

## Unfinished Business in Uganda's Freshwater Ecosystem Restoration:

An integrated assessment of socio-ecological resilience indicators in restored Sironko river wetland, Eastern Uganda

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### OVERVIEW

Uganda, the Pearl of Africa, is endowed with freshwater ecosystems that sustain biodiversity, underpin livelihoods, and drive economic growth. Yet these ecosystems are degrading at an unprecedented rate due to anthropogenic pressures and accelerating climate change impacts. As these impacts intensify, restoration alone is insufficient: Uganda's freshwater ecosystems must be built to withstand shocks, maintain functionality, and adapt to changing conditions over time. Drawing on evidence from the restored Sironko River Wetland, this brief presents options for strengthening policy and scaling restoration actions that build genuine socio-ecological resilience in Uganda's freshwater ecosystems.

### INTRODUCTION

The Sironko River wetland extends approximately 97 km across the Sironko and Bulambuli Districts in eastern Uganda. This policy brief focuses on selected sections of the wetland, including restored river reaches, to assess the ecological and resilience outcomes of restoration efforts. The findings are based on an integrated evidence base that combines ecological assessments and social survey data collected from multiple sources (Photo 1), including:

- 10 macroinvertebrate sampling sites were surveyed across restored and unrestored river sections. At each site, three replicate samples were collected, and specimens were identified to the genus level.
- 15 vegetation plots (10 × 50 m) were established in adjacent riparian forests to assess tree diversity and composition.
- 18 vegetation plots (10 × 50 m) were established in home gardens to assess tree diversity and composition in the adopted agroforestry practices.
- A 10-year (2016–2026) landscape assessment was conducted to evaluate changes in wetland spatial extent, forest cover, and habitat connectivity using GIS and FRAGSTATS.
- 292 household interviews were conducted across 12 villages within the restored wetland landscape to assess community participation and traditional ecological knowledge integration in restoration.
- An institutional and governance assessment was undertaken using ego-alter network analysis to examine stakeholder relationships and institutional linkages, influencing restoration activities.

### POLICY RECOMMENDATIONS

**Build institutional capacity for socio-ecological resilience:** there is need to conduct capacity needs assessments and deliver training on socio-ecological resilience across relevant institutions.

**Embed resilience and traditional knowledge into policy and practice:** there is a need to integrate socio-ecological resilience principles and systematic mechanisms for traditional ecological knowledge into the National Wetland Policy, National Wetland Strategic Plan, and all restoration frameworks and programme designs.

**Conduct a national freshwater ecosystem status assessment:** the State of Wetlands and State of Environment reports should incorporate regime shift assessments to identify and prioritize degraded freshwater ecosystems before they reach irreversible thresholds.

**Establish polycentric, nested governance with genuine community participation:** restoration governance platforms should formally include relevant institutions across sectors and levels, with clear responsibilities, and be structured around genuine community participation and co-governance, and not token consultation.

**Shift from reactive restorative to transformative intervention:** restoration efforts should be transitioned from reactive to a transformative approach, addressing underlying drivers of degradation.

**Secure land tenure for wetland-dependent communities:** there is a need to enact formal land tenure frameworks vesting restored wetland landscapes in the communities that depend on and steward them.

**Strengthen domestic financing for livelihoods and restoration:** there is need for the Ministry of Finance, Planning and Economic Development to allocate adequate domestic funding to sustain alternative livelihood programmes for wetland-dependent communities and ongoing restoration efforts, reducing reliance on short-term donor projects.

**Expand restoration from site-level interventions to full catchment scale:** restoration interventions should be expanded from isolated site-level treatments to the full catchment scale.

## KEY FINDINGS

**Macroinvertebrate diversity:** diversity was low with no significant difference between the restored and unrestored reaches ( $p= 0.42$ ). However, the unrestored reach had a marginally higher median Shannon diversity ( $H'= 1.66$ ) in comparison to the restored reach ( $H'= 1.61$ ) (Fig. 1).

