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The Nile Basin Water Resources: Overview of Key Research Questions Pertinent to the Nile Basin Initiative

Yasir Mohamed and Makonnen Loulseged

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and
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International Water Management Institute

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Acronyms

ALTERRA	Is part of the Wageningen University and Research Center concern
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
ATP	Applied Training Project
AWM	Agricultural Water Management
CBO	Community Based Organization
CBSI	Confidence Building and Stakeholder Involvement
CGIAR	Consultative Group of International Agricultural Research
CIDA	Canadian International Development Agency
CPWF	Challenge Program for Water and Food
EAC	East African Community
EIA	Environmental Impact Assessment
ENSAP	Eastern Nile Subsidiary Action Program
ENTRO	Eastern Nile Technical Regional Office
ESA	Eastern and Southern Africa
EWUA	Efficient Water Use for Agriculture
FAO	Food and Agriculture Organization
FEWS	Flood Early Warning System
GWP	Global Water Partnership
GWP-Ena	Global Water Partnership for Eastern Africa
HYDROMET	Technical Cooperation Committee for the Promotion of the Development and Environmental Protection of the Nile Basin
IAEA	International Atomic Energy Agency
IDEN	Integrated Development of Eastern Nile
IDRC	International Development Research Center
ICRAF	World Agroforestry Center
IFPRI	International Food Policy Research Institute
ILRI	International Livestock Research Institute
ILRI-GIS	International Livestock Research Institute-Geographic Information System
IMAWESA	Improved Management of Agricultural Water in Eastern and Southern Africa
ITC	International Institute for Geo-Information Science and Earth Observation
IWMI	International Water Management Institute
IWMI-DSP	International Water Management Institute -
IWMI-NBEA	International Water Management Institute for Nile Basin and Eastern Africa
IWRM	Integrated Water Resources Management
NTEAP	Nile Transboundary Environmental Action Project
MDG	Millennium Development Goals
MoU	Memorandum of Understanding
NBI	Nile Basin Initiative
NBRP	Nile Basin Research Program
NBTF	Nile Basin Trust Fund
NELSAP-CU	Nile Equatorial Lakes Subsidiary Action Program-Coordination Unit
PMU	Project Management Unit

RPT	Regional Power Trade
SC	Steering Committee
SDBS	Socioeconomic Development and Benefit Sharing
SVP	Shared Vision Project
SWMNet	Soil and Water Management Network
TAC	Technical Advisory Committee
TECCONILE	Technical Cooperation Committee for the Promotion of the Development and Environmental Protection of the Nile Basin
UNESCO-IHE	Institute for Water Education
WMO	World Meteorological Organization
WRPM	Water Resources Planning and Management

Summary

The Nile Basin Initiative (NBI), inaugurated in 1999, is a remarkable achievement towards the cooperative development and management of the common Nile water resources. The NBI reflects a strategic shared vision defined by all riparian states for sustainable socioeconomic development through the equitable utilization of, and benefit from the common Nile water resources. At present (2007), the NBI has numerous ongoing programs, and projects on the ground. These are based on a Shared Vision Program (SVP) and a Subsidiary Action Programs (SAP). The SAPs are implemented in the two subbasins: The Nile Equatorial Lakes Region and the Eastern Nile Region. In general, all programs and projects seek sharing benefits from the common Nile water resources.

It has been recognized that, successful implementation of the NBI projects is challenged by a number of issues: The size and complexity of the basin (over 3 million Km², shared by 10 countries); high population pressure; food insecurity; extreme poverty; political instabilities; limited understanding of the biophysical resources; among other factors. These challenges, clearly recall for research to complement the NBI endeavors, to ensure that policies, investments, and basin management strategies are informed and equipped by the best available scientific knowledge. While many researchable questions are already part of the NBI projects, apparently clear gaps still exist and need parallel investigation.

IWMI, together with other five CGIAR centers (ILRI, IFPRI, WorldFish Center and ICRAF) the CPWF (Challenge Program for Water and Food) and ASARECA (Association for Strengthening Agricultural Research in Eastern and Central Africa) worked together with the NBI projects in a long consultation process to identify knowledge gaps, and assess opportunities to foster synergies and information sharing for the support of the NBI mission. Extensive consultative discussions have been conducted separately with (almost) all the NBI, SVP and SAP projects. The objective has been to identify research gaps of direct support to the given projects. Research areas were prioritized during the large workshop held in Entebbe, in February 2007, which was attended by researchers, NBI staff and, donors.

This paper presents the main findings on: (i) Identified and prioritized research questions related to the Nile water resources; (ii) pertinent research projects ongoing and the implementing institutions; and (iii) the available databases hosted by different centers and a bibliography of relevant Nile research. Possibilities to enhance synergies and support future research in the Nile have been discussed at the end of the paper. Key research areas identified among a number of topics include:

1. Generation and provision of data on the Nile Basin natural resources (mainly land and water resources), and the status of their use. The objective is to fill in the noticeable data gaps, in particular in the upper catchments.
2. Climate change, climate variability, impacts and adaptation. A cross cutting topic pertaining to several NBI projects.
3. Conjunctive use of ground and surface water resources. A topic not sufficiently revealed within the NBI projects.

4. Land use change, impacts and feedbacks: Identifying main drivers of land use change; valuation of different ecosystem resources; implications on water resources, and the socioeconomics of the Nile people.
5. Agricultural water productivity. Measures (research, extension and/or training) required to increase agricultural water productivity. Trade offs on sustainable livelihood and environmental stability.
6. Benefits and beneficiaries: What types of benefits pertinent to NBI projects? Who are the beneficiaries? Identifying criteria for benefit sharing at various scales.
7. Institutional and legal issues for managing multi-country projects.
8. Harmonization of policies and legislations among countries and across sectors.

INTRODUCTION

The Nile Basin

The Nile Basin, having the world's longest river (6,700 km) is shared among ten countries. The catchment area of the basin is about 3.3 million km². It stretches over different geographical, climatological and topographical regions. The climate and vegetation cover in the basin are closely correlated with the amount of precipitation, which decreases from above 1,000 mm/yr in the southern part to virtually zero in the northern part crossing the Sahara Desert.

The precipitation and river-flow also encompasses sharp seasonal variability. The Spatial variability of evapotranspiration shows opposite trends to precipitation, i.e., increases in northward direction. The relative contribution to the mean annual Nile flow at Aswan of 84 billion m³ is approximately 4/7 from the Blue Nile, 2/7 from the White Nile (of which 1/7 is from the Sobat), and 1/7 from the Atbara River, i.e., the Ethiopian catchments (Sobat, Blue Nile and Atbara River) contribute to about 6/7 of the Nile water resources at Aswan.

Despite the fact that, the Nile Basin is endowed with extraordinary natural resources, its inhabitants face considerable challenges. The region is considered as one of the poorest regions of the world. More than 70% of the Nile population depends directly or indirectly on farming for their incomes and livelihoods. Water scarcity is a major challenge for the already closed basin. The challenge is further exacerbated by incidence of climate variability and natural shocks such as droughts and floods. Environmental degradation, high population growth and unstable political conditions are overarching issues in the basin. These challenges pose significant threats for food security and the social welfare of the Nile inhabitants.

It has been increasingly recognized among the riparian states that, cooperation on development and management of the Nile water resources can yield major benefits from the river on food and energy production, and will underpin many other benefits for the welfare of the basin inhabitants. The Nile Basin Initiative, established in 1999, is an exceptional collective basin-wide initiative by nine of the ten states that share the Nile River, namely, Burundi, Congo, Egypt, Ethiopia, Kenya, Rwanda, Sudan, Tanzania and Uganda. It envisages a new path for achieving poverty eradication and prosperity, peace and cooperation, sustainable development and environmental protection within the basin. To realize this shared vision of the NBI, the countries have devised a Strategic Action Program that promotes a Shared Vision Program and two investment Subsidiary Action Programs (SAPs). Additional description of the NBI is given in the section on 'The Nile Basin Initiative'.

The NBI devotes significant efforts and resources for the implementation of their projects. However, mandated with project management and overall control, the NBI staff usually contract international and regional firms to execute the technical assignments of these projects. The question is, in such a set up, why, and how can research be of support to the NBI? Earlier discussions among research centers and the NBI recognized that research is still required to complement best possible execution of the projects. Additionally, there are lots of objectives shared between research organizations and NBI, which gives credence to the efforts on synergism and share results for the benefit of all programs.

