NILE BASIN INITIATIVE


BURUNDI


DRC


EGYPT

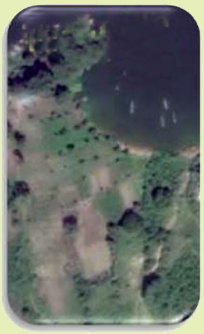

ETHIOPIA


KENYA


RWANDA


S. SUDAN


SUDAN


TANZANIA


UGANDA

QUANTIFYING THE BENEFITS OF TRANSBOUNDARY WATER COOPERATION IN THE NILE BASIN TO SUPPORT NATIONAL AND REGIONAL DEVELOPMENTS

Nile Basin Initiative

April 2016

PREFACE

Quantifying the Benefits of Transboundary Water Cooperation in the Nile Basin to Support National and Regional Developments

Trans-boundary water resources provide drinking and domestic water, support irrigation in agriculture, electricity generation, enable industries to function and conserve ecosystems. Today these trans-boundary water resources are under pressure from growing populations, demand for more development for economic growth and poverty eradication and impacts of climate change, making cooperation over their management and development vital. Nevertheless, many obstacles can prevent countries from strengthening or embracing effective joint management of trans-boundary waters, or can delay this process. These include differing levels of socioeconomic development and institutional capacity, diverging priorities and conflicting policies, but also an incomplete or subjective perception of the benefits that could be achieved by cooperating with Other Basin States.

The Nile Basin Initiative (NBI) promotes cooperation on trans-boundary water resources hence countries are invited to engage into discussions on the benefits and beneficiaries of such cooperation. Considering the need for an accessible guidance booklet, the NBI Secretariat (Nile SEC) has developed such guidance booklet, to support countries in the assessment and communication of the benefits of trans-boundary water cooperation.

The guidance booklet on quantifying the benefits of trans-boundary water cooperation in the Nile Basin offers practical and accessible step by step advice to policy makers and other actors, to enable them undertake benefits assessments for their countries or region through a participatory approach. It highlights the wide range of economic, social, environmental, and governance benefits that effective cooperation can generate and provides direction for the assessment of such opportunities. Building on inputs from case studies and experts from around the world, the guidance note is a relevant tool to promote and enhance trans-boundary cooperation through benefit assessments and the integration of their results into policy processes.

We believe that a benefit assessment can bring new ideas, fact-based arguments and incentives to cooperate, even when cooperation is already in place, needs and priorities can shift over time. The assessment of existing or potential benefits as a regular feature of cooperation can confirm the necessity for countries to cooperate and to help ensure political and civic support. The joint undertaking of a benefit assessment is a way to build and maintain a relationship of mutual trust and support.

I invite you to use the guidance booklet to explore the broad range of benefits of cooperation over trans-boundary water in the Nile Basin.

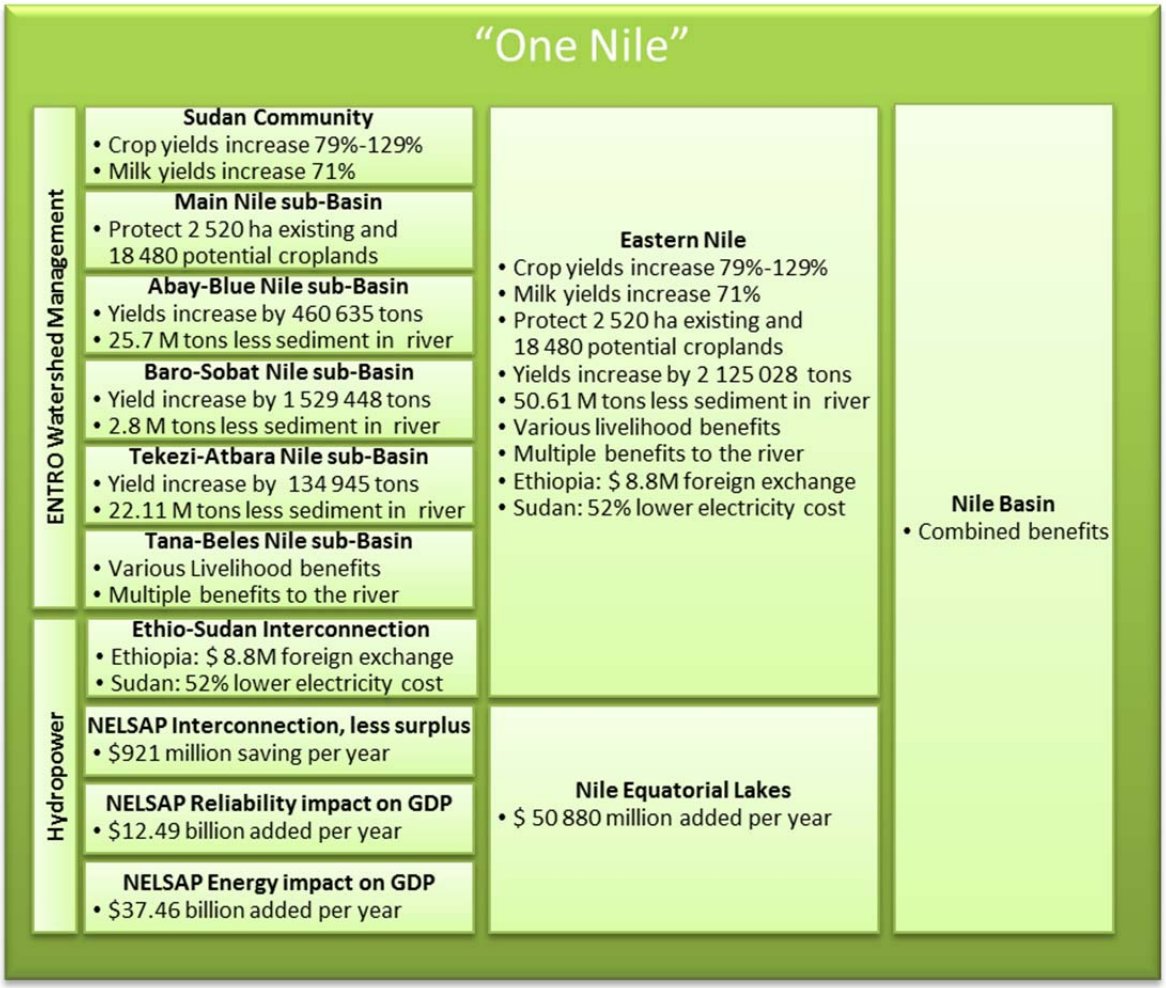
John Rao Nyaoro, HSC, (PhD)
Executive Director
NBI Secretariat

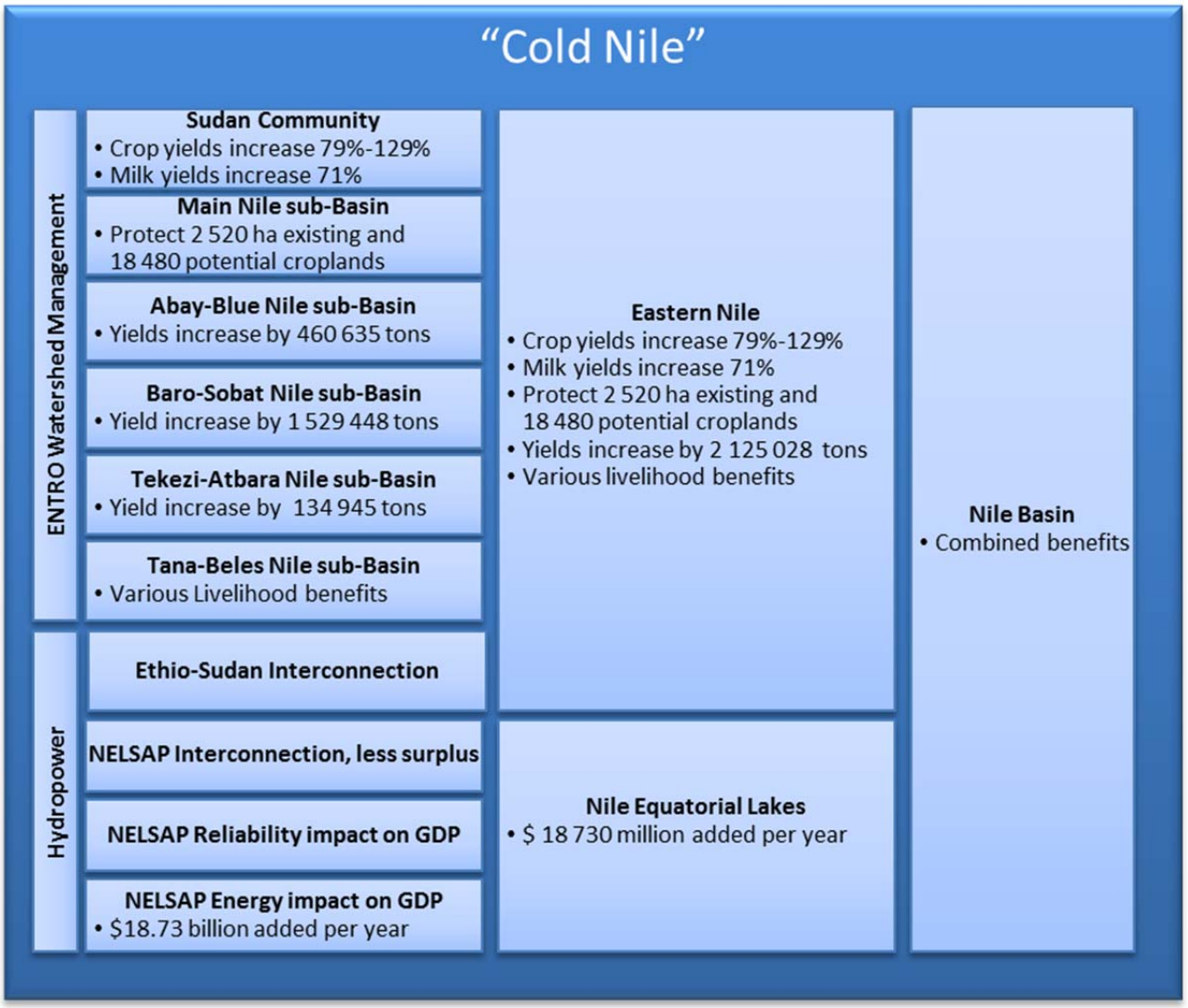
COMMUNICATION BROCHURE

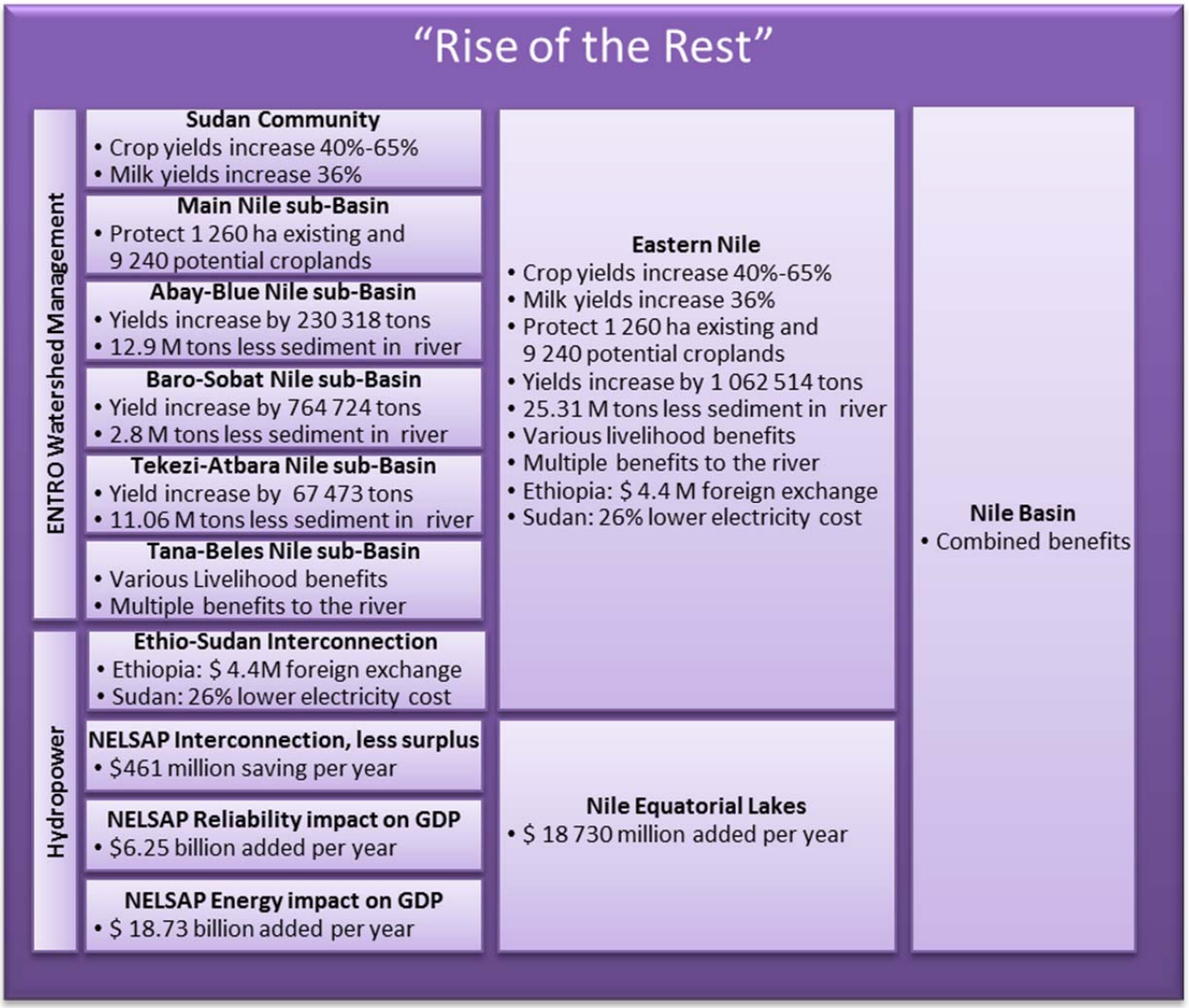
Quantifying the Benefits of Transboundary Water Cooperation in the Nile Basin to Support National and Regional Developments

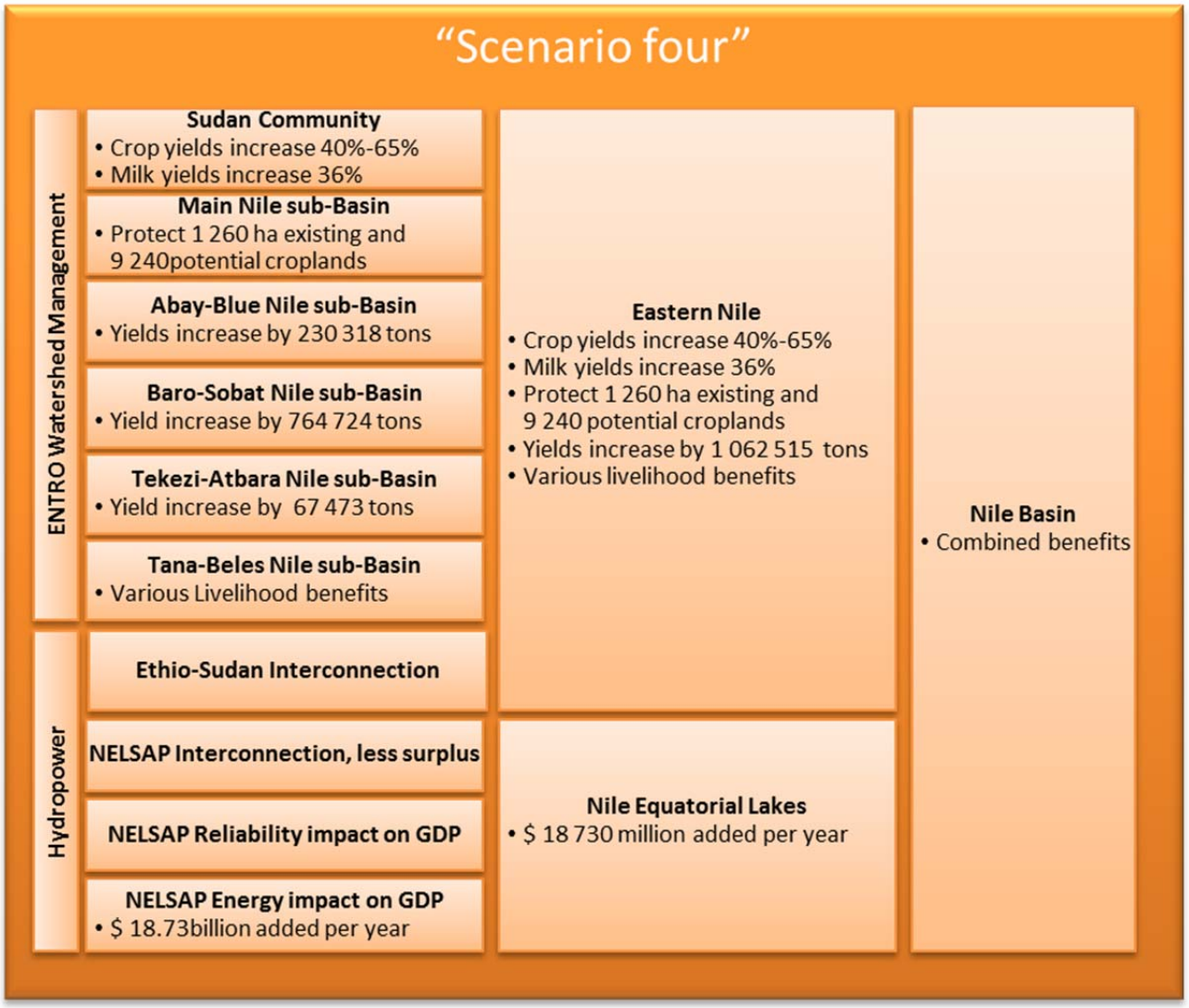
The Nile River is one of the least developed rivers in the world and holds tremendous opportunities for growth. The Nile Basin Initiative (NBI) is a regional partnership for promoting growth and addressing the critical challenges faced by the Nile Basin. It is built around a shared belief that countries can achieve better outcomes for all the people of the Nile Basin through cooperation rather than competition. The regionally agreed strategic programs have contributed to building significant trust and cooperation across the region. This brochure provides an assessment framework, case study examples and scenarios to inform dialogue, decision making, policy and practice. The specific case studies are watershed management in the Eastern Nile and hydropower in the Nile Equatorial Lakes, with reference to the Ethiopia-Sudan power interconnection.

The case studies serve to establish a conceptual approach to consider the benefits and costs of cooperation versus costs of non-cooperation. The benefits are thus described in terms of the four development scenarios for the Nile. The "One Nile" scenario reflects financial sustainability and regional economic integration and goodwill. In this scenario, the benefits of transboundary cooperation are maximised. The "Cold Nile" remains financially sustainable, but with a national focus and no goodwill. In this case benefits are limited to local developments. The "Rise of the Rest" scenario reflects limited funding with regional economic integration and goodwill, which translates to some of the regional benefits being realised. Under "Scenario Four", funding and regional integration is limited, which allows for some local development.



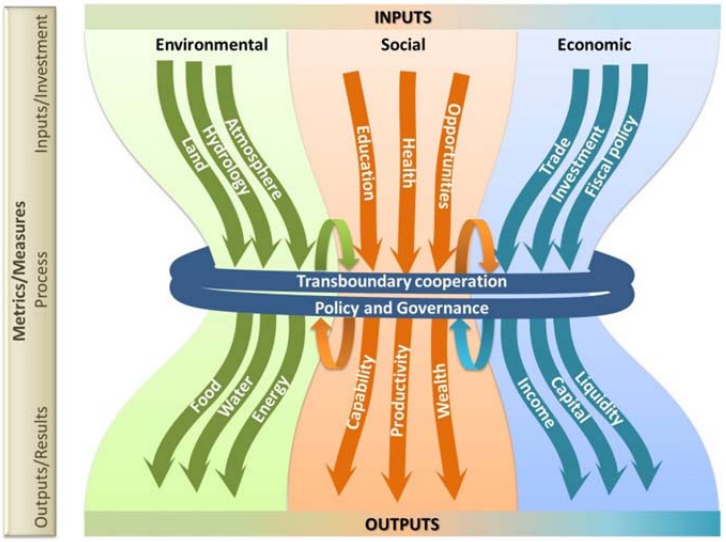

"Cold Nile"
ENTRO Watershed Management
Sudan Community
• Crop yields increase 79%-129%
• Milk yields increase 71%
Main Nile sub-Basin
• Protect 2 520 ha existing and 18 480 potential croplands
Abay-Blue Nile sub-Basin
• Yields increase by 460 635 tons
Baro-Sobat Nile sub-Basin
• Yield increase by 1 529 448 tons
Tekezi-Atbara Nile sub-Basin
• Yield increase by 134 945 tons
Tana-Beles Nile sub-Basin
• Various Livelihood benefits
Hydropower
Ethio-Sudan Interconnection
NELSAP Interconnection, less surplus
NELSAP Reliability impact on GDP
NELSAP Energy impact on GDP
• $18.73 billion added per year
Eastern Nile
• Crop yields increase 79%-129%
• Milk yields increase 71%
• Protect 2 520 ha existing and 18 480 potential croplands
• Yields increase by 2 125 028 tons
• Various livelihood benefits
Nile Equatorial Lakes
• $ 18 730 million added per year
Nile Basin
• Combined benefits


"Rise of the Rest"
ENTRO Watershed Management
Sudan Community
• Crop yields increase 40%-65%
• Milk yields increase 36%
Main Nile sub-Basin
• Protect 1 260 ha existing and 9 240 potential croplands
Abay-Blue Nile sub-Basin
• Yields increase by 230 318 tons
• 12.9 M tons less sediment in river
Baro-Sobat Nile sub-Basin
• Yield increase by 764 724 tons
• 2.8 M tons less sediment in river
Tekezi-Atbara Nile sub-Basin
• Yield increase by 67 473 tons
• 11.06 M tons less sediment in river
Tana-Beles Nile sub-Basin
• Various Livelihood benefits
• Multiple benefits to the river
Hydropower
Ethio-Sudan Interconnection
• Ethiopia: $ 4.4M foreign exchange
• Sudan: 26% lower electricity cost
NELSAP Interconnection, less surplus
• $461 million saving per year
NELSAP Reliability impact on GDP
• $6.25 billion added per year
NELSAP Energy impact on GDP
• $ 18.73 billion added per year
Eastern Nile
• Crop yields increase 40%-65%
• Milk yields increase 36%
• Protect 1 260 ha existing and 9 240 potential croplands
• Yields increase by 1 062 514 tons
• 25.31 M tons less sediment in river
• Various livelihood benefits
• Multiple benefits to the river
• Ethiopia: $ 4.4 M foreign exchange
• Sudan: 26% lower electricity cost
Nile Equatorial Lakes
• $ 18 730 million added per year
Nile Basin
• Combined benefits


"Scenario four"
ENTRO Watershed Management
Sudan Community
• Crop yields increase 40%-65%
• Milk yields increase 36%
Main Nile sub-Basin
• Protect 1 260 ha existing and 9 240potential croplands
Abay-Blue Nile sub-Basin
• Yields increase by 230 318 tons
Baro-Sobat Nile sub-Basin
• Yield increase by 764 724 tons
Tekezi-Atbara Nile sub-Basin
• Yield increase by 67 473 tons
Tana-Beles Nile sub-Basin
• Various Livelihood benefits
Eastern Nile
• Crop yields increase 40%-65%
• Milk yields increase 36%
• Protect 1 260 ha existing and 9 240 potential croplands
• Yields increase by 1 062 515 tons
• Various livelihood benefits
Nile Basin
• Combined benefits
Hydropower
Ethio-Sudan Interconnection
NELSAP Interconnection, less surplus
NELSAP Reliability impact on GDP
NELSAP Energy impact on GDP
• $ 18.73billion added per year
Nile Equatorial Lakes
• $ 18 730 million added per year

Framework for Assessing the Benefits of Transboundary Cooperation

The framework is organised along the three main pillars of the United Nations 2030 Agenda for Sustainable Development, being Social, Economic and Environmental. It brings these aspects together through a Transboundary Cooperation process, where Policy and Governance are key determinants. The benefits of transboundary cooperation are assessed through a causal approach. Environmental drivers and benefits often support social and economic outcomes, with dependencies between social and economic processes. On the left hand side of the figure, the need for metrics or measures are indicated. These should relate to the inputs, the process and the results. Although quantification of metrics is often preferred, this is not necessarily always in monetary terms. The human development index (and imbedded metrics) is a useful framework for the social aspects, whereas the sustainability goals provide useful metrics for the environmental pillar.



The four key steps for the way forward are to:

1 Agree on a systematic approach

Detailed tools, models and frameworks can provide information to feed into the approach. It is also important to consider the spatial and temporal scales of the analysis and in particular the linkages between scales. The above framework shows the relationship between social, economic and environmental inputs and outputs, and the role of transboundary cooperation to facilitate the beneficiation.

2 Identify and populate critical knowledge gaps

The suggested approach requires sufficient knowledge of the context, the conversion of basin resources into socio-economic value and considerations for options and trade-offs. Although it is not necessary to have complete knowledge to make good decisions, the missing knowledge that could pose a risk to good decisions and effective implementation should be populated. Examples of such knowledge gaps are the extent of indirect benefits, unintended consequences and unexpected barriers to implementation. It is of utmost importance to ensure that information is up to date. For example, many of the recent analyses on benefits of cooperation are based on data that is very old. Advances in technological efficiencies, changes in economic drivers and assumptions and changes in societal development aspirations can cause significant differences in cost-benefit ratios.

3 Prioritise and promote development opportunities

A clear articulation of the preferred development opportunities is needed to create a common platform decision-making. Such prioritisation should include a technical evaluation of which developments will yield the greatest benefits for the least cost and risk. The prioritisation should however also include an evaluation of political and policy alignment, attractiveness to financiers, societal perceptions and preferences, and other factors that may support or hamper implementation. Development opportunities should then be actively promoted through popular publications, printed and broadcast media, information brochures, sit visits and briefings.

4 Implement opportunities in a deeply integrated way

Whereas the benefits of transboundary cooperation are vested in the cumulative regional synergies and opportunities, deep integration between sectors will also yield significantly bigger results than each on their own. For instance, irrigation options should be co-developed and jointly implemented to align with access to capital and insurance, regional trade agreements, capacity building programmes, gender equality policies and initiatives, climate change mitigation and adaptation strategies and macro-economic policies. This deep integration is the premise of the "Nexus" approach, but much of the discussions and texts on this is superficial and fail to uncover the causal relationships between sectors.

Nile Basin Initiative Secretariat (Nile-Sec)
Entebbe, Uganda
Contact: nbisec@nilebasin.org
June 2016

CONTENTS

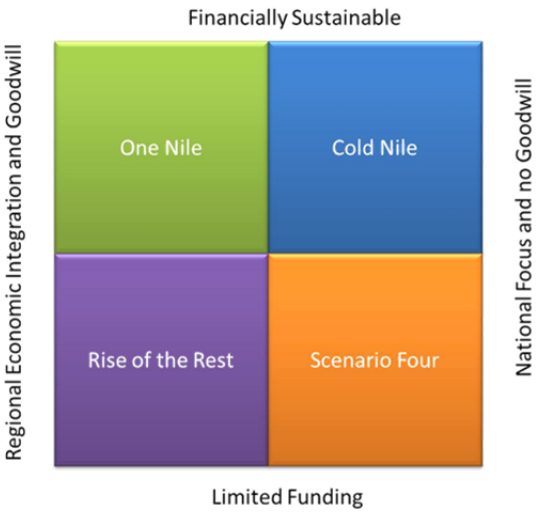
SUMMARY

The Nile River is 6 695 km in length and covers an area of 3.18 million km^2. It is one of the least developed rivers in the world and holds tremendous opportunities for growth. The Nile Basin Initiative (NBI) is a regional partnership for promoting growth and addressing the critical challenges faced by the Nile Basin. It is built around a shared belief that countries can achieve better outcomes for all the people of the Nile Basin through cooperation rather than competition. The regionally agreed strategic programs have contributed to building significant trust and cooperation across the region. The report addresses the need for a common understanding and methodology to consider the benefit of transboundary cooperation in the Nile Basin. It provides a framework, case study examples and scenarios to inform dialogue, decision making, policy and practice. The two case studies serve to establish a conceptual approach for a flexible and adaptable methodology to scope potential scenarios and benefit sharing portfolios and consider the benefits and costs of cooperation versus costs of non–cooperation. The specific case studies are watershed management in the Eastern Nile and hydropower in the Nile Equatorial Lakes, with reference to the Ethiopia-Sudan power interconnection.

