HyCRISTAL

The Contribution of HYCRISTAL to Implementation of HyVIC

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Outline of Presentation

- Challenges;
- Motivation;
- Objectives and implementation arrangements;
- Lessons from the rural pilot project on lakes Wamala and Kawi in Uganda

Challenges

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Climate warming is expected to affect major livelihood sectors especially Agriculture/Fisheries, Energy, Water and sanitation, Health, Transport and infrastructure, and exacerbate disaster risk management and there is need to address the impacts. HyCRISTAL was designed to address this: Genesis

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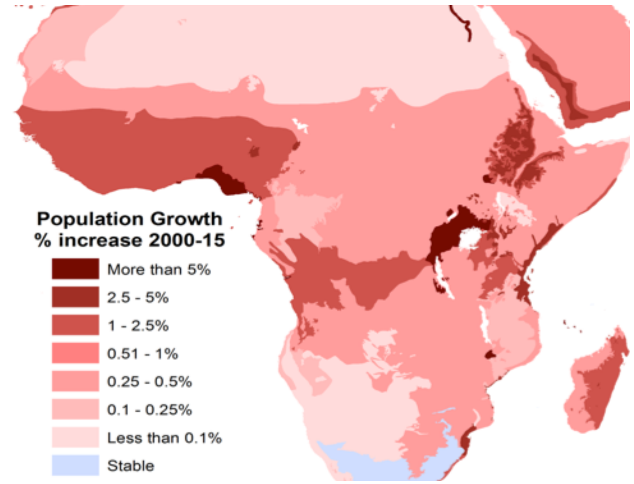
HyCRISTAL Motivation

- Rapidly growing population, depending on climate sensitive resources with highest density around lakes;
- Changes in climate & its impacts in EA are uncertain;
- Changes in water resources from climate change will be critical across climate sensitive sectors;
- There is need to reduce and quantify uncertainty, determine impacts, and develop and implement adaptations



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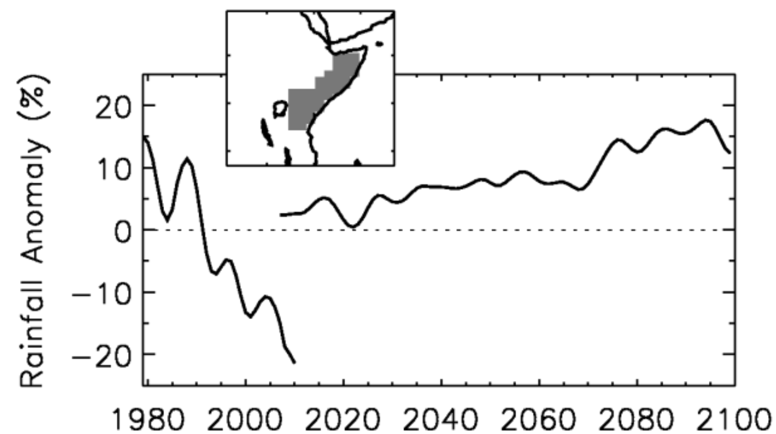

Rapid Change in East Africa: A local example

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Land use change around city of Kampala between 1974 and 2008

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Key Elements of HyCRISTAL Activities

Develop and implement policies to address climate impacts and adaptations

Engage conduct outreach to the communities

Develop adaptation strategies to safe guard resources and livelihoods

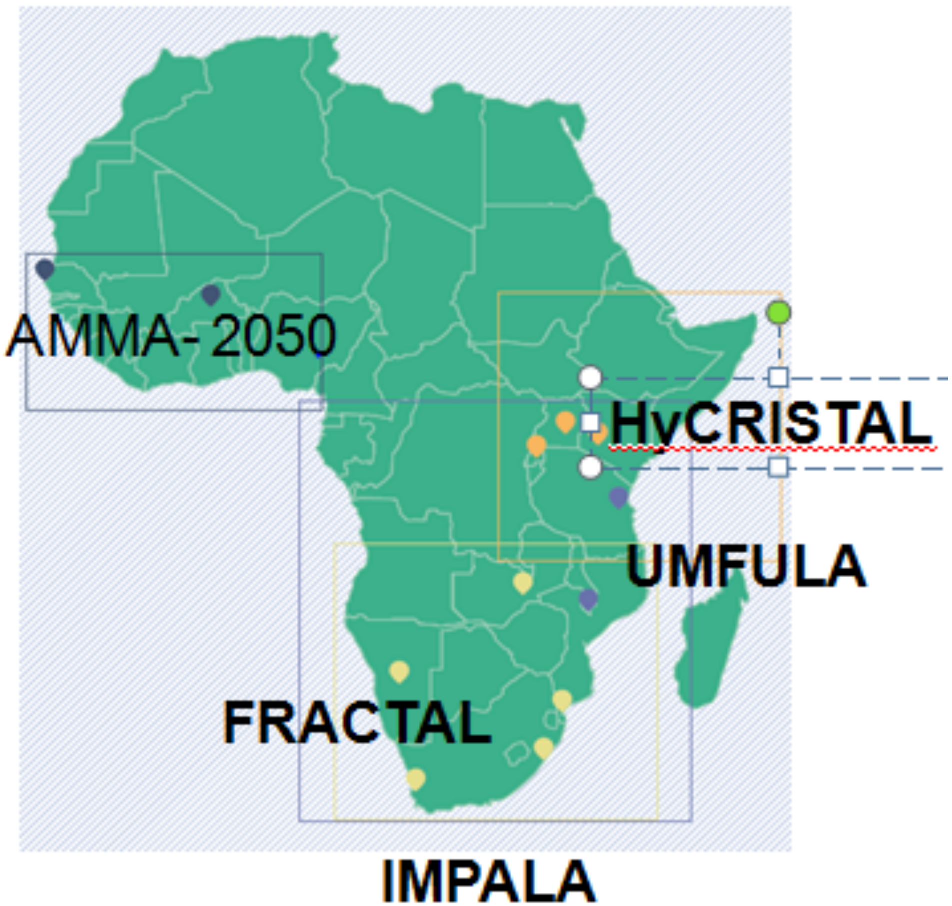
Determine how the changes in climate affect resources and livelihoods

Provide information on how the climate has and will change 5-40 years

Build capacity

FUTURE CLIMATE FOR AFRICA

HyCRISTAL Partner Projects in Africa



HyCRISTAL i.e Integrating Hydro-Climate Science into Policy Decisions for Climate Resilient Infrastructure and Livelihoods in East Africa

