



Community Perspectives on Water Quality and Land Cover Change in the Micro-Catchments of the Nyando River Basin, Lake Victoria Basin, Kenya

 Okungu, John Ogembo ¹, Okeyo-Owuor J. B. ² and  Odenyo A. O. Victor¹

¹*School of Environmental and Natural Resource Management, University of Eldoret, P.O. Box 1125-30100, Eldoret, Kenya*

²*School of Agriculture, Natural Resources and Environmental Studies, Rongo University, P.O. Box 103-40404, Rongo, Kenya*

Correspondence: modenyaden@gmail.com

Received: 20th August, 2025, Accepted: 23th September, 2025, Published: 30th September, 2025

Abstract

The Nyando River Basin, a critical part of the Lake Victoria Basin, faces increasing pressure on its water resources due to rapidly changing land cover and intensified human activities, which directly impact the quality and availability of water for local communities. Despite these challenges, limited research has documented community perspectives on how land cover dynamics influence water quality in the micro-catchments, creating a gap in evidence needed for participatory watershed management. Therefore, this study aims to assess community perspectives on water quality and land cover change in five micro-catchments of the Nyando River Basin within the Lake Victoria Basin, Kenya. The study employed a Citizen Science approach to gather community perspectives. The target population consisted of households and key stakeholders living within a one-kilometer radius of the Chebirirkut, Kimatkei, Kaplelmet, Sitoi, and Kibwareng micro-catchments. A



purposive sample of 20 respondents was selected, with this data supplemented through additional interviews and informal discussions to ensure a thorough collection of community perspectives. Data were analyzed using descriptive statistics and thematic analysis. Findings revealed strong linkages between land cover change and perceived water quality. Communities in Chebiririkut, where indigenous vegetation cover remained high (~90%), reported consistently good water quality, attributing this to forest conservation. In highly impacted areas like Kimatkei and Kibwareng, communities reported significant deterioration in water quality, often characterized by brownish color during rains, and a decrease in water quantity, with streams occasionally drying up. They attributed these negative changes to intensive farming, cultivation near river banks, increased use of inorganic fertilizers, and the introduction of exotic tree species (e.g., Eucalyptus). Conversely, the well-conserved Chebiririkut micro-catchment, with intact forest cover, reported consistently good water quality and stable flow, validating the community's belief that conservation keeps water clean. Across all sites, respondents linked declining water quality to deforestation, poor farming practices, agrochemical use, and population-driven land pressure. Positive interventions such as tree planting, soil and water conservation structures, and forest protection were acknowledged where present. The key recommendation put forth by the communities was the urgent need for grass-roots sensitization and capacity building to promote sustainable agriculture and conservation practices, emphasizing the value of incorporating local knowledge into effective environmental management.

Keywords: Riparian communities, water quality, land cover change, citizen science, micro-catchments, Nyando River Basin, Lake Victoria Basin, Kenya

Introduction

The degradation of freshwater resources represents one of the most pressing global environmental challenges, particularly within rapidly developing regions where pressure on natural ecosystems is intense (Bănăduc et al., 2022). In tropical catchments, where high rainfall and vulnerable soils intersect with expanding human populations, the integrity of hydrological systems is inextricably linked to the stability of the terrestrial landscape. Changes in land cover, such as deforestation, encroachment into riparian zones, and conversion of forests to agriculture, disrupt the natural filtering capacity of the environment, directly impacting stream health (Mir et al., 2025). Global syntheses confirm that landscape change is a dominant pressure



on river and lake water systems, with far-reaching ecological and socio-economic impacts (Shi et al., 2024; Suresh et al., 2023).

Studies conducted globally reveal that agricultural intensification and urban expansion significantly deteriorate surface water quality by increasing turbidity, nutrient loads, and pollutants such as nitrates and phosphates. Large-scale projects further demonstrate that Citizen Science approaches provide reliable records of water quality, including turbidity and algal blooms, which strongly correlate with professional monitoring results (Ahmad et al., 2021; Capdevila et al., 2020; Domínguez-Rendón et al., 2024). These findings emphasize that combining community knowledge with scientific data enhances the accuracy and contextual relevance of water resource management.

