across Asia and Africa. IWMI works in partnership with governments, civil society and the private sector to develop scalable agricultural water management solutions that have a real impact on poverty reduction, food security and ecosystem health. IWMI is a member of CGIAR, a global research partnership for a food secure future. The CGIAR Research Program on Water, Land and Ecosystems (WLE) is a global research program promoting a new integrated approach to sustainable intensification. A healthy functioning ecosystem is seen as a prerequisite to sustainable agricultural development, resilience of food systems and human well-being. Led by the International Water Management Institute (IWMI), the Program combines the resources of 11 CGIAR centres (IWMI, ICARDA, CIAT, ICRISAT, ICRAF, Biodiversity, CIP, IFPRI, ILRI, IITA, WorldFish), and the United Nations Food and Agriculture Organization (FAO). Find out more: www.iwmi.org

As a federal enterprise, the **Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)** supports the German government in achieving its objectives in the field of international cooperation for sustainable development. GIZ operates throughout Germany and in more than 130 countries worldwide, with registered offices in Bonn and Eschborn. GIZ has 16,510 staff around the globe, almost 70 per cent of whom are employed locally as national personnel. GIZ operates in many fields: economic development and employment promotion; governance and democracy; security, reconstruction, peace building and civil conflict transformation; food security, health and basic education; and environmental protection, resource conservation and climate change mitigation.

On behalf of the German government and other co-funding partners, GIZ is currently implementing programmes that support cooperative water management in more than 15 transboundary river and lake basins across Africa, Asia and South-Eastern Europe. GIZ (before 2011 as GTZ) supports transboundary water cooperation in the Nile Basin since 2002, and provides technical assistance to the water sector in most of the NBI member states. For more information visit: www.giz.de

The Nile Basin Discourse (NBD) is a civil society network with over 940 member and partner organizations within the Nile Basin region. NBD offers a public platform for dialogue, partnership and cooperation among civil society organizations in the Nile Basin. The NBD network is open to all civil society organizations involved in basin resources management and development within the Nile Basin Region to join as either full, associate or honorary members. NBD network provides knowledge and builds capacity to strengthen, evidence-based dialogue of civil society organizations within the Nile Basin region. NBD's networking approach has provided a mechanism for coordinated action and has added value to the work of the Nile Basin Initiative (NBI) and other key development partners. NBD is constantly adapting and exploring new ways to enhance its network movement that meets the needs of an ever-changing world. The new strategy – Empowerment through Participation – defines the unique contribution it makes in attaining sustainable development and highlights the direction to be taken as an organization to best achieve its goals. For the period 2013 - 2016, NBD with support from the Cooperation of International Waterways in Africa (CIWA) is working towards engaging stakeholders in climate change resilience through Strengthening the NBD Secretariat functions, Strengthening Communications and Outreach, and Capacity development of NBD members. Website: www.nilebasindiscourse.org

The Stockholm International Water Institute (SIWI) is a Stockholm-based policy institute that generates knowledge and informs decision-making towards water wise policy. Founded in 1991, SIWI performs research, builds institutional capacity and provides advisory services in five thematic areas: water governance, transboundary water management, climate change and water, the water-energy-food nexus, and water economics.

Today, SIWI employs 60 staff with a wide-range of professional experience that enables us to form knowledgeable multi-disciplinary teams that are able to address complex, cross-cutting challenges faced by clients and partners from government and business around the world. Through applied research and policy consultation, capacity-building in individuals and institutions, strategic communication to influence private and public sectors, and linking key actors across sectors, SIWI stimulates the development of innovative policies and scientifically based solutions to water-related challenges. Internationally active, politically neutral, and intellectually objective, SIWI welcomes opportunities for collaboration with partners across the world. Website: www.siwi.org

Since inception in 1944, **the World Bank Group** has expanded from a single institution to a closely associated group of five development institutions. The World Bank provides financial and knowledge resources to its clients, to reach two main goals: to end extreme poverty by 2030 and to boost shared prosperity. The World Bank is a vital source of financial and technical assistance to developing countries around the world. The institution operates as more than a bank in the ordinary sense, as a unique partnership to reduce poverty and support development. Further information about the World Bank can be found at www.worldbankorg.

Since requested by the Nile Water Ministers in 2001, the World Bank has served as lead development partner and administrator of the $203 million Nile Basin Trust Fund, supporting the Nile Countries in their pursuit of their Shared Vision for the Nile. The ten contributing donors to the NBTF have supported the establishment of the Nile Basin Initiative as a transitional basin organization; in the development of shared data, tools and knowledge for water resources management; and the advancement of a pipeline of over US$5 billion of development projects in the Nile Basin. Through the Cooperation in International Waters in Africa (CIWA) Program, the World Bank and participating development partners are continuing support to the Nile countries, for programs to strengthen cooperative management and development of international waters in Sub-Saharan Africa, to facilitate sustainable and inclusive growth, climate resilience, and poverty reduction. Further information about the CIWA program is available at http://www.worldbank.org/en/programs/cooperation-in-international-waters-in-africa.

Opening Session

Key Note Addresses and Presentations:

Key Note Address 1: “The Nile: a Bridge for Unity”, by Hon. Prof. Mark James Mwandosya, Tanzania

Key Note Address 2: “Sustaining Transboundary cooperation” by Gustavo Saltiel, World Bank

Key Note Address 3: “Roles of analytic tools and shared Knowledgebase for transboundary cooperation”, by Dr. Edith Zagona, CADSWES, USA

Launch of two NBI Flagship Papers, by John Rao Nyaoro, Executive Director, NBI Secretariat

Key Note Address 1: "The Nile: a Bridge for Unity"

by Prof. Mark James Mwandosya, Tanzania

Prof. Mark James Mwandosya is the Minister of State (Special Duties) President's Office, United Republic of Tanzania. He has also recently been appointed Chancellor of the Mbeya University of Science and Technology. He is the Member of Parliament for Rungwe East constituency, having been elected unopposed three times consecutively since 2000. Previously he has also been Minister of Communication and Transport (2000-2005), Minister of State (Environment) Vice President's Office (2005-2008), Minister of Water and Irrigation (2008-2010), and Minister of Water (2010-2012). He was Professor in Electrical Engineering holding an endowed Professorial Research Chair in Energy Technology and Management at the University of Dar es Salaam, Tanzania. He has over 20 years of professional and lecturing experience in Tanzania, Norway and U.S.A. He has devoted much of his time in research and studies in energy and natural resource development and use. He has been a consultant in a number of projects both in Tanzania and in Africa. Prof. Mwandosya was a Team Leader of a group which drafted the Southern African Development Community (SADC) Energy Protocol. Prof. Mwandosya also drafted, for the Organisation of African Unity, and the African Economic Community the Protocol on Energy and Natural Resources. He has been Chairman of the Board of Directors, and senior council member of over 20 organizations in various National and Regional organizations.

Prof. Mwandosya holds a BSc (Engineering) 1st class Honours from the University of Aston (1974) and a PhD in Electronic and Electrical Engineering from the University of Birmingham (1977).

Prof. Mwandosya has written a number of books and numerous publications in the fields of engineering systems, energy, water, environment, and regulation of utilities. Since 1993 Prof. Mwandosya has participated actively in and was head of the Climate Change Studies Programme in Tanzania. He has attended meetings of Subsidiary Bodies and Conferences of Parties (CoP) of the United Nations Framework Convention on Climate Change since 1995. In 1997 Prof. Mwandosya was the Chairman of the Group of 77 and spokesman for the Group of 77 and China at the meetings of the subsidiary bodies for the Climate Convention and during the negotiations for the Kyoto Protocol. In 2007 special stamp was issued by the Tanzania Postal Services to recognize his contribution to the protection of the environment. He is currently a member of the Steering Committee of the United Nations Environment Program (UNEP) International Resource Panel.

KEY NOTE:

Herodotus, a Greek philosopher, once described Egypt as ' A gift of River Nile '.The Nile was then, as it is now, a source of fascination, myth and curiosity. The existence of an immense corpus of knowledge about the Nile, and its Basin, is such that what may be termed the Herodotus Dictum can aptly be paraphrased thus: 'Africa is a gift of the River Nile'.

The Nile Basin countries are home to 437million people or 41 percent of the population of Africa, according to the year 2012 estimates. The population of the Nile Basin is 238 million or 54 percent of the population of all the Nile countries. The Nile is the longest river in Africa and in the world. All major rivers on earth flow from north to south. River Nile, in all its splendor and majesty, flows from south to north! In so doing it connects 11 African nations; Burundi, Rwanda, the Democratic Republic of Congo, Tanzania, Kenya, Uganda, South Sudan, Ethiopia, Eritrea, Sudan, and Egypt.

A physical bridge in the built environment is designed and constructed by engineers. In his infinite wisdom and knowledge Almighty God designed and implemented the 'construction' of the Nile, a subsurface structure whose 'traffic' is the everlasting flow of water from the source of Nyabarongo, from Lake Tana, from the western mountains of Ethiopia, from the source of Bahr el Arab, through natural reservoirs, natural filters as regulators, through cataracts, concluding its 6000 plus journey via Rosetta and Damietta into another natural reservoir, the Mediterranean sea.

The Nile, including its tributaries can be conceived as physically connecting eleven nation states. It is a bridge of sorts. Engineers construct bridges as a means to connect people and transport their goods for trade and other purposes, just as the River Nile has done over millennia. The challenge before riparians of the Nile, and this is the theme of the keynote address to the 4th Nile Basin Forum, remains how to translate the existence of God's gift, the Nile, into a bridge for the unity of the governments of the riparian states and the people of the Nile Basin.

Key Note Address 2: "Sustaining Transboundary cooperation"

by Gustavo Saltiel, World Bank

Gustavo Saltiel has an extensive experience (30 years) in the Water and Sustainable Development Sectors. Among his many responsibilities, the following can be mentioned.

Gustavo Saltiel is a Civil and Sanitary Engineer (Buenos Aires University) and holds a Master in Public Policy and Administration (San Andres University, Argentina). He has been a Hubert Humphrey Fullbright Fellow at the University of North Carolina at Chapel Hill and received a Fellowship of the Swedish Government for research in Environmental Engineering at the University of Lund (Sweden).

Currently: Program Manager of Cooperation in International Waters in Africa (CIWA) and Nile Basin Programs. Water Global Practice. The World Bank. Coordinates the CIWA Program that constitutes a key vehicle to promote development and cooperation on transboundary waters in Africa. Leads the Kenya Water Resources Program, including a large transformational investment program, policy dialogue and engagement with the Government and other key stakeholders.

KEY NOTE:

Since their 1999 agreement on the Shared Vision for the Nile, the Nile countries have accomplished a tremendous amount in a relatively short amount of time. By engaging together in joint analysis and planning processes, the countries have advanced preparation of nearly $6.5 billion of regionally significant investment projects. However, large challenges remain. Poverty in the basin is substantial, with one half to three quarters of the population of some of the Nile countries living in extreme poverty. The development and management of the joint Nile waters will be critical in reducing this poverty.

Building on the accomplishments of Nile cooperation, the Nile countries have an opportunity to keep their forward momentum, and to deliver more substantial local benefits from regional engagement. While the Nile is unique, other river basins offer examples of how countries can take part in joint investment processes, to combat poverty and advance socio-economic development, through the management and development of their water resources. With the established tools, knowledge and capacity forming a foundation for greater cooperative engagement, the Nile countries are now well placed to build upon their gains, and to use the momentum of the last 15 years to advance more significant regional investment for the sustainable socio-economic development for the Nile.

Key Note Address 3: "Roles of analytic tools and shared Knowledgebase for transboundary cooperation"

by Dr. Edith Zagona, CADSWES, USA

Edith Zagona specializes in the development of decision support tools for water resources management. As a Research Professor at the University of Colorado and Director of the Center for Advanced Decision Support for Water and Environmental Systems (CADSWES) she has worked closely with water management agencies in the U.S. to build and use analytical tools as a basis for collaborative management and decision making in major river basins, each with significant transboundary issues. Recent R&D projects address topics in hydropower optimization and adaptation to climate change. She was a technical adviser to the Nile Basin DSS development project for five years. Dr. Zagona has B.S., M.S. and Ph.D. degrees in Civil Engineering (Water Resources) from the University of Arizona, Colorado State University and the University of Colorado, respectively.

KEY NOTE:

The future of the countries and peoples of the Nile Basin is at a critical juncture. The need for water and energy are enormous and the resources provided by the Nile are limited. Without careful and insightful management, resources will be squandered and potential benefits will be lost. There is a single path to a possible future in which all people of the Nile Basin can flourish – the path of transboundary cooperation in which all parties collaborate to make decisions that produce the greatest benefits while minimizing risks. Such cooperation is possible only with a deep understanding of the physical system, its behavior, possible future states, and its limitations, and only with the capability to explore all possible future scenarios and quantify the benefits, the costs, the risks and the tradeoffs. Thus the shared knowledgebase and analytical tools are an indispensable cornerstone of collaboration. The way forward is to utilize the knowledge and tools collaboratively with willingness and intent to forge a sustainable future.

Launch of two NBI Flagship Papers

John Rao Nyaoro, Executive Director, NBI Secretariat
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John Rao Nyaoro, HSC is the Executive Director of the Nile Basin Initiative Secretariat since 1st September 2014. Prior to this appointment, he was the Director of Water Resources, Ministry of Environment, Water and Natural Resources in Kenya, Chief negotiator for Kenya on the Nile River Basin Cooperative Framework Agreement and other trans-boundary waters and a Member of the Nile Technical Advisory Committee, IGAD Steering Committee the positions he held since 2008. John Nyaoro has got 30 years of experience as a Hydrologist/Water Resources Expert. He graduated with honors from the University of Nairobi, Kenya with a BSC degree in Water Resources and a Master of Laws (LLM) Water Law and Policy, Dundee University in Scotland, UK. He is a PhD candidate in Water Law and Policy, University of Nairobi, School of Law and expected to graduate in December 2014.

ABSTRACT:
Publication 1 entitled **"Nile Cooperation: Opportunities and Challenges"** provides an overview of the basin, including hydrological, social, economic, geopolitical, environmental, developmental and historical contexts. In addition, it examines and discusses the socio-economic and environmental opportunities that exist within the basin and that can help to meet the development aspirations of basin citizens. It looks at the implications for Nile cooperation of key trade-offs that countries will need to consider and the risks they might face as a result of non-cooperation and addresses appropriate management and mitigation measures that can help to optimize the use of the shared water resources.

The Flagship 2 entitled **"Nile Cooperation: Lessons for the World and Lessons from the World for Nile Basin"** reflects on and critically analyses the Nile cooperation process to date, identifies and documents key lessons learnt to share with the international community. The paper examines implementation and achievements to date and synthesizes lessons learnt in a number of areas including legal and institutional frameworks, quality and extent of cooperation, and commitment and involvement of member states in different approaches to cooperation. It further reflects on and documents relevant lessons from other complex river basins, such as the Nile, that can inform dialogue, policy and practice changes within the Nile Basin, chosen because of their relevance to current Nile basin challenges.

Session I – Use of Analytic tools and planning frameworks in Water Resources Planning and Management

Sub-theme: Knowledge systems and epistemic communities
Co-convener: DHI

Objectives: The session looks at how analytic tools and planning frameworks can advance Nile cooperation and support riparian dialogue. The objective is to demonstrate NBI's state-of-the-art analytic tools and planning frameworks and to share experiences and lessons on how their application can support decision making at basin, sub-basin and national level.

Presentations:

1) A decision support system for integrated water resource management in transboundary river basins, Dr. Abdulkarim Seid, NBI

2) Application of the Nile DSS in the Development of the National Water Resources Strategy for Uganda, Mr. Sowed M. Sewagudde, Ministry of Water and Environment, Uganda

3) Multipurpose Water Resource Planning and Management Using Nile DSS. Case Study Tana Sub Basin, Ethiopia, Mr. Habtam Achenef, Abay Basin Authority, Ethiopia

4) Development of Water Resources Planning Scenarios in the Complex Hydrological System of Eastern Nile Basin, Dr. Ahmadul Hassan, CEGIS, Bangladesh

1. A decision support system for integrated water resource management in transboundary river basins

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Dr. Seid possesses over two decades of experience in academia, water resources analyses, research, policy analysis, and consulting and program management in the water sector. Dr. Seid has Ph.D. in civil engineering (Rainfall-Runoff Modeling) from the University of Technology – Darmstadt, Germany; MSc in Water Resources Systems Engineering from the University of Newcastle Upon Tyne, UK and Bachelor of Science degree in Civil Engineering from Addis Ababa University, Ethiopia. He is currently head of the Water Resources Management Department of the NBI Secretariat. Earlier, as the Regional Decision Support Systems Lead Specialist and he led technically the development of the Nile Basin Decision Support System. He served as Assistant Professor at the Faculty of Technology, Addis Ababa University.

ABSTRACT:

In order to support informed, scientifically based and cooperative decision making in transboundary river basins, a framework is required for sharing knowledge, understanding river system behaviour and designing and evaluating alternative development scenarios and management strategies. An example of such a framework is the Nile Basin Decision Support System (NB-DSS), which has been developed by the Nile Basin Initiative to support water resources planning and investment decisions in the Nile Basin, especially those with cross-border ramifications.

The Nile Basin DSS has been designed as an analytic framework that integrates information management, water resources modelling, water resources scenario management and decision making tools in an integrated environment. It has a modular and open architecture and is capable of expanding its suite of models and toolkit to address evolving needs. The DSS uses user-defined indicators to evaluate system performance under varying water resources development and management scenarios. The indicators are then used to define criteria for ranking of the various scenarios under the Multi-Criteria (Decision) Analysis toolset of the DSS.

The DSS has been used to explore water resources development and management in the Nile Basin. As part of its development, a total of seven application case studies have been carried out to explore potential implications of water resources development and management in the Nile Basin. The Models in the DSS have been used to support the Multi-sector investment planning under the Nile Equatorial Lakes Subsidiary Action Program (NELSAP) of NBI.

This paper presents the context which led to the development of the NB-DSS, describes key DSS functionalities and highlights those features of the DSS which facilitate water resource planning and management decision making in a multi-stakeholder environment. The outcomes of some initial applications of the DSS within the Nile Basin are also presented.

2. Application of the Nile DSS in the Development of the National Water Resources Strategy for Uganda

Jens Kristian Lørup[1], Sowed M. Sewagudde[2] and Duncan Kikoyo[2]

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Sowed M. Sewagudde is a practicing hydrological engineer with eleven years of hands-on experience, in analysing watershed hydrology in order to inform decisions regarding; water resources regulation, planning and early warning. He has worked with models applied to water-based systems and decision support systems to provide expert advice to water resources managers.

ABSTRACT:

The Directorate of Water Resources Management is presently developing a National Water Resources Strategy for Uganda which concerns the use, development, conservation, and protection of the nation's water resources by 2040. Water allocation modelling and scenario analysis of the water resources development options was carried out to support the preparation of the Strategy. Modelling work was based on the nationwide MIKE BASIN model developed as part of the national water resources assessment, while the subsequent analysis, including a Multi-Criteria-Analysis (MCA) was undertaken in Nile Decision Support System (Nile DSS). Scenarios were developed to assess the hydrological and environmental impact and economic benefit of key water resources development plans as outlined in Vision 2040. To assess the impact of the different types of key water resources development options, the scenarios were arranged in three key "building blocks" represented by 1) potential hydropower development, 2) potential wetland irrigation development, and 3) potential upland irrigation development added incrementally one by one in the three scenarios. A set of 101 comparative indicators were defined in the Nile DSS to facilitate a Multi Criteria-based evaluation methodology to evaluate the respective development scenarios.

Results show that Scenario S1 will have insignificant impacts on the flow regimes of the selected Environmental Flow Assessment (EFA) Sites (changes Q10 and Q90 are less than 5 %). Scenario 2 will likewise result in insignificant impacts. Scenario 3 causes Moderate impact (changes in Q90 are between 10 and 20 %) in the Nile River (except for Victoria Nile). The flow regimes of the remaining Environmental Flow Assessment (EFA) Sites are not significantly affected by Scenario 3. From an economic or society viewpoint all three scenarios are viable. However, scenario 3 which represents full hydropower and full wetland

and upland irrigation development according to the master plans for hydropower (MEMD, 2011) and irrigation (MWE, 2011) generates the highest Net Present Value (NPV) and the highest return. This implies that the estimated maximum change in volume flowing out of Uganda to South Sudan corresponds to approximately 2 BCM/yr. This corresponds to about 15% of the Net Internal Renewable Water Resources (NIRWR) and only 5% of the Total Natural Renewable Water Resources (TNRWR). Thus, the projected reduction due to full development of hydropower generation, wetland and upland irrigation according to Vision 2040 are still well within the NIRWR. The total estimated investment cost for scenario 3 amounts to 7,576 million US$ and includes the installation of 1,782 MW hydropower and irrigation facilities for a total of approximately 684,000 ha of which approximately 247,000 ha in wetlands, and 437,000 ha upland.

The study demonstrates that to support policy and decision making regarding water resources development, DWRM and other relevant institutions in Uganda need a tool to screen various combinations of development options, and quickly identify the key trade-offs and implications on the main socio-economic sectors in the country. The methodology developed during this study can serve as a template for supporting future water resources management and planning decisions at national, basin, and catchment level.

3. Multipurpose Water Resource Planning and Management Using Nile DSS. Case Study Tana Sub Basin

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Habtam Achef Makonen has ten years and above professional experience in areas of soil and water conservation, water supply and water harvesting, large scale irrigation project as water resource management engineer constructed by support of Africa Development Bank, water resource planning and management specialist supported by World Bank, head of water management department and water resource management specialist at Abay Basin Authority. BSc degree from Alemaya University, Institute of Technology in Soil and Water Engineering and Management and MSc in Water Resource Engineering (Engineering Hydrology) from Bahir Dar University, Institute of Technology, School of civil and water resource engineering.

ABSTRACT:

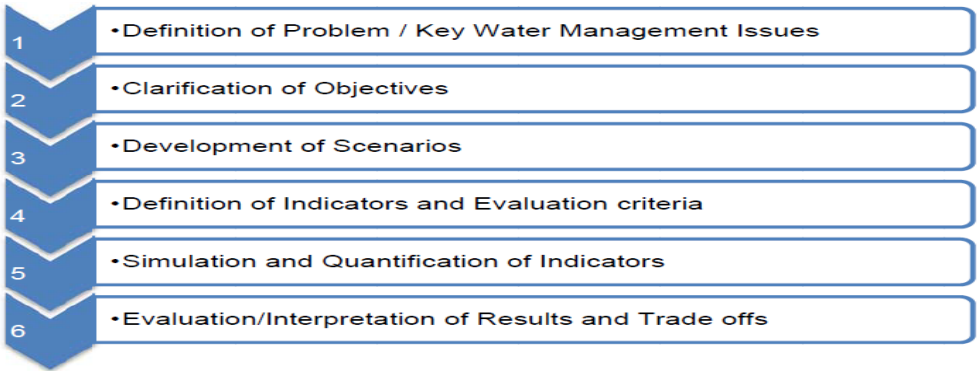
Background

The Lake Tana Sub Basin has a drainage area of 15083 sq. Km, including lake surface area of 3000 sq. km. The lake is the source of Blue Nile River and total storage capacity of 32,000mcmwith a useful storage capacity of 8,500mcm.Water resources planning for the Tana Sub-Basin need to take into account the various, often conflicting, water needs of the economic sectors and the environment. The Government of Ethiopia established the Abay Basin Authority to promote water resources planning and management at local level; the Authority was established in (Reg. 151/2008). As part of its key initial activities, the Authority is embarking on developing a multi-sector water resources plan for the Tana Sub-Basin. The Authority is carrying out a study using the Nile Basin Decision Support System (NB-DSS) to providing the inputs needed for a water resources management and development plan for the Tana Sub-Basin.

Methodology and Approach

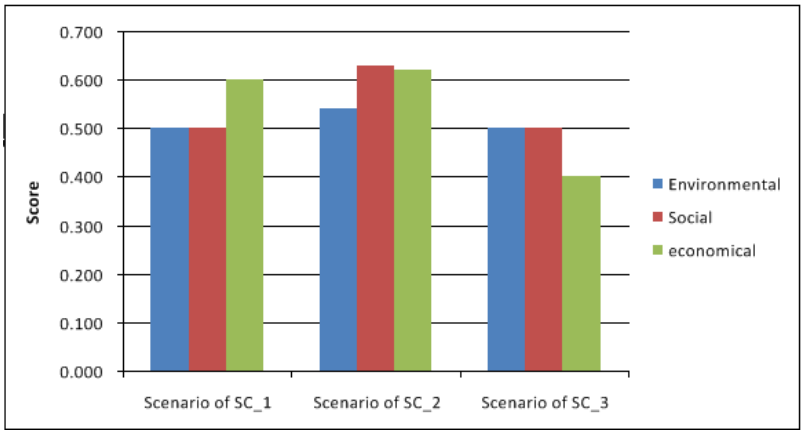
Mike Hydro was selected from Mike Zero for simulation of data from 1960 to 2005 and scenarios for development interventions. Within this context, the objective of this pilot case application for the Tana Sub-Basin was to undertake scenario evaluation using the NB-DSS. This involved the configuration, calibration and validation of a relevant baseline model for representing the present state of water resource development for the pilot application case, defining scenarios and a set of economic, environmental and social evaluation criteria (indicators), using the configured model implemented scenarios in the NB-DSS and employed the MCA tools and associated functionalities embedded in the NB-DSS evaluated scenarios based on the quantification of economic, environmental and social indicators.

However indicators like Hydropower Generation with flow, Navigation with Lake water level, and Fish Production with lake water surface area and Evaporation with the system were used.



Key findings

- Comparing the base case and the worst case scenarios the Tana Beles hydropower product decreases by 16% annually, this indicates that the impact of irrigation development have little impact on the power generation but the study indicates that, this amount of power production have been incorporated in the design of upstream dams of the sub basin.
- As seen from the result of indictor regarding fish production in the Lake, Comparing the base case and the worst case scenarios of fish production, there is an insignificant loss in the sector because it is declining annually by 1% only.
- But the irrigation development in the future will have a greater influence on the Lake navigation; this can be shown by an increase in the number of days per year where the lake level decreases below 1785 masl where navigations blocked from (35 to 141) days/year. Though this values do not shows how many consecutive non-navigable days are present, it is a reasonable assumption to take most of this decrease in lake level happens in the dry seasons of the year. 141 non-navigable days have a greater socio-economical impact.
- The increase in the reservoir development on the total water surface evaporation of the system is insignificant, the result shows that development in the sub-basin have a smaller impact by increasing the amount of water surface evaporation from the sub-basin, the reason can be explained by the fact that the evaporation & rainfall of the u/s dams are almost balanced and the development also increase the surface area that is exposed to evaporation at the lake body but at scenario three utilizations of water resource using pump irrigation from the lake makes it decrease due to minimizing of open surface water area of the lake.
- During Stakeholder consultation of melt-criteria analysis, scenario two has been selected.



Conclusions

Based on the findings, the development of large scale irrigation projects of koga, Ribb, Megech, Gilgel Abay, Jemma, Gumara and lake Tana Pump have no significant effect on evaporations, fish productions and hydropower power generations and also studies show that, some of the dams will have power as well as fish production plan equivalent to the decline amount to be able to compensate the productions. But for navigation it needs some amount of water during dryer period because due to those development interventions the lake level can lower below the average up to 5 months/year of the dryer period. Based on the MCA all irrigation projects are preferred except pump irrigation.

Recommendations

Operation rules of the dams should consider navigation during the dry period, with this result; it has to be able to do further with more indicators and even by CBA method of analysis by considering other sub basin water resource actors. All levels of stakeholders should participate all the way, starting from the early beginning to the implementation process. For further work a lot of data are collected and are organizing, and also scripts are developing. Experience sharing and training with Nile Basin Initiative.

4. Development of Water Resources Planning Scenarios in the Complex Hydrological System of Eastern Nile Basin (ENB)

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Dr Ahmadul Hassan, working as Water Resources Planner in CEGIS (A trust under the Ministry of Water Resources, Bangladesh). Dr Hassan has over 31 years of experience in water resources planning, disaster management, climate change vulnerability assessment and natural resources modeling using GIS and RS as well hydrological and hydrodynamic modeling. He developed an operational hydrological model with SWAT for the Easter Nile Basin to assess the water availability for different development scenarios which contributes in the planning model of ENTRO. He developed Analytical Framework using IWRM participatory concept for macro level planning. Conduct training on IWRM, EIA, GIS, RS to GO and NGO professionals in Bangladesh and on Community based Early Warning System for ENTRO Professionals in Ethiopia.

