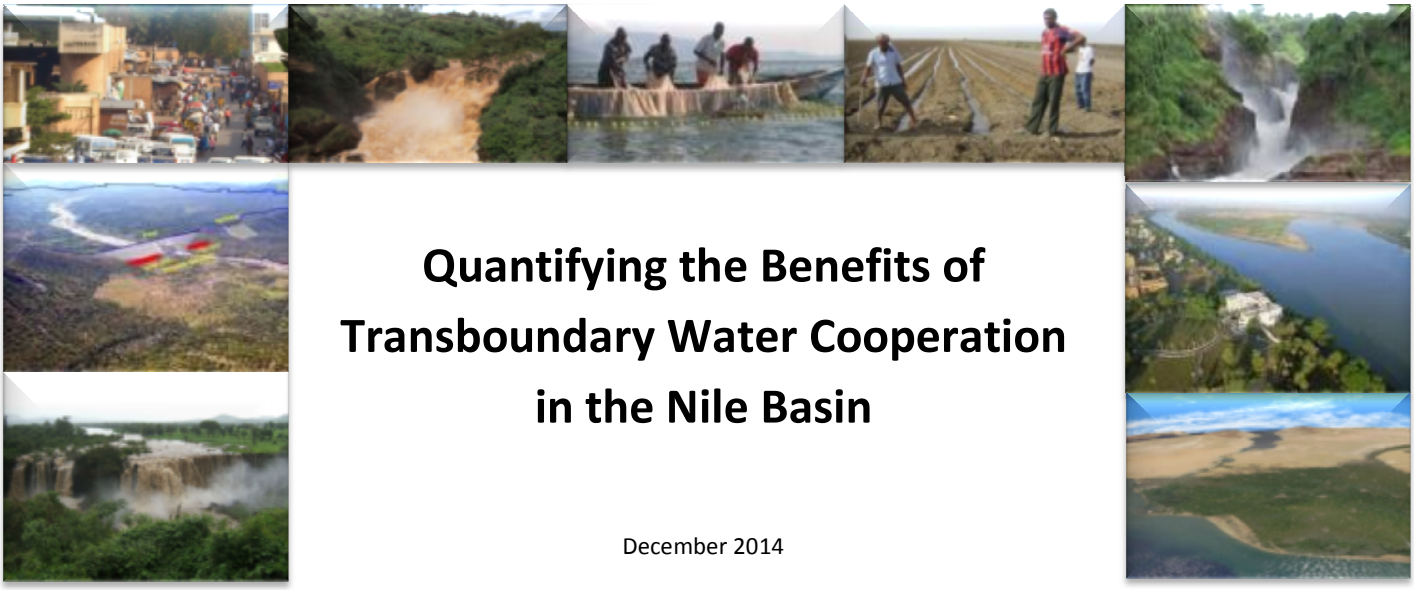

Quantifying the Benefits of Transboundary Water Cooperation in the Nile Basin

December 2014

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EXECUTIVE SUMMARY

The need to share in the bounty of the Nile was emphasised by the NBI Executive Director stating that: "*Increased basin-wide dialogue and exchange of information, more than any time in the history of the Nile cooperation, there is a sustained dialogue and information exchange among riparians and a growing community of interest across in the Nile with a critical stakeholder base for the cooperation; all of which were building blocks for a solid foundation for cooperation. Even though differences still exist today, the Nile Basin is witnessing an observable improvement in both the extent and quality of cooperation among Member States; the question is no longer whether a cooperative approach should be pursued, but how cooperation could be pursued to deliver tangible benefits*." The specific objective of this report is to increase understanding of benefit sharing opportunities in the Nile Basin by synthesizing and presenting highlights of various studies describing (quantitatively and qualitatively) the benefits and costs of cooperation versus cost of non-cooperation of the Nile countries.

The concept of benefit sharing in transboundary basins is based on an understanding that cooperation between countries can unlock more value from the basin than would be available if countries didn't cooperate. Benefit sharing in transboundary basins can thus be defined as: "Cooperation between states to increase the benefits in a transboundary basin and to fairly distribute the benefits in support of local, national and regional development objectives". Cooperation can range from unilateral action to coordination, collaboration and joint action. The services that are available from the Nile are provisioning services, regulating services, cultural services and supporting services, with the benefits that people can get from these services being from the river, to the river, because of the river and beyond the river.

Case studies provide a valuable perspective of the successes in benefit sharing in other basins. In the case of the Senegal, the total value of cooperation was estimated at USD 1.67 billion (USD 206 million from irrigation service, USD 483 million through energy benefits and USD 981 million through navigation benefits). The scenarios for cooperation through the Niger Basin Authority show that (for scenario B), the total benefit will be USD 9.82 billion over 20 years for a total investment of USD 7.89 billion. The scenarios show that Guinea, Mali and Niger generally obtain higher benefits than their investments and that Nigeria has a negative balance that would have to be compensated. Mechanisms for cooperation in the Orange-Senqu River Basin can include payment for water, payments for power-purchasing agreements and financing and ownership arrangements. The Lesotho Highlands Water Project illustrates benefit sharing in practice through payment for water, purchase agreements for power, and financing arrangements. The TWO analysis in the Jordan highlighted combinations of sources of water and development opportunities while the cooperation between Jordan and Israel has been relatively successful, with both sides working out differences bilaterally without escalation of problems. In the Mekong Basin, monetary and non-monetary benefit sharing are linked to hydropower projects. Monetary benefit sharing includes revenue and equity sharing, taxes and royalties, and preferential electricity tariffs. Non-monetary forms range from access to natural resources and project-related development opportunities for riparian communities, to electricity connection and reliable electricity supply to communities. The agreements and institutional mechanisms on the Danube support cooperation, particularly in the areas of navigation and water resource protection. In central Asia, the 1999 agreement linked the regulation of the Toktogul Reservoir in the Naryn-Syr Darya River cascade to a compensatory scheme for oil and gas transfers, which benefit Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan. In the Colombia Basin, initial payments of USD 545 million and annual payments of USD 2 million provide benefits to the Canadian residents of the basin as compensation for benefits of hydropower being delivered in the USA.

The costs and benefits of cooperation in the Nile Basin accrue from hydropower developments, agriculture, watershed management and adaptation to climate change. The total potential hydroelectricity in the Nile Basin is 33 024 MW, of which 6 833 MW (20%) is currently installed[5]. With the power demand in the Nile Basin countries expected to double every 5-10 years, the full potential could be accounted for by demand by 2035.

At an average cost of 6.08 US cents/KWh (2011 values), the total investment required to install the remaining capacity would be USD 13.94 billion (2011 values)[5]. To be very conservative, one can say that a 3% growth in energy production will support a 1.5% growth in GDP[54], which means that the combined economic benefit to the Nile Basin countries would be USD 15.59 billion per annum. Studies have shown that regional interconnections and market structures can increase stability in the electricity system while reducing the need for costly system redundancy[55], which could lead to a direct saving of USD 21.89 million per annum in the Nile Basin. The benefit of increased quality of power through shared surplus[56] will be a basin-wide increase in GDP of USD 20.79 billion per annum. The cost of non-cooperation is also significant. If potential hydropower projects were to be delayed by 12 months due to objections and/or difficulty in mobilising funding for unilateral action, the combined loss in the value of energy[57] in the Nile Equatorial Lakes region alone would be to USD 2.90 billion.

Watershed management could bring about significant shared benefits. In the villages of Argi, Abkar and Afaad for example, a shelterbelt of 40 km (costing USD 2 million) would protect 2 240 ha of existing cropland (worth USD 4.2 million), which translates to a net benefit of USD 2.2 million[60], whereas the annual economic cost of watershed degradation in Ethiopia is estimated at USD 670 million per annum[61]. The implementation of a comprehensive watershed management program in the in the Tekeze-Atbara, Abay-Blue Nile and Baro-Akobo-White Nile Rivers can reduce the sediment loads by 82.5 million metric tonnes per year[51], which would translate to a saving of USD 276 million per annum. The costs and benefits of watershed management in the Eastern Nile translate to a net benefit of watershed management being USD 8.51 billion over 50 years with a discount rate of 10%[62]. Integrated watershed management in the Nile Equatorial Lakes region shows a positive balance of economic costs and benefits of USD 397.5 million over 20 years[63]. Soil and water conservation in the Nile Basin could translate to an increase in crop value of USD 5.49 billion per annum[59, 65, 66].

A range of cooperative interventions are available in the agriculture sector. If through these, the crop yields could be increased by a very conservative 1.5% and the price of agricultural products could be increased by 2.5% through improved regional trade, the result would be a 4% increase in the agriculture component of GDP for all the NBI member states (USD 244.53 billion in total) would bring about an increase in benefits to the value of USD 9.78 billion. With a combined import and export value for fisheries products for NBI member states standing at USD 1.20 billion (2012)[70], an increase of just 2% would translate to an increased import/export value of USD 24 million per annum. Virtual water flows contribute substantially to the water security in the Nile Basin in general and of Egypt in particular. Coping with the impacts of climate change may cost the region as much as USD 5.04 billion. A sensible approach for now would be to prepare for more variable conditions than what is currently recorded.

Benefit sharing tools and approaches have been developed in the Nile Basin and elsewhere. The broader framework adapted from the Millennium Ecosystem Assessment includes the contextual environment, the value chain from basin condition, to basin services and human well-being and supports the evaluation of options and trade-offs. The Cascade Model provides more detail on the relationship between biophysical structures and value, whereas the Common International Classification of Ecosystem Services provides a typology for the services. The proposed scalable approach suggests the Transboundary Waters Opportunity analysis as the first step in the process, followed by Strategic pre-investment and the identification of Barriers to implementation. The different approaches to cooperation (unilateral action, coordination, collaboration and joint action) provide the mechanisms for appropriate action.

INTRODUCTION

PURPOSE

The River Nile holds tremendous opportunities for growth, being one of the least developed rivers in the world. The basin offers significant potential for cooperative management and development of the common water resources that would confer direct and indirect win-win benefits to all riparian countries. The basin has significant potential for clean energy development (hydropower) and power trade; for improving and expanding irrigated and rain-fed agricultural production and increasing water use efficiency; and for preservation and use for eco-tourism of designated biospheres which are significant to sustaining global biological diversity. The River Nile also provides a key resource for drinking water, fisheries production, navigation, recreation and ecosystem maintenance. There is also potential for broader economic-regional integration, promotion of regional peace and security and most important for jointly ensuring the continued existence of the River Nile for posterity through prudent and judicious utilization.[1]

With water being critical for human development and the problems of its increasing scarcity and deteriorating quality, water is often turned into a source of rivalries and conflict. This is especially true in the context of transboundary water resources where the governance of those water resources involves two or more countries with different needs and priorities under different social, economic, political and legal systems. Conversely, the challenges related to transboundary water management also provide opportunities to cooperate and expand the possibilities for economic growth, improved welfare and regional security.

The cooperative management of shared water has shifted from a focus on sharing water to benefit sharing. This concept maintains that an understanding of the potential benefits from water rather than the quantity of water will shift the zero net gain of water sharing to a positive-sum outcome of benefit sharing. With this perspective, riparian countries should focus on optimizing the generation of basin-wide benefits. Accordingly, the use of water provides the basis for identifying mutually beneficial cooperative action. The potential costs and impacts of non-cooperation in transboundary water management have threatened the environmental conditions of the transboundary water resources with its ramifications on the economy and well-being of the people as well as regional security. Recognizing the need for cooperation to address complex water management issues and to ensure reasonable and equitable use of transboundary waters, the NBI intends to strengthen ecologically sound management of transboundary waters and promotes a holistic approach to cooperation that includes environmental, social and economic aspects.

Member countries have expressed a growing demand for quantitative information on the benefits of different activities in transboundary water cooperation, with the extent to which countries are willing to engage in cooperation being influenced by the perceptions on the potential benefits of cooperation.

This report responds to the following stated requirement for understanding benefits:

"*Although benefits of multilateral cooperation might be multifold, they were not fully understood by the decision-makers of the countries – rather abstract conceptualisations such as benefit-sharing need to be 'translated' into real examples. The NBI should develop its Benefit Sharing Framework further and try to reach the highest political echelons in the Nile countries. The exercise should include quantification of benefits, costs and trade-offs using existing, under construction, planned and potential investment projects (unilateral, bilateral and multilateral) as examples.*"[2]

[1] NBI (2014) Understanding the Nile Basin. http://www.nilebasin.org/index.php/about-us/the-river-nile
[2] NBI (2014) Nile Cooperation: Opportunities and Challenges.

AUDIENCE

This report presents the evidence of benefits of potential future cooperation in various sectors for the Nile Basin. This information will assist member countries, basin institutions and practitioners clarify the way forward. The case studies and scenarios that show the benefits of cooperation and the costs of non-cooperation will assist decision makers, opinion leaders and stakeholders to motivate the pursuit of benefit sharing, where appropriate. The consolidation of existing, and recommend new, approaches and methods for the quantification of benefits and costs of no-cooperation will provide guidance to practitioners to establish credible and constructive information to support decision-makers. The Guidance Note will include brief reference to the above information and next steps to develop the benefit sharing framework.

OBJECTIVES

The specific objectives are to increase understanding of benefit sharing opportunities in the Nile Basin; by synthesizing and presenting highlights of various studies describing (quantitatively and qualitatively) the benefits and costs of cooperation versus cost of non-cooperation of the Nile countries. It will lead to recommend next steps in advancing benefits sharing in the basin, including next steps to develop the benefit sharing framework, and potential benefit sharing portfolios for further consideration through existing planning and approval mechanisms.

METHODOLOGY

The process of developing the report includes a review of existing documents and consultations with relevant NBI staff and understanding the range of NBI activities (completed and ongoing) as input to quantifying and describing benefits and the costs of non-cooperation. The inputs also include a review of relevant public and scientific literature on transboundary cooperation and benefit sharing opportunities in the Nile Basin. The activities include the development of a definition of benefits sharing, a typology of benefits to be shared, a methodology of how benefits can be quantified in financial terms, volumes of water, employment, extra quantities of food, economic parameters, etc.

DATA SOURCES

The analysis is based on publically available reports, data and information (both in a NBI context and relevant international sources), scientific and research publications and information received from NBI representatives. The relevant references are included in the report as footnotes.

DATA COLLECTION

Data sources include scientific databases, international organisations, domain experts, the Nile Information System and other NBI sources, country strategies and policies, project documentation, NBI staff and members, and presentations and speeches at relevant events.

ANALYSIS METHODS

The analysis includes evidence of benefits of potential future cooperation in various sectors for the Nile Basin (agriculture, electricity, flood control, navigation, water security, peace and stability, etc) and sub regions, compiled from other studies, reports, and on-going NBI work. This includes quantification of benefit streams, where this quantification already exists. The analysis also reflects on clear, communicable case studies and scenarios that show the benefits, including more effective quantification of these benefits as well as the costs of non-cooperation in understandable terms. The discussion of existing approaches and methods leads to

recommendations of new approaches and methods for quantification of benefits and cost of no-cooperation. The NBI Guidance Note emphasise next steps in advancing the Nile benefits sharing agenda, including next steps to develop the Benefit Sharing Framework. It should be noted that while this report reflects a wide array of inputs and provides a consolidation of existing methods and approaches as well as suggesting new ones, the report should not be considered as a comprehensive and final word on benefit sharing, but rather serve as a foundation to build future efforts on. Furthermore, while the quantification of benefits is an explicit objective of the report, the analysis is limited to existing available information. It should therefore be seen as examples of the rationale for benefit sharing and not as an exhaustive account of all possibilities.

