

African Lake Basin Management: Key Issues and Challenges

by:

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JICA/ILEC Integrated Lake, River and Coastal Basin Management Training Course

Outline of Presentation

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Introduction:

1.1 - Evolution of the Water Sector in Africa

- Over the last 20 years, there has been active national, regional and transboundary water sector reforms continent-wide
- The 2025 Africa Water Vision of the African Ministerial Council on Water (AMCOW) is to realize equitable and sustainable use and management of water resources to promote cooperation, security, social and economic development, and poverty eradication among member states.
- Various regional bodies (e.g. AU, EAC, ECCAS, IGAD, AfDB, COMESA) have been involved in providing the guiding framework for national and transboundary resource development and management.
- National water ministries policies incorporate relevant regional, continental (AU Agenda 2063) and global agenda (Sustainable Development Goals - SDGs), tailored to country or regional needs.
- In addition to the national water agendas, the regional, continental and global agendas are also very important for policies and management targeted at lakes and their basins, and particularly so for transboundary lakes.

Introduction:

1.2 - Continental strategies for water security

- The Africa Water Facility (AWF) was established under AMCOW to mobilize resources to finance water resources development activities in Africa.
- AWF vision is “a water secure Africa where the continent’s water resources are developed and managed equitably and sustainably for poverty alleviation, socio-economic development, regional cooperation, environment protection and climate change resilience”.
- The Science, Technology and Innovation Strategy for Africa 2024 (STISA 2024) is another very important document.
- The STISA 2024 notes that water is essential and has a cross-cutting contribution across the strategy’s six priority areas
- It also notes that it is important to set up flagship programmes to address issues related to water availability, quality, river regimes, water cycles and water resources in different regions of the continent.

Lake basins and their importance: 2.1 – Africa's lakes

- Africa is endowed with both natural and man-made lakes and some are transboundary.
- The total number of lakes in the WORLDLAKE database for the continent is 677 (UNEP 2006).
- The largest and best-known lakes are in the eastern and southern Africa region, and are collectively termed the “African Great Lakes”.
- The large man-made lakes include Lake Volta in west Africa, Lake Kariba in southern Africa and Lake Nasser in northern Africa.