ABSTRACT:

Large basin hydrology is necessary to gather knowledge and understanding the hydrological system complexity to assist in developing opportunities and mitigating constraints. The major constraints of water resources development in the large basin hydrology are: quantification of resources; inadequate treaty & agreements and limited attention about water quality for resource sharing; and unavailability and accessibility to hydro-meteorological data. Resources utilization and equitable distribution of the complex Nile system is a challenge to the planners in the region. To understand this complexity, a hydrological model has been developed using SWAT (Soil and Water Assessment Tools). In this study, a total of nineteen exogenous and endogenous scenarios have been developed and simulated to assess the impacts on water availability and its spatial and temporal distribution for sustainable water resource planning. The exogenous scenarios include two drought scenarios, two climate change scenarios and the combination of drought and climate change. Dam scenario, irrigation scenario, land use change scenario and sediment management scenarios are considered as endogenous. The annual flow from Tekeze-Atbara-Setite (TAS) sub-basin has the highest sensitivity to different climate change and drought scenarios while the sensitivity is lowest for Baro-Akobo-Sobat-White Nile (BAS-WN) sub-basin. For drought scenario, a maximum of 41%, 19%, 63% and 37% reduction of annual flow has been estimated for Abay-Blue Nile (Abay-BN), BAS-WN, TAS and Main Nile (MN) sub-basin respectively while for climate change scenarios, the reduction of flow is 18%, 5%, 38% and 17% respectively for the above four sub-basins. The implementation of dams on Abay-BN sub-basin will affect the stream flow of the Blue Nile and MN River. There is a reduction

and delay of peak flow for all the dam scenarios which is mainly due to the storage of water into the reservoir. The impact on annual stream flow due to dam scenario is insignificant in compared to exogenous scenario but it has a huge impact on the distribution on seasonal flow. The annual average flow to High Aswan Dam is reduced to minimum 18% and maximum 50% for the combination of the scenarios.

Session II – Understanding the complex Hydrology of the Nile

Sub-theme: Knowledge systems and epistemic communities
Co-convener: IWMI

Objectives: The session takes stock of the existing knowledge on the Nile basin hydrology, including evapotranspiration, erosion/sedimentation and impacts of climate change. The objective is to further build a shared understanding on the resource base and to highlight the important role of hydrological monitoring for advancing Nile cooperation.

Presentations:

1) Hydrological monitoring in the Nile basin, Mr. Mark Woodbury, Riverside Technology, USA

2) Linking sediment source to sink. Case study: the trans-boundary Blue Nile River, Mr. Amgad Omer, Dams Implementation Unit, Sudan

3) Understanding the Hydrology of the Nile: Mapping Actual Evapo-transpiration for the Nile Basin Countries, Ms. Milly Mbuliro, NBI

4) Climate Change Impact on Variability of Rainfall Intensity in Upper Blue Nile Basin, Mr. Lakemariam Yohannes Worku, National Meteorological Agency, Ethiopia

1. Hydrological monitoring in the Nile basin

Mark Woodbury, Riverside Technology, USA
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Mark Woodbury is a senior program manager at Riverside Technology and has over 20 years of experience in hydrologic and hydraulic analysis, including flood hydrology, flood inundation mapping, hydrologic forecast system development and implementation, design and implementation of hydro-meteorological monitoring networks, water resources modeling and decision support system development, and analysis of hydrologic impacts of climate change. His project experience has taken him throughout the U.S. and to multiple countries in Latin America, Europe, Asia, and Africa. He has led numerous projects in the Nile River basin, including multi-disciplinary flood risk mapping studies in Sudan and Ethiopia, monitoring network design for flood forecasting in the Blue Nile basin, design and development of a web portal to facilitate outreach and communication for the Eastern Nile Technical Regional Office (ENTRO), a regional monitoring network design for the Lake Victoria Basin Commission as part of a water resources monitoring information system development project, and currently the design of a regional Nile Basin hydromet services system for NBI.

ABSTRACT:
River basin monitoring is essential for effective water resources planning, efficient water resources management, environmental sustainability, and effective response to changing conditions. While many river basins exhibit hydrologic and climatalogical variability from source to mouth, few are as varied as the Nile Basin. Adding to the physical complexity of the basin for monitoring and management is the administrative complexity of a river whose main stem and tributaries are derived from or pass through nearly a dozen countries. Existing monitoring systems operated by the riparian countries include:

- Fragments of legacy monitoring networks implemented throughout the past century which continue to operate
- Elements of recent networks implemented with external lump-sum funding whose operating and maintenance costs cannot be sustained by local governments, and so deteriorate with time
- Networks in various stages of re-development following periods of internal and external strife or social and economic upheaval that have left agencies with limited staffs, abandoned and vandalized sites, and inadequate parts, supplies, and equipment for maintenance

- Modest elements of modern networks being implemented incrementally with foreign and local government funding at a pace that is being sustained using existing staffs and budgets

Along with the loss of continuity in monitoring networks in some cases is the loss of expectation for data which reduces its value because of lack of use. Strategies for establishing effective and sustainable monitoring networks, especially in support of regional or basin-wide cooperation and development objectives need to respond to multiple considerations, including:

- A rational basis for the value of a basin-wide monitoring network, grounded in its ability to provide data to address water resources management issues that can lead to improved socioeconomic outcomes
- Sustainable technologies, combined with sustained training and support to enable firm establishment of capacity to operate common, consistent technologies in the region
- Sustainable designs and implementation plans that permit institutional capacity to keep pace with a growing inventory of modern equipment, stations and communications systems, and can meet growing demand for high quality and timely water information as it becomes more widely available through modern information dissemination channels.
- Sustainable funding that recognizes the necessity for coordinated, incremental development of capacity, technology, network density, and demand for data and the broad base of benefits that justifies investment of public resources.
- Integration with and support for national systems, with the recognition that a successful regional network can only flow from a collective operation of individual successful national networks, and that the regional monitoring system must support and not detract from individual national objectives.
- Flexibility at the national system design level to integrate data from multiple sources by enforcing consistent design standards that permit unified system development based on a national roadmap for data management
- Evolution of policy on data availability to permit effective and timely representation of key hydrologic and meteorological conditions of the river basin to realize the development and management potential of the basin.

2. Linking sediment source to sink. Case study: the trans-boundary Blue Nile River

Yasir S. A. Ali[1,2], Amgad Y. A. Omer[3], Alessandra Crosato[1,4], Yasir A. Mohamed[1,2,4], Paolo Paron[1], Nigel G. Wright[5]

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Amgad Y A Omer is a civil engineer, specialized in Geotechnical and Hydraulic Engineering and water resources. He is presently manager of the technical office of Dam Complex of Upper Atbara Project (DCUAP) and project coordinator of Gedaref Water Supply Project (GWSP) in the Dams Implementation Unit (DIU) of Ministry of Water Resources and Electricity - Sudan. As a joint appointee, he is seconded to Hydraulic Research Center (HRC) as a Senior morphodynamic modeler. Amgad has a respectable experience in hydraulic structures, dams and reservoir morphodynamic modeling. He started his career at the Irrigation Works Corporation-Sudan, in 2002, where he did irrigation water development. He obtained MSc in 2011from UNESCO - IHE, Delft, the Netherlands. He used in his thesis project, quasi (3D) morphodynamic modeling of Roseires Reservoir (Sudan) by Delft3D software. The study is a part of the water resource management project of the Blue Nile. As part of his civil engineering profession, he was further involved in management, design and supervision of heavy civil engineering works such as high earth dams and hydraulic structures.

ABSTRACT:

Introduction

The upper Blue Nile River basin (Figure 1) suffers from erosion and desertification problems that undesirably reduce soil fertility and hence the agricultural productivity up stream. Eroded sediment is transported to the lower Blue Nile Basin, where sedimentation occurs in reservoirs and irrigation canals. In particular, the first sediment trap currently encountered by the sediment transported by the Blue Nile is Roseires Reservoir, which has lost already one third of its volume in 50 years. This is a relevant economical loss both upstream and downstream. The only effective solution to reduce the sedimentation problems will be that

of reducing the sediment input. This can be achieved by means of erosion control practices in the upper basin. For this, given the vastness of the upper basin, it is important to identify the areas where the largest amounts of sediment are produced.

Objectives

The main objectives of this work are to:

1. Estimate the flows and the sediment loads along the river network at the sub-basin level.
2. Identify the origin of the sediment deposited in Roseires Reservoir based on the mineral characteristics of the material of the eroded areas in the upper basins (Ethiopia) and the deposited soil layers inside reservoir.
3. Assess the land use-land cover changes in the sub-basins providing the most sediment and link these to soil erosion rates

Methods

The first sediment balance of the entire basin at the sub-basin scale was obtained by integrating the available and newly measured flows and suspended sediment concentrations and by numerical modelling.

Sediment stratification inside Roseires Reservoir was studied by combining historical data with the results of a 2D morphodynamic model (Delft3D software).

The integration of the results of X-Ray Diffraction laboratory analyses on the mineral content in the sediment samples collected in the upper catchment an in Roseires Reservoir with a cluster analysis allowed identifying the source of the sediments deposited inside the reservoir.

Land-use change detection was performed in the most eroded sub basins to link the sediment product with land-use changes.

Results

- The results show that the sub basins of Jemma, Didessa and South Gojam are the main sediment source areas.
  - Jemma sub-basin 19-27 million tonne/year (1400-2000 tonne/km^2/year),
  - South Gojam sub-basin, 11-17 million tonne/year (680-1000 tonne/km^2/year) and
  - Didessa sub-basin, 12-14 million tonne/year (592-710 tonne/km^2/year).
- The mineral content results analysis show that most of sediment entering Sudan is similar to that from the Jemma, Didessa and South Gojam sub basins.
- Land-cover obtained by analyzing the 1973, 2000 and 2009 satellite images of these sub-basins show a significant decrease innatural forest (from 70% to 25%) and an increase of cultivated area (from 30% to 70% of the total surface area).

Conclusions

The implementation of erosion control practices can therefore start from these sub-basins since they are providing most of the sediment.

Acknowledgments

This study was carried out at UNESCO-IHE as a project within a research program called “In search of sustainable catchments and basin-wide solidarities in the Blue Nile River Basin”, funded by the Foundation for the Advancement of Tropical Research (WOTRO) of the Netherlands Organization for Scientific Research (NWO).

Figure 1: Blue Nile River Basin.

3. Mapping Actual Evapo-transpiration for the Nile Basin Countries

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Milly Mbuliro has over 10 years of working experience as a GIS and Remote Sensing Specialist with a strong back background in Water Resources Management. She graduated from the University of Dar es Salaam, Tanzania with a Masters degree in Integrated Water Resources Management. She has worked with the Nile Basin Initiative under the Water Resources Management unit and Knowledge Management working group for four years to lead the development of a Geographic Information System about the River Nile basin and its natural resources. Currently, she works for the Nile Basin Initiative Secretariat as the Remote Sensing and GIS specialist and she was one of the key contributors towards the first ever State of River Nile Basin Report 2012.

ABSTRACT:

Actual Evapo-transpiration (Evaporation + Transpiration) is the process through which water moves from land, water bodies and water bearing surfaces into the atmosphere. It is one of the largest components of the water balance of any river basin. There is a difference between Potential Evapo transpiration (PET) and Actual Evapotranspiration (AET). PET is the amount of water that would leave a surface if water was abundant while AET is the amount that leaves the surface under the prevailing conditions. Actual ET is a main mechanism through which most of the water received as rainfall returns to the atmosphere. It accounts for more than 70% of the water balance in the wettest areas of the basin like the Blue Nile and the Lake Victoria sub-basin and even a higher percentage in drier areas.

Actual ET values have a number of applications in water resources planning and management. Therefore, any study on water balance of river basins needs ET estimates. Irrigation water scheduling is made largely based on crop water consumption for which ET makes the bulk of the water consumption. ET can also provide estimates of the consumptive use for cropped areas. Having time series estimates for ET can also help in detecting changes in land use/cover and in studying climatic trends in the various regions of the basin.

Actual Evapotranspiration is not easy to measure because it is expensive and demanding in terms of accuracy of measurement. However Remote sensing has been recognized as the most feasible means to provide spatially distributed regional AET on land and water surfaces. Realizing the importance of ET to the water balance of the Nile, and utilizing the available satellite information and advanced algorithms, the Nile Basin Initiative has produced estimates of actual ET over the Nile Basin Countries at a resolution of 1 km^2 at 8-day time step, monthly and annually. This dataset starts from 2000 to date and is freely

available to help in establishing more accurate water balances for the various Nile sub-basins especially those with large swamps (e.g the Sudd) and those with inaccessible river gauges.

Estimating ET for the Nile Basin Countries is based on the MOD16ET algorithm used to produce the global terrestrial MOD16 ET product. MOD16 ET algorithm is based on the Penman-Monteith equation. Major improvements include estimating MOD16 ET not only over vegetated land surfaces but also over deserts, urban areas, inland water bodies such as rivers and lakes. The improved algorithm uses daily meteorological data and MODIS land surface dynamic datasets as input for daily ET calculations.

Analyses have been performed for both spatial and temporal variation over man- made and natural water bodies, over sub- basins, Land-use types, irrigated areas, Wetlands and other areas of interest and the results show that the Nile Basin is dominated by ET and there is high seasonal and spatial variation across the major sub-basins depending on land use and prevailing climatic conditions.

Over 87% of rainfall goes back to the atmosphere with the highest evaporation from open water bodies, followed by Wetlands, Forests and shrublands. Among the major sub-basins, Lake Albert sub-basin seems to have the highest Evapotranspiration to Rainfall ratio (almost 90%) of all water generating sub-basins. AET/Rainfall ratios are highest in the drier areas of northern Sudan and Egypt reflecting the fact that any moisture available evaporates. This is consistent with physical observations on the ground- these areas are very hot and have very little rainfall. In the wetter basins of the Nile Equatorial Lakes region, the ratios are about 0.5 allowing for runoff to be generated. When the ratios are close to 1.0 all the rainfall is lost through evaporation and Evapotranspiration.

The Nile Basin hydrology is characterized by relatively high AET. With more and more storage dams planned by the riparian countries, need for coordinated operation becomes increasingly important to reduce total Evaporation from the dams.

Mapping Actual Evapotranspiration for Nile basin and at smaller sub-basins can play a role in the water resources management through identification of areas where the ET rates are high to propose water conservation projects, help understand the basin better, verify models and detect trends.

4. Climate Change Impact on Variability of Rainfall Intensity in Upper Blue Nile Basin.

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Lakemariam Yohannes Worku studied his Bachelor of Science Degree (B.Sc.) in Meteorology Science from Arba Minch, Ethiopia University in July 2007 and since November 2007 he started working in National Meteorology Agency of Ethiopia as a meteorologist in different department. He did work as a meteorologist in data management and climatology, agrometeorology, and hydrometeorology departments. In the mean time he did his Master of Science Degree (M.Sc.) in Water Resource Engineering (Specialized in Engineering Hydrology) from Bahir Dar University, Ethiopia in January 2014. His Master's thesis topic was "Climate Change Impact on Variability of Rainfall in Upper Blue Nile Basin" and Supervisor name is Dr. Semu Ayalew Moges. He is actively participating in national, regional, and international with training, conference and workshop activities with regards of climate change and water.

ABSTRACT:

Background

Extreme rainfall events are major problems in Ethiopia with the resulting floods that usually could cause significant damage to agriculture, ecology, infrastructure, disruption to human activities, loss of property, loss of lives and disease outbreak. The aim of this study was to explore the likely changes of precipitation extreme changes due to future climate change. The study specifically focuses to understand the future climate change impact on variability of rainfall intensity-duration-frequency in Upper Blue Nile basin.

Methodology

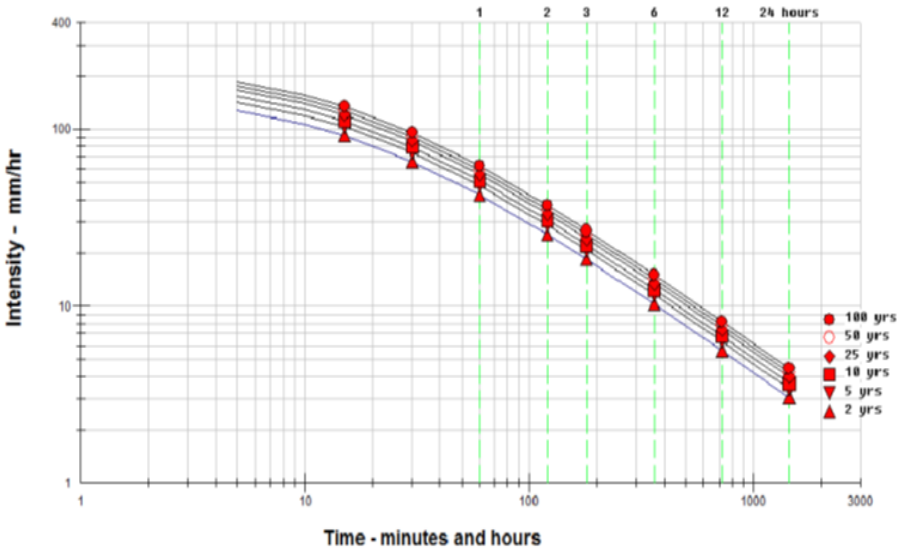
Precipitation data from two Global Climate Models (GCMs) have been used in the study are HadCM3 and CGCM3. Rainfall frequency analysis was carried out to estimate quantile with different return periods. Probability Weighted Method (PWM) selected estimation of parameter distribution and L-Moment Ratio Diagrams (LMRDs) used to find the best parent distribution for each station. Therefore, parent distributions for derived from frequency analysis are Generalized Logistic (GLOG), Generalized Extreme Value (GEV), and Gamma & Pearson III (P3) parent distribution.

Key Findings and Recommendation

After analyzing estimated quantile simple disaggregation model was applied in order to find sub daily rainfall data. Finally the disaggregated rainfall is fitted to find Intensity-Duration-Frequency (IDF) curve and the result shows in most parts of the basin rainfall intensity expected to increase in the future. As a result of the two GCMs output, the study indicates there will be likely increase of precipitation extremes over the Blue Nile basin due to the changing climate. The IDF parameters are highly sensitive to climate change and it needs

update and precaution. Also the study should be interpreted with caution as the GCM model outputs in this part of the world have huge uncertainty.

Bahir Dar IDF Curve (2011-2040)



Session III – The Food-Water Nexus in the Nile Basin

Sub-theme: Water- Energy- Food Security Nexus
Co-convener: GIZ

Objectives: The session explores linkages between water and food security in the Nile Basin. It will look at scenarios of agricultural development and trade in the basin in relation to water security. The session will discuss scenarios of food production and trade from a basin perspective and case studies on water use efficiency changes and management at the irrigation scheme and watershed level.

Presentations:

1) Food for thought: scenarios for the Nile Basin, Mr. Bart Hilhorst, Independent Consultant, Doha, Qatar

2) Emerging Agricultural Trade Potentials to Accelerate Water and Food Security, Dr. Hellen Natu, NBD

3) Harnessing the potential of agricultural water in the Nile Basin through integrated watershed management, Dr. Hezron Mogaka, ASARECA

4) Towards a remote sensing based operational decision support system for agricultural water and crop management in the Gash Delta – Sudan, Mr. Younis Gismalla, Hydraulics Research Center, Sudan

5) The Impact of Climate Change on Crop Productivity in the Eastern Nile Basin of Sudan, Dr. Khalid Biro, Hydraulics Research Center, Sudan

1. Food for thought: scenarios for the Nile Basin

Bart Hilhorst, Consultant, Qatar
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Mr. Bart Hilhorst has over twenty-five years of experience in land and water resources management, with a focus on transboundary rivers and forward thinking in natural resources development and use. He has extensive field experience in complex transboundary water projects in Africa and Asia, and served as a Chief Technical Advisor for FAO project "Information Products for Nile Basin Water Resources Management".

Mr. Hilhorst has particular knowledge of using scenario thinking to support strategy formulation for natural resources management, and to facilitate dialogue processes regarding complex water allocation challenges. He recently facilitated a comprehensive multi-stakeholder scenario process that investigated the complex water-agriculture-energy sector in the Aral Sea basin, and is currently involved in a scenario project on the 'future of Nile cooperation' for the NBI. Bart Hilhorst is now an independent consultant based in Doha, Qatar. He has broad experience as manager and team leader of large projects in the area of natural resources management, and has conducted numerous capacity building and training events.

ABSTRACT:

The presentation describes an interactive process called 'Food for Thought (F4T)', in which a group of some 25 representatives from all Nile countries participated in a joint scenario building exercise to investigate the uncertain future of 'demand for agricultural produce' in the Nile region. It is noted that agriculture is the main driver of water demand in the Nile basin, currently using over 80% of renewable water resources. With high demographic growth rates, demand for agricultural produce is set to rise, further increasing pressure on scarce land and water resources. A plausible range of future demand for agricultural produce is key input for agriculture and water resources development policies, and for exploring joint Nile basin development options.

The presentation details the scenario building process and discusses the starting conditions, redetermined elements, and key uncertainties. It presents four scenario stories with corresponding logics and nutrition requirements in the Nile basin in the horizon year 2030. It sets the F4T scenarios in a global context in which pressure is increasing on all elements of the water-energy-food nexus, with implications for agricultural trade and agricultural price volatility.

Lastly, the presentation discusses the process gains of the scenario exercise. F4T has increased the appreciative understanding of a complex problem in a relatively short period

of time. Further, it has surfaced hidden assumptions, clarified desired futures, and fostered trusting relationships among a diverse set of stakeholders and experts by encouraging a wider perspective.

2. Emerging Agricultural Trade Potentials to Accelerate Water and Food Security

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Hellen Natu (PhD) is the Regional Manager for the Nile Basin Discourse, a network of Civil Society Organizations engaged in climate change resilience, in the Nile Riparian States. She is an Agricultural Economist focused on International Trade, Development Economics and Advisory Policy, in Sub-Saharan Africa**.** She has a PhD in Agricultural Economics-Justus Liebig University-Germany and a Post-Doctoral in Agricultural Marketing, Trade and Policy-Humboldt University-Germany. She has a wealth of knowledge in Agricultural Marketing in Developing Countries-Leeds University; Agriculture & Food Policy Analysis-Harvard; Agribusiness Management & Policy-Kibbutz Shefayim-Israel; Result Based System of M&E-World Bank; Gender Mainstreaming and Institutional Profiling-CIDA; and Water Footprint Analysis & Documentation for Decision Making-World Bank Institute. She has undertaken various assignments. Through IGAD, gave Technical assistance for the implementation of the Inland Water Resources Management Programme in the IGAD member states. Through the Agricultural Trade Policy Advisory Forum for Eastern and Southern Africa (ATPAF-ESA), EAGC, UN-FAO, CTA and Gatsby, studied the Southern Africa grain sector value chains of Botswana, D.R Congo, Lesotho, Malawi, Mozambique, Namibia, South Africa, Tanzania, Zambia and Zimbabwe. In addition, undertook studies on tariff and non-tariff barriers to agricultural trade & investments in Eastern Africa. In the recent past, she was the NBI-Regional Agricultural Trade & Policy Expert for Nile Basin's 10 Riparian States incorporating agricultural trade into water resource planning & management. Previously, she was NBI-Project Coordinator/Specialist of the Socio-Economic Development and Benefit sharing Project, focusing on three clusters that scoped out the agribusiness and food security, cross border trade, and water resources planning & management. In addition, she has a wealth of experience having served as a Planning Officer-Ministry of Agriculture/Livestock-Kenya; Senior Lecturer in Agricultural & Development Economics, Trade, Markets & Policy Analysis at the University of Nairobi. She has been for 9 years part of a WTO-team of African Lecturers on Regionalism and Regional Trade Agreements for English speaking Africa-WTO, in collaboration with Universities of Nairobi, Namibia, and Manzini. Under UNOPS, she has monitored and evaluated IFAD Projects in Zimbabwe, Uganda and Tanzania. She has undertaken several studies in Sub-Saharan Africa and authored a number of publications

ABSTRACT:

The Nile Basin countries are seeking to promote regional agricultural trade as a means to improve the efficiency of water use for productive agriculture towards food security. Trade is considered as an important vehicle for improved water efficiency in the Nile Basin, along with increased agricultural productivity, as it permits production of least-water intensive crops in water scarce countries or regions within a country and importation of water-intensive crops from water abundant countries or regions within a country. Thus, promotion of regional trade based on comparative advantage is expected to save water and enhance sustainable water security, food security and economic growth. Concerns of climate change and food insecurity led Nile Basin countries to undertake the two assignments. The first was a cross border trade value chain analysis of five Nile Basin agricultural corridors, to identify strategic and trans-boundary investment potentials that enhance efficient water use and food security in the region. The second was the virtual water/water footprint capacity building, analysis, documentation and awareness creation, to enhance policy dialogue and decision making for efficient water use towards food security. The two assignments took place in the period of March 2010 to December 2012 and focused on grains and pulses, fruits and vegetables and livestock “on hooves”.

The Nile Basin countries sought collaboration with private sector regional commodity groups with focus on specific commodity categories as strategic partners, such as the Eastern African Grain Council (EAGC) and the Horticultural Council of Africa in the assignments and the uptake of the potential investments that were identified along the corridors. In case of livestock “on hooves” however, the strategic partners sought were the African Union Inter-African Bureau for Animal Resources (AU-IBAR) and the Intergovernmental Authority on Development (IGAD). In addition, strategic collaboration of the Common Market for Eastern & Southern Africa (COMESA) and the East Africa Community (EAC) were sought.

The assignments identified opportunities of trade, constraints to trade, potential investments as well as policy & regulatory actions at country & regional levels required to ensure higher returns to investments; and how to enhance water security, food security, and improved community livelihood especially the gender & youth dimensions through agricultural trade. This paper presents the key results of the assignments.

3. Harnessing the potential of agricultural water in the Nile Basin through integrated watershed management

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Hezron (50 years) currently works for the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) as the head of Natural Resource Management and Biodiversity Programme. He has previously worked as a long-term consultant of the World Bank (Nairobi) in coordinating the preparation of the 2nd phase of Lake Victoria Environmental Management Programme – a programme being implemented in 5 countries (Burundi, Kenya, Rwanda, Tanzania, and Uganda). In addition, Hezron has worked with the European Union in Nairobi for 5 years as the Manager of the Biodiversity Conservation Programme. Hezron has also thought at Kenyatta University in Kenya i.e, (i) Economics of land and water resource management and (ii) Social participation in community development. In total, Hezron has 23 years of professional experience in natural resource management as a researcher, lecturer and manager. Hezron has an undergraduate degree from Moi University (Kenya) in natural resource management with a bias in forestry. In an attempt to understand the role of forestry resources in rural development, Hezron proceeded to undertake a Master of Arts degree in Environment, Development and Policy at Sussex University (UK) and a PhD in environmental economics from Strathclyde University.

ABSTRACT:

The low input agriculture widely practiced by farmers in the countries of Nile Basin cannot meet the growing demand for food and cash income whilst the high risk associated with the variable weather conditions acts as a major constraint to increased uptake and utilization of production technologies that have the potential to increase productivity while maintaining or improving the resource base. This paper is based on the findings from a number of initiatives supported in the Nile Basin Countries by the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA). One such on-going initiative is 'Improving Agricultural Water Productivity under varying and changing climatic conditions. The initiative seeks to increase the availability and productivity of water in smallholder rain-fed and irrigated agriculture at both farm and catchment levels and thereby alleviating the negative impacts of variable rainfall.

Two watersheds were identified in each of the participating countries (Kenya, Ethiopia, Madagascar, Eritrea and Rwanda) to serve as field laboratories for future work on integrated watershed management (IWM). From the surveys conducted in these watersheds, it was noted that the majority of the residents (over 80%) were full time farmers who relied

entirely on production from their farms to meet all the food and income needs of their households. However, majority of them (over 50%) live below the poverty line (on less than US$ 1 per person per day) and experience serious food insecurity for most months in a year. In Kenya, for instance, over 50% of the households in both watersheds lacked sufficient food to meet the family needs. The situation was the same in Ethiopia, Madagascar and Eritrea where over 44, 45 and 55%, respectively, of the households were food insecure.

Through the IWM approach adopted by the initiative, several productivity-enhancing technologies were evaluated and promoted with remarkable success. In Kenya, for instance, out of 198 farmers trained on terracing to conserve soil and water and improve productivity, 252 constructed them on their farms and realized increased maize yields despite the seasons being bad. Similarly, of the 146 farmers trained on pitting to harvest run-off and grow fodder, 251 managed to dig over 20,000 pits on their farms and plant Napier grass for their livestock. The extra adopters learnt from their neighbours who attended the trainings. About 1658 farmers were mobilized in Ethiopia to construct 2970m of soil bunds and cut-off drains worth US$ 4736 to control soil erosion in the Ketchema and Adulala watersheds. Six households in Eritrea planted sorghum using tied-ridges after SWC training and harvested very good yields despite the season being very poor.

Majority of the technologies adopted were mainly for SWC due to their perceived benefits. In Kenya, the benefits included decreased run off and erosion (81%), increased water infiltration (56%), improved soil moisture conditions (48%) and improved soil physical properties (38%). Yields and income increased significantly across the countries as result of these interventions. In Kenya, for instance, maize yields increased from less than 500kg/ha at project inception to between 1.2-3.2t/ha. Hence, over 70% of the watershed communities are now food-secure. In addition, farmers were able to produce over 10 tonnes of Napier grass compared to “zero” at project inception and now they have sufficient fodder to feed their animals, especially in the dry seasons. Similarly, adoption of improved rice varieties increased rice yields from 2 to 4 t/ha whilst onion yields increased from 10 to 25 t/ha due to prudent management of water and other inputs. As a result, watershed communities in Madagascar are now 60% food-secure and are able to earn additional income of about US$ 2500 /ha/year from the sale of onions and potatoes during off-season. The same applies to Ethiopia and Eritrea. Farmers in Ethiopia were able to harvest and sell 102 kg of honey worth US$ 568 from just 10 out of 28 beehives installed by the project. About 22 households benefitted from these proceeds. They were also able to harvest and sell pasture/grass worth US$ 10,749 from the hillside rehabilitation activity initiated by the project and about 720 families benefitted from these proceeds. In Eritrea, sorghum yields increased from 600 kg/ha at project inception to 1.5-2t/ha due to SWC initiatives; farmers also earned US$ 930 each from agroforestry activities in just six months.