THE NILE BASIN

EARLY HISTORY

The Nile River (Eonile) started to cut its valley about 6 million years ago, but it was only 800 000 - 700 000 years ago that the continent pushed skywards and shifted along the Great Rift Valley to guide the river (Prenile) northwards to the Mediterranean. Lake Albert and Lake Victoria previously flowed westwards to the Congo, but overflowed into the Nile River (Neonile) about 12 000 years ago to establish the White Nile that we know today.[3]

ion years ago)

000 years ago)

Efforts to harness the rich bounty of the Nile have persisted over the centuries, with the first irrigation canals being built 4 000 years ago. The complexities associated with the use of the Nile waters was already reported in 1960, with reference to the importance of the Nile for livelihoods in the north and for hydropower and irrigation in the south, concluding that "*A rational comprehensive view of the whole Nile basin should be the basis of planning for societies and communities dwelling therein.*" [4]

Today, the Nile River has a total length of 6 695 km and drains and area of 3.18 km^2, which is about 10% of the area of the African continent[5][6]. The Nile River is shared by 11 countries with a wide range of environmental, social, economic and political conditions. The highest flow in the Nile River is recorded at Dongola/Aswan, where flows varied from 45 to 125 km$^{3/}$annum between 1890 and 1994 [7]. The Basin is has inverse rainfall and evaporation gradients from south to north and experience high climatic variability. The demands for water to meet agricultural, domestic, industrial, and environmental needs have reached the limits of water availability while water demands continue to increase due to population growth and economic development needs.[5]

The need to share in the bounty of the Nile persists in 2014, with the NBI Executive Director stating that: "*Increased basin-wide dialogue and exchange of information, more than any time in the history of the Nile cooperation, there is a sustained dialogue and information exchange among riparians and a growing community of interest across in the Nile with a critical stakeholder base for the cooperation; all of which were*

[3] Said R (1993) The River Nile – Geology, Hydrology and Utilization. Pergamon Press.
[4] Lebon JHG (1960) On the Human Geography of the Nile Basin. Geography, Vol. 45(1-2): 16-26
[5] NBI (2012) State of the Nile Basin 2012. Nile Basin Initiative Secretariat, Entebbe, Uganda
[6] FAO (2011) FAO-Nile Basin Project GCP/INT/945/ITA; Synthesis Report. Rome
[7] Sutcliffe JV & Parks YP (1999) The Hydrology of the Nile. IAHS Special Publication no. 5.

building blocks for a solid foundation for cooperation. Even though differences still exist today, the Nile Basin is witnessing an observable improvement in both the extent and quality of cooperation among Member States; the question is no longer whether a cooperative approach should be pursued, but how cooperation could be pursued to deliver tangible benefits." [8]

INSTITUTIONAL ASPECTS

The Nile Basin Initiative (NBI) is a regional intergovernmental partnership that seeks to develop the River Nile in a cooperative manner, share substantial socio-economic benefits and promote regional peace and security. It was launched on 22nd February 1999 by Ministers in charge of Water Affairs in the riparian countries namely Burundi, DR Congo, Egypt, Ethiopia, Kenya, Rwanda, South Sudan, The Sudan, Tanzania, and Uganda. Eritrea participates as an observer. It was established as a transitional institution until the Cooperative Framework Agreement (CFA) negotiations were finalized and a permanent institution created. The highest decision and policy-making body of NBI is the Nile Council of Ministers (Nile-COM), comprised of Ministers in charge of Water Affairs in each NBI Member State. The Nile-COM is supported by the Nile Technical Advisory Committee (Nile-TAC), comprised of 20 senior government officials, two from each of the Member States. NBI provides riparian countries with the first and only 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.

COUNTRY CONCERNS AND INTERESTS

The current environmental, social, economic and political situation for the 11 countries that share the Nile Basin is presented in the following table[9]. The statistics highlight the acute need for development, but also point to the large disparities between countries. The key challenges and priorities of the NBI member countries are then summarised.

	Burundi	DR Congo	Egypt	Ethiopia	Kenya	Rwanda	South Sudan	The Sudan	Tanzania	Uganda	Eritrea
Human Development Index	0.39	0.34	0.68	0.44	0.54	0.51	-	0.47	0.49	0.48	0.38
Life expectancy (years)	54	50	71	64	62	64	55	62	62	59	63
GNI/capita (US$)	749	444	10400	1303	2158	1403	1450	3428	1702	1335	1147
Population below $1.25/day	81%	88%	2%	31%	43%	63%	-	-	68%	38%	-
Literacy rate (adults)	87%	61%	74%	39%	72%	66%	-	72%	68%	73%	69%
Unemployment rate	-	-	9%	18%	-	-	-	20%	4%	9%	3%
International tourists (000's)	142	186	9497	523	1470	619	-	536	795	1151	107
% Population with internet	1%	2%	44%	2%	32%	8%	-	21%	13%	15%	1%
% Population trusting other people	38%	39%	25%	-	10%	30%	-	31%	26%	17%	-
% Population trusting the government	85%	44%	60%	-	40%	95%	-	54%	41%	40%	-
Internal renewable water resources (km^3) [5]	10	900	1.8	122	21	9.5	30		84	39	2.8
Total water withdrawals (km^3) [5]	0.3	0.6	68	5.6	2.7	0.2	37		5.2	0.3	0.6

[8] Nyaoro JR (2014) Messages from the Executive Director, John Rao Nyaoro, HSC at the Opening of the NBI-Development Partners Roundtable – 8 October 2014. Nairobi, Kenya

[9] UNDP (2014) Human Development Report 2014. Sustaining Human Progress: Reducing Vulnerabilities and Building Resilience. UNDP. New York

BURUNDI

Burundi's Poverty Reduction Strategy Paper II (PRSP)[10] identified six major development challenges. **Demographic growth** is a challenge, with the population growth rate standing at more than 3%[9], with the goal being to achieve a population growth of 2 percent by 2025. The overall **agricultural productivity** is not high enough to ensure food security for Burundi's people and generate a marketable surplus. The ineffective **public expenditure** should be improved by giving preference to sectors with growth potential in the allocation of resources. The **private sector** represents the greatest hope for more rapid growth of Burundi's economy, but there is also underinvestment in this sector. The persistent **electricity deficit**, resulting from unreliable electricity production, is a major obstacle to development. The gaps in human resource capacities, institutional structures and performance, legal and institutional frameworks, and the weak contribution from the non-government sector contributes to the lack of **capacity to manage development**, which point to the need for a coherent strategy. Agricultural productivity and the electricity deficit are issues that relate directly to the development of benefits from the Nile Basin, whereas growth in the private sector can also unlock development opportunities.

DEMOCRATIC REPUBLIC OF THE CONGO

The key challenges[11] for the DR Congo include **population growth** and the achievement of **double-digit growth** through the reconstruction and rehabilitation of basic socio-economic infrastructure, particularly in rural areas and the revitalization of agriculture. DR Congo further needs improved measures to ensure the **security** of its territorial integrity and the consolidation of peace and democracy, while improvements in financial and economic **governance** should support greater effectiveness of public policies. The country needs to build the **capacity** of institutions and human resources and public administration, while the mobilization of **resources** is needed to ensure the implementation of national strategies. There is recognition of the need for **environmental protection** through a systematic consideration of issues related to climate change and lastly the importance of accelerating the implementation of the **decentralization** process. Nile Basin development opportunities are closely aligned with economic growth aspirations, particularly through agriculture, for which the mobilisation of resources is a prerequisite. The enormous hydropower potential of the Congo River is a key aspect of this potential. The environmental protection priority is also directly aligned with the principles of benefits sharing in a basin context.

EGYPT

The government of the Arab Republic of Egypt identified ten opportunities in its strategic framework for economic and social development plan[12]. The first is to take advantage of Egypt's **resources**, with the water of the Nile River explicitly mentioned. Further opportunities are sustainable natural **energy** resources; smart **cities**; **science and research** cities; supporting small and medium **enterprises** (SMEs); cluster **industries**; building **technical alliance** with major companies in the world; improving the conditions of **state-owned companies**; the cultivation of a high **competitiveness** and added value; and adopting an integrated strategy for **regional development** in various economic and social fields. The issues related to resources, energy and regional development is directly aligned with the benefit sharing approach.

[10] IMF (2012) Burundi: Poverty Reduction Strategy Paper II. IMF Country Report No. 12/224

[11] IMF (2011) Democratic Republic of the Congo: Growth and Poverty Reduction Strategy Paper 2. IMF Country Report No. 13/226

[12] Arab Republic of Egypt (2012) Strategic Framework for Economic and Social Development Plan. Ministry of Planning and International Cooperation.

ETHIOPIA

The strategic pillars of Ethiopia's Growth and Transformation Plan[13] are to sustain rapid and sustainable **economic growth**; to maintain **agriculture** as a major source of economic growth; to create conditions for **industry** to play a key role in the economy; to expand and improve the quality of **infrastructure**; to enhance the expansion and quality of **social development**; to build capacity and deepen good **governance**; and promote gender and youth **empowerment and equity**. These pillars support the vision which includes "*to become a country where democratic rule, good-governance and social justice reign…*" and the focus on economic sector includes "*a modern and productive agriculture sector*". Although the focus is generally aligned with benefits from the Nile Basin, growth in agriculture is a specific focus area.

KENYA

The Medium Term Plan of Kenya[14] is focussed on accelerating annual GDP growth to 10 percent on a sustained basis. This **economic** pillar is requires private sector investment in tourism, agriculture, manufacturing, wholesale and retail trade, business processing outsourcing, and financial services. The Medium Term Plan also focusses on achieving cohesive society enjoying equitable social development, with the key elements of this **social** pillar being education and training; health; water and sanitation; environment; housing and urbanisation; and gender, youth and vulnerable groups. In addition to a focus on **poverty** levels and progress on the attainment of MDG goals, the **political** pillar targets the building of an issues-based, accountable democratic political system through the key areas of rule of law and judicial reforms; electoral and political process; transparency and accountability; and security and peace building. The government is also implementing cross-cutting policies to generate broad-based growth, being infrastructure, information communication technology (ICTs), land reforms and public sector reforms. The economic pillar in particular will benefit from the development of Nile Basin resources.

RWANDA

In accordance with the Economic Development and Poverty Reduction Strategy[15], the drivers for Rwanda's **economic transformation** are domestic interconnectivity through investments in hard and soft infrastructure; external connectivity and boosting exports; increasing private investment in priority sectors; facilitating and managing urbanisation, and promoting secondary cities as poles of economic growth; and a 'green economy' approach to economic transformation. The drivers for **rural development** are: an integrated approach to land use and human settlements; increasing the productivity of agriculture; enabling graduation from extreme poverty; and connecting rural communities to economic opportunity through improved infrastructure. **Productivity and youth employment** is being supported through the development of critical skills and attitudes for service and industrial sectors; technology and ICT; entrepreneurship, access to finance and business development; and labour market interventions. Accountable governance is also required in the plan, which will be achieved through the strengthening of citizen participation, awareness and demand for accountability and service delivery. It is worth noting that one of the cross-cutting issues of the plan is environment and climate change. The rural development objectives will be advanced through the development of Nile Basin resources, while economic transformation will also be supported by such developments.

[13] Federal Democratic Republic of Ethiopia (2011) Growth and Transformation Plan: 2010/11 – 2014/15. Ministry of Finance and Economic Development.
[14] Republic of Kenya (2011) Kenya vision 2030: First Medium Term Plan Update. Ministry of State for Planning, National Development, & Vision 2030 and Office of the Deputy Prime Minister and Ministry of Finance
[15] Republic of Rwanda (2013) Economic Development and Poverty Reduction Strategy 2013 – 2018: Shaping Our Development.

SOUTH SUDAN

The Republic of South Sudan gained independence in 2011. The South Sudan Development Plan (SSDP)[16] includes a focus on institutional strengthening and improving transparency and accountability in **governance**; rural development supported by infrastructure improvements towards **economic** development; investment in people towards **social and human** development; and deepening peace and improving security to prevent **conflict** and improve security. In the context of a dire need for development, the SSDP states that water control infrastructure, such as hydropower and water storage dams, will enable economic activities and it lists water resources management, development, utilisation and provision of sanitation services as a priority for public expenditure.

SUDAN

According to the Interim Poverty Reduction Strategy Paper[17] the key challenges for the country are: The legacies of long years of internal **violent conflicts**; Disparities in **economic development** and access to opportunities; **Employment** creation; The need for a more diverse economy; **Human capital**, technical and institutional capacities; **Institutional** and structural reforms; and **External debt** burden and limited access to external aide and foreign financing. These challenges are framed in the context of major opportunities, which include: **Natural resources** including fertile land and water resources to support farming and livestock production and related agroprocessing industries; Wealthy countries to the north; Foreign direct investments; Momentum for change since the Comprehensive Peace Agreement; and Learning and partnerships.

TANZANIA

The development outcomes that Tanzania aspires to are stated in the National Strategy for Growth and Reduction of Poverty (II)[18]. The first cluster is growth for **reduction of poverty**, which emphasise equitable and employment-generating growth, sustainable development, food security, affordable and reliable modern energy services, and adequate infrastructure for production purposes. The second cluster is the Improvement of **quality of life** and social well-being that focuses on the poorest and most vulnerable groups, access to social services, survival, health, clean and safe water, sanitation, decent shelter, energy, a safe and sustainable environment, access to social security and social protection, and thereby, reducing vulnerability from environmental risk. The third cluster targets **good governance** and accountability to ensure that the poor have access to and control over natural resources for lawful productive purposes, checking waste and diversion of public financial resources, ensuring democratic participation in the monitoring of public resources, applying the rule of law, securing human rights, and a business environment conducive to attracting investments.

UGANDA

The National Development Plan[19] theme of "*Growth, Employment and Socio-Economic Transformation for Prosperity*" is pursued through the eight objectives of: Increasing household **incomes** and promoting equity; Enhancing the availability and quality of gainful **employment**; Improving stock and quality of **economic infrastructure**; Increasing access to quality **social services**; Promoting science, technology, innovation and ICT to enhance **competitiveness**; Enhancing **human capital** development; Strengthening **good governance**, defence and **security**; and Promoting **sustainable population** and use of the **environment** and natural resources. This last objective includes measures of restoration of degraded ecosystems and the quality of environmental resources management, which is closely linked to benefits from the Nile Basin.

[16] Republic of South Sudan (2011) South Sudan Development Plan 2011-2013: Realising freedom, equality, justice, peace and prosperity for all. Juba
[17] IMF (2012) Interim Poverty Reduction Strategy Paper. IMF Country Report No. 13/318
[18] IMF (2010) United Republic of Tanzania National Strategy for Growth and Reduction of Poverty (II). IMF Country Report No. 11/17
[19] IMF (2010) Uganda: Poverty Reduction Strategy Paper. IMF Country Report No. 10/141

BENEFIT SHARING APPROACH

The concept of benefit sharing in transboundary basins is based on an understanding that cooperation between countries can unlock more value from the basin than would be available if countries didn't cooperate. Benefit sharing in transboundary basins can thus be defined as:

"Cooperation between states
to increase the benefits in a transboundary basin
and to fairly distribute the benefits
in support of local, national and regional development objectives"

The benefits of multilateral cooperation have not been fully understood by decision-makers in basin countries. The NBI should therefore develop its benefit sharing framework further to include the quantification of benefits, costs and trade-offs.[20] The Millennium Ecosystem Assessment[21] classified the benefits that people get from ecosystems as provisioning services, regulating services, cultural services and supporting services. The application of benefit sharing in the context of transboundary basins was popularised through the analytical framework with four types of benefits, being environmental (to the river), direct economic (from the river), political (because of the river) and indirect economic (beyond the river)[22]. These benefits can be realised through four types of cooperation, being unilateral action, coordination, collaboration and joint action[23]. The types of benefits to be shared (table hereunder) is based on the above frameworks. The benefits are related to services provided in the basin and the benefits that can be derived from them. It is important to note that this typology extend the services beyond just sources of water, but takes into account the water-related systems and processes in the basin. More detailed information on approaches for assessing services and potential benefits are presented in the Benefit Sharing Methodology section.

Type of Service	Examples of Services	Type of Benefit
Provisioning Services	Water, Energy, Food, Medicine, Minerals, Construction material	*"From the River"*
Regulating Services	Flow regulation, Water quality maintenance, Disease regulation, Pollination, Carbon sink	*"To the River"*
Cultural Services	Spiritual, Religious, Recreation, Tourism, Aesthetic, Education, Cultural heritage Policy shifts, Reduced conflict	*"Because of the River"* *"Beyond the River"*
Supporting Services	Water cycling, Nutrient cycling, Primary production	*"To the River"*

[20] NBI (2014) The Nile Basin: Lessons for the World and Lessons from the World for the Nile Basin. NBTF/CIWA
[21] MEA (2003) Ecosystems and Human Well-being: A Framework for Assessment. Island Press
[22] Sadoff CW and Grey D (2002) Beyond the river: the benefits of cooperation on international rivers. Water Policy 4: 389-403
[23] Sadoff CW and Grey D (2005) Cooperation on International Rivers A Continuum for Securing and Sharing Benefits. Water International 30(4): 420-427

CASE STUDIES

SENEGAL

BACKGROUND [24]

The Organisation pour la Mise en Valeur du fleuve Senegal (OMVS) - a Senegal River Basin organization – was established in 1972 by Mali, Mauritania, and Senegal. Two large reservoirs were envisaged to control the flows along the river, with the three countries aiming to develop large areas of land for agriculture and generate hydroelectricity to solve the problem of the low supply and high cost of electricity in the region. The structures would also maintain a sufficient flow depth in the rivers to make navigation to the Atlantic Ocean possible, opening opportunities to exploit the mineral resources in the basin.

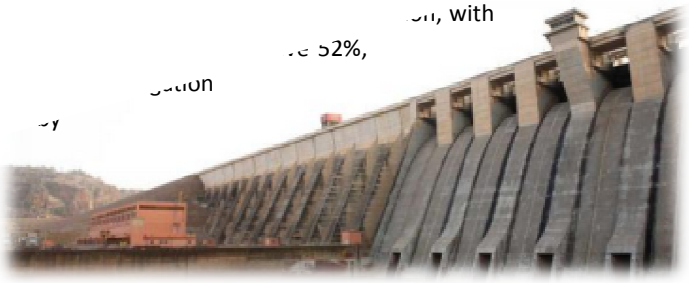
Construction began in 1981 on two multi-purpose reservoirs, with donors providing USD 620 million in financing. The reservoir at Diama on the river delta was completed in 1986. Its purpose was to prevent the intrusion of salt water and raise river levels to reduce the cost of pumping. A second reservoir at Manantali in western Mali, with a storage capacity of 11 BCM and a generation capacity of 200 MW was completed in 1987 for storage, river flow regulation, and power generation. The power generation facilities that were completed in 2002 required a separate USD 445 million investment.

