VULNERABILITY AND ADAPTATION OF FISHERIES AND RIPARIAN RESOURCES TO CLIMATE CHANGE

Background

Fisheries contribute 2.5% to national and 12.5% to agricultural GDP, employ about 1.2 million people, generate over US$ 150 million in export earnings and provide about 50% of protein food to Ugandans. The fisheries resources are vulnerable to over-exploitation, pollution, invasive species, habitat degradation, and climate variability and change. Consequently, the diversity and quantity of fishes has changed which threatens livelihoods of communities who depend upon fisheries resources. However, management of fisheries has concentrated on addressing the other threats and less on climate variability and change. The United Nations Intergovernmental Panel on Climate Change (IPCC) has reported that global temperatures have increased by about 1^{o}C since the last two decades of the 20th century and an increase of more than 2^{o}C would have negative consequences on natural resources such as fisheries and consequently on livelihoods.

Vulnerability

Climate warming contributes to reduction in water circulation and reduces mixing and recycling of nutrients and oxygen in aquatic systems. When surface water warms it becomes lighter and stays on top of heavier colder water: Solubility of oxygen decreases with temperature thus warmer water has less oxygen for respiration of fishes and other aquatic organisms. The effects of climate warming on mixing of nutrients affects production of plant and invertebrate materials upon which fish feed. In addition, fish are cold blooded organisms and their physiology depends on water temperature. Climate warming therefore affects the compositions and life history of fishes and other aquatic organisms. Hence it is those organisms which can persist or adjust to the changed conditions that are expected to survive. Riparian and terrestrial resources are also vulnerable to floods and drought.



Flooded maize in riparian zone around Lake Kawi (left) and wilting crops around Lake Wamala due to drought (right). These make crops and livelihoods vulnerable

There is growing evidence that aquatic productivity processes, fisheries and livelihoods are vulnerable to climate change. In Lake Tanganyika climate warming is thought to have contributed to a decrease in algal productivity by about 20% and fisheries yield by 30%. Fluctuations in fishery yield in Lake Chilwa in Malawi has been correlated with changes in water level associated with changes in precipitation. In Lake Chad, the number of fish species decreased from about 40 to 15 between 1971 and 1977 following a period of drought. The FAO has predicted that climate change will shift fisheries to smaller, faster growing, opportunistic species that can adapt fast to the changing environment and this appears to be happening in some fisheries. For instance,

changing climate is thought to have affected stocks of the pelagic kapenta in Lake Kariba in Zambia. In Uganda, stocks of the pelagic Mukene (*Rastrineobola argentea*) have increased to over 40% of the fish catches in lakes Kyoga and Victoria and related species Muziri (*Neobola bredoi*) and Ragooge (*Brycinus nurse*) have increased to contribute 80% to fishery yield in Lake Albert over the period when climate warming has intensified.



Fishes like Mukene have increased in abundance with and become more commercially important during the period when climate change has become more intense

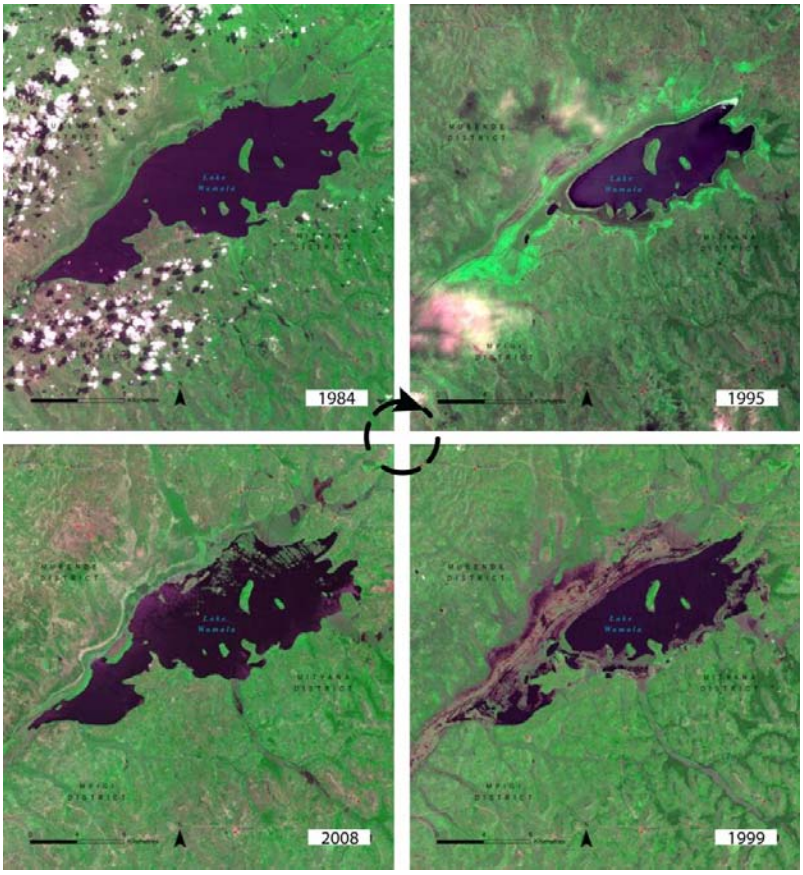
Our findings on Lake Wamala (Uganda) show that there has been a shift in fish species dominance from tilapias to more resilient species like the African catfish (*Clarias gariepinus*) and the Lungfish (*Protopterus eathiopicus*) with fluctuations in climate parameters like precipitation and this cannot be accounted for sorely by fishing. The life history characteristics of tilapia in the lake have adjusted with water level. When the lake was about 4.5 m deep, Nile tilapia grew to about 40 cm and matured at about 25 cm but when the depth of the lake dropped to about 1.5 m, the fish became stunted and grew to about 20 cm and matured at about 15 cm.