Finally, through field experimentation, simulation modelling and field surveys the project has generated key scientific findings that will inform future work on enhancing agricultural water productivity in the region through IWM. Some of the findings include:

1) There was no difference in the rate of adoption of agricultural water management (AWM) technologies between male and female-managed farms. Further, there was also no difference in farm productivity or soil fertility between farms managed by either gender resulting from these technologies.
2) Investing in irrigation was 12.7% and 42.7% more costly than terraces and water harvesting respectively in maize production while under beans production, it was 55.5% pricey compared to the latter technologies in the two watersheds in Kenya. However, returns from irrigated maize and beans were 40% and 43.5% higher than other technologies, respectively. Thus, irrigation is more profitable than other SWC technologies and gives the highest returns during poor seasons (below normal seasons).
3) The use of downscaled forecasting was key in addressing agricultural water productivity in the drier parts of the Nile Basin Countries.
4) The high level of adoption of improved agricultural water management practices in the target watersheds in all countries clearly indicate that available technologies are acceptable to farmers if the same are tailored to meet the needs and requirements of the farmers with due consideration to their biophysical and socio-economic conditions compare to generalized recommendations targeting a given agro-ecology or administrative unit.
5) Mobilizing communities and enhancing their capacity to better understand the tangible and intangible benefits from the proposed interventions has much bigger impact than dealing with individual farmers. The watershed committees and innovation platforms established under this project played a vital role in increased adoption of technologies in all target countries
6) Market driven integrated watershed management provides the best-bet in enhancing the productivity of agricultural water in the drier parts of the Nile Basin countries.

4. Towards a remote sensing based operational decision support system for agricultural water and crop management in the Gash Delta – Sudan

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ABSTRACT:

Background

Water scarcity and food security are the important issues for the growing population in the arid and semi-arid zones. Water is becoming an increasingly scarce resource for agriculture and other competing uses. However, optimal use of water is hampered by insufficient infrastructure to capture these resources and knowledge on appropriate use. Smart and affordable technologies need to be adapted to customize farm management for smallholders.

The Smart ICT for Weather and Water Information and Advice to Smallholders is an innovative project implemented in the Gash Delta-Sudan, among four other developing countries. The developed tools can monitor plot specific information and generate advice to farmers, management and decision makers. The objective is to improve access to and use of

information that aims to produce more yield while increasing water use efficiency. The tools setup consists of a web portal service complemented by an SMS service to reach managers as well as local farmers.

This paper illustrates the potential of using the ICT as a decision support system for agricultural water and crop management in Gash, Sudan. Interesting results were obtained on the estimation of sorghum yield from biomass production, as well as how information on soil moisture availability has impacted productivity of sorghum, and cultivated onion.

Methodology and approach

Smart ICT technologies for transmitting agricultural information and advice to farmers and extension workers have been piloted. Appropriate information packages and communication technologies were established based on User Needs Assessments and expert knowledge from national partners. The setup of the project comprises a web portal service complemented by an SMS service. The web service facilitates the dissemination of spatial information, an important advantage of satellite-derived data. Extension officers can use this service to identify weakly performing fields, or zones within a field, and can communicate this to the farmer in case any anomalies are observed. For the individual smallholder farmers, an SMS service was designed to disseminate agricultural information and irrigation advice. This corresponds with the fact that most smallholder farmers do not have access to internet.

Figure 1 provides an overview of the system as it was designed for disseminating field-specific agricultural information and irrigation advice to the smallholder farmers and extension staff through Smart ICT channels. Using satellite information, ground data and meteorological measurements computation of crop water parameters that are indicative of the current fields' conditions were carried out. This results in a spatial database of relevant data layers for the entire Gash area. Registering individual farm locations through the web portal, enables users to view weekly updates of data related to crop growth and water use on these fields. The Irrigation Planner tool is also accessible through this website, giving direct advice on when to irrigate each field given the weather forecast and field-specific conditions.

Through the User Needs Assessment the SMS was identified as the farmers' preferred way of receiving agricultural information. Therefore, an SMS service has been designed to summarize spatial information in a short message in the most meaningful way to the farmer. The SMS service also enables the farmer to access the Irrigation Planner service by sending information requests and receiving advice by mobile phone.

Several capacity building sessions were organized for training the farmers and extension staff in operating the services and interpreting the information that is disseminated. In addition, the farmers received continuous support throughout the project from the project.

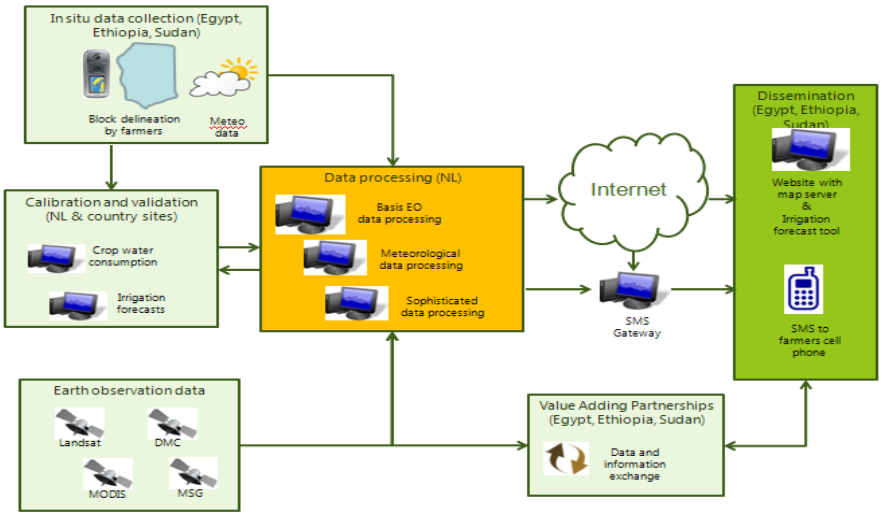

Figure 1: Overview of the Smart ICT system design.

The delivered data on crop growth and agricultural water management are derived using the Surface Energy Balance Algorithm for Land (SEBAL). The SEBAL is an algorithm based on the energy budget reaching the earth's surface. It can compute the actual evapotranspiration by the crops, as well as the biomass production. High-resolution satellite images from Disaster Monitoring Constellation (DMC) and Landsat 8, supplemented by NPP VIIRS surface temperature, were used in operating the SEBAL algorithm for the Smart ICT project in the Gash.

The web portal "fieldlook-Sudan" was operational for 2012 & 2013 crop seasons and provides the agricultural information by measuring 9 parameters covering Crop Growth, Moisture and Minerals. The SMS service was operational during 2013 agricultural season. In the SMS service, average biomass production and water use efficiency for each registered user field is sent out every week to all registered users.

Key findings

The smart ICT techniques have been successfully piloted in the Gash Delta, in Sudan to support productivity increase, and contribute to livelihood improvement. Feedback from farmers shows that both 'push' weekly SMS and on demand SMS information was used in making informed decisions on crop and water management. The impacts of these decisions are decreased labour and pumping costs, savings in the limited groundwater, and better planning for agricultural operations.

Correlations were established between the sorghum biomass production and the actual crop yield at field level. Early informed decisions on food security can be made based on crop yield estimates from such correlations.

The information on biomass productivity and crop health e.g. NDVI are very useful for making informed decisions on crop loss claimed to the insurance companies.

The information collected by the Smart ICT project is very valuable for further research on optimal flooding days for different crops, making decisions on what type of crop suitable for

a specific soil. Ayoub Abu Fatima is an example for using the information to decide on soil suitability for cropping Aklamoy variety of sorghum. Ayoub has never cultivated Aklamoy in his spate field because he thinks the water holding capacity of his field is not adequate for cultivating this variety of sorghum which takes 120 days. Based on an advice given to Ayoub, he decided to cultivate Aklamoy in 2013 and achieved a good yield of 31 sacks/ha. The different parameters for Ayoub field during 2013 season shows 17 days of inundation, a healthy and strong growing crop throughout the season, average NDVI=0.43, and an evaporation deficit fluctuating around an average of 5.25 mm/week.

Another example is the influence of water shortages on onion yields of Faky Mahmoud, who attained the lowest onion yield of 3.5 sacks/F (8.3 sacks/ha) compared to an average of 13 sacks/F (31 sacks/ha) due to two spells of water shortage.

Conclusions and recommendations

- Remote sensing can play a pivotal role in decisions regarding agricultural water management; flood forecasting and planning
- Successful application of 'fieldlook' information in real time decision making in the Gash;
- Further analysis of the collected information will help promoting the decision making in agricultural water and crop management.
- Limitations such as farmers' illiteracy, limited electricity coverage in the field were overcome;
- There is a high potential for using the tool in decision making in the future at different stakeholder levels.
- It is recommended to pilot test the tool in Gezira Scheme

5. The Impact of Climate Change on Crop Productivity in the Eastern Nile Basin of Sudan

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Khalid Guma Biro Turk graduated in 1999 from the University of Gezira, Sudan, received his Msc in Agricultural Engineering from the University of Khartoum, Sudan and a PhD in a Natural Sciences "Geosciences" from the Dresden University of Technology, Germany. Since 2004 he is a lecturer at the Department of Agricultural Engineering, University of Gadarif, Sudan. Currently he is a researcher at the Hydraulics Research Center (HRC), Sudan. His research areas of interest are the applications of remote sensing & GIS in land use systems assessment, sustainable land use management and the impacts of land use/land cover changes on soil prosperities.

ABSTRACT:

Nile Basin (NB) countries, as many parts of the world, are vulnerable to climate change. Climate change proved to affect agricultural sector as well as other sectors. There are different varieties of agricultural products in the NB because of different climatic zones that vary from the arid and semi arid in the North to tropical climates in the South. Therefore, it's important to encourage agricultural trade among the Nile basin countries. The present study is a part of project funded by the Nile Basin Capacity Building Network (NBCBN) under the title "Integration Climate Change Uncertainty to the Development of the Nile Basin - (ICCUD-NILE)". The project phase 1 is concentrate in strengthening regional resilience to cope with/adapt with climate change Future risks. A pilot project was selected to study the effect of climate change on agricultural productivity of Gadarif rain-fed agricultural scheme, Sudan. The research team includes five interdisciplinary researches from Sudan and Egypt.

This study was conducted in the Eastern NB of Sudan at Gadarif Region of Sudan in order to investigate the effect of climate change on agricultural production. Moreover, efforts were made to analyze rainfall and temperature variability and correlate them with some agronomical parameters. Historical temperature and rainfall data were used to predict the future temperature and rainfall based on statistical predictions, for the period 2012 – 2052. Rainfall data were collected from eight agricultural schemes namely; Gadarif, Gadambalia, Simsim, Umsinat, Doka, Hawata, Shwak and El hori. Nevertheless, only temperature data for Gadarif city have been used in the analysis and considered as representative station for Gadarif agricultural schemes due to unavailability of data from the other stations. Time

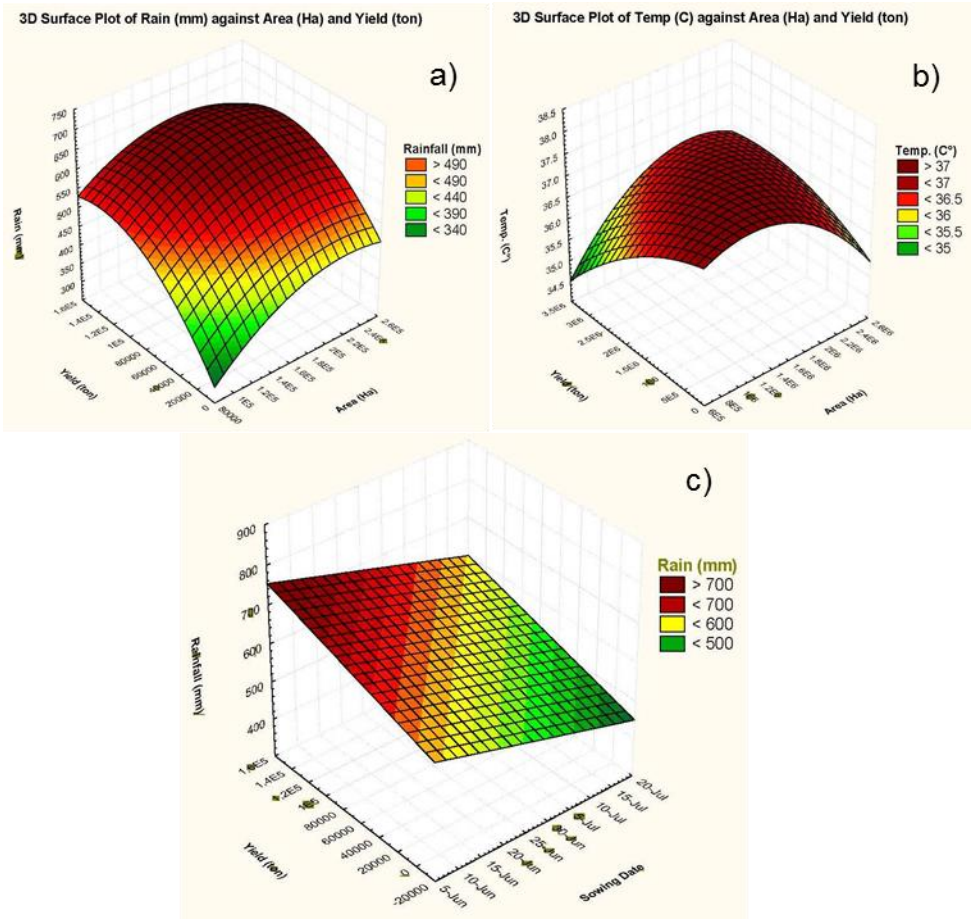
series (TS) analysis statistical method was applied to perform rainfall and temperature prediction as well as to show the effect of rainfall amount and temperature on crop yield. Principal components analysis (PCA) was used to describe the relationship between the rainfall, cultivated area and crop yield.

Results show that, Temperatures increase more in the months (December – February) than in the months (March – November). Excluding the (December – February) months with low correlated temperatures, result in an average increase of monthly mean temperature by 5% for the months (March – November) in the period 2020 – 2052. Rainfalls are concentrated in the period April to October, following a dry period between November and March. The highest mean monthly values are approximately 215 mm in during August in Umseinat, 213 mm for SimSim and 211 mm for Doka. The Gadarif station has the highest mean monthly value, which is 193 mm in August and register total monthly rainfall of 459 mm and 342 mm for the years 1982 and 1999 respectively. Rainfall trends; decrease or increase vary from month to month and from station to station. The correlation is generally weak and the relatively high-obtained correlations depend on station and vary between June and September. Weak correlations mean high uncertainties were involved in predicted rainfall. The highest correlation was 0.464 for El hori station in September. The annual rainfalls increase for all stations except for Gadambalia and Shwak stations for which the annual rainfalls decrease. The standard anomaly index (SAI) was 2.3 for the year 1999 indicating that, it was the wettest year. The year 1984 was the driest year with SAI of -2.1throughout the study period.

Also, the results revealed that, high productivity is associated with high rainfall and low temperature. Nevertheless, low productivity during extreme events “low rainfall” was observed also in the early 1980s and 1990s. Sorghum yield is increasing with the increase of the rainfall and cultivated area. Not only variation in rainfall affected the crop productivity, but also its distribution during the season. Even distribution of rainfall throughout the growing season was hardly to be achieved in the recent years. This normally has adverse effects on crop productivity. There is a continuous trend of sowing date shifting due to rainfall variation. Early sowing date, normally coupled with highly rainfall and high crop yield. Sorghum yield is obviously affected by the shifting in sowing date during 1980 – 2010. Nevertheless, for the same period there was no yield optimisation for the all sowing dates.

We conclude that, the temperatures increase for the period 2020-2052 will have significant consequences on the ecosystem including agriculture. The warming trends seem to be particularly strong since the early 1980s. Therefore, the master plan of the Gadarif Region should consider both rainfall variability and temperature increase and their effect on the existing ecosystem. Shifting in the sowing date is mainly due to rainfall variability from one year to another. Farmers normally used their local knowledge to estimate the suitable amount of soil moisture, which is sufficient for planting at the beginning of the rainy season. Late sowing results in short growing period and thereby reduced crop yields. Hence, new

measures that are compatible with new situation should be adopted. The applied methodology in this pilot project could be used for the other areas of Nile Basin.



3D surface plots. a) Rainfall versus yield and cultivated area; b) temperature versus yield and cultivated area; c) rainfall versus yield and sowing date.

Session IV – Cooperative Water Development and Management

Sub-theme: Knowledge systems and epistemic communities

Objectives: The session looks at practices of cooperative water resources development and management in the basin. The objective is to exchange knowledge and experience and to create a common understanding on what win-win opportunities can be tapped through cooperative approaches in water resources development and management.

Presentations:

1) The Kagera River Basin: A Framework for the Sharing of Resources, by Dr. Verno Jonker, Aurecon, South Africa

2) Reservoir Filling Options Assessment for the Great Ethiopian Renaissance Dam using a probabilistic approach, Ms. Azeb Mersha, NBI

3) Modifying the Operation Rules of Jebel Aulia Reservoir for higher reservoir levels, Mr. Ahmed Hayaty, Hydraulics Research Center, Sudan

4) A simplified method in assessing reliabilities of a multipurpose reservoir using equivalent catchment concept and stochastic modeling and simulation techniques, The case of Lake Tana, Ethiopia, Mr. Mulugeta Azeze Belete, Bahir Dar University, Ethiopia

5) Challenges and prospects of community-based gully rehabilitation in the Birr Watershed, Upper Blue Nile Basin, Ethiopia, Mr. Getaneh K. Ayele, Bahir Dar University, Ethiopia

1. The Kagera River Basin: A Framework for the Sharing of Resources.

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Verno Jonker has close to two decades of experience as a water resources engineer in the fields of catchment and flood hydrology, river hydraulics, integrated water resources management and operational decision support systems. He obtained his PhD in civil engineering from the University of Stellenbosch in 2002, and earned his first degree in Civil Engineering from the same university. He has worked extensively in Africa and recently fulfilled the role of Team Leader for the NBI project on NB-DSS applications. He is currently a Technical Director with Aurecon and is based in Cape Town, South Africa.

ABSTRACT:

Background

The Kagera River is the single largest river in the Lake Victoria Basin, with the catchment comprising much of Burundi and Rwanda, and smaller portions of Tanzania and Uganda. A framework for joint management of the Basin's water resources was established through the development of a transboundary Basin Development Plan, with sustainable development-oriented investments, to improve the living conditions of people and to protect the environment.

Poverty in the Basin is endemic and land pressures extreme. The situation could be a recipe for conflict, yet the Basin holds significant opportunities for win-win development. Cooperative water resources management can serve as a catalyst for greater regional integration.

This paper highlights the success factors, challenges encountered and lessons learnt during the development of the Kagera Basin Plan with a focus on the sharing of transboundary water resources.

Methodology and approach

Strategic Planning included collective development of a vision and objectives for the Basin, preparing a prioritized portfolio of projects and programmes, modelling Basin-wide development scenarios and developing IWRM-based strategies, in the quest for socio-

economic good and an equitable user mix. Existing water resource project plans were evaluated for possible inclusion.

Projects evaluated included hydropower projects, larger and smaller dams, irrigation schemes, domestic water use, and water quality projects. To these were added watershed and wetlands management programmes necessary for sustainability. The Prioritised Portfolio of Programmes and Projects is aimed at recommending a "*package of structural and non-structural options providing security of access to water and an environment that is resilient to change*".

The project portfolio includes structural investment projects and supporting non-structural projects, seeking to share and to optimise the use of available water in the Kagera Basin, whilst minimising negative impacts both locally and on Lake Victoria and the greater Nile Basin. Through the implementation of the project portfolio, water would be provided in a sustainable manner for people (domestic supply), economic activities (irrigation and hydropower generation) whilst limiting environmental and social impacts of such schemes and for environmental improvement (catchment-, wetlands- and water quality management).

A key element in the selection of investment projects for initial screening was that of 'bankability' and screening based on social, environmental, economic and Basin-sharing criteria. The proposed project portfolio (Aurecon and Wema, 2012) seeks to provide security of access to water, an environment that is resilient to change, sharing of resources and optimisation of the use of available water in the Kagera Basin, whilst minimising negative impacts locally, on Lake Victoria, and on the greater Nile Basin.

The process followed that led to the selection of investment project is illustrated in **Figure 1**.

Figure 1: Workflow of the Development Plan phases

Project priorities were discussed in focussed interviews with key stakeholders and in workshops, where differing national priorities became evident but could be debated and accommodated. All basin countries showed a strong preference for multi-purpose schemes.
Drawing from the Basin criteria, the Basin vision and objectives, and on different development scenarios, 23 Basin strategies were developed. The Basin Plan, which focussed on significant transboundary water infrastructure development, forms a subset of the final Implementation Plan.

Key findings

Successful development of the Basin Plan was achieved through a good Basin knowledge base, gaining a good understanding of key Basin issues, and effective interaction with and buy-in from a wide range of key stakeholders of the Basin countries.
Basin-sharing is not dependent on matching projects, and is best managed through a continuous audit of overall water use by member states, with projects based on agreed principles. The most suitable solutions for utilization of the Kagera River Basin were considered at the basin scale, within the larger institutional framework.

Conclusions and Recommendations

A challenge that had to be overcome was the differing priorities of the Basin countries, and the need of each country to embrace an equitable sharing in the benefits flowing from the Basin Plan. The range and diversity of projects and programmes on the table proved adequate to reasonably align the prioritising of projects on good-practice principles with the priorities of the countries.
The Basin Plan (Aurecon and Wema, 2012) recommended that a number of the proposed large-scale investment projects, most of which focused on large water storage dams for multipurpose uses, be subject to further evaluation. Projects from the Prioritised Portfolio being implemented include the Rusumu Falls Hydropower Scheme, Muvumba, Ruvyironza, Kabuyanda and Ngono Irrigation Development and Watershed Management Projects.
The cornerstones of successful development of the sustainable management framework for the Basin is an excellent Basin knowledge base, good understanding of key Basin issues, interaction with and buy-in from a wide range of key stakeholders of the Basin countries, and a focussed, fundable, prioritized and sequenced Development Plan and associated Action Plan.

2. Reservoir Filling Options Assessment for the Great Ethiopian Renaissance Dam using a probabilistic approach

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ABSTRACT:

Introduction and Objective

The River Nile has a great potential for development in the Eastern Nile Basin but if this development is not planned and coordinated well it can be the source of conflict in the basin. The current tension observed between Egypt, Ethiopia and Sudan is an example of the water stress in the region and the growing need for development. With this respect the Eastern Nile Riverware model was developed by the Eastern Nile Technical and Regional office to support the investigation of development options for best utilization of the resources and promote benefit sharing among the Eastern Nile countries. The Model was calibrated to historical conditions, and configured to the baseline representing the current infrastructure and known management practices. In this paper it is being used for a case study to assess alternative reservoir filling options of the Great Ethiopian Renaissance Dam which is around 30% in the construction phase and expected to generate 6000 MW of electricity, the biggest hydropower plant in Africa, with some 74 BCM of storage capacity.

Methodology and Approach

In order to minimize the impact on existing infrastructures a well-studied and coordinated filling option is required since the natural flow of the river at the dam site is 48 BCM per annum on average. The study follows a probabilistic approach in presenting the results to account for future hydrological uncertainties. This was possible by running 35 traces or realization of hydrology and a scenario matrix to represent different filling periods and downstream conditions. A total of 525 runs have been made and results are presented for possible impacts and power generation at the dam using statistical and probabilistic approach.

Key findings, conclusions and recommendations

The scenarios are then analyzed to indicate the pros and cons of each case in order to open the table for negotiations between the stakeholders and inform the associated probabilistic risks with each of them for all parties. This approach is expected to replace the classical method of evaluating the impact of filling under three hydrological conditions i.e Wet sequence of years, Dry sequence of years, Normal or Average condition. The classical approach only presents decision makers with extreme cases which is still an obstacle for negotiation as each party favors one of those conditions. The approach followed by this paper can provide the probability of energy shortage, energy production, water shortage, water saving, water level drop in downstream reservoirs below a threshold value, probability of meeting/not-meeting environmental flows, evaporation losses, etc. during the filling of the reservoir by running multiple traces of hydrology. This will allow all parties to be aware of the risks in each scenario.

The objective of this paper is not to identify the best scenario for filling the dam, but rather to present the stake holders with a tool and a wide range of results to weigh the pros and cons of each and reach on a common understanding.

Analysis of results are summarized and presented below.

Table 1. Average annual percentage change of the three filling scenarios from baseline until the system fully recovered. (13 Years From the start of filling). 173 masl for initial water level of High Aswan Dam.

Parameter	Change from the current situation during the first 13 years from the start of impoundment.
Egypt hydropower production	8.34 % (Decrease)
Ethiopia hydropower production	400 % (Increase)
Sudan Hydropower production	14.47% (Increase)
Ethio-Sudan border (El-diem station) stream flow.	3.33 % (Decrease)
Nile at Aswan station stream flow	8.02% (Decrease)
Water released from High Aswan Dam	3.01 % (Decrease) *operation of the dam unchanged.

The effect of impoundment on agricultural production in the Main Nile can be roughly approximated by calculating any potential shortage in water use and using the agricultural production value for Egypt as almost all of the agricultural water use in the Main Nile sub-basin is in Egypt (The Agricultural value of 1 MCM of Nile water in Egypt can be extracted from the Agricultural Production Value for Egypt from FAOSTAT and Egypt's current use i.e. 55.5 BCM). The agricultural losses in Sudan can also be quantified in the same manner.

Table 1. Average annual system shortage in the Main Nile in MCM and associated loss in Million USD. Given as the 13 years average from the start of the filling for the three filling scenarios from baseline until the system fully recovered. 173 masl for initial water level of High Aswan Dam.

Scenarios	Average annual system shortage in the Main Nile in MCM.	Average annual value of the agricultural loss in Million USD[1]
Current Situation (Base-case)	0	0
5 Years filling strategy for GERD	129.208	69.612
6 Years filling strategy for GERD	59.1667	31.876
7 Years filling strategy for GERD	0	0

[1]The Agricultural Production Value for Egypt was extracted from FAOSTAT. Net agricultural production of Egypt (for 2012) is 21.901 Billion USD.

Flood Damage

The estimated average annual damage in rural villages riparian to the Blue Nile and Main Nile in Sudan is about 25.77 Million USD (Eastern Nile Flood Preparedness and Early Warning Project report ENTRO, 2009). After regulation the risk of flood damage in Sudan is almost completely eliminated as is shown in the Annex of the full paper for El Diem Gage flow data.

Simplified economic analysis of the different scenarios from energy perspective only:

The electricity selling price (not the economic value) in the three countries (current figures when the paper was produced) are Egypt: 0.0303 USD/KWh, Ethiopia 0.0261 USD/KWh and Sudan 0.03103 USD/KWh.

Note: Selling price is much lower than the economic value of electricity and this paper used selling price as a conservative approach.

With these assumptions the cost of shifting from 5 years filling plan to a 7 years filling plan from electricity point of view is 14,347.25 GWh or 14,347,250,000 KWh multiplied by basin average cost i.e 0.02941 USD/KWh. Which is around 418 Million USD.

Note: This analysis didn't assume any appreciation or depreciation in either the currency or the selling rates.

To conclude, there is a systematic way of addressing the concerns regarding the filling and long term operation of the GERD. The dam offers a development window for the much needed growth and cooperation in the region and downstream impacts can also be managed and well-studied with an all-inclusive process using tools like Riverware and such. As is indicated in the Annexes of the full paper, there is no significant harm expected from the dam if we follow an appropriate filling mechanism, and the long term benefits as a climate shock absorber, flood risk mitigation tool and more importantly a power hub in the region is reflected in the analysis results.

3. Modifying the Operation Rules of Jebel Aulia Reservoir for higher reservoir levels

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ABSTRACT:

Introduction

The Jebel Aulia Dam (Figure 1); the only dam a cross the White Nile River in Sudan has a significant value for irrigating several agriculture schemes along its sides. The dam was completed in 1937 to provide river flows for Egypt during summer flows. Unlike the Blue Nile, the White Nile is a very flat and wide river. Large variation of the reservoir levels means wider variation of the wetted area – an unfavorable condition for the various pumping schemes abstracting from the White Nile upstream the dam. Therefore, historically, there was always the tendency to maintain high reservoir levels for the upstream pumping stations. However, this is restricted by other constraints of the operation policy of the reservoir. In this paper, the possibility of modification the operation rules of the reservoir is investigated in-order for sustainable irrigation. The operation of the dam serves two main requirements:

1. Providing sufficient command level to the pumping schemes upstream the dam,
2. Supplying downstream demands during recession time of the Blue Nile (around 65 M m3/day in the Main Nile), and emptying usually commences during the second period of March.

The average operating policy during the last 20 years, shows start of filling around third week of June to reach level 376.5 m by July 31st. The emptying usually starts by mid March, and ends by May 15th at level 373.2 m.