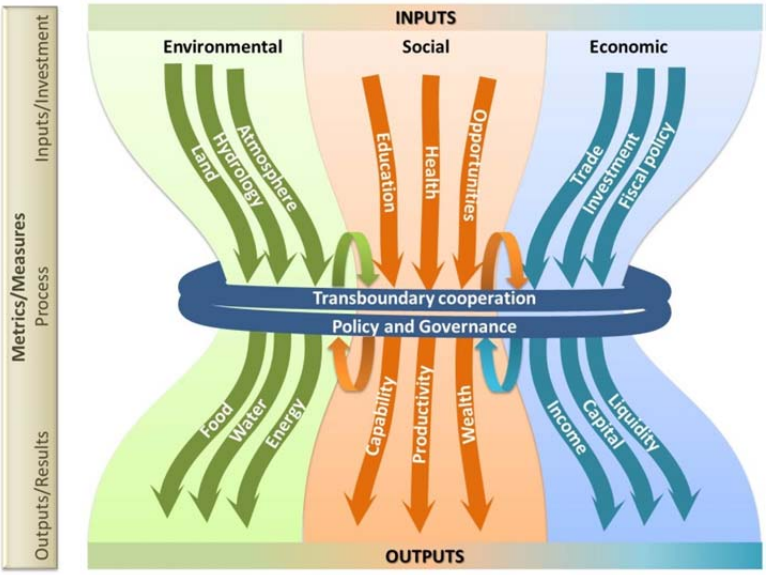
The Community Watershed Management Project in Sudan resulted in yield increases of an average of 131% for sorghum; 79% for sesame; 126% for white beans; and 71% in cow milk. In the Main Nile sub-Basin the reported benefits of watershed management include improvements in : water quality and river flow characteristics; agricultural output; hydropower development; flood/drought management; navigation; environmental conservation; reduced costs on military expenditure; economic integration; and regional infrastructure. Erosion control in the Abay-Blue Nile sub-Basin was associated with crop yield increases of between 7% and 14%, sediment reduction of 60% (from 42.8 million to 17.0 million tons) in the Abbay river system and an increase in crop production of 47 345 tons/annum. Annual benefits from reclaimed kerib land could yield 17 020 tons of wood and 34 030 tons of forage and an additional production of 413 290 tons of sorghum. Benefits from watershed management in the Baro-Sobat sub-Basin include an annual increase in grain production of 1 223 862 tons and a reduction in the suspended sediment load of the Baro and Akobo Rivers from 9.48 million tons to about 6.6 million tons per annum. Watershed management in the Tekeze-Atbara sub-Basin can reduce sediment to the Tekeze river system by 22.11 million tons and increase annual grain production by 49 845 tons. Reclamation of kerib land in the Tekeze-Atbara sub-Basin can yield nearly 10 000 tons of wood, 20 000 tons of forage an additional production of 85 100 tons of sorghum annually. The benefits from the Tana-Beles Integrated Watershed Management Project include diversification of income sources (such a bee hives), alternative energy sources, training, veterinary services, job creation, irrigation infrastructure and water supply. Benefits to the river include soil conservation, reversing land degradation and the planting of 46 million seedlings.

Hydropower production in the Nile Equatorial Lakes region is associated with benefits such as reliable water supplies, reduced floods, reduced sedimentation, reduced greenhouse gas emissions reduces the reliance on energy imports and high capacity transmission lines, and recreational opportunities. With 20% of the hydropower potential in the Nile Basin having being installed, a modest growth in electricity supply of 6% per annum will add $37.46 billion in member countries' annual GDP (based on 2014 values). Regional connections will reduce the need for national surplus which translates to a saving of $921 million in production costs. The benefit of an increase in the quality of electricity supply will be $12.49 billion per annum.

The benefits of transboundary benefits are related to different development scenarios. In the One Nile scenarios, all the identified benefits can be realised. In the Cold Nile scenario, there is limit transboundary cooperation, therefore only national benefits will accrue. In the Rise of the Rest scenario, there is limited finance available, which means that only 50% of the calculated benefits can be realised. In Scenario Four, there is no regional economic integration and limited funding, which will translate to only 50% of local benefits being possible.



Approaches to identifying and assessing benefits of transboundary cooperation include the *Beyond the River* approach, the *Benefits continuum* approach, the *TWO analysis*, the *Scalable approach*, and the *Ecosystem Services* approach. These approaches can provide inputs to the proposed framework for assessing the benefits of transboundary cooperation. The framework is organised along Social, Economic and Environmental pillars. The framework brings these aspects together through a Transboundary Cooperation process with Policy and Governance being key mechanisms. The framework is applied through a systematic approach of spatial aggregation and disaggregation, which means that the environmental, social and economic resources and potential are aggregated at a regional level to assess the most productive development and deployment options. The development options can then be disaggregated to assess the best distribution of costs and benefits at the sub-basin and country level.



The development of high-confidence data on the benefits of transboundary cooperation should be driven by a strategic framework. The question to ask is "*What information will make the biggest difference in supporting high-confidence planning and decision-making?*". The answer to this should guide the commitment of resources to establish a comprehensive framework, populated with relevant data that can serve as an authoritative source on the benefits of transboundary cooperation to promote regional development.

The four key steps for the way forward are to:

Agree on a systematic approach

Detailed tools, models and frameworks can provide information to feed into the approach. It is also important to consider the spatial and temporal scales of the analysis and in particular the linkages between scales. Figure 26 provides an approach to dealing with different spatial scales. The framework to consider the relationship between social, economic and environmental inputs and outputs, and the role of transboundary cooperation to facilitate the beneficiation is presented in Figure 27.

Identify and populate critical knowledge gaps

The suggested approach requires sufficient knowledge of the context, the conversion of basin resources into socio-economic value and considerations for options and trade-offs. Although it is not necessary to have complete knowledge to make good decisions, the missing knowledge that could pose a risk to good decisions and effective implementation should be populated. Examples of such knowledge gaps are the extent of indirect benefits, unintended consequences and unexpected barriers to implementation. It is of utmost importance to ensure that information is up to date. For example, many of the recent analyses on benefits of cooperation are based on data that is very old. Advances in technological efficiencies, changes in economic drivers and assumptions and changes in societal development aspirations can cause significant differences in cost-benefit ratios.

Prioritise and promote development opportunities

A clear articulation of the preferred development opportunities is needed to create a common platform decision-making. Such prioritisation should include a technical evaluation of which developments will yield the greatest benefits for the least cost and risk. The prioritisation should however also include an evaluation of political and policy alignment, attractiveness to financiers, societal perceptions and preferences, and other factors that may support or hamper implementation. Development opportunities should then be actively promoted through popular publications, printed and broadcast media, information brochures, sit visits and briefings.

Implement opportunities in a deeply integrated way

Whereas the benefits of transboundary cooperation are vested in the cumulative regional synergies and opportunities, deep integration between sectors will also yield significantly bigger results than each on their own. For instance, irrigation options should be co-developed and jointly implemented to align with access to capital and insurance, regional trade agreements, capacity building programmes, gender equality policies and initiatives, climate change mitigation and adaptation strategies and macro-economic policies. This deep integration is the premise of the "Nexus" approach, but much of the discussions and texts on this is superficial and fail to uncover the causal relationships between sectors.

1. INTRODUCTION

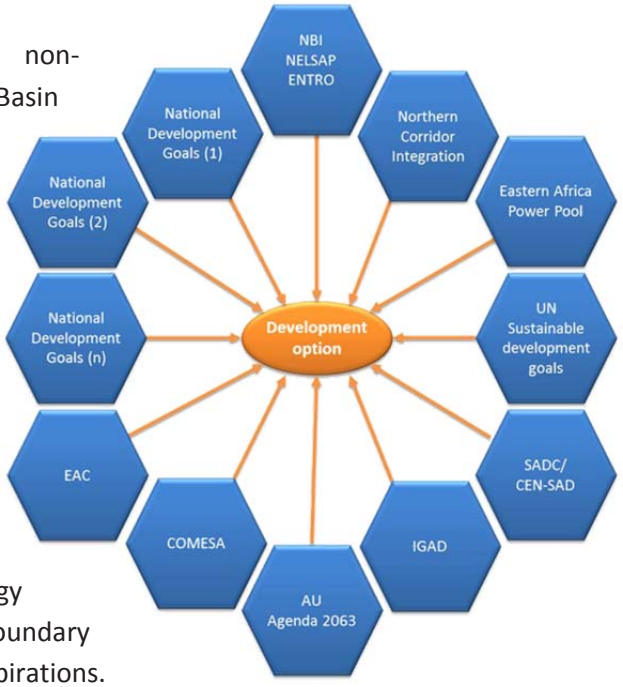
1.1. PURPOSE

The overall objective of the report is to create and enhance a common understanding and methodology for the Basin States to consider the benefit of transboundary cooperation in the Nile Basin. The report provides a framework, case study examples and scenarios to inform dialogue, decision making, and policy and practice changes within the NBI and the Member States. Within the framework of the case studies in the Nile Sub-basins, the specific objectives are to:

- Establish a conceptual approach for a flexible and adaptable methodology, to scope potential scenarios and recommend quantified benefit sharing portfolios for further consideration through existing planning and approval mechanisms.; and
- Quantify the benefits and costs of cooperation versus costs of non–cooperation under the sub-basin case studies for countries to maximize optimal benefits. The specific case studies are watershed management in the Eastern Nile (ENTRO) and hydropower in the NELSAP region. Reference is also be made to the Ethiopia-Sudan power interconnection.

1.2. AUDIENCE

The report is directly aimed at government, non-government and private sector entities in the Nile Basin countries to foster cooperation and increase benefits of transboundary cooperation. Practitioners and international partners will also benefit from the report, in particular the methodology. The adjacent diagram points to some of the policies and institutions that should be considered when considering development options in the Basin. The report will therefore be of interest to individuals and organisations that contribute to discussion, analysis, planning and actions that relate to development in the Nile Basin, but the methodology will also be relevant in other regions where transboundary cooperation is necessary to achieve development aspirations.



1.3. OBJECTIVES

The scope of work includes all reviews, consultations and analyses required for quantifying the benefits of cooperation and the costs of non-cooperation in the two sub-basin case studies. It also includes communicating the results. The consultant will build on existing studies in this field, as well as on the direct experiences of Nile Basin countries and other river basins. Furthermore, the consultant will review available documents and consult NBI staff to document the key features of

Nile Basin water resources management and development and to broadly map country concerns and interests.

1.4. METHODOLOGY

The approach includes:

- Engaging with NBI, NELSAP-CU, ENTRO and other groups to discuss details on the way forward.
- A review of all existing information for the two case studies to achieve more precise quantification.
- Drawing available information into an assessment framework to quantify the benefits for two case studies.
- The identification of key gaps and uncertainties in the quantification of costs and benefits for the case studies.
- Collecting data to fill critical gaps in the quantification process, including a view on data exchange protocol.
- An updated assessment framework at a high level of confidence for the case studies.
- The development of options and scenarios at a high level of confidence for the two case studies.
- Drawing examples from the case studies to suggest an approach and way forward for transboundary water cooperation, including a monitoring and evaluation system.

1.5. DATA SOURCES

Data was collected through various approaches, including literature, online platforms and in-person interviews. All data are stored in electronic formats that are accessible through Microsoft Office (2010) and Adobe Reader software. The data make reference to sources, are stored in multiple locations and are made available with the final report.

1.6. DATA ANALYSIS

The study will be drawing on experience from a number of river basins to identify practical mechanisms to foster 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 services will be arranged in accordance with the typologies developed during previous analyses[1] and will be developed in such a way that they identify options where there are a net gain in benefits (positive sum outcome) and refer to the equitable distribution of benefits. 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[2], which compares socio-economic, environmental and political benefits and allows for basin and sub-basin analysis, will be used to compare different development scenarios. The framework will be used to organise the 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 will allow for the construction of different development scenarios and pathways and also provide a

[1] NBI (2014) Quantifying the Benefits of Transboundary Water Cooperation in the Nile Basin. Nile-SEC, Entebbe.
[2] Claassen M (2009) 2Tool version 1.03. www.waternet.co.za/SADCRBO/docs/2Tool103.xls.

platform to simulate different development options. This approach will be particularly useful in multi-party discussions and negotiations.

The quantification of benefits is, however, not a simplistic calculation because 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 food processing plant depends on agricultural crops, packaging material, skills, infrastructure, transport systems, etc. The value should therefore often be expressed as an opportunity cost, for example "*If the (transboundary water-related) service was not available, what is the 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 are required, but also other inputs (i.e. finance, infrastructure, technical capability, enabling policies, social acceptance, political support, etc.).

2. Benefits of Cooperation

2.1. The Nile Basin Initiative

The Nile Basin Initiative (NBI) is a regional partnership for promoting growth and addressing the critical challenges faced by the Nile River Basin (hereafter referred to as the Nile basin). The countries of the Nile Basin, namely Burundi, the Democratic Republic of the Congo (DRC), Egypt, Eritrea, Ethiopia, Kenya, Rwanda, South Sudan, The Sudan, Tanzania and Uganda jointly established the NBI in 1999 to harness the potential gains of cooperative management and development of the Nile Basin. The partnership continues to be led by the riparian states of the Nile. It is built around a shared belief that countries can achieve better outcomes for all the people of the Nile Basin through cooperation rather than competition. At the heart of this initiative lies the imperative to eradicate poverty. The NBI was conceived as a transitional institution, with the Cooperative Framework Agreement (CFA) negotiations envisaged to lead to the establishment of a permanent river basin commission.

The NBI provides the only regional forum that brings together all Nile Basin riparian countries. It has provided the platform for dialogue among the riparian population (political, technical and civil) for implementation of good practices in transboundary water resources management and development. The NBI is one institution with three centres responsible for day-to-day management. The Nile Basin Initiative Secretariat (Nile-SEC) located in Entebbe, Uganda is the executive arm of the NBI responsible for the overall corporate direction as delegated by the Council of Ministers (Nile-COM). The Nile Equatorial Lakes Subsidiary Action Program Coordination Unit (NELSAP-CU) based in Kigali (Rwanda) is the executive arm of the Nile Equatorial Lakes Subsidiary Action Program (NELSAP). The Eastern Nile Technical Regional Office (ENTRO) based in Addis Ababa (Ethiopia) is the executive arm of the Eastern Nile Subsidiary Action Program (ENSAP). In each country, the National NBI Office headed by the respective Nile Technical Advisory Committee (Nile-TAC) member serves as the focal point for all NBI-related activities.

The NBI facilitated the development and adoption of basin-wide transboundary policies and strategies. The Nile Basin Sustainability Framework (NBSF) consists of a suite of policies, strategies,

shared framework, agreed principles, priority outcomes and unified approaches to support the sustainable development and management of the common Nile resources. The Environment and Social Policy ensures that NBI-supported water resources investment should not happen at the cost of people (e.g. forced displacement without livelihood guarantee and compensation) and the environment (e.g. wanton and avoidable destruction of critical habitats, wildlife refuges, ecosystem and environmental services - grazing, fishing). The implementation of the Environment and Social Policy is supported by the NBI's Stakeholder Involvement and Communication Strategy and Gender Mainstreaming Strategy, which spell out specific modalities to enhance public disclosure of information on NBI projects and activities and access to foster transparency and accountability. The Climate Change Strategy and Wetland Management Strategy stipulate that adaptation to the threat of climate change impact is urgent, thus giving rise to Climate-proofing of NBI investments. The strengthening of a trans-boundary perspective in national water policies is addressed through an Approach Paper that defines the NBI-specific approach to promoting trans-boundary cooperation in the Nile basin by supporting the development of adequate national water policies. The NBI is undertaking a study on "Preparation of NBI Guidance Document on Environmental Flows" to determine science-based procedure for establishing environmental flows requirements. Commensurate with its transitional nature and taking into account that the CFA is not yet fully ratified, NBI has adopted an interim data and information sharing procedure to facilitate preparation of NBI projects. There is also ongoing effort to develop standardized project information disclosure. The degree of internalization and mainstreaming of the above policies at national level is not yet uniform, which reflects the variation in the robustness of national water resource management institutions. At a trans-boundary level, these policies and strategies have proven indispensable in informing and guiding how NBI does its water resources management and investment planning and implementation. [3]

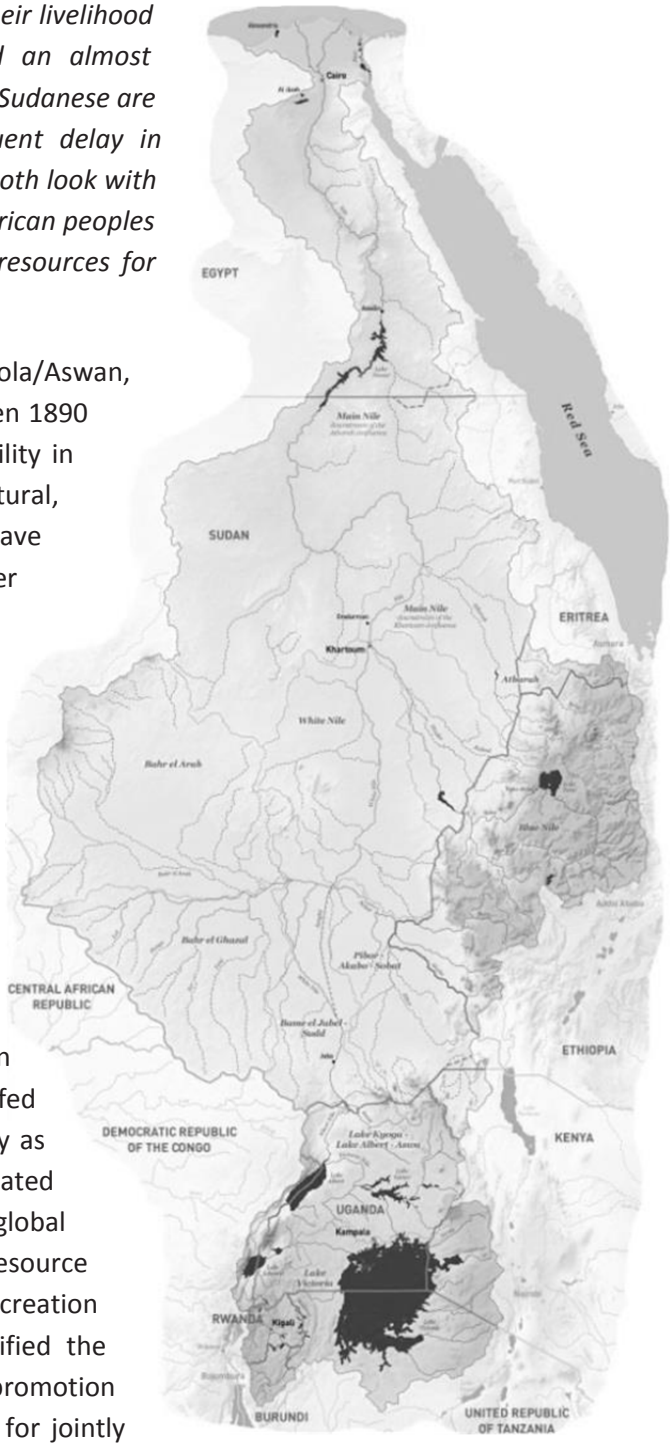
2.2. THE NILE BASIN

The Nile River is 6 695 km in length and covers an area of 3.18 million km^2. The average rainfall is 615mm/annum [4] and ranges from over 2 000 mm in the Ethiopian Highlands to less than 300 mm in the lower reaches [5]. The historic value of the Nile River is captured in a "Hymn to the Nile" on the Papyrus Sallier 2, dated 1 200 BC - 1 194 BC [6], which includes:

"Hail to thee, O Nile, that issues from the earth
and comes to keep Egypt alive! …
He that waters the meadows which He created …"
and
"O, Nile, verdant art thou, who makes man and cattle to live."

[3] NBI (2016) From Shared Vision to Shared Benefits Nile Cooperation - Transforming Lives.
[4] FAO (1997) Irrigation potential in Africa: A basin approach. FAO Land and Water Bulletin 4. FAO Land and Water Development Division. ISBN 92-5-103966-6.
[5] NBI (2012) State of the River Nile Basin 2012. http://nileis.nilebasin.org/content/state-river-nile-basin-report. Last accessed 30 September 2015.
[6] British Museum (2015) Collection online: Papyrus Sallier 2. http://www.britishmuseum.org/research/collection_online/ Last accessed 7 October 2015.

The need to share the rich bounty of the Nile, and the complexities associated with it, was already reported in 1960, with the statement that "*Egyptians, aware that the source of their livelihood is now within the control of others, have evinced an almost neuropathic attitude towards the Nile waters problem. Sudanese are perplexed by the misunderstanding of and consequent delay in executing new schemes to strengthen their economy. Both look with anxiety to the southern watersheds where emerging African peoples are confidently expecting schemes to harness water resources for power production and perhaps also for irrigation.*"[7]



The highest flow in the Nile River is recorded at Dongola/Aswan, where annual flows varied from 45 to 125 km^3 between 1890 and 1994[8]. This is a result of the high climatic variability in the basin. 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 as a result of population growth and economic development[4].

According to the NBI [9], the Nile River is one of the least developed rivers in the world and holds tremendous opportunities for growth. There is significant potential for cooperative management and development of the common water resources with direct and indirect win-win benefits to all riparian countries. The NBI identified the areas with significant potential for development, namely clean energy development (hydropower); trade in electricity, improving and expanding irrigated and rain-fed agricultural production; increasing water use efficiency as well as preservation and use for eco-tourism of designated biospheres which are significant to sustaining global biological diversity. The Nile River also provides a key resource for drinking water, fisheries production, navigation, recreation and ecosystem maintenance. The NBI further identified the potential for broader economic-regional integration, promotion of regional peace and security and most importantly for jointly ensuring the continued existence of the Nile River for posterity through prudent and judicious utilisation[9].

[7] Lebon JHG (1960) On the Human Geography of the Nile Basin. Geography, Vol. 45(1-2): 16-26.
[8] Sutcliffe JV & Parks YP (1999) The Hydrology of the Nile. IAHS Special Publication no. 5.
[9] NBI (2015) Understanding the Nile Basin. http://www.nilebasin.org/index.php/about-us/the-river-nile.

2.3. KEY FEATURES OF THE NILE BASIN WATER RESOURCES

The water resources in the Nile Basin are affected by inverse gradients of rainfall and evapotranspiration, as indicated in Figure 1[4]. The natural water balance for each of the sub-basins shows that evaporation is generally high in areas of low rainfall, whereas high rainfall areas are associated with areas of low evapotranspiration. The flows in the Nile Basin are driven by seasonal patterns, with the sub-basins of the Eastern Nile and Main Nile receiving peak rainfall from June to October and the rain in northern Uganda and South Sudan being fairly evenly distributed, with a single peak from April to October. The Nile Equatorial Lakes (NEL) plateau experiences a twin-peaked distribution with a peak from March to May and a peak from September to November [4]. Groundwater resources that occur in localized and regional basins are an important resource for supporting social and economic development generally and food security in particular. The extent of groundwater utilization varies from country to country, with groundwater often being the most important source of drinking water for rural communities. The water quality in the Nile Basin varies greatly. While the upper reaches in the NEL region generally carry heavy sediment loads (up to 1 500 mg/l), bacteriological contamination is pervasive throughout the basin (with values above 50 cfu/100ml). The salinity in the upper reaches of the NEL region is generally low (10-100 mg/l) with levels increasing to above 400 mg/l in the Nile Delta [4].

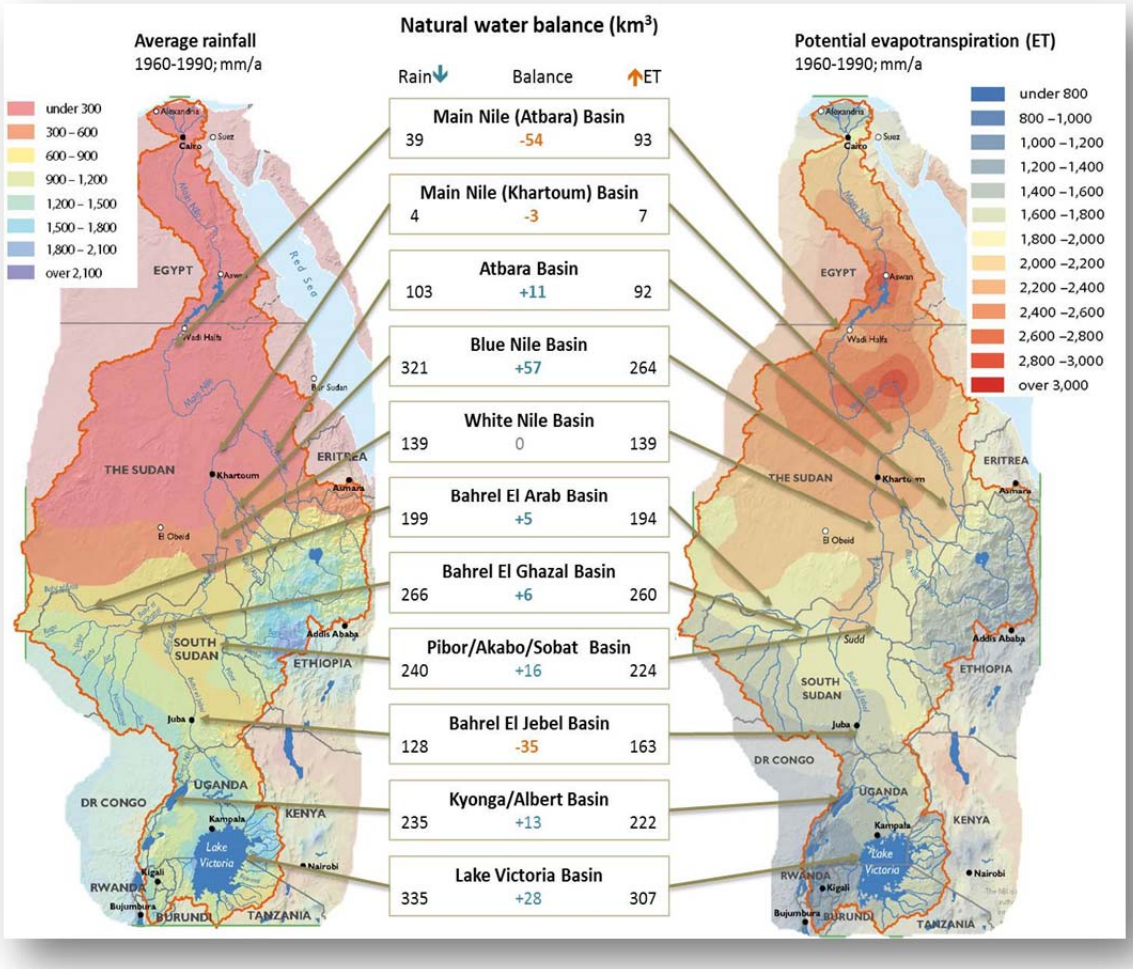


Figure 1: The average rainfall, natural water balance and potential evapotranspiration for the 11 countries that share the Nile Basin.