Across Africa, rapid land cover changes have similarly intensified pressures on rivers and lakes. Research in West, Central, and Southern Africa highlights deforestation, poor land management, and agricultural expansion as major contributors to nutrient and sediment fluxes in catchments, often leading to eutrophication in downstream water bodies (Namugize et al., 2018; Nakkazi et al., 2024). These studies consistently recommend participatory monitoring and locally driven management frameworks to address data gaps and improve environmental governance.

In Kenya, micro-catchments provide an important scale for studying the direct impacts of land use on water resources. Small tributaries in agricultural and settlement areas quickly register changes in turbidity, flow variability, and visible pollution caused by poor farming practices, fertilizer application, and riparian degradation (Lekarkar et al., 2024). Empirical studies have shown strong associations between land cover shifts and water quality declines, particularly in intensively cultivated and urbanizing regions such as the Athi and Tana river basins (Nyamweya, 2023). Participatory mapping and community observation are increasingly applied in these studies to identify pollution hotspots and validate satellite-based land cover analyses (Capdevila et al., 2020).

Lake Victoria, shared by Kenya, Uganda, and Tanzania, remains highly vulnerable to nutrient enrichment, sedimentation, and declining fisheries. Research attributes these challenges to increased nutrient inflows from tributaries and lakeshore settlements, resulting in frequent algal blooms and nearshore oxygen depletion (Nyamweya, 2023; Nakkazi et al., 2024). Basin-wide assessments emphasize the importance of combining satellite imagery, hydrological monitoring, and community-based observations to guide sustainable interventions.

The Nyando River Basin, one of the most environmentally stressed sub-catchments of Lake Victoria, has experienced extensive forest clearance,



agricultural expansion, and settlement growth over the past decades. These changes have been linked to higher runoff, increased flooding, and elevated sediment loads into Winam Gulf (Olang et al., 2011). While studies have examined land cover dynamics and their impacts on hydrology, limited research integrates systematic community perspectives to understand how riparian populations perceive and respond to these changes. Therefore, this study addressed a critical research gap by focusing on the local knowledge held by the riparian communities residing within the micro-catchments of the Nyando River Basin. The central objective was to compare the perceived changes in water quality and water quantity as articulated by long-term residents with the documented land cover change observed in the five specific micro-catchments (Chebirirkut, Kimatkei, Kaplelmet, Sitoi, and Kibwareng).

Methodology

The study adopted a mixed-methods approach that incorporated a Citizen Science framework to capture community perspectives on land cover change and its influence on water quality and quantity. This approach was selected because riparian communities are not only primary users of stream resources but also direct observers of gradual changes in their environment, making them a credible source of longitudinal information that complements formal scientific assessments.

The target population comprised households, opinion leaders, organized groups, and other stakeholders residing within a one-kilometer radius of the identified sampling stations in the five micro-catchments of Chebirirkut, Kimatkei, Kaplelmet, Sitoi, and Kibwareng. These communities were purposively targeted because of their proximity to the streams and frequent reliance on them for domestic and livelihood needs. A purposive sampling strategy was applied to capture individuals with observable knowledge of changes in vegetation, land use, and water resources. The final sample size included 20 structured respondents, with between two and five individuals drawn from each micro-catchment. To strengthen coverage and minimize gaps arising from non-responses, additional interviews and informal discussions were held with other residents encountered around the sites.

Data collection relied on a structured questionnaire designed with guiding questions on perceived changes in land use and vegetation cover, as well as on water quality and streamflow across three temporal windows: within the past 5 years, 10 years, and more than 10 years ago. Respondents were asked to describe water conditions in terms of clarity, turbidity, and flow consistency, as well as their observations of land use practices such as fertilizer application, farming methods, or deforestation that they believed influenced



stream health. This allowed the study to document both observable indicators and community interpretations of cause-and-effect relationships.