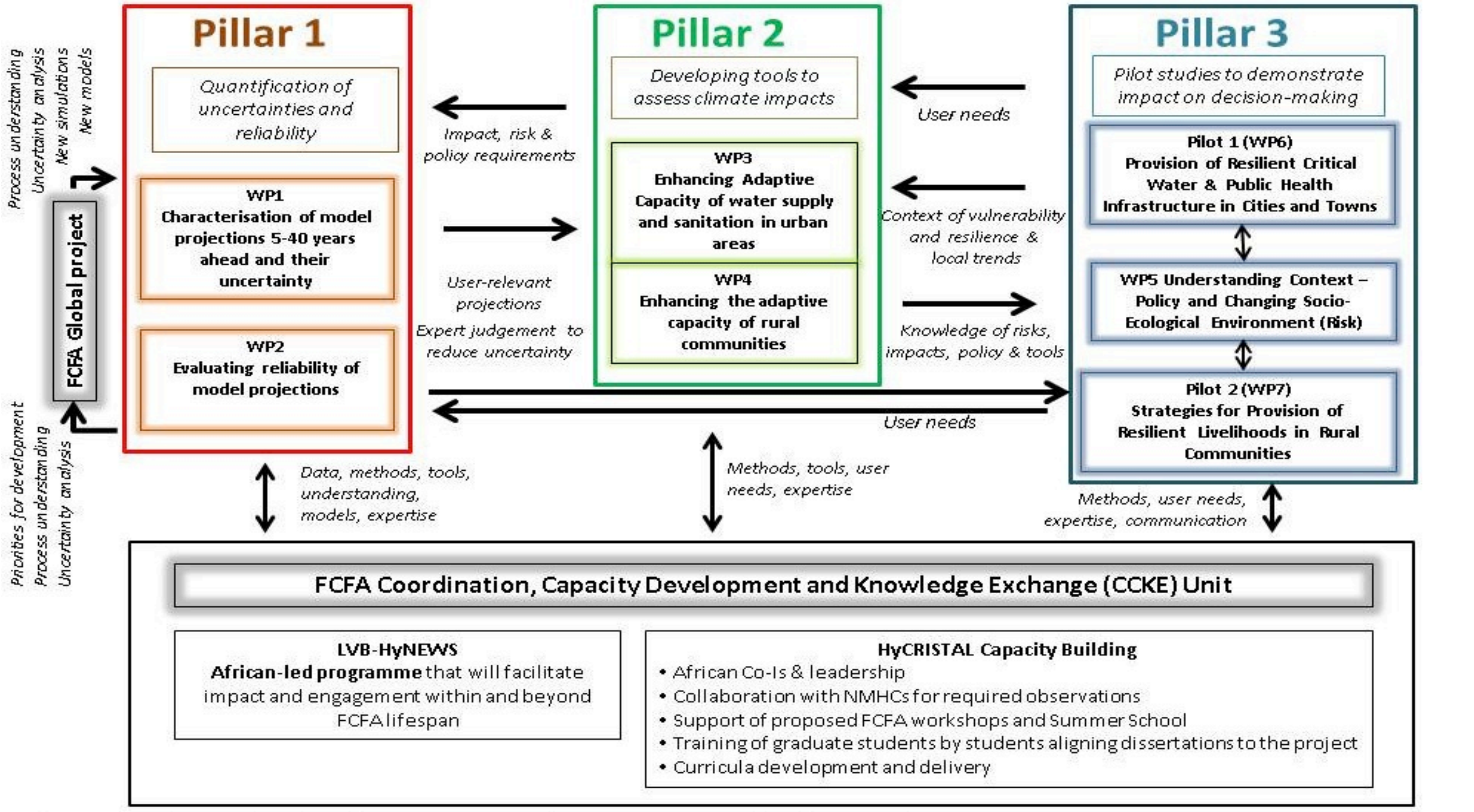
Major Activities of HYCRISTAL

Organized under three interlinked pillars:

- ❖ Quantify uncertainties and reliability in climate projections for the Lake Victoria region;
- ❖ Develop tools and assess climate impacts; and
- ❖ Undertake pilot studies to demonstrate impacts in decision making to support adaptation

Improve capacity for project implementation at different levels and increase awareness

HyCRISTAL Structure



The project is implemented under three interactive pillars operating under seven work packages (WPs) each with several sub-WPs

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Pillar 1. Quantification of Uncertainty and Reliability of Climate Data 5-40 Years

WP1: Characterization of Model Projections and their Uncertainty by assessing:

- Risks of change using decision-relevant climate metrics;
- Projected lake hydrology & uncertainty;
- Uncertainty due to aerosol emission;
- Uncertainty due to urbanization and land-use change;

WP2: Evaluating reliability of model projections assessing:

- Reliability of multi-model EA rainfall projections;
- Uncertainty from representation of moist convection;
- Evaluation of the global (CMIP) & regional (CORDEX) climate models; and
- Processes driving recent 5-40 year EA climate variability

Pillar 2. Developing Tools for Assessing Climate Impacts

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WP3: Enhancing adaptive capacity of water supply and sanitation in urban areas

- Assessing risks at regional-level;
- Modeling climate impacts;

WP4: Enhancing adaptive capacity of rural communities

- Assessing the status of livelihoods, risks and coping strategies;
- Development of livelihood strategies;
- Assessing policies at regional level;

Pillar 3. Pilot to Demonstrate Impacts on Decision Making

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WP5. Understanding policy and changing socio-economics

- Understanding past, current & future vulnerability;
- Understanding policy decision-making pathways, governance structures and institutional influence;
- Examining enabling policy, delivering evidence and demonstrating resilience;

WP6: Pilot 1: Operationalizing and delivering evidence on climate risks and response strategies for resilient critical water and public health infrastructure in cities and towns

- Technical assessment and design of environmental sanitation solutions for pilot cities, economic and lifecycle costing and feasibility;
- Quantification of reduction in climate-related risk under planned interventions
- Policy consultation at city and regional level

WP7: Pilot2: Operationalizing and delivering evidence on climate risks and response strategies for provision of resilient livelihoods in rural communities

- Community consultation;
- Assessment of national/regional-scale livelihood sustainability;
- Quantification of risks;
- Development of high level socio-economic planning guidelines

Capacity Building

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The is dedicated funding under DFID / NERCH to support capacity building activities including:

- Promoting new African-Northern research partnerships, with secondments
- Obtaining required observations builds trained observing capacity
- Facilitates capacity building workshops
- Developing mobile regional postgraduate course on ‘Climate and Society’
- Implementing a monitoring, evaluations & learning programme to increase the visibility of the benefits of investments in climate research

HyCRISTAL Team

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- **Academic Institutions**
- Leeds, UK: Marsham, Evans
- **Makerere, Uganda: Efitre, Sabiiti**
- Connecticut, USA: **Anyah**
- **JomoKenyatta University, Kenya: Mutua**
- North Carolina State University, USA: **Semazzi**
- University of Reading, UK: Cornforth, Ainslie, Black
- Centre for Ecology & Hydrology, UK: Evans
- Loughborough University, UK: Wilby
- **University of Maseno, Kenya:** De Giusti, RA (funded by Maseno)
- British Geological Survey, UK: Lapworth, Macdonald
- Stony Brook University, USA: **Lwiza**