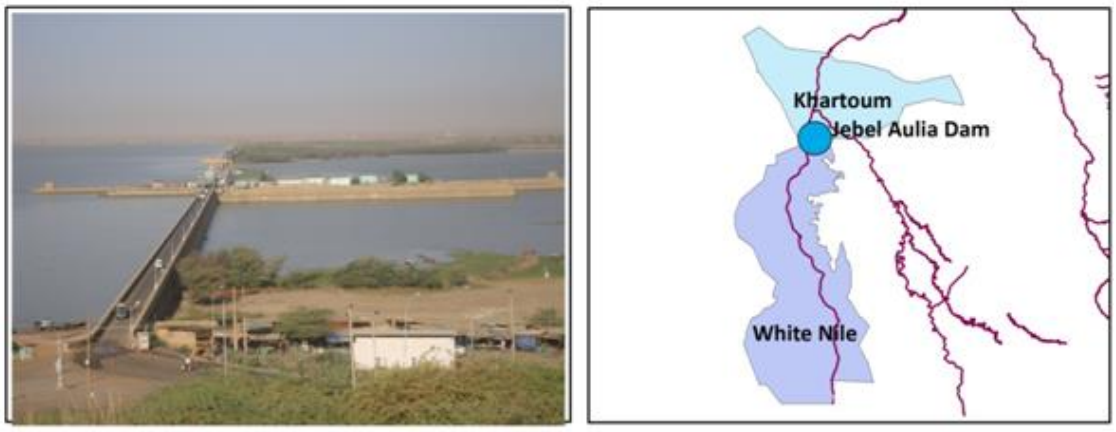

Fig. 1: Jebel Aulia Dam location

The main objective of this research was to provide advice on the modification of the Jebel Aulia Reservoir operation to meet the requirement of agriculture schemes along the White Nile River, and assess possible impacts. Therefore, the specific objectives are:

(i) Attempt different filling/emptying dates, e.g.,

(a) Starting earlier filling of the reservoir to obtain a level of 377.50 m or 376.5 m by the first of July instead of 31 of July. This may allow pumping schemes to start summer season (sorghum, cotton) by early July.

(b) Delaying reservoir emptying from 15 of March to the 30 of March to allow for sustainable irrigation for the winter crops.

(ii) Assess the impacts of the modified operation scenarios on all possible uses, including: downstream requirements in the reach Khartoum to Merowe, maintenance of the dam and the embankments, floodplain agriculture, evaporation, and hydropower.

Methods and Approach

First, water balance model was applied to the existing operation policy, and evaluated outputs parameters, viz: (i) number of days of high reservoir levels, (ii) area of flood plain agriculture, (iii) open water evaporation from the reservoir, (iv) satisfaction of downstream water demands, (v) duration of minimum water level, required for maintenance, and (vi) hydropower generation. The same model was then used for modified operating rules, and same parameters were evaluated. The most optimal operating policy has been suggested.

Three modified operation rule scenarios were attempted in the analysis (scenario 0 is the average existing operation rule 1989-2009). The start and end of filling and emptying dates, as given in Table 1 below:

Table 1: Different operation rules: existing, and modified

Scenario	Emptying		First Filling to 376.5 m		Remarks
	start	End	start	End	
Scenario 0	15 March	15 May	15 June	31 July	Mean operation 1989 to 2009
Scenario 1	01 April	15 May	15 June	15 July	Max = 377.2 m, Min = 373 m
Scenario 2	01 April	15 May	01 June	01 July	Max = 377.5 m, Min = 372.5 m, requested by WN State
Scenario 3	01 April	15 May	10 June	31 July	Max = 377.2 m, Min = 373 m

Results

- The water levels obtained for different scenarios allow acquiring good operation level to meet the requirements of the White Nile Pump Schemes.
- The results showed that the impact of evaporation loss for different scenarios is insignificant.
- The annual hydropower production is estimated to be 66, 71, 74 and 71 GW/year for average operation rule, scenario 1, scenario 2 and scenario 3 respectively.
- The impact on floodplain agriculture areas for different scenarios is significant in some months in particular during March and July.
- The gates maintenance period will be affected by reservoir operation rules modification since the filling starts after 30, 15, 25 days after the low level

The impact on other factors of the water use in Jebel Aulia reservoir (evaporation, area of Guroof, downstream release, etc.,) is given in Table 2. Downstream demands have been satisfied by scenario 3. This is possible because of the increased downstream flow from Roseires reservoir after heightening.

Table 2: different Summary of operation modification impact on other factors of the water

Scenarios	Evaporation increase 10^9 m^3	No. of days of h>= 376.5 m	Number of days of h <373 m	Hydropower GWh/year	Positive impact on Guroof area in March
Scenario 0	0	236	50	66.03	+++
Scenario 1	0.37	266	34	70.95	+
Scenario 2	0.58	272	27	74.20	+
Scenario 3	0.15	250	30	71.20	+

It is clear that evaporation loss doesn't change much compared to existing scenario, about 11, 17, 4% respectively for Scenario 1, 2 and 3. The annual hydropower production showed small increase of 7.5%, 12.4%, and 7.2% for the three scenarios compared to baseline scenario. The flood plain areas (guroof) were affected significantly by the three scenarios. Highest decrease in area found for the two weeks of March. The time required for gates maintenance (minimum operation level), will reduce from 50 days for base line scenario (average of last 20 years), to 34, 27, and 30 days respectively at a level of 373 m for scenarios 1, 2, and 3 respectively. However, our discussion with the operation engineers reveal that, longer time for minimum operation level may not be strict requirements if certain precautions were provide to speed up maintenance of the gates.

Conclusions

This study concluded that it is possible to modify the operation rule via emptying the reservoir in the first of April and filling it to the level of 376.5 m by 31st of July. From the above mentioned points, scenario 3 was found to be the best operation rule among others and it is recommended to be used.

4. A simplified method in assessing reliabilities of a multipurpose reservoir using equivalent catchment concept and stochastic modeling and simulation techniques, The case of Lake Tana, Ethiopia

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ABSTRACT:

Lake Tana, the largest natural fresh water reservoir in Ethiopia, is located from 11.62^0N to 12.31^0N latitude and from 37.01^0E to 37.64^0E longitude with average natural altitude of 1786meter above sea level (m asl). At similar elevation the lake has a surface area of about 3050km^2 and storage capacity of 29km^3. The Lake has a maximum depth of 14m and mean depth of 9m. The drainage area of Lake Tana sub basin has a size of 15,320km^2. The lake is fed by four major perennial rivers namely Gilgel Abay, Reb, Gumara, and Megech, and several seasonal streams. It is the head water of Abbay (Blue Nile) river which is the only natural out flowing river from the lake. Lake Tana is one of nature's special gifts to Ethiopia with unique and diversified socioeconomic benefits. The Lake and its sub basin are endowed with good potentials of water and land resources and have been identified as one of the most important area for various socioeconomic developments by the federal democratic republic government of Ethiopia. In recognition to this some national and regional water resources projects of various kinds are developed and the development of some more additional projects are still going on and some more will also be realized very quickly in the near future.

The available hydro-meteorological data in the sub basin are very scanty. The sub basin hydrology and water resources systems are not well studied and documented in scientific journal articles. However, there are some projects and master theses studies and very few journal articles. Very high discrepancies are observed in many of the water balance terms of the Lake in most of these studies. Thus it appears very vital to ensure the sustainability and

viability of all ongoing and envisaged development plans in the sub basin while maintaining the natural integrity and health of the ecosystem. The conventional approach doesn't work because of data limitation. In view of this an attempt is made to conceptualize the sub basin's water resources systems problems in a simplified way, in light of the available data, by using a hypothetical equivalent catchment and net supply concept. The application of the concept helps to disregard the concern in estimating each terms of the Lake water balance and leads anyone to assess and measure sustainability criteria directly by using the net supply series of the equivalent catchment. A stochastic modeling and simulation techniques are used very effectively in handling the problem. The purpose of this article is, therefore, to introduce the importance and application of equivalent catchment and net supply concept in assessing the storage-yield characteristics and performance measuring indices of Lake Tana.

The stochastic modeling effort shows that a first order autoregressive model and a normal distribution can adequately represent the deseasonalized series of the net supply. Using this model different synthetic net supply series have been generated. Using the historic and the synthetic generated series of the net supply different simulation runs have been carried to evaluate the storage-yield characteristics and performance measuring indices of the Lake. As a result it has been ascertained that an additional active volume of 4.73BCM has been created by regulating the Lake to balance the mismatch between supply and demand. Besides, it has been revealed that the most viable minimum operating level of the Lake is 1784.55m asl. It has been also identified that more than 10% reduction in net supply capacity of the sub basin as a result of upstream irrigation developments has a serious consequence in the reliabilities of the services offered by the Lake and in significantly reducing its average surface elevation.

The conceptualization and subsequent modeling and simulation works are very simple that can be easily applied and used as guiding tools in the planning and management practices of the sub basin water resources systems and in other areas with similar problems in Nile basin and elsewhere. It is an alternative new and simple approach that may be taken as an agenda by the scientific community in the Nile Basin for making further dialogue and hence enhances the knowledge sharing, cooperation and also confidence building in resource utilization. This will facilitate and strengthen the efforts for developing more advanced and robotic water resources systems planning and management tools in the basin.

5. Challenges and prospects of community-based gully rehabilitation in the Birr Watershed, Upper Blue Nile Basin, Ethiopia

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ABSTRACT:
Although erosion in the Ethiopian highlands has been occurring for thousands of years, rivers sediment concentration has increased two to three fold during the last fifty years, reducing crop and livestock production and the volume of irrigation water stored in reservoirs. Gully erosion in particular has become much more severe and is a major cause of increased sediment loads. This paper describes the process and potential outcomes for a community participatory gully rehabilitation project conducted in the Birr watershed. In this watershed, gullies are deepening and widening and are rapidly advancing upstream. We used a participatory watershed management process and measured pasture production and sediment deposition to assess preliminary outcomes. The first step in the gully rehabilitation project consisted of discussions with the religious leaders and local respected elders, followed by meetings with local village farmers about approaches to rehabilitate the gull. Initially, the local community was of the opinion that it was impossible to rehabilitate

existing gullies, because the gullies were created by their God to punish them for acts against His will. However, after further discussions and a visit to a rehabilitated gully, a consensus was reached to rehabilitate a 0.71 ha upland gully that was advancing into the grazing land in the middle of a village consisting of twenty two farming families. The twenty two farmers of the community and surrounding farmers came to the agreement that each would contribute labor and wood to fence for the protection of the gully and share equally the grass at the end of the rainy season. The rehabilitation measures were cutting the gully head at $45^0$and constructing check dam from locally available materials; soil, stone and wood; in addition grass and *Sasbania Sesban* were planted. The estimated forage yield after *one* rainy season in the gully closure were 8.36 tons, based on local demand, the monetary value of the forage yield is 10,120 Ethiopian Birr. In addition, around 2,323 tons sediment was captured in one rainy season by physical and biological practices. The total return from gully rehabilitation including the value of retained nutrients was 58,997 ETB whereas the total cost was 5,684 ETB. Thus, the financial benefits outweigh than the costs by 53,313 ETB. Without consideration of soil nutrient retention value, the net return was 4,436 and the marginal rate of return (MRR; increased net benefit/increased costs) was 0.78. Therefore, the gully rehabilitation activities appear financially feasible even if only the value of forage production was considered. In addition, this study convinced farmers of the feasibility of gully rehabilitation. As a result, farmers have modified their soil conservation priorities: they asked the local District officers to allow their labor to be used for gully rehabilitation rather than digging deep infiltration furrows in the uplands. Although our results are preliminary and for a single watershed, they suggest that participatory community gully rehabilitation, involving religious leaders and local elders appears to have potential to decrease sediment concentration in rivers, extend the life expectancy of the reservoirs, and support increased crop and livestock production.

Session V – Nile Discourses: Evidence for "One Nile – One Family"?

Sub-Theme: Transboundary water governance
Co-convener: Nile Basin Discourse

Objectives: The session takes an empirical approach to look at Nile discourses in the political and technical arenas and riparian communities. The objective is to better understand the role of social capital formation and stakeholders' perceptions for transboundary cooperation, and exchange lessons from 15 years of Nile cooperation.

Presentations:

1) Discursive Institutionalism Analyzing the Evolution of the NBI Cooperation Discourse over the last decade (2004-2014), Mr. Ramy Lotfy Hanna, University of Sussex, UK

2) Governance of Transboundary Basins: Lessons learnt from NBI, Mr. Tom Waako, NBI

3) Political Economy Analysis of Good Enough Governance to Building Partnerships in Nile Co-operation for Confidence Delivery of Benefits, Mr. Donald Kasongi, Governance Links, Tanzania

4) Future Nile Vision: Technical and Hydro political Imperatives to Address Future Water Security and Sustainable Cooperative Development, Dr. Semu Ayalew Moges, Addis Ababa University, Ethiopia

5) Community Based Adaptation to Water under Climate Change as a tool for Conflict Transcendence in the Nile River Basin, Ms. Lama El Hatow, Erasmus University Rotterdam, the Netherlands

1. Discursive Institutionalism: Analysing the Evolution of the NBI Cooperation Discourse over the last decade (2004-2014)

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Ramy is currently a PhD candidate at the Institute of Development Studies (IDS) at the University of Sussex in the UK. His doctoral research explores the role of non-state actors in trans-boundary river basins, with a special attention to water security, land acquisition, and the political economy of energy-food nexus in Africa's Blue Nile. Ramy holds his Master degree in Environmental Studies from York University in Toronto with a specialization in sustainability, governance and water resources management. His working experience includes consulting and advising the Eastern Nile Watershed Management project, in addition to conducting the evaluation of the Nile Basin Discourse (NBD). His portfolio includes different assignments with IFAD, UNECA, AfDB amongst others.

ABSTRACT:

The Nile Basin Initiative (NBI) is the regional inter-governmental partnership that has attempted to promote a trans-boundary cooperative "discourse" in a complex river basin setting since 1999. The presentation examines the *evolution* of Nile Basin Initiative (NBI) institutional discourse over trans-boundary water cooperation throughout the last decade. The presentation attempts to do so by examining the typology of trans-boundary water cooperation (UNECE, 2014) and its corresponding benefits, vis-à-vis the Nile Basin Initiative investment programs through its 'all- inclusive regional platform for multi stakeholder dialogue, information sharing as well as joint planning and management of water and related resources in the Nile Basin'.

The research adopts a discourse analysis methodological approach to analyse the evolution of NBI's discourse. In this context, discourse is viewed as the interactive process of conveying ideas; whereas discursive institutionalism focuses on the substantive content of ideas and the interactive processes of discourse by which they are generated and communicated in given institutional contexts (Schmidt, 2008; 2010). By capturing the framing of "cooperation", I analyse the discourse of the NBI as a regional institutional actor that is entrenched in different policies, programs and projects that aim at advancing cooperative efforts in the hydro-political complex context of the Nile basin. To do so, investment projects and programs were mapped out and classified into the different categories of 'cooperation' based on a double reading of the analyzed sample of official NBI reports and communicative narratives. Data sources include NBI corporate reports, project reports, communication materials, speeches and interviews conducted by NBI officials. Analysed data and reports

include different years of publications from 2004 to 2014 tracing and highlighting the evolution of the term cooperation by the NBI throughout the last decade.

According to the UNECE (2014) trans-boundary water cooperation typology, types of benefits relevant to the NBI are mainly social, environmental and economic benefits "within the basin". The implemented projects and programs provide evidence for the progress of NBI over 15 years of technical cooperation over water resources (quality, quantity, conservation, ecosystems) using advanced tools and techniques, information systems, capacity development, collaboration, dialogue, amongst other tools. In terms of economic benefits beyond the basin and geo-political benefits, much still is to be achieved.

A key finding is that cooperation discourse is slowly shifting from cooperation over technical aspects of water management towards cooperation for benefits of water. This is justified by the progress that has been achieved through the study of multi-purpose projects to unlock the potential benefits of the basin (energy, fisheries, transport, agriculture and trade, etc…).The analysis realizes that the NBI discursive institutional approach promotes cooperation and a shared vision through different themes, practices, policies and rationalities. Much work is still needed for the Nile basin stakeholders to move to the stage of cooperating "beyond" water resources in a regionally integrated fashion. Although the cooperation discourse is slowly shifting from cooperation over technical aspects of water management towards cooperation for benefits of water, it requires multi-level cooperation (horizontal and vertical interactions) to integrate political will, knowledge, science, voices of local communities, innovation and capital in a dynamic fashion to address dynamic challenges. It also requires the evolution of discourse beyond sharing benefits towards a wider participation beyond traditional key players and institutions to engage and mobilise human and "social capital" within the basin including civil society, academia, epistemic communities, local communities, (responsible/innovative) private sector, amongst other emerging players.

In conclusion, evidence based on progress achieved during recent years as well as the results of different programs and projects indicate that there is a discursive evolution of the concept of cooperation within the NBI institutional setup from managing water resources towards sharing water benefits. Nevertheless, the evolution of the cooperation discourse within NBI is perhaps faster than the development and political realities of different stakeholders from the social and economic spheres. This requires a dynamic governance model where there is more interaction between social capital within the Nile basin, and the promotion of a discourse of cooperation "beyond" water.

2. Governance of Transboundary Basins: Lessons learnt from NBI.

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Mr. Tom Waako has been directly involved in Nile Basin affairs since 2003 as a Program Officer. Before Joining NBI, he served as a Senior Hydrologist in Uganda's Ministry of Water and Environment and was Uganda's National liaison officer with NBI. He has more than 20 years experience in water resources planning and management. He contributed to development and the implementation of the Nile Basin Initiative's Strategic Action Program I, and design and current implementation of NBI Strategic Action Plan 2012/2017.Mr. Waako is a Hydrologist, with a Masters degree in Engineering Hydrology and Water Resources from IHE, Delft, the Netherlands.

ABSTRACT:

Cooperation on shared water resources promotes wise use and sustainability of the finite resource. A strong institution facilitates a common understanding of the basin wide perspective and optimal practices in harnessing the resources.

Good Governance of Transboundary basins has gained recognition as a key factor to the wise use and sustainable management of the shared water resources. Transboundary institutions have distinctive roles in streamlining governance of shared river basins. They provide a platform for regional dialogue and enhance development of the water resources to optimal capacities.

Since its establishment, the Nile Basin Initiative (NBI) has nurtured regional policies and practices of transboundary water resources management and development in the Nile Basin. Riparian countries agreed on a common vision that has motivated the cooperation to date.

Prior to NBI, the basin was characterized by mistrust and negative perceptions among riparian states. Knowledge on the Nile water resources was hardly shared and therefore no common understanding of the opportunities and challenges, and the benefits of cooperation. There were no frameworks for transboundary management and development of the water resources. Capacity for cross border trade in beneficial areas was inadequate. Human, Institutional and investment capacities were inadequate and characterized by disparities among countries. Unilateral action informed by national development agendas, incognizant of regional needs was a common occurrence. Involvement of non state actors like civil society, private sector, and others was low.

NBI has transformed that paltry situation to a promising future. Trust and confidence has been built among the riparian states as reiterated by members of Nile-COM and evidenced by the ever growing portfolio of joint investment projects prepared. The technical basis for water resources management and development has been enhanced through capacity

development. Institutions have been facilitated with tools and equipment to carry out their functions. A wealth of knowledge is generated and informing policy and technical choices at regional and national levels. Regional Policy regime has been augmented with the Nile Basin Sustainability Framework and its associated policies and strategies. Strategic partnerships have been formed with development partners, including like-minded organizations. Despite being a transitional institution, NBI is phenomenal and has performed exceedingly well in delivering on its mandate.

Achievements notwithstanding, NBI has learned lessons from the 15 years of existence.

Policy guidelines, a participatory visioning process and clarity of roles of the different governance levels and management enable efficient and effective implementation of programs.

A parallel track, comprising of a political track, which refers to the Cooperative Framework Agreement, and the development track which comprises of the Programs was adopted by NBI member states. The Development track provides a motivation to promulgate a CFA as it demonstrates the benefits of cooperation. In essence, while CFAs provides an enabling environment for development, they are not necessarily a prerequisite for cooperative development.

Owing to lack of a CFA, there is no permanent river basin institution in place. NBI remains a transitional institution awaiting the coming into force of the CFA. Due to the urgency of implementing national development plans, unilateral action has thrived as the process of implementing the regional planning framework is lengthy. The gains realized to date risk being reversed as they are built on trust and confidence which can be a fragile achievement. The transitional nature of NBI also renders it limited mandate for its policies to be binding on the riparian states.

Subsidiarity principle was adopted for effective implementation of the strategic action program conceptualized as a parallel track of basin-wide and sub-basin parallel actions. The three NBI centres were formed to ease management owing to the large basin. Contingent challenges comprise of the blurred one NBI image, unclear hierarchical and institutional relationships.

Stakeholder engagement is a key factor for a productive cooperative process. Though it is a lengthy and expensive process, it results in enhanced commitments and ownership. Engagements through regional events like Nile Day, NBDF, National events are sustained. Although NBI is promoting knowledge based decision making, wrong perceptions about the Nile resource base are still prevalent. Uncertainty looms on the future of the Nile cooperation; whether it will be all inclusive, or by those that recognize the CFA, and the date this will happen.

Cooperation takes time and results are often not visible or easily measurable. This may lead to fatigue among the partners leading to the relegation of the cause. Cooperation among riparian countries is however seen as the only way NBI will achieve its desirable goals.

Sustaining effective communication remains pivotal to the success of the Nile cooperation. It glues the stakeholders together, highlights facts and clarifies the wrong perceptions. Involvement of key stakeholders and building strategic alliances with partners outside of the water sector will further enhance the sustainability of NBI. Strategic alliances with other institutions promote synergetic interventions.

Strengthening the coordination mechanism at national level remains a daunting task yet it is imperative for sustainability of the cooperation. National platforms ought to be nurtured. They champion sharing of information, provide a link of regional plans to national plans, oversee implementation of regional programs, articulates national priorities in regional plans, and convene the stakeholders.

NBI will continue doing more of its business and doing it better. A systemic and coordinated water resources management and planning is taking root. Data and information sharing will become a common practice. The established knowledge base will be continually updated. The water resources based development investment projects will be implemented as more transformational investment projects are continually identified and prepared. These efforts are expected to transform lives of the riparian population. The spirit of cooperation will continue growing leading to strong regional integration. A strong economic community is expected to emerge around the Nile Basin. NBI institutions are envisaged to provide leading centers of excellence in water resources fields. Overtly, NBI will contribute to long term political peace and stability within the region.

The purpose of this paper is to share the lessons learnt by NBI in promoting the transboundary development. The feedback will support in the process of continually improving the transboundary WRM&D of shared water resources.

3. Political Economy Analysis of Good Enough Governance to Building Partnerships in Nile Co-operation for Confidence Delivery of Benefits.

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ABSTRACT:

It is a *fait accompli* that transboundary co-operation in critical resources like water provides an opportunity for reciprocating cross-state trust, a prerequisite for partnership across sovereignties.

Partnership is therefore a governance issue rather than a delivery process. Understanding that governance is shaped by the combination rules, norms and institutions, Good enough Governance calls for a platform for questioning the variety of institutional changes and capacity-building approaches necessary towards a rational minimum of better governance within and across the riparian states for keeping the momentum of comprehensive partnership in the Nile Basin. Good enough governance, as a concept, suggests that not all governance deficits need to (or can) be tackled at once, emphasizing the need to understand the key drivers prioritizing and sequencing what needs to happen at every stage.

How do we explain the factors for effective partnership through tracking the basin-wide norms of good governance? How do the norms become the ethical basis for promoting sustainable partnership with respect to transboundary water management with social and human capital being at the heart of co-operation? What are the lessons for informing the future basin-wide consensus? Using a Political Economy Analysis of the pathways for cross-territorial partnership in the basin, the complex model of co-operation is examined through mirroring the Co-operation Framework Agreement (CFA) and the UN Water Convention on non-navigational waters, and underlining critical drivers of the co-operation. Learning from the complementarity between UN Water Convention for Non navigational water and CFA provide some useful background for strengthening partnership. The progress made so far in mobilizing social and human capital in the basin has largely been driven by jointly agreed

purpose clearly identifying justification for collective responsibility across partner states, the scope of co-operation reflecting the social, economic and institutional horizons to which partners should demonstrate commitment and openness to contemporary understanding of the dynamics affecting the Nile water particularly the irreversible threat of climate change.

Despite acknowledging the consensus on these factors, three elements seem to evade the process for building effectively mutuality: shared willingness for leveraging sustainability beyond just a shared vision, widely acknowledgement of incentives for sustaining social and human capital capital and defining pathways for local competence through capacity building. The three missing but critical factors for an inclusive co-operation for delivery of benefits to need to be addressed through effective engagement, a responsibility for policy entrepreneurs both in the inter-state Nile Basin Initiative (NBI) and the civil society family of Nile Basin Discourse (NBD).

The overarching conclusion is that while the current institutional framework sets a foundation for enabling the co-operation to yield the expected perpetual management of the basin, a considerable catch up with the less attended but critical drivers is necessary. Four emerging recommendations include: The need for strengthening the engagement with non-water but influential governance institutions covering both upstream and downstream member states (like EAC, IGAD, ICGLR, COMESA), Promoting context-specific and innovative communication strategies across communities using cultural competence, enabling competence-focused capacity building coupled with facilitating result-based sustainability dimensions amongst riparian communities.

4. Future Nile Vision: Technical and Hydropolitical Imperatives to Address Future Water Security and Sustainable Cooperative Development

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ABSTRACT:
This paper attempts to address the challenges of future water security and pathway to cooperative development in the Nile basin. In spite of growing water demand and future climate uncertainty in the Nile basin, there is hydropolitical, hydrological and technological possibilities that ensures physical as well as economical water availability in the basin under strict framework of cooperative agreement.
From hydrological context, the paper attempted to quantify the potential water gain in the system that improves the availability of water to the basin. FAO (2011) estimate shows that the total rainfall in the basin may reach 2000 BCM, of which Sudan generates 51%, Ethiopia 23% and Uganda 13% of the Nile basin total volume rainfall. Though it is highly variable and is the cause of rainfed agriculture failure in many parts of the basin, some part of this rainfall can be arrested through i) Improving at site water infiltration through technological innovations, ii) reducing non-productive evaporation water through converting into evapotranspiration (green water) and iii) Improving water availability through supplementary irrigation on the basis of efficient and effective water harvesting and watershed rehabilitation technologies. Secondly, Bahr El Ghazal looses almost all of the water generated from that sub-basin when it joins White Nile at Malakal (Sutcliffe and Park, 1999). It loses almost 11.3 BCM of flow out of nearly 12 BCM of inflow generated from the sub-basin. Only about 0.6 BCM outflow is contributed to the White Nile. There are potential storage possibilities in the upper reaches of the Bahr El Ghazal for generating hydropower to South Sudan and facilitating enhanced regulated flow during the dry seasons to the white

Nile without affecting the swamps behavior. Thirdly, the total water use efficiency in Egypt is about 51% (CEDARE, 2011). Likewise studies show that water use efficiency of large scale irrigation in Sudan is about 22 % (Mohamed et al, 2005). There is a wider scope and opportunity to improve system efficiency and unlock the lost water in the large scale irrigation schemes in lower riparian countries. Improving overall efficiency of irrigation schemes in the Nile basin may unlock tremendous amount of water from Nile. If, for instance, the agricultural water user of Egypt and Sudan is improved by at least 20%, it means unlocking about 5 BCM additional water from the system. These are some not all of the evidences that water can be gained in the system for beneficial use.

From hydropolitical context, the spirit of basin hydrosolidarity, scientific knowledge and water diplomacy are described as major drivers to facilitate cooperative engagement in the basin for sustainable development. Evidence suggests that prior engagement in science diplomacy between Israel and Jordan has served Jordan to save lives during the drought year of 2008 (UNDESA, accessed in March 2003). Thanks to the increased scientific cooperation, the Jordanians were able to confidently call the Israeli Water Authority to request assistance. This connection allowed the Jordanians to receive significantly more water resources from Israel that summer than were required by treaty obligations, undoubtedly saving lives. This episode demonstrates how hydrosolidarity and scientific cooperation benefit those beyond the immediate scientific community. Similar evidence can be cited from Pakistan and Indian water cooperation. Some recommended entry point to strength hydrosolidarity in the basin include

i) Recognizing ongoing projects as part of the grand Nile basin storage schemes and work very closely to improve the construction, the filling and operation aspects of the reservoirs in tandem with other reservoirs that improve downstream safety and water availability,

ii) Initiate primary hydrometric stations operated and owned jointly by basin countries. It helps build uncontested data and information in the basin,

iii) Encourage formation of basin wide think-tank group consisting of independent minded scientists, scholars, and diplomats. These groups are highly desirable group of people to shape and disseminate scientifically tested alternative pathways, noble idea, and promote shared understandings into main stream public and policy makers,

iii) Launching independent but highly technical regional water research center as a knowledge hub and regional think-tank center to promote interaction and knowledge generation that facilitates common understanding and consensus building in highly pertinent issues of the basin.