Data analysis combined both qualitative and descriptive quantitative approaches. Responses from questionnaires, interviews and informal discussions were first coded thematically to identify recurring patterns in community observations. Themes included changes in vegetation cover, farming practices, riverbank cultivation, perceived water quality (clarity, turbidity, color), stream flow fluctuations, and the impacts of population pressure. Narrative accounts were organized by micro-catchment to highlight variations in local experiences and to enable cross-site comparison. Descriptive statistics such as frequencies and percentages were used to summarize responses on observed changes across the three timeframes of reference: five years ago, ten years ago, and more than ten years ago. These summaries highlighted the proportion of respondents reporting deterioration, stability, or improvement in water quality and land cover. Comparative analysis across micro-catchments allowed for identification of areas with high vegetation retention versus those with significant degradation.

Results and Discussion

Analysis of Micro-Catchment Observations

Chebirkut Micro-Catchment

Respondents reported minimal land use change, with large-scale tea farming and a well-conserved forest dominating the landscape. Indigenous vegetation cover remained at about 90%, supported by a protected government forest. Water quality was described as consistently good over the past two decades, though occasional turbidity was noted downstream after rainfall events due to road runoff.

Kimatkei Micro-Catchment

In contrast, Kimatkei had experienced population growth and expansion of intensive farming. Communities observed clearance of indigenous vegetation, replacement with exotic eucalyptus, and cultivation close to riverbanks. These changes were linked to declining water quality, with the stream often turning brown during rains and even drying up in dry seasons. Respondents associated the deterioration with soil erosion and agrochemical runoff.



Kaplelmet Micro-Catchment

Kaplelmet presented a mixed picture. While earlier land degradation was observed due to overgrazing and vegetation loss, recent rehabilitation through the Lake Victoria Environmental Management Project (LVEMP) improved vegetation cover and water quality. Community members noted positive impacts of terracing, tree planting, and soil conservation structures. However, new disturbances, such as brick-making along riverbanks, reintroduced localized degradation.

Sitoi Micro-Catchment

Although small and relatively less populated, Sitoi experienced pressure from neighboring settlements. Communities reported disturbance from increased water access, bathing, and poor sanitation practices. Water quality remained relatively good but showed slight decline over the last five years, attributed to fertilizer use and subsistence farming around tea estates.

Kibwareng Micro-Catchment

Kibwareng was the most degraded micro-catchment. Respondents described extensive deforestation, steep slopes left bare, and riverbank farming. Fertilizer use and poor farming practices were widespread. Communities observed severe soil erosion, declining flows, and water that was consistently turbid and unfit for domestic use. Indigenous vegetation had declined to about 13%, with eucalyptus replacing native cover.

Comparative Analysis of Micro-Catchments

A comparison of responses across the five sites highlights clear differences in land cover and water quality status (Table 1). Chebiririkut, with nearly intact forest cover, consistently reported very good water quality, while Kibwareng and Kimatkei, where vegetation loss exceeded 70%, reported poor water quality. Kaplelmet and Sitoi occupied intermediate positions, with localized improvements or declines linked to human interventions.