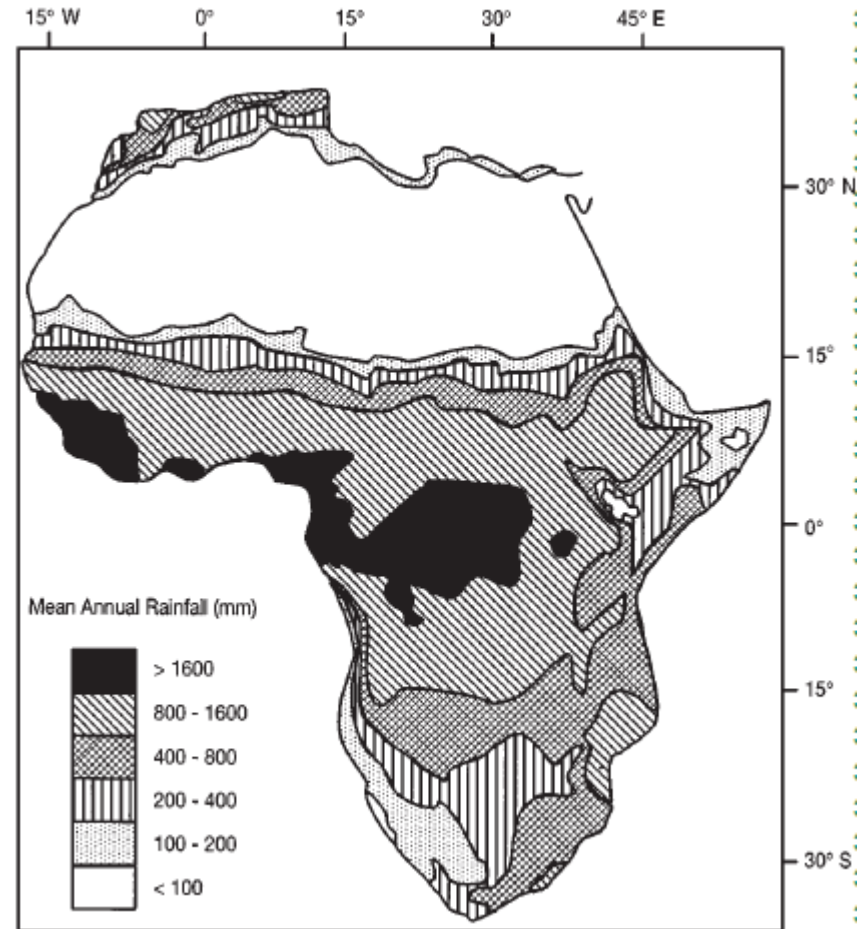


Lake basins and their importance: 2.2 – The importance of Africa's lakes

- The lakes and their associated rivers and wetlands in the African continent are unique natural resources
- They are heavily utilized for transportation, water supply, fisheries, waste disposal, recreation and tourism, among other uses/services.
- Human populations are fast increasing in many of Africa's lake basins, and they exert increasingly rising pressures on the lakes as they exploit their ecosystem goods and services.
- Consequently, over the past couple of decades, a variety of inter-linked human activities in the lakes and their catchments have led to in-lake problems such as sedimentation, eutrophication, overfishing, species introductions, and industrial pollution.
- Global warming and climate change pose the latest threat to the natural state and function of the lakes as we have known them through human history.
- Past, current and ongoing research provide the context and evidence-base for the effective and sustainable management of the lakes.

The implications of the geological context of lake basins: 3.1 - The present climatic and hydrological context

- On the African continent, rainfall amounts to about 20,360 km³/yr, with an average of 678 mm/yr, and is highly variable in space and time (FAO, 2016), and evaporation is generally high.
- Consequently, much of the continent experiences extreme hydrological variability.
- Its renewable water resource, distributed among lakes and reservoirs, rivers, glaciers, and groundwater, is estimated at 3,930 km³/yr, and is also recognized to be highly variable in time and space (FAO, 2016).



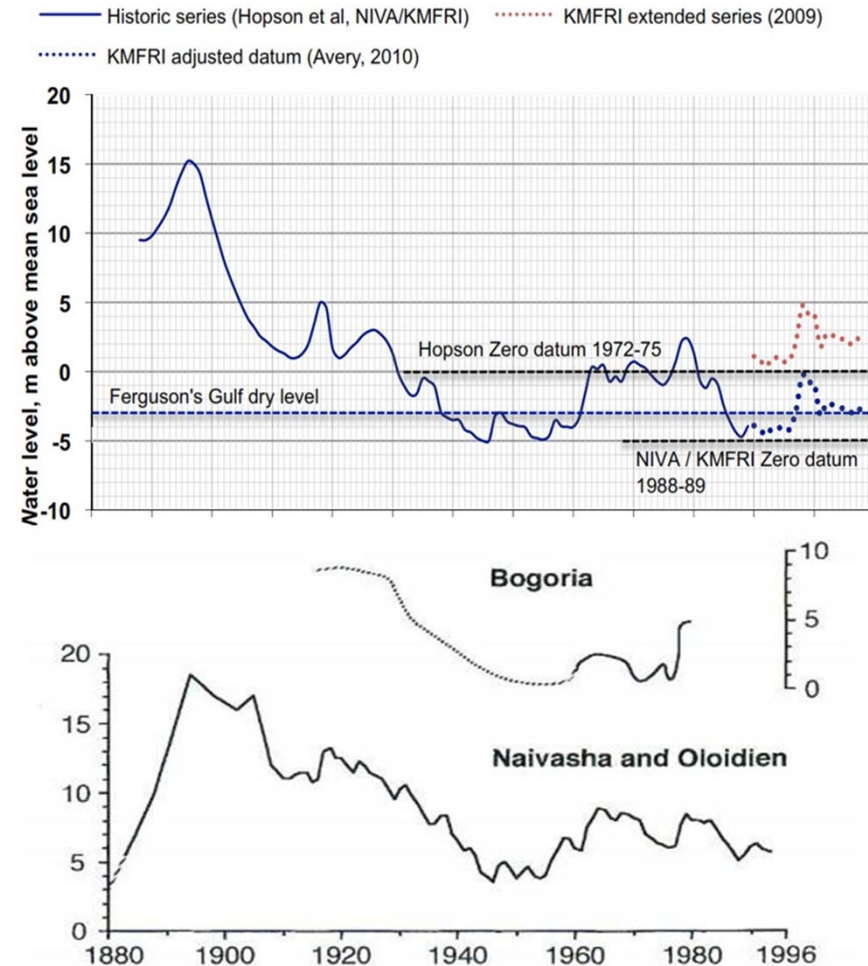
Rainfall map of Africa (from Street-Perrott & Perrott 1993; after Nicholson 1980)

The implications of the geological context of lake basins: 3.2 - The geological context

- Most of the large lakes in Africa, and numerous small lakes, occur within the confines of the East African Rift System (EARS).
- The larger rift lakes such as Tanganyika, Albert, and Malawi/Nyasa started forming between 12 and 8 million years ago (Tiercelin et al., 2002).
- Lake Victoria lies in a cratonic sag between the western and eastern arms of the EARS., and came into being ca. 400,000 years ago (Johnson et al., 2000).
- The present-day rift lakes in central Kenya developed during the Lower-Middle Pleistocene times (ca. <780,000 yr ago) (Tiercelin et al., 2002; Woldegabriel et al., 2016).
- Other much smaller lakes form within volcanic craters either on the floor of the rift or on volcanic mountains that flank the rift system to the east and west.
- Similar types of crater lakes are seen also in west Africa (e.g. Lake Barombi Mbo in Cameroon); Lake Bosumtwi in Ghana is a unique impact crater lake that was formed about one million years ago and is the only natural lake in that country.