National Met Services & Specialist Institutes

- **Ugandan Ministry of Water Resources: Tindimugaya**
- **National Fisheries Resources Research Institute (NaFFIRI), Uganda: Ogutu-Ohwayo,**
- **Tanzanian Meteorological Agency: Waniha**
- **Ugandan Department of Meteorology, Sekunda**
- Met Office, UK: Rowell, Bonoth, Kendon
- **Non-Governmental Organizations**
- Evidence for Developmet: Petty, Seaman, Clegg
- Practical Action: Clenaghan, **Umubyeyi**
- **Knowledge Intermediaries**
- **African Centre for Technology Studies (ACTS): Kingiri**
- AfClix: Cornforth

(With 20 partners, 14 in East Africa)

Expertise from across East Africa, UK and USA, with Co-Is from universities, NGOs, research institutes and operational climate prediction.

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Lessons from the Pilot Project on Lakes Wamala and Kawi

This pilot project was undertaken by NaFIRRI with support from the Rockefeller Foundation and HyCRISTAL has been build around the outcome of that project

Objective

The objective of the pilot project was to equip small scale fishers, lake and communities with knowledge and adaptations to cope with impacts of climate variability and change

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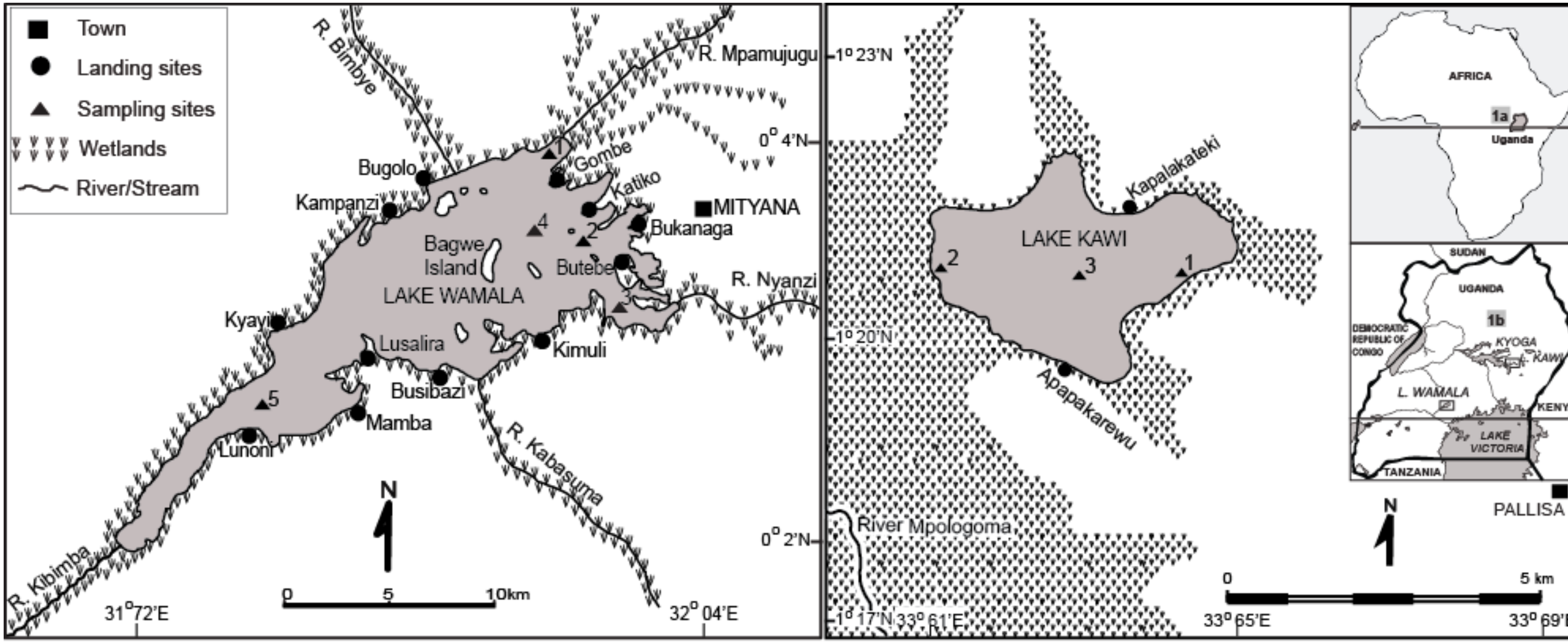
Pilot area



The study was based on two small lakes (Wamala and Kawi) which have undergone changes in hydrology, productivity and livelihoods with changes in climate parameters

Plans under HyCRISTAL

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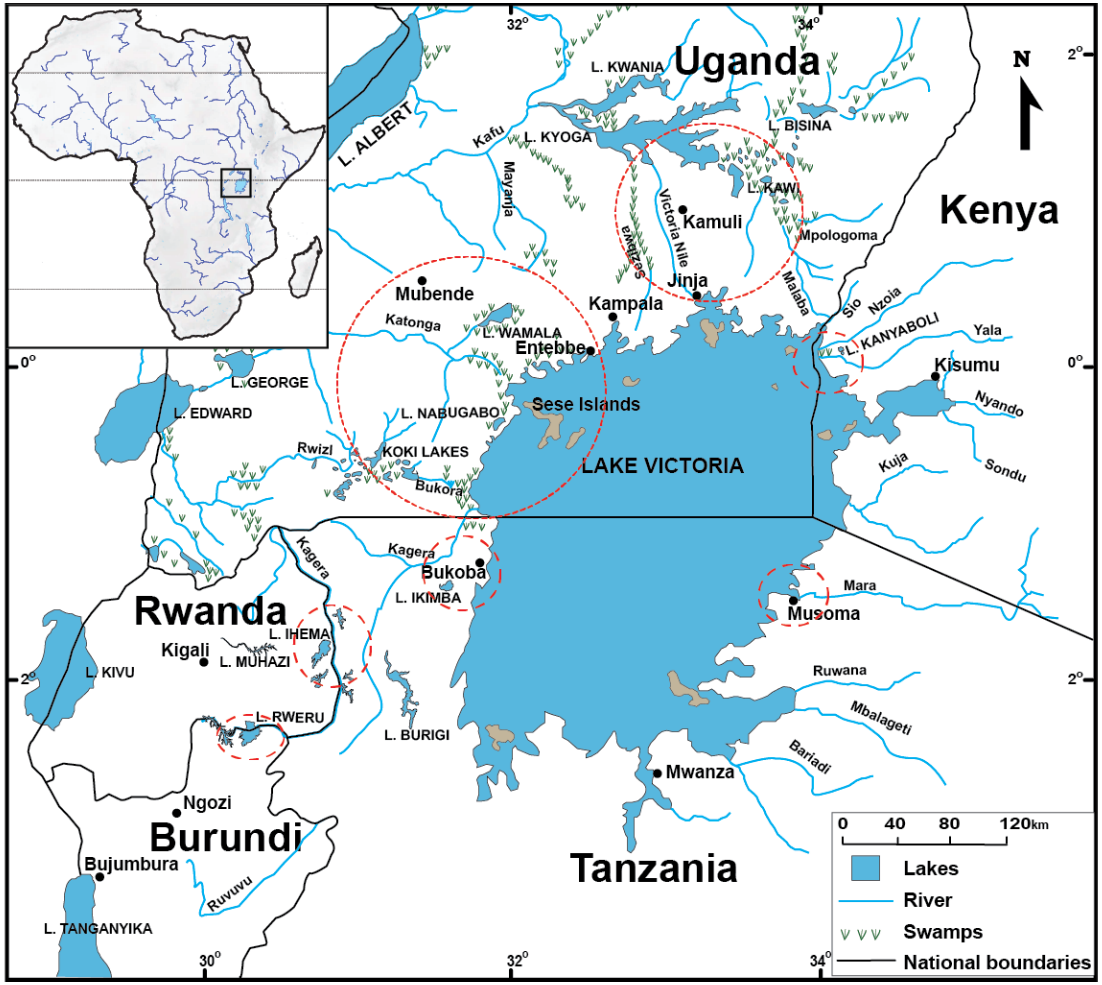
The plan was to develop tools that could be refined and expanded to other areas of Lake Victoria and LVB in this is partly being done under HyCRISTAL