Table 1: Summary of Community Responses to the Questionnaires

Micro-Catchments Information	Kimatkei	Kaplelmet	Kibwareng'	Sitoi	Chebirkut
1. How long have you stayed in this area?	Ave 23.4 years	Ave 17.7 years	Ave 24.5 years	Ave 22.5 years	Ave 21.5 years
2. What is the name of this river?	Kimatkei	Mogoyuet	Cheptaburbur	Kibekelek	Kibirirkut
3. What farming activities are carried out in this region?	All: Tea, Maize and Livestock	Tea, Maize (All) and Bananas	Mixed Crop farming and livestock rearing	Large scale Tea and small scale Maize	Tea, Maize, Trees and Livestock
4. What types of fertilizers are used in this area?	NPK and some Animal manure	NPK	Nitrogen, Phosphorus and Manure	Nitrogen and Phosphorus	Nitrogen and Phosphorus
5. What land use changes have taken place in this area?	More intensive farming	Change from pasture to farming, and intensive farming	More extensive and river bank farming and use of inorganic fertilizers	Soil erosion control improved	None, Conserved forest
6. How has the population change in this area affected land use?	More land cleared for cultivation	Land sub-division and more intensive farming	Pressure on land, and destruction of vegetation	Destruction of trees, and increase in subsistence farming	No effect
7. How can you describe the water quality of this river?	The quality depreciated	Good	Poor water quality	The quality depreciated	Good Quality
8. How was the quality before as far as you can remember?					



Micro-Catchments Information	Kimatkei	Kaplelmet	Kibwareng'	Sitoi	Chebirkut
a. 5 years ago	Fair 4/5	Clean	Poor water quality, 5/5	Little change	Good Quality
b. 10years ago	fair 1/5, Good 3/5	Clean	Fair 5/5	Fair	Good Quality
c. More than 10 years ago	Good, 1/5, Very good 3/5	Good	Very good 4/5	Very good	Very good
9. What do you think has caused the change?	Blue gum, clearing of trees, and cultivation near banks	Clearing of trees, and cultivation near banks	Use of inorganic fertilizers, poor farming methods, destruction of trees, and cultivation near banks	Use of fertilizers, and poor farming practices	Road erosion
10. What good practices have been introduced in this area that has improved the water quality?	None	Trees planting, and soil and water conservation structures on the firms	None	None	Conservation
11. What bad practices have been introduced in this area that has interfered with the water quality?	Cutting Trees 2/5, Planting Eucalyptus 2/5, Use of Chemicals 1/5	Clearing of vegetation, and Making of Bricks near the river banks	Use of inorganic fertilizers, poor farming methods, cultivation near banks	Use of fertilizers and Cultivation along the river banks	None



Micro-Catchments Information	Kimatkei	Kaplelmet	Kibwareng'	Sitoi	Chebirkut
12. In your opinion, do you see any relationship between land use change and water quality of this river?	Soil erosion/water pollution	Yes, it influences water quality	Decrease in water quality	Change in quality	Yes, Conservation keeps water clean
13. Has there been any change in the quantity of water flowing in this river with time?	Decrease in volume	Decrease and then Increase in volume	Decrease in water quantity	Decrease in quantity	No
14. Are the indigenous species of vegetation which used to be in this area still found?	Most indigenous trees cut	Few indigenous trees	No 2/5, Yes 2/5	Yes 1/2,; No 1/2	Yes
a. If yes what percentage of the present vegetation cover?	Ave 25%	Ave 8.3%	Ave 12.5%	60% 1/2, None 1/2	Ave 90%
b. If no, what is there now?	Maize farms, exotic trees	Maize farms, exotic trees	Eucalyptus trees	Exotic trees	Roads took small portion
15. Do you have any other information you wish to add that is relevant to this discussion?	Stop trees Cutting and Cultivating near the river, Sensitization	Sensitization Needed	Sensitization	Sensitization on sanitation	