The implications of the geological context of lake basins: 3.3 - Climate-sensitive “amplifier” lakes

- Studies of the African lakes over geological timescales show that the lakes are highly sensitive to climatic changes, particularly in rainfall and temperature.
- Hence the term “amplifier lake” (Street, 1980; Street-Perrott and Harrison, 1985; Olaka et al., 2010, Trauth et al., 2010)
- Apparently small changes in precipitation can result in large hydrological responses
- Such abrupt changes can have adverse impacts on the lakes themselves, environment and human civilisation (Alverson et al., 2003; Olago and Odada, 2004; Olago et al., 2007).



Exploitation of lake basins and their impacts:

4.1 - Environmental factors

- Land degradation associated with agricultural expansion and poor land management has been a major issue in many lake basins over the past century, but particularly since the 1960s to date.
- Consequences include erosion, turbid rivers and lakes, and sediment accumulation in lakes and rivers.
- Large-scale biomass burning conveys nutrient elements (N and P) to the lakes via the atmosphere
- Chemicals from agriculture and industries have introduced other types of pollutants into lakes.
- Discharge of untreated sewage from towns into lakes
- Impacts on lakes include: poor water quality, eutrophication, changes in aquatic communities, reduced fish stocks and overall biodiversity



Exploitation of lake basins and their impacts:

4.2 - Ecological aspects

The ecological impacts include:

- Changing food web structure due to hydrological changes and water/sediment contamination;
- Reduction of the amount of available habitat through sedimentation, particularly in littoral zones, e.g. in Lakes Tanganyika and Malawi;
- Habitat degradation and biodiversity loss e.g. Lake Turkana macrophytes;
- Eutrophia and anoxia in lake waters, e.g. Lake Victoria, affecting fish species number, biomass and diversity;
- Aquatic species extinctions, invasions and introductions;
- Increased frequency of algal blooms.
- Elimination of some fish species e.g., the cyprinid fish *Opsaridium microlepis* in Lake Malawi, from a combination of siltation and fishing pressure.



Exploitation of lake basins and their impacts:

4.3 - Ecosystem goods and services

- Modification of aquatic ecosystems through increased sedimentation, pollution, species introductions, and overfishing leading to sometimes dramatic changes in the structure of fish communities
- In Lake Nakuru, pollution affects flamingos and adversely impacts on lake aesthetics and tourism
- Wetlands are threatened by irrigation schemes, cultivation, over-grazing, harvesting of resources e.g. clay for bricks, buildings, and pottery, and papyrus for thatching houses and making carpets/mats.



Exploitation of lake basins and their impacts:

4.4 – Economic aspects

- The key sectors that derive high incomes from lake resources are fisheries and tourism, with the fisheries sector having a much greater impact, generating millions of dollars annually in revenue.
- Fisheries and aquaculture are an integral part of food security for Africa, and more generally, fish are important to the livelihoods of the numerous artisanal fishers and their dependents in terms of food security and employment.
- The total revenue generated from inland fisheries (lakes, reservoirs and their catchments) is US\$ 6,275 million contributing to 1.26% GDP of the continent (de Graaf and Garibaldi 2014).
- 60% of fish consumed in countries such as Tanzania and Malawi is from freshwater fish predominantly from the lakes (UNEP, 2006).
- Over exploitation, illegal fishing and harvesting of juvenile fish in lakes is a key threat to the sustainability of the fisheries sector, in addition to the other environmental and ecological impacts of anthropogenic activities.
- The introduction of cage culture in lakes such as Lake Victoria and Malawi has led to new challenges related to pollution, introduction of exotic species, and new diseases (e.g. Njiru et al., 2018).

Exploitation of lake basins and their impacts: 4.5 – Social aspects

- Rapid population growth, expanding settlements and land use changes increase waste and pollutant discharge into the lakes, reducing their aesthetics and restricting other traditional and non-economic uses of the lake waters, such as for bathing and washing.
- The demand for water for multiple uses threatens, through abstractions, the quantity of water available to lakes from influent rivers and groundwater systems that discharge into lakes.
- Loss of fish foods has been reported to adversely affect the nutritional status of communities living around lakes.
- Income from lake tourism and fish revenues have declined, reducing the incomes of dependent communities and hence affecting their quality of life and general wellbeing.
- There are also gendered aspects that have to be considered – e.g. wetland degradation in Kampala area was noted to affect men and women differently (Nakijoba, 1996; UNEP, 2006).