Research in the Nile Basin

There are a number of ongoing and planned research projects in the Nile Basin that are pertinent to the NBI, which are being executed by several research organizations. IWMI has a Nile Basin and East Africa office in Addis Ababa, Ethiopia, which undertake a number of research projects on land and water management. Two CGIAR centers have their headquarters in Nile Basin countries: World Agroforestry (ICRAF), and the International Livestock Research Center (ILRI), and most other centers, like IFPRI, WorldFish Center, ICRAF working in areas of food policy, fisheries, forestry, are active in one or more of these countries. The Nile is one of the nine ‘*Benchmark Basins*’ of the CGIAR Challenge Program on Water and Food (CPWF). ASARECA, its head quarter located in Entebbe, Uganda, operates in nine out of ten riparian countries aiming to support agricultural research that adds value to national programs.

Therefore, both NBI and the CGIAR centers, including IWMI and ASARECA recognize the common shared objectives, and that creating an effective partnership could make a major contribution to the achievement of the Shared Vision of the NBI. Accordingly, a project entitled ‘*Creating Synergies and a Partnership among the CGIAR, Nile Basin Initiative and ASARECA: Consultations to Identify Opportunities to Support NBI through Research and Capacity Building*’ was commenced in early 2006 and completed in April 2007. This project seeks consultation to jointly provide, a strategic demand-driven research program, and to create a long-term partnership of key players in knowledge generation and management for developing and managing land and water resources in the Nile Basin. Though this project was completed in April 2007, it has forwarded some thoughts for follow up, which are mentioned in the section on ‘Discussions’. The formal partners that initiated the project, in addition to the NBI, IWMI and ASARECA-SWMNet are: ILRI, IFPRI, ICRAF, WorldFish Center, and the CPWF. Other research partners, e.g., Food and Agricultural Organization of the United Nations (FAO), Alterra, UNESCO-IHE, ITC, and IAEA joined along the course of the project. Attempts are being made to bring new research partners to work in the Nile Basin. A final project workshop was held to prioritize researchable areas during February 9–10, 2007, in Entebbe, Uganda. This workshop was attended by more than 35 participants from the NBI projects and from various other research centers in the region and overseas (all involved or interested in the Nile Basin research). http://www.iwmi.cgiar.org/africa/East/Workshop/CGIAR-NBI%20strategies_WORKSHOP.htm

This paper presents the main findings of the technical part of the research, i.e., identification of research gaps with regard to the Nile Basin water resources, inventory of available databases and ongoing research programs, and a brief review of the basin’s main stakeholders. The section on ‘The Nile Basin Initiative’ gives a brief description of the NBI projects as an introduction to the following section— ‘Research Areas Pertinent to the NBI Program’, which discusses the research areas. The section titled ‘Ongoing Research Projects and Institutions Working in the Nile’ presents a summary of ongoing research projects and institutions involved in the Nile Basin research. Databases currently built by different organizations are listed in the section on ‘Available Databases and Bibliography Pertinent to the NBI’, together with a bibliography of the Nile literature. Lastly, the section on ‘Discussions’ discusses the future prospect of synergies and partnerships for research of the Nile.

THE NILE BASIN INITIATIVE

This chapter aims to present a pithy review of the NBI and its associated projects. The countries sharing the Nile Basin are: Burundi, Congo, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Tanzania, and Uganda. Demands for the Nile water resources for food security and development has been increasing among different uses as well as among the countries. This poses increasing pressure on the already closed basin, and results in increasing environmental degradation within the basin. However, the Nile is also endowed with rich natural resources and hold huge opportunities for win-win development that could enhance food production, energy generation, and other related development openings. As clearly acknowledged by many stakeholders, this can be attained only through cooperative management and development of the shared river among the riparian states. The Nile Basin initiative provides a unique forum for the countries of the Nile to move towards the cooperative process to realize tangible benefits in the basin and build a solid foundation of trust and confidence.

Prior to the emergence of the NBI, collective cooperation and development in the basin had been constrained by disagreements as to the supervision and management of the Nile water resource. Historically, there were initiatives and treaties for joint cooperation, mostly bilateral and trilateral (Waterbury 1979; Okidi 1990). Recent cooperative initiatives (after obtaining independence) includes: the HYDROMET project from 1967 to 1992, in the Equatorial Lakes. The TECCONILE (Technical Cooperation Committee for the Promotion of the Development and Environmental Protection of the Nile Basin) was started in 1993, focusing on a development agenda. The series of the 'Nile 2002 conferences' also started in 1993 and continued up to 2002. It provided good forum for scientific discussions and (informal) dialogues on Nile issues.

These cooperative efforts, with the support of the international community, paved the way for the Nile Basin Initiative (NBI) established in 1999. It is the first collective basin-wide initiative by nine of the ten states that share the Nile River (Eritrea holds an observer status). After an intensive dialogue and consultation, the Nile Basin countries have agreed on a 'Shared Vision' that seeks *"to achieve sustainable socioeconomic development through the equitable utilization of, and benefit from, the common Nile Basin water resources."* The objectives of the NBI are:

1. To develop the water resources of the Nile Basin in a sustainable and equitable way to ensure prosperity, security and peace for all its peoples;
2. To ensure efficient water management and optimal use of the resources;
3. To ensure cooperation and joint action among the riparian countries, seeking win-win gains;
4. To target poverty eradication and promote economic integration; and
5. To ensure that the program results in a move from planning to action.

To realize these objectives, the countries have devised a Strategic Action Program (SAP) that promotes a Shared Vision Program (SVP) and two investment Subsidiary Action Programs. The SVP is designed to build the institutional capacity, relationships and technical skills needed to support the NBI's two investment programs: the Nile Equatorial Lakes Subsidiary Action Program (NELSAP) and the Eastern Nile Subsidiary Action Program (ENSAP).

Shared Vision Program (SVP)

The components (portfolios) of the SVP projects include the following eight projects. More particulars on the SVP projects' objectives and description are given in Appendix A1.1; this information is also available on <http://www.nilebasin.org>.

1. The Applied Training Project (ATP);
2. The Nile Transboundary Environmental Action Project (NTEAP);
3. The Nile Basin Regional Power Trade Project (RPTP);
4. The Efficient Water Use for Agriculture Project (EWUAP);
5. The Water Resources Planning and Management Project (WRPMP);
6. The Confidence-Building and Stakeholder Involvement Project (CBSIP);
7. The Socioeconomic Development and Benefit Sharing Project (SDBSP); and
8. The SVP Execution and Coordination Project.

The Subsidiary Action Program (SAP)

In parallel to the SVP, groups of countries have initiated Subsidiary Action Programs (SAPs) to cooperatively identify and implement investment projects that confer mutual benefits. To date, the Nile riparian states have formed two Subsidiary Action Programs—one on the Eastern Nile region and the other in the Equatorial Lakes region based on wide consultation at the political and technical levels.

Eastern Nile

ENSAP (The Eastern Nile Subsidiary Action Program): The ENSAP currently includes Egypt, Ethiopia, and Sudan. The primary objectives of ENSAP are to: (a) ensure efficient water management and optimal use of resources through equitable utilization and causing no significant harm; (b) ensure cooperation and joint action between the Eastern Nile countries seeking win-win gains; (c) target poverty eradication and promote economic integration; and (d) ensure that ENSAP results in a move from planning to action. Consequently, consensus was reached that the objective of a first ENSAP project, referred to as the 'Integrated Development of the Eastern Nile (IDEN) Project', will be to "initiate a regional, integrated, multipurpose development project through a first set of investments that confer tangible, win-win gains and demonstrate joint action between the Eastern Nile countries." Further information on the ENSAP is given in Appendix A1.2.

NELSAP (The Nile Equatorial Lakes Subsidiary Action Program): The Nile Equatorial Lakes region includes the six countries in the southern portion of the Nile Basin: Burundi, Democratic Republic of Congo, Kenya, Rwanda, Tanzania and Uganda, as well as the downstream riparian states Egypt and Sudan. The water resources of the Nile Equatorial Lakes region include one of the world's great

complexes of lakes, wetlands, and rivers. The region's economies are characterized by rain-fed agriculture, subsistence farming, low industrialization, and poor infrastructure development. The objectives of the Nile Equatorial Lakes Region Subsidiary Action Program (NELSAP) are to contribute to the eradication of poverty, promote economic growth, and reverse environmental degradation. Twelve NELSAP projects have been identified by the Nile Equatorial Lakes riparian in a consultative manner, targeting investments in water resources management of shared-sub-basins, hydropower development and transmission interconnection, fisheries development and lakes management, water resources management, agriculture development, and water hyacinth control. More information on these projects is given in Appendix A1.3.

