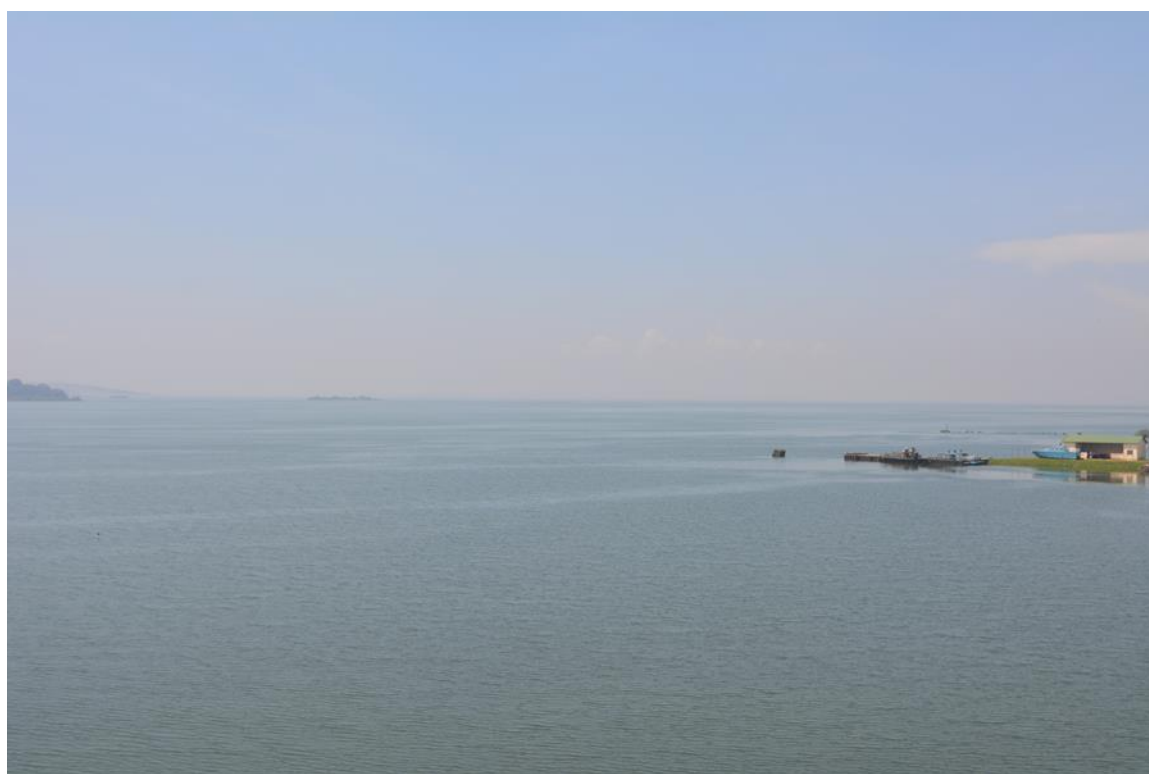


CTCN assistance in Uganda

Adaptation to climate change through improved information and planning tools for Lake Victoria

Deliverable 2 (activity 1.1) Report on feedback and decision problems

Deliverable 3 (activity 1.1) Summary of findings of potential case studies for demonstration and testing of technologies



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CONTENTS

1	Background	1
1.1	Objective and scope for the CTCN assistance	1
2	Environmental context.....	3
3	Existing projects in the region	4
4	Planning decision problems related to the CTCN assistance.....	6
5	Potential case studies.....	8
6	Next steps.....	10
7	References.....	11

Acronyms and Abbreviations

CTCN	Climate Technology Centre & Network
DHI	DHI - see more at www.dhigoup.com
GCF	Green Climate Fund
IUCEA	Inter-University Council for East Africa
LVBC	Lake Victor Basin Commission
LVEMP	Lake Victoria Environmental Management Project
MUST	Mbarara University of Science Technology
MWE CCD	Ministry of Water and Environment Climate Change Department
MWE ESSD	Ministry of Water and Environment Environment Support Services Department
MWE DWRM	Ministry of Water and Environment Water Directorate of Resources Management
NAPE	National Association of Professional Environmentalists
NBI	Nile Basin Initiative
NDE	National Designated Entity
NELSAP	Nile Equatorial Lakes Subsidiary Action Program
MGLSD	Ministry of Gender Labour and Social Development
RAN	Resilient Africa Network
STEPUP	STEPUP Standard Limited
UNCST	Uganda National Council for Science and Technology
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNMA	Uganda National Meteorology Authority