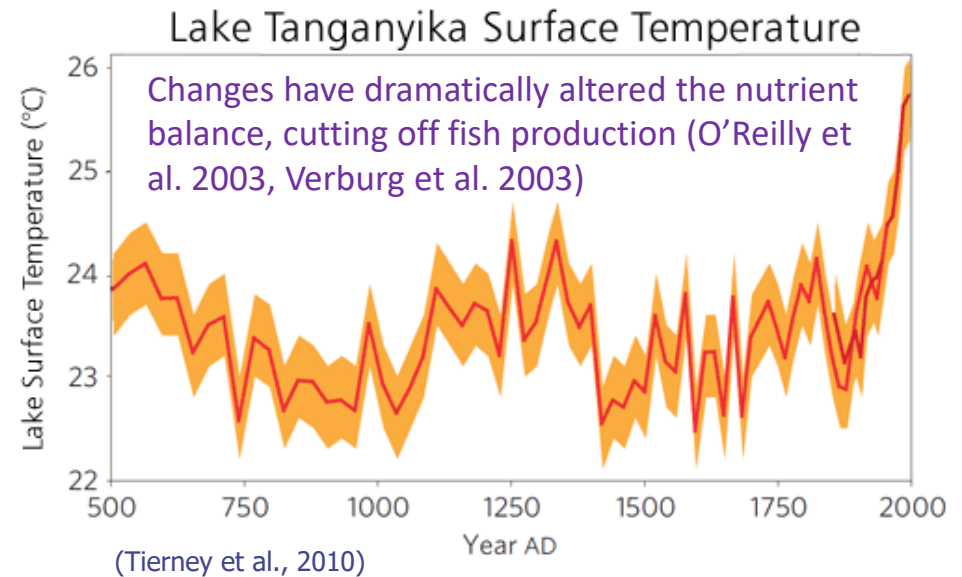
Exploitation of lake basins and their impacts: 4.6 - Governance aspects

Issues here include:

- Political jurisdictions (within and between countries) with competing needs;
- Sectorally driven approaches to governance and management;
- Different institutions in the same lake basin have overlapping or duplicated mandates;
- Inadequate levels of, or complete absence of, transboundary coordination and/or institutional structures in the case of transboundary lakes;
- Differentiated and generally low capacities to manage the lakes and their basins within and across borders;
- Inadequate or ineffective decision-support tools;
- Low and uncoordinated participation by stakeholders.

Lakes and climate change

- Lakes are sensitive to changes in climate
- Global warming has been observed in the recent decades in air and water temperatures of tropical lakes
- Climate change, will alter the timing, distribution and quantity of water resources across the region



- In Lake Tanganyika, warmer lake surface temperatures have drastically altered the nutrient balance, cutting off fish production (O'Reilly et al. 2003, Verburg et al. 2003).
- Changes in the lake levels themselves can have significant impacts on a lakes habitat and food web structures through exposure/submergence of littoral communities and changes in the lake water's physico-chemical properties, among other effects.

Integrated Lake Basin Management

- Sectoral interventions have not been as successful as desired because they have not been able to anticipate or redress the impacts from other sectors
- The ILBM approach provides an integrated framework for the sustainable management and use of lake basin resources and guides coordinated agency actions
- The ILBM approach is anchored on six inter-related and supporting pillars, namely; policies, institutions, participation, technologies, institutions, and finance.
- ILBM is an holistic and integrated approach that also fully incorporates IWRM and IRBM principles and approaches, to ensure that there is a balance between conservation and sustainable development of lakes and their resources.
- The approach was endorsed by a high-level African Water Ministerial Dialogue on “Management of Lake Basins for their Sustainable Use: Global Experience and African Issues” held during the 11th World Lakes Conference in Nairobi in 2005.

Conclusions

- Lakes are highly sensitive to natural changes and anthropogenic activities within their basins
- Anthropogenic activities adversely impacts on lakes ecosystem health and its resource values.
- To understand and solve the problems relating to lakes and their sustainable management requires many different insights and contributions encompassing considerations of the geological context, historical factors/decisions through to cultural, ecological, socio-economic, governance and other aspects.
- Taking a long-term view (trans-generational) is important since lakes tend to have a slow response time to some types of perturbations (e.g. pollution), a rapid response time to other types of perturbations (e.g. hydrological changes), and react with perceptible ecological effects to climate change.
- The ILBM framework captures these notions and nuances and is the best context within which to sustain healthy and productive lakes for posterity in the context of sustainable development.

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