RESEARCH AREAS PERTINENT TO THE NBI PROGRAM

Identification of knowledge gaps and researchable areas to support the NBI program is not self-evident and automatic. The NBI is an extensive program, although encircled around the Nile Basin water resources, it is addressing almost every aspect: socioeconomic (food security and livelihood), technology (management and development), politics (benefits and transboundary relations), among others. How all these are interlinked to national, subbasin and basin scales, and stakeholders interests is also very complex. Through confining objectives of the proposed research topics to support NBI projects, we clearly define a focussed goal and a domain of activities. However, the challenge—in order to avoid duplicating NBI work—is how to create clear distinction between research and actual NBI project activities. Next, what is the best possible research path; should it include holistic research programs; or a demand driven research for specific NBI project(s); or separate research topics? Are we going to first redefine the NBI project problem tree, and identify a research that omit elements covered by the NBI project, and work on the absent parts? Who is going to do the research? How are we going to create the integration among different research projects, and the synergies with the NBI projects? How to get funding for the research projects? These have been evolving questions, from the start of this project up to the final workshop, partly resolved, and partly suggested for future discussion.

Although it is difficult (occasionally) to find a clear cut between research and NBI projects, the proposed research questions given above are supposedly not duplicating NBI's projects. A clear example of not being a research question, though a well-known research tool is the modelling task. NBI devotes substantial efforts and resources for modelling projects, e.g., the Nile Decision Support System DSS, or the several planning and forecasting models. Are we going to suggest modelling as a research assignment? Of course, not, but we can target research gaps that exist within specific model(s), e.g., knowing that the Nile is a data scarce region, what is the best possible input data (boundary conditions) for a given model(s). A second example, what is the most suitable (locally adapted) reservoir sedimentation algorithm to be imbedded in a river simulation model? Is there also a research gap in river simulation models? Therefore, right from the start, two conditions were set to identify researchable areas of support to the NBI projects:

1. The identified question(s) should not duplicate project work, at least the obvious project parts.
2. The output of the research question(s) should directly be valued by a one or more NBI projects.

The procedure adopted along the course of this synergy project to identify research questions followed the three steps given below:

First, research questions were extracted from literature reviews. Normally, address prominent (known) problems in the Nile Basin such as land degradation (soil erosion, deforestation and sedimentation), climate change, low agricultural productivity, etc.

Second, research gaps for an NBI project were identified through mini workshops and consultation with the NBI staff. The NBI project staff was requested to provide research gaps within their project, or comment on research questions suggested from step one above. This is to exclude research questions already addressed by the given NBI project.

Third, to assemble research questions from different projects and address cross cutting areas, a final workshop had been conducted, whereby both NBI projects and scientists from research centers have discussed and prioritized research areas. The workshop included presentations on knowledge gaps given by all NBI SVP projects (except RPT and CBSI), NELSAP, and ENSAP. Presentations on relevant research were made by most of research centers working in the Nile Basin, including: IWMI, ILRI, CPWF, IFPRI, FAONile, UNESCO-IHE, ITC, IAEA, ALTERA, and ASRECA-SWMNet. Sufficient time had been devoted for group discussion to prioritize and classify research questions into four thematic areas: (1) Water Resources; (2) Agriculture; (3) Environment; and (4) Socioeconomic Development and Benefit Sharing. The workshop material (presentations, discussions, etc.) is available at <http://www.iwmi.cgiar.org/africa/East/PROJECTS/CGIAR-NBI%20strategies.htm>.

The workshop discussions showed that many topics were cross cutting over several projects, and that some of the questions raised by the NBI projects were not exactly research questions. In fact, they were more like a combination of problems that include research, consultancy (information provision) and project activities. For example, some of the raised questions can be resolved directly by the NBI projects, or by consultants, others, were actually implementation problems and not research-related. The ample time allotted for group discussion during the workshop, allowed sufficient debates to refine and prioritize the relevant research areas. The summary of a consolidated list of cross cutting topics is given below and additional details on the research problem, objectives, and relevancy to NBI projects are presented in Appendix 2. One may notice that, strong division of NBI project activities and research questions in some cases is still not crystally clear. Research questions related to the NBI projects: RPT and CBSI are not included in the list. The identified main research areas, pertinent to the NBI projects include:

1. Data: Provision of data on the natural resources system and uses to fill in (noticeable) data gaps within the basin, in particular in the upper parts, including data on actual use and performance.
2. Hydroclimatology: Improve understanding of climate change and climate variability. Improve assessment of vulnerability of resource and use systems (land and water). Improve assessment of impacts on those systems. Provide recommendation to enhance adaptation and coping strategies.
3. Watershed Management: Improve understanding of available watershed resources, and the existing practices and needs for better utilization. Identify best possible watershed management interventions and their impacts.

4. Agriculture: Assessment of agricultural water potential, use, and productivity, and how to improve.
5. Environment: Environmental resource assessment, status of use, and how to reverse degradation.
6. Socioeconomics: Improve understanding of available Nile resources, potential development and their impact on socioeconomics of the Nile people, benefits, and benefit sharing.
7. Water Resources:
 - a) integrating groundwater into surface water management;
 - b) assessment of the spatio-temporal variability of water resources, and how should they be managed to enhance economic development and reduce inequities sustainably;
 - c) research to improve understanding of river morphology, and reservoir sedimentation;
 - d) research on options and modalities of water resources institutions and associated policies at subbasin (national) and basin (trans-regional) levels; and
 - e) research on water resource development/management and their health impacts.

ONGOING RESEARCH PROJECTS AND INSTITUTIONS WORKING IN THE NILE

As part of stakeholders mapping, and to review ongoing research projects pertinent to the NBI, this section presents a brief overview of national, regional, and international research centers currently involved in research projects relevant to the NBI program. Some of these are initial project partners (IWMI, ASARECA-SWMNet, ILRI, CPWF, IFPRI, WorldFish Center, ICRAF), others participated in the project's final workshop (ALTERRA, FAONile, UNESCO-IHE, ITC, IAEA), and the rest too are equally involved/interested in the Nile Basin research. A brief summary is given in this section, while additional information about institutions and their projects is presented in Appendix 4.

National Research Institutions

Except for Egypt, and to a limited extent Sudan, there are few national centers specialized in water-related research. Usually such research is carried out by universities and academic institutions. In general, the capacity of water professionals and institutions in the Nile region is weak, let alone national research centers and their cadre. These have been clearly revealed by the need assessment reports of the Applied Training Project ATP, namely, (a) lack of capacity on integrated water resources management; (b) uneven distribution of capacity between basin countries; and (c) little interaction among water professionals within the basin.

The list of national training institutions prepared by the ATP is amended in Appendix 3 as potential research centers from the riparian countries. The corresponding column gives potential areas of specialization of each institute.

CGIAR Centers

All main partners of the project except ASARECA are members of the Consultative Group on International Agricultural Research (CGIAR). The CGIAR is a strategic alliance of countries, international and regional organizations, and private foundations supporting 15 international agricultural centers that work with national agricultural research systems and civil society organizations including the private sector. The alliance mobilizes agricultural science to reduce poverty, foster human well-being, promote agricultural growth and protect the environment. The CGIAR generates global public goods that are available to all. The CGIAR's Regional Plan for Collective Action in Eastern and Southern Africa is a very recent institutional innovation of the CG Centers and is aimed at fostering greater cohesiveness, economies of scale and scope and regional impact.

IWMI NBEA <http://www.iwmi.cgiar.org/Africa/East/>: Nile Basin and East Africa Office of IWMI located in Addis Ababa. It is the lead partner of this project, and implements numerous research projects on water resources, hydrology, and irrigation management. Please refer Table A 4.1 for ongoing projects.

CPWF <http://www.waterandfood.org/basins/nile-river-basin.html> : The Challenge Program on Water and Food (CPWF) is a CGIAR program. The Nile is one of the CPWF's benchmark basins for basin focal studies.

ILRI <http://www.ilri.org/>: The International Livestock Research Centre, having its Head Quarter in Nairobi, Kenya is actively engaged in most Nile Basin countries. ILRI works on livestock-related projects, see Table A 4.2 for more information on ILRI research programs.

IFPRI <http://www.ifpri.org/>: The International Food Policy Research Institute has several ongoing research projects in some of the Nile countries that focus on main research themes: food system functioning, food system governance, and food system innovations. Please refer Table A 4.3 for more information on these research programs.

WorldFish <http://www.worldfishcenter.org/> WorldFish Center having a regional office in Cairo Egypt, specializes in research of living aquatic resources. Please refer Table A 4.4 for more information on these research programs.