2.4. International and African Development Perspective

The United Nations adopted the 2030 Agenda for Sustainable Development on 21 October 2015[10]. The resolution, which came into effect on 1 January 2016, sets out to balance the three dimensions of sustainable development, which are social, economic and environmental. The specific goals agreed to for each of the dimensions are listed hereunder.

These goals and the associated actions provide good pointers to assess the impacts of transboundary cooperation. At a continental level, the African Union Commission set out the African aspirations for 2063 in "Agenda 2063: The Africa we want"[11]. The vision and associated processes are aimed at encouraging discussion among all stakeholders, with "Agenda 2063" being an approach to how the continent should effectively learn from the lessons of the past, build on the progress now underway and strategically exploit all possible opportunities available in the short, medium and long term, so as to ensure positive socioeconomic transformation within the next 50 years. The implementation plan builds on the Agenda 2063 Framework Document adopted in January 2015, and seeks to accelerate Africa's political, social, economic and technological transformation while continuing the Pan African drive for self-determination, freedom, progress and collective prosperity.[12] The Agenda 2063 aspirations, goals and priority areas have been linked to the Sustainable Development Goals[13]. The relationships are listed in Table 1.

Social		Economic		Environmental	
1 NO POVERTY	End poverty in all its forms everywhere	7 AFFORDABLE AND CLEAN ENERGY	Ensure access to affordable, reliable, sustainable and modern energy for all	13 CLIMATE ACTION	Take urgent action to combat climate change and its impacts
2 ZERO HUNGER	End hunger, achieve food security and improved nutrition and promote sustainable agriculture	8 DECENT WORK AND ECONOMIC GROWTH	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	14 LIFE BELOW WATER	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
3 GOOD HEALTH AND WELL-BEING	Ensure healthy lives and promote well-being for all at all ages	9 INDUSTRY, INNOVATION AND INFRASTRUCTURE	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	15 LIFE ON LAND	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation and halt biodiversity loss
4 QUALITY EDUCATION	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	10 REDUCED INEQUALITIES	Reduce inequality within and among countries	16 PEACE, JUSTICE AND STRONG INSTITUTIONS	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
5 GENDER EQUALITY	Achieve gender equality and empower all women and girls	11 SUSTAINABLE CITIES AND COMMUNITIES	Make cities and human settlements inclusive, safe, resilient and sustainable	17 PARTNERSHIPS FOR THE GOALS	Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development
6 CLEAN WATER AND SANITATION	Ensure availability and sustainable management of water and sanitation for all	12 RESPONSIBLE CONSUMPTION AND PRODUCTION	Ensure sustainable consumption and production patterns		

[10] UN (2015) Resolution adopted by the General Assembly on 25 September 2015. Transforming our world: the 2030 Agenda for Sustainable Development. A/RES/70/1

[11] African Union Commission (2015) Agenda 2063: The Africa We Want. ISBN: 978-92-95104-23-5

[12] African Union (2015) Agenda 2063: The Africa We Want. First ten year Implementation Plan 2014-2023

[13] African Union (2016) Agenda 2063 Linkages with the Sustainable Development Goals.

Table 1: Agenda 2063 Aspirations and Goals and the UN Sustainable Development Goals.

Agenda 2063 Aspirations	Agenda 2063 Goals	UN SD Goals
A prosperous Africa, based on inclusive growth and sustainable development	A high standard of living, quality of life and wellbeing for all citizens	1, 2, 8, 11
	Well educated citizens and skills revolution underpinned by science, technology and innovation	4
	Healthy and well-nourished citizens	3
	Transformed economies	8, 9
	Modern agriculture for increased productivity and production	2
	Blue/ocean economy for accelerated economic growth	14
	Environmentally sustainable and climate resilient economies and communities	6, 7, 13, 15
An integrated continent, politically united, based on the ideals of Pan Africanism and the vision of Africa's Renaissance	A United Africa (Federal or Confederate)	
	Continental financial and monetary institutions established and functional	
	World class infrastructure criss-crosses Africa	9
An Africa of good governance, democracy, respect for human rights, justice and the rule of law	Democratic values, practices, universal principles of human rights, justice and rule of law entrenched	16
	Capable institutions and transformative leadership in place	16
A peaceful and secure Africa	Peace, security and stability is preserved	16
	A stable and peaceful Africa	
	A fully functional and operational APSA	
Africa with a strong cultural identity, common heritage, values and ethics	African cultural renaissance is pre-eminent	
An Africa whose development is people-driven, relying on the potential offered by African people, especially its women and youth, and caring for children	Full gender equality in all spheres of life	5
	Engaged and empowered youth and children	4, 5
An Africa as a strong, united, resilient and influential global player and partner	Africa as a major partner in global affairs and peaceful co-existence	17
	Africa takes full responsibility for financing her development	10. 17

2.5. National Priorities and Opportunities

The environmental, social, economic and political contexts for the countries that share the Nile Basin highlight the acute need for development, but also point to the large disparities between the countries. The key challenges and priorities of the NBI member countries are summarised hereunder.

Burundi

Estimated at 4.7% in 2014, GDP growth should rise to 5% in 2016, thanks to the implementation of infrastructure projects in the energy and mining sectors.

Institutional weakness in tax administration still hampers the deployment of internal resources, despite significant structural reforms undertaken by the government.

There has been substantial progress in the elimination of regional disparities, but spatial inclusion remains a major issue for the country because of land issues and related conflicts. [14]

Population (millions, 2014)	10.5
Human Development Index	0.40
Life expectancy (years)	56.7
GNI/capita (US$)	758
Population below $1.25/day	81%
Literacy rate (adults)	87%
Employment to population ratio	76.9
International tourists (000's)	142
% Population with internet	1.4%

[14] AFDB, OECD, UNDP (2015) African Economic Outlook. www.africaneconomicoutlook.org Last accessed 8 April 2016.

Burundi is a landlocked, resource-poor country with a poorly developed manufacturing sector. Agriculture accounts for over 40% of GDP and employs more than 90% of the population. The primary exports are coffee and tea, which account for 90% of foreign exchange earnings. Burundi's export earnings and its ability to pay for imports therefore rest primarily on weather conditions and international coffee and tea prices. Environmental problems include the following: Soil erosion as a result of overgrazing; The expansion of agriculture into marginal lands; Deforestation (little forested land remains because of uncontrolled cutting of trees for fuel); and Habitat loss that threatens wildlife populations. Burundi is heavily dependent on aid with foreign aid representing 42% of Burundi's national income in 2014, which is the second highest rate in Sub-Saharan Africa.[15]

Burundi's Poverty Reduction Strategy Paper (PRSP)[16] identifies a number of major development challenges. Firstly, the population growth rate currently stands at more than 3%[8Error! Bookmark not defined.], with the government aiming to reduce it to 2% by 2025. Secondly, Burundi's overall agricultural productivity is not high enough to ensure food security for its people as well as generate a marketable surplus. Thirdly, the persistent electricity deficit, resulting from unreliable electricity production, is a major obstacle to development. Fourthly, the gaps in human resource capacities, institutional structures and performance, legal and institutional frameworks, and the weak contribution from the non-government sector contribute to the lack of capacity to manage development. All of this points to the need for a more coherent national development 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, which is still hampered by a lack of investment, can also unlock development opportunities. In addition, the weak execution of public expenditure could be improved by giving preference to sectors with growth potential and allocating more resources to them.

The economy was negatively affected by the unstable political situation. This caused blocked transportation routes that disrupted the flow of agricultural goods and the withdrawal of aid, which increased Burundi's budget deficit.

DEMOCRATIC REPUBLIC OF THE CONGO

The economy did fairly well overall in 2014, with sustained growth of 8.9%, controlled inflation (1.2%) and a virtually-stable exchange rate.
Growth should continue in the short and medium term, with favourable external conditions, steady reduction of the infrastructure deficit and expanding investment due to continuing government reforms.
Despite these macroeconomic performances, the country still has very high poverty, large development disparities among provinces and weak spatial inclusion due to slow decentralisation and delayed completion of infrastructure projects. [14]

Population (millions, 2014)	69.4
Human Development Index	0.43
Life expectancy (years)	58.7
GNI/capita (US$)	680
Population below $1.25/day	88%
Literacy rate (adults)	61%
Employment to population ratio	66.2
International tourists (000's)	191
% Population with internet	3.0%

The DRC economy consists of subsistence farming and hunting, an industrial sector based largely on oil and support services, and government spending. Oil has supplanted forestry as the mainstay of the economy, providing a major share of government revenues and exports. Natural gas is

[15] CIA (2016) The World Factbook. www.cia.gov/library/publications/the-world-factbook/ Last accessed 4 April 2016
[16] IMF (2012) Burundi: Poverty Reduction Strategy Paper II. IMF Country Report No. 12/224.

increasingly being converted to electricity rather than being flared, greatly improving energy prospects. New mining projects, particularly iron ore, which entered production in late 2013, may add as much as $1 billion to annual government revenue.[15]

The key challenges[17] for the DRC include population control and the achievement of double-digit growth through the reconstruction and rehabilitation of basic socio-economic infrastructure, particularly in rural areas, as well as the revitalisation of agriculture. Furthermore, the DRC needs to develop and adopt improved measures to consolidate peace and democracy. At the same time, improvements in financial and economic governance should help improve the effectiveness of the country's public policies. In addition, the DRC needs to build the capacity of its institutions, human resources and public administration, as well as mobilise resources to ensure the implementation of national strategies such as: The emergency multi-sector infrastructure rehabilitation and reconstruction program; The agriculture and rural sector rehabilitation project in Katanga, West Kasai and East Kasai provinces; The agriculture and rural sector rehabilitation support project in Bandundu and Bas-Congo provinces, The Lake Tanganyika integrated regional development program; and The program in support of community development initiatives [18].

The government also recognises the need for environmental protection through the systematic consideration of issues related to climate change, and acknowledges the importance of accelerating the implementation of the decentralisation process. The Nile Basin development opportunities are closely aligned with economic growth aspirations (particularly through agriculture) for which the mobilisation of resources is a prerequisite. The environmental protection priority is also directly aligned with the principles of benefit sharing in a basin context. Specific environmental challenges in the DRC include: Air pollution from vehicle emissions; Water pollution from raw sewage; Tap water that is not potable; and Deforestation[15]. In addition, since the mining sector is one of the most active parts of the economy and has the potential to incur serious environmental impacts [19].

EGYPT

The economic outlook for 2015 is cautiously optimistic, with the GDP growth rate projected at 3.8% in 2014/15 in the wake of important ongoing reforms and anticipation of parliamentary elections. The successful outcome of the March Egypt Economic Development Conference secured over $60 billion and reinforced the government's commitment to continue the structural reforms and promote inclusive growth and restore back investor confidence. Economic activity, policy making and development are concentrated in Cairo and major cities, which perpetuates spatial disparities. [13]	Population (millions, 2014)	83.4
	Human Development Index	0.69
	Life expectancy (years)	71.1
	GNI/capita (US$)	10512
	Population below $1.25/day	2%
	Literacy rate (adults)	74%
	Employment to population ratio	42.9
	International tourists (000's)	9174
	% Population with internet	31.7%

Egypt's economy was highly centralized during the rule of former President Gamal Abdel NASSER but opened up considerably under former Presidents Anwar EL-SADAT and Mohamed Hosni MUBARAK. From 2004 to 2008 the country pursued business climate reforms to attract foreign investment and

[17] IMF (2011) Democratic Republic of the Congo: Growth and Poverty Reduction Strategy Paper 2. IMF Country Report No. 13/226.
[18] IMF (2010) Democratic Republic of the Congo: Poverty Reduction Strategy Paper - Progress Report. IMF Country Report No. 10/328
[19] Walmsley B and Tshipala K E (2007) Handbook on Environmental Assessment Legislation in the SADC Region. Published by the DBSA. Midrand. 420pp

facilitate growth. The poor living conditions and limited job opportunities contributed to public discontent, leading to the January 2011 revolution that ousted President Mubarak. The uncertain political, security, and policy environment since 2011 caused economic growth to slow significantly, which impacted on tourism, manufacturing and other sectors and ultimately increasing unemployment. Low growth and limited foreign exchange earnings have made public finances unsustainable, with authorities depending on expensive borrowing for deficit finance and on Gulf allies to help cover the import bill. Higher levels of foreign investment in 2015, contributed to a slight improvement GDP growth.[15]

The government of the Arab Republic of Egypt identified ten opportunities in its Strategic Framework for Economic and Social Development Plan [20]. The first is to take advantage of Egypt's resources, with the water of the Nile River being explicitly mentioned. Additional opportunities include 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 are directly aligned with the benefit sharing approach. Key environmental issues in Egypt include: Agricultural land being lost to urbanization and windblown sands; Increasing soil salinization below Aswan High Dam; Desertification; Oil pollution threatening coral reefs, beaches, and marine habitats; Water pollution from agricultural pesticides, raw sewage, and industrial effluents; Limited natural freshwater resources away from the Nile, which is the only perennial water source; and Rapid growth in population overstraining the Nile and natural resources.[15]

ETHIOPIA

In 2013/14, Ethiopia's economy grew by 10.3%, making the country one of Africa's top performing economies and this strong growth is expected to continue in 2015 and 2016.
Owing to a co-ordinated prudent fiscal and monetary policy stance, inflation has been contained to single digits since 2013.
Federalism and devolution of power to the regions are paving the way to overcoming geographic and socio-economic barriers to inclusive growth and structural transformation. [13]

Population (millions, 2014)	96.5
Human Development Index	0.44
Life expectancy (years)	64.1
GNI/capita (US$)	1428
Population below $1.25/day	37%
Literacy rate (adults)	39%
Employment to population ratio	79.0
International tourists (000's)	681
% Population with internet	2.9%

Ethiopia's economy is based on agriculture, but the government is pushing to diversify into manufacturing, textiles, and energy generation. Coffee is a major export crop, but the agricultural sector suffers from poor cultivation practices and frequent drought. Although recent joint efforts by the Government of Ethiopia and donors have strengthened Ethiopia's agricultural resilience, changes in rainfall associated with world-wide weather patterns continue to create food insecurity for millions of Ethiopians[15]. As of March 2016, more than 10 million people are in need of emergency food assistance as a result of subsequent impacts to food availability and access [21]. Key

[20] Arab Republic of Egypt (2012) Strategic Framework for Economic and Social Development Plan. Ministry of Planning and International Cooperation.
[21] USAID (2016) Famine Early Warning System. www.fews.net/east-africa/ Last accessed 11 April 2016

environmental issues in Ethiopia include: Deforestation; Overgrazing; Soil erosion; Desertification; and Water shortages in some areas due to water-intensive farming and poor management.[15]

The strategic pillars of Ethiopia's Growth and Transformation Plan[22] 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 to promote gender and youth empowerment and equity. These pillars support Ethiopia's vision, which is, among other things, "*to become a country where democratic rule, good-governance and social justice reign…*" and which includes having "*a modern and productive agriculture sector*". While the country's focus is generally aligned with benefits that could result from greater cooperation in the Nile Basin, there seems to be a particular emphasis on agricultural growth and development.

GDP growth, based on high saving and high investment, has remained high, but per capita income is among the lowest in the world. Ethiopia issued a second state-led Growth and Transformation development plan in mid-2015, which prioritizes industrialization and urbanization. Ethiopia has achieved high single-digit growth rates for the last decade through government-led infrastructure expansion and commercial agriculture development.[15]

KENYA

- GDP growth amounted to 6.9% and 5.7% in 2012 and 2013, respectively, while the 2014 estimate and the 2015 projection show economic expansion of 5.3% and 6.5%, respectively.
- In 2013 and 2014, the economy experienced a stable macroeconomic environment with single-digit inflation, whereas the political scene was dominated in 2014 by calls to amend the constitution.
- Reforms have been introduced in Kenya since 1990 to address critical differences in access to economic, political and social services, culminating in the introduction of 47 county governments in 2010. [13]

Population (millions, 2014)	45.5
Human Development Index	0.55
Life expectancy (years)	61.6
GNI/capita (US$)	2762
Population below $1.25/day	43%
Literacy rate (adults)	72%
Employment to population ratio	61.1
International tourists (000's)	1434
% Population with internet	43.4%

Kenya is the economic and transport hub of East Africa, and although its GDP growth averaged around 5% for the past several years, Kenya is among the low middle income countries. While Kenya has a growing entrepreneurial middle class, faster growth and poverty reduction is hampered by reliance upon several primary goods, with unemployment being high at around 40%. Agriculture remains the backbone of the Kenyan economy, contributing 25% of GDP. About 80% of Kenya's population work at least part-time in the agricultural sector. Over 75% of agricultural output is from small-scale, rain-fed farming or livestock production. This emphasise the vulnerability to environmental risks. Key environmental issues in Kenya include: Water pollution from urban and industrial wastes; Degradation of water quality from increased use of pesticides and fertilizers; Water hyacinth infestation in Lake Victoria; Deforestation; Soil erosion; Desertification; and Poaching.[15]

[22] Federal Democratic Republic of Ethiopia (2011) Growth and Transformation Plan: 2010/11 – 2014/15. Ministry of Finance and Economic Development.

The Medium Term Plan of Kenya[23] is focussed on accelerating annual gross domestic product (GDP) growth to 10% on a sustained basis. The economic pillar of the plan requires private sector investment in tourism, agriculture, manufacturing, wholesale and retail trade, the outsourcing of business processing, and financial services. The Medium Term Plan also focusses on achieving a cohesive society that enjoys equitable social development, with the key elements of its social pillar being education and training, health, water and sanitation, environment, housing and urbanisation and gender, youth and vulnerable groups. The plan's political pillar focuses on decreasing poverty levels and making progress in meeting the Millennium Development Goals (MDG), as well as building an issue-based, accountable democratic political system. This will be achieved by focusing on a number of key areas such as the rule of law and judicial reforms, electoral and political processes, transparency and accountability, and security and peace building.

The Kenyan government has adopted an economic pillar in the form of cross-cutting policies aimed at generating broad-based growth. These policies focus on infrastructure, information communication technology (ICT), land reforms and public sector reforms. The economic pillar in particular will benefit from the development of the Nile Basin resources.

RWANDA

Real GDP growth increased from 4.7% in 2013 to 7.0% in 2014, exceeding the programmed 6.0% and is projected to rise to 7.5% in both 2015 and 2016.

Twenty years after the Rwandan Genocide, the country has become a development success story and unity and reconciliation have been consolidated, strengthening good governance in the medium term.

Efforts to promote spatial inclusion are bearing fruit, with the share of rural households living in integrated and economically viable planned settlements increasing from 37.5% in 2012 to 53.0% in 2013/14. [13]

Population (millions, 2014)	12.1
Human Development Index	0.48
Life expectancy (years)	64.2
GNI/capita (US$)	1458
Population below $1.25/day	63%
Literacy rate (adults)	66%
Employment to population ratio	85.4
International tourists (000's)	864
% Population with internet	10.6%

About 90% of the population in Rwanda is engaged in subsistence agriculture, although there is some mineral and agro-processing. Tourism, minerals, coffee and tea are Rwanda's main sources of foreign exchange. Despite Rwanda's fertile ecosystem, food production often does not keep pace with demand, requiring food imports. Energy shortages, instability in neighbouring states, and lack of adequate transportation linkages to other countries continue to handicap private sector growth. Environmental issues that put further strain on development include: Deforestation results from uncontrolled cutting of trees for fuel; Overgrazing; Soil exhaustion; Soil erosion; and Widespread poaching.[15]

In accordance with the Economic Development and Poverty Reduction Strategy[24], 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; promoting secondary cities as poles of economic growth and a 'green economy' approach to economic transformation. The drivers for rural

[23] 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.
[24] Republic of Rwanda (2013) Economic Development and Poverty Reduction Strategy 2013 – 2018: Shaping Our Development.

development include 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 opportunities through improved infrastructure. Productivity and youth employment are being supported through the development of critical skills and aptitudes for service and industrial sectors, technology and ICT, entrepreneurship; access to finance and business development and labour market interventions. The plan also mentions accountable governance, which will be achieved through the strengthening of citizen participation, awareness and demand for accountability and service delivery. It is worth noting that two of the plan's cross-cutting issues include the environment and climate change. The rural development objectives of the plan will be advanced through the development of Nile Basin resources, while economic transformation will also be supported by such developments.

SOUTH SUDAN

South Sudan's GDP grew by 30.7% in 2014 but 2015 is likely to see negative growth as the ongoing conflict and declines in national oil production and global oil prices devastate the economy.

The outlook for economic growth largely depends on a recovery in global oil prices and a comprehensive resolution of civil conflict rather than a mere cessation of hostilities.

South Sudan could face a widening financing gap this fiscal year and long-term economic troubles due to its political crisis and declines in national oil production and global oil prices. [13]

Population (millions, 2014)	11.7
Human Development Index	0.47
Life expectancy (years)	55.7
GNI/capita (US$)	2332
Population below $1.25/day	-
Literacy rate (adults)	-
Employment to population ratio	-
International tourists (000's)	-
% Population with internet	15.9%

Several decades of civil war with Sudan have led to industry and infrastructure in South Sudan being severely underdeveloped and poverty being widespread. Subsistence agriculture provides a living for the vast majority of the population. Property rights are insecure and price signals are weak, because markets are not well organized. South Sudan has little infrastructure, with electricity being produced mostly by costly diesel generators and indoor plumbing and potable water being scarce. South Sudan depends largely on imports of goods, services, and capital from Uganda, Kenya and Sudan. South Sudan does have abundant natural resources, having produced nearly three-fourths of former Sudan's total oil output of nearly a half million barrels per day in 2011. The government of South Sudan derives nearly 98% of its budget revenues from oil. The outbreak of conflict in December 2013, combined with a reduction of oil exports, meant that GDP growth fell significantly in 2014 and poverty and food insecurity rose. South Sudan does hold one of the richest agricultural areas in Africa with fertile soils and abundant water supplies.[15]

The Republic of South Sudan gained independence in 2011. The South Sudan Development Plan[25] includes a focus on strengthening institutions and improving the transparency and accountability, promoting rural development through infrastructure improvements towards economic development, investing in people to promote social and human development, and deepening peace and improving security to prevent conflict. In the context of a dire need for development, the plan also states that water control infrastructure, for example hydropower and water storage dams, will

[25] Republic of South Sudan (2011) South Sudan Development Plan 2011-2013: Realising freedom, equality, justice, peace and prosperity for all. Juba.

enable economic activities. The SSDP also lists water resources management, development, utilisation and sanitation services as priorities for public expenditure.

SUDAN

Driven by agriculture and the extractive industries, GDP growth (3.4% in 2014) is projected at 3.1% in 2015 and 3.7% in 2016, with inflation anticipated to remain high (21.8% in 2015), according to the African Economic Outlook[14]. Dialogue between government and opposition should lead to political reform, while implementing the Interim PRSP should support inclusive growth and improve MDG achievement prospects. Geographic concentration has hindered business clustering and employment in lagging states. Spatial planning is needed to concentrate resources in urban agglomerations and stimulate employment in agriculture. [13]	Population (millions, 2014)	38.8
	Human Development Index	0.48
	Life expectancy (years)	63.5
	GNI/capita (US$)	3809
	Population below $1.25/day	19.8
	Literacy rate (adults)	73%
	Employment to population ratio	45.4
	International tourists (000's)	591
	% Population with internet	24.6%

The oil sector had driven much of Sudan's GDP growth since 1999, but the country has experienced protracted social conflict, civil war, and the loss of three-quarters of its oil production in July 2011 due to the secession of South Sudan. Sudan has since struggled to stabilize its economy and make up for the loss of foreign exchange earnings. Ongoing conflicts in Southern Kordofan, Darfur, and the Blue Nile states, lack of basic infrastructure in large areas, and reliance by much of the population on subsistence agriculture keep close to half of the population at or below the poverty line. Agriculture continues to employ 80% of the work force. Sudan also faces high inflation, which reached 47% on an annual basis in November 2012 but subsided to 21.8% in 2015. Key environmental issues include: Inadequate supplies of potable water; Wildlife populations threatened by excessive hunting; Soil erosion; Desertification; and Periodic drought.[15]

According to the Interim Poverty Reduction Strategy Paper[26], the key challenges for the country are: The legacy of long years of internal violent conflicts; Disparities in economic development and access to opportunities, Employment; The need for a more diverse economy; Human capital; Technical and institutional capacities; Institutional and structural reforms; The country's external debt burden; and Limited access to external aid and foreign financing. These challenges are framed in the context of major opportunities, which include natural resources, fertile land and water resources to develop vibrant farming and livestock production and related agro-processing industries, foreign direct investment, momentum for change and development since the signing of the Comprehensive Peace Agreement (CPA), and learning and partnerships.

TANZANIA

The economy grew by 7.3% in 2013, driven by continued strong performance in most sectors and supported by public investment in infrastructure, with growth projected to remain above 7% in the medium term. The draft new constitution proposed by the Constituent Assembly in October 2014 preserves the existing two-government union structure. Spatial exclusion is high in Tanzania, mainly due to regional disparities, but inclusion could be increased by boosting agricultural productivity, supported by rural infrastructure investments and improved connectivity between rural and urban areas. [13]	Population (millions, 2014)	50.8
	Human Development Index	0.52
	Life expectancy (years)	65.0
	GNI/capita (US$)	2411
	Population below $1.25/day	44%
	Literacy rate (adults)	68%
	Employment to population ratio	86.0
	International tourists (000's)	1063
	% Population with internet	4.9%

[26] IMF (2012) Interim Poverty Reduction Strategy Paper. IMF Country Report No. 13/318.

Tanzania is one of the world's poorest economies in terms of per capita income, but achieved high growth rates based on its natural resource wealth and tourism. GDP growth from 2009 to 2015 was 6-7% per year and the country has largely completed its transition to a market economy. The economy depends on agriculture, which accounts for more than one-quarter of GDP, provides 85% of exports, and employs about 80% of the work force. All land in Tanzania is owned by the government and can be leased for up to 99 years. Proposed reforms to allow for land ownership, particularly foreign land ownership, remain unpopular.[15]

The development outcomes that Tanzania aspires to are stated in the National Strategy for Growth and Reduction of Poverty (II)[27]. The first cluster of the strategy focuses on growth for poverty reduction and emphasises equitable and employment-generating growth, sustainable development, food security, affordable and reliable modern energy services, and adequate infrastructure for production purposes. The second cluster addresses the improvement of quality of life and social well-being and includes a focus 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, and access to social security and social protection (thereby reducing vulnerability from environmental risks). 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 investment. Specific environmental challenges in Tanzania include: Soil degradation; Deforestation; Desertification; Destruction of coral reefs that threaten marine habitats; Recent droughts affecting marginal agriculture; and Wildlife threatened by illegal hunting and trade, especially for ivory [15].

UGANDA

In 2014 Uganda saw the consolidation of macroeconomic stability and a gradual recovery of economic activity, with real GDP growth projected to reach 5.9% in FY 2014/15 from 4.5% growth in FY 2013/14.
This is supported by public investment on infrastructure, recovery in private domestic consumption, investment demand, and rebound in agriculture.
Absolute poverty rates continue to drop, from 24.5% in FY 2009/10 to 19.7% in FY 2012/13 (with corresponding improvements in child nutrition and declining infant mortality) and overall life expectancy advances to 59, three years higher than in 2009. [13]

Population (millions, 2014)	38.8
Human Development Index	0.48
Life expectancy (years)	58.5
GNI/capita (US$)	1613
Population below $1.25/day	38%
Literacy rate (adults)	73%
Employment to population ratio	74.5
International tourists (000's)	1206
% Population with internet	17.7%

Uganda's substantial natural resources include fertile soils, good rainfall, small deposits of copper, gold, and other minerals, and recently discovered oil. Environmental challenges related to these resources include: Draining of wetlands for agricultural use; Deforestation; Overgrazing; Soil erosion; Water hyacinth infestation in Lake Victoria; and Widespread poaching[15]. Agriculture is the most important sector of the economy, employing over two-thirds of the work force, with coffee accounting for the bulk of export revenues. Economic reforms since 1990 brought an era of solid economic growth based on continued investment in infrastructure, improved incentives for

[27] IMF (2010) United Republic of Tanzania National Strategy for Growth and Reduction of Poverty (II). IMF Country Report No. 11/17.

production and exports, lower inflation, better domestic security, and the return of exiled Indian-Ugandan entrepreneurs.[15]

The National Development Plan [28] 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 to restore degraded ecosystems and the quality of environmental resources management, both of which are closely linked to benefits that could be derived from the Nile Basin.