The notion of current and future water insecurity tied to water scarcity due to growing demand in the basin is over emphasized. Given potential hydrological and hydropolitical opportunities, water security in the basin is realistically tied to early conclusion of cooperative agreement and shared management of the resources. Early conclusion of cooperation in the Nile enhances water availability through harnessing additional water from the identified water gain areas and building hydrosolidarity provides time for adaptive

management offsetting potential scarcity due to emerging population and economic growth. However, delayed cooperation may become irrelevant due to emerging hydropolitical complexities associated with continued socio-economic development in the basin. Note that assuming the average fertility variant, the total population of the basin countries was about 86 Million in 1950. The basin population has grown almost five folds and ten folds in 2010 (417 million) and will grow to about 889 million in 2050 United Nation, 2011) underlying the importance of early conclusion of cooperation. Therefore, the fundamental water security threat in the basin is therefore not water scarcity but uncooperativeness stances, lack of permanent cooperative institutions and unilateral development activities of the riparian countries for over more than half a century. Therefore, strict cooperative framework is a necessary condition for future sustainability of the Nile basin.

5. Community Based Adaptation to Water under Climate Change as a tool for Conflict Transcendence in the Nile River Basin

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Lama El Hatow is a PhD candidate at Erasmus University Rotterdam in the Netherlands. Her PhD dissertation is entitled "Trans-boundary water solutions under climate change across the Nile River Basin including Egypt".
She is also a co-founder of the Water Institute of the Nile (WIN).

ABSTRACT:

Stakeholder engagement at the community level, can in theory bridge the gap between communities across a river basin. Communities can better their understanding of water sharing and water cooperation through water dialogue. Sharing knowledge of traditional methods of water resource management, including ethics and values, lets water sharing be an avenue of peace building. Climate change is expected to affect the local level the most, so communities need to be prepared to deal with the consequences. This research is intended to explore how to have water cooperation across a river basin using community based approaches for climate resilience with different communities along the Nile River basin. A case study will look at community based adaptation approaches to water resources in the city of Aswan in Egypt by the Nubians. The context of selection of this case study was intended to focus on a group of people who have overcome trials in their community with respect to livelihoods changes and water management and have hence endured and coped with these trials by utilizing community based approaches. This research looks at the existing practices of the Nubians prior to the construction of the HAD, and then after the construction of the HAD. This research will ultimately be used to determine whether the lessons learned by the Nubians in Aswan from community based adaptation approaches to water, can also hence be used by other communities along the Nile River Basin under similar conditions of resettlement from infrastructure projects, such as the Gumuz in Ethiopia from the Grand Ethiopian Renaissance Dam (GERD), or in Sudan from the Merowe Dam. Hence can Community Based Adaptation (CBA) approaches to climate change in water management demonstrate lessons learned for other communities along a river basin such as the Nile River? And can knowledge transfer of these lessons learned be a platform to bridge the gap between communities across this trans-boundary river body to reduce conflict from water sharing? Can these communities' experiences apply on the basin wide level and hence has basin wide cooperation or not had any implications on the communities in any way? This research will explore these elements within the context of resilience in communities on this

river body and to see how communities can create cooperation. This research will also aim to explore if there is evidence of a trans-boundary Eastern Nile local community that demonstrates that connectedness, networks and groups are a vital aspect of social capital, and social and human capital have led to improved natural capital. This research will also aim to explore the potential for the technical community to increase political will to cooperate and the potential leverage that the civil society may or may not have on this cooperation.

Background and Methodology

Stakeholder engagement at the community level, utilizing the Human Integrated Management Approach (HIMA), can in theory bridge the gap between communities across a river basin. HIMA; which translates into "Protected Area" in Arabic; can be defined as a community Based Natural Resources Management (CBNRM) System that promotes sustainable livelihoods, resource Conservation, and environmental protection, for human wellbeing. More recently the HIMA Conflict Resolution Model has been used to address human basic needs for water cooperation and water sharing for communities across a river basin. Once communities are able to understand one another, water sharing across a river basin may be accepted. The HIMA model depends on several principles includes engaging the local community, having a collective action principle, a financial sustainability principle, good governance principles and others. The HIMA model was used and applied on a specific context case study to determine how effective it would be. The Nubians in Aswan upon resettlement were examined to determine the effectiveness of such a model.

Key Findings, Conclusions and Recommendations

By assessing this community of Nubians in Aswan and their water management practices upon resettlement through the lens of HIMA Conflict Resolution and conflict transcendence, it can be seen how to assure sustainability of a water resource in a river basin through simply having communities identifying with one another. Within the Nubian community the sense of acknowledging the rights of the other were evident not only within the Nubian community themselves but also with respect to their co-inhabitance with the Saiidis in Kom Ombo. These were new communities that they needed to co-exist with in Kom Ombo upon being resettled to this area. The Nubians were able to identify with these people not on the basis of ethnicity or culture, as their ethnicities and cultures were largely different, but based on a common understanding of income and livelihoods for land cultivation. The Saiidis were prominent farmers and quite familiar with the terrain and soil structure of the area. The Nubians were not originally farmers and yet were given land as compensation for resettlement by the Government to cultivate for sugar cane which required a change in their livelihoods and income. This essentially created an economic incentive and a strong business case that encourage cooperation between the Saiidis and the Nubians for a share-holding agreement for the land cultivation in that area.

The HIMA model is one of many models that can be examined as a tool for conflict transcendence across a river basin to be able to adapt to climate change using traditional

local knowledge on the ground. The role of civil society and communities is imperative in bridging the gap across a river basin. Civil society and NGOs are often used for various purposes including being domestic watchdogs against municipal or industrial pollution of a water body, raising awareness on water usage and consumption, acting as lobby groups to pressure the government towards sustainable water policies, allowing oppressed and voiceless communities to be heard, enhancing cooperation with other communities across a river basin for knowledge transfer and lessons learned, etc. Their role is not only paramount, but endless in opportunities. Civil Society and NGOs are able to tap into local and traditional knowledge of communities for adaptation mechanisms to water, as was observed with the Nubians in Aswan.

Session VI – The Water-Energy Nexus in the Nile Basin

Sub-theme: Water-Energy-Food Security Nexus
Co-convener: GIZ

Objectives: The session will explore how the water and energy systems interconnect in the Nile Basin. The discussion will focus on how a nexus perspective can induce policy- and decision-making that accounts for external effects across sectors – reducing the negative effects and maximizing the synergies.

Presentations:

1) Energy situation in the Nile Basin – Demand, Supply and Potential, Dr. Humphrey Ndwiga, AfDB

2) Validating a WEAP Model for the Whole Nile Basin, Dr. Mohamed Elshamy, NBI

3) Integrating Climate Change Uncertainty to the Development of the Nile Basin: Mainstreaming Climate Change into Regional Hydropower Project, Mr. Asegdew Gashaw Mulat, Addis Ababa University, Ethiopia

4) Use of a water resources model for basin planning in the Nile Equatorial Lakes region, Mr. Benjamin Ssekamuli, NBI

5) Economically optimal hydropower development trajectories, by Prof. Kenneth Strzepek, MIT, USA

1. Energy situation in the Nile Basin – Demand, Supply and Potential

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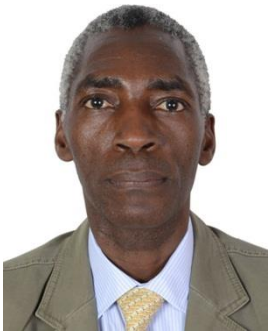

Dr. Ndwiga has extensive experience in the areas of power system planning and modelling, project appraisal, investment, implementation and operations. He is currently a Power & Energy specialist with the African Development Bank Group and is based in Kigali, Rwanda. He worked with the NBI for over 6 years in particular in the delivery of the Comprehensive Basin-wide Wide Study of Power Development Options and Trade opportunities in the Basin. He has wide experience in the power industry spanning over 25 years within the Eastern Africa Region. He holds a PhD in Power System Engineering and an MSc in Project Management.

ABSTRACT:
In the last decade, the Nile Basin Countries have experienced a steady GDP growth recording an average GP over 6%. The countries are expected to maintain an average figure above 5.4% over the next decade driven by exploitation of newly found natural resources and growing industrial sophistication among the Nile Riparian. Consequently, demand for energy has increased rapidly from 97 TWh in 2000 to 183TWh in 2010 to 279TWh in 2015 and in many member states outstripped available generation capacity leading to programmed load shedding and increased use of expensive oil based power production. Member states have however scaled up implementation of new power projects mainly from renewable energy resources (Ethiopia, Uganda and Kenya) and less CO_2 intensive resources (Tanzania). Most of the new power generation is located on the Nile River in the Nile Equatorial Lakes region (Uganda, Rwanda, S. Sudan) and the Eastern Nile Region (Ethiopia). This trend is expected to continue putting pressure on other economic uses of the waters of the river Nile, in a region where the population growth is projected to remain among the highest in Africa and environmental degradation presents serious food production challenges.
The Nile Basin is home to vast hydro resources unevenly distributed amongst the member countries. Most of the most interesting sites have remained unexploited due to inability of the national grids to absorb the vast amounts of energy and lack of cross-border interconnections to export surplus generation. The situation will be very different come 2017 when the electricity grid systems of eight of the Nile Basin countries are interconnected, establishing the prerequisites for a regional electricity market - thanks to the great efforts of NELSAP and ENTRO. This important milestone is expected to be accompanied by increased private sector interests in power generation and development of large power plants through IPP or PPPs to supply an energy deficient region. The resulting competition in the electricity market will reduce the overall cost of electricity, improving the economic competitiveness of the local industries, and impacting positively on the livelihoods

of every Nile riparian family. By 2035 focus will inevitably shift away from hydropower to more expensive alternatives form of energy as most of the economically feasible hydropower sites will have been exhausted.

The AfDB has contributed significantly to support new generation and transmission projects in the region. The Bank remains committed to support the development of a competitive power market in the NBI region and continue to build its portfolio of power infrastructure projects.

2. Validating a WEAP Model for the Whole Nile Basin

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Dr. Mohamed Elshamy: PhD in hydrology and climate change from Imperial College London, Regional Water Resources Modeller at Nile-SEC and former NB-DSS Specialist for Egypt under the Nile Basin Initiative Water resources planning and management project. He was formerly the Manager of the Nile Forecast Center of the Ministry of Water Resources and Irrigation in Egypt and the Egyptian National Coordinator of the "Flood Preparedness and Early Warning" Project of the Eastern Nile Subsidiary Action Programme (Nile Basin Initiative). He has more than 15 years experience in hydrologic modelling and climate change impact studies and conducted post doctoral research on the subject at the University of Bergen, Norway and at UNESCO-IHE in Delft, The Netherlands. Research Interests: Climate change impacts on water resources and hydrology, satellite rainfall estimation techniques, and river flow forecasting.

ABSTRACT:

Within the World Bank coordinated project *"Enhancing the Climate Resilience of Africa's Infrastructure"*, the Nile Basin Initiative has developed and validated a basin-wide hydrological and river basin model for the Nile using the WEAP software. The main objective of the project is to assess the impact of climate change on infrastructure across Africa and to suggest options and methodologies to enhance the resilience of existing and planned infrastructure to it. A key extension of the existing knowledge on Africa's infrastructure development is to incorporate a new dimension: how climate change may affect the desirable design, location, timing, and composition of the stock of infrastructure that is needed. This is done in a comparative way across 7 basins in Africa through the use of the same datasets (Princeton climate dataset, downscaled climate change scenarios) and modeling tools (WEAP).

WEAP is a river basin modeling system that allows the schematization of a river system using the link-node system while nodes can be coupled to a rainfall-runoff component for catchments and water demand component for domestic, industrial, and agricultural users in addition to allowing for prioritization of demands and supplies across the whole system and scenario management. The Nile model developed by the Nile-Sec team incorporates rainfall-runoff modeling of 170 catchments calibrated using flow measurements at some 60 gauging stations distributed unevenly throughout the basin. The calibration approach maximizes the benefit of available flow records by adjusting the calibration period to what is available and in some cases using only average flow patterns (e.g. in many catchments in South Sudan).

Catchments were delineated based on locations of available gauging stations and existing and proposed infrastructure. In addition, about 60 (including proposed and existing) irrigation schemes, 40 hydropower stations (16 of which are run-of-the-river), and 30 dams and barrages have been incorporated in the schematization.

The quality of the calibration/validation varies from a catchment to another based on several factors, the most important of which, are the length and completeness of available flow records. Modeling of wetlands required special attention and several trials to match the scarce observations of wetland outflows and extents without over-fitting the model. The model can be used to analyze basin-wide impacts of climate change, water infrastructure development, as well as to study large-scale trade-offs, e.g. impacts of developments in the Equatorial Lakes basins on the Sudd, unilateral versus coordinated operation of reservoirs, etc.

Hydropower development is selected as an example to show the utility of the model in studying basin wide impacts. Figure 1 below shows the increase in hydropower generation without climate change (assuming the climate of 1950 – 1990 would repeat during 2010 – 2050). The added HP capacity over the period triples total generation from around 20,000 GWh to fluctuate around 60,000 GWh. The major schemes contributing to such increase are the Ethiopian Blue Nile dams (Karadobi, Beko Abo, Mendaya, and GERD) with the proposed hydropower schemes in the Equatorial Lakes (e.g. Ayago, Murchison Falls) and the Baro Akobo Sobat basin (e.g. Tams) have their considerable contribution as well. The generated power from some existing schemes (e.g. HAD) is expected to reduce considerably (by around 25%). The trade-off between the overall increase in power generation and the reduction for some schemes should be a subject of negotiation between riparian countries. Power trade and inter-connection can offer a solution while system-wide saving in water might also provide incentive for coordinated operation of water storage dams.

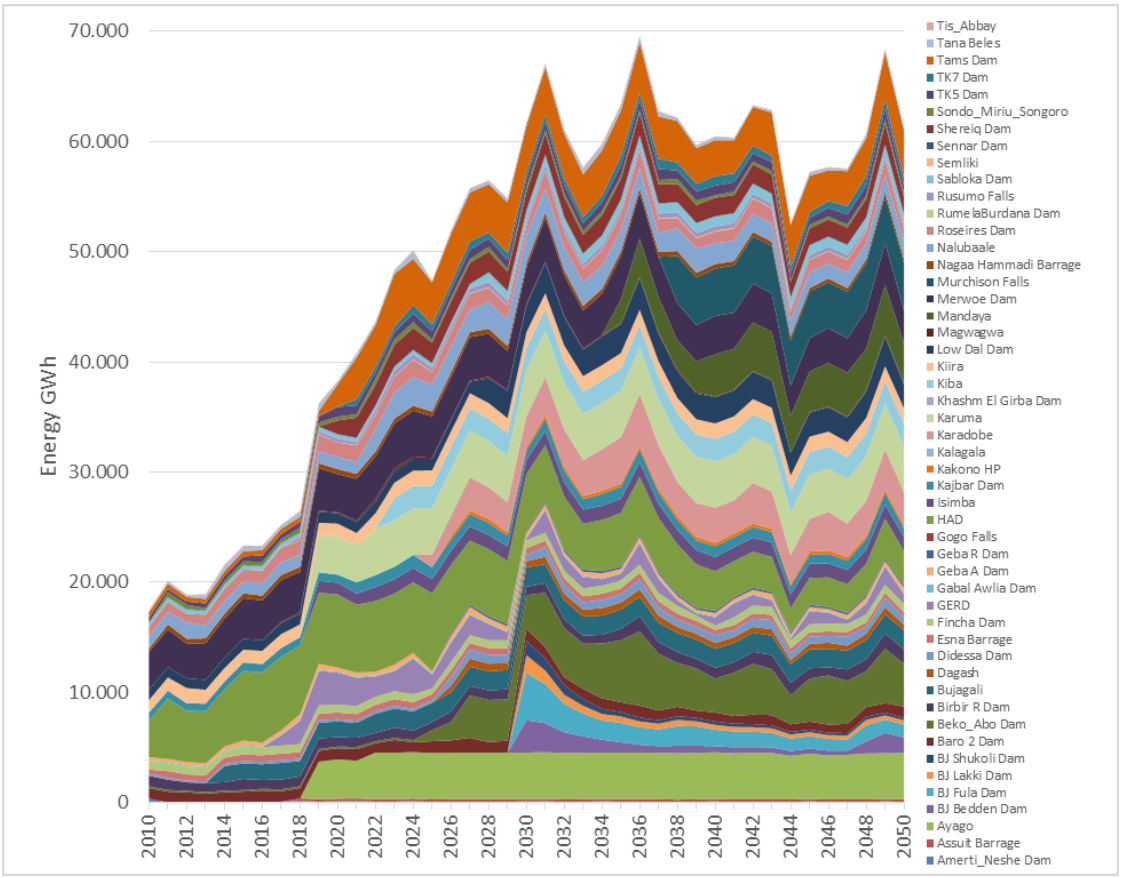

Figure 1: Basin-Wide Energy Generation under Baseline Climate

3. Integrating Climate Change Uncertainty to the Development of the Nile Basin: Mainstreaming Climate Change into Regional Hydropower Project

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ABSTRACT:

The Nile Basin area is one of the most vulnerable areas to climate change and climate variability. Though non-consumptive water use, the potential to develop hydro-electric power in the Nile Basin is enormous. The study is to develop eastern Nile river basin model to evaluate the impacts of climate change on hydropower production by applying Nile DSS tools by considering endogenous and exogenous scenarios. This is to provide answers to important management questions regarding climate change impacts on hydropower by considering the following objectives:

- find flow data of the eastern Nile with climate changes
- assess the effects of climate change on hydropower production
- Building new water resource management scenarios to mitigate climate change impacts on hydropower production.

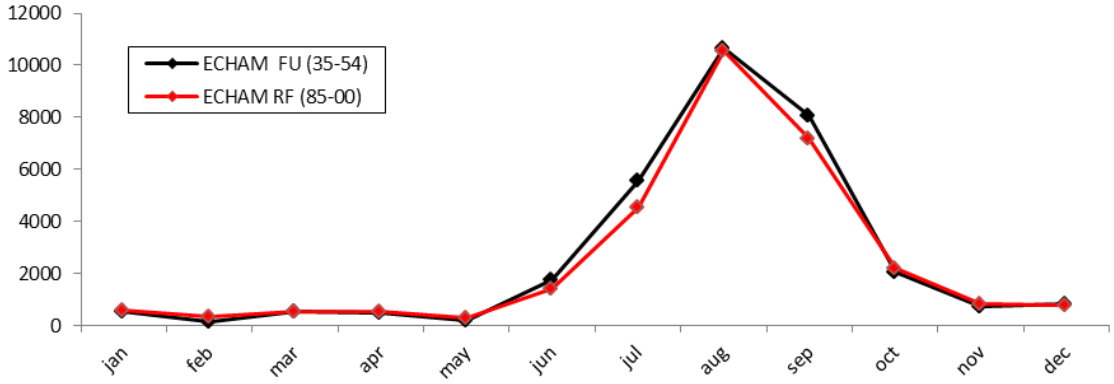
Methodology and Approach

Water resources model (Mike hydro) was set for the case study. The reservoirs are Roseires (Sudan) and Grand Ethiopian Renaissance Dam (Ethiopia), which is under construction. A total of eight scenarios have been developed and simulated and compared with the reference condition. These eight scenarios are the combined scenarios of two exogenous (Ex00: reference and Ex01: Echam A1B) and four endogenous, which are the hypothetical GERD operation rules by considering minimum operation level and target power (Table below). There is 6.5% mean annual flow incremental as compared to the Echam reference after 50 years. The mean annual reference flow is 29.72BCM (1985 to 2000) and it will be

31.6BCM after 50 years. Figure 1 and 2 shows the reference (1985 to 2000) and future (2035 to 2050) flow of Abbay river basin at El-Deim.

Table: Scenarios

		Exogenous (climate change flow) scenario	
		Reference (Echam 00)	Echam A1B).
Endogenous scenario (GERD operation)	622 masl and 1800MW		
	600 masl and 1800MW		
	600masl and 1700MW		
	622 masl and 1700MW		



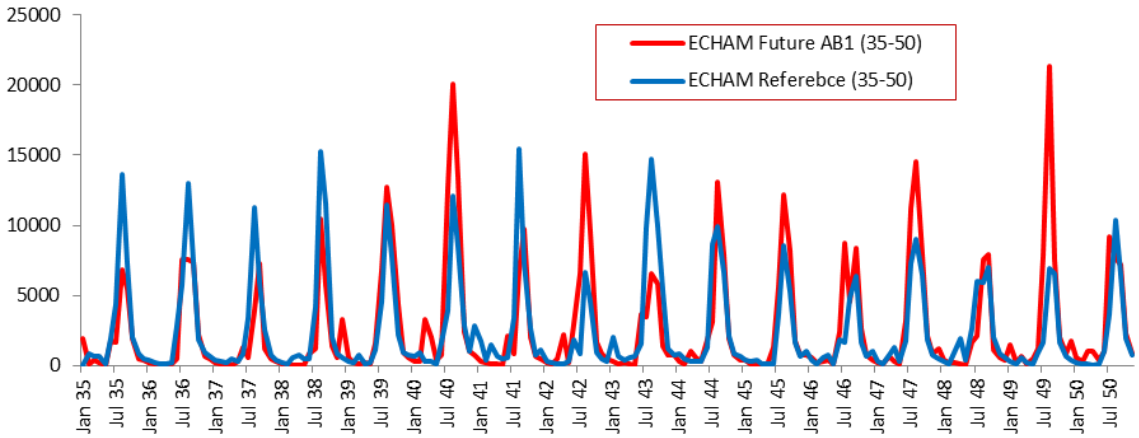


Figure 1 (above): Mean monthly reference (1985 to 2000) and future (2035 to 2050) flow at Border (MCM)

Figure 2 (below): Monthly reference (1985 o 2000) and future (2035 to 2050) flow time series at El-Deim (MCM)

Results

Since the flow difference is not significant (only 6.5%), the energy generation doesn't have significant difference among the scenarios. Either minimizing the minimum operation level or reducing the target power could have a little modification in the energy production from the two reservoirs. Maximum energy can be achieved by reducing the targeted power. In both the reference and future flow condition the maximum energy is with 622 masl minimum operation rule and 1700 MW hydropower target.

The annual energy generation at GERD will not be affected by climate changes. The energy production at Roseires will increase due to GERD implementation for both reference and future flow conditions. The minimum energy production at Roseires is before GERD with reference flow condition. Implementation of GERD will mitigate the impacts of climate change at Roseires that is there could be. This indicates that by increasing storage capacity in the basin will modify the hydrological regime of the downstream reservoirs' inflows and offer regulated and consistent flow. Maximum energy generation at Roseires will be in the baseline climate change and after GERD scenarios. There could be up to 75% energy incremental of Roseires due to GERD.

Recommendation

This study is an indicative analysis of the potential impacts of climate change without affecting the hydropower production of the eastern Nile basin. The study advises to utilize the results cautiously as it is based on only two flow scenarios without considering future agricultural water demand. Further scientific analysis in this direction helps the Nile countries to reach in their pursuit to water use agreement. The following recommendations are stated based on the problems which face to conduct this study and based on future insights of the eastern Nile water resource development/management and research works:

- Valid and reliable data of stream flow of every catchment of eastern Nile basin with their spatial and temporal distributions is crucial.
- Detail information of under operation and future plan infrastructure development; data for metrology and climate change are essential for further research works
- Optimization study is essential by considering different water use sectors with the climate change scenarios
- Further works are required to develop mitigation plan under deficit scenarios
- Regional operation plan that integrate hydrological forecast model, dynamic operation rules common strategy is required

4. Use of a water resources model for basin planning in the Nile Equatorial Lakes region

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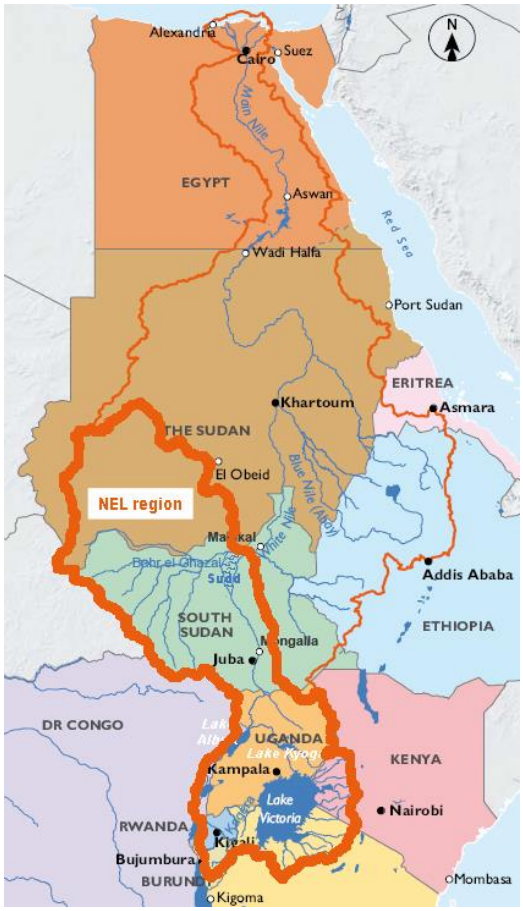
ABSTRACT:

The Nile Equatorial Lakes (NEL) region is the southern part of the Nile River basin and comprises the White Nile River basin, upstream of the outlet of the Sudd. The NEL region therefore covers parts of 8 countries, namely Burundi, Democratic Republic of Congo, Kenya, Rwanda, South Sudan, Sudan, Tanzania and Uganda, and exhibits a very complex water system with different hydrological patterns comprising of the Lake Victoria basin, Lakes Kyoga and Albert, the Albert Nile and Bahr el Jebel, the Sudd swamps, and the Bahr el Ghazal.

For investment planning, a study (NEL MSIOA) to help prioritize and sequence potential investments in water resources management and development at the regional scale was undertaken by the NELSAP in which several tools were developed including the water resources planning model; the NEL Basin Planning Model (NEL-BPM).

The NEL Basin Planning Model, a surface water distribution model based on MIKEBASIN® software, was developed to understand the complex NEL region water system aiming at supporting strategic planning decisions at the scale of the NEL region, by assisting to foresee the impacts of future possible water resources management and development scenarios in the region. The model simulates the distribution of water through the main branches of the NEL region water system, on a monthly basis, over the period 1951-1990.

The main components of the model include catchment inflows, potable water demands, irrigation water demands, water storage required for the satisfaction of the downstream water demand, environmental flow requirement downstream any abstraction or storage point, lakes and reservoirs, hydropower plants. Sets of water resources management and development options based on selected combinations of different levels of the key drivers were developed and tested by the NEL-BPM. The key drivers considered include potable water supply, environment, hydropower, irrigation, water storage, climate change. These combinations are referred to as scenarios in which a total of eleven (11) scenarios were created and analysed.



The outputs generated from the NEL Planning model were used for water system analysis and these included the statistical analysis of the discharge at key locations and main reservoirs, as well as the water balance of main reservoirs. Some more model outputs including the average annual energy production, guaranteed energy production (4 out of 5 years), average surface of the main water bodies (to be used for fisheries and environmental costing), irrigated area satisfied 4 years out of 5 (to be used for irrigation costing), were used generated and used in the economic analysis to quantify the socio-economic of the interventions.

The key results from the comparison of the scenarios developed included:

- The water resources quantities are hardly affected at all by the current relatively low levels of water resources management and development
- The water resources quantities will be scarcely affected by the near future levels of water resources management and development (consisting mainly of an increase in potable water supply requirements), except for the Sudd area in dry years.
- creation of supplementary storage reservoirs allows for more irrigation, especially in Kenya, South Sudan (Bahr el Ghazal), Tanzania and Uganda (small tributaries of Lake Kyoga) where the low flow levels in the dry season limit irrigation. However, this supplementary irrigation has a significant impact on the Sudd areas in dry years (-20%).
- The planned hydropower development has no significant impact on the regional water quantities and the total hydropower generation is 10 times the current situation

Key messages:

- There is a significant increment in irrigation area, for the selected optimal scenario, with very small impact on outflow from the NEL region; and implementing this would greatly improve regional food security. The increase of imported food prices reemphasizes the role of irrigation in food security.
- The potential increment in energy generation for the selected optimal scenario is an important ingredient to socio-economic development (improved access to power, small scale industries, low cost power, employment opportunities…)
- Sound water resources management is a significant public good and is part of an effective strategy for poverty reduction (employment generation, health and livelihood enhancement)
- Contribution to regional integration since power production and food generation is not evenly distributed across the region – opportunities for trade and cooperation.
- There are some inaccuracies in the model, especially regarding the data, but it can be considered as reliable for broad scale water resources planning and management and the model can be further refined to increase the level of detail.

5. Economically optimal hydropower development trajectories

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Kenneth Strzepek has spent 40 years as a researcher and practitioner at the nexus of engineering, environmental and economics systems, primarily related to climate change impacts, water resource planning and management, river basin planning, and modeling of agricultural, environmental, and water resources systems. He has worked for a range of national governments as well as the United Nations, the World Bank, the USAID and a Lead Author for the IPCC 3rd and 5th Assessments for which he is a co-recipient of 2007 Nobel Peace Prize.

ABSTRACT:

Long-term changes in the prices for the benefits of water resource projects greatly affect their value, however, the traditional approach to river basin planning has not been able to take full account of these uncertainties. Additionally, the relatively recent approach of adaptive management does not provide much systematic guidance for planners. We propose an approach that allows planners of river basins to incorporate flexibility into the design, to enable them to increase the expected value of these projects by avoiding untimely elements, and taking advantage of favorable opportunities.

This paper applies the concept of the mid-fidelity screening model to discover flexible design strategies. The paper presents such a model based on The Investment Model for Planning Ethiopian Nile Development, and uses it to explore the impacts of future electricity price uncertainty in the proposed hydroelectric system of dams in Ethiopia.