ICRAF <http://www.worldagroforestry.org/>: The World Agroforestry Centre has its headquarters in Nairobi-Kenya and its research is organized around the four themes: (1) Trees and Markets; (2) Strengthening Institutions; (3) Land and People; and (4) Environmental Services.

ASARECA-SWMnet <http://www.asareca.org/>: The Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) is an organization of the National Agricultural Research Institutes (NARIs) in Madagascar and the Nile Basin Countries except Egypt. The Soil and Water Management Research Network (SWMnet) for East and Central Africa was started in 1998 to respond to the Millennium Development Goals (MDGs) on poverty eradication, hunger; and environmental sustainability. Please refer Table A 4.5 for more information on these research projects.

Other Research Institutions

The following are other research organizations involved in research work within the Nile Basin. Although these are not initial partners of the project, their inclusion aims at further expanding synergies and partnerships in the future.

FAONile <http://www.faonile.org>: The Information Products for Nile Basin Water Resources Management Project is intended to strengthen the abilities of the Nile Basin states to take informed decisions with regard to water resources policy and management. Supported by the Government of Italy, the FAONile project is carried out under the umbrella of the NBI. It is implemented by the ten Nile riparian states with technical and operational assistance of the Food and Agriculture Organization FAO. Please refer Table A4.6 for more information on the ongoing projects.

GWP-EnA <http://www.gwpena.org/>: The Global Water Partnership is a working partnership among all those involved in water resources management. The Eastern Africa Global Water Partnership was launched in November 2002 and is now hosted by the NBI Secretariat at Entebbe in Uganda.

UNESCO-IHE <http://www.unesco-ihe.org/about/intro.htm>: Is the International Institute for Water Education, Delft, The Netherlands. Large numbers of the Nile water professionals have completed their post graduate or are currently studying at UNESCO-IHE. The knowledge networks project for the Nile Basin (Cairo, Egypt) is run by the UNESCO-IHE to create networks and Communities of Practice on the basis of the ongoing project (NBCBN-River Engineering), <http://nbcbn.com/Home.asp>

ITC <http://www.itc.nl/research/default.asp>: The International Institute for Geoinformation Science and Earth Observation, Enschede, The Netherlands, is similar to IHE. Many water professionals from the Nile region who specialize in remote sensing and GIS applications have graduated or are currently studying at the ITC. The institute carries out multidisciplinary and problem-oriented research in support of its education and project services.

University of Bergen <https://nile.uib.no/>: The UiB hosts the Nile Basin Research Program NBRP. The program is associated with the Applied Training Program (ATP) of the NBI. The NBRP focuses thematically on contested resources, climate dynamics, health and socioeconomic aspects.

ALTERRA <http://www.alterra.wur.nl/UK/>: Alterra is the research institute of the Wageningen University. Their ongoing project in the Nile Basin entitled '*New Water Adaptive Water Management Research in the Nile Basin*' focuses on integrated water management, and effects of climate. The project aims at developing adaptive water management systems, both for infrastructure (storage and buffering capacity), and management (regime and institutions).

IAEA <http://www.iaea.org/>: The International Atomic Energy Agency is a United Nations Agency that works on the peaceful uses of nuclear technology. The objective relevant to NBI is to improve the management of water resources through use of isotope technologies. Please refer Table A 4.7 for more information on the ongoing projects in the region.

FRIEND NILE <http://62.193.88.134/fn/>: The FRIEND (Flow Regimes from International Experimental and Network Data). The FRIEND/Nile Project aims at improving the river basin management of the Nile through promoting cooperation in the field of water resources management and regional-scale analysis of hydrological regimes.

Nile Basin Discourse http://www.nilebasindiscourse.org/index_EN.php: It is a network of civil society organizations from the ten countries of the Nile Basin which seeks positive influence over the development of projects and programs under the NBI and other Nile-related programs.

AVAILABLE DATABASES AND BIBLIOGRAPHY PERTINENT TO THE NBI

The discussion on research needs to support the NBI projects' emphasise on the need for good quality data by almost all the NBI projects. Availability of the data in the basin has been a challenge for planning, development, management and research projects. In addition to national databases built by riparian states, a number of organizations have been active in building databases of different types within the Nile Basin. The section titled 'Pertinent Databases to the NBI', which is given below presents a list of temporal and spatial databases currently being built by several partners/organizations. And the section titled 'Bibliography on the Nile Research' gives a list of some of the literature citations on Nile Basin research.

Pertinent Databases to the NBI

FAONile Databases: <http://www.faonile.org/whatwedo/database.htm>: This is a part of the FAONile projects. It includes scattered databases from a host of different institutions organized at national level in a comprehensive georeferenced Nile Basin database. A large set of hydrologic and meteorological data has been quality controlled and transferred into an electronic format. Please refer Table A4.5 for further information on the databases.

IWMI-IDIS <http://dw.iwmi.org/dataplatform/home.aspx>: The Integrated Database Information System (IDIS) is an on-line data sharing platform that provides access to water, agriculture and environment data on several basins, including the Nile.

IWMI-DSP <http://www.iwmidsp.org/iwmi/info/main.asp>: The Data Storehouse Pathways of IWMI contains large volumes of multi-temporal data from multiple satellite sensors, which were used in several IWMI research projects, including: Global Irrigated Area Mapping GIAM.

FAO Land and Water <http://www.fao.org/ag/agl/lwris.stm>: The Land and Water Development Division of FAO operates a number of databases, e.g., :AQUASTAT — Global Information System of Water and Agriculture; CLIMWAT — Climatic Database to be used with CROPWAT; Digital Soil Map of the World; Land Degradation Assessment for Dry lands (LADA); Land-water Linkages in Rural Watersheds; among others.

ILRI-GIS www.ilri.cgiar.org/gis/igis.asp: Is a database related to livestock distribution, health and production. Other layers, however, cover more general topics such as human population density, climate and infrastructure. Some of the datasets cover only a specific project, while others are county-wide, regional, continental or even global.

TIGER <http://www.tiger.esa.int/EOdata.asp>: Is an initiative by the European Satellite Agency—to assist African countries on collection, analysis and dissemination of water related geo-information data. The project offers numerous spatial data on different sources.

FEWS NET <http://earlywarning.usgs.gov/adds/>: The Famine Early Warning System Network (FEWS NET) produces information for disaster and crisis prediction. The program monitors numerous data and information—including remotely sensed as well as ground-based data on meteorological, crop, and rangeland conditions.

IFPRI http://www.ifpri.org/data/data_menu.asp: Includes databases on: Geospatial Datasets of Agro-MAPS; Global Rural-Urban Mapping (GRUMP); Agroecosystems Dataset, among others.

CGIAR-CSI <http://www.csi.cgiar.org/index.asp>: The Consortium for Spatial Information links all of the CGIAR's GIS/RS laboratories, and many geospatial scientists and researchers. It includes databases on population, poverty, climate, soil, crops, livestock, transportation, biodiversity and other geospatial Global Public Goods.

FishBase http://www.worldfishcenter.org/cms/list_article.aspx?catID=42&ddIID=65: WorldFish Center is having the FishBase database, which provides detailed information on most of the known world fish species.

There are many other databases that include valuable data on the Nile that have not been covered as above, e.g., University of East Anglia, Global Runoff Data Centre, Tropical Rainfall Measuring Mission, Earth Observing System Data Gateway of NASA, among others.

Bibliography on the Nile Research

This section aims at reviewing some of the popular bibliography on the Nile. The list cannot be claimed complete. The idea is to present main bibliography information, and famous books on the Nile. These may include references to a wide range of literature and research on the Nile.

The River Nile and Its Economic, Political, Social and Cultural Role. An Annotated Bibliography by Terje Tvedt: The book includes an extensive, multidisciplinary bibliography on the Nile of 3,490 entries. It is organized in eight categories: (1) Political and Cultural History; (2) Fisheries; (3) Flora and Fauna; (4) Health; (5) Physical Characteristics; (6) Projects and Reports; (7) Travel and Exploration; and (8) Water Use and Water Management.

http://www.global.uib.no/home/index.php?module=article&view=36&page_num=4

Cornell Blue Nile: Is a website recently developed by the Cornell University to organize information about hydrological modeling in the Nile River Basin. It includes a reference list of journal articles on the Nile hydrology, sediment, and other aspects. The site is protected by a user name and password. <http://nile.cornell.drfuka.net/>

Nile Hydrology by J.V. Sutcliffe and Y.P Parks: IAHS Special Publication No. 5, 1999: This book describes the Nile Basin in its historical setting and the hydrology. The book also includes mean hydrological data on key variables at key locations in the basin. <http://cerf-jcr.org/Books/Nile.htm>

The Nile: Sharing A Scarce Resource by P.P. Howell, Published by Cambridge University Press in 1994: This is a historical and technical review of water management and of economical and legal issues.