APPROACH

To above development raised issues of the ownership of the regional infrastructure, allocation of the costs of these civil works, financing of the construction, and the management and rules governing the utilization of the river waters. It was also clear that solutions could not be found without strong cooperation among the member states. This resulted in the signing of two conventions: the Convention Concerning the Legal Status of Jointly-Owned Structures (December 1978), supplemented by the Convention Concerning the Financing of Jointly-Owned Structures (March 1982). Between them they declared that: All structures are the joint, indivisible property of the member states throughout their life; Each co-owner state has an individual right to an indivisible share and a collective right to the use and administration of the joint property; The investment costs and operating expenses are distributed between the co-owner states on the basis of benefits each co-owner draws from exploitation of the structures; and Each co-owner state guarantees the repayment of loans extended to the OMVS for the construction of the structures

BENEFITS

Member states identified a potential of 375 000 ha of agriculture, with 9 000 ha in Mali, 126 000 ha in Mauritania and 240 000 ha in Senegal. Total irrigation service benefits were estimated at USD 205.56 million. It was estimated that 800 GWh/a could be generated in 9 out of 10 years while allowing for an artificial flood of 50 000 ha. The final project energy be…on, with the 1985 Council of Ministers Resolution stat…e 52%, Mauritania 15%, and Senegal 33% of the ener…gation benefits were divided among the member s…y assuming that goods unloaded at a specific port would go to the state in which the port was located. The final project navigation benefits were estimated at USD 981.48 million.



[24] World Bank (2009) Benefit Sharing in International Rivers: Findings from the Senegal River Basin, the Columbia River Basin, and the Lesotho Highlands Water Project. Report no. 46456. Africa Region Water Resources Unit Working Paper 1

NIGER

BACKGROUND [25]

The independent countries of the Niger Basin decided to coordinate their efforts in order to exploit the natural resources of the basin, through the Niamey Act (1963) and the Niamey Agreement (1964). The Commission of the Niger River was renamed the Niger Basin Authority (NBA) in 1980, with the member countries being Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Guinea, Mali, Niger, Nigeria and Chad. The objectives of the Shared Vision are to: Develop, in a participatory and consensual basis, and implement at the basin level, a strategic framework for integrated development; Strengthen the existing legal and institutional framework for dialogue and consultation for cooperative action among the member countries and the NBA; and Develop water resources sustainably and equitably to promote prosperity, security and peace among the peoples of the Niger.

APPROACH

The 2008 Summit also resulted in the adoption of a "Water Charter" designed to ensure that NBA Member States share the river's resources fairly and responsibly.[26] Among the purposes of the Water Charter is to "provide a framework to the principles and procedures for the allocation of water resources between various use sectors and the associated benefits." Additionally, the Water Charter provides for the right of Basin populations to water, and calls for the just and equitable use of water – with particular attention paid to "essential human needs." The Water Charter also establishes new provisions for the recognition of "common facilities" and "facilities of common interest." "Common facilities" are defined in the Water Charter as facilities that NBA Member States have decided by legal instrument to be of common and indivisible ownership. "Facilities of common interest" are facilities in which two or more NBA Member States have an interest and have decided, by mutual agreement of NBA Member States, to coordinate management. With respect to such facilities, the Water Charter envisions future agreements to determine their status, as well as conditions for funding, management and the sharing of benefits.

BENEFITS

Benefits and investments in the hydro-agricultural sector are the main items in the scenarios. For instance, for point B[27], the total benefit will be USD 9.82 billion over 20 years for a total investment of USD 7.89 billion. The selection of scenarios hereunder show that Guinea, Mali and Niger generally obtain higher benefits than their investments and that Nigeria has a negative balance that would have to be compensated for either on the Niger supply line or on the Benue. The Fomi + Kandadji scenario (point C2) and the smaller Fomi scenario (point B) give the most balanced distribution for Mali.[27]

Tronc commun / Main branch		Branche 1-1 / Branch 1-1									
point A		point B		point C1		point C2		point C3		point D	
actuel + optim / present + optimization		FO		FO-TA		FO-KD		FO-DI		FO-TA-KD	
Bénéfices totaux (M. F.CFA) / Total benefits (M. F.CFA)	Investissements totaux (M. F.CFA)/ Total investments (M. F.CFA)	Bénéfices totaux (M. F.CFA) / Total benefits (M. F.CFA)	Investissements totaux (M. F.CFA)/ Total investments (M. F.CFA)	Bénéfices totaux (M. F.CFA) / Total benefits (M. F.CFA)	Investissements totaux (M. F.CFA)/ Total investments (M. F.CFA)	Bénéfices totaux (M. F.CFA) / Total benefits (M. F.CFA)	Investissements totaux (M. F.CFA)/ Total investments (M. F.CFA)	Bénéfices totaux (M. F.CFA) / Total benefits (M. F.CFA)	Investissements totaux (M. F.CFA)/ Total investments (M. F.CFA)	Bénéfices totaux (M. F.CFA) / Total benefits (M. F.CFA)	Investissements totaux (M. F.CFA)/ Total investments (M. F.CFA)
117 768	54 411	630 766	264 099	709 511	269 721	663 176	266 910	1 103 702	456 400	776 062	275 342
149 208	90 063	149 208	90 063	149 208	90 063	149 208	90 063	149 208	90 063	149 208	90 063
919 184	955 809	2 110 868	1 447 524	2 490 376	1 625 900	2 202 540	1 674 759	2 513 881	1 839 350	3 337 790	2 257 491
0	0	1 008	522	2 016	1 044	3 024	1 566	2 016	1 044	3 024	1 566
-3 419	1 967	236 147	47 731	421 601	94 440	1 360 383	369 968	437 321	94 440	1 111 015	369 968
-1 729	0	37 908	19 010	67 303	36 608	107 392	54 205	71 992	36 608	100 742	54 205
0	0	192	184	192	184	192	184	192	184	192	184
-112	0	6 456	0	6 422	0	6 422	0	6 422	0	6 422	0
-197 182	41 719	1 983 527	2 277 156	1 505 711	2 634 664	2 362 501	3 211 099	1 992 659	2 748 539	1 403 155	3 170 091
983 718	**1 143 968**	**5 156 079**	**4 146 288**	**5 352 340**	**4 762 622**	**6 854 838**	**5 668 752**	**6 277 393**	**5 266 627**	**6 887 610**	**6 218 910**

[25] ABN (2014) Autorité du Bassin du Niger. http://www.abn.ne/

[26] International Waters Governance (2014) Niger Basin Legal Basis. http://www.internationalwatersgovernance.com/niger-basin.html

[27] NBA (2007) Master Plan for the Development and Management of the Niger River Basin. http://www.abn.ne/

ORANGE

BACKGROUND

The water scarcities can constrain economic and social development of the dynamic and growing economy in the Orange Senqu River Basin. The Orange-Senqu River Commission (ORASECOM) promotes the equitable and sustainable development of the resources of the Orange-Senqu River. ORASECOM provides a forum for consultation and coordination between the riparian states to promote integrated water resources management and development within the basin. The goals of ORASECOM are to: Develop a comprehensive perspective of the basin; Study the present and planned future uses of the river system; and Determine the requirements for flow monitoring and flood management. ORASECOM is expected to strengthen regional solidarity and enhance socio-economic cooperation within the region.

APPROACH

The Revised Protocol on Shared Watercourses in the Southern African Development Community (Revised Protocol) is an example of a regional agreement. It was originally developed by the Southern African Development Community (SADC) in 1995 as part of the implementation process of the SADC Treaty. The original Protocol on Shared Watercourses (Original Protocol) was revised to recognise the UN Watercourses Convention (ORASECOM 2007j). The Revised Protocol was signed in 2000 and came into force in 2003. The Revised Protocol promotes the establishment of shared watercourse agreements and institutions, and enshrines the principles of reasonable use and environmentally sound development of the resource. It supports Integrated Water Resource Management (IWRM) and the Regional Strategic Action Plan for Integrated Water Resources Development and Management (RSAP–IWRM). The Revised Protocol supports strengthening the principles of integrated management of shared basins with specific provisions for: Equitable Utilisation; Notification of Planned Measures; No Significant Harm; and Emergency Situations The Revised Protocol was been ratified by all of the Orange-Senqu riparian states and is binding on them. The agreement stipulates that any institutions established within the region, such as River Basin Organisations, must implement the principles of the Revised Protocol (ORASECOM 2007j).

BENEFITS [28]

Once the range of potential costs and benefits of cooperation have been articulated and mechanisms for redistributing these costs and benefits can be identified. Mechanisms can include payment for water (example in table hereunder[28]), payments for power-purchasing agreements and financing and ownership arrangements. The Lesotho Highlands Water Project illustrates benefit sharing in practice through payment for water, purchase agreements for power, and financing arrangements. However, this is a bilateral initiative so it does not take into consideration potential benefits, or compensation for loss of benefits, for other riparian countries.

Water use	Upper Vaal (R million)	%	Middle Vaal (R million)	%	Total Vaal (R million)	%
Municipal	9,335	80.8	1,067	93.0	10,942	82.4
- High income households	3,107	26.9	535	31.0	3,642	27.4
- Low income households	542	4.7	93	5.4	635	4.8
- Municipal Parks	1,968	17.0	339	19.6	2,307	17.4
Irrigation	33	0.3	120	7.0	153	1.2
Electricity	1,694	14.7	-	0.0	1,694	12.8
Heavy Industry	484	4.2	-	0.0	484	3.6
Total	11,547	100.0	1,727	100.0	13,274	100.0

[28] ORASECOM (2008) Orange-Senqu River Basin: Preliminary Transboundary Diagnostic Analysis.

JORDAN

BACKGROUND

The Lower Jordan River has flowed freely for thousands of years. This important regional water resource once carried an average of 1.3 billion cubic metres of freshwater from Lake Tiberias to the Dead Sea every year. Today the river's flow has been reduced to a trickle. Ninety-five percent of the river's flow is diverted to meet domestic and agricultural purposes in Israel, Syria and Jordan.[29] Water scarcity has become acute in much of the Middle East, yet economically feasible water projects remain undeveloped due to the need for the involvement of multiple jurisdictions and for cooperation in a tense geography. A focus on sharing the benefits derived from the use of water rather than the allocation of water itself provides far greater scope for identifying mutually beneficial cooperative actions, as Jordan's case illustrates.[30]

APPROACH

Countries that share water bodies need to cooperate and jointly explore opportunities and trade-offs to maximise sustainable development. Based on the work done internationally on benefit sharing, the Transboundary Waters Opportunity (TWO) analysis can assist basin states and other stakeholders to analyse potential benefits in a transboundary river basin to optimise economic growth, political stability and regional integration. The concept stresses key development opportunities and associated benefits and potential sources of water to support development. The different potential combinations of water sources and water uses that can be explored through TWO analysis can be presented as development opportunities.

BENEFITS

The results from the TWO analysis of the Jordan River basin[31] are summarized in the table hereunder. The combinations of sources of water and development opportunities that hold the most promise are indicated in green, with yellow and red shading indicating less attractive options. The cooperation between Jordan and Israel has been relatively successful, with both sides working out differences bilaterally without escalation of problems. This type of cooperation should continue to serve as a way for both countries to work together. It can also be expanded to include countries such as Lebanon and Syria, which have similar water concerns and share the same water sources.[30]

Factor	*Riparian/ Activity*	*Efficient Water Use*	*Flow Management*	*Desalination*	*Wastewater Re-use*	*Inter-basin Transfers*
Primary production	Lebanon					Later stage
	Syria	**High Priority**			**High Priority**	
	Israel					
	Jordan	**High Priority**				
	Palestine	**High Priority**			**High Priority**	
Hydropower potential	Lebanon	Moderate, external to the basin.				
	Syria	The Al-Weydah Dam in the basin and other sites external to the basin.				
	Israel					
	Jordan	Red Sea-Dead Sea Conduit.				
	Palestine					
Urban Growth and Industrial Development	Lebanon	Mostly external to the basin. Medium Priority.				Later stage
	Syria	Mostly external to the basin. **High Priority**.				
	Israel	Ongoing. Agricultural sector to be de-emphasized, as a **High Priority**.				
	Jordan	Ongoing. **High Priority**.				
	Palestine	**Critically High Priority**.				
Ecosystem Services	***Fisheries***					
	Tourism	Potential major driver for the riparian economies; dependent on a sustainable peace.				

[29] Mehyar M, Khateeb N and Bromberg G (2009) Cooperation in a Troubled Region – The FoEME Experience from the Jordan River Basin. In Getting Transboundary Water Right: Theory and Practice for Effective Cooperation. Report 25. World Water Week.

[30] Maysoon Zoubi (Former Secretary General, Ministry Of Water Resources, Jordan) (2014) Benefit sharing, water and cooperation: the Jordanian case. Turkish Review, 01 May 2014.

[31] Phillips D (2008) The Transcend-TB3 Project: A Methodology for the Trans-boundary Waters Opportunity Analysis (the TWO Analysis) Prepared for the Ministry of Foreign Affairs, Sweden

MEKONG

BACKGROUND

Hydropower projects can tap into the Mekong River's natural source of energy and contribute to economic growth and energy security in the region.[32] However, thousands of people depend on the water for navigation, fishing, and other sources of food and income, which renders benefit sharing especially important since hydropower can affect the resources that support economic and livelihood activities.

APPROACH

Measures of compensation for the people resettled from project sites often meet the minimum requirements and are usually a one-off package covered under the costs of the project. In contrast, benefit sharing consists of a range of long-term mechanisms based on an agreed regulatory framework. Monetary and non-monetary benefit sharing mechanisms may span the economic life of hydropower projects, from planning to operations. Unlike compensation, benefit sharing is typically based on a percentage from the revenues generated by the project, with monetary benefit sharing including revenue and equity sharing, taxes and royalties, and preferential electricity tariffs. These benefits are shared when the project starts generating revenue. Non-monetary forms range from access to natural resources and project-related development opportunities for riparian communities, to electricity connection and reliable electricity supply to communities. Additional indirect benefits include investments on public infrastructures, human capacities and job creation.[32] Specific tools, such as a the The Rapid Sustainability Assessment Tool (RSAT) has been developed to support benefit sharing. This enables the MRC and its member countries to evaluate projects in local catchment areas with regard to their environmental and social sustainability, and to adapt policy decisions accordingly.[33] Two sets of benefits based on political boundaries and natural boundaries have been compared using the game theory, which showed depending on the type of riparians chosen, the extent of benefit sharing changes. This provides a basis for local policy decisions and regional planning in the Mekong River and beyond.[34]

BENEFITS

Thailand introduced the local Community Development Funds in 2007 to improve the economic conditions and quality of life of people living in the vicinity of power projects. Such a mechanism should also be implemented for hydropower projects. The Electricity Regulatory Authority of Viet Nam has been developing the provisions of a draft decree law for benefit sharing mechanisms on hydropower, which were pilot tested in 2010 on a 210 MW project in Quang Nam Province in cooperation with the provincial authorities. Viet Nam should now finalise and implement the law on all hydropower projects. Lao PDR target hydropower revenue to tackle poverty and raise the incomes of people affected by the projects as well as revenue-management provisions for projects supported by donors that contribute to poverty alleviation. Lao PDR and Cambodia should now implement benefit sharing mechanisms in all hydropower projects through the development of enabling legislation. China has laws that allocate a portion of revenue from hydropower projects to permanent local development and reconstruction funds in reservoir areas, as well as measures for longer term compensation. Legislation-based benefit sharing ensures a consistent approach in existing and new hydropower projects with a mix of public and private investment. This allows all partners and stakeholders to have a shared understanding of the approaches to be followed and ensures that benefits are delivered to intended beneficiaries.[32]

[32] MRC (2014) Benefit Sharing Options for Hydropower on Mekong Tributaries (ISH13). www.mrcmekong.org
[33] GIZ (2014) Supporting the Mekong River Commission in pro-poor sustainable hydropower development. http://www.giz.de/en/worldwide/14462.html
[34] Bhagabatia SS, Kawasaki A (2013) Comparing benefits of hydropower development in two boundary systems in the Mekong. ICIRD Full Conference Paper.