Decision problems and potential case studies

This document is based on the feedback received at the national workshop, which was held at the Uganda National Council for Science and Technology (UNCST) in Kampala on the 15th of June 2017. It presents and explores the potential case studies and decision problems within the water and energy sectors in Uganda, corresponding to Deliverable 3 (Report on feedback and decision problems) and deliverable 4 (Summary of identification of potential case studies for demonstration and testing of technologies) of the technical assistance.

1 Background

The national workshop marked the initiation of the Climate Technology Centre and Network (CTCN) funded technical assistance on “Adaptation to climate change through improved information and planning tools for Lake Victoria” with the objective of facilitating transfer and capacity building for climate change adaptation focusing on planning related to the Lake Victoria in Uganda. The minutes from the national workshop and the list of attendees is available from the previously submitted deliverable “Minutes from the national workshop”.

The national workshop gathered participants from various institutions from Uganda’s water sector and one participant from the energy sector, as well as the Lake Victoria Basin Commission (LVBC). There was a presentation of the scope and content of the CTCN technical assistance and discussions that could lead to the identification of current needs related to water resources and energy planning in Uganda. On-going activities, projects and programs were also brought forth by the participants in order to provide us with an overview of current investment and efforts in the sectors.

Attendance was in its vast majority stakeholders from the water sector. Attempts to engage stakeholders in the energy sector will be carried out during the next mission to Uganda. However, some stakeholders from the water sector are very much aware and involved with environmental and socio-economic issues pertaining to hydropower production. We were able to obtain information relevant to this sub area of the energy sector, which is also overarching with water resources and will therefore be the starting point for this sector.

The following chapters identify the planning decision problems and case studies, which could potentially be used to test and demonstrate how planning decisions can be supported outputs from the CTCN assistance through improved access to climate data, climate projections, and impact technologies supporting planning related to climate change adaptation.

At this stage, we provide in this document a description and initial appraisal. The detailed methodology will be the subject of the Deliverable5 of this technical assistance “Methodology for testing and demonstration”.

1.1 Objective and scope for the CTCN assistance

The objective of this technical assistance is to strengthen planning in the water resources and energy sectors in Uganda, at both long-term and seasonal timescales. At the conclusion of the technical assistance, local planners and operators should be able to access ensemble climate projections and seasonal forecasts, process these data, use

the data to drive impact models, and use ensemble simulation results to support decision-making for long-term planning and seasonal operations.

The specific objectives of this technical assistance are to:

- Provide access to state-of-the-art ensemble climate projections, seasonal forecasts, and satellite-based historical data through a web based interface.
- Refine the existing impact model used for simulating hydrology and water use in the Lake Victoria basin in order to maximize the utility of the model for estimating climate impacts on the water and energy sectors.
- Provide guidelines for using ensemble projections of climate variables and other drivers in decision-making,
- Demonstrate the utility of the technologies and guidelines through applications to local use cases.
- Enable decision makers and stakeholders to use the transferred knowledge, practices and technologies through dissemination and outreach activities.



Figure 1-1 Participants for the national workshop, which was held at the Uganda National Council for Science and Technology (UNCST) in Kampala on the 15th of June 2017

2 Environmental context

The CTCN assistance has the objective of facilitating transfer and capacity building for climate change adaptation focusing on planning related to the Lake Victoria in Uganda. The Lake Victoria extends into the three countries Kenya, Tanzania and Uganda and the basin extends further into Burundi and Rwanda. While changes in climate have varied across the Lake Victoria basin the effects of climate change and the environmental impacts have been consistent at a regional level within the basin. In general the expectations are an increase in the temperature, increased variability in rainfall patterns and a change in the frequency of extreme climate events (flood and drought). For Lake Victoria, sustainability depends on a fine balance between rainfall and evaporation on the lake itself, which makes the lake very vulnerable to climate change. Climate models predict changes to the climate on a short (10 to 30 years) and longer term (> 50 years) indicating serious impacts on the water balance for the lake, and thereby threatening the socio-economic importance for the around 30 million people living in its basin. Most of the climate related factors affecting the lake and the basin are expected to result in impacts across a number of sectors in the region.