2.6. Cooperation in the Nile Basin

Since the late 1800s there have been several bilateral agreements that have dealt with cooperation in the Nile. Great Britain and Italy agreed on their respective spheres of influence in North-Eastern Africa in the 1891 Anglo-Italian Protocol, which gave the United Kingdom control over the headwaters of the Tekeze River. In the secret tripartite agreement between Great Britain, France and Italy in 1906, France and Italy ceded all Nile Basin interests to Britain. In the Anglo-Egyptian Agreement of 1929, the High Commissioner of Great Britain in Cairo recognised the 'historical and natural rights' of Egypt over the water of the Nile River in an exchange of note with the Chairman of the Council of Ministers of Egypt. The 1959 Egyptian-Sudanese agreement for the full utilisation of the Nile River was initiated, because Sudan rejected the 1929 Anglo-Egyptian agreement. According to the 1959 agreement, Egypt would be allocated most of the available 55.5 billion cubic meters (BCM) of water, Sudan was to be allocated 18.5 BCM and evaporation was estimated to account for 10 BCM[29].

Until the 1990s, there was no common institutionalised and structured mechanism that was all-inclusive to bring together all riparian countries to address a common agenda. The NBI was launched on 22 February 1999 by the ministers in charge of water affairs in the riparian countries namely Burundi, the DRC, Egypt, Ethiopia, Kenya, Rwanda, Sudan, Tanzania and Uganda, with Eritrea participating as an observer (**Error! Reference source not found.** [30]). The agreed minutes[31] noted that the Council of Ministers shared the vision of the NBI, adopted policy guidelines for the Strategic Action Program, instructed Nile-TAC to prepare the Strategic Vision Programme and requested groups of countries to identify projects for the Subsidiary Action Programs. The NBI, as a regional intergovernmental partnership, seeks to develop the Nile River in a cooperative manner, share substantial socio-economic benefits and promote regional peace and security. The NBI was conceived as a transitional institution until the CFA negotiations were finalised and a permanent institution was created. The establishment of the NBI heralded a positive chapter in the hydro-political history of the Nile Basin, namely the beginning of a transboundary perspective informing

[28] IMF (2010) Uganda: Poverty Reduction Strategy Paper. IMF Country Report No. 10/141.
[29] Arsano Y (2011) Negotiations for a Nile-Cooperative Framework Agreement. ISS Paper 222.
[30] NBI (2015) The Nile Story: Briefing Note 1. Highlights of 15 years of Nile cooperation.
[31] Nile-Secretariat (1999) Agreed Minutes. Endorsement of New Transitional Institutional Arrangements: "Nile Basin Initiative (NBI)" Dar es Salaam, Tanzania. 22 February 1999.

national water management policies and plans of the Nile River and a growing recognition of the need for basin wide cooperation. The period from 1999 to 2008 focussed on the establishment of the NBI and confidence building, which was followed by an institutional strengthening phase from 2008 to 2012. The current phase (2012-2016) focusses on consolidation and delivery[32].

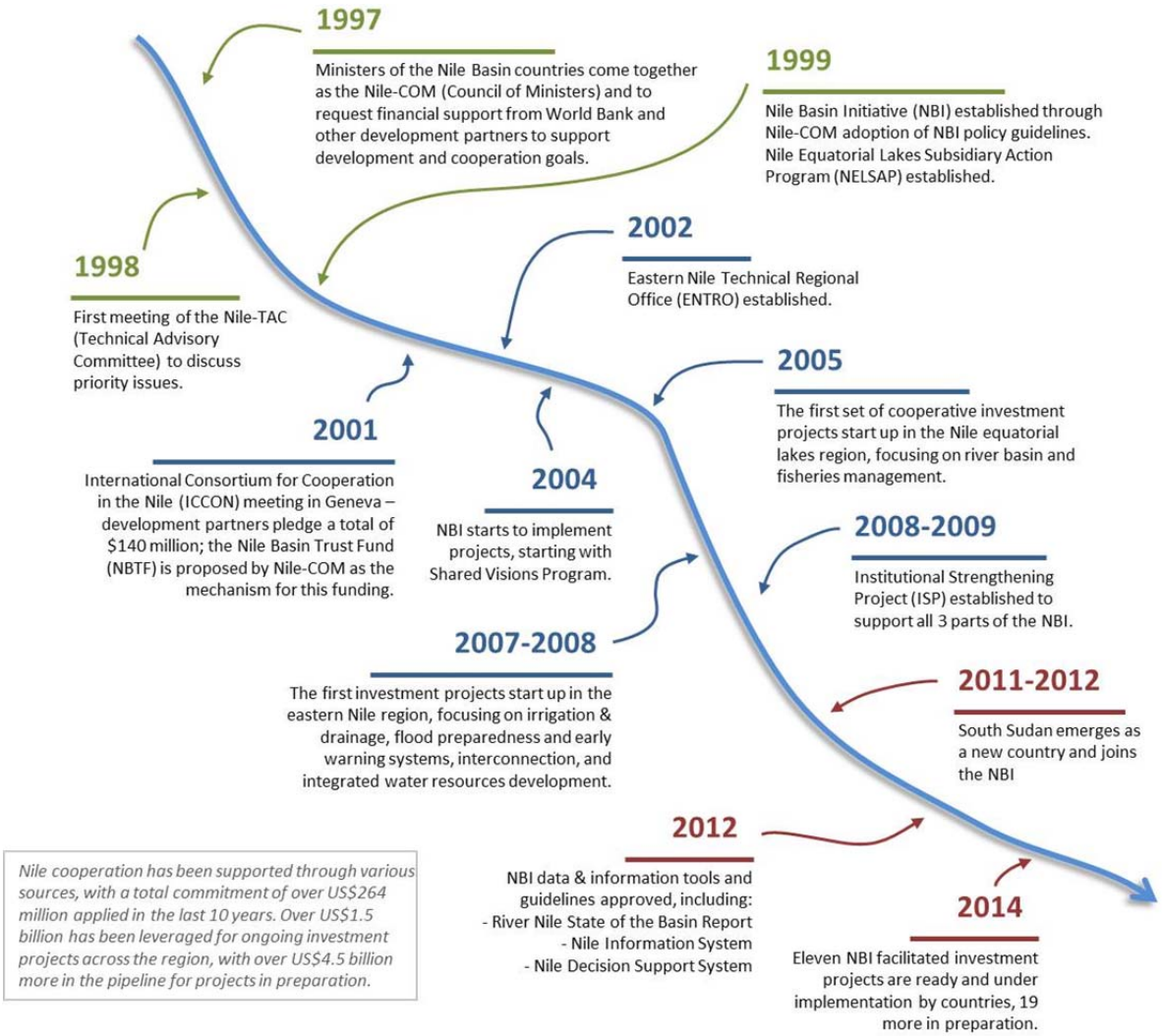


Figure 2: History and key milestones of the Nile Basin Initiative (Adapted from NBI 2015[30])

The regionally agreed strategic programs have contributed to building significant trust and cooperation across the region. From a starting point when discussions between some countries had to be mediated through a neutral third party, countries are now coming together to agree and plan new, largescale projects and recognise the benefits of working collaboratively. This trust and cooperation has in part been achieved through improvements in understanding, capacity and knowledge. Where previously weaknesses in capacity and knowledge were real constraints, now

[32] NBI (2014) Home - About Us - Nile Basin Initiative. www.nilebasin.org.

technicians and Ministers from the Nile countries better understand the realities of transboundary flows, the impacts of water resource management and development on neighbouring countries, and the benefits of working cooperatively. Combined, these achievements inform both developments in national policy and planning, and expectations on shared benefits from transboundary cooperation. This promotes management and development of the Nile that is cooperative, equitable, and sustainable.[30]

3. Case Studies

3.1. Watershed management in the Eastern Nile Region

The Eastern Nile watershed covers an area of 1.7 million km^2, which supports 110 million people. The watershed is severely degraded because of soil erosion, high sedimentation, and over-exploitation of natural resources. The watershed is in need of restoration for the future economic benefit of those who live in Egypt, Ethiopia, and Sudan. The Eastern Nile Watershed Management Project (ENWMP) therefore aims to provide an integrated watershed management system to address the root causes of watershed degradation, to improve the livelihoods of those living in this region and to protect the environment. The specific project objective is to establish a long-term coordinated system for sustainable management of selected watersheds in the Eastern Nile Basin. This involves information and knowledge sharing among the three countries, facilitating stakeholder consultation, and detailing investment-ready projects for specific watershed host spots. The project will result in an improvement of the living conditions of the people that depend on the watersheds by providing alternative or complimentary livelihood opportunities, decreasing population pressure, increasing land productivity, reducing soil erosion, and reducing sediment transport and siltation. Furthermore, the project will lead to ecosystem rehabilitation, environmental protection, infrastructure development and increased regional cooperation. [33]

Watershed management in the Eastern Nile started with two parallel activities. The first was to understand the watershed, which includes an analysis of the status challenges and opportunities. The second was to requested fast track projects from countries. The first activity started with a study at a transboundary level, but by taking out political boundaries and taking a regional view, which was the first study of its kind. The costs and benefits of regional watershed programs were then assessed at a country level as well as from a regional and global perspective. This approach improved the understanding of the watershed at a regional level, including upstream and downstream issues and the costs and benefits. This resulted in a common understanding of the status and what needs to be done. This led to the identification of potentially hotspot areas in terms of biodiversity and degradation from regional perspective. The regional and national reviewed committees also served to build capacity, improve awareness, and ensure that everybody agrees on the information available. This went a long way towards building trust and ensuring buy in on the report and resulted in agreement on hotspot areas and on the long-term programme. The activity

[33] NBI (2016) Eastern Nile Watershed Management Project. http://entroportal.nilebasin.org/Watershed/ Last accessed 10 April 2016

addressed the need to understand the basin and agree on what needs to be done. It is equally important to understand the consequences of inaction at regional level. The second activity was to ask countries to suggest projects and then select priority projects together with countries to fast-track projects development and to prepare projects for implementation. The process of project preparation and selection was based on importance of regional and national level.[34]

The enabling factors for effective watershed management include a need to build institutional capacity at national level. Furthermore, there should be engagement at different levels in all aspects to have common understanding of the benefits and buy-in policy makers. With pilot projects being implemented in bilateral projects in Ethiopia and Sudan and between Egypt and Sudan, capacity building programmes were attached to the pilot projects Information management and knowledge exchange was promoted through workshops on synthesizing information such as the impact of climate change and how watershed management adapts to climate change. Training needs are identified in consultation with the countries and training and are supplemented with field guides and study trips where deficiencies are identified. Documentary films on the projects serve to inform policy makers but also increase general awareness and understanding.

A key issue in implementation and communication is to balance the emphasis between national benefit and regional cooperation. With watershed management, investment is often upstream and benefit is downstream. There is thus a need to know to what extent the programme is looking at benefits upstream. This process starts with site selection, where countries select sites that are priorities for the nation. Implementation is done by national government with transboundary coordination. One of the potential benefits for upstream countries is to learn through sharing experience, such as downstream surveys to show farmers how productivity improves. The main downstream effects are the sediment control, flood management, dredging canals, and measurements on sediment transport. There is an emphasis on complimentary benefits for upstream and downstream users. Education for downstream beneficiaries is very important since people do not always see benefits. Farmers may see sediment as problem, but will not necessarily associate changes or improvements with upstream interventions. It is only when governments and local people see the benefits that there will be buy-in and cooperation. The overall benefit of cooperation is building trust and confidence through transparent processes. The trust built through watershed management projects leads to countries seeking cooperation in other areas as well. [34]

The long term sustainability of watershed management will depend on the establishment of a monitoring system and indicators to track progress and direct action. The programme should progress from a local to a national and regional sustainable approach. The general approach should include a status quo assessment, an understanding of how to show benefits on the ground, establish linkages between national and regional benefits, develop capacity building targets for different groups with different needs, show how a watershed will transform to opportunities rather than challenges, build an understanding that watershed management is a technical issues but also a livelihood issue, recognise interconnectedness, demonstrate that doing things together will benefit people and the environment, and provide inputs to influence policy. A framework to look at the costs and benefits of watershed management is presented in Figure 3.

[34] ENTRO (2015) Staff interviews.

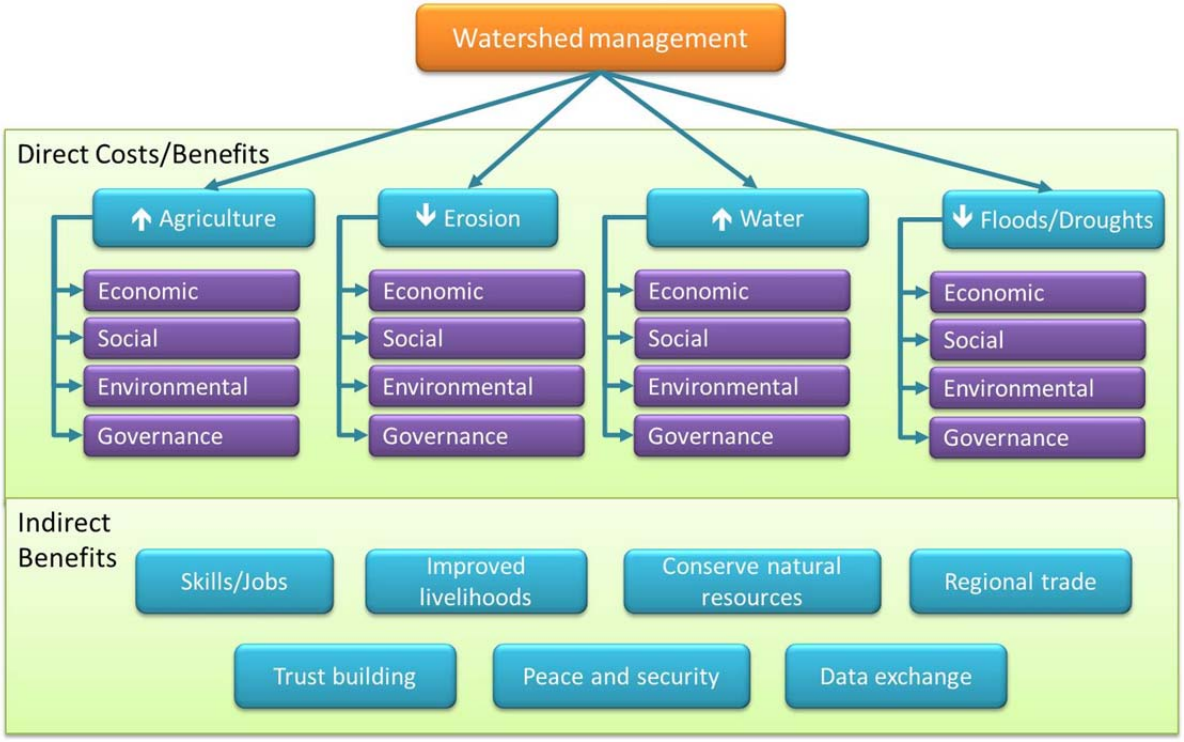


Figure 3: Costs and benefits of watershed management.

The framework highlights an increase in agricultural production, a reduction in erosion, an improvement in the water situation, and reduced risks such as floods and droughts, although there could also be other issues in specific contexts. Within each area of under which costs and benefits should be assessed, the social, economic and environmental aspects should be considered. These are in line with the UN Development Goals as well as the African Union Agenda 2063. The fourth aspect that should be considered is governance aspects. This includes policy considerations for implementation, as well as inputs to policy development, but also institutional structures and processes. The indirect benefits will depend on the case specific conditions, but should also be considered where relevant. The approach is followed in looking at Eastern Nile examples as well as an example from outside of the Nile.[35]

[35] NBI (2014) Keeping the Nile Flowing and Boosting Livelihoods: A Success Story of the Tana-Beles Integrated Watershed Management Project.

SUDAN COMMUNITY WATERSHED MANAGEMENT

A good example of watershed management is the Community Watershed Management Project (CWMP) in Sudan, which is making good progress towards achievement of the project and global development objectives. By 2015, over 39 762 ha of agricultural lands, representing about 99% of the end-of-project target of 40 000 ha, had been brought under sustainable land and water management through appropriate technologies. These include reseeding of animal routes and rangelands with nutritious fodder trees and grasses, expansion of agroforestry, construction of small-scale irrigation facilities, digging trenches, building terraces, utilizing contour furrows and soil bunds, using improved planting materials, etc. The average sorghum yields for the 2014 cropping season in Dinder and Atbara areas were 129% and 133%, respectively over the baselines, while sesame yields in Dinder rose by 79%, as compared to baseline figures. In the Atbara sub-watersheds, white bean yields rose by 126%. The adoption of fodder farming has resulted in an improvement of soil fertility, which led to increased forage productivity and increased farmers' incomes as farmers are in a position to sell their excess fodder. The project reports the doubling of cow milk yield from 3.5 liters/day to 6.0 liters/day.[36]

WATERSHED MANAGEMENT IN THE MAIN NILE SUB-BASIN [37]

The Main Nile sub-basin covers an area of 656 398 km^2, including the catchment of Lake Nasser to the Aswan High Dam. This sub-basin extends from the junction of the White and the Blue Niles at Khartoum in the south to the Aswan High Dam in the north. Land and water use in the Main Nile Sub-basin are varied and reflect the natural resource base as well as the complex social, cultural and economic characteristics of the land users and the economic, institutional and policy environment in which they operate. Moving sand dunes is a key challenge in the area. These can overwhelm settlements, fields and roads. The wind direction is mostly from the northeast, therefore the most hazardous dunes are located to the northeast of the Nile, between Dongola and Karima. Approximately 2 570 ha of irrigated land is immediately threatened by the moving dunes. River bank erosion is another threat, which occurs at any point along the course of the Main Nile from Khartoum to Lake Nubia. Fossil meander belts indicate that river meandering that are causing river bank erosion and subsequent sedimentation are a natural phenomenon, but in a number of areas this process has been accelerated through human interference of the river hydrology. Rangelands in the Main Nile have degraded over the past two decades with increased presence of species of poor forage quality. This has been caused in part by the reduction in rainfall in the early 1980's exacerbated by the increased gazing pressure due to the loss of rangeland to the expansion of the semi-mechanized farms. There are many causes of low productivity in the areas around Lake Nasser. These include technical, economic and institutional issues, but also marketing and agricultural processing and transportation.

Key interventions that have been proposed to counter shifting sand dunes include: A 10 km external shelter-belt at Argi to protect the village and 280 ha existing and 8 960 ha potential croplands; A 40 km "External" Shelter-belt protecting the villages of Argi, Abkar and Afaad to protect 2 240 ha existing and 9 520 ha potential cropland; and A full shelterbelt from Letti to El Bar protecting 14

[36] World Bank (2015) Eastern Nile Watershed Management Project. Implementation Status & Results. Report No. ISR21975
[37] NBI (2007) Eastern Nile Watershed Management Project: CRA for Watershed Management: Transboundary Analysis Main Nile sub-Basin.

villages. Clear land use zoning in a 1km buffer zone on each side of the river could help to prevent tipping of material into the river and extraction of sand for building and other purposes. A shelter belt of 1 500 meters for Aswan town is already established. Shelterbelts and windbreaks are essential for the increase of agricultural crops production, protection of irrigation canals and the agricultural land itself. For the Ababda and the Bishari people two potential pathways for development were identified as greater use of existing vegetation resources for charcoal production and livestock grazing and a change from cash vegetable cropping to fodder production.

Benefits that are reported for the Main Nile sub-Basin include: Benefits to the river such as better water quality and river flow characteristics due to headwater management and wetland maintenance; Benefits from the river, such as agricultural output, hydropower development, flood/drought management, navigation, environmental conservation, and water quality improvement; Benefits because of the river include cooperation to reduce costs on military expenditure; and Benefits beyond the river include economic integration and regional infrastructure to maximize benefits from the basin as a whole rather than within each country separately.

Watershed Management in Abay-Blue Nile Sub-Basin [38]

The sub-Basin covers 311 548 km^2, with the source being Gish Abbay in West Gojam, from where it flows northward as the Gilgel Abbay into Lake Tana. From there it flows in a southerly and then westerly direction. It is joined by a number of tributaries, being Beshilo, Derame, Jema, Muger, Finchaa, Didessa and Dabus from the east and south; and the Suha, Chemoga, Keshem, Dera and Beles from the north. The Abbay exits Ethiopia near Bambudi and becomes the Blue Nile. The Abbay Basin has the highest runoff in Ethiopia, estimated at 51 km^3/annum, which is 50% of water runoff in Ethiopia. According to NBI (2007[38]), it also contributes 62 % of the Nile discharge into Lake Nasser and 72% of the total Ethiopian contribution to the Nile.

Watershed management activities haves been ongoing in Ethiopia for decades. Based on past experience, a number of key points have been drawn for future projects. Whereas community ownership and institutional structures important, watershed management should be based on community catchments in the 200-500 ha range. These could be grouped to form larger projects. Due to the diversity of landscape and socio-economic conditions in Ethiopia, interventions need to be adapted to local conditions rather than following standard models. Implementation is easier in areas that demonstrate immediate benefits. Payment (food or cash for work) will most likely be required for a large part of project implementation. A key issue is how to 'scale up' from the micro-watersheds to larger areas. It is difficult to sustain watershed management on increased productivity of food grains alone; diversification for cash crops adapted to local markets or other income generating activities is essential. There are no evaluation data available on post project benefits as compared to baseline situations. This could either be because post-project evaluations are not regularly carried out, or because the data is not available in the public domain. Most observers agree that, within the moisture deficit and food insecure Weredas, crop and forage production benefits are positive. There is limited evidence of community driven watershed management and self-

[38] NBI (2007) Eastern Nile Watershed Management Project: CRA for Watershed Management: Transboundary Analysis Abay-Blue Nile sub-Basin.

replication is limited. Efforts have been, and remain, primarily supply-driven by government and donor agencies, and supported by payment.

Interventions in the Abay-Blue Nile sub-Basin are applicable at the farm-level and on communal lands and are specific to conditions of agricultural potential and market access. Specific strategies at the farm level include the use of fertilizer and improved seed, improved crop husbandry, improved soil husbandry, improved tillage, grass strips, Fanyaa Juu (terracing), forage development, tree development. On communal land, the strategies include cut-off drains, road and track drains, gully stabilization, stone terraces, communal forage development, communal tree production, small-scale supplementary or full irrigation, and water harvesting. Other strategies include non-farm labour, sales of fuelwood and handicrafts, and honey production.

Vegetative measures, such as grass strips, have been shown to almost as effective as physical structures for soil conservation. With land taken up by the structures being taken into account, crop yield increases of 14% were recorded on 12% slopes and no increase on 28% slopes. It is estimated that grass strips trap between 57% and 72% of soil moved. Similarly, with soil bunds, crop yield increases of 7% were recorded (after land taken up by the structures is taken into account), while soil bunds trap 64% of soil moved. With these measures, soil movement on cropland could be reduced from 101.8 million to 50.1 million tons. Assuming a sediment delivery ratio of 39%, the annual sediment to the Abbay river system within Ethiopia could be reduced by 25.7 million tons (down from 42.8 million to 17.0 million tons/annum). If all croplands were covered with bunds or grass strips, it would reduce the annual losses of soil and soil moisture holding capacity to 40% of current rates. This will achieve a saving of 60% of current annual accumulating losses. This in turn would yield an accumulating annual benefit of 15 115 tons of grain per year, which is sufficient to sustain 75 575 adults. The construction of bunds in moisture deficit areas can results in a 7% yield increase in crop due to increased soil moisture retention and thus increased nutrient availability. Assuming 30% of all cropland with unsustainable soil losses is covered with bunds there would be an additional increase in production of 27 400 tons of grain per year, which is sufficient to feed 137 000 people. The annual net loss of nitrogen is 37 640t/annum. If an annual reduction in nutrient losses through burning of dung and residues of about 3% can be achieved, an annual saving about 4 830 tons of grain can be expected (NBI, 2007 [38]).

Benefits could also accrue from reclaiming around 141 000 ha of kerib land. Assuming a mix of multi-purpose trees and herbaceous forage producing a sustainable yield of 200 kg of woody biomass and 400 kg of herbaceous biomass per hectare per year over 60% of the area, such a restoration programme could yield nearly 17 020 tons/annum of wood and 34 030 tons/annum forage, which is enough to feed nearly 170 150 tropical livestock units. Crop yields can also be increased on 0.94 million ha on large farms (if 25% of the land is rested) by raising sorghum yields from 360 kg/ha to 800 kg/ha. With a 60% adoption rate this would yield an annual additional production of 413 290 tons of sorghum.

WATERSHED MANAGEMENT IN BARO-SOBAT NILE SUB-BASIN[39]

The Baro-Sobat Nile sub-Basin covers an area of 468 215 km^2. The main tributaries of the Sobat are the Baro, Gila and Akobo that rise on the Ethiopian Plateau at around 3 300 meters above sea level. Below Gambela the Baro branches into the Baro and the Adura which rejoin about 70 km downstream. Below Malakal until its junction with the Blue Nile at Khartoum the White Nile falls about 13 meters over a distance of 840 km. A key issue related to soil degradation within the sub-Basin is declining soil fertility. A key driver of the loss of soil nutrients is the burning of organic matter for fuel. Within the Baro-Akobo Basin around 1 730 tons/annum of dung is used as fuel and around 212 600 tons/annum of crop residues are burnt as household fuel, which results in an annual loss of 1 003 tons of N and 102 tons of P. The conversion of forest land to crop land and then grazing land also has implications for hydrology.

A number of technological interventions have been identified in the Baro-Sobat sub-Basin. In areas with high to medium agriculture potential and poor market access, marketable agricultural products will be limited to high value, low volume and non-perishable products such as coffee, tea, honey, butter and Cororrima. On-farm interventions include improved soil husbandry, improved tillage, grass strips, Fanyaa Juu (terracing), on-farm forage development, valley bottom swamp development, and on-farm tree development. The interventions for communal lands include cut-off drains, road and track drains, gully stabilization, and communal forage development. Soil erosion on cropland in the highlands of the sub-Basin is incurring an annual accumulating loss (through the reduction in soil moisture holding capacity) of an estimated 2 590 tons of grain per year. 24% Coverage of cropland with bunds or grass strips would reduce current annual losses of soil and soil moisture holding capacity to 35% of current rates, achieving a saving of 65% of current annual accumulating losses. This would yield an annual benefit of 404 tons of grain, which is sufficient to sustain 2 020 adults per year. Assuming conservatively an increase in fertilizer uptake of 50 kg of urea by 20% of farmers, the annual increase in grain production will be approximately 34 652 tons/annum. The retention of soil nutrients potentially lost through soil erosion by bunds and grass strips (assuming 100% coverage) of cropland with an unsustainable soil loss rate would achieve a saving of about 2 050 tons of grain. Total benefits accruing from reducing soil nutrient losses amount to 41 756 tons of grain per annum, which is sufficient to feed 208 780 people. There is the potential to improve crop production on 1.145 million ha by raising sorghum yields from 360 kg/ha to 800 kg/ha (allowing for 25% of the land to be rested). If there is a 60% adoption rate, this would yield an annual additional production of 1.448 million tons of sorghum. The overall downstream impact on sedimentation in the Baro-Sobat sub-Basin from upstream watershed management and dam operation activities could be a 30% reduction in suspended sediment in the Baro-Akobo river system. The suspended sediment load of the Baro and Akobo Rivers at the border could be reduced from 9.48 million tons to about 6.6 million tons per annum.