Assessment of Community Responses from the Micro-Catchments

The collective assessment by the respondents revealed varying degrees of indigenous vegetation loss across the five sites. The estimates indicated that Kimatkei, Kaplelmet, and Kibwareng micro-catchments had suffered substantial clearance, with remaining indigenous vegetation cover estimated at under 20%. Respondents noted the most significant loss of indigenous cover was initially in Kaplelmet, though direct observation revealed that current vegetation cover in Kaplelmet primarily comprised exotic species used in recent re-forestation efforts, with indigenous vegetation largely restricted to stream banks. Kaplelmet's landscape was dominated by maize farms, which benefited from good soil and water conservation structures. In contrast, Chebirirkut was cited as the least affected area, retaining a significantly higher proportion of its original indigenous vegetation cover. Conversely, both Kimatkei and Kibwareng showed evidence of vegetation destruction extending right up to the river banks. When asked to rate the stream water quality on a scale of 1 (Poor) to 4 (Very Good), the community's perceptions sharply differentiated the catchments. The streams in Kibwareng and Kimatkei were consistently rated as Poor, while the stream in Chebirirkut was rated as Very Good. Every respondent across all sites stated that the observed changes in water quality were directly related to the loss of land cover in the micro-catchments. They affirmed that any reduction in vegetation cover resulted in a subsequent deterioration of water quality and quantity. A near-unanimous theme emerged regarding the necessary steps for remediation. All respondents expressed common concerns about the negative changes in water quality and availability and provided clear proposals for improvement. The primary recommendation across the board was the urgent need for grass-roots sensitization on sustainable land use practices. Communities stressed the necessity of disseminating information related to sustainable agriculture and resource conservation to build capacity at the community level and reverse the observed negative environmental trends.

Discussion

The riparian communities within the Nyando micro-catchments provided compelling, long-term evidence that land cover change is directly and adversely affecting both water quality and quantity. This local, experiential knowledge provides essential corroboration for the study's scientific findings and aligns with documented trends across other Kenyan basins where shifts from natural vegetation to agriculture, settlement, or exotic plantations coincide with increased turbidity, declining flows, and impaired stream health (Matano et al., 2023). For instance, the degradation



observed here mirrors research in the Upper Athi River sub-catchment, where urban expansion into riparian zones affected parameters like electrical conductivity and heavy metal concentrations (Waturu et al., 2023), and similar water quality decline in the Theta River catchment attributed to altered land cover (Gituanja, 2020).

The comparative analysis of the micro-catchments reveals a clear degradation gradient. In Chebirirkut, sustained forest protection maintained largely intact vegetation, leading communities to report consistently good water quality and perennial flow. This stability highlights the crucial buffering capacity of undisturbed land cover. Conversely, the inhabitants of Kimatkei and Kibwareng described sharp declines: streams now turn brown (turbid) during rainfall and dry up during dry seasons. This hydrological instability is a direct consequence of land use intensification and the clearing of vegetation up to the river banks (Olang et al., 2011; Owiti et al., 2025). The community in Kibwareng specifically linked this to poor farming on steep, bare land, confirming that lack of vegetation combined with challenging topography accelerates soil erosion. The resulting flashy flows where water quickly runs off rather than infiltrating indicate a significant reduction in the land's capacity for groundwater recharge, a major concern for the entire Lake Victoria Basin (World Bank, 2022).

The case of Kaplelmet Micro-Catchment provides important evidence of reversibility. Community respondents noted tangible improvements in water quality following interventions such as reforestation, terracing, and soil conservation structures. This is consistent with successful catchment rehabilitation efforts elsewhere in Kenya that have mitigated environmental threats through increased vegetation cover (Ndalilo et al., 2021). However, residents also emphasized the fragility of these gains, noting that new localized disturbances, such as brick-making near the riverbanks, quickly negate earlier conservation efforts. The underlying driver of these unsustainable practices is population pressure, which forces cultivation onto marginal lands, increases the clearance of riparian vegetation, and drives the greater use of fertilizers. This aligns with broader Kenyan research attributing environmental deterioration to rapid population growth (Barasa & Perera et al., 2021; Mango et al., 2011). Ultimately, the community's observations confirm that their short-term economic activities like charcoal burning or agricultural expansion are driven by a critical knowledge gap. They realize the cost only when facing declining soil fertility (requiring more fertilizer) and acute water scarcity (forcing longer water fetching distances). This situation necessitates the sensitization and environmental education unanimously recommended by the communities, confirming that sustained catchment management hinges on bridging this knowledge deficit and that



environmental status is directly linked to the status of water quality and quantity in these vital ecosystems (Olang et al., 2011).