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Specific objectives

The study examined:

- ❑Changes in climate parameters and associated changes in aquatic ecosystems and production processes;
- ❑Impacts on livelihoods, adaptation mitigation measures;
- ❑Policies and regulations and governance systems;
- ❑Conduct outreach and community engagement;
- ❑ Build human resources capacity at research, policy and community level

Temperature

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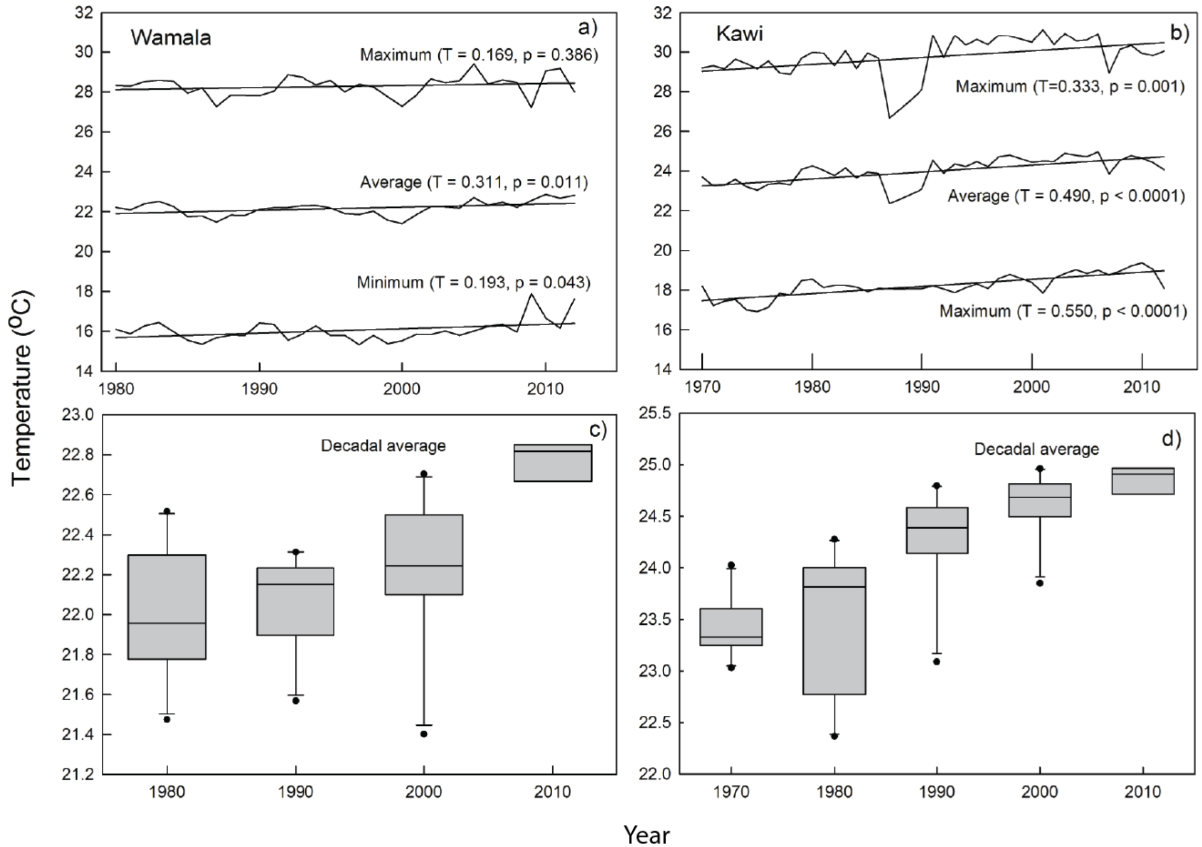

Temperatures around lakes Wamala and Kawi varied before but have increased consistently by 0.02-0.03°C annually since 1980s in line with global predictions