[39] NBI (2007) Eastern Nile Watershed Management Project: CRA for Watershed Management: Transboundary Analysis Baro-Sobat Nile sub-Basin.

WATERSHED MANAGEMENT IN TEKEZI-ATBARA NILE SUB-BASIN[40]

The Tekeze River travels more than 750 km In Ethiopia, from its source near Lake Ashange to the border with Sudan. In Sudan the river extends another 575 km in a north-westerly direction. The Tekeze-Atbara sub-Basin covers an area of 227 128 km^2 and, extending from the north-west of Ethiopia to the lowlands of Sudan, it drains into the Nile approximately 285 km downstream of Khartoum. The land and water use systems in the Tekeze-Atbara sub-Basin are highly varied and reflect not only the natural resource base, but also the complex social, cultural and economic characteristics of the land users and the economic, institutional and policy environment in which they operate. Within the Tekeze Sub-basin the main area of high soil erosion hazard follows the western side of the spur of highland that trends north-westwards from the Simien Massif. The total soil eroded within the landscape in the Tekeze Basin is estimated to be 100.5 million tons per annum and that from cultivated land is estimated to be 27.2 million tons per annum. Thus over 70% of soil being eroded is from communal grazing and settlement areas. Cultivated land in the sub-Basin has soil loss rates of more than 12.5 tons per ha per annum (exceeding soil formation) covers 749 000 ha. The annual crop grain production for the Tekeze Basin is 1.06 million tons, but the annual loss due to soil erosion as a proportion of total production is 0.17%, which increases to 2% after 10 years and 4% after 25 years. In Ethiopia, nutrient losses occur through burning of dung and crop residues (17 460 tons of N and 3 990 tons of P), the removal of grain (14 770 tons of N and 2 950 tons of P) and soil erosion (1 886 tons of N and 810 tons of P).

The following key observations on watershed development are drawn from historical experience:

- In many areas there were substantial benefits with improved soil conservation, planting of woodlots and improved pastureland.
- Many structures were costly in terms of land taken out of production, labour inputs for physical structures were very high, and there was little attempt to incorporate indigenous soil and water conservation techniques. In some areas structures were technically inappropriate and caused water logging.
- The programme focussed narrowly on arresting soil erosion without considering the underlying causes of low soil productivity, the socio-economic factors and the need for immediate tangible benefits to be attractive to poor farmers.
- The programme adopted a very “top-down” approach in its planning and implementation. There was little or no consultation with farmers or communities on felt needs. Woodlots were implemented with no harvesting plans.
- Although a “watershed” approach was adopted the basin size was too large to acquire an understanding of the socio-economics of land degradation and farmers willingness to invest in improved land management.

Technological interventions in highland areas with high to medium agricultural potential and good market access relate to on-farm activities (external inputs, improved crop husbandry, improved soil husbandry, improved tillage, grass strips, Fanyaa Juu, forage development, and tree development) and communal lands (cut-off drains, road and track drains, gully stabilization, forage development,

[40] NBI (2007) Eastern Nile Watershed Management Project: CRA for Watershed Management: Transboundary Analysis in Tekezi-Atbara sub-Basin.

tree production, and small-scale supplementary/full irrigation), with non-farm labour being another possible strategy. In highland areas with high to medium agricultural potential but poor market access, on-farm activities include improved soil husbandry, improved tillage, grass strips, Fanyaa Juu, forage development, and tree development, whereas the interventions on communal lands include cut-off drains, road and track drains, gully stabilization, forage development, and small-scale supplementary/full irrigation, with honey production being another possible strategy. In highland areas with low agricultural potential and good market access, on-farm activities include improved soil husbandry, improved tillage, grass strips, stone terraces, and tree development, whereas interventions on communal lands include cut-off drains, road and track drains, gully stabilization, forage development, small-scale supplementary/full Irrigation, and water harvesting. In highland areas with low agricultural potential and poor market access, on-farm activities include improved soil husbandry, improved tillage, grass strips, stone terraces, forage development, and tree development, whereas interventions on communal lands include cut-off drains, road and track drains, gully stabilization, forage development, small-scale supplementary irrigation, and water harvesting and with honey production being another possible intervention. In lowland areas with medium to high agricultural potential, the three development strategies are available are: Intensification of existing bush-fallowing cultivation; Development of medium to large scale commercial agriculture, and Large-scale irrigation.

In addressing soil erosion and sedimentation, soil movement on cropland and gullies could be reduced from 32.84 million to 12.46 million tons. Assuming a sediment delivery ratio of 60% (and 15% from gullies), sediment to the Tekeze river system within Ethiopia could be reduced by 6.28 million tons. Assuming that an additional 25% of the non-cropland could be brought under closure or sustainable forage or woodland management over the next 10 years (bringing the total to 40%) this could reduce sediment delivery to the river system by approximately 15.83 million tons per annum.

Soil erosion on cropland in the Ethiopian highlands of the Sub-basin incurs an annual accumulating loss (through reduced soil moisture holding capacity) of an estimated 1 850 tons of grain per year. A complete coverage of these croplands incurring unsustainable soil loss would reduce current annual losses of soil and soil moisture holding capacity to 40% and bring about a saving of 60% of current losses. This would yield an accumulating annual benefit of 1 110 tons of grain, which is sufficient to sustain 5 550 adults per year. The reduction in nutrient losses through burning of dung and residues can produce an annual saving of about 3 180 tons of grain. Additionally, the reduction in nutrient losses through grain removal would yield an annual increase in grain production of 16 375 tons. The retention of soil nutrients potentially lost through soil erosion would achieve an annual saving of about 29 180 tons of grain.

In Sudan, there is the potential to reclaim nearly 81 000 ha of kerib land, with such a restoration programme having the potential to annually yield nearly 10 000 tons of wood and 20 000 tons of forage. There is also the potential to improve crop production on 336 680 ha, raising sorghum yields from 360 kg/ha to 800 kg/ha. With a 60% adoption rate this would yield an annual additional production of 85 100 tons of sorghum.

WATERSHED MANAGEMENT IN THE TANA-BELES NILE SUB-BASIN[41]

The Tana-Beles Integrated Watershed Management Project is one of the fast-tracked projects. It is located in the upper Blue Nile region of Ethiopia and is part of the wider Eastern Nile watershed. The Eastern Nile Technical Regional Office (ENTRO) has played a leading role in the conception and preparation of the project. The 85 026 ha Tana-Beles watershed project area was clustered into 163 community-level watersheds of manageable size. Work started in 2009 and since then watershed development plans for all the clusters have been implemented through a range of activities. These include the treatment of 821 ha of gully, the rehabilitation of 16 000 ha of degraded hillside, the development of 4 000 ha of community woodlot forestry, and the construction of 14 small-scale irrigation schemes of a combined 1 000 ha. The integrated approach to watershed management has reduced the loss of top soil and increased crop yields at the farm level. These advances are expected to bring about more downstream benefits, such as improved water quality and reduced silting of the Nile waters in Sudan and Egypt.

One of the community projects is the Aleket Wonze Community Watershed Project, located in the South Gonder Zone of Farta District. The project supports about 360 people who live off the communal grazing land that have been improved through activities undertaken through the Tana-Beles Integrated Watershed Management Project. Previously, the destructive direct grazing method had stripped the Aleket Wonze of its green cover and the soil of its vital nutrients. The community members were in a race to grab whatever they could for their animals. The competitive grazing practices on communal land had undercut the very foundation of the community's livelihood. Within the project the community reached consensus to allocate 19 ha of community land and to close it off to all grazing activities. This served to demonstrate the impact that one specific measure could bring about. The land was rejuvenated and the vegetation recovered. An arrangement was agreed to that kept the earmarked area fenced off and out of bounds to livestock, while allowing all farmers to harvest the grass to feed their animals under a controlled system. There was something in it for people who had no animals, since they could harvest grass and sell it for a personal income.

The development of the Tana-Beles Integrated Watershed Management Project required significant time spent on planning prior to implementation. This approach ensured that there was a robust monitoring and evaluation system in place. This system constantly provides evidence to ensure that the support the communities are getting is changing people's lives and the ecosystem.

Some of the benefits related to livelihoods that have emerged from the project include:

- Farmers who have participated in crop development activities have embraced the recommended practices on their own fields.
- The diversification of income sources for communities in the project areas have been promoted through organising 132 business groups and training more than 2 000 farmers on generating income from off-farm activities, of which at least 180 were female.
- Some of the groups have subsequently branched out into activities like bee-keeping, craft-making, tailoring, and production of forest seedlings. To this end, over 1 900 modern beehives,

[41] NBI (2014) Keeping the Nile Flowing and Boosting Livelihoods: A Success Story of the Tana-Beles Integrated Watershed Management Project.

at least 1 100 bee colonies, more than 130 units of apiculture equipment, and over 2 300 kg of bee wax have been distributed to farmer groups.

- The introduction of alternative energy sources that are not dependent on wood fuel has strengthened the linkages between community watershed management and tree conservation. Over 3 000 energy saving stoves have been produced and handed out to farmers and 95 model biogas plants were constructed to demonstrate alternative energy technologies.
- Since the project inception, there is a farmer training centre in each of the 35 kebeles (localised community) in the project area. More than 3 500 farmers (about 30 per cent of them women) have been trained in crop and livestock management.
- Communities in the Tana- Beles watershed project have access to vastly improved veterinary services, with nine animal health posts having been constructed, three others having been renovated and eleven having been upgraded. Twenty-six technicians who were trained at the regional animal health laboratory are available to help the farmers.
- More than 460 farmers working in forestry-related nursery sites are benefitting from the new jobs created.
- More than 1 000 ha of new irrigation and 14 newly small scale irrigation schemes were established. These areas serve more than 2 800 households. In addition, over 70 motor-driven pumps have been provided to organised groups and almost 650 hand-dug wells have been excavated.
- Furthermore, 680 safe water points have been constructed and have provided access to potable water for at least 75 000 people. To ensure the sustainability of the interventions, committee members have been trained in water and sanitation management.

Some of the benefits that relate to ecosystem are:

- A number of physical and biological soil and water conservation measures have been carried out on 46 276 ha of cultivated land
- In communities like Aleket Wonze, the practice of free animal grazing has largely ended as farmers have been persuaded to adopt stall feeding and zero grazing.
- More than 19 000 ha of previously degraded land, including hillsides, grazing and bush lands, have been treated and protected by constructing enclosures, hillside terraces and trenches. New plantations were established and existing plantations were improved.
- The project has rehabilitated over 1 000 ha of gully land through construction of gabion, loose stone, and brush wood check dams, as well as gully reshaping and levelling. Physical soil and water conservation structures have been reinforced with biological techniques. This has led to:
    - Gully land healing or rejuvenating faster and benefitting the watershed communities
    - Community watershed committees and the beneficiaries are leading the follow-up, maintenance and protection of the rehabilitated land
    - The treated gully lands have become more productive and the communities are realising tangible results
    - The capacity of local watershed communities and experts to rehabilitate gully land has improved appreciably.

More than 5 000 ha of community, private woodlot, and backyard forests have been planted. Forty-two forest and five forage seedling nursery sites are fully operational with a number of private and group nurseries producing a substantial amount of seedlings that are planted in project areas every

year. About 46 million seedlings have been produced and planted on private and project-funded nursery sites.

METRICS OF BENEFITS IN WATERSHED MANAGEMENT IN THE EASTERN NILE REGION

The state of social and economic development, reflected through the Human Development Index (HDI)[42], for the countries in the Nile Basin countries are summarised in Figure 4. The HDI is a summary measure of achievement in key dimensions of human development, being a long and healthy life, being knowledgeable and have a decent standard of living. The HDI is expressed as the geometric mean of normalized indices for each of the three dimensions. The health dimension is represented by life expectancy at birth. The education dimension is expressed as the mean of years of schooling for adults over 25 years of age and expected years of schooling for children of school entering age. The standard of living dimension is measured by gross national income (GNI) per capita, with the logarithm of income used to reflect the diminishing importance of income with increasing GNI. The scores for the three HDI dimension indices are aggregated into a composite index using the geometric mean. The HDI simplifies and captures only part of human development and does not reflect on inequalities, poverty, human security, empowerment, etc. The metrics used in the Sustainable Development Goals (SDGs) presented in Figure 5 covers a range of human development aspects that are not considered in the HDI. The radar diagrams show the international ranking for each metric per country, with values nearer to zero (the centre of the graphs) indicating a very low rating compared to other countries and a rating nearer to 100 (the outer boundaries) indicating a very good rating compared to other countries. Available data for South Sudan and Burundi is insufficient to calculate the performance against the metrics. The reported and potential benefits of transboundary cooperation are discussed under these metrics. While the focus is on direct benefits, it is likely that the other metrics will also be positively affected. For instance, an improvement in life expectancy (a health metric) and an improvement in GNI per capita can also cause average year of schooling to increase, both through improved affordability, but also because of improved food security that allows more time to be dedicated to schooling. The benefits of watershed management in the Eastern Nile, associated with quality of life and linked to life expectancy in the Human Development Index are indicated in

Figure 6. The benefits related to the metrics of the Sustainable Development Goals are shown in Figure 7. The metrics that are directly supported by the listed benefits are underlined in the figure.

[42] UNDP (2015) Human Development Report 2015: Work for Human Development. ISBN: 978-92-1-126398-5. Washington DC

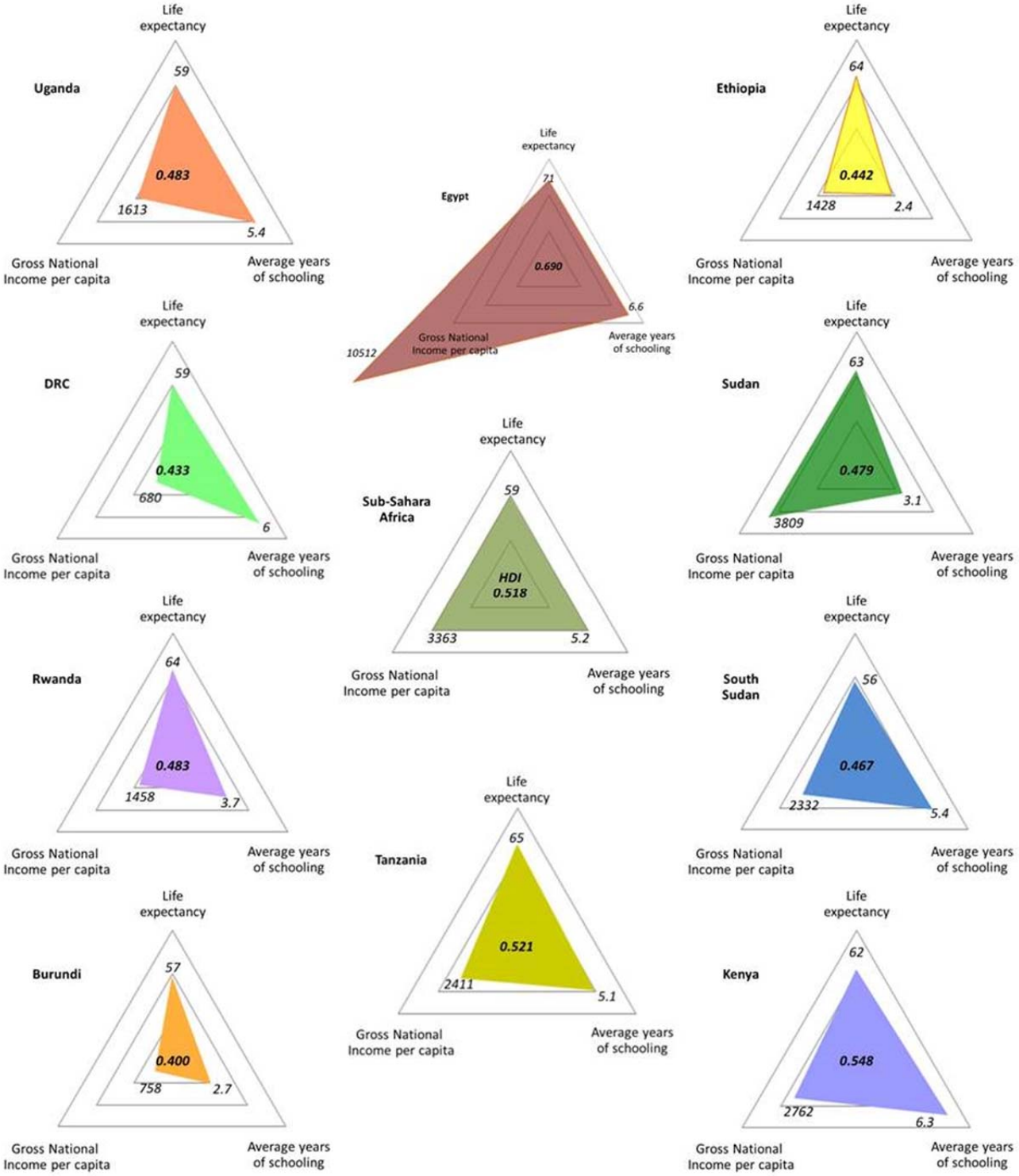


Figure 4: Human Development Index for Nile Basin Countries in 2014

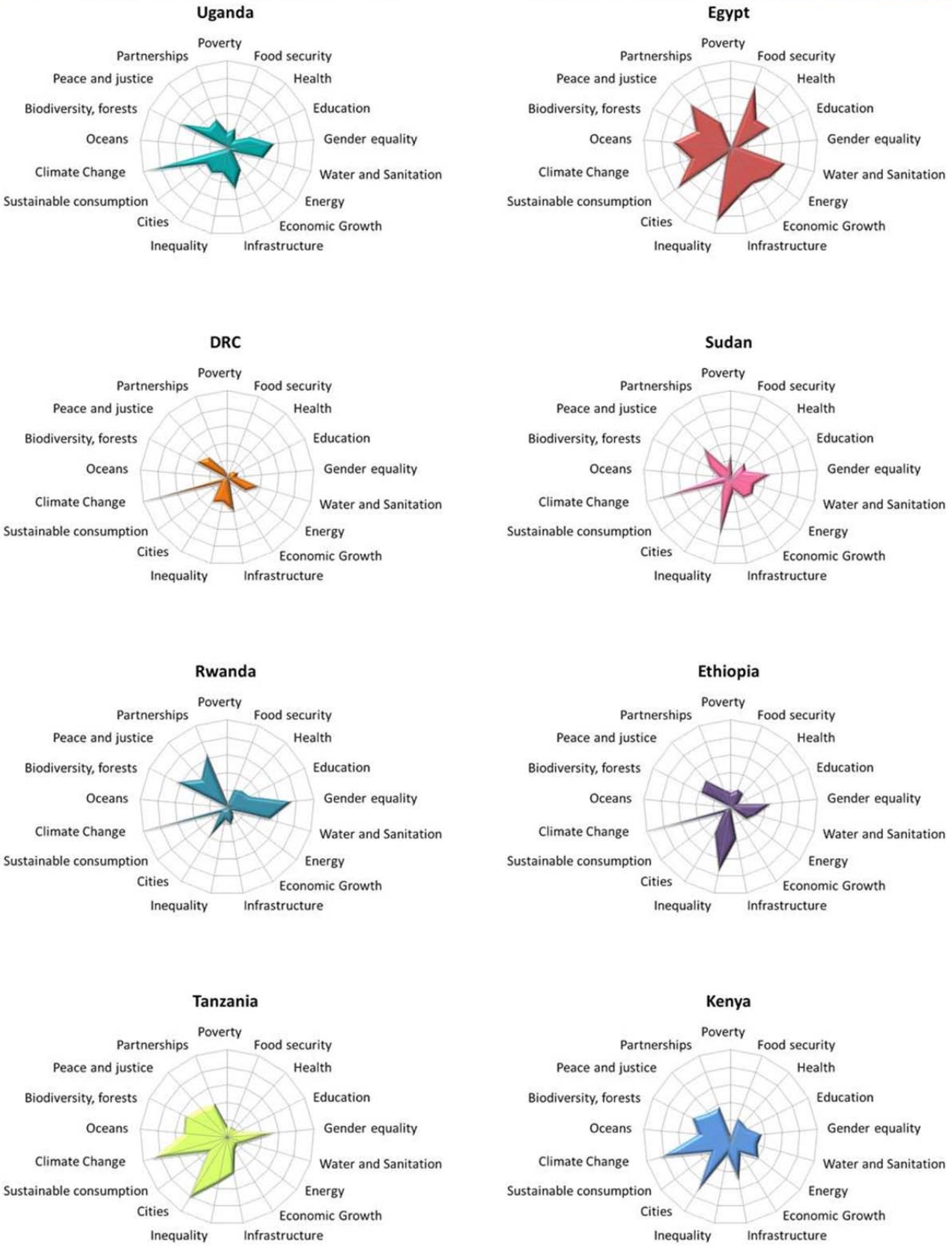


Figure 5: Sustainable Development Goals for Nile Basin countries[43].

[43] Sustainable Development Solutions Network (2016) Preliminary Sustainable Development Goal (SDG) Index and Dashboard. SDSN Working Paper. 15 February 2016

Figure 6: The benefits of sustainable land and water management related to the human development index for the Eastern Nile.

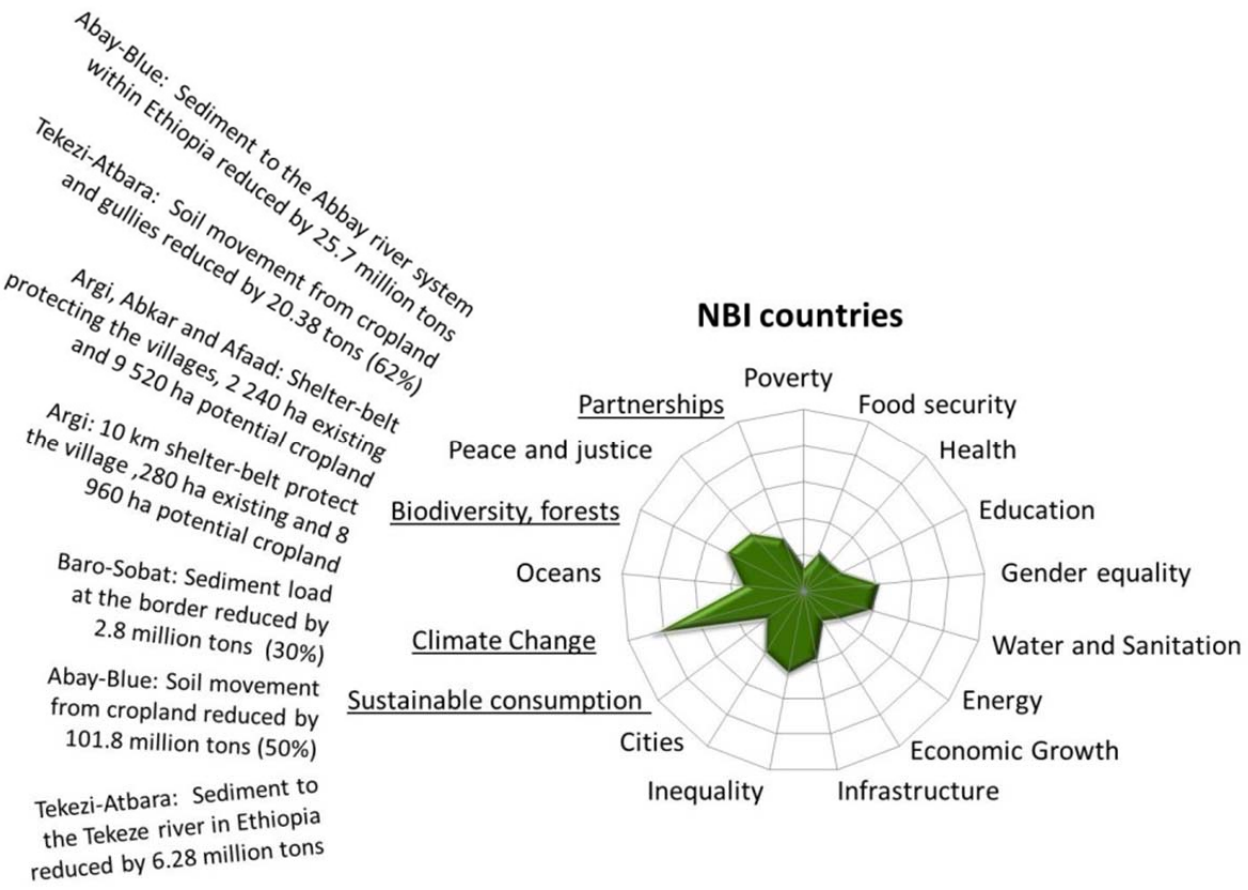


Figure 7: The benefits of sustainable land and water management related to the UN Sustainability Goals.

The benefits listed in Figure 6 and Figure 7 may also translate into improved trade between the basin countries, particularly regarding agricultural products. Improved watershed management upstream of Egypt will reduce sediment loads, which in turn will increase the useful life of dams and also reduce the impact of sediment loads on pumps and water infrastructure. This will increase water yields in the basin. The reduced cost through increased dam and infrastructure life will increase the net benefit in the agricultural sector in Egypt. Import and export trade related to agriculture for Egypt[44] (Figure 9) shows that imports far exceed exports for all three product categories. The benefits of watershed management can bring about increases in crop production, which can reduce the need for imports of wheat, corn and soya beans, and increase exports of citrus, grapes, potatoes and onions. If neighbouring countries also increase their agricultural production, it would increase regional food security and decrease costs compared to imports from distant international suppliers.

[44] Simoes AJG, Hidalgo CA (2011) The Economic Complexity Observatory: An Analytical Tool for Understanding the Dynamics of Economic Development. Workshops at the Twenty-Fifth AAAI Conference on Artificial Intelligence.

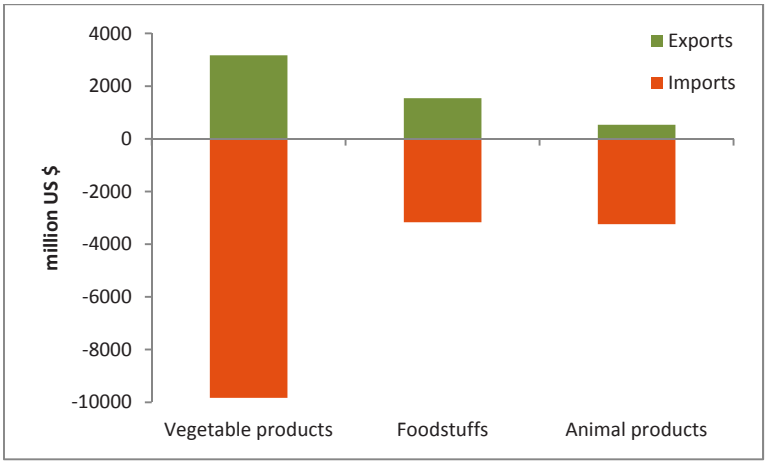


Figure 8: Import and **e**xport of agricultural products for Egypt (2014).

Import and export trade related to agricultural products for Sudan are shown in Figure 9 [41]. The imports of all categories of products exceed the exports, which points to a concern related to national food security, but also affect the national trade balance negatively.

Figure 6 indicates that a reduction in nutrient loss can increase crop yields by between 79% and 133%. With the export of vegetable products being worth $418 million in 2014, and taking a conservative estimate of 50% increase in yield, the potential annual increase in vegetable product exports from Sudan could amount to $209 million, whereas 50% more locally available products would substantially reduce the need for imports.