The results show that incorporating flexibility into the construction start dates adds value to the project. Future price uncertainty can be important when estimating the present value of the hydropower system and should therefore be considered explicitly. In this context, this study highlights the value of the systematic approach of using a mid-fidelity screening model to assess the uncertainties present in water resource infrastructure investments.

This study dynamically couples a water management model of the High Aswan Dam and upstream Blue Nile with two computable general equilibrium (CGE) models of Egypt's and

Ethiopia's economy to analyze how reservoir construction and a changing climate will affect GDP in these nations.

Session VII – Exploring Possible Futures for the Nile

Objectives: The session sets the scene for dialogue on possible and desirable futures of the Nile basin, and on how we can achieve the future we want. The first presentation will focus on the science of scenario construction as a means for stakeholder engagement and policy planning. This will be followed by two presentations, one by NBI and the second by NBD, on results of recent scenario construction exercises for the Nile.

Presentations:

1) How can scenario building inform decision making?, by Dr. Bert Enserink, Delft University of Technology

2) Nile Cooperation 2024, by Dorothy Kaggwa, NBI

3) The Nile Basin in 2050 – Scenario Planning for Effective Water Governance: Strategic Foresight on the Nile Basin Water Governance, by Abby Onencan, Nile Basin Discourse

1. How can scenario building inform decision making?

Bert Enserink, Delft University of Technology, the Netherlands
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Dr. Ir. Bert Enserink is associate professor policy analysis and director of education of the international master program on Engineering and Policy Analysis. He teaches courses in problem structuring, policy analysis and stakeholder management. His main areas of expertise are in the fields of public participation, social learning and stakeholder management, impact assessment, and scenario analysis. Main fields of application are in natural resources management, especially river basin and coastal zone management. Dr. Enserink has extensive international experience and a number of journal publications on the above themes.

ABSTRACT:
The 2014 NBDF is dedicated to transboundary cooperation among the Nile riparian states in a river basin that is facing growing pressures while being exposed to uncertain climate change impacts. The forum faces the challenge of a sustainable development and management of the water resources of the Nile Basin and therefore needs to ensure the conditions for sustainable and equitable use of the scarce resource and meanwhile create and maintain peaceful relations between states and citizens.
At the same time we do not know what the future will bring; the world in 10, 20 or 30 years from now will definitely be different than today. But we can only guess how it will be different and even if we accept there will be changes in the regional climate or in population numbers, there is a lot of uncertainty involved as we know neither how much, nor where and when these changes will occur. Will we get droughts; will we get higher temperatures and if so, how much? But of all the external events that effect Nile Basin management climate change may be the least challenging as it is in a category of events we can anticipate and prepare for, but there are more uncertain issues like the speed of population growth, speed of economic growth and the effects of possible mass migration. And what about the threat of sudden unforeseen events like large floods or droughts, like the unexpected outbreak of infectious diseases or large scale political unrest, or even civil war causing disruption and despair. And on top of all that there is even a category of events we call the 'unknown unknowns' and the 'black swans'; the things we don't know and the events that no one ever had expected to occur. Although most of the latter events; the droughts, the migration, the political unrest may be outside the sphere of influence of the people concerned with river basin management, they will have a big impact on the Nile and its ecosystems services.

The question then is: how can we prepare for such unforeseen events; how can we know these events and how can we design our policies in such a way that even when unforeseen events occur we are prepared for them. What policies do we need to be fairly certain that in the end we will reach our joint objective: this sustainable, equitable future through transboundary cooperation?

The simple answer to the above question is that we cannot know the future, but we can prepare for the unknown and unforeseen and be better prepared for the future. One way to prepare for the unknown is to construct scenarios. Scenarios are stories about possible futures; not just stories though, but carefully designed and detailed stories made according to a well-described scientific method, which allows us to depict a number of plausible stories of possible futures. We design scenarios in a consciously facilitated process by first distinguishing the major factors driving change through a deliberative process of out-scoping and scoping. Once consensus has been reached on these major driving factors they are used to build the scenario logic that allows us to construct a number of logical and internally consistent scenarios.

As suggested designing scenarios is not something a scientist or policy maker should do alone in the confines of his office; scenario construction is a creative interactive process which usually involves a number of content experts, stakeholders and policy makers, as scenarios need to be creative, authoritative, internally consistent and well-thought through. The process of working on the construction and design of scenarios in itself creates trust among participants and legitimacy for its outcomes and typically the participants will learn a lot about the system understudy; in our case the Nile basin, and about the different ideas and perspectives of the other participants.

In the two presentations following this methodological introduction we will present the outcomes of two recent scenarios studies. Dorothy Kaggwa of the NBI and Abby Onencan of the NBD will present scenarios for the Nile Basin in 2024 and 2050 respectively. These scenarios will all be different but they have in common that they all are plausible stories on how the future of the Nile basin might evolve.

Starting from the objective of cooperation in the Nile basin for bolstering a sustainable and equitable use of the Nile basin resources, these scenarios can be used to assess how robust our policies are. These scenarios will help us to answer the question whether this very much wanted sustainable and equitable future will be attained as the circumstances change? Scenarios will help us to think about what we can do to alter our policies and strategies in such a way that we will reach this equitable and sustainable future despite the changes in the environment.

2. Nile Cooperation 2024

Dorothy Kaggwa, Head Strategic Planning and Management, NBI Secretariat, Entebbe, Uganda
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Ms. Dorothy Kaggwa is the Head Strategic Planning and Management at the Nile Basin Initiative Secretariat. She directly oversees delivery of the "facilitating Basin Cooperation Program component of the NBI secretariat program and the implementation of NBI's Strategic Plan and Resource Mobilization strategy in close coordination with the other NBI Centers. She is an environmental Scientist with over 18 years of experience in promoting conservation and management of the environment and natural resources; program planning and management. Prior to joining the NBI Secretariat, Ms. Kaggwa served in different capacities; the Regional Program Operations Manager for FARM Africa in Nairobi, Senior Program Officer – Advocacy, at Environmental Alert, Program Officer at IUCN – The World Conservation Union and Project Officer for Care International in Uganda. She has a degree in Bachelor of Science in Botany & Zoology, Master of Science in Environmental science and Masters of Arts in Development Studies.

ABSTRACT:
The River Nile is one of the world's great assets. It is one of the world's longest rivers, stretching about 6,695 kilometers from the farthest source of its headwaters in the Kagera Basin in Rwanda and Burundi through Lake Victoria, to its delta in Egypt on the Mediterranean Sea. This great river feeds millions and has given birth to entire civilizations. Its Basin extends for more than three million square kilometers which represents about ten percent of Africa's land mass area and it includes world class environmental assets such as the Sudd wetland system in South Sudan.
Now including the territories of 11 African countries namely; Burundi, DR Congo, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, South Sudan, The Sudan, Tanzania and Uganda, the Nile Basin is home to 238 million people, representing 54% of a total population of 437 million people in the Nile Basin countries.
The riparian communities are facing multiple and complex development and environmental challenges, and ongoing population growth puts unprecedented pressure on scarce water resources. Concerted efforts are ongoing to strengthen cooperation among the Nile riparians, and important progress has been made since the establishment of the Nile Basin Initiative (NBI) in 1999. Examples are:

- The Nile Basin is witnessing observable improvements in both the extent and quality of cooperation among member states; the benefits of cooperation are no longer

questioned – what is being discussed is the shape of cooperation and how it could be pursued;

- NBI centers have grown into strong regional institutions that provide an all-inclusive platform for the countries to deliberate on the management and utilization of the common Nile water resources, and for information exchange;
- Member states continue to work together and are committed to the cooperation process even in the midst of a stalled political process; NBI's development track continues to operate smoothly focusing on technical issues and building practical channels for transboundary cooperation.

A complex basin such as the Nile requires its managers to periodically examine the uncertainties and the drivers that shape its future so that appropriate decisions and actions are undertaken in good time in order to advance the cooperation agenda into the future. However, the shape and dynamics of Nile cooperation is subject to a number of uncertainties; funding availability for development programs and investments, political will among riparian countries to advance the cooperation, policy harmonization among the riparian states to facilitate coordinated and integrated management of the Nile waters, transitioning of NBI centers into a permanent institution among others.

With many countries and multiple actors, each with different and sometimes conflicting interests as well as different views on what governs shared natural resources management; it is paramount to create an alignment of views among key stakeholder and actors on how the uncertainties might affect their collective future, and what to do to prevent undesired outcomes.

It is against this background that NBI organized a scenario planning exercise, brought together diverse and multidisciplinary group of stakeholders to brainstorm on these and other challenges in order to more proactively envision a future Nile Basin citizens want, where the Nile Basin water resources are developed and managed cooperatively by riparians to meet the development aspirations of basin inhabitants and the river continues to flow.

While the exercise did not attempt to resolve any outstanding issues, it stimulated debate, promoted mutual understanding and built consensus on what Nile cooperation could look like 10 years from now. 10years represents a window that extends well beyond typical project cycles and the planning of technical programs, but clearly falls within the time frame of most investment decisions or the intended lifespan of the regional NBI centers. Three plausible future scenarios of Nile cooperation in the horizon year 2024 were developed.

The paper will aim to share the outcomes of the scenario planning exercise; the three plausible scenarios of the cooperation and the way forward.

3. The Nile Basin in 2050 - Scenario Planning for Effective Water Governance: Strategic Foresight on the Nile Basin Water Governance

Abby Onencan[1,2] and Bert Enserink[2]

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Abby Onencan (1976) is a Board Member of the Nile Basin Discourse (NBD), a Researcher at the Delft University of Technology and formerly the Manager of NBD. She holds a degree in Law (2000) from Moi University; a Masters in Governance and Development (1993) from the University of Antwerp and an MSC in Education for Sustainability (2010) from the London South Bank University. She previously worked with UNHCR, UNDP, the Kenyan Office of the President and Local Government. Her main areas of expertise are in the field of project management, water governance, stakeholder management, scenario analysis and serious gaming simulations.

ABSTRACT:

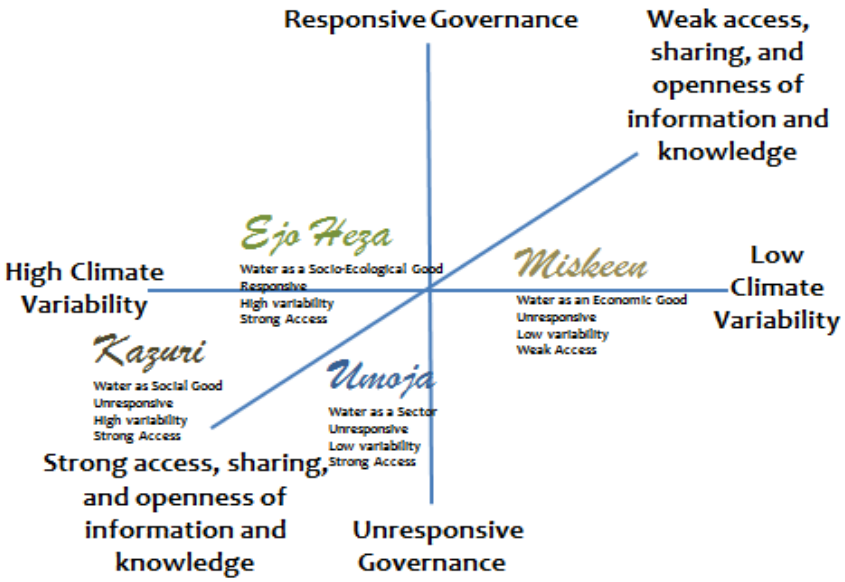
Background

The paper explores whether participatory scenario construction in the form of stories can contribute to strategic foresight on benefit sharing. The Nile Basin discourse has largely focused on water sharing. This discourse is embedded in prevailing short-term institutional planning that leads to limited perspectives of future benefits and risks of cooperation or non-cooperation. Benefit-sharing as opposed to water sharing has been proposed as the solution to changing the current discourse and consequently resolving the water security deadlock. There has been a lot of talk within the Nile Basin on the need to adopt the benefit-sharing principle; with very little guidance on how riparian states can make this paradigm shift. The shift from water to benefit sharing requires an institutional change from short to both short and long-term planning and thinking. Long-term planning can only be effective if strategic foresight is incorporated into the planning process.

Methodology and approach

The scenarios were developed following the methodology as developed by RAND Corporation in the 1950s and later popularized as 'Shell-scenarios.' Four scenarios were developed, namely: Kazuri, Miskeen, Umoja and EjoHeza. The scenarios are not the best or the worst case scenarios but all represent some emerging potential opportunities, strengths, weaknesses and even threats that the Nile Basin may face in the near future. The scenario logic is illustrated in figure 1. The scenario workshop was held in Jinja Uganda, 11-13

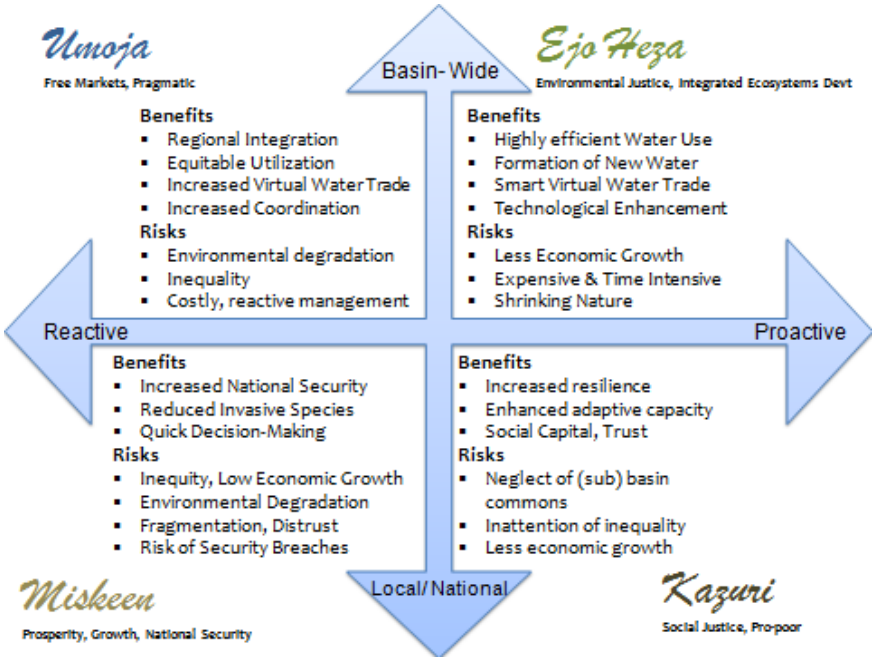
February 2014. It was organized by Nile Basin Discourse and sponsored by Both Ends. The Workshop participants represented the ten riparian states and formed a multi-disciplinary group of experts and stakeholders from regional and national organizations with a spread of expertise around the various sectors and issues, local actors, as well as international partners. And the potential negative consequences of developments that are set out in each of the four scenarios (see figure 2). Each scenario has its own benefits and negative consequences that emerge as a result of external events leading to a certain development path.



Key findings, conclusions and recommendations

Each of the four scenarios is an illustration of the potential benefits and the potential negative consequences of possible futures for the basin (see figure 2). Each scenario has its own benefits and negative consequences that emerge as a result of external events leading to a certain development path. What is important are the trade-offs being made across the scenarios to realise certain benefits and what are the negative consequences of these trade-offs. This is discussed in detail in the full paper.

One key strategic foresight is the power of legitimacy in shaping the Nile Basin futures. Legitimacy seems to be emerging as a key pre-condition to trans-boundary cooperation. In the past, there has been so much focus on basin and sub-basin cooperation. However, the foundation of basin-wide cooperation seems to stem from national legitimation of the existing state. It is evident that countries that are struggling with legitimacy issues at the national level are the least willing to cooperate at the basin level. There is need for more in depth studies on the power of legitimacy and how this power can be harnessed to foster Nile Basin Cooperation.



The paper concludes that scenarios in the form of stories proved to be an effective tool in contributing to strategic foresight on benefit sharing. In addition, the benefit sharing principle was found to be a feasible approach to effectively manage Nile Basin water resources amidst complexity, scarcity and deep uncertainty. The scenarios communicated a consistent plausible story on the danger of not recognizing or giving priority to the less tangible benefits like a healthy ecosystem. Future work will entail analyzing the uptake of the scenarios to resolve deadlocks and enhance cooperation through benefit sharing.

Session VIII – Nile Basin Joint Development Planning: Way Forward

Sub-theme: Benefits of cooperation and risks of non-cooperation
Objective: The session discusses the challenges and prospects of moving towards a basin wide approach in development planning in the Nile basin. Short input presentations on the concrete benefits of cooperative development planning and the risks that fragmented planning can pose on achieving development objectives will form the basis for a panel discussion.

Input presentations and panelists:

1) Benefits of transboundary cooperation – the broader perspective, by Ms. Dorothy Kaggwa, NBI

2) Integrating regional and national plans for water, food and energy security – lessons from southern Africa, by Prof. Mike Muller, South Africa

3) Basin wide power development and integration: plans and status, by Dr. Humphrey Ndigwa, AfDB

4) NBI investment planning in the Nile Equatorial Lakes Region, by Mr. Emmanuel Olet, NBI

5) National development planning and the Nile basin – a basin manager's perspective, by Dr. Abdulkarim Seid, NBI

1. Benefits of transboundary cooperation – the broader perspective

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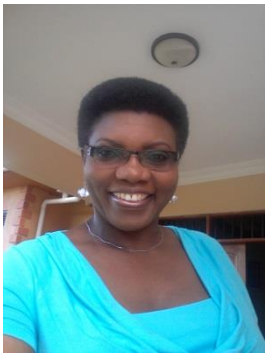

Ms. Dorothy Kaggwa is the Head Strategic Planning and Management at the Nile Basin Initiative Secretariat. She directly oversees delivery of the "facilitating Basin Cooperation Program component of the NBI secretariat program and the implementation of NBI's Strategic Plan and Resource Mobilization strategy in close coordination with the other NBI Centers. She is an environmental Scientist with over 18 years of experience in promoting conservation and management of the environment and natural resources; program planning and management. Prior to joining the NBI Secretariat, Ms. Kaggwa served in different capacities; the Regional Program Operations Manager for FARM Africa in Nairobi, Senior Program Officer –Advocacy, at Environmental Alert, Program Officer at IUCN - The World Conservation Union and Project Officer for Care International in Uganda. She has a degree in Bachelor of Science in Botany & Zoology, Master of Science in Environmental science and Masters of Arts in Development Studies.

ABSTRACT:

Rivers cross political boundaries, where there are multiple actors each with different and sometimes conflicting needs, claims and cultures. International basins cover around 46% of the Earth's land surface, host about 40% of the world's population in 148 nations and account for approximately 60% of global river flow. International cooperation is necessary to manage and equitably share the benefits that accrue from a shared water resource. Willingness to cooperation however depends on how the different users perceive the benefits of cooperation; and as such these need to be effectively communicated to the multiple actors at different levels, in ways that make sense to them.

If any of the people involved in water management do not cooperate, the water resources will not be managed in the most effective way, with adverse effects on human lives and the economy. When water resources are cooperatively shared and managed, peace, prosperity and sustainable development are more likely to be achieved. Access to water is a catalyst for cooperation and peace building. Cooperation on such a practical and vital issue as water management helps overcome cultural, political and social tensions, and can also build trust and social peace between different groups, genders, communities, regions or states.

Cooperation over water advances cross scale learning and makes possible and promotes the exchange of scientific knowledge, management strategies and best practices which is fundamental for the protection of the environment. Further cooperation opens up markets for goods and labor, business opportunities for private sector and enhances trade opportunities.

Cooperation provides opportunities for improved basin planning and management for the river and offers opportunities to tackle shared challenges such as sedimentation, climate change, environmental degradation and poor water resources management and water use efficiency. It results in reduced costs (in case of joint actions), tourism, human satisfaction, etc and easier access to financing for joint investments-(economies scale, cost of productions). Overall, cooperation leads to a more efficient and sustainable use of water resources, creating mutual Socio and economic benefits, trust and confidence and better living conditions as well as gender sensitive water governance. Transboundary water cooperation does provide transboundary solutions which would otherwise not be achieved by individual countries at national level. Regional development efforts complement and amplify national development efforts, ultimately promoting national development of the individual countries**.**

Other benefits of cooperation include;

- Enhanced institutional and human resources capacities,
- New networks of stakeholders,
- Interaction between experts of the different Nile Basin countries (and different fields of expertise), that before the establishment of the NBI was extremely limited;
- A platform for discussion and understanding of the interests, positions and expectations of the neighbouring riparians in what concerns the utilisation (current and future) of the Nile waters resources
- Personal insight knowledge about the social, cultural, environmental, economic and political realities of other countries due to multiple visits to the neighbouring countries, that helped to go beyond pre-conceived (and often unsubstantiated) ideas and perceptions;
- Awareness of the continuity and interdependence between the ecosystems, and the need for an integrated approach in order to protect the 'common goods';
- Increased mutual understanding between experts from different countries that has helped fostering mutual trust and confidence, and a sense of community.

2. Integrating regional and national plans for water, food and energy security – lessons from southern Africa

Prof. Mike Muller, South Africa
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Mike Muller is a Commissioner of South Africa's first National Planning Commission and a Visiting Adjunct Professor at the University of the Witwatersrand Graduate School of Governance. He advises a range of organisations, including the African Development Bank, on water and development issues and chaired the World Economic Forum's Global Agenda Council on Water Security between 2012-2014. As Director-General of South Africa's Department of Water Affairs and Forestry (1997-2005) he co-chaired water-sharing negotiations with Mozambique and Swaziland which produced the "IncoMaputo Treaty" and led the South African side in the on-going Lesotho Highlands Water Project. He was also responsible for the development and implementation of policy, legislative reform and national programmes brought safe water to that gave 10 million people. Between 1988 and 1994, he managed infrastructure and policy programmes at the Development Bank of Southern Africa; from 1979 to 1988 he worked on water and sanitation programmes for the Government of Mozambique. A registered professional engineer in South Africa, he is a Fellow of the South African Institute of Civil Engineer (SAICE) and the Water Institute of Southern Africa and is a Chartered Engineer and a Member of the UK Institution of Civil Engineers. He holds a BSc (Hons) from the City University, London and an MSc from the University of Witwatersrand.

3. Basin wide power development and integration: plans and status

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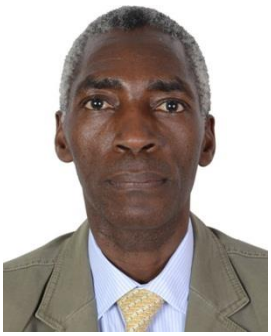

Dr. Ndwiga has extensive experience in the areas of power system planning and modelling, project appraisal, investment, implementation and operations. He is currently a Power & Energy specialist with the African Development Bank Group and is based in Kigali, Rwanda. He worked with the NBI for over 6 years in particular in the delivery of the Comprehensive Basin-wide Wide Study of Power Development Options and Trade opportunities in the Basin. He has wide experience in the power industry spanning over 25 years within the Eastern Africa Region. He holds a PhD in Power System Engineering and an MSc in Project Management.

4. NBI investment planning in the Nile Equatorial Lakes Region

Emmanuel Olet, NBI / NELSAP, Kigali, Rwanda
Email: eolet@nilebasin.org

Eng. Emmanuel Olet is a Civil Engineer with an MSc degree in hydraulic engineering from the UNESCO-IHE Institute for Water Education in Delft (Netherlands) and a BSc Degree in civil engineering from Makerere University in Kampala (Uganda). He is a registered engineer with the Engineers Registration Board in Uganda and a Member of the Uganda Institution of Professional Engineers. His speciality is water resources infrastructure planning in river basins, Regional Multi Sector Investment Opportunity Analyses, hydropower planning, watershed management, flood and drought control, design of hydraulic structures, construction supervision, engineering audits, environmental and social impact assessment and economic and financial analysis of engineering projects. He has 15 years experience working in Government, consultancy and in multi-national river basin organisations. He presently works as program officer in charge of water resources development, at the NELSAP, an investment program of the NBI. Prior to that, he worked with Norplan (U) Limited - consulting engineers and planners, where he was head of the water resources division. He also worked as project engineer in the water for production section of the Ministry of Water and Environment in Uganda.

5. National development planning and the Nile basin – a basin manager's perspective

Dr. Abdulkarim H Seid, NBI Secretariat, Entebbe, Uganda
Email: aseid@nilebasin.org

Dr. Seid possesses over two decades of experience in academia, water resources analyses, research, policy analysis, and consulting and program management in the water sector. Dr. Seid has Ph.D. in civil engineering (Rainfall-Runoff Modeling) from the University of Technology – Darmstadt, Germany; MSc in Water Resources Systems Engineering from the University of Newcastle Upon Tyne, UK and Bachelor of Science degree in Civil Engineering from Addis Ababa University, Ethiopia. He is currently head of the Water Resources Management Department of the NBI Secretariat. Earlier, as the Regional Decision Support Systems Lead Specialist and he led technically the development of the Nile Basin Decision Support System. He served as Assistant Professor at the Faculty of Technology, Addis Ababa University.

ABSTRACT:

In any river basin, water resources planning is undertaken at national (sometime referred to as 'federal'), river-basin, sub-basin, district or county levels. Water resources planning at transboundary level by riparians states a river basin often pose a special type of planning problematic due to the multi-jurisdictional nature of the exercise. In each of these levels, there are also cross-sectoral coordination (e.g. agriculture, energy, tourism, etc) – with varying degrees of success. At the heart of all these planning at different levels and sectors is the very understanding that waters of a river basin (or catchment) are interconnected. Changes in flow regimes due to actions upstream are transmitted downstream. Water allocated for irrigation may not be available for energy production or other uses downstream, or to sustain the aquatic environment.

The need to take into account this spatial, temporal and thematic (read sectoral) interdependence of the waters of a river basin led to the adoption of the principle of Integrated Water Resources Management (IWRM). The implementation of IWRM at national level has its own challenges but has been pursued with some success in the last 2 decades or so. On the other hand, the implementation of this principle at transboundary river basin is beset with many challenges. However, with the growing demands for water, food and energy and the many competing uses for water, the need to coordinate water resources planning activities at national levels of riparian states is a necessity.

In the panel discussion, the author presents the concept of a 'basin-manager' as a neutral player that endeavors to maximize the net benefits from allocation of water to various uses; the environment being one 'water user'. Four arguments are put forward for the need to have the basin-manager's perspective that focus on sustainable economic development, balancing water supply with demand (current and anticipated future), disaster management

and environmental sustainability. Examples from the Nile Basin shall be given to support the arguments.

Session IX – Multi-level Nile Basin Governance – what next for legal, institutional and policy frameworks?

Sub-theme: Transboundary water governance

Objective: The session discusses the role of multi-level water governance for moving forward in Nile Cooperation. Short input presentations on the role of international and regional legal agreements, joint policy frameworks and the role of (sub-) basin organizations form the basis for a panel discussion.

Input presentations and panelists:

1) Challenges Facing Nile Transboundary Water Cooperation, by Prof. Dr. Abdalla Abdelsalam Ahmed, UNESCO Chair in Water Resources, Sudan

2) Building Sustainable Transboundary Cooperation in the Nile Basin: The Contribution of the UNWC to the Nile River Basin Cooperative Framework Agreement, Dr. Musa Mohammed Abseno, Ethiopia

3) Policy Framework for Nile Basin Sustainable Management and Development, by Eng. Teferra Beyene, NBI

4) The place of sub-basin organizations in the Nile Basin Governance Framework, by Prof. Albert Mumma, Kenya

1. Challenges Facing Nile Transboundary Water Cooperation

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Prof. Dr. Abdalla Abdelsalam Ahmed has more than 36 years of experience. He is the Director General of UNESCO Chair in Water Resources – Sudan, Professor of Water Resources Management of Omdurman Islamic University and Chairman of KIMA Consultancy Board of Directors. Prof. Abdalla is basically a Civil Engineer graduated in 1978- Khartoum Univ. and obtained his PhD from Glasgow Univ. – UK (1984) in Hydraulics Engineering. He has a wide experience in various fields of water resources issues, e.g. Policies, Planning and Management, Irrigation Managements, Water Harvesting, Reservoirs and Irrigation Canals Sedimentation, River Basin Management, River Bank Protection, Water Supply and Sanitation, Water Pollution, Environment and related fields, etc. Being Deputy Commissioner of the famous Gezira Irrigated Scheme and a Minister of Agriculture, Animal Wealth and Natural Resources, Prof. Abdalla chaired many Board of Directors and National Committees in the field of Agriculture Production, Animal Wealth and Water Resources Management and related fields. Prof. Abdalla gained a comprehensive experience through his work as an international, regional and national Consultant in various fields of water resources projects. He also worked as an instructor, a lecturer and a facilitator for several training courses e.g. PhD, M.Sc and Higher Diploma programmes, in addition to the short training courses.

