



## MODELLING, SCENARIO ANALYSIS, AND PLANNING

Modelling and scenario analysis are tools for quantifying effects of development, rehabilitation, adaptation and climate change, facilitating transboundary dialogue

Lake Turkana is the world's largest permanent desert lake and lies in Kenya and Ethiopia. The lake is rich in birdlife and has a sizeable population of large water turtles. The Turkana mud turtle is endemic to the lake. The Lake Turkana National Parks are listed as UNESCO World Heritage sites in Danger.

### LAKE TURKANA — A FRAGILE ECOSYSTEM

The lake is crucial for the livelihood in the area. The people around the lake originally subsisted through pastoralism, but today fishery is widespread and has become an alternative livelihood.

The lake has no outlet, making it very sensitive and vulnerable to changes in the amount of inflow. This can be caused by changes in upstream abstraction for irrigation, severe climatic variability (like the 1997-98 El Niño), or climate change. Additionally, the optimal water level range is very narrow, making the lake further sensitive to changes. Levels below 362 m.a.s.l. are detrimental for fishery, while severe flooding starts around 364 m.a.s.l. Lake Turkana experienced a very dramatic rise in water levels in 2020, resulting in great damage to settlements, infrastructure, and wildlife. From a historical perspective, this was a rare event but with climate change it may become more common.



Flooding damages in 2020. ©Turkana County Government

Major water resources developments have taken place in the basin within the last 15-20 years. Four major hydropower plants are already operating and more are planned / under construction. Furthermore, major irrigation is already taking place, including the Kuruz Sugarcane Plantation. The inflow to Lake Turkana has already been reduced by these activities and planned extensions will inevitably cause further reduction.

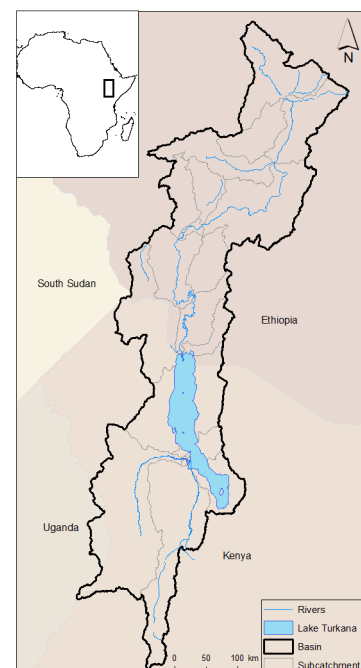
### SUPPORT TO SUSTAINABLE DEVELOPMENT IN LAKE TURKANA AND ITS RIVER BASINS

#### CLIENT

- UNEP and the Basin Countries
- Co-funded by European Union Emergency Trust Fund for Africa

#### THE PROJECT

The focus of the project is to establish a common scientific understanding of Lake Turkana and its river basins and to promote transboundary dialogue. In the course of the project, a web portal with application for monitoring, planning and management of water resources has been set up and scenario modelling has been carried out.



Lake Turkana lies in the Omo-Turkana Basin, which is divided between Kenya and Ethiopia. The lake is part of the Kenyan Rift Valley and located mainly in Kenya, with the northernmost part extending into Ethiopia. The lake has an area of 6,400 km<sup>2</sup> and a depth of approx. 32 m.

Furthermore, the reservoirs have affected the seasonality of the flow which is important for fish production in the lake.

A key purpose of this project was to try to quantify the impacts of rehabilitation and adaptation measures, planned upstream water resources development activities and possible impacts of climate change on Lake Turkana. The hope is to provide a common reference of data and information, which can facilitate transboundary collaboration in the basin. Water resources modelling provides a useful tool in this situation.

## MODELLING REHABILITATION AND ADAPTATION

The models in this project focus on development and rehabilitation. The scenarios are considered in a changing climate.

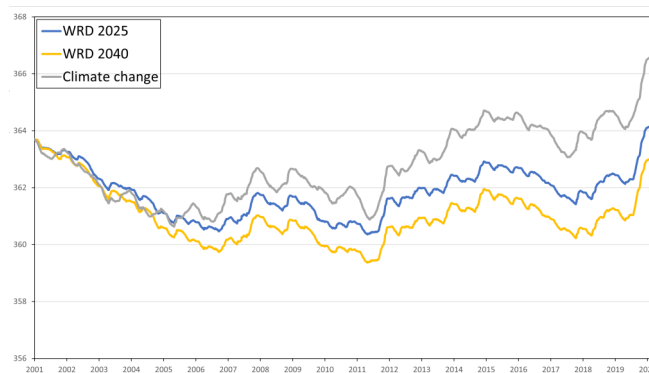
The water resources development (WRD) scenarios are:

**WRD 2025:** Developments in irrigation and hydropower that are already existing or very likely to happen by 2025.

**WRD 2040:** Developments in irrigation and hydropower included in known basin plans by 2040.

Taking WRD 2025 as the starting point, rehabilitation and adaptation scenarios were developed in collaboration with stakeholders. These are:

- Regenerating natural flow conditions through reservoir management
- Enforcing riparian and land legislation restricting construction close to the lake to avoid flooding
- Transferring water to Lake Logipi to avoid flooding
- Reforestation, soil and water conservation measures to alleviate land degradation and landslides



Water level (m.a.s.l.) in Lake Turkana for water resources developments in 2025 and 2040 as well as under climate change.

WRD 2025 and WRD 2040 lead to significant drawdown in water levels compared to current conditions. Annual variations in water level are also significantly dampened. These developments are detrimental for fish breeding, but there is low risk of flooding.

Rehabilitation involving regulating reservoir releases restores annual water level fluctuations to a certain extent, thus improving conditions for fish. The total annual hydropower production is maintained, although seasonality is now introduced in the power production. The measure does not have significant impact on water levels.

Two of the rehabilitation and adaptation scenarios are related to flooding. These are relevant due to expected rising water levels caused by climate change.

A way to adapt to flooding is to enforce the current legislation restricting construction close to the lake. This would allow high water levels for fishery while ensuring that settlements, hospitals, schools, etc. are not flooded. There will be negative consequences as people live further from the lake that is their livelihood, but it may prove a good compromise.

In case of continuously rising water levels in the future, a last-resort to mitigate flooding could be diverting water to nearby Lake Logipi. The impacts on Lake Logipi should be thoroughly investigated.

Although there are potential negative impacts from future developments and climate change, some win-win situations have also been identified.

- Reservoir operation allows restoration of lake water level fluctuations while still maintaining the total annual hydropower production.
- Increasing the size of irrigation investments in the basin could reduce flooding under climate change. However, the effects of climate change are very uncertain.
- Soil and water conservation methods, reforestation, and agro-forestry will reduce the risk of landslides and land degradation. These measures may also combat global warming and restore habitats.

## TOWARDS TRANSBOUNDARY COLLABORATION

To realize these win-win situations in the future and to ensure a sustainable way forward for the Omo-Turkana Basin, transboundary dialogue and discussion will be necessary, respecting the chief concerns and priorities of different stakeholders. The Planning application, developed in this project, can be used to present, analyse and evaluate scenario results, and provide a starting point for discussions.

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For more information, visit: [www.omoturkana-tmo.org](http://www.omoturkana-tmo.org)