FRESHWATER SYSTEMS · RIVER WATER QUALITY

Pollutant Drivers of the Auji and Kibos Urban Rivers

Characterizing the physical and chemical drivers of pollution in two urban rivers that drain through Kisumu City into Lake Victoria.

REFERENCE	ISSUED	REGION
C82_15(1)	**June 2026**	**Kisumu, Auji & Kibos Rivers**

FRESHWATER SYSTEMS

0
mg L^{-1} dissolved oxygen (anoxic) at downstream stations

3,805
µg L^{-1} peak total phosphorus (Auji downstream)

830
µS cm^{-1} peak conductivity, versus 76 upstream

9.91
peak pH, exceeding WARMA and WHO limits

Background

Rivers transport dissolved and particulate materials through their catchments and are increasingly used as sources of domestic, irrigation and industrial water, as well as recipients of wastewater and pond-aquaculture effluent. With rapid population growth along river basins, these pressures intensify. The Kibos and Auji Rivers drain through Kisumu City into Lake Victoria and play a critical hydrological and ecological role, while facing significant pollution that threatens their ecosystem health and functioning.

Understanding the current physical, chemical and biological drivers of pollution is essential for designing effective management strategies that protect water quality, conserve biodiversity and sustain the riparian communities that depend on these rivers for their livelihoods.

Methods

Each river was divided into upstream, mid-stream and downstream sections and sampled in duplicate. A YSI multiparameter meter measured temperature, dissolved oxygen, pH, total dissolved solids, salinity and conductivity in situ at the sub-surface, following APHA (2012). Water samples for total nitrogen (TN) and total phosphorus (TP) were collected and analysed by the same standard methods, and water depth and channel characteristics were recorded at each site.

Key Findings

Oxygen collapses downstream

Dissolved oxygen averaged 3.38 ± 2.67 mg L^{-1} across the rivers but fell to 0 mg L^{-1}, fully anoxic, at the Auji (Kapwothe) and Kibos downstream stations, while the well-aerated Kibos upstream station reached 7.34 mg L^{-1}. Temperature averaged 23.78 ± 2.03 °C, from 19.6 °C at Kibos upstream to 27.9 °C at Auji upstream. Conductivity rose from 76 µS cm^{-1} upstream to 830 µS cm^{-1} at Auji downstream, signalling heavy ionic input from municipal treatment ponds and surrounding domestic effluent. pH averaged 7.55 but peaked at 9.91 at Kibos upstream, exceeding the WARMA and WHO range of 6.5 to 8.5, likely from alkaline agricultural inputs.

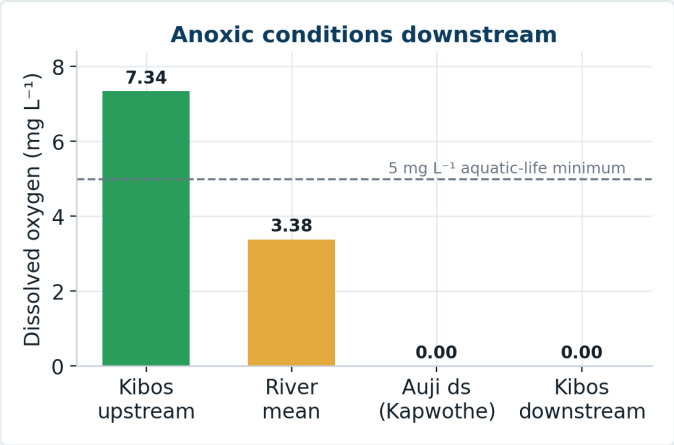


Figure 1. Dissolved oxygen falls to anoxic (0 mg L⁻¹) downstream on both rivers, far below the 5 mg L⁻¹ aquatic-life minimum.

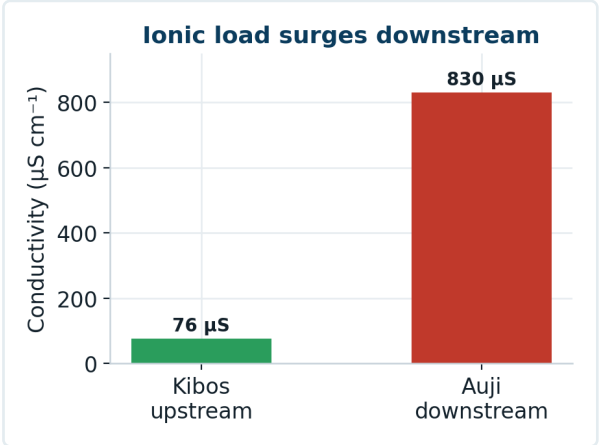


Figure 2. Conductivity climbs roughly eleven-fold from Kibos upstream to Auji downstream.

Severe nutrient enrichment

Total nitrogen averaged 757.5 µg L⁻¹ and reached 2,017.1 µg L⁻¹ at the Auji downstream tributary at Kapwothe, an indication of highly eutrophic accumulation points along the river. Total phosphorus averaged 860.5 µg L⁻¹ and peaked at 3,805.1 µg L⁻¹, a hypertrophic condition that fuels algal blooms which then decompose and create anoxic conditions for aquatic organisms. These results connect directly to Sustainable Development Goal 6 on clean water and sanitation, and to the social pillar of Kenya Vision 2030.