Adaptation

Climate change seems to be increasing vulnerability of lake productivity processes and fisheries resources and needs to be addressed to avoid getting fisher communities into poverty and food insecurity and to guide utilization of any opportunities that may arise from the changing climate. There is however limited knowledge, capacity, policy, regulations, governance systems and awareness to enable the fishers and riparian communities to adapt and mitigate its impacts. Climate change has also not been incorporated into many research, development and training programs.

The National Fisheries Resources Research Institute (NaFIRRI) of the National Agricultural Organization (NARO) with support from The Rockefeller Foundation is implementing a project in collaboration with other partners including communities around lakes Wamala in Central Uganda and Lake Kawi in Eastern Uganda to examine vulnerability of aquatic productivity processes, fisheries resources, fishers and riparian

communities to climate change and identifying, developing and testing adaptation and mitigation measures, building capacity and increasing awareness.



The area of Lake Wamala shrunk between 1984 and 1995 followed by an increase between 1999 and 2008 due to variability in rainfall.



The African cat fish (top) is tolerant to extreme environmental conditions while Nile tilapia (bottom) can adjust its life history parameters to changing environmental conditions response to changing climate factors

Results from the NaFIRRI intervention in the study areas show that aquatic productivity processes, fisheries, and fishers are vulnerable to climate variability and change and there is need for the fishers to adapt first by ensuring that they exploit the emerging fisheries sustainably and secondly by diversifying to other livelihoods like crops and livestock, and trade. Fishers and riparian communities can adapt to drought. by irrigating their crops during drought and growing crops like rice in flooded areas to reduce dependence on fisheries. Fishers and riparian communities should also contribute to mitigation of climate warming by protecting habitats such as wetlands which assist in holding and releasing water slowly during both floods and drought and are critical habitats for fish and planting trees to contribute to absorption of carbon-dioxide which is the main contributor to global warming.



NaFIRRI is identifying and scaling up adaptation strategies practiced by local communities. The photograph shows can irrigation(1&2) and drip irrigation (3) which are practiced by local communities around lakes Wamala in Mityana and Kawi in Pallisa. These are being scaled up by promoting cheap manual irrigation pumps (4) launched by the LCV Chairperson of Mityana District.

Factors affecting adaptation

There are some factors that affect sustainable adaptation such as limited knowledge and awareness, and lack of capital to facilitate adaptation measures. Policies and practices are required to help vulnerable communities and sectors to adapt to climate change. There is also need to strengthen expertise and establish networks to strengthen capacity in adaptation research and knowledge generation and sharing and to define gender roles in adaptation efforts. These issues need to be addressed by development agencies by increasing accessibility to low interest loans and micro-finance systems, providing implements such as irrigation pumps, and appropriate planting materials such as drought resistant crops and tree seedlings. NaFIRRI plans to up-scale work on lakes Wamala and Kawi to other lakes.

For more information contact:
National Fisheries Resources Research Institute (NaFIRRI),
P. O. Box 343, Jinja, Uganda,
Tel.: +256 434 120484; Fax: +256 434 120192
URL: www.firi.go.ug