<http://www.cambridge.org/us/catalogue/catalogue.asp?isbn=0521450403>

The Nile Basin Volumes: These are the first series of literature on the Nile. It includes volumes from I to XI containing data series and description of the hydrological characteristics of the Nile basin and subbasins including general information on meteorology, topography, conservation projects etc.

HYDROMET (<http://www.nilebasin.org/library.htm>): The HYDROMET project was initiated by WMO in 1968 to collect information related to hydro-meteorological data linked to the White Nile. Reports and other outputs of the project are available in the NBI Nile-Sec library, Entebbe, Uganda.

TECCONILE Atlas (<http://www.nilebasin.org/library.htm>): The Technical Cooperation Committee for the Promotion of the Development and Environmental has participated in the preparation of an atlas of the Nile Basin, which includes different types of data.

Nile 2002 Conference Series (<http://www.nilebasin.org/library.htm>): A series of conferences that was started in 1993 and concluded in 2002. The proceedings encompassed a wealth of information on Nile technical issues.

DISCUSSIONS

It has been increasingly recognized that the Nile Basin Initiative program needs research to complement optimal implementation of the Shared Vision and Subsidiary Action projects. Similarly, research organizations working in the region acknowledge the many shared objectives they hold with the NBI program. These, actually initiated the notion of creating synergies and partnerships among research institutions and the NBI to ensure that the best available knowledge is made use of when making policies, investment and strategies.

An intensive consultation has been completed with all NBI, SVP and SAP projects (except Regional Power Trade and CBSI). The discussion focused on exploring research questions directly impacting NBI projects. This has been further refined in a larger workshop attended by NBI projects as well as research organizations actively working in the Nile research.

Many topics have been raised for research, and prioritized through group discussions on four thematic areas: (1) Water Resources; (2) Agriculture; (3) Environment; and Socioeconomic Development; and (4) Benefit Sharing. Research topics of high relevance have been summarized in Appendix 2, including research on data availability, climate, agriculture, water resources, land use, socioeconomics (benefits and benefits sharing), policies and institutions.

The discussion on how to support the NBI through research and capacity building was started in September 2004 at a workshop in Entebbe, whereby NBI and research centers including IWMI discussed on how to collaborate in research and capacity building. The project on creating synergies on research among research centers and the NBI, which started early 2006 was completed early 2007.

What is next, after identifying research topics pertinent to the NBI projects, has been an important question right from the start. The list of questions is available to the research community and anyone can make use of it. In fact, as we have seen, a lot is already undergoing with regard to land and water resources research in the Nile. However, it is strongly recognized that creating

synergies and partnerships among research community and the NBI would optimally benefit the NBI program, as well as the research community. A suggestion has been made and discussed during the project workshop that was held in February 2007, to enforce a 'Steering Committee (SC)', as a governance body to continue coordinating research efforts that support the NBI projects. The SC is chaired by the Nile-SEC, while IWMI provides the secretariat. Potential members of the SC would be ASARECA-SWMnet, FAONile, relevant SVP project managers, ENSAP, NELSAP, and Civil Society representatives. The main role of the SC is to provide strategic guidance and coordination on research activities directly pertinent to NBI. In sum, efforts should continue to support the SC, as well as for research projects to ensure coordination/collaboration is strengthened among partners, and also mobilize partnerships to further use the research results.

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Appendix 1. The Nile Basin Initiative

APPENDIX A1.1: Summary of the SVP Project Portfolio.

Project	Objective	Description	Status
Nile Transboundary Environmental Action	Provide a strategic framework for environmentally sustainable development of the Nile River Basin	Identifying environmental and development synergies contributing to sustainable development opportunities will be an important task. Improve understanding of the relationships of water resources development and the environment in the basin	Being the first has made significant progress in implementing the planned activities
Nile Basin Regional Power Trade	Establish the institutional means to coordinate the development of regional power markets among the Nile Basin countries	The present limited development of national power systems in the basin imposes a constraint on the exploitation of these resources at affordable costs at the national level. These constraints on supplying affordable power could be overcome by expanding the market for these resources by developing power trade among Nile Basin countries	Significant progress has been made in each of the components
Efficient Water Use for Agricultural Production	Provide a sound conceptual and practical basis to increase availability and efficient use of water for agricultural production	Irrigation is the dominant human use of water in the basin and that agriculture is an important element of the economies of all riparian countries in terms of employment, exports, and contribution to GDP. Hence, the judicious use of this resource in the sector is critical	Being the last, project personnel are in place and project activities are picking up
Water Resources Planning and Management	Enhance the analytical capacity for basin wide perspective to support the development, management, and protection of Nile Basin waters	Components of water resources management that help in furthering cooperation include effective policies and implementation strategies, project planning and management skills, and communication and decision making tools	All the staff being in place the project is operating at full capacity
Confidence Building and Stakeholder Involvement	Develop confidence in regional cooperation under the NBI, both at basin and local levels, and ensure full stakeholder involvement in the NBI and its projects	Confidence in regional cooperation and full stakeholder involvement are prerequisites to sustainable socioeconomic development and poverty reduction	Various types of workshops and training are being conducted by the project
Applied Training	Strengthen capacity in selected subject areas of IWRM, strengthen centers with capacity to develop and deliver programs on a continuing basis	Most of the basin countries are burdened by weak human and institutional capacity to manage water resources in an integrated manner. This situation applies not only to the management of international waters but also to management of national waters	A number of training courses, seminars, long-term training, curriculum development are being conducted
Socioeconomic Development and Benefit Sharing	Strengthen Nile River basin wide socioeconomic cooperation and integration	Broader cooperation could enable enhanced intra-regional trade and promote investment in the region's infrastructure, such as roads, rail, and telecom links that could increase the productivity of all countries within the region and allow them to develop more rapidly and trade more effectively both within and beyond the region	Although the project started late activities of the project are picking up

APPENDIX A1.2: ENSAP Projects Portfolio.

Project	Objective	Description	Status
Eastern Nile Planning Model Sub-Project	To identify, prepare, and implement cooperative development projects that provide mutual benefits in the Eastern Nile	Provides a common analytical basis for identifying and assessing options, quantifying benefits and impacts, evaluating tradeoffs, and analyzing and managing information	Ongoing at full pace
Flood Preparedness and Early Warning Sub-Project	To reduce damage from major floods, and to increase the benefits from excess flood waters, in the EN countries	The project includes: assessment of flood risk and vulnerability, develop a flood forecasting system, identify options for enhancing flood mitigation.	Project preparation is in progress, pre-appraisal report prepared
Baro-Akobo Multi-purpose Water Resources Development Sub-Project	The Baro-Akobo Basin project provides a potential opportunity to develop a multi-purpose water resources project, which may provide win-win benefits to the Eastern Nile countries	The multi-purpose project intends to provide: hydropower generation, irrigation development, flood management, increased water yield, environmental protection and enhanced watershed management	Discussion with funding agency is going on, revised TOR is prepared
Ethiopia-Sudan Transmission Interconnection Sub-Project*	To promote regional power trade through coordinated planning and development of power projects and transmission interconnection	Construction of a transmission interconnection between Ethiopia and Sudan, taking into consideration future power trade with Egypt and possibly other countries	Updating of the feasibility study
Eastern Nile Power Trade Investment Program	To initiate the development of a regional power trade generation and investment program	To initiate an investment program that prioritizes hydropower development and transmission interconnection investments in the Eastern Nile region	Consultant hiring is in progress for project preparation
Irrigation and Drainage Sub-Project	To increase agricultural productivity through irrigation development	To support the development and expansion of irrigated agriculture, as well as to improve the productivity of large-scale agriculture through improved agricultural water use	Consultant hiring for project preparation is in progress
Watershed Management Sub-Project	To establish a framework for the management of selected watersheds on the Eastern Nile (EN)	The project is expected to lead to: increased land productivity, reduced sediment load, poverty alleviation	Draft report prepared
Joint Multi-purpose Project	Launch the first phase of identification of a major program of multi-purpose joint development of the Eastern Nile	A 'scoping study' has been initiated to support the process by providing information on key multi-purpose opportunities in the Eastern Nile that could form part of a Joint Multi-purpose Project	Improvement of the knowledge base and refinement of the models
Ethiopia-Sudan Transmission Interconnection Sub-Project*	To promote regional power trade through coordinated planning and development of power projects and transmission interconnection	Construction of a transmission interconnection between Ethiopia and Sudan, taking into consideration future power trade with Egypt and possibly other countries	Updating of the feasibility study

APPENDIX A1.3: NELSAP Project Portfolio.