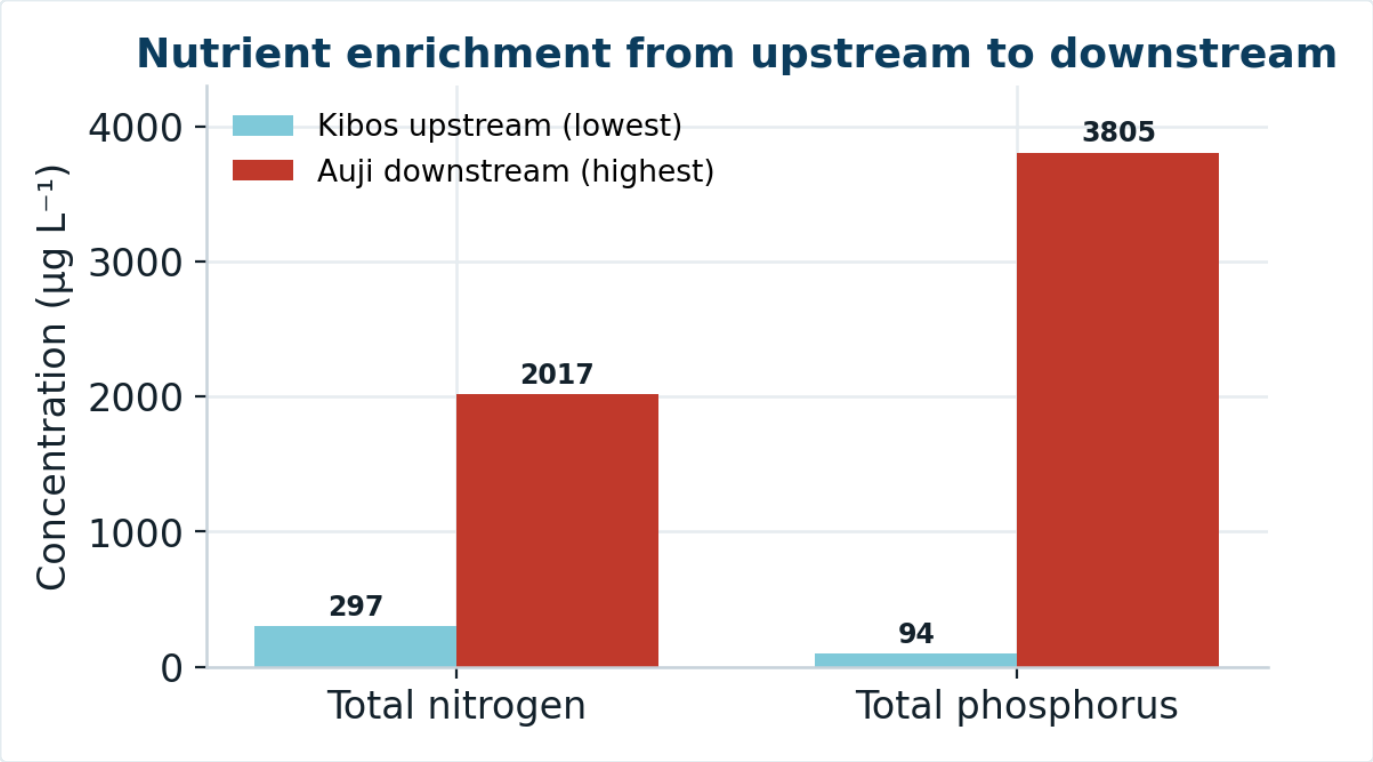


Figure 3. Total nitrogen and total phosphorus rise sharply from the cleanest upstream station to the most polluted downstream station, confirming nutrient loading from industrial, agricultural and domestic sources.

Conclusions

- Most physico-chemical parameters exceeded or fell below recommended standards, rendering the downstream environment unsuitable for aquatic life.
- Critically low to zero oxygen downstream reflects industrial effluent and domestic sewage driving nutrient overloading and organic decay, a known precursor to fish mortality reaching the lake.

- High total nitrogen and total phosphorus across downstream stations indicate nutrient pollution from industry, agricultural runoff, domestic seepage and sewage discharge.

Recommendations

1. Coordinate NEMA, county and stakeholder action to manage raw-sewage and industrial-effluent discharge, extending sewer lines to slums and suburbs.
2. Discourage catchment deforestation, which drives nutrient runoff, eutrophication, fish kills and sedimentation.
3. Strengthen community engagement, and require associated companies to implement and report oil-spill and effluent controls.
4. Conduct periodic agency inspections of point sources, and improve wastewater-treatment facilities.
5. Implement wetland reclamation to filter runoff before it reaches the lake, noting that de-siltation of the Kibos interfered with the Dunga wetland, and enforce existing regulatory frameworks with continuous scientific monitoring.

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