ABSTRACT:
Water is crucial element for human being and natural system. Water availability is becoming national, regional and international concern. The Nile is unique river for many reasons: *first* it is the longest river in the world and running from south to north, *secondly* it is found in one of the driest area in the world, i.e. its annual flow is low compared to others, e.g. Amazon, Niger, Congo, Yangtze and Zambezi.
The share per capital for those who live in the Nile Basin (NB) is less than 150 m^3 annually. Therefore, challenges facing the Nile water transboundary are natural and human.
The NB framework of cooperation goes back to 1967 when the Hydromet Survey Project was launched. Undugu (the Swahili word for brotherhood), which was formulated in Khartoum in 1983, succeeded the Hydromet. It drew its members from six Nile riparian states, in addition to one-riparian neighbouring state, namely, Central African Republic. Although, the Undugu was aimed to forge cooperation in areas of infrastructure, environment, culture and trade, but due to many factors it failed to meet its objectives. Nevertheless, Undugu paved the road for the TECCONILE (Technical Cooperation Commission for Promotion and

Development of the Nile), which was established in 1992 in Kampala, Uganda when the Nile-COM signed its agreement. The main objective of TECCONILE was to promote in a series of ten Nile2002 conferences, an informal platform for professionals to present their technical works and other views on regional dimensions of the Nile water. The Nile Basin Initiative (NBI) followed as a necessity because of two main reasons:

i. Recognizing that the basin has a shared past and a shared future.
ii. Urgent need for development and the eradication of poverty.

The main objective is "*to achieve sustainable socio- economic development through the equitable utilization of, and benefits from, the common NB water resources*". In addition there are several specific objectives.

Does the NBI achieve its goals? The answer is not simple; however, NBI is the first programme to include all the NB riparian countries and tries to disclose the sensitive issues for discussion. Moreover, several joint researches, studies and projects were implemented. The most important thing is the huge information and data, regarding many related water resources management issues, were collected in one place for the first time.

Based on the experience of the pervious mentioned cooperation programmes, the following are the main problems and challenges facing the NB countries: Population growth and poverty: rapid growth at 2.5-3.0% per annum; Displaced people and refugees (their negative practices on the natural system); Climate change, erosion and sedimentation; Institutional structures and capacity for effective water resources management are weak and often well trained professionals are commonly over-burdened and poorly under-resourced; Political commitment and conflicts within the region of the NB; Natural disasters: (a) Flood devastation, (b) Drought and desertification. (iii) Watershed degradation; Lack of financial resources and technology to improve management; Enabling environment for cooperation; Trust and confidence building which require time and good politic will.

However, the major challenge that faces the Nile Riparian States is how to augment the flow of the Nile River to meet the existing and growing uses of Egypt, Sudan and the emerging, though limited, uses of the other riparians. It is worth noting that Ethiopia's main use is the generation of hydropower, with limited uses for irrigation and water supply.

The present dilemma among the NB countries is related to the Cooperative Framework Agreement (CFA).

It is widely believed that we should tap into the NB issues in a workable cooperative framework. The CFA is not specifically a water sharing agreement, but it is rather a framework agreement that establishes the necessary legal and institutional mechanism, which indeed will facilitate and lead to eventual water sharing the benefits of the Nile water resources good management based on equitable utilization among riparian states. Therefore, the best option and way forward for all the NB countries is not to derail the spirit of cooperation and mutual trust that has long been invested in.

However, there are major developments in the NB which are going to have impact on the transboundary water management, e.g. GERD (Grand Ethiopian Renaissance Dam). Based on

scientific methodology and analytical procedure, a number of conclusions and recommendations are pointed out. They are expected to help in facilitating the future dialogue among the NB riparian countries. To ensure collaboration and combat detrimental conflicts, here are some recommendations:

- Platforms like Nile2002 conference series should be created to increase confidence building and build the bridge of trust.
- Creation of links among related institutions in the NB through exchange programs and joint research with mutual benefits.
- Building confidence and capacity is a slow process, and the issues will be there for decades; however efforts to meet the urgent and essential needs should be realized.
- It is important to replace the mal-feelings (if any) with trust and partnership – recognition and sharing common goals.
- Efforts should focus on opportunities, cooperation and issues that bring people together. On the other hand controversy issues should await more discussions and deliberations.
- Development of alternative energy sources to conserve the natural resources: such as solar, wind, and gas.
- Enhance cooperation in the management of the NB national resources using the relative advantages within each riparian country.
- Each of the NB riparian countries with relatively different, but integrative potentials will lead to basin-wide benefits.
- Establishment of Permanent Joint Commission to guide and coordinate cooperation to further integration.
- Establishment of Trust Fund for the development of the NB projects to achieve common goals by adopting the CFA principles after solving the disputed issues through negotiations.
- Adopt new technology in water related systems.
- Coordination to protect the environment elements and water quality.
- Successful experiences in the field of water transboundary, in particular African experience e.g. Senegal River

Despite all the challenges, the NB governments have begun to take important steps towards developing frameworks to jointly manage their water resources. It is important to engage in and expand basin-wide dialogue on diverse issues, with the goal of seeking common ground. Data, information, and experiences exchange and sharing, are critical issues in the development of transboundary waters. Thus, it is in the interest of riparian countries to seek building capacity of institutions and human resources. Moreover, it is important to replace the mal-feelings (if any) with trust, partnership, recognition and sharing common goals. Building confidence and capacity is slow process, and the issues will be there for decades; however efforts to manage the system to meet the urgent and essential needs cannot wait. However, cooperation is a long process which requires patience.

2. Building Sustainable Transboundary Cooperation in the Nile Basin: The Contribution of the UNWC to the Nile River Basin Cooperative Framework Agreement

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Dr. Musa Mohammed Abseno has obtained LLB from the Law Faculty, Addis Ababa University (Ethiopia); LLM in International Water Law and Policy (Dean's Medal) from the Centre for Water Law, Policy and Science, University of Dundee, Scotland, U.K.; and a PhD from Centre for Water Law, Policy and Science, University of Dundee. He authored a number of journal articles and book chapters on international water law issues. He is as a consultant on international and national water law, policy, and water conflict.

ABSTRACT:

Background

There are more than 263 international watercourses covering nearly half of the Earth's land-mass accounting for 60% of the global river flows. The use of transboundary water in one part of riparian state may affect the availability of water in another state boundary, which may lead to competition of uses; disputes; and sometimes conflict. International water law has plays an important role in the management of international watercourses by setting principles that enable watercourse States, such as the Nile Basin States to address disputes over their shared fresh water resources. In this regard, the adoption of the UN Convention on the Law of Non-Navigational Uses of International (UNWC) was a milestone in the codification of universal principles of international watercourses. With Vietnam becoming the 35th State Party to the Convention on the 19 May 2014, the UN Watercourses Convention has now obtained the required number of parties for its entry into force on 17 August 2014.

Methodology and approach

The influence of the UNWC is demonstrated in many international watercourses, in particular, the Nile River Basin Cooperative Framework Agreement. This article argues that the Convention has helped narrow down the rift between upstream and downstream riparian countries on a number of substantive and procedural issues. The methodology used in support of this argument, will be by examining the content of the Nile River Basin Cooperative Framework Agreement (CFA) vis-à-vis basic principles of the UNWC. The approach is to draw findings exhibiting the significance of the rules of the Convention in resolving some seemingly intractable transboundary water disputes in one of the world's

largest river, the Nile. The article then makes recommendations for strengthening the applicability of the Convention as an emerging treatise.

Key findings, conclusions and recommendations

The 1997 UN Watercourses Convention is a product of the work of the ILC; a UN body responsible for progressive development of international law and its codification. The process of the work had been participatory, with governments, among them; a number of the Nile Basin countries being able to debate the issues during its drafting, elaboration and adoption. The Convention was adopted by a large majority of countries voting in its favour, which enhanced its importance as evidentiary authority on international watercourses.

The principles of the Convention were able to make in-roads in to a number of international watercourses agreements; among them, the 1995 Agreement on the Cooperation for the Sustainable Development of the Mekong Basin (1995); the SADC Revised Protocol on Shared Watercourses (2001); and Protocol for Sustainable Development of Lake Victoria Basin (2003), which all were influenced by the UNWC in one way or the other. However, its strongest influence has been amply demonstrated in the Nile Basin Cooperative Framework Agreement (CFA).

The findings based on examination of the CFA rules vis-à-vis the UNWC demonstrate that most of the basic substantive and procedural principles adopted by the CFA are from the UNWC and many of them are rules of customary international law.

It is, therefore, important to note that the influence of the UNWC on the CFA could play positive role in resolving transboundary water disputes in the Nile River.

Despite these positive aspects, the failure of the Convention to come into force until recently, and the lack of structures for championing its entry into force and its implementation remain important challenges. Moreover, the confinement of knowledge about the Convention within a small group of legal experts in the field and the lack of awareness among water experts, professionals and officials responsible for making decisions on transboundary water matters require fresh approach on how to narrow the existing knowledge gaps. It is, therefore, imperative that further exposition of the role and relevance of the Convention in resolving transboundary water disputes in the Nile is further enhanced on the basis of the following recommendations.

Follow up and implementation

The entry into force of the Convention can be a significance shift on the status of the Convention as a binding international instrument. The world's international watercourses and their governance can be effectively addressed if states can feel their international responsibilities through a universal instrument legally binding on them all. There is a need for the follow up of its implementation by an international body championing its cause and advancing its implementation by water course States, mainly, through incorporation of its basic rules by States within regional watercourse agreements.

Understanding between law and science

The gap of knowledge about international water law, the Convention and the CFA among water professionals in the Nile Basin is imperative for creating understanding between law and science. Thus, a multidisciplinary approach in the advancement of the role of the Convention and the CFA can be realized through the involvement of informed disciplinarians in international watercourse negotiations.

Institutional mandates and public participation

Institutional mandates of the Nile River Basin Commission must be effectively exercised in order to advance the implementation of the CFA. Public participation is critical for advancing effective implementation and compliance rules on the Convention and the CFA.

3. Policy Framework for Nile Basin Sustainable Management and Development

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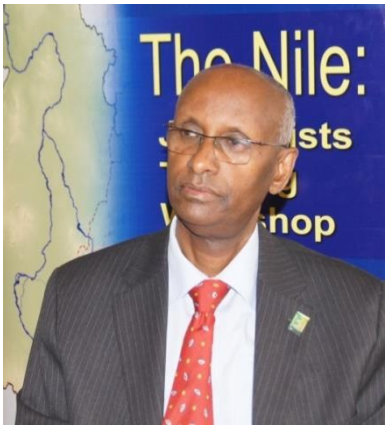

Eng. Teferra Beyene is a Senior Advisor to the Executive Director of the Nile Basin Initiative (NBI). He possesses over 29 years of work experience in the water sector in policy, leadership, institution building and technical management domains, both in national and transboundary settings. After holding senior management positions at the Ministry of Water, Irrigation and Energy, Ethiopia, he served as an Executive Director of the Nile Basin Initiative Secretariat from September 2012 to August 2014. He had been a member of the NBI governance (at basin-wide as well as sub-basin levels) before he took charge of the Office of the Executive Director. He has a degree in civil engineering from the University of Calicut (India) and has attended post graduate courses on water resources / hydropower development & management.

ABSTRACT:

The **Nile Basin experiencing steady increase in hydraulic infrastructure**: the Nile Basin is witnessing an upward trend in development of water infrastructure. After a relative stagnation in the construction of dams after the commissioning of the High Aswan Dam, there is now a steady increase in total storage and hydropower capacity added to the basin's water infrastructure. More and more irrigation schemes are being developed and existing ones expanded. It is anticipated that this growth in water infrastructure (number and size of each infrastructure element) shall continue as countries are grappling with the challenge of meeting the growing demands for food, water and energy. The Multi-Sector Investment Strategy Action Plan developed under the NBI – Nile Subsidiary Action Program (NELSAP) envisages an increase in irrigated areas of about 500,000 hectares in Nile Equatorial Lakes region while the total installed hydropower installed capacity is expected to increase by 6000 MW. The picture on the Eastern Nile side depicts a much higher potential increase in total storage capacity of dams (new and existing) and several fold increase in installed capacity of hydropower plants. Overall, the total water storage capacity in the Nile Basin is anticipated to increase by more than double over the coming three decades.

Changes in the hydrologic regime are occurring: the hydraulic infrastructure that is built in the basin will result in changes in the flow regimes of the basin. Major rivers will be regulated and, thus, the flow patterns will be altered. As a result, more and more changes are expected in water-dependent sectors along the river network – not to mention the aquatic environment (flora and fauna).

Most of the changes happening in upstream parts with effects downstream: most of the new water infrastructure will be built in the upstream parts of the basin, which has very weak infrastructure base for meeting growing demands for energy, food and water. This part of the basin, by and large, has been in pretty pristine condition so far but that is changing. Given the transboundary nature of the Nile, possible effects of changes in hydrologic regime can only be addressed through cross-border cooperation. Collaboration between the riparian countries are needed to optimize system-wide plans for water resources development, have agreed transboundary policies, for instance, on minimum flows, water quality standards, reservoir release rules, acceptable impact levels, and many more. This is needed to develop and manage the water resources of the Nile Basin in a sustainable manner.

The Nile Basin Sustainability Framework (NBSF) is an important first step: the NBI formulated the NBSF, which was approved by the Nile Council of Ministers (Nile-COM) in 2012. The NBSF outlines a set of policies, strategies and guidelines to ensure the water resources of the Nile Basin are developed and managed in a sustainable manner. Since the endorsement of the NBSF, the NBI has developed its Environmental and Social Policy, Wetland Strategy, Climate Change Strategy, the NBI Information Disclosure Policy and few other strategies and guidelines.

The National vs. regional (development) planning and the place for transboundary policies: it is true that most anticipated changes in the basin are due to hydraulic infrastructure primarily implemented by individual riparian states. Given that Cooperative Framework Agreement is not yet in place, how would policies formulated at regional level inform national development planning? What is the way forward in the interim to make sure riparian countries are carry out their development planning taking into account basin-wide (or sub-basin-wide) considerations? Is having a joint set of policies at regional level an option under current settings of the Nile cooperation? What are the lessons from other transboundary river basins? These and more questions shall be presented in the panel discussion to stimulate deliberations on this vital area of the Nile cooperation.

4. The place of sub-basin organizations in the Nile Basin Governance Framework

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Professor Albert Mumma is a lawyer with 27 years' experience both in legal consultancy and private legal practice. He is a specialist in the public private partnership arrangements, the regulation of utilities; procurement law and environmental and natural resources law. Prof. Mumma has worked professionally at national, regional and international levels. His experience includes assignments in the UK, in Eritrea, Somaliland, Kenya, Uganda, Lesotho, Rwanda, Burundi and DR Congo. He prepared the initial drafts of the Water Act 2002, the Kenya Roads Board Act, 1999 and the Kenya Railways Amendment Act 2005 on behalf of the Government of Kenya. He provided consulting and advisory services to international Regional and Kenya based organizations, including the World Bank, Rural Electrification Authority, JICA, City Council of Nairobi, Ministry of Water and Irrigation on a project to reform Kenya's water legislation.

Professor Mumma is a frequent speaker at international and local conferences and an experienced facilitator of workshops and meetings. For ten years, he was on the Faculty of the Rome based International Development Law Organization and annually teaches courses to lawyers from developing countries. He also holds the post of Associate Professor at the School of Law of the University of Nairobi. He is a member of several local community organizations.

ABSTRACT:

The Nile Basin Cooperative Framework provides a mechanism for cooperation in regard to the sustainable management of the shared water resources of the Nile Basin. Within the Nile Basin there are many smaller basins which constitute shared waters between a sub-set of countries. The countries sharing the water resources of the sub-basins have in many instances sought to cooperate directly in managing the sub-basin water resources. For this purpose several sub-basin cooperative frameworks are in the pipeline.

This paper will examine the role place of sub-basin organizations in the Nile Basin Cooperative Framework. It will argue that the Nile Basin Cooperative Framework makes provision for the concept of subsidiarity and that sub-basin organizations and the possible conflict an expression of subsidiarity.

Nevertheless, if duplication, competition, wastage of resources and the potential for institutional rivalry and conflict is to be avoided, clarity in regard to the respective mandates of Nile basin Cooperative Framework and the sub-basin cooperative frameworks, and the inter-linkages between the two frameworks need to be developed and built into the design of the sub-basin cooperative frameworks. The paper will examine the proposed cooperative

frameworks within the East African Community region as a case study on how this issue is being approached in that region.

Session X – Regional integration and the Nile – a common agenda?

Sub-theme: Building partnerships

Objective: The Nile Basin Initiative is an intergovernmental partnership whose member states are – in various compositions – also members of the regional economic communities (RECs) that share parts of the basin. The session explores how NBI's agenda complements the regional integration agenda particularly in the areas of water, food and energy security in the realms of infrastructure development, power- and agricultural trade and transboundary environmental management. Ways ahead to enhance synergies and cooperation amongst the organizations will be discussed.

Input presentations and panelists:

1) NBI in the regional integration agenda – areas of synergy with NBI's basin program, by Mr. John Rao Nyaoro, Executive Director, NBI Secretariat

2) The regional power integration and trade agenda, by Eng. Lebbi Mwendavanu Kisitu Changullah, Secretary General, EAPP

3) The agricultural trade integration agenda in the Nile Basin, by Mr. Boaz Keizire, Senior Advisor, CAADP

4) The drought resilience agenda in the IGAD region, by Dr. John Kabayo, Drought Resilience Platform Coordinator, IGAD

5) Transboundary water management in the Lake Victoria Basin under LVBC/EAC, by Dr. Canisius Kanangire, Executive Secretary, LVBC

6) Enhancing Partnership for Transboundary Water Resources Management in the Nile: Experiences from GWP Eastern Africa, by Mr. Patrick Safari, Regional Coordinator, GWP Eastern Africa

1. NBI in the regional integration agenda – areas of synergy with NBI's basin program

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John Rao Nyaoro, HSC is the Executive Director of the Nile Basin Initiative Secretariat since 1st September 2014. Prior to this appointment, he was the Director of Water Resources, Ministry of Environment, Water and Natural Resources in Kenya, Chief negotiator for Kenya on the Nile River Basin Cooperative Framework Agreement and other trans-boundary waters and a Member of the Nile Technical Advisory Committee, IGAD Steering Committee the positions he held since 2008. John Nyaoro has got 30 years of experience as a Hydrologist/Water Resources Expert. He graduated with honors from the University of Nairobi, Kenya with a BSC degree in Water Resources and a Master of Laws (LLM) Water Law and Policy, Dundee University in Scotland, UK. He is a PhD candidate in Water Law and Policy, University of Nairobi, School of Law and expected to graduate in December 2014.

2. The regional power integration and trade agenda

Eng. Lebbi Mwendavanu Kisitu Changullah, Secretary General, Eastern Africa Power Pool (EAPP), Addis Ababa, Ethiopia
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Eng. Lebbi Mwendavanu Kisitu Changullah is appointed as the Secretary General of the EAPP during the 9th East Africa Power Pool (EAPP) Conference of Ministers (COM) held on 25th April, 2014 at Addis Ababa, Ethiopia. In 1984 he earned his Master's Degree in Mechanical Engineering from Lumumba University in the Soviet Union. Upon return to Tanzania in October 1984, he joined TANESCO in the Planning Department as a Planning Engineer. In 1987 he went to the USA for a one year course on Engineering Economics and Energy Planning at the University of Pennsylvania – Philadelphia. Since then he has been working in the same department where he was elevated to the post of Manager Strategic Planning, until his appointment as SG of EAPP.

During his employment period at TANESCO, he attended training in several courses related to Power Sector- specializing among others on Project Management, Generation and Transmission Planning and preparation of Power System Master Plans in the countries of Canada, Sweden, Norway, Denmark, Brazil, South Africa, Ghana, Togo, Benin, Kenya, Rwanda, Burundi, Ethiopia, Sudan, Egypt and Botswana.

His vast knowledge of the Power Sector was accelerated by his participation in various Study Tours, Workshops and Meetings in and outside the country when he represented TANESCO and the country as a whole.

3. The agricultural trade integration agenda in the Nile Basin

Mr. Boaz Blackie Keizire, Senior Advisor, CAADP, Addis Ababa, Ethiopia
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Boaz Blackie Keizire is a currently a Senior Advisor and Team Leader of a Pan African Agricultural Reform Program, the Comprehensive Africa Agriculture Development Program (CAADP) at the African Union Commission in Addis Ababa Ethiopia. Prior to this, Boaz was a Senior Advisor on CAADP and before a Head of Agriculture and Natural Resource Planning, at the National Planning Authority in Uganda and previously a Principal Economist and a CAADP Lead Person in the Ministry of Agriculture, Animal Industry and Fisheries-Uganda. His bias is in the areas of Agricultural Economics and generally in Agriculture and Natural Resource Policy, Planning, Analysis and Development.

Boaz has used the national skills and experiences to translate and influence actions at continental level. His work has raised the profile of the African Union Commission in placing the institution as a leader in advancing political and policy agenda to mobilize African Member States towards Agricultural transformation through CAADP. Specifically, Boaz has been instrument and using country specific models and examples to change the quality of leadership of CAADP provided by the African Union Commission. Boaz is the link for the Grow Africa at the African Union, a Partnership between World Economic Forum, NEPAD and African Union to mobilize the Private Sector investment to Agricultural Value Chains.

Boaz has written and published papers for ACODE, UNEP, FAO and UNDP among others. Boaz holds a Masters Degree in Agricultural Economics from Makerere University - Uganda and a Post Graduate Diploma in Policy and Planning from the United Nations University Reykjavik –Iceland. He is a Research Associate with Advocates Coalition for Development and Environment (ACODE)-an Environment and Policy Research Think Tank in Uganda- and also was a part time Lecturer of Fisheries Economics in the Zoology Department, Makerere University.

4. The drought resilience agenda in the IGAD region

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Dr John Kabayo has training, research and teaching experience in biochemistry, nuclear techniques and industrial production; and a keen interest in Africa's sustainable development. Dr Kabayo served as a member of the Constituent Assembly, which wrote Uganda's Constitution and was an elected Member of Parliament of Uganda. He has served various functions as an international civil servant; he was a research biochemist for the International Atomic Energy Agency; he pioneered and led the Pan African Tsetse and Trypanosomiasis Eradication Campaign (PATTEC), at the African Union Commission; he worked for the African Development Bank as a Consultant on drought resilience; and he is currently based at the IGAD Secretariat, in Djibouti, where he the Coordinator of the Drought Resilience Platform.

5. Transboundary water management in the Lake Victoria Basin under the LVBC/EAC

Dr. Canisus Kanangire, LVBC Executive Secretary
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Dr. Canisius Kanangire is the Executive Secretary of the Lake Victoria Basin Commission (LVBC). He has got a professional experience and skills in leadership, management and diplomacy, especially in the areas of institutional strengthening and management of academic and research institutions as well as river and lake basin organizations. Prior to joining LVBC, Dr. Kanangire was the Head of Strategic Planning and Management at the Nile Basin Initiative (NBI) and the Manager of the NBI Institutional Strengthening Project. At NBI, Dr Kanangire has also served as the Regional Project Manager for NBI's Applied Training Project (ATP), based in Cairo - Egypt. Prior to his service with NBI, Dr. Kanangire worked at the National University of Rwanda as Dean of the Faculty of Agriculture and Senior Lecturer in Aquatic Sciences, Wetlands Management and Aquaculture, besides leading different research projects at the same University.

Dr. Kanangire holds a PhD in Aquatic Sciences from Facultes Universitaires Notre-Dame de la Paix (FUNDP), Namur, Belgium, attained in 2001. He specialized in Lake Ecology, Aquaculture and Wetlands Management. He also holds an MSc in Freshwater Ecology from the same university.

6. Enhancing Partnership for Transboundary Water Resources Management in the Nile: Experiences from GWP Eastern Africa

Mr. Safari Patrick, Regional Coordinator for GWP Eastern Africa, Entebbe, Uganda
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Mr SAFARI K. Patrick is the Regional Coordinator for GWP Eastern Africa. His appointment was ratified by the GWPEA CP meeting in their Ordinary General Assembly Meeting in Nairobi on 29th March 2012. Patrick is a Rwandan Citizen who has technical and political background in his profession. He has been working with Government, NGOs and Donors for more than 20 years in different capacities as Mayor of District, Director, Coordinator and Expert in various programmes. He has a M.Sc. Degree in Development Studies and Policy and a Bachelor's Degree in Business Administration. He has a sound experience in the area of environment and natural resources management. More specifically; Mr SAFARI K. Patrick has been working with the Ministry in charge of Lands, Environment, and Forestry, water Resources and Mines for six years as Director of Strategic Planning, Policy and Capacity Development. He has coordinated and contributed in the elaboration of policies, laws and regulations related to the Environment and Natural Resources in Rwanda.

ABSTRACT:

Background

Global Water Partnership (GWP) is an inter-organizational partnership gathering all actors involved in water management from government agencies, academia, private sector and civil societies committed to the Dublin-Rio principles to support countries in the sustainable management of their water resources.

GWP Eastern Africa (GWPEA) was established in May 2003 to support the sustainable development and management of water resources at all levels in the Eastern Africa Region. The GWPEA has the following governance structures. The overall highest decision making body is the Meeting of the Consulting Partners (MCP) which represents all stakeholders in nine countries in the region. Below the MCP is the Regional Steering Committee (RSC) which meets twice in a year. This is a policy and oversight committee that oversees programs in the region. It is composed of two members from country water partnerships from nine countries in the region. It has a secretariat office, GWPEA-Secretariat, which is hosted at the Nile Basin Initiative secretariat office in Entebbe, Uganda. Each of the nine countries (Burundi, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, Somalia, Sudan and Uganda) established Country Water Partnerships (CWP) that provides multi-stakeholders platforms.

From ten years back, GWPEA has been closely working with and collaborated with regional RBO's & REC's (NBI, IGAD, LVBC, etc.) as well as Development Partners to promote and

advocate for water security and climate resilience at all levels in the Region. In collaboration with CAPNET and Nile IWRM net, GWPEA has also conducted a number of Capacity Building and Knowledge Management sessions with the aim of upgrading technical capacity of younger water professionals and media practitioners from its partner States so as to understand the dynamics and impacts of Climate Change on national and trans boundary waters and other natural resources, so that they can play instrumental role, as future leaders in addressing the climate and water related challenges. Similarly, GWPEA has engaged academia institutions to customize teaching materials on IWRM in the educational curricular.

Methodology and Approach

GWPEA focuses on providing effective but neutral stakeholder forum to facilitate consultation processes amongst different actors in the region, aimed at enhancing livelihoods through sustainable water use and management. It promotes the Integrated Water Resources Management (IWRM) approach to foster the coordination, development and management of water resources for sustainable development. GWPEA has very good stakeholder platforms at both eastern African region and country levels to facilitate coordination and dialogue among various stakeholders, and among different programs/initiatives. They are key in enhancing coordination/collaboration, networking and information/knowledge sharing, capacity building, and for policy dialogue.

Major Findings

Over the past decade, GWP Eastern Africa has had tremendous outcomes which largely hinged on the neutrality of the platform and widespread stakeholder involvement. The following are the summary of key results:

- The Partnership organized sub-regional and country meetings on different issues related to financing water, climate change adaptation,
- The Partnership has supported the development of several country water policies that consider IWRM approached in the implementation.
- The Partnership has facilitated and supported the development and implementation of IWRM Plans for countries in the region.
- The Partnership has facilitated AMCOW to address water resources management issues such as climate change and financing water resources AT Pan African level. GWPEAF is now implementing the Water Climate and Development Program (WACDEP) of AMCOW in Burundi, Rwanda and in Kagera river basin
- The Partnership has engaged Eastern Africa young water professionals and Media in promoting water and climate adaption issues
- The Partnership supported in strengthening capacities of different partners such as on IWRM, gender, Financial instruments, climate change adaption
- The Partnership has supported National multi-stakeholders' Consultations on water for the post 2015 development agenda with the aim of voicing for water goal in the SDG's

CWPs were instrumental in facilitating the development of national IWRM Plans, and piloting IWRM at local and community levels. This has successfully helped to change the prevailing mind-set about water from a narrow, technical, single-purpose focusing to a broader, multi-purpose socio-political and institutional outlook. This has implied changes for countries to view water as a resource which is critical for development and poverty reduction and water management as a critical part of a response to new challenges such as climate change adaptation, food security and energy security.

Currently, the Country Water Partnerships are actively facilitating implementation of WACDEP programme in Rwanda and Burundi. Kenya CWP is very active in supporting sustainable management of Kenyan water resources and addressing issues of climate change adaptation at community and catchment level. CWPs of Ethiopia, Eritrea, Sudan, and Uganda were in the past very active in implementing activities. For example, Eritrea CWP successfully facilitated the process of National WRM Plan for Eritrea. Ethiopia CWP was one of the exemplary CWPs in the region and was successful in piloting IWRM at the local catchment level. Lessons from this piloting were documented and shared at national and global levels (contributed to global GWP Tool Box).

Conclusions and Recommendations

The approach/strategy followed by GWPEA in promoting the integrated and sustainable management of water resources is at transboundary, national and community. Impacts of climate change are also not limited to certain local communities or countries. It is impacting all communities and countries. Therefore, response to the challenges of water security and climate change impacts should be addressed through the cross border and trans boundary cooperation amongst riparian States and require joint and collaborative actions by all at different levels.

In this respect, the role of water partnerships remains crucial. GWP utilized its extensive and wider national, regional and global level networks and experiences to catalyze changes in the policy and regulatory frameworks for water security and resilience to climate change. GWPEA is operating in countries of the Nile basin through Country Water Partnership (CWP) bringing together various stakeholders for water resources management. These platforms, familiar with IWRM issues, have been utilized to promote and uptake on the opportunities for adaptation and the synergistic benefits of transboundary actions.