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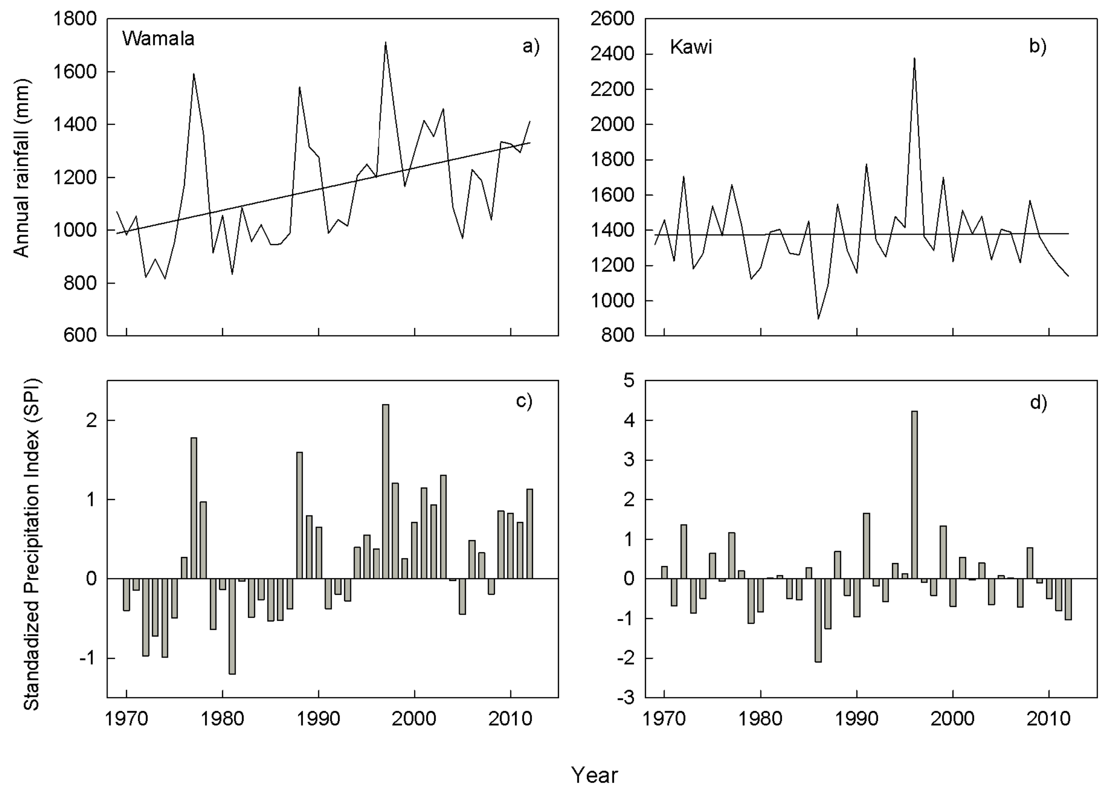
Rainfall

Rainfall around Lake Wamala deviated from annual average in the past but has generally been above average since the 1980s which is consistent with IPCC predictions for the East African region



Wind speed

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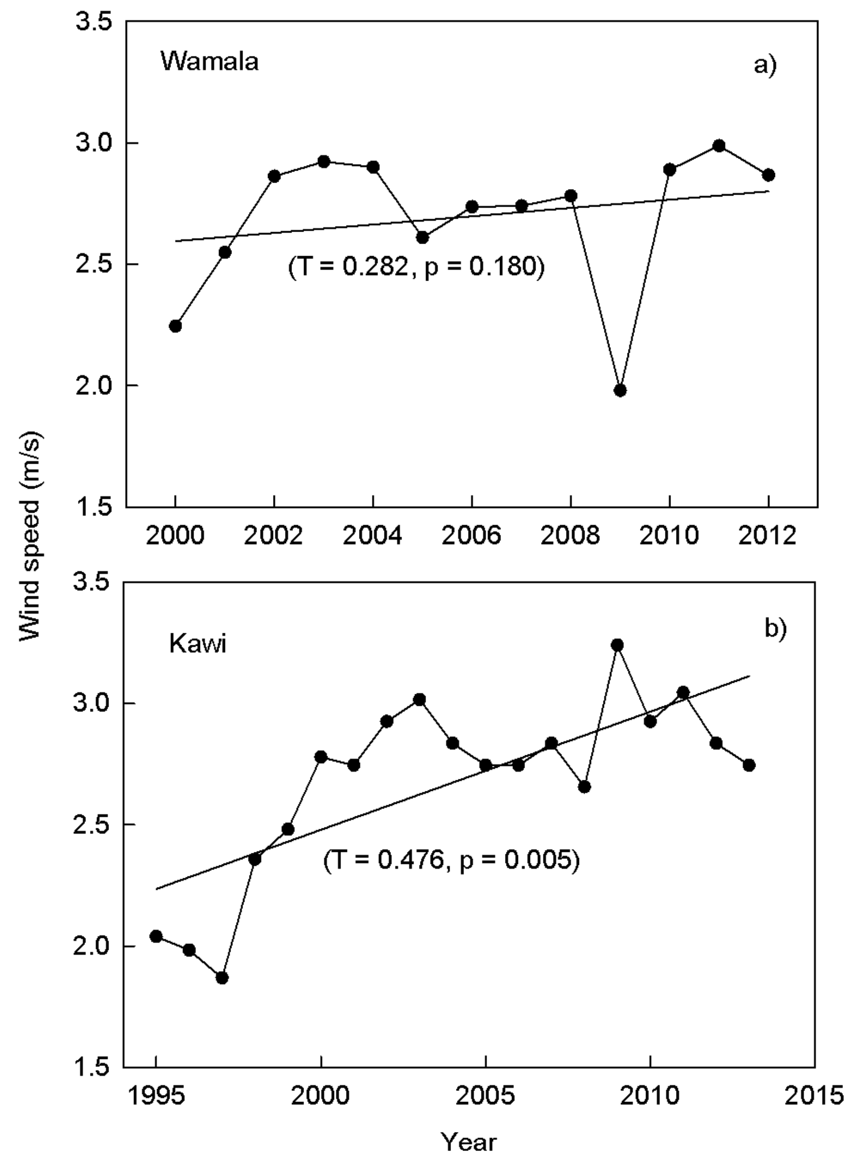
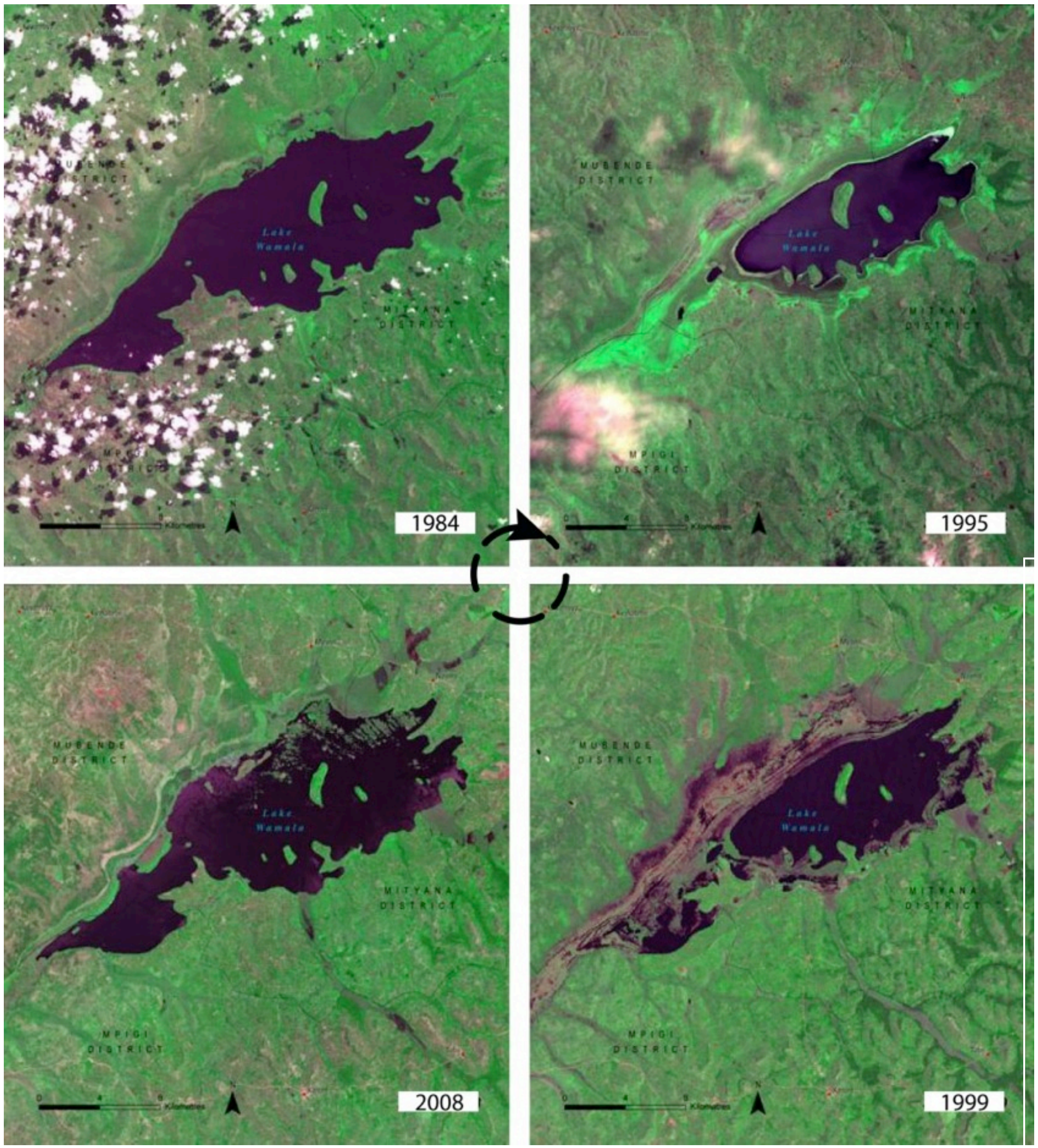
Wind speed around both lakes increased, but was only significant around Kawi