**Riparian forest diversity:** was dominated by non-native *Eucalyptus grandis*, with an overall average tree density of 17 trees per 500 m<sup>2</sup>. Tree species diversity was very low (median  $H'= 0.99$ ) and varied significantly across plots ( $H'= 27.88$ ,  $p= 0.015$ ) (Fig. 2).

**Home-garden diversity:** was dominated by the native species *Markhamia lutea*, with an overall average tree density of 18 trees per 500 m<sup>2</sup>. Tree species diversity was moderate (median  $H'= 2.3$ ) and varied significantly across gardens ( $H'= 66.98$ ,  $p= 0.001$ ) (Fig. 2).

**Landscape connectivity:** despite restoration efforts, wetlands continue to experience progressive loss, fragmentation, and increasing isolation highlighted by declining largest patch index (Fig. 3). Forest patches also remain in an unstable fragmentation trajectory (Fig. 3-4).

**Community participation:** majority of the respondents (84.2%) opined that they were consulted and have access to relevant restoration information (58.9%), yet exercise minimal influence over decisions (0%), planning (17.8%), and *on-the-ground* restoration activities (10.4%).

**Traditional ecological knowledge:** majority of the respondents (82%) held valuable knowledge of native species, restoration seasons (92%), and practices (60%), but majority (86.7%) opined that their knowledge was not integrated into formal restoration programmes.

**Institutional governance:** institutional collaboration in wetland restoration was very weak, with a low network density (0.05), high fragmentation (fragmentation index= 0.91), and a governance structure that was highly centralized around the Ministry of Water and Environment, which had the highest in-degree and out-degree centrality.

## CONCLUSION

Although the government is actively implementing Ecosystem-based Adaptation (EbA) restoration initiatives since 2012, current conditions in Sironko restored landscapes remain insufficient to deliver genuine socio-ecological resilience. Future EbA restoration projects should focus on freshwater connectivity conservation to halt further landscape fragmentation, and be designed and implemented as comprehensive socio-ecological resilience-building programmes, one that fully integrate social and ecological subsystems rather than treating them as separate concerns.

## KEY REFERENCES

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Photo 1. Cross-section of field data collection and laboratory analyses

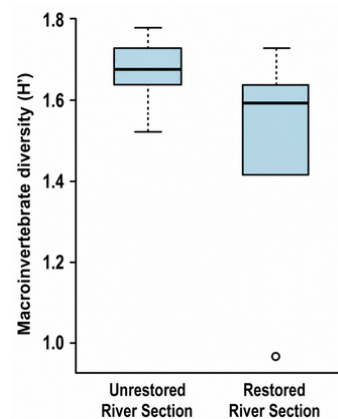


Fig. 1. Macroinvertebrate diversity

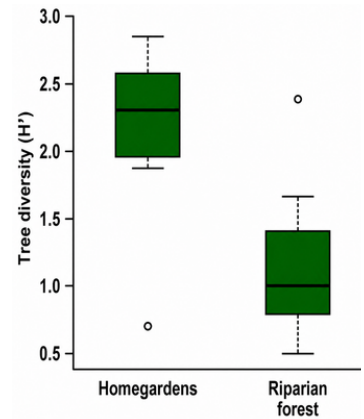


Fig. 2. Tree diversity ( $H'$ )

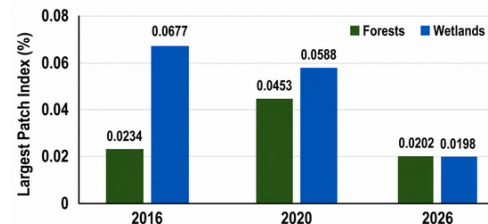


Fig. 3. Landscape connectivity as highlighted by the Largest Patch Index

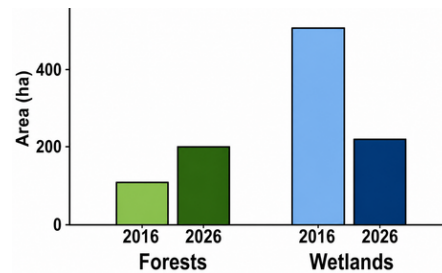


Fig. 4. Forests and wetland changes between 2016 and 2026



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