Economic impact is occurring within some of the key sectors, relevant for the ongoing CTCN assistance will be:

- Agricultural sector: Change in the temporal and spatial variability of the rainfall will impact the food production and the availability of crops. Climate change is expected to contribute to increased food insecurity.
- Fishery sector: The expected change in climate and especially the balance between rainfall and evaporation on the Lake Victoria itself will impact the water volume and water quality of the lake with likely impacts on the existing fish populations in the lake.
- Energy sector: Climate variability will most likely impact the water volume and the water level fluctuations of the Lake Victoria. Impacts resulting in a declining water level coupled with an increasing demand for power will lead to power shortage.
- Mining sector: Increased mining activity resulting in large scale deforestation will combined with the expected increase in rainfall intensity impact the sediment transport and erosion transport into the lake.

Social impact caused by climate change in Lake Victoria region and Uganda is directly linked to the economic impacts listed above as the section of the population most reliant on natural resources for their livelihoods are also the poorest. Among the most vulnerable are women who have an unequal participation in climate related decision and policy making while facing higher risks. This is true not only in the region but worldwide, even though they are many times the agents responsible for resource management and household practices being sustainable.

Environmental impact caused by a combination of climatic and non-climatic factors brought about by socio-economic impacts mentioned, threatening the sustainability of wetlands and natural habitats in the region. The non-climatic impacts relate to intensive cultivation of crops such as sugar cane, sweet potatoes and yams in shallow wetlands, excavation of sand and clay for brickworks, and the invasion of water hyacinth while climatic impacts mainly relates to changes to the hydrological regime connected to changes to the rainfall pattern and evaporation amounts.

The environmental status or context of the Lake Victoria region, including Uganda, is a result of both climatic and non-climatic factors. The CTCN assistance will focus on addressing climate related impacts with regards to the water resources and energy with specific focus on Uganda.

3 Existing projects in the region

As the Lake Victoria region is sensitive towards changes to the climate, a number of past and ongoing efforts have been initiated to mitigate the issue.

To combat the challenges the East African governments have entered into a number of transboundary collaboration initiatives. The main collaboration and agreements governing the Lake Victoria Basin fall under the East African Community (EAC), a regional intergovernmental organization, established in 1999, and comprising of Kenya, Uganda, Tanzania, Rwanda and Burundi. There are several specialised institutions under EAC including the Lake Victoria Basin Commission (LVBC), which play an important role in coordination. The Nile Basin Initiative (NBI) consisting of the 10 riparian states provide an important framework for cooperation and management of the Nile River Basin resources. EAC and NBI signed a memorandum of understanding in 2006 regarding efficient management of the Lake Victoria Basin.

The East African countries have undertaken numerous projects in relation to Lake Victoria. The most notable projects have been Lake Victoria Environmental Management Project I and II (LVEMP-I and II), which made a lot of progress in relation to the water quality of the lake and in addressing the hyacinth infestation. However, activities related to climate change have been limited, and a key constraint is the lack of data and the sharing and organisation of existing data. Presently, the LVBC is developing a Water Resources Information System (WRIS). This should be used as an opportunity to establish a coordinated updated network of automatic weather stations, which via the network links up to the WRIS via the mobile network, and which could take its point of departure from the work done under FAONILE. Likewise, previous UNEP projects, eg. Nile Basin Adaptation to Water Stress executed by DHI (2013), have made significant progress in understanding the impact of climate change within the region.

The 2014 National Water Resources Strategy for Uganda identified a number of different future scenarios under which water resources management and infrastructure play an important role in national economic and social development. These include scenarios related to water use in the domestic and livestock sectors; increased hydropower production on the Nile River; increased irrigation; and oil and gas production. The strategy also identifies areas where increased water use has the potential to have adverse impacts, including impacts on tourism and wildlife; water quality; navigation; and fisheries. The 2014 strategy presents a blueprint for water resources management and development, as well as a framework for prioritizing future actions. As Uganda moves forward to implement the plan, it may be useful to prioritize actions that are likely to contribute to economic and social development regardless of future conditions, including climate change conditions. The robust decision-making approaches implemented as part of this assistance have the potential to provide valuable insight to decision-makers as implementation of the 2014 plan moves forward.