Conclusion

This study demonstrates a profound and directly perceived linkage between land cover change and the degradation of water quality and quantity across the micro-catchments of the Nyando River Basin, as validated by both community perspectives and scientific observations. The riparian communities' long-term experiential knowledge provides compelling evidence that the loss of indigenous vegetation, coupled with unsustainable land use practices such as cultivation near river banks and increased inorganic fertilizer use, is the primary driver of environmental decline. Catchments with high conservation status, like Chebiririkut, maintained good water quality and quantity, while those severely impacted by agricultural expansion and population pressure, such as Kimatkei and Kibwareng, experienced marked depreciation in water quality (notably increased turbidity) and severe reduction in stream flow, often leading to streams drying up. This convergence of community perception and environmental reality underscores that catchment degradation, exacerbated by rapid population growth and a lack of awareness, poses a critical threat to public health and livelihoods in the Lake Victoria Basin. The study confirms that sustainable water resource management in this region is inextricably linked to the protection and restoration of riparian and catchment vegetation cover.

Recommendations

To effectively address the degradation observed, a multi-pronged strategy targeting relevant bodies is recommended.

The Water Resources Authority (WRA) and the National Environment Management Authority (NEMA) should prioritize the rigorous enforcement of riparian buffer zone regulations, particularly within the highly degraded micro-catchments of Kimatkei and Kibwareng, to halt riverbank cultivation and exotic species planting.

The County Governments of Nandi and Kericho, in collaboration with the Ministry of Agriculture and Livestock Development, must urgently launch and sustain large-scale, grass-roots community sensitization and environmental education campaigns. These efforts must focus on educating farmers about the long-term hydrological consequences of clearing indigenous vegetation and promoting the adoption of sustainable land management (SLM) practices, such as terracing and appropriate soil and



water conservation structures, which were demonstrated to be effective in the Kaplelmet micro-catchment.

Furthermore, the Lake Victoria Basin Commission (LVBC) and international partners should invest in developing and disseminating practical knowledge that links short-term economic activities (e.g., charcoal production, fertilizer use) to long-term resource depletion, thereby empowering communities to make informed decisions that ensure the perennial flow and quality of the Nyando River system.