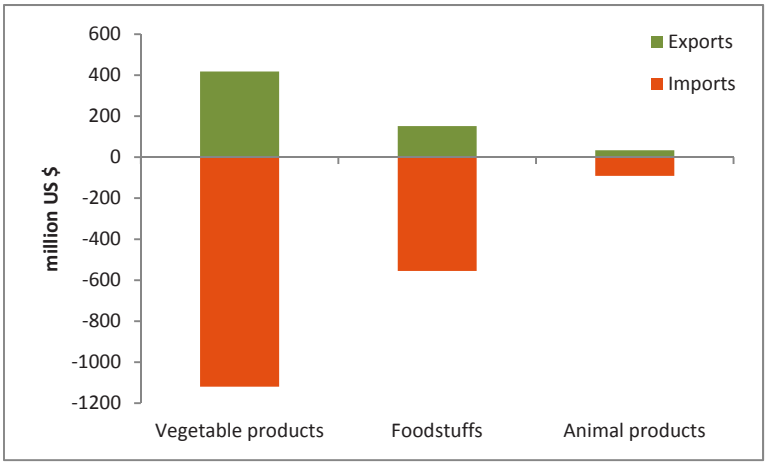


Figure 9: Import and **e**xport of agricultural products for Sudan (2014).

The trade in agricultural products South Sudan show substantial imports but nearly no exports[41] (Figure 10). It should be noted that the export of crude petroleum (worth $2.25B) make up 99.7% of all exports. Watershed management could increase crop production and export, with such a diversification of export products also contributing to a more robust economy, which will be less sensitive to fluctuations in commodity prices.

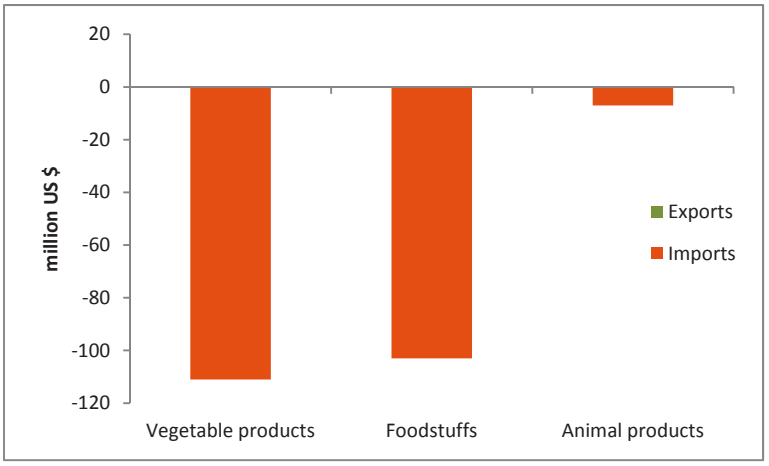


Figure 10: Import and **e**xport of agricultural products for South Sudan (2014).

Exports for Ethiopia in Figure 11 point to a large proportion of exports compared to imports. The top exports of being coffee ($732M), other vegetables ($550M), other oily seeds ($465M), cut flowers ($346M) and refined petroleum ($260M)[41]. While national food security in Ethiopia is very important, the significant increases in crop production discussed in the different sub-basin studies would also yield benefits in terms of exports and associated revenue as well as national and regional food security.

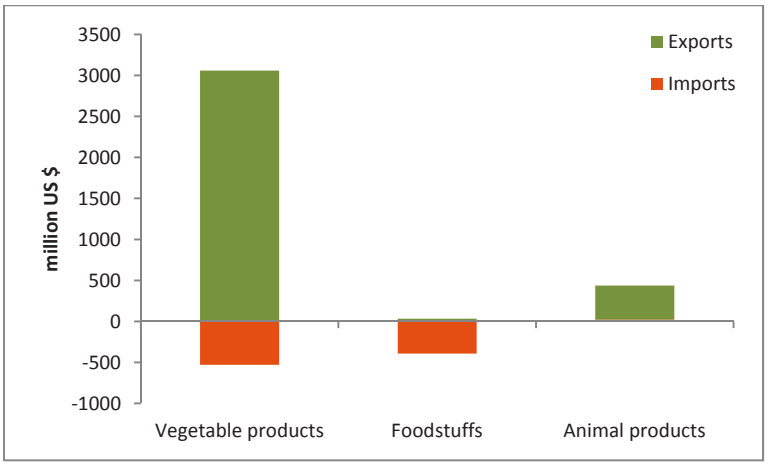


Figure 11: Export products for Ethiopia (2013).

3.2. HYDROPOWER IN THE NILE EQUATORIAL LAKES REGION

PERSPECTIVES ON HYDROPOWER

Hydropower is often a major factor in economic and social development at local, national and regional levels. The International Hydropower Association identified three key areas for cooperation between groupings of countries. The first is the potential to share cross-border electricity supply through regional power trading pools and the expansion of regional energy markets. The second is the need to minimize the social and environmental impacts on a given river or river basin through a shared strategic plan. The third area is the potential to locate energy-intensive industries close to hydropower resources to reduce the need to utilize more polluting sources of energy, as indicated in Figure 12. [45]

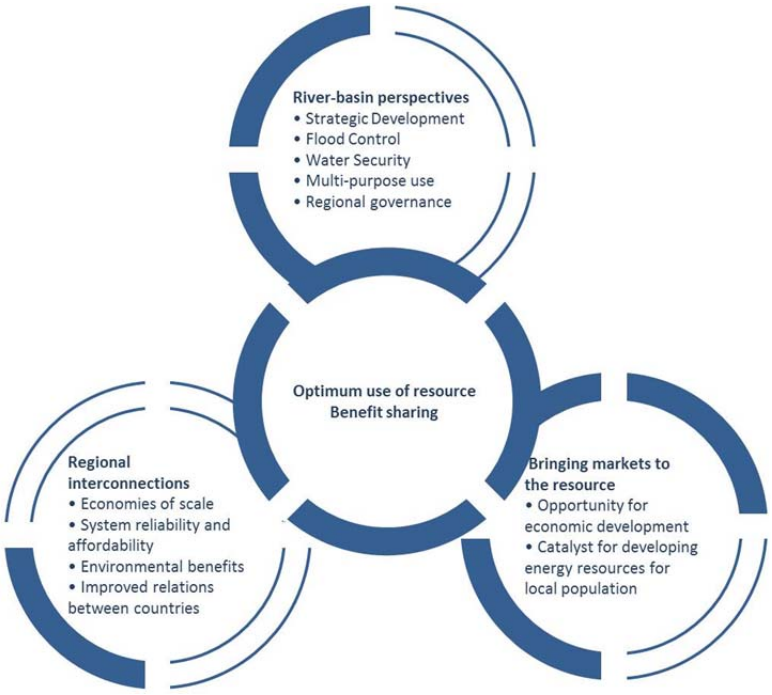


Figure 129: Benefits associated with hydropower and regional development

Hydropower offers a number of advantages to the communities that they serve. It is a clean fuel source, which means it is environmentally friendly and climate change responsive. It is often a domestic source of energy, which reduces the reliance on external fuel sources. Hydropower facilities create reservoirs that offer a range of other benefits, such as flood control and more secure water availability. The IHA conducted case studies in Canada and USA, India and Bhutan, the Mekong Region, Costa Rica and Vietnam, Iceland, and Malaysia, which provided useful insights into the benefits of regional electricity interconnections, strategic river basin management, and the potential for clean energy such as hydropower to attract industry to remote project sites. The requirements for successful hydropower development maximum in regional development were similar for the different case studies and included the following[45]:

[45] IHA (2013) Hydropower and Regional Development; Case studies. Sutton, London

- The inherent complexity of hydropower projects that cross regional boundaries require strong government leadership and political will. The private sector should play a more collaborative role in project development, providing the necessary commercial expertise and financial support;
- The costs and benefits of water and electricity usage are crucial in profiling the risks and opportunities associated with given projects. Stakeholders require the appropriate tools to quantify the costs and benefits of water and electricity usage, and how these are shared among transboundary project proponents. River basin organisations can play an important role in brokering shared costs among project proponents;
- The loss of potential revenue from projects that fail to go ahead due to the lack of political support highlights the importance of international financial institutions and multilateral development banks in enhancing local capacity;
- Although hydropower potential is often spread unequally between countries, all of those involved may incur different types of costs. To ensure cooperation throughout project implementation, options to encourage benefit sharing and redistribution must be considered;
- Regional cooperation promoted by regional hydropower development should be harnessed to promote political stability, economic benefits, energy security, environmental stewardship and improved water management.

The International Hydropower Association (IHA)[46] identified key trends in hydropower. In assessing the impact of international policy and agreements on hydropower growth, they found that UN Sustainable Development Goals (SDGs) include a goal to "ensure access to affordable, reliable, sustainable, and modern energy for all", whereas the UNFCCC agreed to reduce anthropogenic greenhouse-gas emissions to limit global warming to "well below 2°C". Both agreements will drive further growth in the hydropower sector, especially in emerging and developing economies. The IHA also found that advanced hydropower control technologies enable solar-hydro and wind-hydro hybrids, which minimises the grid's need for reserve capacity. Furthermore, climate aspects increasingly influence project design, accounting for changing environmental conditions, such as different flow regimes. The value of pumped storage is being recognised worldwide, with hydropower accounting for more than 97% of global energy storage capacity. New financial instruments are also making investing in hydropower more attractive, with private sector finance based on build, own, operate and transfer models being encouraged. Climate bonds market attracts strong hydropower interest, which is demonstrated by hydropower being the largest sub-sector within climate-aligned bonds. Mergers and acquisitions indicate a larger role for the private sector with a number of state-owned hydropower assets and concessions being transferred to the private sector in 2015. Another trend is China continuing to promote regional hydropower development in Eurasia and Africa through the *One Belt, One Road* initiative. Transformative projects are also moving forwards in Africa, including Gilgel Gibe III (Ethiopia), GERD (Ethiopia), the Kaleta project (Guinea), Inga 3 (DRC), and Kafue Gorge Lower project (Zambia). The last key trend is hydropower that is driving regional interconnections (see section 3.3). Since large-scale hydropower often produce more electricity than is required to meet local demand, regional interconnections are essential to make projects financially viable.

[46] IHA (2016) 2016 Key Trends in Hydropower. Sutton, London

Key issues that need to be considered in the Nile basin are the identification and quantification of benefits, but also how to package the benefits, how benefit sharing links into policy, and how these benefits can be implemented. It is important to note that benefits are not just financial. Other benefits include political benefits, increased trust, and collaboration. There is a need to develop a practical framework to implement the benefit sharing approach to make it more practical. Such an approach will also look at what will cause the future to be different to the present. Benefits that can be expected include: Projects bring countries together for cooperation for common benefits; Funding provided by the World Bank for development; and increased commitment of countries. Enhanced power trade can reduce the costs of electricity, increase the share of clean energy from hydropower, increase employment and education, and increase reliability and security of power supply. Other benefits are the increase in rural electrification, reduction in biomass and petroleum consumption, promoting small and medium industries, and supporting agricultural development. Furthermore, hydropower projects created a platform for trade and market development, which enhances cooperation, information exchange, and sharing of technical experience at different levels.

The Sub-Saharan Africa region is characterised by ageing power infrastructure that is unable to meet current power demands and therefore suppresses the power demand. Power consumption, at 124 kilowatt hours (kwh) per capita per year is barely enough to power one 100-watt light bulb per person for three hours a day.[47] Although 14% of the world's population lives in Africa, the continent only uses 4% of the global electricity total. Figure 13 shows the comparison of energy use per capita vs. the Human Development Index for all countries[15] [48]. The graph shows a clear relationship between these metrics, with countries that have a higher electricity use, also having improved human development. The NELSAP countries are indicated with star symbols, showing that these countries (with the exception of Egypt) have relatively low electricity use and similarly, relatively low human development.

The region has abundant energy resources, including around 10% of the world's total hydropower potential, but access to electricity remains limited and unevenly distributed, with only 290 million out of 915 million people currently have access to electricity in sub-Saharan Africa[49]. Ensuring the availability of affordable and reliable energy is essential to the continued and sustainable development of a region that has seen rapid economic growth in the recent past. The increased focus on regional planning and integration is demonstrated through the Programme for Infrastructure Development in Africa (PIDA), led by the African Union and African Development Bank.[47] The total potential and current installed hydropower capacity for NELSAP countries are shown in Figure 14 [5]. The data supports the view that there are large reserves of hydropower in the Nile Basin that can support regional development.

[47] KPMG (2014) Sub-Saharan Africa Power Outlook.
[48] Gapminder Foundation (2012) Gapminder World. http://www.gapminder.org/ Last accessed 11 October 2013
[49] OECD/IEA (2014) Africa Energy Outlook. A Focus on Energy Prospects in Sub-Saharan Africa. World Energy Outlook Special Report.

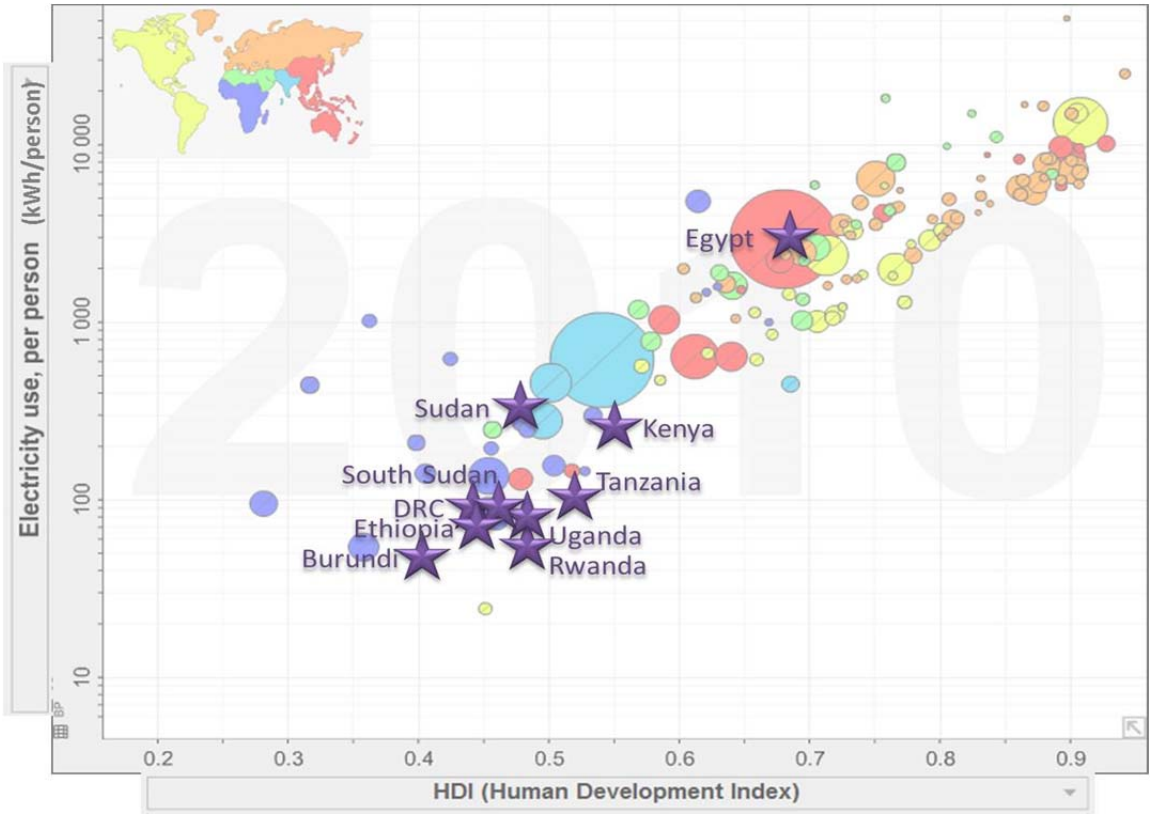


Figure 1310: Per capita energy use vs. HDI for countries globally, with NELSAP countries highlighted.

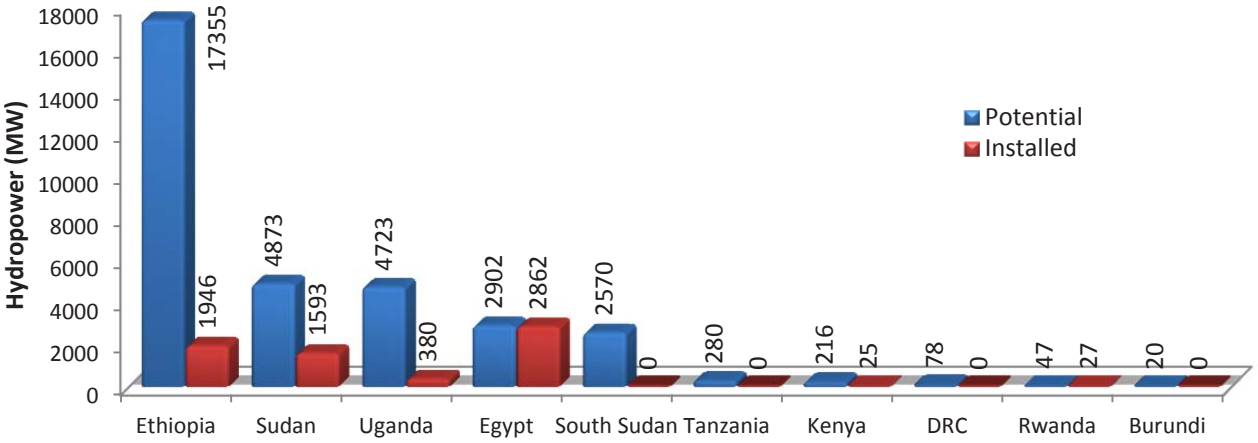


Figure 1411: Total potential and installed hydropower in the Nile Basin (MW).

Major opportunities for hydropower development in the Nile Basin are shown in Figure 15. The most economical option in the Nile Basin is the Baro II project, which will have a generation capacity of 500 MW[50] at 2.47 US c/kWh[5]. Baro II is located on the Baro River between Gore and Bonga, approximately 600km by road west of Addis-Ababa. This is followed by Halele Worabesa Stage II (Ethiopia), which will generate 326 MW at 2.58 US c/kWh, Genji in Ethiopia (216 MW at 2.65 US c/kWh), Beko Abo in Ethiopia (2 100 MW at 3.15 US c/kWh), Semliki in Eastern DRC (28 MW at 3.17 US c/kWh), and Kishanda Valley in Tanzania (200 MW at 3.27 US c/kWh) [5 50]. Other hydropower options include the Mandaya (2 000 MW at 2.15 US c/kWh), Birbir R (367 MW at 3.62 US c/kWh), Tekeze II (450 MW at 3.86 US c/kWh), Busanga (224 MW at 4.15 US c/kWh), Geba I (215 MW at 4.21 US c/kWh), Wanie Rukula (690 MW at 4.31 US c/kWh). The cost and capacity of all schemes can be seen in Figure 15, with the total capacity adding up to 22.59GW (although interdependencies are not accounted for).

These capacities should also be seen in the context of the Congo River, with the Inga III scheme with a potential of generating 4.8 GW at 2.15 US c/kWh, and the Grand Inga scheme that is able to deliver 40 GW at 2.59 US c/kWh [5 51].

HYDROPOWER POTENTIAL IN THE CONGO RIVER[35]

The Congo River currently hosts 40 hydropower projects, nine of which are in DRC, including the country's two largest, which are Inga I (354 MW) and Inga II (1,424 MW). Significant additional capacity is planned as part of the Grand Inga project, which would become the largest hydropower project in the world at 40 GW if fully developed. With an estimated generation cost of $0.03 per kWh, it would be one of the most affordable sources of energy in Africa. A key hurdle to development has been the lack of a firm market for the electricity generated. However, in 2014, South Africa ratified an agreement with DRC to purchase over half of the output of Inga III. This is roughly equivalent to dedicating 2 500 MW of a planned 4 800 MW to South Africa. Construction of Inga III is now expected to begin in 2017, with completion slated for 2020. DRC has an additional 2 020 MW of capacity in the planning and construction phases. Although this capacity is not in the Nile Basin, it does have significant implications for power interconnections and regional electricity security

[50] SNC Lavalin International Inc. & Parsons Brinckerhoff (2011) Regional Power System Master Plan and Grid Code Study. Appendix B Part II: Supply Study – Supply Demand Analysis.
[51] International Rivers (2016) The Inga 3 Hydropower Project. http://www.internationalrivers.org/campaigns/the-inga-3-hydropower-project Last accessed 24 April 2016.

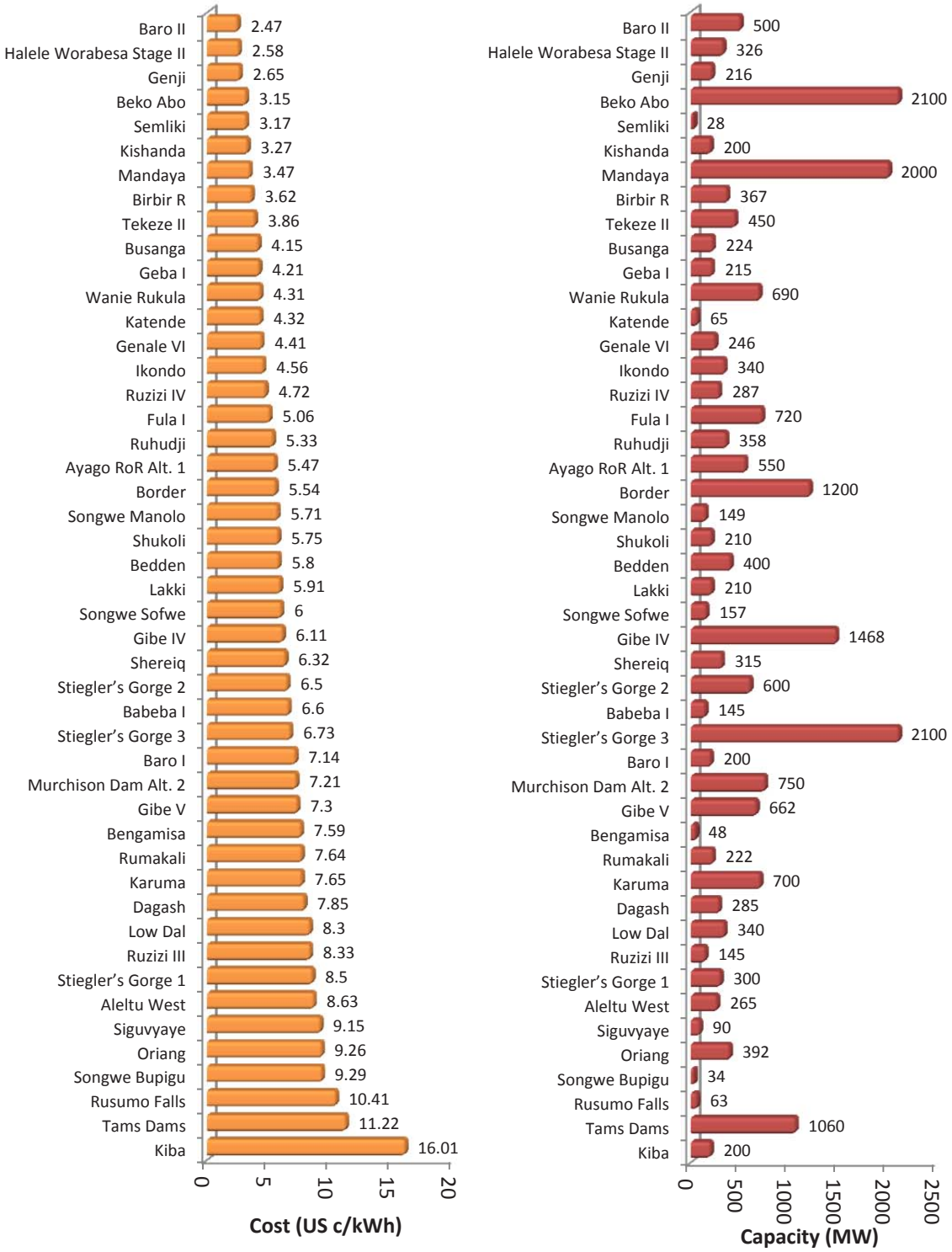


Figure 1512: Major opportunities for hydropower development in the Nile Basin indicating the unit cost of power production (US c/kWh) and the potential capacity of each scheme (MW)

BENEFITS FROM HYDROPOWER

River regulation associated with hydropower installations provides more reliable water supplies for agricultural production, industrial development, environmental flows and downstream hydropower installations. Flow regulation also reduces floods, which reduces damage to crops, property and infrastructure. Hydropower infrastructure furthermore reduces 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 facilities also reduce greenhouse gas emissions by replacing fossil fuel alternatives. With hydropower often being a local source of energy, it reduces the reliance on energy 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, 53]

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]. With only around 20% of the hydropower potential in the Nile Basin having being installed, there is much potential for this growth. The 6 000 MW from the Grand Renaissance Dam represents an 88% growth in the hydropower production in the Nile Basin once it is completed in 2017. This far exceeds the 6-12% growth described above, which will be associated with an additional 6% growth in GDP. This will add $37.46 billion per year, based on 2014 GDP values[55], with Figure 16 indicating the respective country benefits. While electricity is a key requirement for economic growth, it is not the only requirement. Various other factors, such as political stability, manufacturing and trade would also affect GDP. The analysis also assumes the distribution of additional electricity to be proportional to GDP.

The value of regional interconnections and associated market instruments (such as power pools) can improve the stability of electrical transmission systems while reducing the need to plan for surplus electricity for each country (redundancy in case of failures). In terms of regional power interconnections, the benefit of reduced surplus can be calculated by starting with the 10% surplus margin required at the national level to ensure reliable supplies. The surplus can be pooled at the regional level, which means the surplus can be reduced to 5% for each country (based in the principle of pooled risks and

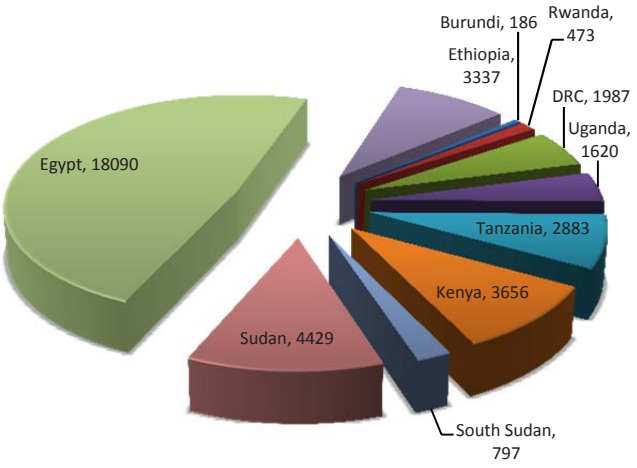


Figure 1613: Annual benefit in GDP (millions US$) based on 12% growth in electricity production and associated 6% GDP growth.

[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 Bank (2016) World Bank Data http://data.worldbank.org/data-catalog/GDP-ranking-table Last Accessed 24 April 2016

benefits), which translates to 5% less electricity being required across the power pool to provide the same reliability of supply. With the current generation capacity from hydropower in the Nile Basin being 6 833 MW, the reduction in required generation capacity is 341 MW. With the average project costs for hydropower installations being $2.7 million per MW[56], the saving through reducing the need for surplus electricity adds up to $921 million.

An increase in the reliability of electricity supplies on national GDP can also be estimated through calculating the economic impact of power interruptions. A recent study found that if African countries had the same quality of electricity supply than South Africa, the average rate of per capita GDP growth would be increased by two percent[57]. Considering the combined GDP for all NBI countries[55], the benefit of increased electricity supply quality of power will be $12.49 billion per annum. The additional GDP for the respective countries (assuming that benefits will be shared in proportion to GDP) are shown in Figure 17.