A number of relevant national programmes and initiatives was identified and discussed as part of the national workshop, which was held at the Uganda National Council for Science and Technology (UNCST) in Kampala on the 15th of June 2017. These are listed in Table 1.

Both the National Water Resources Strategy and LWEMP II programmes, as well as the list projects and initiatives collected during the workshop, will be considered in the assembly of the case study candidates for the demonstration and testing of climate change technologies provided by this technical assistance, to facilitate the sustainability of the outcomes from the CTCN assistance. This will be achieved by exploring collaboration with stakeholders having ongoing projects, which can be potential sources of input to the technologies to be delivered on the one hand, whilst on the other hand, meeting the needs of stakeholders which can be potential recipients of the assistance.

Table 1 Previous experience of projects in Uganda and the region, related to climate change in Lake Victoria as collected in the national workshop

No.	Programme or project	Institution
1	"VicRes" project focusing on livelihood in Lake Victoria. Historical perspective of Climate Change(CC) / Policy implementation	IUCEA
2	Severe Weather Project WMO (Lake Victoria safety)	MNA
3	UK Met office climate model of Lake Victoria providing 24h forecast	MNA
4	Climate Change projections 20/50/100 years provided by MNA	MNA
5	Project for blending of satellite data with station data	MNA
6	Baseline and situation studies by MWE, focus on dropping water levels in Wamala/Rwizi catchments	MWE
7	Catchment Management Plans for Rwizi and Katonga, have some focus on Climate Change impact	MWE
8	Wetland coverage dataset for monitoring purposes	MWE
9	Project for incorporation of Climate Change into Catchment Management Plans	MWE
10	Nile Water Allocation Tool Study	NBI
11	Incorporation of Climate Change in NBI water resources model	NBI
12	Qualitative study of resilience of community against floods, drought and landslides; Community survey conducted	RAN
13	Training on gender mainstreaming emphasized within RAN activities	RAN

4 Planning decision problems related to the CTCN assistance

The CTCN assistance aims at facilitating transfer and capacity building for climate change adaptation focusing on planning related to the Lake Victoria in Uganda. The decision problems within the water and energy sectors in Uganda supported by this CTCN assistance are those related to and affected by climate change. This represents a very extensive and broadly defined range of decisions problems within both the water resources and the energy sector. Therefore, the stakeholder workshop was the means to discuss and enhance our understanding of what should be highlighted and supported by the ongoing CTCN assistance

The main challenge participants pointed out, during the national workshop, in contributing to planning on short on long term within the water resources or energy sector is lack of data and effective capacity in interpreting, reading and applying datasets related to climate change. In addition, monitoring how outcomes of different studies make it into the decision process included in the implementation of actual interventions focussing on climate change adaptation, as well as monitoring their effective implementation on the ground was also mentioned.

Based on the discussions during the national workshop and subsequent analysis of the outcomes the key areas for planning decisions to potentially be supported by the CTCN assistance will be as follows:

- **Data and information management:** The influence of rainfall on water volume within the Lake Victoria basin is critical, and the ability to access accurate and timely climate information is one of the means to allow for long term planning decisions to improve resilience to climate change in sectors such as agriculture, hydropower and water management. There are many new technologies emerging making it possible to access and use high quality climate information in near real time based on satellite or a combination of satellite and ground stations.
- **Actions for climate change adaptation:** Decision-making related to climate change adaptation needs to take the uncertainty of future projections into account. The key challenge is to characterize uncertainty and integrate it into the planning process. Currently there is a lack of knowledge and guidelines on planning methods that incorporate the climate and other drivers into impact modelling, so that the performance of planning alternatives can be evaluated across a range of uncertain future conditions. The approach can be extended to include uncertainty about other drivers, such as population or economic growth. Technology required to implement the guidelines includes ensemble climate projections, an impact model, and tools for processing ensemble impact model results.
- **Water resource management:** As livelihoods and many national sectors depend on natural resources, climate change may result in negative socioeconomic effects. Climate change introduced water scarcity, may have severe impacts on many of the national sectors, and decisions taken to manage water resources need to include climate change impacts. Technologies for utilising the latest climate information and disseminating the results in form of indicators to the relevant end-users are critical for a sustainable water resource sector.
- **Management of agricultural climate change impacts:** Improved resilience of food security to climate change and variability is a key concern in the region as climate change is expected to influence the current crop types, cropping patterns, food production and result in increased food insecurity in the region. Management decisions can be improved through the following means: regional and local near real time monitoring of crop conditions, drought early warning systems, improved water

management systems and increased local knowledge and capacity for adaptation to the expected climate conditions.