DANUBE

BACKGROUND

The Danube is Europe's second longest river, extending 2,778 km from its source to its delta at the Black Sea. It straddles nineteen countries with vastly different political, economic and historical contexts. With over 80 million people, the Danube is the most international river basin in the world. Many other European rivers drain into the Danube River, including the Inn River (Germany), the Morava River (Czech Republic, Austria and Slovakia), the Tisza River (Hungary and Romania), the Sava River (Slovenia, Croatia, Bosnia & Herzegovina and Serbia & Montenegro), the Prut River (Romania and Moldova), etc.[35]

APPROACH

The Danube Commission was established by the Convention regarding the regime of navigation on the Danube signed in Belgrade on 18 August 1948. The main objectives of the Danube Commission are to provide and develop free navigation on the Danube as well as to strengthen and develop economic and cultural relations of the states among themselves and with the other countries. The interests of the Member States of the Danube Commission (the Republic of Austria, the Republic of Bulgaria, Hungary, the Federal Republic of Germany, the Republic of Moldova, the Russian Federation, Romania, the Republic of Serbia, the Slovak Republic, Ukraine and the Republic of Croatia) are focused on unifying and providing mutual recognition of the basic regulatory documents, required for the navigation on the Danube and contributing to the improvement of navigation conditions and safety of navigation, creating requirements for the Danube integration into the European system as the significant transport corridor. The non-navigational use of waterways in the Danube River Basin is governed by the Convention on Cooperation for the Protection and Sustainable Use of the Danube (DRPC), signed on 29 June 1994 in Sofia, Bulgaria. The DRPC, which entered into force in October 1998, is the overall legal instrument for cooperation and transboundary water management in the Danube River Basin, with the main objective of ensuring that the surface waters and groundwater within the Danube River Basin are managed and used on a sustainable and equitable basis. To accomplish these objectives, the DRPC established the International Commission for the Protection of the Danube River (ICPDR).[36]

BENEFITS

There are no specific provisions in the DRPC for benefit sharing, but the DRPC does provide for several forms of cooperation, including consultations and joint activities, the exchange of information and technical assistance. The DRPC also obligates the Contracting Parties to establish "*complementary or joint programmes of scientific or technical research*" and to transmit to the ICPDR the results of such research and relevant parts of other programs or scientific and technical research. Finally, the DRPC obligates parties to provide mutual assistance on requests to facilitate compliance with the obligations, particularly where a critical situation of river conditions may arise.[36] The ICPDR mission is to promote and coordinate sustainable and equitable water management, including conservation, improvement and rational use of waters for the benefit of the Danube River Basin countries and their people. The ICPDR makes recommendations for the improvement of water quality, develops mechanisms for flood and accident control, agrees on standards for emissions and assures that these are reflected in the Contracting Parties' national legislations and policies.[37]

[35] UNDP/GEF (2014) Danube Regional Project. http://aws.undp-drp.org/drp/danube.html
[36] International Waters Governance (2014) Danube River Basin. http://www.internationalwatersgovernance.com/danube-river-basin.html
[37] ICPDR (2014) International Commission for Protection of Danube River. http://www.icpdr.org/main/

CENTRAL ASIA: AMU DARYA AND THE SYR DARYA

BACKGROUND [38]

There were fixed allocations of water from these river systems in the Soviet era (pre-1989) for Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan and regimes for flow regulation in the entire basin. The Kyrgyz Republic in the upper basin was allocated 25 percent of the water originating in its territory (for abstraction), including both surface and groundwater. Thirty-nine large water reservoirs were built prior to 1989 to regulate flows and support diversions, which were optimized for downstream irrigation during the summer growing season, and to provide storage for drought security. In the post-Soviet era, controversy arose over conflicting needs for winter-time water releases for hydropower generation and maintaining the summer release for irrigation.

APPROACH

Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan agreed to cooperate on water resource management measures within the framework of what later emerged as the Aral Sea Basin Program (ASBP). An Interstate Agreement was signed in February 1992, expressing the principles of co-operation, management, utilization, and protection of water resources in the Aral Sea Basin and the need for joint measures to address the Aral Sea problem.

BENEFITS

The 1999 agreement linked the regulation of the Toktogul Reservoir in the Naryn-Syr Darya River cascade to a compensatory scheme for oil and gas transfers. Electric power generation in excess of summer demand in the Kyrgyz Republic is sent through the Central Asian power grid to Kazakhstan and Uzbekistan in equal portions. In return (and as compensation for agreeing to a reduction in winter season generation in favour of summer releases for irrigation), the Kyrgyz Republic receives coal, gas, heavy oil and other types of petroleum products from downstream countries (mainly Kazakhstan).


Agreement

Between the Republic of Kazakhstan , the Republic of Kirgyzstan, the Republic of Uzbekistan, the Republic of Tajikistan and Turkmenistan

On Cooperation in the Field of Joint Water Resources Management and Conservation of Interstate Sources

[38] MRC (2011) Knowledge Base on Benefit Sharing: Volume 1 of 5. Summary and Guide to the Knowledge Base (KB) Compendium.

COLUMBIA BASIN

BACKGROUND [38]

A leading example of a basin-level benefit sharing programme on an international river system is the Columbia Basin Trust (CBT). The Columbia River Basin Treaty (1964) between Canada and the USA stipulated the mode of development of large dams in Canada. In accordance with the bi-national benefit sharing arrangement, the United States makes payments to Canada to regulate the large dams in ways that are beneficial to the downstream hydropower projects in the USA. By the early 1990's, it was apparent to local communities in Canada that the benefits accrued major regional population centres in the USA and Canada (where power services were delivered), but felt they received little direct economic benefits. The communities had a series of demonstrations in the early 1990's to petition the British Columbia Provincial Government for recognition of what they called "the injustice of the situation".

APPROACH

Province of British Columbia (BC) agreed to set up the Columbia Basin Trust to share a portion of hydropower revenues from the hydropower projects in the basin as well as the payments for downstream flow regulation that the Province received annually from the USA. The specific aims of the CBT[39] are to: "*Columbia Basin Trust (CBT) supports efforts by the people of the Basin to create a legacy of social, economic and environmental well-being and to achieve greater self-sufficiency for present and future generations. Working closely with people who live in the Basin, CBT develops and delivers programs and initiatives that respond to their needs and supports communities. By focusing on local priorities and issues, bringing people together around key issues, providing information, encouraging collaboration, and supporting planning, CBT is delivering benefits to the residents of the Columbia Basin. Learn more about how CBT works with communities.*" The CBT also functions as a basin-wide public monitoring mechanism publishing annual reports to Residents of the Basin on the state of Basin, with indicators to illustrate changes in the ecological, economic and social health of the basin.

BENEFITS

The Columbia Basin Trust initially received a USD 295 million endowment from the Province of BC. Of this amount, USD 45 million was reinvested for the benefit of basin residents through a range of community development and grant-based programs (e.g. short-term cash investments, business loans, real estate ownership, and venture capital projects). In addition, the CBT receives USD 2 million per year (from 1996 to 2012), paid by Provincial royalties charged on generation reflected in the power export tariffs. The Province of BC committed to transfer a further USD 250 million to an entity called the Columbia Power Corporation (CPC), a specialized equity vehicle, which is the CBT's Joint Venture Partner in power projects in the Basin. From the CPC, 50% of the net profits go to the CBT. This is to be spent on social, economic and environmental benefits for the residents of the Basin. The delivery of benefits under the CBT is community managed with an elected Board of basin residents.

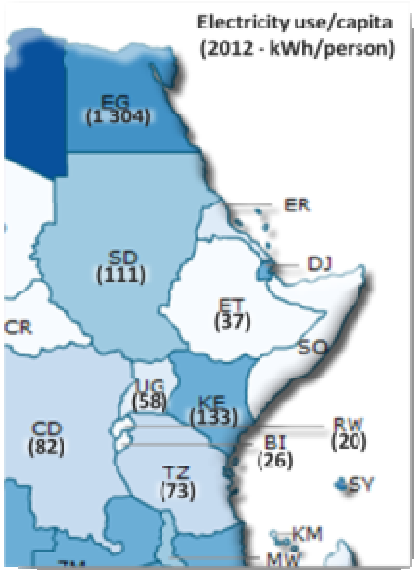
[39] Columbia Basin Trust (2014) About Us. http://www.cbt.org/About_Us/

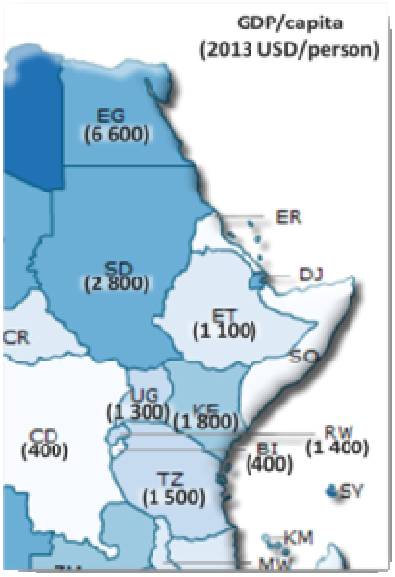
NILE BASIN DEVELOPMENT OPTIONS

HYDROPOWER

POWER SUPPLY AND DEMAND

Energy use and output are tightly coupled with energy availability playing a key role in enabling growth[40]. An increase in electricity consumption can directly stimulate economic growth and indirectly achieve enhanced social development. In most cases, the threshold for moving from a low to a medium human development index (HDI) economy is at 500 kWh per capita[41]. The relationship between electricity consumption and development is shown in the adjacent maps, with the specific values for the NBI countries indicated[42]. The reliable supply of power serve to attract investments to the region and will support expansion of industrial and service sectors, thereby creating employment opportunities and improving quality of life[5].





Electricity generating capacity In Egypt has almost doubled between 1990 and 2009 in line with peak demand. Government policies consistently emphasize hydropower, but most potential hydro resources have been already developed[43]. Egypt generated 1.32 billion kWh of hydroelectricity in 2012, almost all of which came from the Aswan High Dam and the Aswan Reservoir Dams on the Nile River[44]. This is about 10% of their total production of 138.7 billion kWh[45]. Total electricity generation in Sudan and South Sudan was 9.7 billion kWh in 2012, of which almost all was generated in Sudan. Hydroelectricity is Sudan's largest source of power, accounting for 68% of generation in 2011. Although power generation has more than tripled since 2000, millions of people are still without access to electricity.[46] Accelerating socio-economic growth in Ethiopia has led to increased energy consumption and unmet demand. Total power demand is projected to grow from 4 billion kWh in 2010 to a maximum of nearly 70 billion kWh in 2030. The steep annual increase in demand (14%) will be driven by growing electrification (to connect nearly 100% of the population by 2020) and rapid growth of electricity-intensive industries. Specific energy efficiency measures may decrease the demand to 50 billion kWh in 2030, which still represents a more than tenfold increase over current demand.[47] In Kenya, household access to electricity increased by about 4% per year between 1989 and 2009, but over 75% of households still do not have access to electricity[48]. There is an urgent need for improved

[40] Stern DI (2010) The Role of Energy in Economic Growth. CEP working paper 3.10
[41] Leung CS (2005) How electricity consumption affect s social and economic development by comparing low, medium and high human development countries.
[42] Index Mundi www.indexmundi.com
[43] AFDB (2010) The Arab Republic of Egypt. Power Sector in Brief – 2010.
[44] US Energy Information Administration (2014) Country Analysis Brief: Egypt.
[45] CIA (2014) The World Fact Book, www.cia.gov/library/publications/the-world-factbook
[46] US Energy Information Administration (2014) Country Analysis Brief: Sudan and South Sudan.
[47] Ministry of Water and Energy (2012) Scaling - Up Renewable Energy Program. Ethiopia Investment Plan (Draft Final)
[48] World Bank (2013) Kenya Economic Update

reliability of service supply, increase access to electricity, and lower energy costs in Kenya[49]. The electricity production was 7.33 billion kWh in 2010, of which 44.8% was from hydropower sources, with consumption standing at 6.15 billion kWh[45]. Uganda generated about 2.41 billion kWh of electricity in 2010, of which 65% was from hydropower[45]. This translates to a relatively low energy use per capita, which stood at 58 kWh/person in 2012. Tanzania generated 2.87 billion kWh of hydroelectricity in 2010, which was 67% of the total national production of 4.3 billion kWh. With 80% of jobs in Uganda being provided in the agriculture sector, there is a need to diversify the economy.[45] According to their power system master plan the forecasted demand is 10.8 billion kWh for 2025 and 23.5 billion kWh for 2035 [50]. Rwanda has the lowest electricity use per capita of any NBI country at 20 kWh per person. They generated 0.28 billion kWh in 2010 (of which 47% are from hydropower) and consumed 0.32 billion kWh in the same year, which translates not only to low availability and connection levels, but also a national deficit[45]. According to Rwanda's energy sector review and action plan, the government recognizes that availability of efficient and reliable energy supply is a pre-requisite for social prosperity, human development and economic growth. The new government has therefore set a generation target of 3.3 billion kWh for 2015[51]. Burundi generated 0.15 billion kWh of electricity in 2010, which was almost entirely from hydropower installations. Burundi's electricity consumption for the same year outstripped supply by 0.07 billion kWh, which translated into a net import of electricity[45].

Hydropower Potential

The total potential hydroelectricity in the Nile Basin is 33 024 MW, of which 6 833 MW (20%) is currently installed[5]. With the power demand in the Nile Basin countries expected to double every 5-10 years, the full potential could be accounted for by demand by 2035. At an average cost of 6.08 US cents/KWh (2011 values), the total investment required to install the remaining capacity would be USD 13.95 billion (2011 values).[5]

The NBI has identified a 47 hydropower generation projects in the Nile Basin that could be part of the regional power grid. It is however important to take account of the spatial distribution of hydropower potential. The hydropower sites are mainly located in the upper reaches of the Blue Nile and the White Nile, which are associated with the topographic gradient (head of water) and flow. The generation capacity of the hydropower sites and associated generation costs are indicated in the table below.

Hydropower site	Cost*	Hydropower site	Cost*	Hydropower site	Cost*
Aleltu West	8.63	Gibe IV	6.11	Ruzizi III	8.33
Ayago RoR Alt. 1	5.47	Gibe V	7.3	Ruzizi IV	4.72
Babeba I	6.6	Halele Worabesa Stage II	2.58	Semliki	3.17
Baro I	7.14	Ikondo	4.56	Shereiq	6.32
Baro II	2.47	Karuma	7.65	Shukoli	5.75
Bedden	5.8	Katende	4.32	Siguvyaye	9.15
Beko Abo	3.15	Kiba	16.01	Songwe Bupigu	9.29
Bengamisa	7.59	Kishanda	3.27	Songwe Manolo	5.71
Birbir R	3.62	Lakki	5.91	Songwe Sofwe	6
Border	5.54	Low Dal	8.3	Stiegler's Gorge 1	8.5
Busanga	4.15	Mandaya	3.47	Stiegler's Gorge 2	6.5
Dagash	7.85	Murchison Dam Alt. 2	7.21	Stiegler's Gorge 3	6.73
Fula I	5.06	Oriang	9.26	Tams Dams	11.22
Geba I	4.21	Ruhudji	5.33	Tekezze II	3.86
Genale VI	4.41	Rumakali	7.64	Wanie Rukula	4.31
Genji	2.65	Rusumo Falls	10.41		

* US cents/kWh

[49] IMF (2005) Kenya: Poverty Reduction Strategy Paper.
[50] Tanzania Ministry of Energy and Minerals (2013) Power System Master Plan
[51] AFDB (2013) Rwanda Energy Sector Review and Action Plan.

BENEFITS OF HYDROPOWER

Hydropower installations regulate river flow, thus providing more reliable supplies for agricultural production, industrial development, environmental flows and downstream hydropower installations. The flow regulation also reduces floods, which reduces damage to crops, property and infrastructure. Hydropower structures reduce sedimentation of downstream storage facilities, thereby increasing their effective storage and useful life. Where dams with hydropower are planned as multipurpose structures, there is increased assurance of direct water supply and consequent reduction of alternative water pumping. Hydropower also reduces CO_2 emissions by replacing fossil fuel alternatives. Hydropower is often a local source of energy, which reduces reliance on imports and high capacity transmission lines. Dams built for hydropower installations can also offer a variety of recreational opportunities such as fishing, swimming and boating. [52, 5, 53]

SHARING BENEFITS FROM HYDROPOWER

Regional markets for electricity often support the business case for hydropower development, particularly in cases where hydropower resources exceed the local requirements. With 26 191 MW of hydropower potential still being available in the basin, the joint investment and increased leverage to secure third party funding will expedite future developments. Ethiopia provides a case in point with the local demand not justifying the full development of its tremendous hydropower potential, but the neighbouring Kenya and Sudan have limited domestic hydropower potential. In such cases, countries can jointly invest to develop hydropower projects and share both the direct benefits (electricity provision) and indirect benefits, such as reliable supplies for irrigation and other uses, sediment reduction and the balancing of electricity from different sources. In the case of direct benefits, it has been shown for developing countries that an average GDP growth rate of between 3% and 6% is associated with growth in energy generation by between 6% and 12% respectively[54]. To be very conservative, one can say that a 3% growth in energy production will support a 1.5% growth in GDP, which means that the **combined economic benefit to the Nile Basin countries would be USD 15.59 billion** (based on a combined GDP for NBI countries of USD 1.039 trillion in 2013).