NEL-COM Priority Area	Project	Countries	Description
1. Water Use in Agriculture	Enhanced Agriculture Productivity Project	Burundi, DR Congo Kenya Rwanda Tanzania Uganda	The regional agriculture program, which is under preparation, will promote opportunities for cooperation in the Nile Basin through private investment, public-private partnerships and enhanced trade through increased investment, income generation and pro-poor growth. Financing for this project is not yet secured
2. Sustainable Management and Conservation of Lakes and Wetlands	Fisheries Project for Lake Albert and Lake Edward	DR Congo Uganda Egypt Sudan	The objective of the project is to establish a sustainable framework for the joint management of the fisheries in Lake Albert and Lake Edward to improve the living condition of the people and to protect the environment
3. Watershed Management	Development of a Framework for Co-operative Management of the Mara River Basin Water Resources	Kenya Tanzania	The objective of the project is to establish a sustainable framework for the joint management of the water resources of the Mara River Basin, in order to prepare for sustainable development oriented investments
	Kagera River Basin Integrated Water Resources Management	Burundi Rwanda Tanzania Uganda	The objective of the project is to develop tools and a permanent institution for the joint, sustainable management of the water resources in the Kagera River Basin.
	Development of a Framework for Co-operative Management of the Malakisi-Malaba-Sio River Basin Water Resources	Kenya Uganda	The objective of the project is to reverse the environmental degradation trends in the catchments by supporting the rural communities in adopting appropriate technologies in catchment management
4. Water Hyacinth and Water Weed Control	Water Hyacinth Abatement in the Kagera River Basin	Burundi Rwanda Tanzania Uganda Sudan Egypt	The objective of the project is to eliminate adverse effects on environment, health and socioeconomic activities that are caused by water hyacinth infestation, by reducing to manageable levels the infestation of water hyacinth in the Kagera River basin
5. Hydropower Sub-program 1	A Rusumo Falls Hydro-Electric Power Development, HEP	Burundi Rwanda Tanzania	The objective of the project is to supply new energy and capacity to the existing power grid based on renewable hydropower energy, to foster international cooperation in hydropower project development, and to electrify new areas and improve regional power supply reliability by interconnecting the power networks of DRC-East/ Burundi/ Rwanda and the national network of Tanzania
Sub-program 2	Regional Transmission Feasibility Interconnection Study	Burundi Rwanda Tanzania Uganda Sudan Egypt	A feasibility and design study for six power transmission lines between Burundi, DRC, Kenya, Rwanda and Uganda is being carried out for future strengthening of the existing and new interconnections between the NEL countries and to other regional grids

Continued

APPENDIX A1.3: NELSAP Project Portfolio. (continued)

NEL-COM Priority Area	Project	Countries	Description
	Strategic Sectoral Social and Environmental Assessment of Power Development options	Burundi Rwanda Tanzania Uganda Sudan Egypt	The objective is to prepare an indicative NELSAP Power Master Plan to assist the NELSAP riparian countries in selecting best power supply options and regional transmission inter connection
6. NEL-Coordination Unit (NEL-CU)	Coordination	Burundi Rwanda Tanzania Uganda Sudan Egypt	The project provides institution and capacity building funds to NELSAP-CU. The member countries are currently seeking funds for a follow-up on refinement NELSAP-CU institutional support project for the next 4 years to support the NELSAP Scaling Up Strategy

Appendix 2. Research Topics Pertinent to the NBI Projects

No.	Research Problem	Research Area and Objectives	Possible Research Questions and Outputs	Relevance to NBI Projects
1.	<p>Scarcity of data in the Nile Basin:</p> <ol style="list-style-type: none"> 1. Data on biophysical resources (lands, water, hydrometeorology, etc.) 2. Data on socioeconomic activities (population, livelihood, land use, water use, etc.) 	<p>Data Provision of data on the natural resources system and uses to fill in (noticeable) data gaps within the basin, in particular in the upper parts, including data on actual use and performance</p>	<ol style="list-style-type: none"> 1. What tools and methods are available for filling in data gaps and how can they be effectively utilized to alleviate data constraints in implementing NBI projects? <ul style="list-style-type: none"> - Tools and methods for cost-effective data collection of water quality and quantity, for example, simple methods of sampling the main water quality parameters using bio-indicators - Utilization of modern techniques such as satellite, radar, models, and data assimilation techniques to fill in data gaps - Use of isotope hydrology to generate and verify hydrometeorological information 2. How can the data generated using the above tools be made part of an integrated data and information system and used to validate hydrological and water quality processes? 3. How can we ensure that the information users have confidence in the data used, the analysis, and that the analytical tools aid in producing credible information? 	<p>The data on natural resources system (e.g., hydro-meteorological data) are basic input for all catchment and river models used by different NBI projects: Watershed, DSS, agriculture, flood forecasting, etc.</p> <p>Data on socioeconomics (population, land and water uses, productivity, performance, etc) are needed by planning models SDBS, CBSI, etc.</p>
2.	<p>Climate change, climate variability, vulnerability, impacts, and adaptation requirements</p>	<p>Hydroclimatology: Improve assessment of climate change and climate variability.</p> <p>Improve assessment of vulnerability of resource and use systems (land and water)</p> <p>Improve assessment of impacts on those systems</p> <p>Recommendation to enhance adaptation and coping strategies</p>	<ol style="list-style-type: none"> 1. How are different parts of the river basin affected by climate variability and change? And what institutional set up (policy, legal and organizations), programs and projects would be required to reduce vulnerability, negative impacts and build local and basin capacities to adapt? <ul style="list-style-type: none"> - Assessment of climate change and climate variability to reduce uncertainty (e.g., cc computations, frequency analysis of floods and droughts, etc.) - Assessment of impacts of climate change and climate variability on natural resources (e.g., water resources supply and demand, ecosystems, agricultural productivity, etc.). - Understand vulnerability of the different production systems - Provide guidelines and recommendations for enhanced adaptive capacity and resilience of socioeconomics and management practices to climate change and climate variability 2. What is the social, economic and environmental impact of floods and droughts and how can short-, medium- and long-term forecasting contribute to reducing their negative impacts? 3. What is the impact of land use change on the Nile regional climate? How does climate change affect land use? How does climate change and land use affect the availability and quality of surface and groundwater resources? 4. What is hydroclimatological linkage of the different subbasins, e.g., the White and Blue Nile rivers? 	<p>The output of these researches is essential information that is required by almost all the NBI projects, in particular, by the water resources projects: agriculture, SDBS, and many of the ENSAP and NELSAP projects</p>

3.	<p>Limited understanding of best possible watershed management and the interlinked implications</p> <p>Watershed Management Improve understanding of available watershed resources Improve understanding of existing practices and needs for better utilization. Identify best possible watershed management interventions and their impacts</p>	<p>1. What watershed management interventions would reduce the negative hydrologic and environmental impacts on downstream parts of the catchments/basin? What are the trade-offs and how can they be addressed?</p> <ul style="list-style-type: none"> - Understanding of the root causes of land degradation and how to address them appropriately - How to integrate multi-sector, multi-disciplinary issues in land degradation analysis, e.g., livelihood vs. land degradation, interaction domestic-agricultural water sectors, etc. - Improve assessment of land degradation and its impacts, e.g., computation of soil erosion, and the downstream implications of reservoir and canal sedimentation - Improve understanding of how to reduce/stop land degradation, and its negative impacts - Research on water harvesting <p>2. What livelihood options exist? How are they affected due to land and water degradation?</p> <p>3. What are values and reasons for low water productivity of different systems: farming, livestock, etc? How can water productivity be increased? What are the trade-offs?</p> <p>4. What is the enabling environment (policies, institutions, etc) for a successful watershed project?</p> <p>5. What are the improved IWRM technologies, analytical methods and tools to foster integrated watershed management for productivity and conservation of agro-ecosystems?</p> <p>6. How to up-scale results derived from watershed pilot sites?</p> <p>7. What are the best technical, policy, institutional, management interventions that could be used in various production systems?</p> <p>8. What is the impact of upstream development on aquatic ecosystems and the goods and services that they provide?</p>	<p>The knowledge on improved watershed management is required by a number of NBI projects. Specifically relevant to watershed management projects of ENSAP and NELSAP; to EWUA on agriculture systems; and on the ecosystem part it is relevant to NTEAP. On water resources and downstream implication it is related to the WRPM project</p>
4.	<p>Low water productivity from agriculture systems</p> <p>Assessment of agricultural water potential, use, and productivity: and how to improve the use</p>	<p>1. How can we better manage water and land resources in the basin to enhance economic development, reduce inequities and environmental degradation?</p> <ul style="list-style-type: none"> - Mapping of existing/potential agricultural production systems (irrigated, rain-fed, livestock, fisheries, etc.) - Assessment of water productivity of the different systems (irrigation, rain-fed, livestock, fisheries, etc), and analysis of the determining factors (technical, policies, support conditions, externalities, etc.) - Impact assessment of improved water productivity on livelihood and environment (including health) - Guidelines and frameworks for improved productivity, efficiency, adequacy, etc. - Identifying factors (environmental and socioeconomic) influence farmer's adoption of improved technologies and management practices - Recommend synergies between different water uses to enhance productivity, whilst maintaining or improving environmental security <p>2. Are there any better options or management arrangements in terms of saving and efficiently using water and land resources?</p> <p>3. How do we reverse adverse effects such as salinity, pollution, environmental and health impacts (planning, design, policies, etc...)?</p>	<p>Pertinent to EWUA project, and to watershed management projects, and indirectly to NTEAP and WRPM projects</p>