- **Land degradation:** Land degradation in the form of land use changes is mainly a result of non-climatic factors such as deforestation, unsustainable agricultural practices and lack of knowledge or capacity. Combined with the expected increase in high intensity rainfall it results in increased erosion and loss of natural habitat. Decisions on prioritization of adaptation action scan be better informed by having improved capacity for monitoring and evaluation, and capacity building at national and local level.
- **Wetland monitoring:** Loss of wetland habitat is a problem across the Lake Victoria region due to population increase, agricultural production, deforestation for timber and abstraction of water for irrigation purposes. The degradation of the available wetland habitat is expected to increase with the combined impact from non-climatic and climatic factors as changes to the hydrological regime will impact the water availability within these areas. Monitoring and evaluation systems based on a combination of satellite and ground based information could provide a better overview of these areas, combined with the ability to include the environmental water requirements for these areas into the regional water management decisions.
- **Energy production and planning:** Historical climate variability has resulted in fluctuations in the volume of water in Lake Victoria. These fluctuations have adversely affected the generating capacity of hydropower facilities and infrastructure within the LVB. Uganda is dependent on the power supply from Nalubale, Kiira and Bujagali. All located on the Victoria Nile and depending on the outflow from Lake Victoria. For example, in 2002 and 2004, the declining volume of water in Lake Victoria coupled with an increasing demand for electricity led to several power shortages and blackouts in Kampala (Uganda). The CTCN assistance will focus on decision issues related to the hydropower production through tools providing the ability to assess the climate change impact on the hydropower production but also the impacts coming from non-climatic factors such as population change.
- **Solar energy development:** Solar energy is potentially one of the future energy forms which could benefit from the expected climate change due to expected longer periods with little rainfall and increased periods with clear skies. The development of solar plants could be facilitated through access to radiation maps assisting in determining where solar energy plants could be located; this information could be prior to conducting any feasibility study and assist decision making at an initial stage.

5 Potential case studies

The ongoing CTCN assistance aims at developing capacity and technology allowing national and regional stakeholders to address climate change adaptation with specific focus on issues connected to Lake Victoria. The outputs from the assistance will be tested and demonstrated on one to two potential case studies. The selection of the case studies will depend on the identification of relevant cases and the resources within the CTCN assistance to apply the outputs from the CTCN assistance within these potential case studies.

The potential case studies must comply with the following criteria accounting for relevance to the technical assistance, accessibility to sufficient information and documentation and effective engagement of the stakeholder(s) involved:

1. The outcome of the issue represented by the case study should have a significant environmental or socio-economic impact on a local or regional scale.
2. Climate change impacts need to be one of the critical factors influencing the success or failure of the case study
3. The case study should address existing or future investments related to the energy sector or water management within Uganda
4. Possibility to evaluate the case study using the water resources model established for impact assessment will be a great benefit
5. Be in line with national climate change priority sectors or plans

Based on the above, potential case studies are listed below.

Table 2 List of potential case studies for the testing and demonstration of the outcome of the technical assistance

N.	Title	Link to existing programme or activity	Stakeholder	Potential scope for a case study within the CTCN assistance
1	Management and dissemination of climate information	Adapting to climate change in Lake Victoria	LVBC	Providing and testing the use of different types of climate information of relevance for the upcoming programme. Development and implementation of a web based portal providing access to climate information e.g. the latest regional climate projections and satellite based near real time and historical climate information
2	Climate change impact on hydropower	National plans for future energy production in Uganda	Ministry of Energy and Mineral Development	The predicted climate change will impact the potential for hydropower production and hence the plans for the future energy production. The CTCN assistance will be able to provide tools for improved climate resilient decisions related to the sustainability energy production in the Lake Victoria basin. The tools will enable decision makers to evaluate the available water resource taking climate change projections into