Studies have shown that Regional interconnections and market structures can increase stability in the electricity system while reducing the need for costly system redundancy.[55] In terms of regional power interconnections, the benefit of reduced redundancy can be calculated by starting with the 10% surplus margin required at the national level to ensure reliable supply. If this surplus is pooled at the regional level, the surplus can be reduced to 5% for each country, which translates to 5% less capacity being required across the basin to provide the same reliability of supply. Since the current generation capacity is 833 MW (7.3 billion kWh on an annual basis) the reduction in required surplus (redundancy) would translate into 356 million kWh (5% of 7.3 billion) multiplied by 6c/kWh (average hydropower unit cost), which is a **direct saving of USD 21.89 million per annum**. This is merely one of the potential benefits of cooperation. The impact of increasing the reliability if power supplies (through stronger regional business cases and capacity for investment) on GDP can be estimated through calculations of the economic impact of power outages. Anderson and Dalgaard[56] found that if African countries had the power quality of South Africa, the average rate of per capita GDP growth would be increased by two percentage points. Considering that the combined GDP for all NBI countries is just over USD 1 trillion (2013), the benefit of increased quality of power (through shared surplus) will be a basin-wide **increase in GDP of USD 20.79 billion per annum**. The indirect benefits such as agricultural production and improved watershed management are discussed in the in the next sections.

[52] EDF and Scott Wilson (2007) Eastern Nile Power Trade Program Study AFDB Pre-Feasibility Study of Mandaya Hydropower Project, Ethiopia. Final Report. Funded by Africa Development Bank for ENTRO
[53] US Department of Energy (2014) Benefits of Hydropower. http://energy.gov/eere/water/benefits-hydropower
[54] Abaidoo R (2011) Economic growth and energy consumption in an emerging economy: augmented granger causality approach. Research in Business and Economics Journal. Volume 4 - August, 2011
[55] World Energy Council (2013) World Energy Resources. 2013 Survey
[56] Anderson TB, Dalgaard C-J (2013) Power outages and economic growth in Africa. Energy Economics 38:19-23

THE COST OF NON-COOPERATION

In addition to the obvious cost of foregoing the above benefits, there are also direct costs and risks associated with non-cooperation. A cost that is often incurred through non-cooperation is the delays in project implementation, for instance due to downstream riparian states objecting to developments. For example, a 12 month delay in the implementation of a single project could **cost up to USD 429.72 million in the loss of the potential value of the electricity** in the case of Murchison Falls and **a loss of income amounting to USD 35.17 million** in the case of Rusumo Falls (ignoring the losses in benefits to indirect social and economic development - table below[57]). If all projects were to be delayed by 12 months due to objections and/or difficulty in mobilising funding for unilateral action, the combined loss in the value of energy in the Nile Equatorial Lakes region would be **to USD 2.90 billion.**

Name of the hydropower plant / Dams	Installed Capacity (MW)	Total Project Cost (106USD2012)	O&M Cost (106USD2012/Year)	Cost of Environmental Impact (106USD2012)	Average annual production (Gwh)	Value of electricity
Fula	890	1 080.87	4.05	20.90	2 673.06	267 305 572
Shukoli	235	511.65	1.92	20.90	1 137.19	113 718 647
Lakki	410	525.08	1.97	20.90	1 163.91	116 391 394
Bedden	570	1 029.90	3.86	20.90	1 945.46	194 546 160
Karuma	600	1 658.38	34.04	20.03	3 153.97	315 397 257
Ayago	612	1 344.64	11.59	106.60	4 036.63	403 662 928
Murchison Falls	648	979.04	8.09	69.48	4 297.24	429 723 831
Kiba	288	1 873.08	16.17	151.87	2 019.25	201 924 784
Oriang	392	1 452.58	12.58	102.93	2 632.58	263 258 307
Nalubaale	180	39.81	0.26		1 267.32	126 732 345
Kiira	200	336.33	1.62		-	0
Bujagali	250	800.00	3.00		1 381.87	138 187 261
Isimba	188	529.37	4.50	47.43	887.13	88 712 644
Semliki	28		13.40	51.58	167.30	16 730 262
Rusumo Falls	63	326.46	2.89	108.80	351.71	35 171 070
Kakono	53	169.14	1.47	108.80	349.05	34 904 743
Nshungenzi falls	180	279.63	2.53	10.00	262.21	26 220 865
Chikagati	16	139.82	1.27	20.00	113.53	11 352 659
Sondu Miriu	60	31.24	0.13		313.33	31 333 286
Sang'oro	21	53.45	0.20		109.44	10 944 066
Gogo Falls	2	5.00	0.02		16.53	1 653 169
Nandi Forest	50	305.52	2.73	40.00	409.47	40 947 433
Magwagwa dam	120	291.62	2.60	30.00	294.25	29 424 573

Non-cooperation and unilateral actions could also strain political relations, which could lead to negative impacts in regional trade at least or conflict at worst. The economic costs of such situations are difficult to calculate due to the uncertainty of the severity and extent of the impact, but the consequences are likely to be much greater than the losses caused by project delays, listed above.

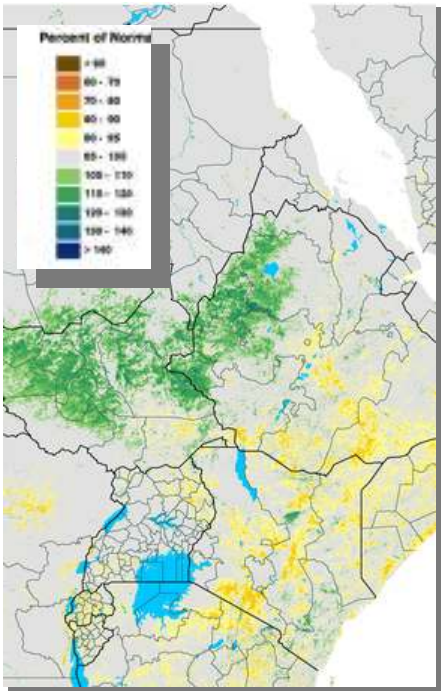
[57] NELSAP (2014) NELSAP Economic Model

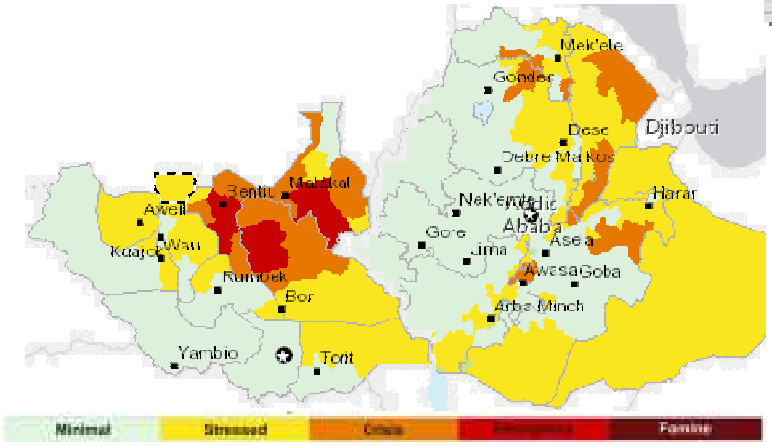
WATERSHED MANAGEMENT

RATIONALE FOR WATERSHED MANAGEMENT

Joint river basin management supports integrated water resources management (IWRM) at sub-basin scale and underpins the sustainable development and management of resources across a range of sectors from farming, to energy production and industry. The adoption of an IWRM approach in the sub-basins is important for allowing all concerned riparian countries to identify the challenges and risks of non-cooperation, including the costs of inaction. It also supports the development of policy, legal and institutional mechanisms that can maximize socio-economic and environmental benefits from watershed management, including the production of important ecosystem benefits.[2]

Catchment areas in the Nile Basin face a variety of challenges, such as population growth, increasing migration towards riparian areas, agricultural practices that reduce soil cover, and deforestation for grazing or charcoal production. The sustainable management of watersheds (river basins) provides an opportunity to generate multiple benefit streams, which can include reduced soil loss and enhanced water retention supporting greater food security in rain fed farming, reduced impacts on downstream reservoirs and support flood mitigation.[2] Regional variability of environmental factors further complicate development options and risks, with the adjacent diagram showing the exceedance (green) or deficit (yellow) of photosynthetic absorbed radiation (plant growth) for the Nile region for 1-10 May 2014 [58]. This variability contributes to differences in social and economic development, with the food security outlook for January-March 2015 for South Sudan and Ethiopia in the figure hereunder highlighting areas of future risk[59].





[58] USGS (2014) Normalized Difference Vegetation Index (NDVI). East Africa. Percent of Average. http://jisao.washington.edu/data/ndvi/)
[59] FEWS Net (2014) East Africa. Food Security Outlook Update. http://www.fews.net/east-africa

OPPORTUNITIES FOR SHARED BENEFITS THROUGH WATERSHED MANAGEMENT

A number of opportunities for cooperative basin management have been identified in the Main Nile sub-basin of the Eastern Nile[60]. The problem of shifting sand dunes can be mitigated by planting shelterbelts to protect croplands, but communities are reluctant to construct external shelterbelts far away from their fields, although the benefits will be far greater. With the establishment of a shelterbelt costing USD 50 000/km and the cost of establishing new irrigation land being USD 1 900/ha, the economic break-even occurs when at least a 300m wide strip of cropland is protected by the shelterbelt, which translates to 30ha being protected (worth USD 57 000) for each km of shelterbelt (costing USD 50 000). The effective protection could be much more in the long term. For example, in the villages of Argi, Abkar and Afaad, a shelterbelt of 40 km (costing USD 2 million) would protect 2 240 ha of existing cropland (worth USD 4.2 million), which translates to a **net benefit of USD 2.2 million**. This excludes the further protection of 9 520 ha of potential croplands.[60] Other opportunities for basin management include river bank erosion control, the extraction and use of sediment deposits, the planting of shelterbelts to reduce sedimentation from wind-blown sand, and livelihood opportunities [60]. A significant opportunity for transboundary benefits from watershed management is erosion control and sediment management. The annual economic cost of watershed degradation in Ethiopia is estimated at USD 670 million per annum (2012), with up to 200 million metric tonnes of fertile topsoil being washed away every year.[61] The figure is expected to reach at least USD 4.5 billion in 25 years unless the problem is addressed urgently. These watershed degradation impacts are not confined to the Ethiopian highlands, but run all along downstream in Sudan and Egypt. Between 157.2 and 207.2 million tons of sediment are transported annually from the Ethiopian highlands along the Blue Nile, Tekeze and Sobat main sub-basins of the Nile. These sediments translate to significant costs downstream in Sudan and Egypt including hydropower underperformance, high maintenance costs of hydropower infrastructure, dredging costs of clogged irrigation channels, etc[5]. The implementation of a comprehensive watershed management program in the Tekeze-Atbara, Abay-Blue Nile and Baro-Akobo-White Nile Rivers can reduce the sediment loads by 82.5 million metric tonnes per year[60], which would translate to a **saving of USD 276 million per annum**. Support for sustainable livelihoods can be strengthened for the Ababda and the Bishari people through greater use of existing vegetation resources for charcoal production and livestock grazing and a change from cash vegetable cropping to fodder production. The costs and benefits of watershed management in the Eastern Nile are summarised in the tables on the next page[62], with the **net benefit of watershed management being USD 8.51 billion** (over 50 years with a discount rate of 10%).

[60] NBI (2007) East Nile Watershed Management Project. Cooperative Regional Assessment for Watershed Management. Transboundary Analysis. Main Nile sub-Basin.
[61] ENTRO (2012) Inheritance for my Descendants. Documentary Film.
[62] NBI (2007) East Nile Watershed Management Project. Cooperative Regional Assessment for Watershed Management. Distributive Analysis.

	Incremental cost	Incremental benefit
ETHIOPIA		
National		
Soil conservation: Bunds	77	133
Soil conservation: Grass strips	6	53
Fertilizer/Improved seed	162	-
On-farm Forage	22	348
On-farm Trees: Fuelwood	28	279
On-farm Trees: Crop Production saved: Soil N retained		141
Improved stoves	6	83
Area enclosure	585	8 053
Small-scale Irrigation	366	760
Small-scale Irrigation: Multiplier Impacts	-	135
Supporting Interventions		
Sub-total	**2 390**	**9 984**
Regional (none)	-	-
Global		
Soil conservation: Soil Carbon seq.	-	66
On-farm Trees: Tree carbon	-	19
Improved Stoves: Fuel saving: Tree Carbon seq.	-	8
Enclosed areas: tree carbon	-	395
Enclosed areas: Soil carbon	-	170
Sub-total	**-**	**659**
TOTAL ETHIOPIA	**2 390**	**10 643**

	Incremental cost	Incremental benefit
SUDAN		
National		
Traditional Rainfed Farms: Crop production	502	1 222
Semi-mechanised farms: Crop production	673	893
Semi-mechanised farms: Charcoal production	46	49
Semi-mechanised farms: Residue: Livestock feed		16
Reclamation: Kerib land	3	8
Supporting Interventions		
Sub-total	**2 277**	**2 188**
Regional		
Increased irrigation water	-	11
Reduced OM Costs: Irrigation schemes	-	34
Reduced fertilizer value: Sediment	-	-10
Sub-total	**-**	**34**
Global		
Traditional Rainfed Farms: Soil carbon	-	23
SMF's : Soil carbon	-	12
SMF's : Tree Cover: Soil carbon	-	39
Kerib land: Soil carbon	-	1
Sub-total	**-**	**34**
TOTAL: SUDAN	**2 277**	**2 256**
EGYPT		
Regional		
Reductions in lost Power Generation		16
Reductions in lost Irrigation Water		243
TOTAL: EGYPT	**-**	**277**

The Nile Equatorial Lakes region also shows much opportunity for integrated watershed management. The seven management objectives for the Kagera Integrated Watershed Management Programme (KIWMP) are to: Increase scientific understanding of wetlands and their management requirements; Maintain, or where appropriate restore, suitable hydrological regimes in wetlands; Address adverse processes and activities causing wetland degradation; Manage wetlands within an integrated watershed management framework; Manage wetland resource utilisation on a sustainable basis; Protect, and where appropriate enhance, wetland ecosystem services; and Encourage strong partnerships between wetland management agencies. The net present value (2012 values) of proposed actions under the KIWMP shows a **positive balance of economic costs and benefits of USD 397.5 million** over 20 years[63] (first table on next page). The financial costs and economic benefits for the Wetlands Management Programme (WMP) and the Watershed Management (WSM) are listed for each country (second table on the next page), noting that the Financial costs are for a 5 year period and the Economic benefits are for one year (per annum).

[63] NELSAP (2012) Feasibility Study for an Integrated Watershed Management Programme for the Kagera River Basin.

Description	Year1	Year2	Year3	Year4	Year5	Year6	Year7	Year8	Year9	Year10	Year11	Year12	Year13	Year14	Year15	Year16	Year17	Year18	Year19	Year20
Programme costs																				
Coordination and management	7.38	6.70	2.90	2.86	2.76															
Wetlands management	4.20	4.59	7.70	6.65	6.78	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99
Watershed management	47.93	61.75	102.58	112.90	121.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capacity building and Policy dev	0.58	0.95	1.24	1.41	0.74															
Total programme cost	60.08	74.08	114.42	123.82	131.29	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99
Programme benefits																				
Wetlands management	0	0	2.07	3.11	4.14	5.18	6.21	7.25	8.28	9.32	10.35	10.35	10.35	10.35	10.35	10.35	10.35	10.35	10.35	10.35
Watershed management	0	21.72	43.03	66.60	94.27	102.47	110.67	127.08	127.08	127.08	127.08	127.08	127.08	127.08	127.08	127.08	127.08	127.08	127.08	127.08
Total programme benefits	0	21.72	45.10	69.71	98.41	107.65	116.89	134.33	135.36	136.40	137.43	137.43	137.43	137.43	137.43	137.43	137.43	137.43	137.43	137.43
Net Benefits Stream	-60.08	-52.36	-69.32	-54.11	-32.88	104.66	113.89	131.33	132.37	133.40	134.44	134.44	134.44	134.44	134.44	134.44	134.44	134.44	134.44	134.44

NPV	397.50
IRR	25.8%
NPV Benefits	779.53
NPV costs	382.03
BCR	2.04
Switching value costs	2.08
Switching value maintenance	29.12
Switching value Benefits	0.49

Riparian State	Financial Costs US$ m			Economic Benefits US$ m		
	WMP	WSM	Total	WMP	WSM	Total
Burundi	2.71	273.46	276.17	0.80	52.23	53.02
Rwanda	1.89	114.32	116.21	3.70	39.47	43.18
Tanzania	4.08	81.23	85.31	2.23	24.89	27.12
Uganda	15.72	63.98	79.70	1.60	11.60	13.20
Total	24.39	533.00	557.39	8.33	128.20	136.52

The cost-benefit analyses for the Mara sub-Basin and the Sio-Malaba-Malakisi sub-Basin have not been completed at the level of the Kagera. Sound watershed management will also bring about other benefits such as flood control. According to an ENTRO study, the estimated average annual damage due to floods is estimated at **USD 25.77 million in Sudan and USD 5.54 million in Ethiopia** respectively[64].