Continued

Appendix 2. Research Topics Pertinent to the NBI Projects (Continued)

No.	Research Problem	Research Area and Objectives	Possible Research Questions and Outputs	Relevance to NBI Projects
5.	Environmental degradation of different ecosystems, including wetlands, rivers, etc.	Environment Environmental resource assessment, status of use, and how to reverse degradation	<p>Possible Research Questions and Outputs</p> <ol style="list-style-type: none"> 1. How does changes in the status of: forest, woodlands, grasslands, croplands and wetlands affect goods and services available to local and downstream communities 2. What technical and institutional interventions would be required to attain acceptable levels of environmental status? 3. What is the status of our wetland resources and how can they be optimally and sustainably utilized: <ul style="list-style-type: none"> - Rapid assessment of the river ecosystem health - Threats and opportunities of alien aquatic species (fish and weeds) - Valuation of lakes and wetlands ecosystem resources - Assessments of lakes and wetlands for multiple uses: poverty reduction, and ecosystem services; How to consider environment conservation in accordance with sustainable livelihood - Assessment of environmental flows at key locations in the basin - Assessment of impacts of interventions (hard and soft) on socioeconomies (including health impacts), and on ecosystem services 4. Micro-grant projects: <ul style="list-style-type: none"> - What are the most appropriate funding mechanisms for community-based projects (micro-grant projects) and how can they be effectively implemented? - How to link micro-grant projects to national plans of riparian countries, and how to upscale research output to national or basin scales? - How deeply rooted are the NGOs to help local communities? Are they representative in the given locality, area, catchment? 5. What is the environmental policy and regulatory framework in different countries? How can sectoral policies in a given country be better integrated and how can they be harmonized basin wide to support implementation of interventions that achieve NBI objectives? <ul style="list-style-type: none"> - To what extent is lack of information affecting policymaking in environmental issues? - How to coordinate environmental policies among riparian countries and how it will be at the basin level. What is the impact of macro-policies on the environment? - How to implement research output in real life situations 6. What is the status of our fish and other aquatic resources and how can they be sustained and enhanced to support livelihoods? 7. What are the impacts of point and non-point pollutants on water bodies, ecosystem and human welfare and livelihoods and how can negative impacts be minimized? 8. Comparative research on nutritional, social and economic values of aquatic, crop and livestock for smallholders 9. EIA process, gaps, recommendations and harmonization of process 10. How to link human and environmental health 	Relevant to SV Environment, and water resources projects; NELSAP Lakes and wetlands projects; ENSAP multi-purpose projects, etc.

<p>Socioeconomic development and benefit sharing</p>	<p>Socioeconomics</p> <p>Improve understanding of available Nile resources, potential development and their impact on socioeconomics of the Nile people</p>	<p>1. What socioeconomic factors affect cooperation and benefit sharing?</p> <ul style="list-style-type: none"> - What are the potentials and opportunities - Improve poverty mapping in the basin, in particular water-related poverty mapping - What levels of socioeconomic development could be achieved - Improve understanding of the basin's opportunities and risks, at different scales (basin and subbasin levels) - Research on policy-related issues to support transboundary cooperation, e.g., valuing and monitoring transboundary benefits/risks - Identify principles and mechanisms for benefit/risk sharing, review of successful transboundary management and agreements in other river basins - How to effectively involve stakeholders at different levels in the basin to support optimal cooperation? <p>2. What are the benefits obtained through different uses of water in the basin and what is their value? What is the scope (health, nutrition, economic development, environmental management)?</p> <p>3. Who are the beneficiaries?</p> <p>4. How can those benefits be shared more equitably and more efficiently?</p>	<p>Relevant to SDBS, CBSI projects, and to some of ENSAP, and NELSAP projects</p>
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Few potential topics that were highlighted during the workshop discussion but not classified or partially classified in the above table include:

1. Integrating groundwater into surface water management:
 - a. Understanding groundwater potential, use, and behavior.
 - b. Understanding wetlands-groundwater and surface water interdependencies.
2. Water resources:
 - a. How do the water resources vary spatially and temporally and how should they be managed to enhance economic development and reduce in-equities sustainably?
 - b. Research to improve understanding of river morphology, and reservoir sedimentation.
 - c. What are the experiences of other basins, possible options and modalities of water resources institutions at subbasin (national) and basin (trans-regional) levels that can be adopted in the Nile Basin?
 - d. How are the policy objectives upon which the water resources are planned, developed, allocated and utilized? What are the policy constraints and how can they be alleviated?
 - e. What are the most appropriate DSS techniques as applicable to large basins like the Nile?
3. Health impacts of water resources development: What are the links between water resource development/management and health impacts?

Appendix 3. National Water-related Research Institutions

Country	Training/Research Institutions	Potential Areas of Specialization
Burundi	<ol style="list-style-type: none"> 1. University of Burundi 2. Institut Des Sciences Agronomiques du Burundi (ISABU) 	Water Resources Management and Engineering (could collaborate with Rwanda), Agriculture
DRC	<ol style="list-style-type: none"> 1. University of Kinshasa 2. Centre Regional d'Etudes Nucleares de Kinshasa (CREN-K) 3. University of Kisangani 	Water Quality Management, Environmental Management, Sanitary Engineering; Surface and Groundwater Hydrology, Soil Conservation; Hydrobiology
Egypt	<ol style="list-style-type: none"> 1. Regional Training Center, Ministry of Water Resources and Irrigation (Host center for ATP) 2. Cairo University 3. Hydraulic Research Institute 	Water Resources Management and Engineering ; Hydraulics Engineering; River Engineering
Ethiopia	<ol style="list-style-type: none"> 1. Arbaminch Water Technology Institute 2. Addis Ababa University 3. Alemya University 	Water Resources Management and Engineering; Hydraulics, Hydrology, Water Supply and Sanitation; Irrigation and Drainage
Kenya	<ol style="list-style-type: none"> 1. University of Nairobi 2. Institute for Meteorological Training and Research 3. Kenya Water Institute 	Water Resources Management; Meteorology, Hydrology
Rwanda	<ol style="list-style-type: none"> 1. National University of Rwanda: Faculty of Science 2. Kigali Institute of Science, Technology and Management (KIST) 3. Institute of Agronomic Sciences 	Water Resources Management and Engineering; (Could collaborate with Burundi); Science and Technology programs; Agricultural Sector, Water and Soil Conservation
Sudan	<ol style="list-style-type: none"> 1. Institute for Water and Irrigation 2. University of Khartoum 3. The Hydraulic Research Station, Wad Medani 	Water Resources Management and Engineering; Water Sector Assessment; Hydrology and Hydrogeology, Irrigation and Drainage
Tanzania	<ol style="list-style-type: none"> 1. University of Dar-es-Salaam 2. Department of Research and Development 3. Institute of Resources Assessment 	Water Resources Management; Soil and Water Management; Hydrology; Natural Resources Management.
Uganda	<ol style="list-style-type: none"> 1. Makerere University: Department of Civil Engineering 2. Agricultural Engineering and Appropriate Technology Research 	Water Resources Management and Engineering; Livestock and Fisheries

Appendix 4. Ongoing Research Projects Relevant to the NBI

The Nile has been selected by the CPWF as one of the benchmark basins for basin focal studies. A number of CPWF projects have been completed or ongoing in the Nile Basin on ‘Crop Water Productivity’, ‘Watershed Management’, ‘Aquatic Ecosystem and Fisheries’, and ‘Integrated River Basin Management’. A forthcoming project by CPWF is the ‘Nile Basin Focal Project’.

