Status of Pollution in Lake Naivasha Basin

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Overview

Lake Naivasha Basin is one of Kenya's most valuable freshwater ecosystems, supporting rich biodiversity, fisheries, horticulture, tourism, geothermal development and domestic water supply. Despite its ecological and socio-economic importance, the basin is increasingly threatened by pollution, excessive water abstraction, catchment degradation and sedimentation.

To assess the health of the basin, the Kenya Marine and Fisheries Research Institute (KMFRI) conducted a comprehensive assessment between 2024 and 2026. The study covered the three main inflowing rivers, Malewa, Gilgil and Turasha, as well as Lake Naivasha itself. Water quality, nutrient concentrations, microbial contamination, phytoplankton, zooplankton and macro-benthic invertebrates were analysed across nine river sampling sites and eight lake sampling sites to determine the current pollution status and ecological condition of the basin.

Nutrient Enrichment and Water Quality

The assessment revealed spatial differences in water quality across the basin. The inflowing rivers consistently recorded higher concentrations of total phosphorus (TP) and total nitrogen (TN) than the lake, demonstrating that the rivers are the primary pathways through which nutrients enter Lake Naivasha. In addition to river inflows, sewage discharges were identified as significant contributors to nutrient enrichment.

Elevated nutrient concentrations increase the risk of eutrophication, promoting excessive algal growth that can reduce water quality, lower dissolved oxygen levels, and negatively affect aquatic biodiversity.

Microbial Pollution

Microbial contamination was highest at downstream sections of the rivers where agricultural runoff and domestic wastewater accumulate before entering the lake. Total coliform counts reached up to 25,000 cfu/100 ml in

downstream River Turasha, while faecal coliforms peaked at 11,000 cfu/100 ml in downstream River Gilgil.

Stations where faecal coliforms formed a large proportion of total coliforms, particularly River Gilgil downstream and the Lake Naivasha sewage discharge point, could be and indication of direct contamination from sewage or livestock waste. While total coliforms provide an indication of general water quality deterioration, faecal coliforms present a direct public health concern because they signal contamination by human or animal waste.

The findings demonstrate that all three rivers serve as major conduits transporting microbial pollution into Lake Naivasha.

River Flow, Sedimentation and Catchment Degradation

The study found that the rivers generally had low flow rates coupled with high sediment loads. Significant quantities of sediment originate from riverbank erosion and surface runoff from neighbouring agricultural land before being deposited into the lake.

These sediments contribute to accelerated siltation, reducing water depth and altering aquatic habitats. The findings highlight the need for catchment restoration, riverbank stabilization and improved soil conservation measures to reduce sediment transport into the lake.

Given the increasing sediment accumulation, a comprehensive bathymetric survey together with a sediment accumulation assessment is recommended to quantify changes in lake depth and guide long-term restoration interventions.

Phytoplankton Response to Pollution

Phytoplankton communities reflected increasing nutrient enrichment within the lake. Bloom-forming cyanobacteria, particularly *Microcystis* and *Anabaena*, were recorded in Lake Naivasha, while they were largely absent from the river sampling sites.

The abundance of Anabaena increased substantially from earlier sampling periods to 12.81 individuals/L by June 2026. Similarly, Microcystis increased from 1.67 individuals/L in March to 6.56 individuals/L in June 2026.

The dominance of diatoms such as *Nitzschia* and *Aulacoseira*, together with green algae including *Pediastrum*, indicates ongoing shifts in phytoplankton community structure associated with changing environmental conditions.

The increasing abundance of toxic cyanobacteria is an early warning sign of eutrophication and presents potential risks to fisheries, aquatic biodiversity, livestock, wildlife and human health.

Zooplankton and Macro-benthic Communities

Zooplankton abundance remained low in the rivers and was considerably higher within the lake. More concerning, however, was the condition of the macro-benthic invertebrate community.

The study recorded exceptionally low biodiversity together with substantial declines in both macro-benthic abundance and biomass during the most recent sampling periods. Pollution-sensitive species were either greatly reduced or completely absent, indicating increased ecological stress within the lake ecosystem.

Macro-benthic organisms perform critical ecological functions by breaking down organic matter, recycling nutrients and maintaining sediment quality. Their decline reduces the lake's natural capacity to process organic waste and recover from pollution. In addition, the loss of these organisms disrupts the aquatic food web by reducing food availability for benthic-feeding fish species, thereby threatening fisheries productivity and ecosystem stability.

The decline also suggests increasing shoreline instability, as healthy benthic communities contribute to sediment stabilization. Continued deterioration may therefore accelerate shoreline erosion and habitat degradation.

Long-term ecological monitoring will be essential to understand the drivers of these community changes and evaluate the effectiveness of future management interventions.

Overall Assessment

The study demonstrates that Lake Naivasha is experiencing increasing pollution pressures driven primarily by nutrient loading, microbial

contamination and sediment inputs from Rivers Malewa, Gilgil and Turasha, as well as sewage discharges within the basin.

Evidence of nutrient enrichment, increasing cyanobacterial abundance, widespread microbial contamination and declining benthic biodiversity indicates that the ecological health of the lake is under considerable stress. Without timely intervention, these pressures are likely to compromise water quality, fisheries productivity, biodiversity conservation and the many ecosystem services that Lake Naivasha provides.

Recommendations

To safeguard the ecological integrity of Lake Naivasha Basin, the following actions are recommended:

- Strengthen pollution control measures targeting municipal wastewater, agricultural runoff and industrial discharges.
- Restore degraded catchments through riverbank rehabilitation, afforestation and soil conservation practices to reduce erosion and sediment transport.
- Improve sewage management and sanitation infrastructure to minimise microbial contamination.
- Undertake comprehensive bathymetric and sediment accumulation studies to quantify siltation and support evidence-based restoration planning.
- Enhance long-term monitoring of water quality, nutrients, phytoplankton, zooplankton and macro-benthic communities to track ecosystem changes and evaluate management interventions.
- Promote integrated catchment management involving government agencies, local communities, the private sector and other stakeholders to ensure the sustainable conservation and management of Lake Naivasha Basin.