A reviewed past studies in Rwanda[65] showed that yield increases due to soil and water conservation range from 45 to 216%. Based on current cropping practices in the sub-project sites, the World Bank's Land Husbandry, Water Harvesting and Hillside Irrigation Project Appraisal Document[66] a conservative increase in yield of 30% was used for traditional annual crops and 50% for perennial crops. The total value of the 20 most important crops from each of the NBI member states is USD 43.90 billion[69] (see detail in next section). If soil and water conservation were only applied to 50% of the crop areas and the increase in crop yields was estimated at a very conservative 25%, then the value of the watershed management intervention would translate to an **increase in crop value of USD 5.49 billion per annum**. Such gains would be amplified in transboundary contexts, such as the Sio-Malaba-Malakisi, where farmers from the different countries share experiences in exchange visits and workshops and report significant gains through shared learning and practice[67].

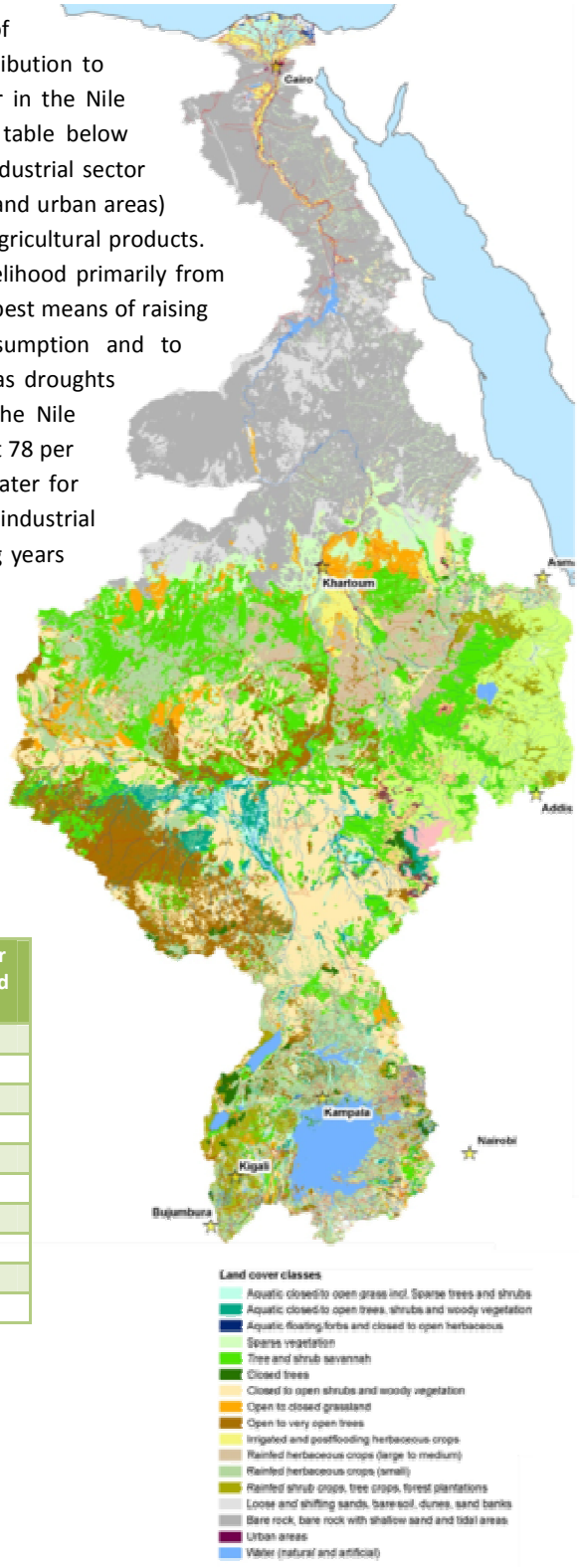
The costs of non-cooperation can be calculated as a loss of the above opportunities, but the potential risks stretch much further. If riparians don't cooperate to contribute to good watershed management, individual countries may attempt to maximise short term gains at the expense of downstream countries. The impacts would include increased sedimentation (with significant impacts on hydropower, dam storage capacity and other uses), reduced water quality (impacting on human health, crops, livestock and other users) and increased risks of floods. These risks can be calculated as a fractional cost of the value of the downstream activities, but expressing human health in financial terms is more difficult.

[64] ENTRO (2014) Management Challenges. entroportal.nilebasin.org/Pages/problems.aspx
[65] Bekele-Tesemma et al. (2009) The 3R Technologies at work: The Case of Rwanda", paper presented to World water Week, Stockholm.
[66] World Bank, 2009, Land Husbandry, Water Harvesting and Hillside Irrigation Project. Appraisal Document
[67] Personal communication

AGRICULTURE

IMPORTANCE OF AGRICULTURE

The agricultural sector, including livestock and fisheries, is of immense importance to all Nile Basin countries in terms of contribution to GDP and source of employment. The adjacent map of land cover in the Nile Basin indicates the extent of agriculture-related areas[68] and the table below provides the key statistics[45]. The agricultural sector sustains the industrial sector and contributes to the growth of non-farm activities (both in rural and urban areas) and to the strengthening of regional integration through trade in agricultural products. Over 60 per cent of the region's poor households derive their livelihood primarily from agriculture. Increasing agricultural productivity and trade offer the best means of raising income for these families to ensure adequate food for consumption and to accumulate the assets necessary to survive periodic shocks such as droughts and floods.[5] Agriculture is the single-largest water consumer in the Nile Basin, with the total withdrawal for irrigated agriculture being about 78 per cent of the peak flow at Aswan. Competition between users of water for agriculture and water for other uses, such as domestic supply, industrial processes and ecosystem needs, is expected to intensify in coming years as demand from the other sectors rises, while impacts from agriculture, such as surface and groundwater pollution, soil erosion and increased salinity can be expected to increase with the expansion and intensification of agriculture. Agriculture is thus expected to remain of critical importance to water resources managers due to the increased demand for freshwater resources while supplies are limited and due to water pollution.[5]



Country	Agriculture as % of GDP	Agriculture as % of labour	% of total water withdrawal used for Agriculture
Burundi	34%	94%	79%
DR Congo	44%	N/A	11%
Egypt	15%	29%	86%
Ethiopia	47%	85%	86%
Kenya	29%	75%	79%
Rwanda	32%	90%	55%
The Sudan	27%	80%	95%
South Sudan	N/A	N/A	N/A
Tanzania	28%	80%	89%
Uganda	23%	82%	43%

[68] NBI (2014) The Nile River Awareness Kit. http://nile.riverawarenesskit.org/English/NRAK/RS_L3/index.html

STATUS AND PRODUCTION OF AGRICULTURE

Rainfed agriculture in the Nile basin covers an area of 31.2 million ha, which is about 87 percent of the total cultivated land. These areas support the livelihood of large rural populations of the upper riparian communities through mixed smallholder systems, mixed highland smallholder systems, forest-based systems and mechanised systems. Irrigated land covers approximately 4.9 million ha (with an additional 0.7 million ha equipped for irrigation), which are either smallholder or commercial systems. 60% of the irrigated land is in Egypt and 36% in Sudan. The values of the 20 most important crops for each of the NBI countries are listed in the table on the following page[69]. While there are similarities in major crops, the table also highlights the differences due to climatic conditions and cultural preferences. Livestock production is through nomadic, semi-nomadic, lowland smallholders and shifting agro-pastoral systems, as indicated on the adjacent map[5] . There is about 150 million head of cattle in the Nile Basin, with Ethiopia accounting for one third, The Sudan holding 20%, 13% being in Tanzania and 12% in Kenya. Fisheries consist of aquaculture systems or capture fisheries. The trade in fisheries products (import and export) is provided in the table hereunder[70]. Burundi, DR Congo, Egypt, Ethiopia, Rwanda and Sudan (former) are net importers of fisheries products, whereas Kenya, Tanzania and Uganda are net exporters.

USD (2012)	Fisheries Imports	Fisheries Exports
Burundi	2 215 000	179 000
DR Congo	175 200 000	650 000
Egypt	782 003 000	18 298 000
Ethiopia	2 138 000	477 000
Kenya	12 296 000	62 870 000
Rwanda	8 312 000	150 000
Sudan	5 229 000	169 000
Tanzania	3 503 000	121 994 000
Uganda	3 291 000	64 074 000

[69] FAO (2014) Food and Agricultural commodities production. http://faostat.fao.org/site/339/default.aspx
[70] FAO (2014) 2012 Yearbook. Fishery and Aquaculture Statistics. http://www.fao.org/3/a-i3740t.pdf

USD (000s) (2012) [69]	Burundi	DR Congo	Egypt	Ethiopia	Kenya	Rwanda	Sudan (2010)	Tanzania	Uganda	Total
Milk, whole fresh cow	9 924		126 730		1 164 911	58 043	1 676 704	578 280	376 814	3 991 406
Meat indigenous, cattle	31 961		69 089		1 110 396	95 126	912 322	783 276	513 804	3 515 974
Cassava	130 015	1 654 694			93 298	283 765		570 624	514 434	3 246 830
Maize	18 965	155 439	24 974	780 290	483 817	80 101		667 938	343 687	2 555 211
Mangoes, mangosteens, guavas		194 729	61 415		1 666 706		374 240	200 721		2 497 811
Plantains		104 662				664 684		148 712	1 424 560	2 342 618
Beans, dry	109 509	69 882	61 609	267 419	361 192	251 660		685 240	223 960	2 030 471
Bananas	333 472	90 685	10 473		392 710		192 636	711 045	160 530	1 891 551
Tea	9 720			997 833	392 848	23 931	342 063		54 147	1 820 542
Milk, whole fresh goat	5 973			1 187 389	89 903		492 175			1 775 440
Sugar cane	7 235	61 663	185 760	889 257	191 198		220 927		82 093	1 638 133
Potatoes	5 484			134 966	472 655	372 311		126 424	119 902	1 231 742
Meat indigenous, sheep				241 331			937 736			1 179 067
Meat indigenous, pig	7 867		14 560	897 562					176 721	1 096 710
Sorghum	4 684		14 726	549 085		21 033	379 127	124 479		1 093 134
Groundnuts, with shell		148 187					336 334	348 380	121 691	954 592
Meat indigenous, goat	15 328	45 077		163 596	82 899	18 149	368 923		84 088	778 060
Vegetables, fresh nes	83 856	75 376			113 065			330 714	169 597	772 608
Sesame seed				121 805			157 724	306 472	125 631	711 632
Rice, paddy	17 579	91 958	7 782			23 163		481 694	56 512	678 688
Coffee, green	28 299		96 143	296 018		21 482			199 966	641 908
Wheat				523 958						523 958
Sweet potatoes	49 818					75 929		152 429	200 149	478 325
Meat, game		239 563		184 949		28 721				453 233
Meat indigenous, camel					135 176		272 411			407 587
Tomatoes					146 717	42 500	186 260			375 477
Sunflower seed								307 547	62 666	370 213
Broad beans, horse beans, dry				319 211						319 211
Milk, whole fresh camel					318 336					318 336
Avocados		48 507			129 093	100 479				278 079
Meat indigenous, chicken	5 365		180 790						86 892	273 047
Fruit, fresh nes	41 186					27 923	167 536			236 645
Onions, dry							234 397			234 397
Chillies and peppers		43 817		189 296						233 113
Dates							220 113			220 113
Pineapples		58 434			132 814	24 371				215 619
Barley				202 894						202 894
Milk, whole fresh sheep							194 960			194 960
Chick peas				191 381						191 381
Tobacco, unmanufactured								191 132		191 132
Okra							163 710			163 710
Cotton lint								141 491		141 491
Millet				133 122						133 122
Eggs, hen, in shell			51 667		79 691					131 358
Roots and tubers, nes		125 736								125 736
Nuts, nes				118 247						118 247
Cashew nuts, with shell								107 028		107 028
Pigeon peas								106 983		106 983
Wool, greasy							105 221			105 221
Cabbages and other brassicas					102 355					102 355

Opportunities for Growth

The full potential of agricultural trade depends on surplus production in one or more Nile Basin countries and conditions that support cross-border trade. According to the Comprehensive African Agricultural Development Program (2003 Maputo Declaration) investments to the agriculture sector should increase to 10 per cent of national budgets. The private sector has an important role to play in growing the agriculture sector and several foreign organisations have leased land to grow crops for biofuel, flex crops and commodities.

Although the expansion of agricultural land has been responsible for historical growth in the sector, the opportunities for further expansion are limited. Achieving greater yields from the same land will require good crop selection and improved growing conditions. One of the ways to improving growing conditions is to turn rainfed agriculture into irrigated fields. This approach will require significant investment in infrastructure and will be constrained by the availability of water, but greater efficiencies will be required to ensure economic growth and food security. Irrigation methods that deliver water more efficiently should be considered in place of flood or overhead irrigation systems. Rainwater harvesting is another relatively cheap but effective means of achieving higher yields without the capital burden of irrigation infrastructure. Other means of increasing

productivity include fertilization, crop and cultivar selection, sustainable land practices, collective bargaining, bringing the benefits of research and technology to the farmer, participatory approaches, capacity building and making market information accessible to farmers and traders.

VIRTUAL WATER TRADE

The above development options focus on the utilisation of resources in the Nile Basin to advance local, national and regional objectives. Changing rainfall patterns and growing conditions compounded by extreme rainfall variability and increased use of irrigated agriculture present food producing and trading countries with unique challenges. In addition to the direct impact on the food security of households, states or regions, food trade also has significant influence the water resources used for production of the food. An assessment of the impact of food trade on water resources is possible by the concept of 'virtual water which relates to the water used in the production of any commodity [71]. Food trade between states may be considered as a water pipeline with the adjacent figure indicating the virtual water flow through agricultural trade (livestock and crops) in the Nile Basin[72]. The specific flows are shown in the table hereunder, which also indicate the virtual water flows from the basin countries globally and virtual water flow globally to the basin countries. It is important to note that the Nile Basin countries are a net virtual water importer from global markets, with the net import volume of 27.43 billion m^3. These virtual water flows contribute substantially to the water security in the Nile Basin in general and of Egypt in particular.[72]

Imports by		Imports from										
		Egypt	Sudan	Ethiopia	Eritrea	Uganda	Kenya	Tanzania	Rwanda	Burundi	DRC	Global
	Egypt	0	110	2	0	0	258	19	0	0	0	32 206
	Sudan	4	0	0	0	78	100	1	0	1	1	3 658
	Ethiopia	0	0	0	0	0	1	0	0	0	0	1 061
	Eritrea	0	0	0	0	0	0	0	0	0	0	8
	Uganda	2	1	0	0	0	26	12	0	0	2	688
	Kenya	43	30	6	0	55	0	52	0	0	12	1 818
	Tanzania	3	0	1	0	15	15	0	0	0	0	1 828
	Rwanda	0	0	1	0	14	7	26	0	1	0	57
	Burundi	0	0	0	0	7	0	22	1	0	0	28
	DRC	0	0	0	0	0	0	0	0	0	0	0
	Global	1 062	3 155	1 081	34	2 503	2 914	1 888	301	318	667	

[71] Allan JA (1997) Virtual Water: A Long Term Solution for Water Short Middle Eastern Economies? SOAS Occasional Paper 3. King's College-London.
[72] Zeitoun M, Allan JA, Mohieldeen Y (2010) Virtual water 'flows' of the Nile Basin, 1998–2004: A first approximation and implications for water security. Global Environmental Change 20 (2010) 229–242

International trade is driven by supply and demand patterns and cost and price dynamics, whereas virtual water trade through agricultural products should also be governed by the most efficient use of water resources for agricultural production. Transboundary benefit sharing can be promoted by evaluating the best configuration of production in the basin and establishing trade relations that will promote food security at the household, national and regional scales.