References

- Ahmad, W., Ahmad, S., & Al-Shaibah, B. (2021). Impact of land use/land cover changes on water quality: A global perspective. *Scientific Reports*, 11(1), 17858. <https://doi.org/10.1038/s41598-021-96075-3>
- Bănăduc, D., Simić, V., Cianfaglione, K., Barinova, S., Afanasyev, S., Öktener, A., ... & Curtean-Bănăduc, A. (2022). Freshwater as a sustainable resource and generator of secondary resources in the 21st century: Stressors, threats, risks, management and protection strategies, and conservation approaches. *International Journal of Environmental Research and Public Health*, 19(24), 16570.
- Capdevila, A. S. L., Kokimova, A., Ray, S. S., Avellán, T., Kim, J., & Kirschke, S. (2020). Success factors for citizen science projects in water quality monitoring. *Science of the Total Environment*, 728, 137843. <https://doi.org/10.1016/j.scitotenv.2020.137843>
- Domínguez-Rendón, E., Martínez-Ruiz, R., & López-Ortiz, C. (2024). Community strengthening through citizen monitoring of water resources. *PLOS ONE*, 19(3), e0305723. <https://doi.org/10.1371/journal.pone.0305723>
- Gitunja, G. G. (2020). *Impacts of land use and land cover on water quality and benthic macroinvertebrates in Theta River Catchment* (Master's thesis). Kiambu County, Kenya.
- Lekarkar, K., Kipkorir, E., & Koech, R. (2024). Assessing spatio-temporal land cover changes within the Nyando River Basin using Landsat data and community inputs. *Environmental Monitoring and Assessment*, 196(5), 412. <https://doi.org/10.1007/s10661-024-12345>
- Mango, L. M., Melesse, A. M., Kutya Buganda, S. (2011). Land use and climate change impacts on the hydrology of the Upper Mara River Basin, Kenya. *Hydrology and Earth System Sciences*, 15(7), 2245–2254. <https://hess.copernicus.org/articles/15/2245/2011/>
- Matano, A. S., Kanangire, C. K., Anyona, D. N., Abuom, P. O., & Ofulla, A. V. O. (2023). Influence of land use cover on selected water quality parameters of River Isiukhu, Kenya. *International Journal of Water Research*.
- Mir, Y. H., Mir, S., Ganie, M. A., Bhat, J. A., Shah, A. M., Mushtaq, M., & Irshad, I. (2025). Overview of land use and land cover change and its impacts on natural resources. In *Ecologically Mediated Development: Promoting Biodiversity Conservation and Food Security* (pp. 101-130). Singapore: Springer Nature Singapore. https://doi.org/10.1007/978-981-96-2413-3_5
- Nakkazi, M. T., Mugizi, F., & Tumusiime, D. M. (2024). Linking land use, precipitation, and water quality patterns in the Lake Victoria basin (2000–2022). *Frontiers in Environmental Science*, 12, 11511718. <https://doi.org/10.3389/fenvs.2024.11511718>
- Namugize, J. N., Jewitt, G., & Graham, M. (2018). Effects of land use and land cover changes on water quality in river systems: A review of case studies in Africa. *Environmental Reviews*, 26(4), 438–450. <https://doi.org/10.1139/er-2018-0035>



- Ndalilo, L. A., Maranga, E. K., & Kirui, B. K. (2021). Land use and land cover change along River Lumi riparian ecosystem in Kenya: Implications on local livelihoods. *Open Journal of Forestry*, 11, 206-221. <https://doi.org/10.4236/ojf.2021.113014>
- Nyamweya, C. S. (2023). Lake Victoria: Overview of research needs and management priorities. *Science of the Total Environment*, 886, 163962. <https://doi.org/10.1016/j.scitotenv.2023.163962>
- Olang, L. O., Fürst, J., & Kundu, P. M. (2011). Analysis of spatio-temporal land cover changes for the Nyando Basin of Kenya. *Hydrological Sciences Journal*, 56(1), 101–118. <https://doi.org/10.1080/02626667.2011.553616>.
- Shi, X., Wang, H., & Zhao, Y. (2024). Effects of landscape changes on water quality: A global synthesis. *Global Environmental Change*, 84, 102849. <https://doi.org/10.1016/j.gloenvcha.2023.102849>
- Suresh, K., Patil, S., & Sivakumar, B. (2023). Recent advancements in water quality indicators for lake eutrophication. *Environmental Research Letters*, 18(6), 063004. <https://doi.org/10.1088/1748-9326/acd6f9>
- Umukiza, E., Raude, J. M., Wandera, S. M., Petroselli, A., & Gathenya, J. M. (2021). Impacts of land use and land cover changes on peakdischarge and flow volume in kafia and esamburmbur sub-catchments of narok town, kenya. *Hydrology*, 8(2), 82.
- Waturu, M., Sitoki, L., Lalah, J., Chasia, S., & Mbao, E. (2023). Effect of land use/land cover changes on water quality in the Upper Athi River sub-catchment in Kenya. *African Journal of Aquatic Science*, 48(3), 247-260. <https://doi.org/10.2989/16085914.2023.2207098>
- World Bank. (2022, March 15). *Protecting Lake Victoria for a green, resilient, and inclusive future*. World Bank Blogs. <https://blogs.worldbank.org/en/water/protecting-lake-victoria-green-resilient-and-inclusive-future>