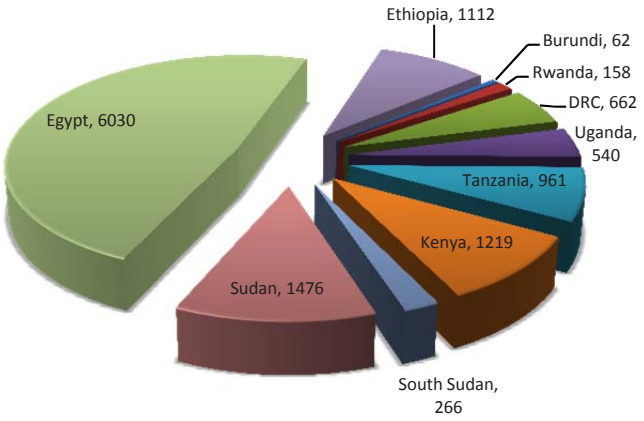
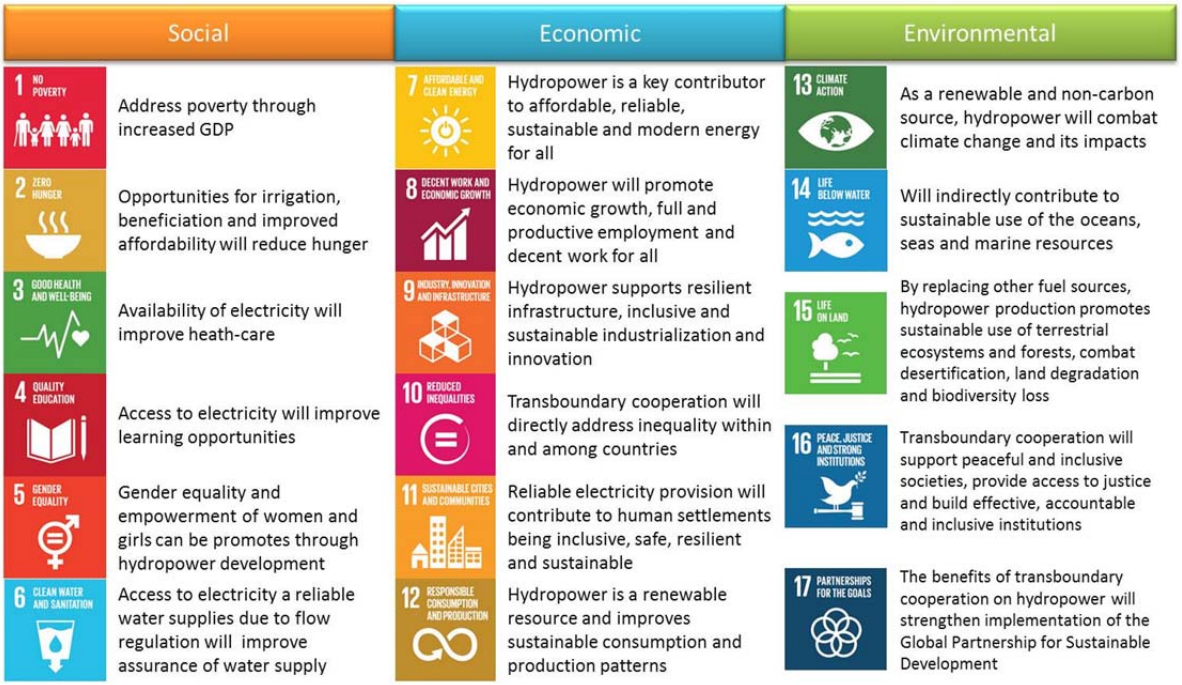


Figure 1714: Increase in GDP due to increased reliability of electricity supply

Cooperation to promote hydropower development and transboundary cooperation will also bring substantial benefits in line with the UN Sustainable Development Goals, listed in Section 2.4. The specific benefits are outlined hereunder.



[56] NELSAP (2013) NELSAP Economic Model. NELSAP-CU. Entebbe.
[57] Anderson TB, Dalgaard C-J (2013) Power outages and economic growth in Africa. Energy Economics 38:19-23

The benefits of transboundary cooperation related to hydropower generation and distribution is summarised in Figure 18 for the HDI metrics. These benefits relate to direct impacts, such as GDP growth, but also to indirect impacts, such as improved academic performance. The UN Sustainable Development Goals cover a broader spectrum of impact areas, with the benefits associated with these metrics listed in Figure 19.

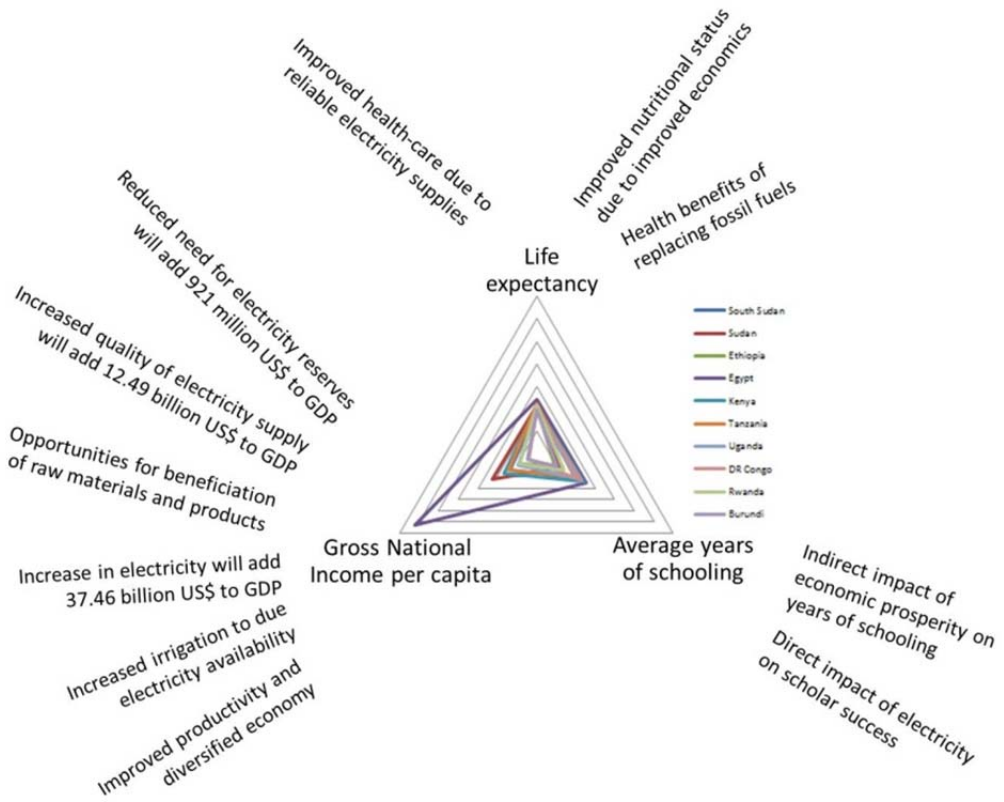


Figure 1815: Benefits of transboundary cooperation on hydropower related to the Human Development Index metrics.

The water-energy nexus has become a key perspective for the hydropower sector. The nexus defines the relationship between the impact on water caused by the provision of energy, and also the energy needed to collect, clean, store and supply water. The concept of the nexus is based on an understanding of the relationship between the sectors to manage them in an integrated way. All technologies that produce energy require water. This includes water for cooling in thermal generation, for irrigating crops for biofuel, as a process requirement for extracting fuels, and as the energy source in hydropower. In this context, it is important to distinguish between consumptive use of water, where the water is not returned to the system for reuse, and non-consumptive use, where hydrology and water quality may be affected, but the water is available for downstream use[44]. In the case of hydropower in particular, the nexus approach looks at the close linkages between water and energy as a portfolio, thus taking into account the transboundary costs and benefits, which includes security of power supply, increased water security through flow regulation, flood control, and a reduction of sediment loads. The associated costs include the capital investments required, operation and maintenance costs, and water lost through increased evaporation.

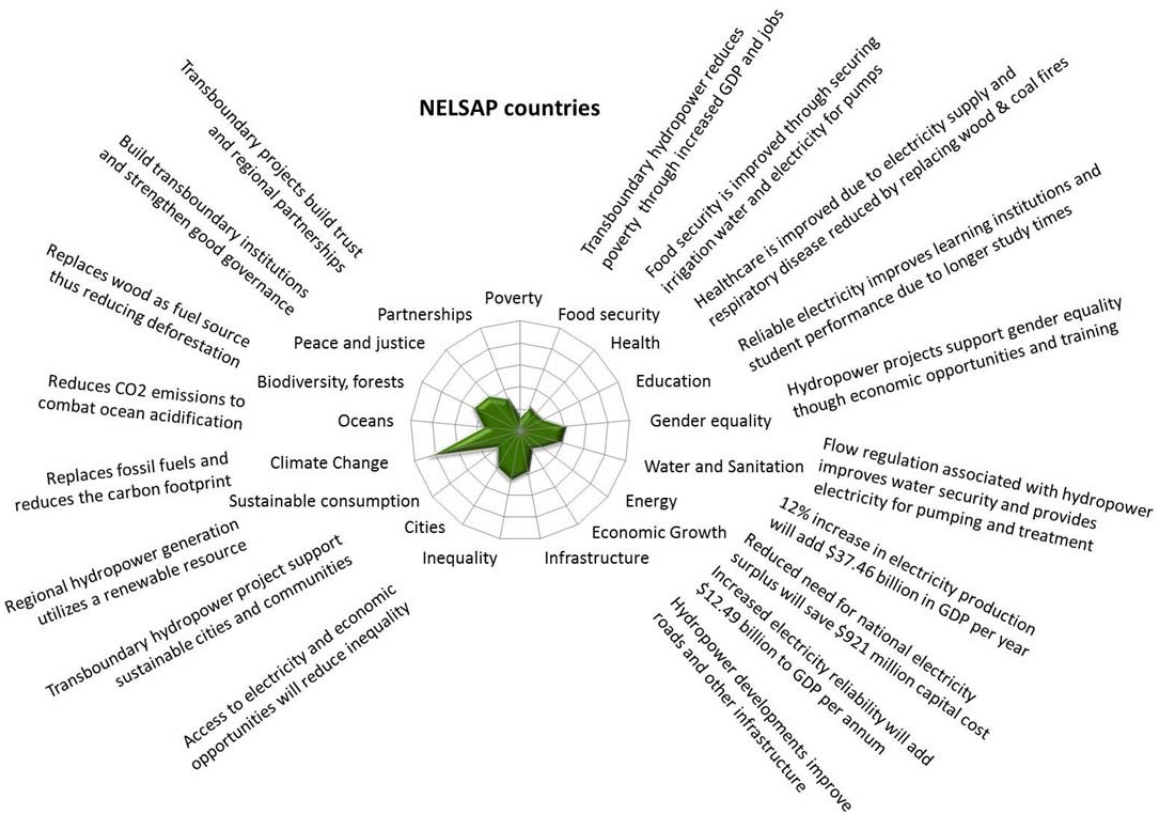


Figure 19: Benefits of transboundary cooperation on hydropower related to the Sustainable Development Goals.

The increasing awareness of transboundary benefits is changing the minds of people. Examples include access to electricity that supports livelihoods for artisans, improved access to communication, improvement in quality of people's lives through financial security, political security, education, health, etc. The benefits go beyond direct dollar value, but also include cultural aspects. People from different cultures and countries start to mingle and through that people become enriched and become friends. There are also changes at the political level. Whereas the focus was initially just on hydropower, it is now much bigger integrated cooperation, for example with the Northern Corridor development. There are many things that can cause the future in the Equatorial Lakes region to be different than the present. These include climate change, instability (terrorism), migration (refugees), ICT development, threats of water being the reason for war, land issues as populations are growing, perspectives from the younger generation, the need to create opportunities, and the fact that there is still a lot of unexplored resources. Transboundary resources should be developed jointly, but member countries should also be clear on their national benefits in terms of project tangibles to ensure that there is complete buy in. Cooperation only works when every participant understands that their net benefit, based on investments, risks and returns, are beneficial from a national and regional perspective.[58] An example of this is the Rusumo Falls

[58] NELSAP (2015) Staff interviews

scheme, where regional cooperation facilitated funding from the World Bank (US $340 million), the African Development Bank (US $113 million) and USAID (future support). Each of the partner countries (Burundi, Rwanda and Tanzania) will receive 26 MW from the scheme.[59] The Ruzizi III hydropower scheme also demonstrates the benefits of transboundary cooperation between Rwanda, the Democratic Republic of the Congo and Burundi. The 147 MW scheme will be built at a total cost of $625 million, with the African Development Bank (AfDB) having approved $139 million from the AfDB's public sector window and $50.22 million from the private sector window. Other funding partners are the European Investment Bank (23.40%), the World Bank (18.72%), KfW (2.65%), European Union (2.34%), Agence Française de Développement (2.34%), and the Project Company (22.46%). As a public-private partnership, the implementation of the project will be the responsibility of the Great Lakes Energy Organization. The Ruzizi III scheme will create opportunities for jobs and local economic development during the construction phase and macro-economic development benefits for the partner countries during the operational phase.[60]

3.3. THE ETHIO-SUDAN POWER SYSTEMS INTERCONNECTION

The development objective of the Ethiopia-Sudan Interconnector Project, which is an Ethiopia/Nile Basin Initiative, is to improve the effectiveness of the power systems in the Eastern Nile region by promoting regional power trade through the establishment of coordinated planning and the construction of transmission interconnections in the context of multi-purpose water and energy resources development in the region[61]. The project involves the construction of 544 kilometres of 500KV AC interconnector line from Ethiopia to Sudan and 1 665 kilometres of 600KV DC interconnector line from Sudan to Egypt. The connection point in the original study was from Mendaya in Ethiopia to Kosti in Sudan and finally from Kosti to Naghamadi in Egypt, but with the implementation of the Grand Ethiopia Renaissance Dam in Ethiopia, the connection point will be changed. An update is to be incorporated in the feasibility study before embarking on implementation of these interconnectors[62].

Prime Minister Hailemariam Desalegn and President Omar Hassan Al Beshir inaugurated the Ethio-Sudan Power Systems Interconnection in Gedarif, East of the Sudan on 4 December 2013[63]. On the occasion of the inauguration, Alemayehu Tegenu, Minister of Water, Irrigation and Energy of the Federal Democratic Republic of Ethiopia said "*the completion of the project will elevate the economic and political relation of the two brotherly countries in to a higher level.*" He noted that increasing border trade is increasing the demand for power and affirmed Ethiopia's readiness to supply electric power not only Sudan but to the region as a whole given it is blessed with huge renewable source of energy. He added that, the project in particular will have significant contribution to alleviate the low

[59] NBI (2014) Regional Rusumo Falls Hydroelectric Project Fact Sheet. NELSAP-RUSUMO.
[60] AfDB (2015) Environmental and Social Impact Assessment (ESIA) Summary.
[61] World Bank (2013) Ethiopia/Nile Basin Initiative Power Export Project: Ethiopia-Sudan Interconnector. Washington, DC: World Bank Group.
[62] COMESA (2013) Project Profile of Egypt Sudan Ethiopia Power Interconnector.
[63] AllAfrica (2013) Ethiopia: Ethio-Sudan Power Systems Interconnection Inaugurated. http://allafrica.com/stories/201312050077.html. Last accessed 3 December 2015.

power voltage problem in East Sudan. The importation of power through the new transmission line is deemed to have vital role in reducing the dependency of Gedaref State on thermal power. Prime Minister Hailemariam thanked the government and people of Sudan for their unreserved effort to make the completion of the project a reality. He reaffirmed the current Ethiopian leadership's commitment to continue building on the foundation laid by the late Prime Minister Meles and President Al Bashir.[63]

The Ethio-Sudan interconnection project has established 296 km of lines with a transmission capacity rating of 1200 MW. Around 1.4 million households (8 million people) are expected to benefit from access to cheaper and more reliable power. The power trade has increased Ethiopia's foreign-exchange earnings by US$8.8 million per year. The consumers in Sudan benefit from lower tariffs (US$0.05 per kWh for imported power, compared to US$0.096 per kWh from power generated domestically).[64] The Ethio-Sudan interconnection was originally a bilateral venture, with the Nile Basin Initiative coming into the picture at later stage, with the aim of fast-tracking the project and initiate cooperation for transboundary management. There are benefits for Sudan and Ethiopia in terms of power trade. Sudan has got cheapest power from Ethiopia, replacing thermal power. To promote benefit sharing, the concept has to be mainstreamed within the project itself to clarify how benefit sharing is going to take place. For future developments, it is important to establish the benefit sharing concept early on and follow up to quantify benefits in terms of water and economic benefits for the countries. It is important to note that benefits can't always be quantified. A strategy should be developed to assess benefits in monetary terms and other non-quantifiable items. While there are many things that constrain collaboration, it is not possible to meet shared objectives without cooperation. Some of the key lessons from the implementation of the Etiopia-Sudan interconnection are that actions should be more transparent and involve stakeholders. Implementation should also be closely linked to the reality on the ground, rather than theoretical arguments. It is also important to realise the complexities of cooperation and the associated patience required to achieve success. This requires a balance between urgent things that need to be done and patience to get and keep stakeholders and partners on board. Consequently, it is important to involve key stakeholders in the different aspects of the projects so that they can understand the true concept of benefit sharing. There is still a gap in terms of the awareness of benefit sharing. Stakeholders need to understand that it is not just water sharing, but increasing the sum of benefits so that partners can receive more benefits than was possible without cooperation.

The Ethio-Sudan Interconnection has significant impact in the region. It connected the two countries grid for the first time ever. The power trade was initially 100 MW, but has grown to 200MW during the Sudanese heat season. Sudan is willing to buy more, provided there is supply. This is understandable, since it is a cheaper option than locally produced electricity from thermal sources. The electricity will expand both in terms of the quantity of power traded and the quality (for instance a 500kV interconnection instead of 230 kV to carry more volume). This will be possible once GERD comes into operation. With GERD in place, export to Egypt will be a feasible proposition. The transboundary cooperation will also lead to enhanced regional integration and security.[65]

[64] NBI (2015) The Nile Story. Briefing Note 2. Powering the Nile Basin.
[65] ENTRO (2015) Staff interviews

Ethiopia, Sudan and Egypt will share in a number of benefits once the interconnection is fully operational. The stability of electricity supply will support social and economic growth, but also encourage investment in areas that were previously plagued by electricity shortages. The complete integration of the power systems in Egypt, Ethiopia and Sudan will strengthen the resilience of supply. This will also establish capacity for developing larger power projects to meet increasing power demand in regional markets. The increased economies of scale will also allow the member countries to negotiate better terms for procurement of power equipment and technical assistance. The reduced cost of power through the increased utilisation of hydropower resources will benefit all the member countries, but importantly, the electricity generation is also environmentally friendly, which will promote sustainable development in the region and have a positive impact on community health. The partnership will support employment and economic development by facilitating industrial and commercial activity through the provision of reliable sources of electricity. Lastly, but importantly from a social development perspective, the electrification of rural communities are possible at marginal costs compared to current options available. This will bring about significant improvements in the quality of life of rural communities.

From an economic perspective, the Ethio-Sudan Interconnection is securing important income from Ethiopia, which is an offset against that high capital cost of the GERD (4.8 billion USD[66]) and other hydropower developments. The transboundary cooperation on the interconnection has also prompted cooperation in other areas. Anecdotal evidence suggests that there is significantly increased travel and trade in goods and services between Addis Ababa and Kartoum. While these can't be attributed only to the power interconnection, the cooperation certainly contributed to trust and neighbourly relations that also benefit cooperation in other sectors.

[66] Chen H, , Ashok S (2014) The Grand Ethiopian Renaissance Dam: Evaluating Its Sustainability Standard and Geopolitical Significance. Energy Development Frontier Vol. 3 Iss. 1, pp 11-19.

4. SCENARIOS

The scenarios that have been developed for cooperation in the Nile by 2024 was characterised by the degree to which regional integration is realised and the degree to which funding is available to support regional integration. The Scenario matrix is presented in Figure 20 [67]. The scenarios have significant implications for realising the benefits from transboundary cooperation.

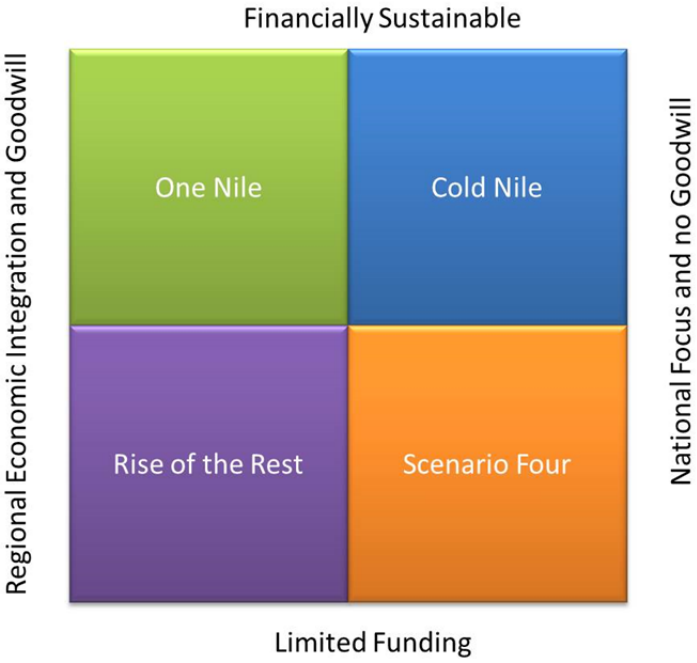


Figure 20: Scenario matrix for the future of Nile cooperation by 2024

The "*One Nile*" scenario is the future desired state where the benefits of cooperation are maximised and the riparian countries enjoy benefits beyond those that would be possible through unilateral action. As described in the scenario story: "*In this scenario, visionary leaders realize the benefits associated with a permanent resolution of the Nile water issue, and hammer out – Camp David style – a comprehensive water management and benefit sharing agreement.*" Furthermore "*The projects create facts on the ground and demonstrate tangible benefits of cooperation, while directly contributing to socio-economic development. It further cements the cooperative spirit.*" The consequences are clear in the statement: "*The new cooperative dynamic instils confidence and provides a stable investment environment, and international investors line up to get a piece of the action*" From an institutional perspective, it is also a positive story, with "*An effective and sustainable Nile Basin Commission that maintains the basin-wide focus is now firmly established. It plays an essential role in capturing the full benefits from the shared Nile resources.*" This is the Nile that NBI is working towards and the Nile that is aligned with "Agenda 2063: The Africa we want". Under the "One Nile" scenario, the full spectrum of benefits discussed in the case studies will accrue, as indicated in Figure 21. Only direct benefits that can be quantified are included in the summary. There are various indirect benefits related to quality of life, environmental improvements and economic returns that are not listed.

[67] Hilhorst B (2014) Scenario Construction: The Future of Nile Cooperation Ten Years from Now.

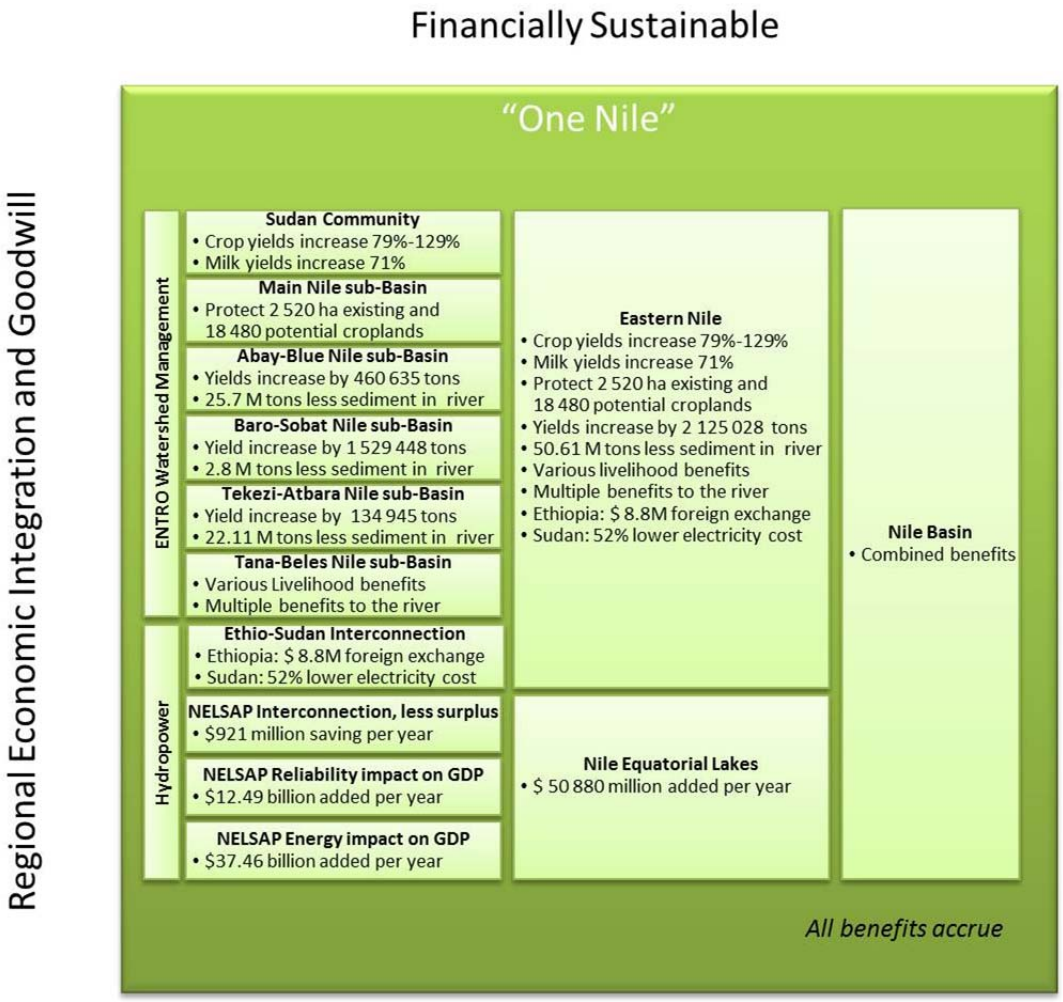


Figure 21: Benefits of transboundary cooperation in the case studies for the "One Nile" scenario.

The "*Cold Nile*" scenario reflects financial progress, but a national focus and unilateral action, stating that "*Populist politicians ignore information from technical specialists about the integrated nature of water resources management.*" Cooperation is strained under these conditions, with "*the general atmosphere regarding cooperation deteriorates. The basin-wide perspective is under threat.*" "*countries cannot agree on mechanisms for benefit sharing. Without this, and with disagreement on water-related development priorities, the Nile countries struggle to mobilize large-scale funding for cross-border investment projects.*" This in turn has implications for regional stability, "*With population growth and autonomous socio-economic development further increasing pressure on land and water resources, tensions start rising over use of the Nile waters.*" Institutions also fail, with the story stating that "*Cooperation efforts, therefore, are fragmented and despite the best efforts from the Nile institutions it is simply not possible to maintain the 'One Nile' focus in this tense and opportunistic atmosphere.*" Since there is limited cooperation in the Cold Nile scenario, transboundary benefits are not included in the summary (Figure 22). However, since there is a good economic climate, all local benefits are assumed to be realised. 50% of the impact of energy on GDP is included, since transboundary installations and interconnections will not be developed, thus only accounting for local generation and local supply.