BENEFITS OF COOPERATION

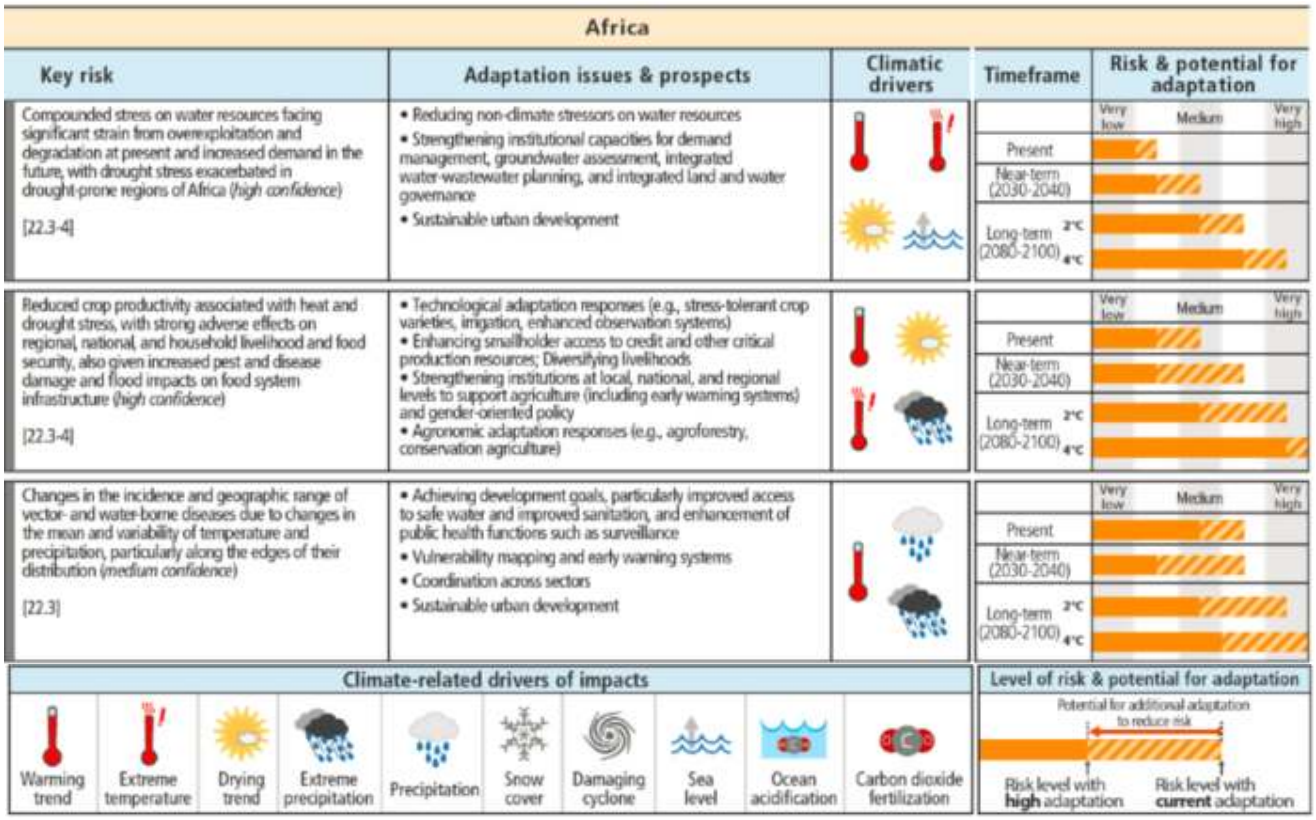
A regional approach to agricultural development will provide significant gains through a number of mechanisms. Since great improvements in productivity can be gained through turning from rainfed to irrigation agriculture, more precise joint planning of water resource availability and use will create opportunities for extending irrigation. When riparian share knowledge, technology and experience, farmers can make more informed choices of crops and practices, thereby also increasing yields. Rainwater harvesting in particular holds much promise in this regard. The above advances would be hard to achieve without significant investment from the respective governments with support from the private sector. Ultimately, if countries want to advance from subsistence agriculture to significant gains through regional and international trade in agricultural products, a supportive policy and trade environment must be created, with substantial support in marketing, logistics and finance. Although the virtual water traded in the Nile Basin show a net inflow of virtual water, the challenge will be to decrease the virtual water content of exported products by increasing the efficiency of farming techniques. The earlier table also shows the diversity of crops being produced by the NBI member states, which provides good opportunities to exploit trade between partners with complementary products. If through the above interventions, crop yields could be increased by a very conservative 1.5% and the price of agricultural products could be increased by 2.5% through improved regional trade, the result would be a 4% increase in economic value of agricultural product. If we accept that the multiplier value of labour, vendors, etc. are discounted in agriculture's share of National GDP, a 4% increase in the agriculture component of GDP for all the NBI member states (USD 244.53 billion) would bring about an **increase in benefits to the value of USD 9.78 billion.**

Fisheries production is an area that will specifically benefit from transboundary cooperation and increase the benefits to the respective riparian countries, particularly because the fish stocks are often a shared resource. With a combined import and export value for fisheries products for NBI member states standing at USD 1 200 million (2012)[70], an increase of just 2% would translate to an **increased import/export value of USD 24 million per annum.**

CLIMATE CHANGE

CLIMATE CHANGE IN THE NILE BASIN

The Nile Basin is highly vulnerable to the impacts of global warming. One of the compounding factors is that flows in the Nile are very sensitive to small changes in average rainfall. The basin communities also have limited ability to cope with the negative impacts of climate variability.[5] The Intergovernmental Panel on Climate Change (IPCC) describe the risks for Africa[73] under the main themes of water availability, food production and disease in the following summary.



Factors increasing the region's vulnerability and sensitive to impacts of global warming include[5]:

- The fact that two-fifths of the basin consists of arid and semi-arid drylands, which are fragile systems
- Poor and rural people in the upstream countries depend heavily on sectors such as agriculture, fishing, and forestry that are highly sensitive to climate variability
- Poor people have limited opportunities to diversify into less climate-sensitive sectors
- The growing population puts significant pressure on the natural resources
- Communities have a high exposure to natural disasters such as floods and droughts
- Many of the Nile sub-basins are highly sensitivity to changes in precipitation
- The strong agricultural sector in downstream countries is reliant on Nile-fed irrigation
- There is a high dependency on hydropower for energy across the basin

[73] IPCC (2014) Climate Change 2014: Impacts, Adaptation, and Vulnerability. Summary for Policymakers.

SHARING BENEFITS AND RISKS

Climate-change adaptation measures will be most effective when undertaken in coordination with other riparian countries. Joint measures can include collective adaptive capacity such as coordinated reservoir operation, promoting agricultural trade, interconnecting power and transport systems, joint mechanisms for mobilising resource for climate-change programmes and conducting joint research.[5] The Vulnerability Assessment Report on Adaptation to Climate-change Induced Water Stress in the Nile Basin[74] identified several climate change adaptation options for each country. Those that depend on, or will benefit from, transboundary cooperation are listed hereunder.

Burundi	• Manage of existing protected areas and expand protection to vulnerable ecosystems • Increase the number of hydropower micro stations • Popularize rainwater harvesting techniques for agricultural or domestic use • Install erosion control mechanisms in sensitive areas, including strategic buffer zones in Lake Tanganyika floodplain and around the lakes of Bugesera • Improve seasonal early-warning climate forecasts
DRC	• Improve the management of water resources and reservoirs • Increase the productivity of agricultural and pastoral systems • Improve communication networks for example through multimedia channels • Improve the management of forest resources, reduce erosion and land degradation • Increase the capacity of the meteorological service
Egypt	• Implement improved agricultural approaches (e.g. high yielding crops; skip irrigation at different growth stages; on-farm systems and fertilization; special adaptation fund for agriculture; scientific capacity; public awareness on climate; adaptive capacity of rural communities; simple and low-cost technologies) • Improve water resources management (e.g. public awareness; impact of climate change on local (Egypt) and regional (Nile) water resources; research capacity; exchange data and information between basin countries)
Eritrea	• Drought- and disease-resistant high-yield crops to maintain or improve crop production • Improve rangelands management through community based improvements • Encourage afforestation and agroforestry through community forestry initiatives • Enhance groundwater recharge for irrigation wells
Kenya	• Promote drought or crop insurance programs and strength drought and flood early warning systems • Develop small scale irrigation and water harvesting schemes in the dryland areas and improve rangeland resource management practices in the pastoral areas. • Implement community based sustainable wetlands use and management and implement a capacity building program for climate change adaptation. • Promote on-farm and homestead forestry and agro-forestry in the dryland areas.
Rwanda	• Reduce the vulnerability of regions affected by torrential rains, erosion and floods • Enhance hydro-meteorological information and early warning systems for prevention and management of climate-related hazards, including installation and rehabilitation of hydrological and meteorological stations • Reduce dependence on rain-fed agriculture by establishing round irrigation perimeters from water flows in vulnerable regions and implementing water storage and conservation measures. • Implement a National Woody Combustible Substitution Strategy to combat deforestation, reverse erosion and reduce pressures from fuelwood demand.
Sudan	• Enhance resilience to increasing rainfall variability through rangeland rehabilitation and water harvesting • Reduce the vulnerability of communities in drought-prone areas through improved water harvesting • Improve sustainable agricultural practices under increasing heat stress • Execute environmental conservation and biodiversity restoration as a coping mechanism for rangeland protection under conditions of increasing climate variability.
Tanzania	• Introduce alternative farming systems and improve the application of irrigation technologies to boost crop production in all areas • Introduce water harvesting for rural communities and launch community-based catchment management • Afforest degraded lands, using more adaptive and faster-growing tree species and develop community forest-fire prevention plans and programmes. • Establish and strengthen community health awareness and implement sustainable tourism activities
Uganda	• Promote on farm tree-growing, use trees to demarcate protected areas and the cultivation of medicinal and edible forest plants like bamboo, outside protected areas.

[74] ENEP (2013) Adaptation to Climate-change Induced Water Stress in the Nile Basin: A Vulnerability Assessment Report. Division of Early Warning and Assessment (DEWA). United Nations Environment Programme (UNEP). Nairobi, Kenya.

STRATEGIC ACTION

The NBI Climate Change Strategy[75] suggests that 5-10% of the continent's GDP may be required to cope with the impacts of climate change. Taking only 5% of the GDP of NBI countries, **the cost of adapting to climate change would be more that USD 5.039 billion** (based on a combined GDP for NBI countries of USD 1.039 trillion in 2013). According to the Strategy, the specific objectives for the NBI region are:

Objective 1: Strengthen the knowledge base to enhance common understanding of climate change risks and its impacts on water resources, ecosystems and the socio-economic system of the Nile Basin.

Objective 2: Strengthen long-term capacities for addressing climate risks and uncertainty in the Nile Basin at national and transboundary levels.

Objective 3: Support climate resilient planning and implementation addressing climate risks and uncertainty in NBI's programs.

Objective 4: Promote scalable low carbon development through enhanced transboundary cooperation in areas such as protection of wetlands as well as clean energy use and development.

Objective 5: Strengthen basin-wide climate finance access and the capacity for development of feasible projects in the Nile Basin.

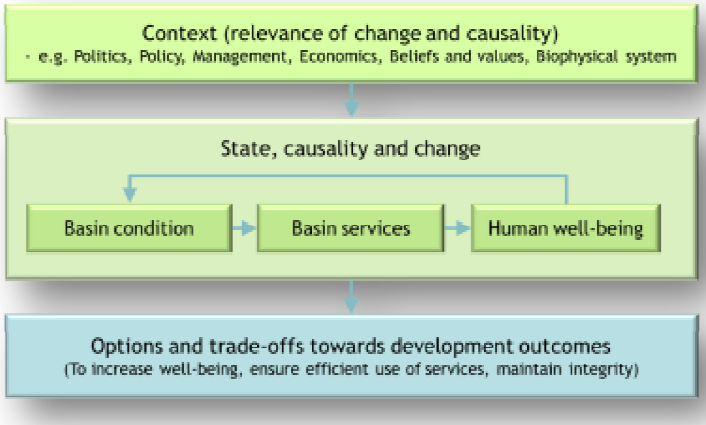
The impacts of a global warming trends are not yet clear at a regional and local level, but the basin countries can implement a number of 'no-regret' or proactive measures aimed at building resilience to current climate variability while enhancing adaptive capacity for future threats. A sensible approach for now would be to prepare for more variable conditions than currently recorded.[5]

[75] NBI (2013) Nile Basin Initiative Climate Change Strategy. June 2013

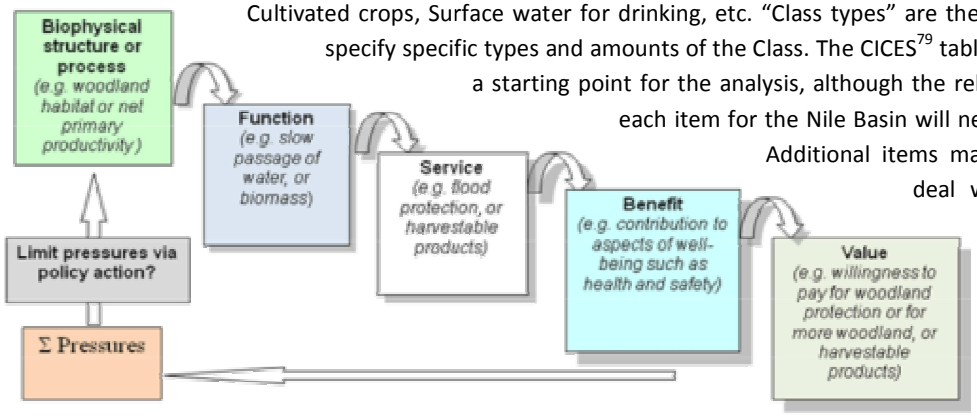
BENEFIT SHARING METHODOLOGY

ECOSYSTEM SERVICES AND HUMAN DEVELOPMENT

Human development towards freedom of want, freedom of fear and freedom to live in dignity[76] depends in the effective and responsible use of the earth's resources. The provision of goods and services by these resources depends on the biophysical template (including geology, soil, water and relief), chemical constituents (including oxygen, nutrients and minerals), energy (including light, heat, wind and currents), climatic conditions (including temperature, light and precipitation), and biotic component (ecosystem diversity, structure and function)[80]. The goods and services provided through the above elements in integrated ecosystems (and basins) result in an interdependent social-ecological. The Millennium Ecosystem Assessment[77] confirmed the linkages between ecosystem condition and human well-being, with the adapted framework[80] including context and trade-offs as part of the broader framework (adjacent figure).



The Ecosystem Services Cascade Model[78] below describes the continuum in the "State, causality and change" function above, but provides greater detail on the biophysical structures and processes, functions, service, benefits and value (to people). The Common International Classification of Ecosystem Services (CICES)[79] provides a robust typology for mapping the "services" and Benefits components of the continuum. The conceptual approach is outlined in the table on the next page[80]: The CICES (v4.3) hierarchical structure defines five levels for ecosystem services. The "Section" refers to Provisioning, Regulation and maintenance and Cultural services. The next level is the "Division", which refers to Nutrition, Energy, etc. "Groups" are found within Divisions and can be Biomass, Water, etc. Groups are further divided in "Classes", which can be Cultivated crops, Surface water for drinking, etc. "Class types" are the last level and these specify specific types and amounts of the Class. The CICES[79] table is provided here as a starting point for the analysis, although the relevant equivalent for each item for the Nile Basin will need to be developed. Additional items may also be added to deal with context-specific ecosystem services and socio-economic values.



[76] United Nations (2005) Report to the Secretary General. Integrated and coordinated implementation of and follow-up to the outcomes of the major United Nations conferences and summits in the economic, social and related fields. UN General Assembly A/59/2005

[77] Millennium Ecosystem Assessment (2005) Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC.

[78] Potschin MB, Haines-Young RH (2011) Ecosystem services: Exploring a geographical perspective. Progress in Physical Geography 35: 575-594,

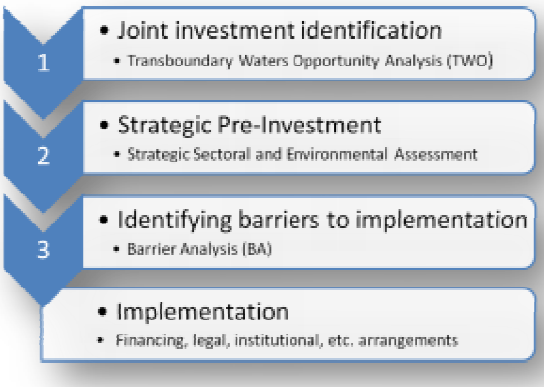
[79] Haines-Young, R. and Potschin, M. (2013): Common International Classification of Ecosystem Services (CICES): Consultation on Version 4, August-December 2012. EEA Framework Contract No EEA/IEA/09/003

[80] Claassen M, Nortje K (2014) In Betwixt and Between: Ecosystem Services and Human Benefits. Unpublished manuscript.