Changes in area of Lake Wamala



Lake Wamala shrunk to about one half its area between 1984 and 1995 and increased between 1995 and 2008 but has not fully recovered with water gauges still on land by 2014

Impact of floods and drought

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Climate variability and change was accompanied by floods and drought

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Nutrients and Algal communities

Parameter	1999	2000	2011	2012	2013
Physico-chemical					
TP ($\mu g l^{-1}$)	137	91	55	313	
SRSi ($\mu g l^{-1}$)	1958	4184	1239	8197	6453
Algal biomass ($\mu g l^{-1}$)					
Cyanobacteria	175	135	690	2460	630
Green algae	17	34	12	150	590
Diatoms	40	30	1710	9600	610

Algal communities

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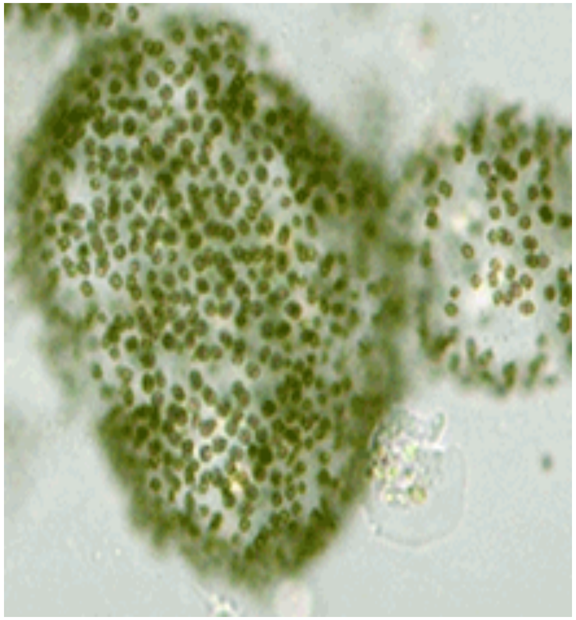

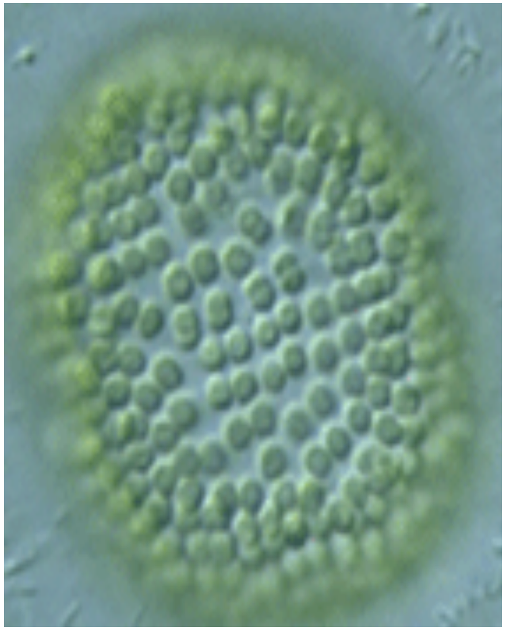

The algal community is dominated by fast growing opportunistic blue green algae which are common under low oxygen and unpredictable nutrient conditions. The abundance of the diatom *Aulacoseira* in Lake Wamala may be due to high concentration of silicon.

Invertebrate composition

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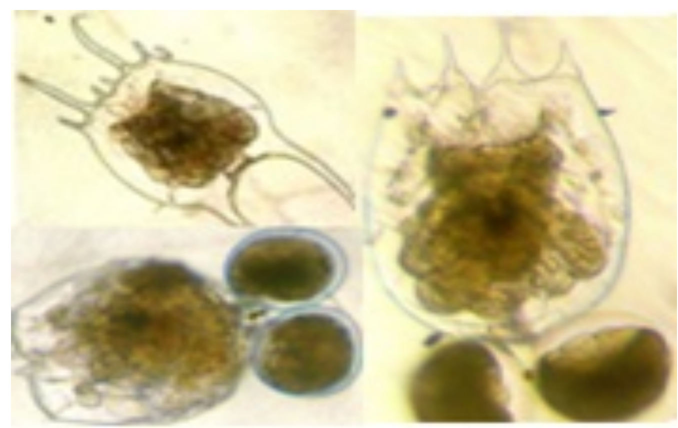
Macro-invertebrates in Lake Wamala are dominated by chironomids and chaoborids while the zooplankton are dominated by smaller rotifers comprising opportunistic organism common under low oxygen conditions