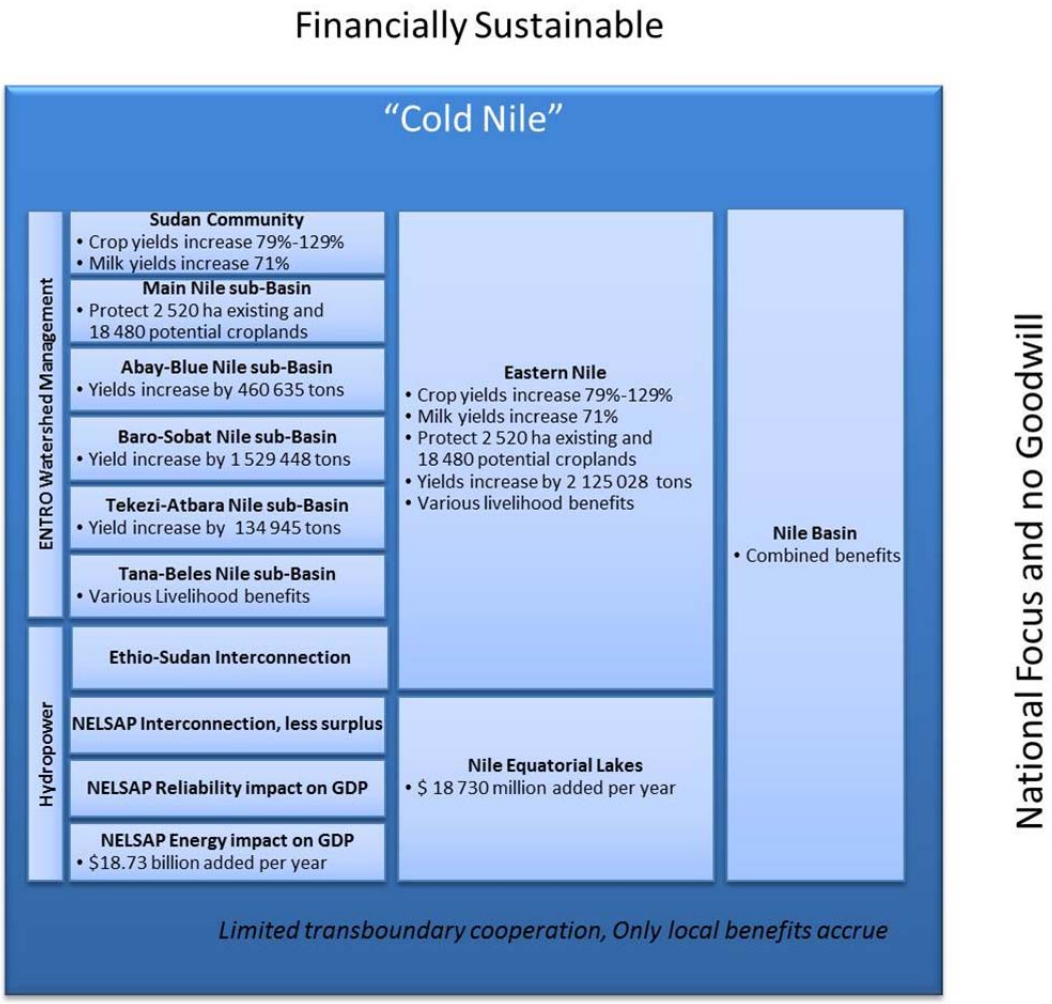


Figure 22: Benefits of transboundary cooperation in the case studies for the "Cold Nile" scenario.

In the "Rise of the Rest" there is cooperation and goodwill, but limited funding. Under these conditions "*…broad cooperative agenda stretches to the shared Nile resources, and there is political will at the highest level to achieve optimal and basin-wide socio-economic benefits from the common Nile water resources*" This is however not enough to maintain cooperation in a poorly funded environment, "*With inadequate funding to maintain its strong technical expertise and institutional support, the basin commission with its sub basin organizations finds it difficult to coordinate the myriad water related development initiatives across the basin.*" Finally, "*… the Nile basin splits into a number of well-coordinated sub-basins and regional programs. Basin-wide coordination, however, is poor and potential benefits from the shared Nile waters are not realized.*" The "Rise of the Rest" scenario supports regional economic integration, but under challenging economic conditions. The benefits discussed under the case study sections are included in the summary (Figure 23)), but only at 50%, to account for the impact of economic constraints.

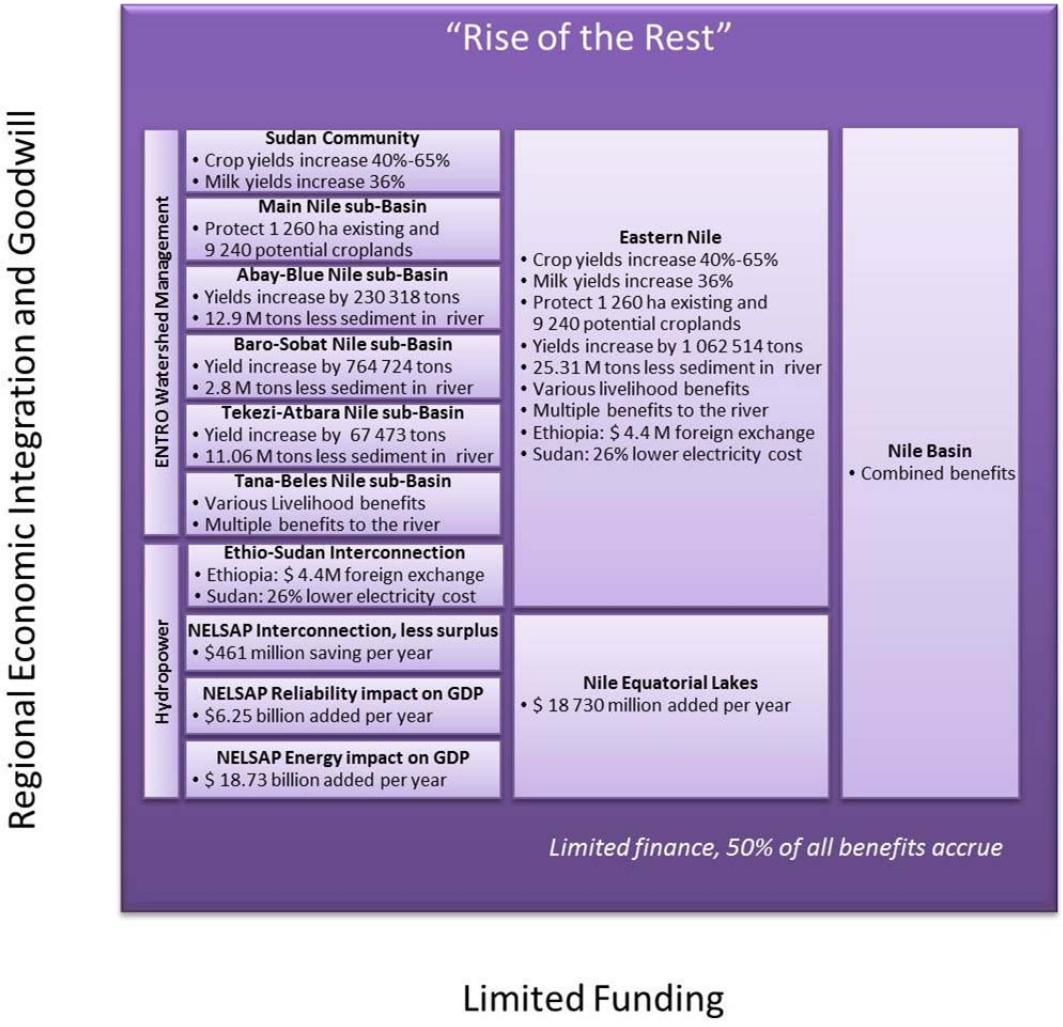


Figure 23: The benefits of transboundary cooperation related to the case studies for the "Rise of the Rest" scenario.

"*Scenario Four*" is the scenario which is least favoured and according to the scenario story, "*traditional development partners withdraw from the NBI project when not all riparians participate in the new commission.*" Due to the inward focus and short term pressures "*… the national water development agenda dominates, and unilateral water projects conflict repeatedly with equally uncoordinated development efforts in the neighboring states.*" Finally, "*In this environment, Nile cooperation slowly disintegrates and the basin-wide focus is lost. Foreign investors stay out, and the development potential of the Nile water cannot be realized.*" In "Scenario four" the economic conditions are constrained and there is a lack of regional economic integration. The benefits discussed earlier are only included in the summary (Figure 24) where they can be realised at a national or subnational level, and in addition, only 50% of the potential benefits are included, which accounts for the limited funding available to support developments.

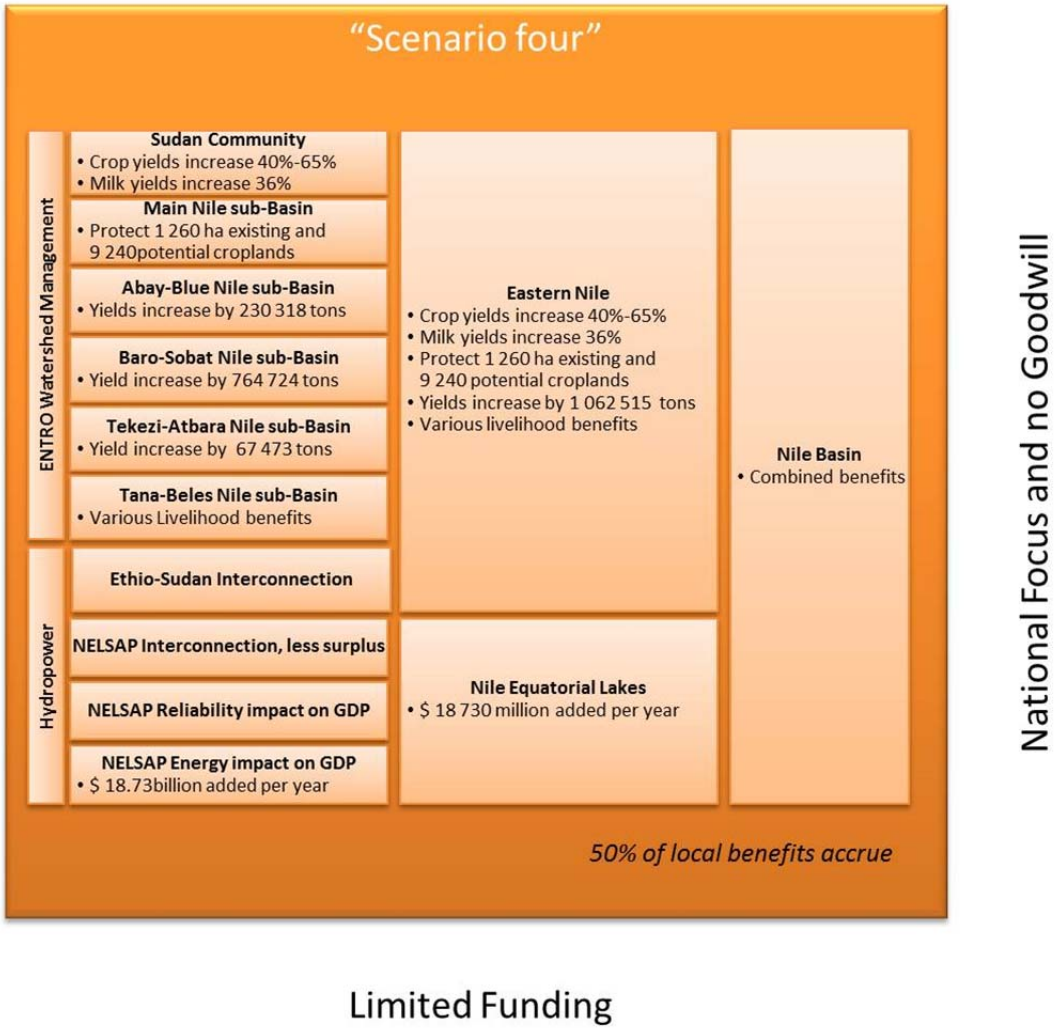


Figure 24: The benefits of transboundary cooperation related to the case studies for "Scenario four".

The benefits of cooperation described earlier can thus only be realised in the "*One Nile*" scenario. These benefits include improved crop production due to effective watershed management. The examples from the Eastern Nile point to increases of between 80% and 133%. If these gains were to be replicated throughout the Nile Basin the impact on food security, nutritional status and economic security will be remarkable. The reduction of soil and nutrient loss through watershed management will also increase grain yields significantly and reduce the financial cost of mitigation, including fertiliser application. The useful life of dams and water infrastructure will also be significantly extended through reduced sediment loads. The potential benefits of transboundary cooperation in hydropower development add up to $50.880 billion per annum. This is based on the direct impact of additional electricity on the GDP of riparian countries ($37.46 billion), the impact of increased quality and reliability of electricity supplies ($12.49 billion), the reduced need to maintaining national electricity surplus ($921 million), and $8.8M foreign exchange for Ethiopia. While some of the development can be implemented as unilateral or bilateral ventures, the bulk of the benefits will only accrue if all Nile Riparian countries cooperate.

5. Framework to Assess the Benefits of Transboundary Cooperation

Various approaches have been published on identifying and assessing benefits of transboundary cooperation. These include the "Beyond the River" approach[68], the "Benefits continuum" approach[69], the TWO analysis[70], the "Scalable approach"[71], and the "Ecosystem Services" approach[72]. While all these approaches are valid and useful within certain contexts, a simplified framework is needed to establish a common approach. The above (and other) technical tools can then be used to provide input to this approach. A simplified systematic approach is presented in Figure 25. The systematic approach starts with an analysis of the context, which includes politics, policies, economics, beliefs, values and the biophysical system. This should be followed by the basin condition (including available resources), the services that the resources can provide (resource use options), and the human well-being (socio-economic development) options that can be supported by these services. The information is then analysed from a portfolio perspective to come up with possible development scenarios. The preferred options would be those that bring about the greatest benefits in the context of development objectives, while utilising resources efficiently and maintaining the resource base for future generations.

The process should start at the basin scale for the analysis of the context, the available resources and the resource use options (Figure 26). The socio-economic development opportunities are then analysed at a sub-basin scale. This could be at the level of tributaries, countries, districts and communities. The analysis of options should be done at the broadest geographical scale possible to capitalize on the benefits of aggregation. However, when distribution of benefits is considered, the analysis needs to go to the sub-basin level. This will allow for the equitable distribution of benefits, but also the equitable distribution of costs and risks. The specific approach to evaluating the distribution of benefits from different development options at a basin level, at a country level and at a local level should be sensitive to the local context. Approaches such as cost-benefit analyses and multi-criteria decision analyses can be used to organise the available information in an accessible format and to provide technical pointers for optimal development scenarios. Such approaches do not necessarily provide a final answer, but should support the dialogue towards consensus on the best development configurations.

[68] Sadoff CW and Grey D (2002) Beyond the river: the benefits of cooperation on international rivers. Water Policy 4: 389-403

[69] Sadoff CW and Grey D (2005) Cooperation on International Rivers A Continuum for Securing and Sharing Benefits. Water International 30(4): 420-427

[70] 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

[71] 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.

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

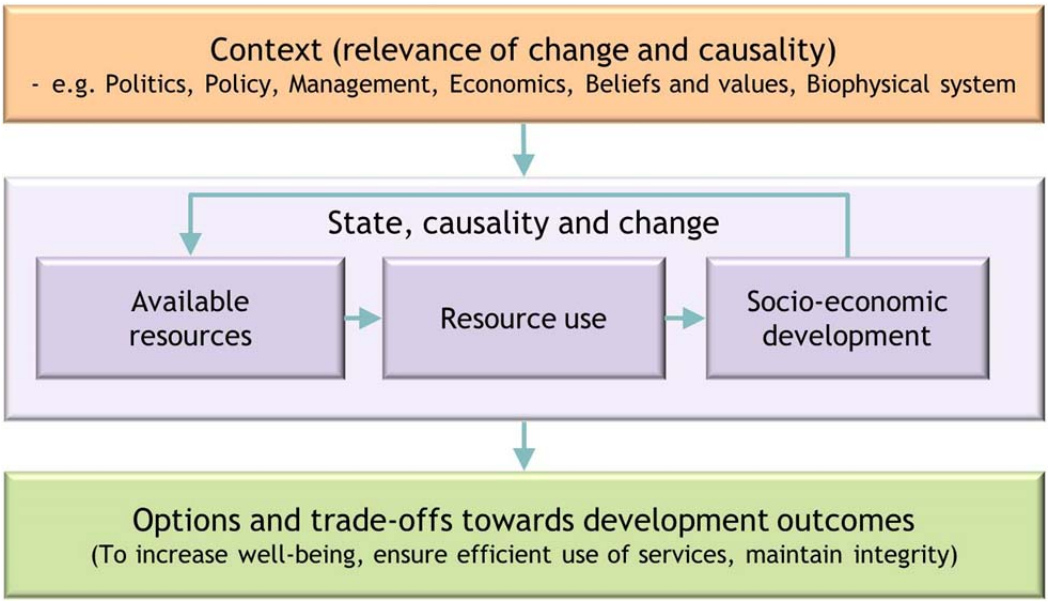


Figure 25: Simplified systematic approach to assessing the context and available resources and determining the best options in support of development outcomes.[73]

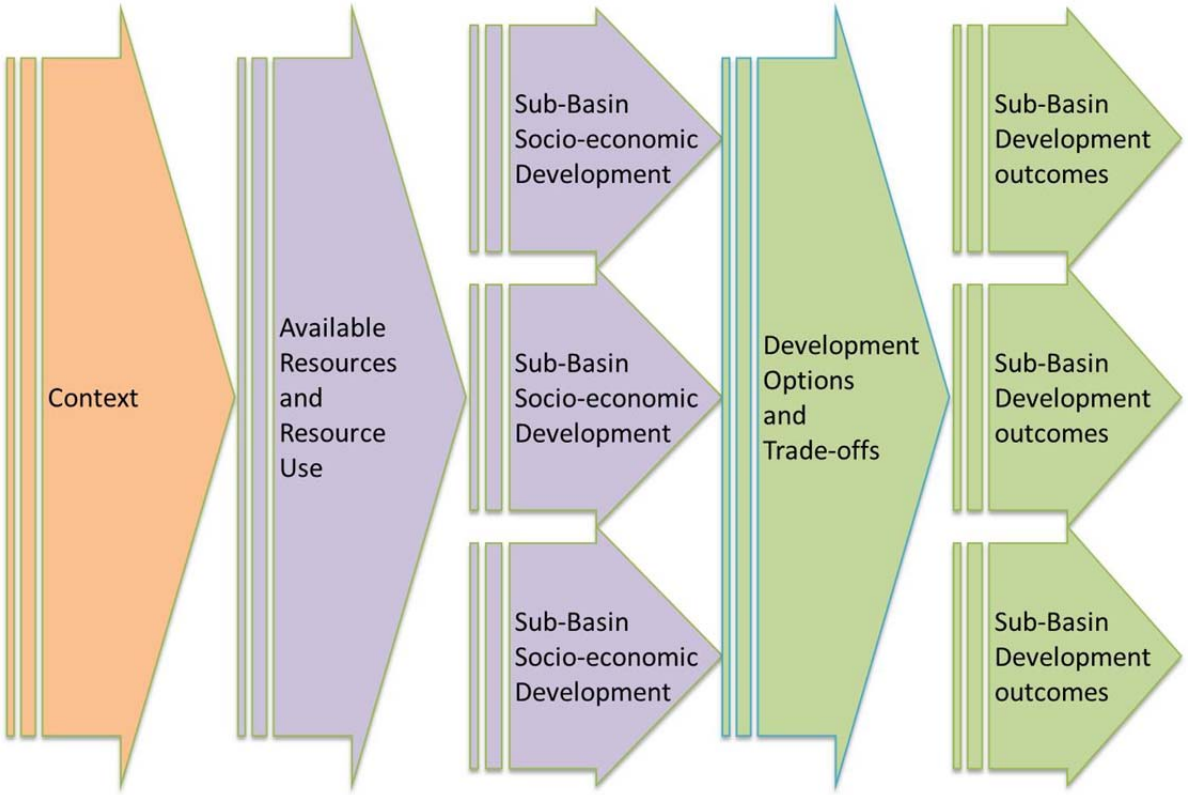


Figure 26: Aggregation and disaggregation to assess the best options in support of development outcomes.

[73] Claassen M and Nortje K (2015) Presentation at AFRICOM Horn of Africa Water Security Workshop - 24 August 2015

The framework for assessing the benefits of transboundary cooperation presented in Figure 27 is organised along the three main pillars of the United Nations 2030 Agenda for Sustainable Development, being Social, Economic and Environmental. The framework then brings these aspects together through a Transboundary Cooperation process, where Policy and Governance are key determinants. The benefits of transboundary cooperation are assessed through a causal approach. In the Environmental pillar, the key drivers are Land, Hydrology and Atmosphere, including all abiotic and biotic elements therein. These are the conditions that produce Food, Water and Energy. These benefits of transboundary cooperation should thus be increased through the Policy and Governance processes to nurture and improve the conditions and to increase the benefits derived from Food, Water and Energy. Some benefits can however also be directly derived from Land, Hydrology and Atmosphere. Similarly, the conditions for Social benefits are Health, Education and Opportunities. These conditions are translated through Policy and Governance to Capabilities, Productivity and Wealth. The latter is a multidimensional perspective on wealth and includes cultural and spiritual aspects. The fourth pillar is Economic, which is enabled by Fiscal policy, Investment and Trade. Benefits that accrue through this pillar are Liquidity, Capital and Income. The realisation of benefits is facilitated through the Policy and Governance process in a transboundary context. While the causality is approached in a linear way, the interrelations are equally important. Environmental drivers and benefits often support social and economic outcomes, with dependencies often being clear between social and economic processes. On the left hand side of Figure 27, the need for metrics or measures are indicated. These should relate to the inputs, the process and the results. Although quantification of metrics is often preferred, this is not necessarily always in monetary terms. The human development index (and imbedded metrics) is a useful framework for the social aspects, whereas the sustainability goals provide useful metrics for the environmental pillar.

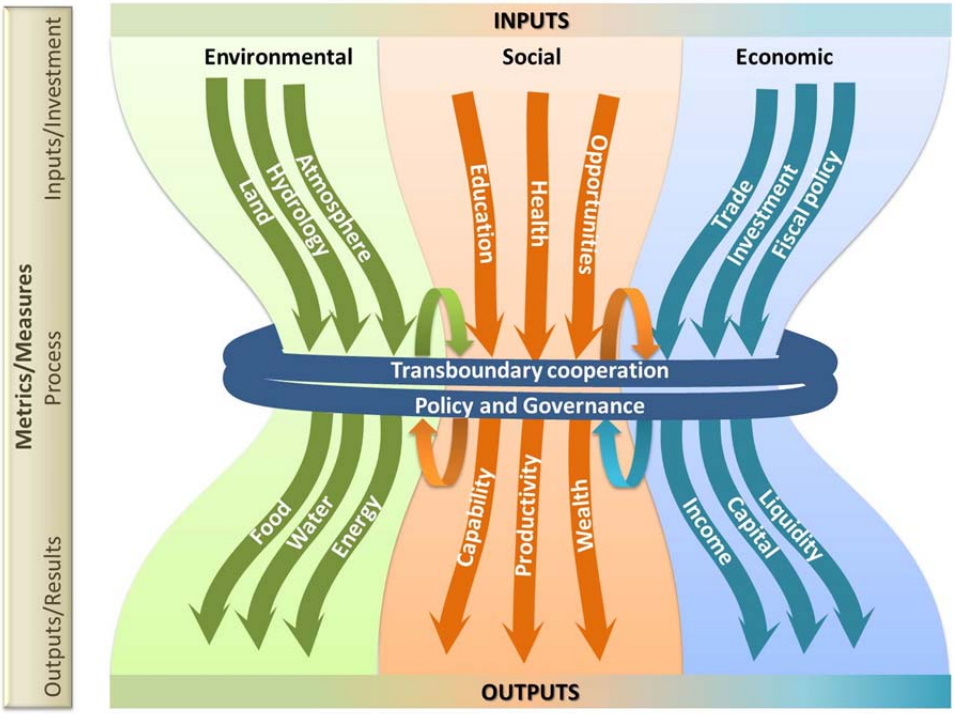


Figure 27: Framework for assessing the benefits of transboundary cooperation.

The application of the framework should follow a systematic approach of spatial aggregation and disaggregation. In practical terms this means that the environmental, social and economic resources and potential ("Inputs") should first be aggregated at a regional level. In the case of water-related developments, this should be at the basin scale. A comprehensive analysis should then be conducted to assess the most productive development and deployment options ("Outputs/Results") of the resources. The development options can then be disaggregated to assess the best distribution of Inputs and Outputs at the sub-basin and country level. These configurations would then encompass the benefits of regional cooperation (such as economies of scale, interdependencies, shared markets, multi-purpose infrastructure options), but be tailored to deliver benefits at the local level. The process component ("Metrics/Measures") indicated in Figure 27, should facilitate the translations of "Inputs" to "Outputs" through policy and governance, which includes the necessary institutions and finance mechanisms. A broad range of tools and approaches (mentioned above) are available to support the analyses, but earlier attempts failed to bring together the information in a single, systematic framework, where development options, benefits and costs can be compared at different scales.

6. WAY FORWARD

Previous attempts to quantify the benefits of transboundary cooperation followed a variety of approaches. These approaches are not always consistent in the metrics used for the assessment, nor are they consistent in the causality applied to the calculations. The above framework provides a common approach that can accommodate inputs from different technical approaches and present it in a consistent manner. While a lot of information has been generated in previous studies - some of which having been quoted in this report – the information is not always tailored to answering key questions. The development of high-confidence data related to the benefits of transboundary cooperation should be driven by a strategic framework. The question to ask is "*What information will make the biggest difference in supporting high-confidence planning and decision-making?".* The answer to this should guide the commitment of resources to establish a comprehensive framework, populated with relevant data that can serve as an authoritative source on the benefits of transboundary cooperation to promote regional development. An example of the need to be very clear on causality and data requirements is related to watershed management. Soil conservation would have an impact on crop yields, but it is not the only aspect that would affect this output. In a complex environment, many outputs depend on multiple drivers of change. While it is almost impossible to account for all possible drivers of a specific output, the analysis should focus on those elements that have the biggest impact on the desired outcome.

There is already substantial information and compelling arguments available on the benefits of transboundary cooperation. There should therefore be a parallel process of communicating the benefits of cooperation in innovative ways to different audiences, while the critical knowledge gaps should be filled through robust technical analyses. It is however important to prioritise technical analyses to address uncertainties that can lead to poor decisions or delays in decision-making.

6.1. PRACTICAL STEPS TO DELIVER BENEFITS FROM TRANSBOUNDARY COOPERATION

Agree on a systematic approach

The approach presented in Figure 25 provides a robust structure for analysis. Detailed tools, models and frameworks can provide information to feed into the approach. It is also important to consider the spatial and temporal scales of the analysis and in particular the linkages between scales. Figure 26 provides an approach to dealing with different spatial scales. The framework to consider the relationship between social, economic and environmental inputs and outputs, and the role of transboundary cooperation to facilitate the beneficiation is presented in Figure 27.

2 Identify and populate critical knowledge gaps

The suggested approach requires sufficient knowledge of the context, the conversion of basin resources into socio-economic value and considerations for options and trade-offs. Although it is not necessary to have complete knowledge to make good decisions, the missing knowledge that could pose a risk to good decisions and effective implementation should be populated. Examples of such knowledge gaps are the extent of indirect benefits, unintended consequences and unexpected barriers to implementation. It is of utmost importance to ensure that information is up to date. For example, many of the recent analyses on benefits of cooperation are based on data that is very old. Advances in technological efficiencies, changes in economic drivers and assumptions and changes in societal development aspirations can cause significant differences in cost-benefit ratios.

3 Prioritise and promote development opportunities

A clear articulation of the preferred development opportunities is needed to create a common platform decision-making. Such prioritisation should include a technical evaluation of which developments will yield the greatest benefits for the least cost and risk. The prioritisation should however also include an evaluation of political and policy alignment, attractiveness to financiers, societal perceptions and preferences, and other factors that may support or hamper implementation. Development opportunities should then be actively promoted through popular publications, printed and broadcast media, information brochures, sit visits and briefings.

4 Implement opportunities in a deeply integrated way

Whereas the benefits of transboundary cooperation are vested in the cumulative regional synergies and opportunities, deep integration between sectors will also yield significantly bigger results than each on their own. For instance, irrigation options should be co-developed and jointly implemented to align with access to capital and insurance, regional trade agreements, capacity building programmes, gender equality policies and initiatives, climate change mitigation and adaptation strategies and macro-economic policies. This deep integration is the premise of the "Nexus" approach, but much of the discussions and texts on this is superficial and fail to uncover the causal relationships between sectors.