Section	Division	Group	Class	Class type
Provisioning	Nutrition	Biomass	Cultivated crops	*Crops by amount, type*
			Reared animals and their outputs	*Animals, products by amount, type*
			Wild plants, algae and their outputs	*Plants, algae by amount, type*
			Wild animals and their outputs	*Animals by amount, type*
			Plants and algae from in-situ aquaculture	*Plants, algae by amount, type*
			Animals from in-situ aquaculture	*Animals by amount, type*
		Water	Surface water for drinking	*By amount, type*
			Ground water for drinking	
	Materials	Biomass	Fibres and other materials from plants, algae and animals for direct use or processing	*Material by amount, type, use, media (land, soil, freshwater, marine)*
			Materials from plants, algae and animals for agricultural use	
			Genetic materials from all biota	
		Water	Surface water for non-drinking purposes	*By amount, type and use*
			Ground water for non-drinking purposes	
	Energy	Biomass-based energy sources	Plant-based resources	*By amount, type, source*
			Animal-based resources	
		Mechanical energy	Animal-based energy	*By amount, type, source*
Section	**Division**	**Group**	**Class**	**Class type**
Regulation & Maintenance	Mediation of waste, toxics and other nuisances	Mediation by biota	Bio-remediation by micro-organisms, algae, plants, and animals	*By amount, type, use, media (land, soil, freshwater, marine)*
			Filtration/sequestration/storage/accumulation by micro-organisms, algae, plants, and animals	*By amount, type, use, media (land, soil, freshwater, marine)*
		Mediation by ecosystems	Filtration/sequestration/storage/accumulation by ecosystems	*By amount, type, use, media (land, soil, freshwater, marine)*
			Dilution by atmosphere, freshwater and marine ecosystems	
			Mediation of smell/noise/visual impacts	
	Mediation of flows	Mass flows	Mass stabilisation and control of erosion rates	*By reduction in risk, area protected*
			Buffering and attenuation of mass flows	
		Liquid flows	Hydrological cycle and water flow maintenance	*By depth/volumes*
			Flood protection	*By reduction in risk, area protected*
		Gaseous / air flows	Storm protection	*By reduction in risk, area protected*
			Ventilation and transpiration	*By change in temperature/humidity*
	Maintenance of physical, chemical, biological conditions	Lifecycle maintenance, habitat and gene pool protection	Pollination and seed dispersal	*By amount and source*
			Maintaining nursery populations and habitats	*By amount and source*
		Pest and disease control	Pest control	*By reduction in incidence, risk, area protected*
			Disease control	
		Soil formation and composition	Weathering processes	*By amount/concentration and source*
			Decomposition and fixing processes	
		Water conditions	Chemical condition of freshwaters	*By amount/concentration and source*
			Chemical condition of salt waters	
		Atmospheric composition and climate regulation	Global climate regulation by reduction of greenhouse gas concentrations	*By amount, concentration or climatic parameter*
			Micro and regional climate regulation	
Section	**Division**	**Group**	**Class**	**Class type**
Cultural	Physical and intellectual interactions	Physical and experiential interactions	Experiential use of plants, animals and land-/seascapes in different environmental settings	*By visits/use data, plants, animals, ecosystem type*
			Physical use of land-/seascapes in different environmental settings	
		Intellectual and representative interactions	Scientific	*By use/citation, plants, animals, ecosystem type*
			Educational	
			Heritage, cultural	
			Entertainment	
			Aesthetic	
	Spiritual, symbolic and other interactions	Spiritual and/or emblematic	Symbolic	*By use, plants, animals, ecosystem type*
			Sacred and/or religious	
		Other cultural outputs	Existence	*By plants, animals, feature/ecosystem type or component*
			Bequest	

Mapping Benefit Streams

The scalable approach towards realizing tangible benefits in transboundary river basins [81] (adjacent figure) lists the identification of joint investments through the transboundary waters opportunity (TWO) analysis as the first phase in a stepwise approach to realize tangible benefits from cooperation. This is followed by a strategic pre-investment phase to evaluate the opportunities through strategic sectoral environmental assessment and a third phase to identify barriers to implementation.



The conceptual framework for the TWO analysis presented here has been developed to be a flexible tool to support decision-making at the level of basin States, within Regional Economic Communities, and for potential investors engaged in the identification and implementation of development opportunities**Error! ookmark not defined.**. The TWO analysis supports the identification of development opportunities by mapping different sources of water to different development options (uses of water). The diagramme provides an example of the matrix used for the analysis. The construction of the matrix and evaluation of development scenarios (baskets of benefits) are typically done in a consultative environment, where is serves to facilitate discussion on options and trade-offs.

Categories: Sources / Factors: Development	a) New Water	b) Efficient use of water	c) Other sources in basins that are not closed
1. Hydropower and power trading	Location of reservoirs in high altitudes to minimise evaporative losses	Siting of multipurpose dams for e.g. hydropower and irrigation in optimal locations	Additional electricity generation through hydropower schemes and power pooling
2. Primary production	Re-use of treated wastewater for irrigation Interbasin water transfer schemes	Green Water use to increase agricultural outputs Increase efficiency in irrigation	Investment in bio-energy crops Introducing aquaculture
3. Urban growth and industrial development	Strengthen institutional management for water allocation to more high value use	Maximising economic returns per unit of water in industry	Recharge of groundwater
4. Environment and ecosystem services	Use of "green credit schemes" through e.g. water purification in wetlands	Optimising economic returns from developing fisheries and tourism sector	Allocate water to restore ecosystems
5. Others (every basin is unique and other opportunities may exist)	Desalinate water for high value use	Drought-proofing through improved land management	Flood protection

Quantification of Benefits

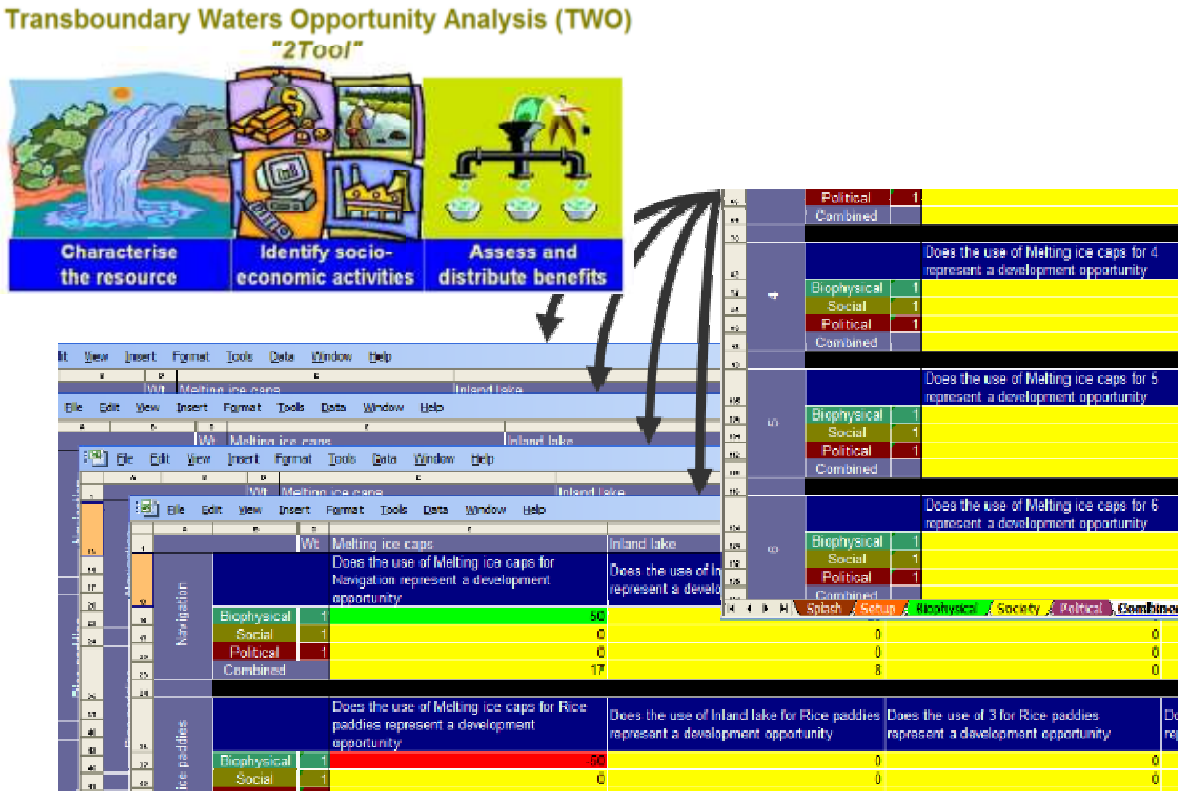
A variety of approaches are available for the quantification of benefits to evaluate and compare options. When services are directly tradable in normal markets, the price is the exchange value of the product or commodity. In such cases, the market value can be used to compare options. In cases where the value that people derive from the basin is not directly traded (or tradable), the "social value" approach can be used, which determines people's willingness to pay for the particular service. There are also a number of non-market valuation techniques to serve as proxy for economic value. Avoided costs can be calculated by determining the costs or damage that is avoided through the provision of the services. An example of this approach is the determination of the value of flood control interventions. The replacement cost of a service can also be used for proxy, in other words, if the service is not provided, what would be the cost of replacing the service. The factor Income can also be determined, which is the multiplier value of the services (e.g. the enhancement of other sources of incomes). People's willingness to travel to benefit from the service and the associated

[81] Granit J and Claassen M (2012) A Scalable Approach Towards Realizing Tangible Benefits in Transboundary River Basins and Regions. pp 140-154. In: de Chazournes LB, Leb C, Tignin M. International Law and Freshwater: The Multiple Challenges. Edward Elgar Publishing. pp 496.

expenditure also gives an idea of the value of the service. Travel cost is typically used in the tourism domain. Hedonic pricing is the premium that a property carries because of its access to a particular service, such as a view or access to resources. Lastly, one can use the value of alternatives to the service provide, which is known as contingent valuation.

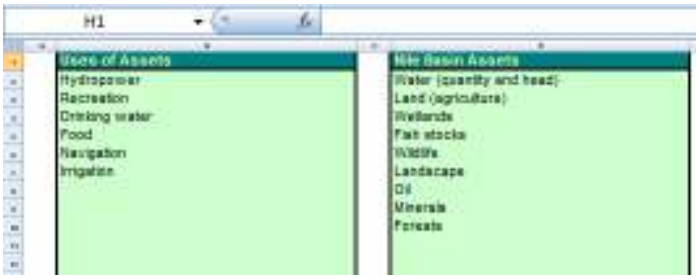
COMPARING OPPORTUNITIES

Drawing on experience from a number of river basins, Qaddumi discussed several practical mechanisms to foster movement towards cooperation. These include quantifying the benefits and costs of optimal water management, addressing equity concerns, and recognising the link between volumetric water allocations and benefit sharing. The analysis suggest that process-oriented approach is the most feasible, that dividing the river basin into subunits is useful in arriving at initial agreement, and that the role of third parties has been instrumental in promoting sharing arrangements.[82] The services arranged in accordance with a typology in the previous section should be developed such that there is a net gain in benefits (positive sum outcome) and that the benefits are distributed equitably. The approach for transboundary benefit sharing is thus based on the characterisation of services that are provided in the basin and the development of portfolios of benefits (development scenarios). The 2Tool[83] (figure hereunder) compares socio-economic, environmental and political benefits and also allows for basin and sub-basin analysis. The framework will be used to organise available information in accordance with the type of the service (not just water) and the benefits that can be derived from it (not just economic). The analysis allows for the construction of different development scenarios and pathways and also provides a platform to simulate different development options. This approach is particularly useful in multi-party discussions and negotiations.

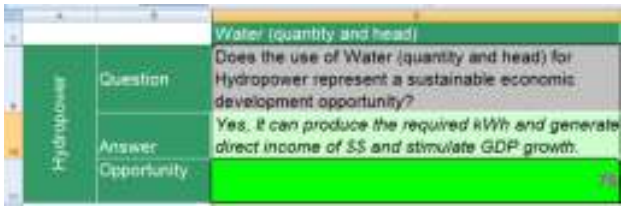


[82] Qaddumi H (2008) Practical approaches to transboundary water benefit sharing. ODI Working Paper 292
[83] Claassen M (2009) 2Tool version 1.03. www.waternet.co.za/SADCRBO/docs/2Tool103.xls

In a practical sense, the 2Tool allows for the identification of assets (Basin services) and potential uses of the assets (Benefits), with the adjacent figure providing an example. Although the example is at a high (aggregate) level, which is typical for basin-wide screening analysis, each option can also be unpacked for detailed, site-specific analysis, such as different types of wetlands and different types of irrigation on specific crops.



Each combination of a service and a potential use is then evaluated according to the economic, social and political costs and benefits, so that different portfolios of development options can be compared. An example of the economics matrix blocks for the combination of Water (flow and head) and Hydropower is shown in the adjacent figure.

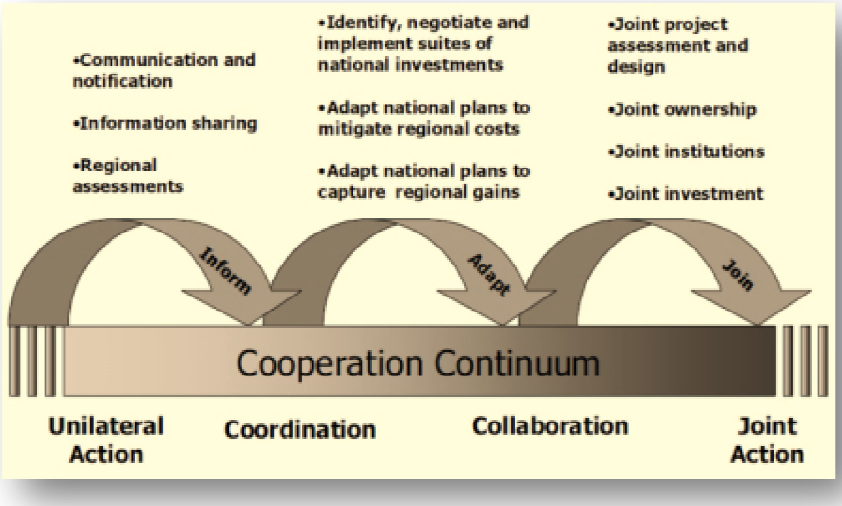


Ultimately, a combined matrix with all the potential assets and potential socio-economic activities is compiled to easily compare and screen development options and decide on the preferred portfolio of options (example in the adjacent figure). The colour-coding (green being preferred, yellow being neutral and red being negative) assists with the comparison, especially if the matrix becomes complex with many assets and activities and where nested matrices are developed for sub-basins or to expend on the detail of specific options.

The quantification of benefits is however not a simplistic calculation, since most development options also depend on other resources and inputs. For instance, a hydropower facility depends mainly on the water flow and infrastructure, whereas a trade in agricultural products depends on agricultural production, packaging material, skills, infrastructure, transport systems, etc. The value should therefore often be expressed as an opportunity cost, i.e. "*If the (transboundary water-related) service was not available, what is value of the development opportunity that will be foregone*?" At the same time, the expression of benefits should not only be mapped against the water-related services that is required, but also other inputs such as finance, infrastructure, technical capability, enabling policies, social acceptance, political support, etc.

TAKING ACTION

Different types of cooperation are possible[23] and it should be noted that not all cooperation should necessarily be at the level of joint action. The shift from unilateral action to coordination occurs when there is communication and notification regarding a specific development option or a suite of options. Such communication would be associated with information sharing and could be in the context of regional assessments. Collaboration is achieved when the suite of national investment options are identified, negotiated and implemented through constant liaison with the other basin country(ies). Such engagement would lead to changes in national planning to take regional costs and benefits into account. Where joint action is appropriate, it is achieved through joint project assessment and design (often through pooling resources), which would lead to joint ownership, joint institutions and joint investment.



Riparian countries should therefore follow structured approaches to evaluating, assessing and agreeing on the costs and benefits of opportunities and programs. Where joint action is appropriate, riparian countries should have access to the same information to evaluate benefits and trade-offs of cooperation. This allows for informed decision-making and timely agreement on next steps towards development. Data and information sharing also promote transparency and trust, which is important in the transboundary context and can build a shared vision. The engagement process is iterative and will be repeated in different forms as cooperation evolves and new information or issues emerge. The approach should be scaled at the appropriate level for the issue at hand. Basin-wide strategic issues should include all relevant countries and focus on decadal time scales. The high-level agreements will typically contain less detail about specific options. Development options within the broader agreed framework can then be discussed with the relevant parties. The engagement should include sufficient detail to decide on the best development configurations and provide a sound motivation for investment decisions. The iterative approach also facilitates an adaptive management approach, where decisions need to be made under conditions of uncertainty, but where future decisions can be improved by learning through feedback loops.[81]

Specific steps that the NBI can take to promote benefit sharing are:

- Communicate the quantified benefits of cooperation (initial numbers) to member states to increase buy-in for the benefit sharing approach.
- Refine and publish the tools and approaches to implement benefit sharing in the Nile Basin context in a popular publication that is clear and accessible to member countries and stakeholders.
- Identify and quantify benefits beyond those provided in this Guidance Note to aid in prioritisation and decision-making.
- Develop institutional and legal frameworks and instruments to implement benefit sharing for specific applications.

ABBREVIATIONS

ASBP	Aral Sea Basin Program
BCM	Billion cubic metres
CBT	Columbia Basin Trust
BC	British Columbia
CFA	Cooperative Framework Agreement
CFAF	Central African Franc
CICES	Common International Classification of Ecosystem Services
CPA	Comprehensive Peace Agreement
CPC	Columbia Power Corporation
DRPC	Danube River Protection Protocol Convention
ET	Evapotranspiration
ENTRO	Eastern Nile Technical Regional Office
FCFA	CFA franc
GDP	Gross Domestic Product
GNI	Gross National Income
GWh	Gigawatt hour
ICPDR	International Commission for the Protection of the Danube River
ICT	Information Communication Technology
IWRM	Integrated Water Resource Management
km	kilometre
KWh	Kilowatt hour
MDG	Millennium Development Goals
MW	Megawatt
NBA	Niger Basin Authority
NBI	Nile Basin Initiative
NELSAP	Nile Equatorial Lakes Strategic Action Programme
Nile-COM	Nile Council of Ministers
Nile-TAC	Nile Technical Advisory Committee
OMVS	Organisation pour la Mise en Valeur du fleuve Senegal
ORASECOM	Orange Senqu River Commission
PRSP	Poverty Reduction Strategy Paper
RSAT	Rapid Sustainability Assessment Tool
SADC	Southern African Development Community
SSDP	South Sudan Development Plan
SMEs	Small and Medium Enterprises
TRWR	Total Renewable Water Resources
TWO	Transboundary Waters Opportunity (analysis)
USA	United States of America
USD	United States Dollar