Fish species composition

The composition of the fishes in lakes Wamala and Kawi has shifted from dominance of Nile tilapia to the African catfish and the lungfish that are more tolerant to lower oxygen conditions

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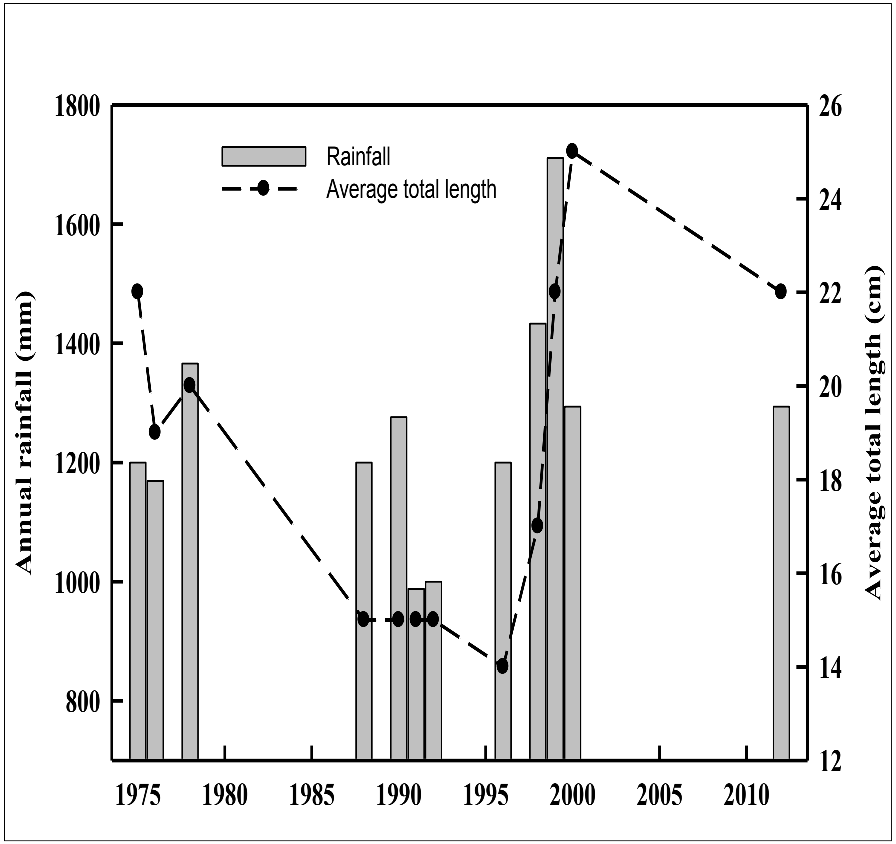
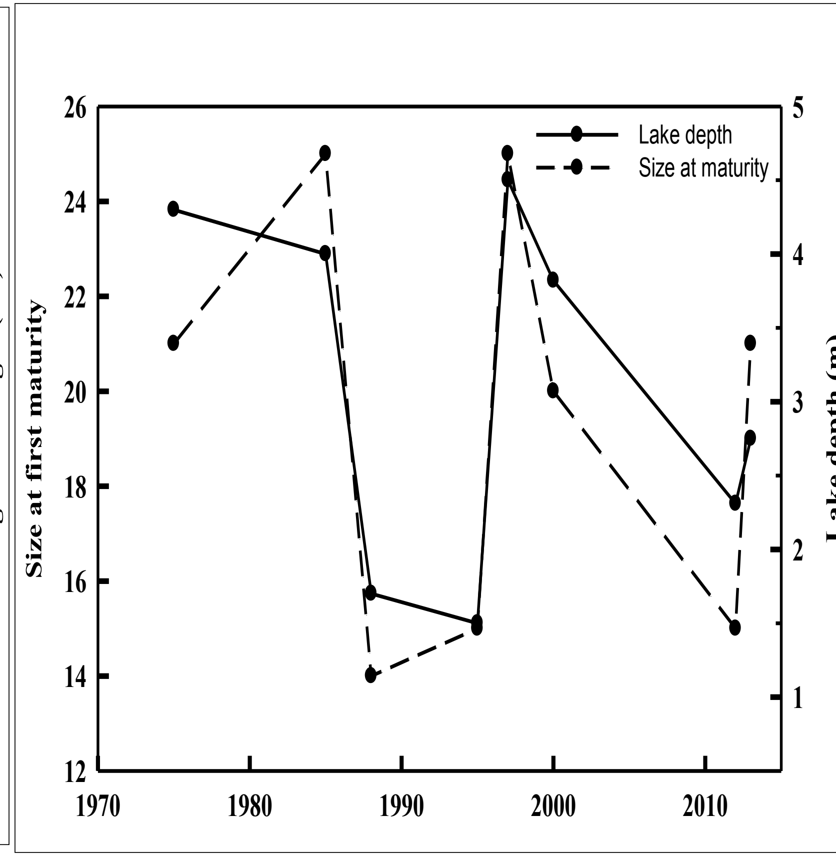
Life history parameters of Nile tilapia





Life history parameters of Nile tilapia in Lake Wamala changed in rainfall (left) and lake depth (right)

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Life history parameters of The African catfish

Parameter	**1999**	**2000**	**2012**	**2013**
Average temperature (°C)	21.6	21.4	22.8	-
Annual rainfall (mm)	1166	1294	1411	-
Water level (m)	4.5	4.3	4.3	4.3
Modal class	31-40	31-40	31-40	31-40
Size at first maturity(cm)	34.5	34	30	34
Relative condition	1.01	1.01	1.01	1.02

Major life history characteristics of the African catfish such as size structure, relative condition, size at maturity did not change apparently due resilience to stressful conditions