GWPEA is committed to collaborate further with NBI and other RBO's to strengthen partnerships at various levels (regional/transboundary, country, local) using the existing GWP wider networks as a path way towards cooperation and collaboration amongst various stakeholders and countries in the Nile Basin to pursue the struggle for socio-economic development and climate resilience.

Session XI – Hydro-Diplomacy in the Nile Basin – converging political and technical tracks of cooperation

Sub-theme: Hydro-diplomacy in transboundary cooperation
Co-convener: SIWI

Objective: The session discusses the prospects of hydro-diplomacy in the Nile basin and how NBI and partners can support the diplomatic process through enhancing the links between the political and the technical track of cooperation. After an introduction by SIWI on the concept of hydro-diplomacy, short input presentations on lessons from other regions, and the role of decision makers, the technical community and civil society in the hydro-diplomatic process will form the basis for a panel discussion.

Input presentations and panelists:

1) The contingent nature of transboundary water issues: How do we identify binding constraints and enabling conditions for actionable outcomes, by Dr. Shafiqul Islam, Tufts University, USA

2) The Rise of Hydro-Diplomacy – Strengthening Foreign Policy for Transboundary Waters, by Mr. Alexander Carius, Adelphi

3) The New Nile Cooperation: A Hydro-Mentality Approach, by Mr. Wondwosen Michago Seide, IGAD

4) Knowledge Networks as a means for integrated capacity development in Transboundary River Basins, by Dr. Amel M. Azab, NBCBN

Hydro-Diplomacy in Transboundary Cooperation – Concept Note by SIWI

The term 'water diplomacy' is a relatively modern term but emerges from the ambit of conventional diplomacy which has a long and rich history. There is need to distinguish 'water diplomacy' from traditional diplomacy because water that crosses international borders or form international borders adds a political and international relations dimension to water allocation and management.

Approximately 276 river basins cross the political boundaries of two or more countries, and serve as a primary source of freshwater for approximately 40 percent of the world's population. Globally about 2 billion people depend on groundwater, sourced from over 300 transboundary aquifer systems. Around 60 percent of the world's international river basins lack any type of cooperative management framework.

Interactions between states over shared waters will increasingly be influenced by the growing demand for water from growing populations and growing economies. To meet multiple demands for water and energy, investments in infrastructure is high on the agenda of many Governments. All of this adds a sense of urgency to transboundary water management that has the potential to exacerbate the already politically sensitive task of water allocation. History tells us that humans have more often than not found ways to resolve water allocation tensions peacefully rather than resorting to conflict or violence.

Water diplomacy is a process which operates under the authority of nation-states, requiring their involvement, but also unlocks cooperation among multiple stakeholders at multiple levels. Water diplomacy represents a good starting point for these different stakeholders to promote peaceful solutions to water allocation and management, and regional collaboration and cooperation.

Water diplomacy aims to achieve the principles of ` equitable and reasonable use' and 'no significant harm' of internationally shared water resources. It does this via a number of channels that can be described as Track I, Track II and sometimes referred to as Track III diplomacy. Track I diplomacy is official high level interaction and dialogue between nation-states; Track II diplomacy is unofficial high level interaction and dialogue between nation-states; and Track III diplomacy is interaction and dialogue between individuals and private parties often initiated at a grassroots level. Water diplomacy can occur via one or all of these tracks.

Water diplomacy can be utilized in situations to promote social inclusion, dialogue and trust building between stakeholders either within the water sector or expanded to include other water related sectors. Engaging in dialogue on benefit sharing which embraces the water-food-energy-environment nexus is a means to address some aspects of conflict management and mitigation. In reality there is no one-size-fits-all approach but rather water diplomacy offers a suite of avenues that promote a regional level outcome to the management and allocation of transboundary water resources that are context specific and relevant.

1. The contingent nature of transboundary water issues: How do we identify binding constraints and enabling conditions for actionable outcomes

Shafiqul Islam[1], Enamul Choudhury[2]

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Dr. Shafiqul Islam is a Professor of Civil and Environmental Engineering and Professor of Water Diplomacy at the Fletcher School of Law and Diplomacy at Tufts University. He is the Director of the Water Diplomacy Program. Dr. Islam works on availability, access and allocation of water within the context of climate challenges, health, and diplomacy. His research group focuses on interdisciplinary approaches to create actionable knowledge by blending science, policy, and politics in contextually relevant ways using complexity theory and mutual gains approaches.

ABSTRACT:

There seems to be growing dissonance regarding the causes, characterization, and possible resolution of many international water (IW) problems. We posit that many transboundary water issues are rooted in interactions and feedback among natural, societal and political processes and variables that create complex water networks. Understanding and characterizing the nature of these networks – through a creative synthesis of science, policy, and politics – are critical to address these transboundary water issues. Our emerging Water Diplomacy Framework (WDF) begins with three key assumptions. First, water is a flexible, not a limited resource. Second, the boundaries of water systems are open, not closed. Third, resolution of boundary crossing water problems must be designed to achieve non-zero sum outcomes. We hold that WDF facilitates the civic engagement and political agreement necessary to support the formation and sustenance of a water regime at the macro level, thereby enabling micro level resolution and operationalization of transboundary water issues with competing and often conflicting interests.

The complexity in the allocation of IW arises from different political boundaries, knowledge, know-how, management capacity, and political power, which presents complex set of choices to the stakeholders involved. The choices are complex both because of the uncertainties that have to be addressed in solving water problems, and the multiplicity of values that may enter as criteria in decision making. Recognizing the allocation of IW as a set of complex choices thus shifts the boundary of the problem from that of finding efficient tradeoffs between the demand and supply of water to identifying and negotiating the needs

of multiple stakeholders. The purely economic frame of balancing demand with supply fails to account for other important goals of managing water resource that are continuously framed in the two domains of water research and practice – the knowledge domain and the political domain. These two domains have framed two overarching goals to manage water resource. The first goal is based on the hydrological-ecological-engineering knowledge of water, which has given rise to integrated water resource management as a paradigm. The second goal is based on affecting equity in the allocation of water resources, especially to the economically disadvantaged population and vulnerable ecosystems. Within WDF, these two overarching goals – integration and equity - are viewed as guiding principles in deciding the issues to be resolved through negotiation. Consequently, they are not considered as just another set of choices subjected to tradeoffs in the negotiated process. In the context of addressing these two overarching goals, effective resolution of IW conflicts also rests on managing the complexity that arise from the knowledge and political domains, and in the interaction of the two.

We will examine the efficacy of a set of necessary and sufficient conditions for WDF in terms: (a) Commitment of a capable mediator to overcome the zero-sum framing of the problem; (b) Framing of mutual interests through joint fact finding of Interests framed in terms of achieving mutual gain; and (c) Formation of a water regime to disaggregate the problems and find solutions as well as adaptively address new problems as they emerge. We will use historical evolution from the Indus basin, Jordan river, Aquifers in West Bank, and the Nile basin to test and refine the contingent nature of international water issues within the context of Water Diplomacy Framework.

2. The Rise of Hydro-Diplomacy – Strengthening Foreign Policy for Transboundary Waters

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Alexander Carius is co-founder and Managing Director of adelphi. The core topics of his research and consultancy work are: resources and governance, climate and energy, and development and security. He provides advice on institutional matters with respect to environmental and development policy, policy integration and the development regional and multilateral cooperation frameworks. He advises federal ministries, aid agencies, the European Commission and various international organizations. Since 1995, he has managed more than 200 national and international research and advisory projects with inter-disciplinary teams. In 2012 and 2013 he was a senior advisor to GIZ's support program for the NBI Secretariat to assist in the development of the NBI's climate policy strategy, wetlands strategy and environmental and social policy. In 2014, he co-authored a paper policy paper on the hydro-politics for the German Federal Foreign office to explore the potential for foreign policy to engage in transboundary water politics.

ABSTRACT:
Water is a fundamental precondition for human life. No substitute for freshwater exists, and it is scarce in many regions. Simultaneously, much of it transcends state borders via shared river and lake basins or groundwater aquifers. The resulting political, economic, social and environmental interdependencies give water resources the crucial potential to either foster cooperation or exacerbate conflict. The significance of access to water is growing as demographic and economic drivers as well as deteriorating water quality interact with climate change that will regionally increase water scarcity and variability.
Competition over shared waters should warrant strong interest from foreign policy makers. Foreign policy can help improve transboundary water governance, and transboundary water governance can give foreign policy makers a toehold for making progress on crucial foreign policy interests. Thus, encouraging greater cooperation over transboundary waters offers significant prospects for the resolution of political conflicts and greater regional integration. Transboundary waters constitute a promising entry point for diplomats aiming for high peace dividends.
Foreign policy makers can and should do more to realize these dividends. Diplomats should accompany and facilitate the efforts of technical and development experts in transboundary basins. In particular, foreign policy makers must:

- exert political leadership in fostering intra-basin cooperation and integration;

- connect and reinforce appropriate institutional structures for coordinated and cross-sectoral, comprehensive engagement; and
- strengthen the diplomatic track of transboundary cooperation on water by investing more in training and capacity-building, expanding efforts to build confidence in shared basins, and improving water-related crisis response and conflict resolution mechanisms.

Transboundary basin management is frequently eclipsed by intra-basin politics, which in turn is often compounded by power asymmetries. In this context, a focus on technical solutions for shared basins is often not enough; it needs to be complemented by political engagement. Foreign policy makers can provide crucial support in this respect, even if their engagement also entails risks by inserting (perceived) outside agendas.

There are several foreign policy objectives connected to transboundary water governance: facilitating the containment and resolution of conflicts in the short term; managing resources so that conflicts are avoided in the longer term; and harnessing water cooperation mechanisms to promote regional integration. Yet for all three purposes, there is a lack of agency at the international level. As a result, the international community faces huge challenges when it comes to systematically taking early action to both respond to emerging crises and reinforce cooperation.

Foreign policy makers should therefore help to strengthen and connect existing international and transnational institutions for coordination so as to allow for concerted foreign policy approaches. The end game of solving conflicts over water is to build the appropriate institutions to safeguard and extend cooperation. This quest for closer cooperation should simultaneously seek to enhance the cross-sectoral synergies between 'high' and 'low' politics such that water-related technical and economic opportunities are used (or better used) to strengthen political efforts to prevent and resolve conflicts and vice versa. Technical efforts that improve local and national water management can significantly contribute to safeguarding international security, just as foreign policy efforts can significantly contribute to the development and well-being of riparian people by helping them avoid conflict and harness the opportunities that closer cooperation brings about.

To underpin such greater political and diplomatic engagement and translate it into action, foreign policy makers should pursue a three-pronged strategy of support regarding institutions, capacity and funding. Preventing conflict over water requires better understanding among the water, climate and foreign policy communities, as does using water as an instrument for greater overall cooperation. Training the respective communities to this effect is a necessary first step. More capable national institutions can directly contribute to more sustainable water management; they can also encourage national governments to 'risk cooperation', as policy makers will feel reassured about their ability to estimate its effects. Climate change is predicted to bring about an increase in the variability of water, adding urgency to the task of building trust and a shared understanding of the challenges in transboundary basins. Building capacity and supporting institutions that are

conducive to intra-basin cooperation will require funding. The amounts necessary, however, pale in comparison to the costs of the physical water infrastructure – as well as to the hypothetical cost of the conflicts that they can help to prevent.

There are thus a number of specific steps foreign policy makers could take to strengthen cooperation in transboundary basins. Yet, as useful as all these instruments could individually be, they depend on an internationally coordinated, cross-sectoral engagement on transboundary water issues – engagement that must be driven by foreign policy makers. In the end, strengthening the governance of transboundary waters hinges on strengthening and connecting the international institutions that can channel political will into coherent action.

3. The New Nile Cooperation: A Hydro-Mentality Approach

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Wondwosen Michago Seide is currently a Water Resources Expert at Intergovernmental Authority on Development, IGAD. He has MSc in Water Science, Policy and Management, Oxford University. He has been involved in various research works on the Nile River including cooperation, conflict, food security and environment, benefit sharing and payment for ecosystem services. He used to work as a Researcher in the Nile Basin Discourse Forum, NBDF, and Ethiopia Office. He also worked as a Regional Water Consultant for the Stockholm International Water Institute, SIWI, to evaluate 'The Nile Basin Trust Fund, NBTF' of the Nile Basin Initiative, NBI. He has produced articles, policy briefings and newspaper piece in related to transboundary water governance particularly on the Nile issue.

ABSTRACT:
This article tries to see the politics of the Nile from what I hope is a fresh angel by analyzing the mind-set that informs the politics of the riparian states, particularly by focusing on Egypt and Ethiopia. In doing so, it tries to expose the important relationships between 'Mentality' and 'Nile Politics', which I call 'Hydro-Mentality' of the Nile. This writing therefore focuses on state and popular perceptions of the Nile and its use by other member states of the basin. I argue that because of the emphasis given to the issues of hydro-politics, hydro-hegemony, geopolitics, cooperation and conflict, the very important subject of "mentality" and "perceptions" that inform the politics of the Nile has received very little or no attention by scholars. This writer is of the opinion that it is not the presence of dams on the ground, but the presence of fear and suspicious, which is complicating the upper-down riparian relations. I argue that mentalities that impact and at times determining the policies and positions of states when it comes to the use of the Nile waters has to be given serious attention among policy makers, in the scholarship and debate. The Nile war prediction tendency in scholars and commentators can be understood from this lens of hydro-mentality. In fact, without a proper understanding of the hydro-mentality of both the state and popular perceptions of the Basin states, it is almost impossible to address the problems currently facing the Nile.

4. Knowledge Networks as a means for integrated capacity development in Transboundary River Basins

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Dr. Amel M. Azab, from Egypt, graduated in 1996 from Irrigation and Hydraulics Department, Faculty of Engineering, Cairo University. She was awarded her PhD Degree in water quality management from UNESCO-IHE and TU-Delft, the Netherlands in January 2012. Her main research field is surface water quality and wetlands management. She started her career in 1997 as a staff member of Water Resources Research Institute; in 2000 she joined the Hydraulics Research Institute, as research assistant and senior technical officer of the Nile Basin Capacity Building Network (NBCBN); since 2009 she was appointed by UNESCO-IHE as the Manager of the Nile Basin Capacity Building Network. She has thirteen years of experience in the field of knowledge networking and capacity development, where she has been involved in many collaborative regional and international research and capacity building projects in the Nile Basin.

ABSTRACT:

The river Nile is the longest river in the world shared by 11 countries in the Nile Basin: Burundi, Congo, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, South Sudan, Tanzania and Uganda. The basin represents one of the most complex and sensitive hydrological systems in the world including eleven countries with different cultural, language, religious and historical background. The Nile Basin countries are experiencing a number of problems such as rapid population growth, limited water resources, environmental degradation, poverty and an increasing concern about the impact of climate change for the region. In 25 years time the population of the Nile riparian countries is expected to have doubled to more than 300 million people. At the beginning of the '90's it was increasingly realized that co-operation among the Nile countries would become a prerequisite for the further development of the Basin and that capacity building would play a crucial role in that process.

As a response to these needs, continuous and major efforts were done, and since the year 2000 a unique network has developed in the Nile Basin in support of capacity building of

water professionals from each riparian country: The Nile Basin Capacity Building Network (NBCBN). It is unique in that it achieved to create collaboration between formerly isolated water professionals in a region characterized by political tension, poverty and growing water scarcity, while it was generally understood that a stable economic growth can only be guaranteed through agreed use of the water resources of the river Nile. The initiative on "Establishing a Nile River Basin Capacity Building Network (NBCBN) was launched, with the support of the Dutch Government. This initiative had regional ambitions in building and strengthening institutional capacity for a sound development of water resources in the Nile River Basin. By stimulating the interaction between professionals and institutions the network contributed to a subtle process of confidence building between riparian states. Collaboration between water professionals contributes to improved knowledge, based on applied collaborative scientific research on alarming water issues and problems in the basin, which at its turn contributes to the dialogue over water issues in the region. After many years of parallel co-existence an MoU was signed between NBI and NBCBN in 2012 to acknowledge each other's complementary strengths and fields of further collaboration for capacity development in the Nile basin.

The developed network approach NBCBN, addressing knowledge and capacity development in a more integrated way, differs from the traditional 'project' approach where consultants deliver a single-dimension project result which finalises the project. Through the network approach of NBCBN different forms of relevant knowledge generation become connected to different knowledge sharing and use mechanisms within or initiated through the network members in order to improve the impact of capacity development.

NBCBN was built on a "middle-up-down" approach: hosting organisations and their active water professionals, facilitating joint knowledge development and sharing to the benefit of regional understanding and individual capacity strengthening. Transboundary water management needs knowledgeable professionals and relevant data, information and knowledge to support regional cooperation processes and this was the key objective behind NBCBN as a knowledge network in the Nile basin. Almost all water related questions and alarming water issues in the Nile basin have a regional dimension and interventions have regional impacts, therefore NBCBN focused on using knowledge networking as a tool for capacity building and creating regional collaborative research groups and communities of practice to address these issues.

This paper presents the network establishment methodology as a tool for regional cooperation and capacity building, its ownership and governance, the network structure, activities and achievements in ten years. The paper focuses on the impact of such organized network on the Nile basin capacity development in the last ten years. The paper also highlights the future Strategy and trend of the network, as a knowledge service provider, in order to continue its mission for creating more positive impacts and well established capacities in the basin.

Session XII – Sustainable financing for institutions, information and infrastructure

Sub-theme: Financing transboundary cooperation
Co-convener: World Bank

Objective: The session discusses established and new ways of financing the NBI as a platform for cooperation, as well as joint investments in infrastructure in the basin. Input presentations on lessons from NBI financing and on examples of RBO financing in other basins will form the basis for a panel discussion.

Input presentations and panelists:

1) Financing of the Nile Basin Initiative: lessons and future directions for institutional and infrastructure development funding, by Ms. Dorothy Kaggwa, NBI

2) Institutionalization of transboundary cooperation as a key determinant of sustaining the Nile Basin Initiative, by Dr. Wubalem Fekade, NBI

3) Financing transboundary river basin management – comparison of member country contributions across African River Basin Organizations, by Dr. Susanne Schmeier, GIZ, Germany

4) The cooperative multi-sector investment program, an effective driver of transboundary water cooperation, by Mr. Olivier Cogels, CIWA Program Adviser, World Bank

1. Financing of the Nile Basin Initiative: lessons and future directions for institutional and infrastructure development funding

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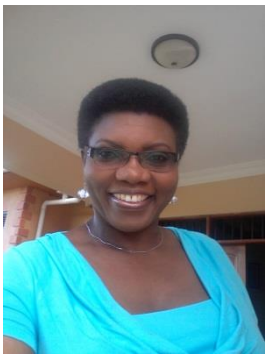

Ms. Dorothy Kaggwa is the Head Strategic Planning and Management at the Nile Basin Initiative Secretariat. She directly oversees delivery of the "facilitating Basin Cooperation Program component of the NBI secretariat program and the implementation of NBI's Strategic Plan and Resource Mobilization strategy in close coordination with the other NBI Centers. She is an environmental Scientist with over 18 years of experience in promoting conservation and management of the environment and natural resources; program planning and management. Prior to joining the NBI Secretariat, Ms. Kaggwa served in different capacities; the Regional Program Operations Manager for FARM Africa in Nairobi, Senior Program Officer –Advocacy, at Environmental Alert, Program Officer at IUCN - The World Conservation Union and Project Officer for Care International in Uganda. She has a degree in Bachelor of Science in Botany & Zoology, Master of Science in Environmental science and Masters of Arts in Development Studies.

ABSTRACT:
NBI institutional and program costs are financed through Nile Basin Member States annual contributions to the NBI, bilateral donors (SIDA, BMZ/GIZ, UNDP, African Development Bank) and grants from the international community under a World Bank managed Nile Basin Trust Fund (the major source of finance over the last 14 years. In 2001, the International Consortium for Cooperation on the Nile (ICCON) met in Geneva, convening both the Nile Basin governments and their international development partners who pledged to support the Nile cooperation. After the ten donors actualized their pledges, the Nile Basin Trust Fund was established. Over US$ 200 million was channeled through the fund by Development Partners to support the Nile Ministers working in water resources to achieve the shared vision objective.
NBI has learnt a number of lessons through the 10 year period of the NBTF; and these lessons have informed the design of the NBI Resource Mobilization strategy going forward. Key lessons include the importance of long term, predictable and flexible funding is critical to advancing cooperation. A multi donor trust fund reduced transaction costs for both the donors and the NBI as grant management, monitoring and reporting was all streamlined and led by the World Bank on behalf of the contributing partners. The association with World Bank was good for the NBI; through World Bank, NBI accessed high quality technical and strategic input into its program implementation and operations and further raised the profile

of the Nile cooperation; a key question however was whether this engagement was value for money. The flexibility of funding enabled NBI to undertake even those priorities such as strengthening the NBI institutions that had not been thought about at the time the fund was established.

2. Institutionalization of transboundary cooperation as a key determinant of sustaining the Nile Basin Initiative

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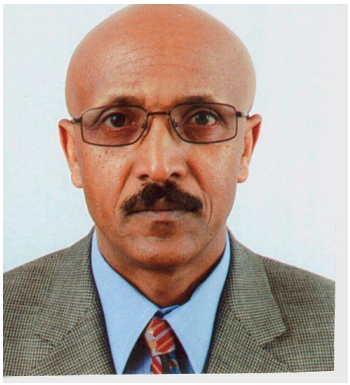

Dr. Wubalem is presently head of Social Development and Communication at ENTRO/NBI Addis Ababa. He holds a PhD in Spatial Planning, MSc in Development planning and Management and a BSc in Agricultural Economics.

Dr. Wubalem also has undertaken several trainings in social development, communication, conflict management, and peace building; project planning and management; democracy and governance, among others. Dr. Wubalem has published in peer reviewed journals on urban planning and has authored and co-authored several books on development planning; peace building-conflict management; rural development. Dr. Wubalem has taught planning and research methods course at universities, has been independent consultant and project coordinator at the University of Maryland's Center for International Development and Conflict Management.

ABSTRACT:

I posit that it is critical to make distinction between Nile Basin cooperation as an emerging process of institution building and the NBI, as a structural or organizational manifestation and embodiment of the institutionalization process. The two are related and linked, but getting clarity about their distinction is even more important, if the goal is promotion of transboundary cooperation.

The concept of institutions has been widely used in diverse disciplines including economics, philosophy, political science, and sociology, to mention only a few. However, most scholars mean different things when they speak of institutions. There is still no universal definition of the term, though there is an overarching consensus on the key elements that distinguish institutions from organizations.

Institutions are unwritten but powerful rules - norms, values and expectations (specifying what is good, desirable and "normal") that help individual members of an organization form mutual expectations, habits, dispositions and self-enforced behavior to facilitate and structure interaction, coordination and collective enterprise. The easiest way to gauge whether something is an institution or is becoming an institution is to ask if members of a community (of nations included) or of an organization whether they are willing or not to live and function effectively without it, or in its absence. Families are (social) institutions. Rule of law is also (political) institution. Churches and mosques are also social institutions.

Organizations, on the other hand, are (legally) established structures set up to serve predefined purpose(s) with clearly set organizational boundaries, hierarchies of authority and responsibilities and incentives and chains of command and even residence (geographical locations). One can think of a wide variety of organizations – educational, financial, political, local, regional, international, etc. In this sense NBI is an organization of the riparian countries of the Nile Basin headquartered in Entebbe, Uganda. Organizations (e.g. churches with hierarchies and structures) are at the same time institutions (meaning their members accept them and are willing to be guided by the norms and values they set). It is difficult to say an organization is becoming an institution if its members are not (in addition to official rules and regulations) governed by a set of shared expectations, norms and values that they share and respect (in order to sustain the organization).

Institutions, first and foremost, are accepted by and reside in the hearts and minds – and therefore in the habits and predispositions - of members of an organization. These are manifested in their routine behavior, inside and outside the organization. In my presentation, therefore, institutionalization refers to the process of embedding the cooperation facilitating and nurturing norms, dispositions and values in NBI, which shapes the attitudes and behaviors of its employees and decision making individuals and hierarchies. In this latter sense NBI can currently at most be described as an emerging institution, with lots of work ahead of it in terms of building the "normative" infrastructure, the type of mindset, mutual expectations and "self-enforcing" behavior and values shared by all its constituent members who all should consider it a given that without cooperation there will be no Nile and cooperation diminishing behaviors are socially undesirable. Building and nurturing cooperation facilitating norms, values and embedding them in NBI is a task that is critical to sustain Nile Basin cooperation, no less, if not more determinant, than formal treaties! Yet from another vantage it can also be posited that as transboundary cooperation becomes firmly institutionalized within NBI the very same process will contribute to reduction of a myriad of financing risks (reputational risks, political risks, social risks, environmental risks). For example, when transboundary cooperation becomes a norm, and consensual, peaceful resolution of differences become routine, this reduces the Nile Basin political risk investors and public and private financiers might worry about. Similarly when protection of the Nile ecosystem is a water resource management norm in the basin, it reduces environmental risks. When livelihood supporting ecosystem services are routinely respected in the planning and management of investment, social risks are reduced. All these institutionalization processes synergistically increase the reputation of the NBI, which in turn contributes to increasing the likelihood of financing Nile Basin cooperation.

How can the various Nile epistemic communities help in the Institutionalization of Nile Basin transboundary cooperation? What role can they play? Which local institutions can be tapped, and which "value assets" of managing the commons, sharing and mutuality, can they leverage? These and similar questions will be raised in the panel discussion.

3. Financing transboundary river basin management – comparison of member country contributions across African River Basin Organizations

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Dr. Susanne Schmeier is the coordinator for transboundary water management at the Deutsche Gesellschaft für internationale Zusammenarbeit (GIZ). Prior to this, she held the position of technical advisor to the Mekong River Commission (MRC), focusing in particular on the MRC's organizational transition process. She has also worked with various other international institutions, including river basin organizations, and academic institutions on issues related to transboundary water resources management.

ABSTRACT:

Background

In order to fulfil their mandate and govern their watercourse, River Basin Organizations (RBOs) require sufficient financial resources. As experiences over the past decades in a number of river and lake basins have indicated, insufficient funding for transboundary water resources management can lead to disruptions in the cooperation process and the insufficient implementation of water resources development projects, thus hampering the overall sustainable development of the basin. Reliable and sustainable funding is hence a prerequisite for effective institutionalized river basin management. The ways how RBOs are financed do, however, vary considerably: while some RBOs do not possess any regular budget and hence depend on irregular and often project-specific contributions, other RBOs have established complex budgets and thus financing structures. In the latter cases, sources for RBO budgets most often comprise member country contributions as well as external financial resources in the form of donor financing through financial and/or technical cooperation.

Methodology and Approach

The presentation addresses the question how RBOs can be funded sustainably over time, with a particular focus on financial self-sustainability, that is, the financial ownership of the RBO by its member countries. It identifies different mechanisms of RBO financing that exist (with regards to the RBO's overall budget as well as with a specific interest in the different budget categories, especially an RBO's core costs, that is, the costs occurring from the RBO's core river basin management functions) and maps their distribution across the world's different RBOs (with a particular emphasis on African RBOs). It is particularly interested in member country contributions to RBOs and the different mechanisms for cost-sharing

among members. And it investigates the different financing mechanisms' influence on the long-term financial (self-) sustainability of RBOs.

Key Findings

The analysis of the financing mechanisms of RBOs shows that, firstly, RBOs require sufficient, reliable and sustainable funding in order to fulfil their mandate and implement their activities. It secondly shows that while the financing can stem from different sources, member country contributions are both crucial for the long-term financial sustainability of the RBO and an indicator for member countries' commitment to cooperative water resources management. And it thirdly provides detailed insights into how member countries to different RBOs share costs and contribute to their organizations' budget.

Based on these findings, it seems that in many of the world's RBOs, a transition to more financial self-sustainability, most likely in the context of a more general organizational transition process that addresses an RBO's governance and administrative structure in a comprehensive manner where necessary, is the only way towards long-term effective cooperation over shared watercourses through RBOs.

4. The cooperative multi-sector investment program, an effective driver of transboundary water cooperation. Lessons learned from global experiences

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Olivier Cogels, former Mekong River Commission CEO (2004-2007) and Extraordinary Professor at the Catholic University of Louvain in Belgium, is an International Consultant in Transboundary Water Resources Management and Water Diplomacy with a strong scientific and academic background, completed by thirty-five years of professional experience in strategic planning, program management, institutional development, and executive management in more than 30 countries worldwide. Over his career, Olivier Cogels has been working with a wide range of international organizations and development agencies including the World Bank, the African Development Bank, the European Commission, the FAO, the Global Water Partnership Organization, the Swiss Agency for Development and Cooperation, and the Belgian Technical Cooperation Agency. He also gained a comprehensive knowledge of several International River Basin Organizations. In recent years, he focused his activities mainly on the Nile Basin and the Mekong Basin.

ABSTRACT:
Considering the increasing water-related investment needs in international river basins in the developing world in a context of growing water, food, and energy security nexus, this paper promotes the concept of "Cooperative Multi-Sector Investment Program" as a driver of effective transboundary water cooperation. The paper recommends implementing this concept through a cyclic and multi-stages process, called the Transboundary Water Cooperation Cycle (TWCC). The concept and methodology are based on lessons learned from global experiences. The main advantages of this approach are: increased visibility of the benefits of cooperation, attractiveness for potential investors, improved coordination at regional and national levels, more optimal investments with higher returns, and conflict prevention through enhanced dialogue around concrete issues.