This Appendix gives additional information on the ongoing projects pertinent to the NBI conducted by different research organizations.

TABLE A 4.1 IWMI-NBEA ongoing projects.

No.	Research Project	Brief Description
1.	NBI Synergy project	Creating ‘Synergies’ and ‘Partnerships’ among the CGIAR, Nile Basin Initiative and ASARECA: Consultations to identify opportunities to support NBI through research and capacity building
2.	Dam Decision Support System	The project aims to investigate which DSS are most appropriate for the complexity of large dam operation to ensure successful stakeholder participation
3.	APPIA Improving Performance of Irrigated Agriculture in sub-Saharan Africa	To improve the capacities of farmers and field level staff in enhancing performance of small- and medium-scale irrigation schemes (French-supported)
4.	MUS Multiple Use Systems	The focus of Multiple Use Systems (MUS) is on developing tested tools and guidelines for multiple-use water services delivery as an effective way to use water for poverty alleviation and gender equity http://www.musproject.net
5.	Blue Nile: Upstream Downstream project	To identify major water, land and livestock management constraints, opportunities, impacts of interventions within the Blue Nile catchment and downstream
6.	IIPE Impact of Irrigation on Poverty and Environment	Research and capacity building project applying new methodologies for assessing the impacts of irrigation on poverty and environment and finding ways to enhance the positive impacts (Austria-supported)
7.	IPMS Improving Productivity and Market System for Smallholder Farmers in Ethiopia	ILRI led project, IWMI contribution is in relation to small-scale irrigation, water harvesting and development of training module (CIDA-funded)
8.	RIPARWIN Raising Irrigation Productivity and Releasing Water for Intersectoral Needs	The project studies competition for water in the upper part of the Great Ruaha River (Tanzania)
9.	POADIUM	Application of the POADIUM decision tool for assessing water and food tradeoffs in Ethiopia and at the river basin level
10.	Agricultural Water Management Technologies	Small-scale irrigation technologies inventory, impact assessment and dissemination of best practices
11.	Improving Water Productivity of Crop-Livestock Systems of sub-Saharan Africa	The project aims to optimize productive use of water to increase incomes and improve the environment, within crop-livestock systems in the semi-arid areas of southern Africa (Zimbabwe) and the Blue Nile Basin (Ethiopia). http://www.vslp.org

TABLE A 4.2 ILRI ongoing projects.

No.	Research Programs and Projects	Brief Description
1.	Nile Basin Livestock Water Productivity	The project aims to improve food security and reduce poverty through policies that promote equitable, productive and sustainable use of water, land and livestock (funded by the CPWF)
	Livestock Systems Evolution	The objective is to improve understanding of how livestock systems evolve in order to anticipate where, when, and how to make livestock-related policy and technological interventions to alleviate poverty, sustain rural livelihoods and protect the environment http://www.ilri.org/research/Content.asp?CCID=44&SID=7
	Targeting Pro-poor Interventions	The objective is to improve understanding of trends and alternative features of livestock sector development used to set priorities and influence resource allocation decisions. http://www.ilri.org/research/Content.asp?CCID=44&SID=7
	Poverty, Sustainable Livelihoods, and Livestock	To enhance the livelihoods of livestock-keepers through improved understanding of the poverty process and livelihood strategies and role of livestock, strengthened research-policy linkages, information sharing, and dissemination of knowledge http://www.ilri.org/research/Content.asp?CCID=44&SID=7

TABLE A 4.3 IFPRI ongoing programs.

No.	Research Project	Brief Description
1.	Food System Functioning	<ul style="list-style-type: none"> - Global food scenarios - Managing natural resources - Food systems: disaster prevention, relief, and rebuilding after crises
2.	Food System Governance	<ul style="list-style-type: none"> - Food and water safety - Enhanced food and diet quality - Sustainable poverty reduction and nutrition improvement - Country and regional food, nutrition, and agricultural strategies
3.	Food System Innovations	<ul style="list-style-type: none"> - Pro-poor science and technology policies - The future of smallholder farming - Capacity strengthening for policy and research

TABLE A 4.4 WorldFish Center ongoing programs.

No.	Research Project	Brief Description
1.	Manage implications of expanding markets and trade	The project activities will be centered on the fisheries of Lake Tana (Ethiopia), Lake Nasser (Egypt) and Lake Volta (Ghana) where research will assess current markets and marketing systems as well as the potential for increased market integration www.worldfishcenter.org/cms/list_article.aspx?catID=38&ddIID=63
2.	International Network on Genetics in Aquaculture	The prospects for genetic improvement of tropical finfish, as demonstrated by the Genetic Improvement of Farmed Tilapia (GIFT) Project www.worldfishcenter.org/inga/index.htm

TABLE A 4.5 Some of ASARECA-SWMnet ongoing projects.

No.	Research Project	Brief Description
1.	Managing nutrients and water together in response to markets	Issues addressed: Commercialization and enterprise orientation of smallholder agriculture; soil-fertility recapitalization.
2.	Promoting natural resources management through effective governance and farmer-market linkages	Issues include: Product-chains, investment and partnership arrangements that effectively link integrated natural resource management interventions to markets
3.	Efficient use of crop residues: animal feed versus conservation agriculture	Issues addressed include: Nutrient recycling from crop residues; Direct incorporation into the soil; Crop residues fed to animals
4.	Improved management of agricultural Water in eastern and southern Africa (IMAWESA)	Issues addressed: Improved policy and strategic framework for AWM in the ESA Region
5.	Spatial mapping, forecasting and predicting climate variability trends and associated risks to agricultural productivity and profitability	<ul style="list-style-type: none"> - Making the best of climate: adapting agriculture to climate variability - Managing uncertainty: innovation systems for coping with climate variability and change
6.	Investments necessary for successful integrated management of watersheds	<ul style="list-style-type: none"> - SWMnet Project 8: Proof-of-Concept that the IAR4D approach improves delivery and impact of agricultural research - task force: Integrated Watershed Management (IWM)

TABLE A 4.6 FAONile ongoing projects.

No.	Research Project	Brief Description
1.	Agricultural Water Productivity Case Study	The project intends to produce: Agricultural production database for a baseline year (2000); Analysis of the current agricultural water productivity under rain-fed and irrigated conditions
2.	Basin Wide Survey of Agricultural Water Use	The project intends to produce: A baseline survey (for the year 2000) of agricultural water use, includes maps of population, land use, cropping patterns in irrigation, water use in rain-fed and irrigated agriculture, and an assessment of current water development facilities, together with estimates of water use in other sectors
3.	Consolidation of the Nile Decision Support Tool Nile-DST	The project intends to produce: Consolidated Nile-DST; updating and documenting some components of the Nile-DST
4.	Development of Geo-referenced Nile Basin Database	The project intends to produce: Development of a metadata catalogue listing web-based data sources for water resources in the Nile Basin
5.	Development of GIS Information Products	The project intends to produce: Set of specific GIS products integrating physical and socioeconomic data. Expanded database, in particular of basin-wide data layers
6.	Development of Scenarios of Demand for Agricultural Produce in the Nile Basin	The project intends to produce: Identification and analysis of the major drivers of future demand of agricultural produce in the Nile Basin
7.	Legal and Institutional Component	The project intends to produce: Strengthened skills of decision makers in interest-based negotiations; Enhanced understanding of how customary law could support formal law in local dispute resolution
8.	Transboundary Hydro-meteorological Monitoring Network	The project intends to produce: Limited extension of hydrometric monitoring network of a transboundary nature. Establishment and operation of an Internet forum supporting hydro- meteorological network

TABLE A 4.7 IAEA ongoing projects.

No.	Research Project	Brief Description
1.	Improving water balances for: Lake Victoria Blue Nile Basin High Aswan Dam	This project aimed at addressing the importance and interaction of groundwater and surface water in Nile Basin
2.	Mainstreaming groundwater Considerations into the Integrated Management of the Nile River Basin	The objective is to enhance national and regional capacity to add a 'groundwater dimension' to joint management of the Nile Basin. The use of isotope hydrology is central to the generation of the necessary data required to understand the role of groundwater in the shared Nile water resources

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