Changes in fishery yield

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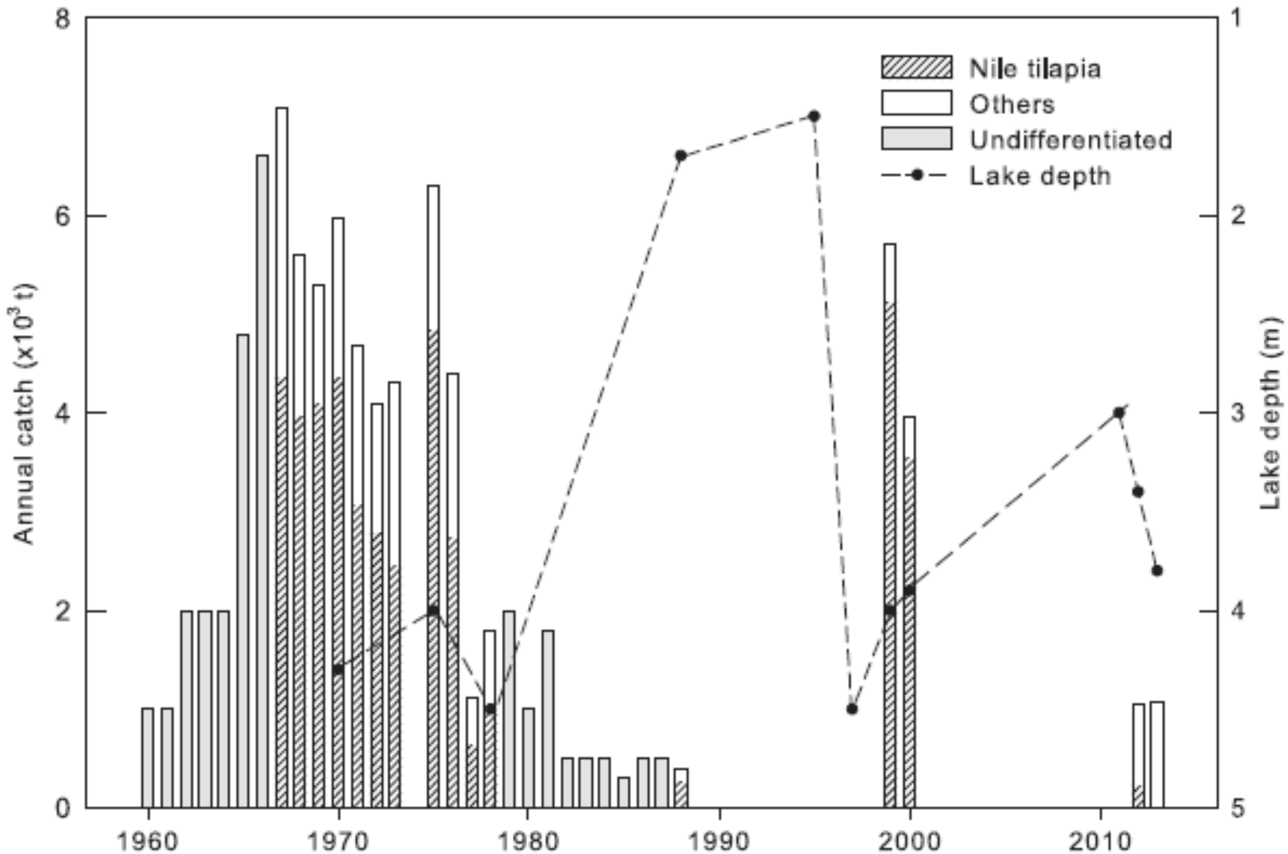

Annual fishery yield from Lake Wamala has changed with rainfall and depth but has generally declined (Natugonza et al. 2015.

Fishery livelihoods around Lake Wamala

Fishery livelihoods around Lake Wamala are fishing, fish trade and processing but are limited by the decline in the quantity and shifts in fish types associated with changes in climate and other stressors.

Adaptation strategies of fishers

Some fishers adapted to changes in fisheries by exploiting emerging fishes such African catfish and lung fish and by growing crops and rearing livestock in riparian zones

Adaptation to drought

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More innovative communities adapted to drought by practicing irrigation and the project promoted this introducing more effective and affordable systems like the manual irrigation pumps

Innovations around Wamala

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More innovative communities around Lake Wamala diversified to high value crops like, pineapples, tomatoes, egg plants, cabbages, and oranges which more than doubled their income beyond what they used to get from fishing alone






Model innovative fishermen

Model innovative fishermen like Swabi, although still fishing diversified to crop farming, chicken and zero grazing cattle – which also served as sources of organic manure, and practiced irrigation which improved his income, and was able to buy more land and acquire a motorcycle






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An innovative former fisherman

Some fishers like Lule abandoned fishing, hung up his nets and diversified to growing pineapples, and rearing livestock which have enabled him to acquire more land and purchase a pick-up van for marketing his crops.

Innovations around Kawi

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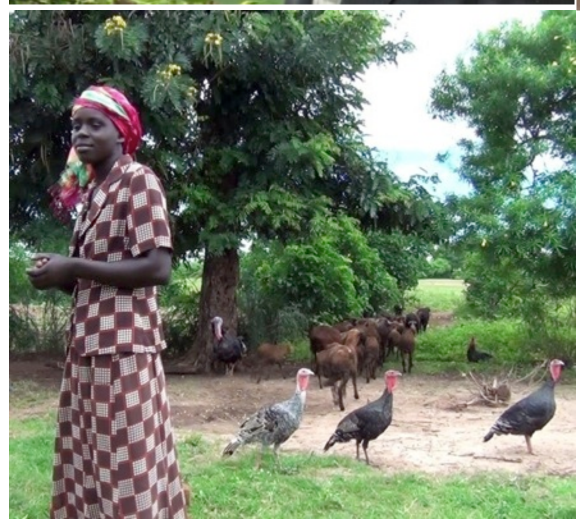
Innovative communities around Lake Kawi diversified to high value crops like passion fruits, mangoes, and keeping a variety of livestock which can also serve as sources of manure for the crops, and collect water from roof tops for watering their crops



These innovations if promoted can provide alternative livelihoods and reduce pressure on the declining fishery.

Other threats on riparian and lake systems

Cultivation up to the edge of the lake and extensively harvest papyrus exposes the water bodies to contamination and should be managed in accordance with existing laws

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Some mitigation measures

The impacts of climate variability and change and contamination of the water can be reduced by planting appropriate trees in lakeside zones and preserving the papyrus fringes and is being promoted

Factors affecting adaptation

Sustainable adaptation is limited by inadequate:

- ❑ Knowledge;
- ❑ Capacity;
- ❑ Capital;
- ❑ Awareness;
- ❑ Planting materials;
- ❑ Land; and
- ❑ Law enforcement.

Institutions and governance systems, policies, regulations

There are institutions, governance systems, policies, and regulations that should be applied to address climate issues such as:

- The decentralization;
- Tree planting;
- Protecting marginal areas of lakes and rivers by prohibiting developments within 200 m of the shoreline;
- Enforcing regulating on use of destructive fishing gears and methods such as monofilament nets, beating water to frighten fish into nets, and use of nets less than four and a half inches

Capacity Building

- ❖ The project increased awareness by sensitizing communities through workshop.
- ❖ Four students completed their MSc under the projecct

Conclusion from the pilot study

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- The pilot study indicates that climate variability and change is affecting productivity of lake and riverside areas, fisheries, and livelihoods. There are some innovations, institutions, governance systems, policies, and regulations that can be applied to increase resilience of the fishers, lake and riverside communities and these need to be promoted. NaFIRRI has created a network to address these issues and plans to refine and roll out the tools developed on the pilot lakes to other water bodies.
- This study provides some ideas of the type of changes that might be expected and the decisions and actions required over the 5-40 year period covered by HYCRISTAL.

We Look Forward to Successful Implementation of HyCRISTAL
Thank you