				<p>account and balance the requirements for the hydropower sector with the requirements from other sectors and evaluate the most “cost effective” solutions based on user defined criteria. The potential case study will support the existing national plans for the future energy production in Uganda with information and availability of tools supporting the national planning process.</p>
3	Establishment of regional water resource assessment model for decisions related to the water resource or energy sector	LVEMP	LVBC and Ministry of Water and Environment	<p>The CTCN assistance will evaluate the existing water resource model located at LVBC and recommend refinements to make the tool more useful for climate change impact assessment within the Lake Victoria Basin. Refinements will be carried out after consultation with LVBC and other stakeholders. The refined model has the potential to be the central water resource model for assessment of climate change impacts within the water resource and energy sectors in Uganda, and potentially the region.</p>
4	Water resource planning at national and regional level related to the water resources and energy sector	National and regional programmes and studies	Ministry of Water and Environment, LVBC and NBI	<p>Technology for utilizing the established water resource model for evaluation of plans and investments, without the requirement of having detailed knowledge of the specific model. The use case will support evaluation of future investments related to water supply, irrigation scheme, hydropower, reservoirs and storage. Climatic change will be included as an external factor along with non-climatic factors as population change and requirements for environmental flow.</p>
5	Capacity and knowledge for decision making in a future climate	National training and capacity programmes focussing on climate change mitigation	UNCST	<p>The CTCN assistance will provide guidelines for decision making under uncertainty about climate change and other drivers. The guidelines will explain how to use uncertainty about climate change, as represented by ensemble projections, in a decision-making process. The use case will focus on embedding the guidelines into the existing workflows and decision processes within relevant ministries and organisations in Uganda. The focus will be on collaboration with selected stakeholders supporting that the guidelines are used actively in Uganda. Gender sensitive considerations will be</p>

				made with regards to the training activities.
6	Providing data and interpretation of climate change data for management of agricultural impacts	Existing activities or programmes	UNMA	Improved resilience of food security to climate change and variability through data and interpretation of climate change data for management of agricultural practices. The use case will support the use and interpretation of specific data related to overview and monitoring of the current and upcoming climate and data for monitoring of the current status within the agricultural sector. The monitoring of the agricultural sector will be based on the use of a number of drought indicators, each relates the current status to the past and enables the user to identify areas where the current management practices results in impacts on the agricultural production.

The six potential case studies in Table 2 will undergo a process of evaluation against the five criteria listed previously with input from the LVBC as the technical assistance request proponent and recipient of the access to climate data, the impact model and decision-making guidelines.

The final decision will be informed by the result of this joint evaluation process and further engagement activities of our team focused on the relevant stakeholders, as well as data collection to support the formulation of a solid decision-making problem for each case study selected.

6 Next steps

The next steps of this technical assistance follow, prior to Deliverable5, “Technology specification report”, and Deliverable 6, “Methodology for testing and demonstration” (November 2017).

- 1) A number of Skype meetings will take place to provide an initial overview of relevance and level of engagement of the stakeholders for the six potential study cases. Special attention will be given to contacting stakeholders in the energy sector.
- 2) A final list of potential case studies is compiled in case other relevant decision making problems are identified.
- 3) An initial analysis of the criteria previously listed will be carried out together with the LVBC to identify the final case studies: one case study must focus on a long-term planning problem, and another in seasonal planning problem.
- 4) A mission to Uganda will be organized to hold physical meetings with the stakeholders of the final two case studies selected. The selection of meetings will depend on the availability of specific organisations and the available resources within the CTCN assistance.

During this phase of the technical assistance, the role of the LVBC will be to provide input to the criteria analysis: the LVBC will weigh in according to their priorities for data and technology demonstration.

With regards to the role of the NDE, the assistance of the UNCST in the setup of meetings would be extremely positive and of great importance. This institution has proven capacity to mobilize stakeholders and articulate communication between our team and the stakeholders. Our team will therefore keep the NDE closely informed of all activities of the project requiring stakeholder input and collaboration, and request their assistance in mediation and logistics when feasible for both parties.

The selection of the case studies and their detailed descriptions will be presented in Deliverable 6 “Methodology for testing and demonstration”.

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