

SCIENCE POLICY BRIEF

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Integrating Biodiversity and Ecosystem Services into Urban climate change Adaptation Strategy: case of an urban watershed

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Purpose of this brief

This policy brief presents key findings and recommendations on the integration of biodiversity and ecosystem services of the Little Akaki River sub-watershed into urban climate adaptation strategies in Ethiopia. It examines the driving factors contributing to the degradation of the sub-watershed. Floristic inventory was undertaken of riparian vegetation by using random sampling design from upper, middle and lower streams of Little Akaki River. In addition, a comparison of current land use and land cover (LULC) conditions with simulated future land-use scenarios in terms of provisioning annual water yield using InVEST proximity based scenario generator.

Background

The Little Akaki River sub-watershed is an urban watershed with a surface extent of 400 km², located in west of Addis Ababa, within the Oromia Region. It is experiencing significant pollution, habitat degradation, and biodiversity loss, adversely affecting the provision of ecosystem services including, supply of water for irrigation and domestic use, flood regulation, storm water retention, ground water recharge and hydro-power generation. While emerging policies, such as Ethiopia's Climate Resilient Green Economy, Ethiopia's water resource management policy and the revised Ethiopia's NBSAP are being implemented to support green urban infrastructures, strengthening governance effectiveness remains central to achieving sustainable watershed management. This study aimed to strengthen this policies by providing scientific evidence for decision makers.

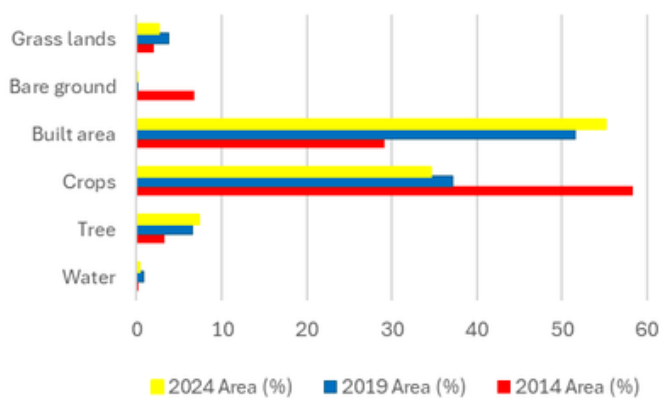


Fig 1. Changes in Land use Land cover (LULC) between 2014 and 2024

Key recommendations

- Watershed protection should be explicitly integrated into the Addis Ababa city master plan to ensure ecologically informed urban planning.
- Reforestation within the sub-watershed should be prioritized as a critical measure for sustaining ecosystem services and enhancing biodiversity.
- Collaboration between regional and city administrations should be strengthened to enable coordinated ecosystem protection across the upper catchment.
- Rigorous environmental impact assessments (EIAs) should be conducted and enforced prior to the establishment of any industrial facilities near the Little Akaki River.
- Industries operating along the river should be required to install and maintain adequate wastewater treatment systems before discharging effluents into the river.

Key Findings

- Land use and land cover (LULC) within the Little Akaki sub-watershed has changed significantly over the past ten years (Fig. 1). Among the drivers of LULC change, rapid urbanization is the predominant factor, contributing most significantly to the degradation of the natural ecosystem.
- Riparian vegetation species richness was highest ($n=23.7\pm 9.87$) in the lower stream compared to the middle ($n=18.3\pm 3.79$) and upper streams ($n=17.6\pm 6.03$), owing to the downstream transport of soil and nutrients from upper catchment areas.
- While the lower stream recorded the highest species richness, its diversity score was relatively low (Shannon index, $H'=0.12\pm 0.03$), indicating an uneven distribution of species.

- Modelling results showed that provisioning ecosystem services, specifically, its annual water yield showed a marginal decrease under both the agricultural expansion (that is, if urban expansion were replaced by agricultural expansion), and reforestation (that is, if urban expansion were replaced by urban greening/reforestation) scenarios compared to current LULC conditions; however, the reduction was less than 1% in both cases, attributable to increased transpiration from forests and crops (Fig. 2).
- Although the reforestation scenario also results in a slight decrease in water yield, it is the preferred pathway given its broader benefits for sustainability and ecosystem services.

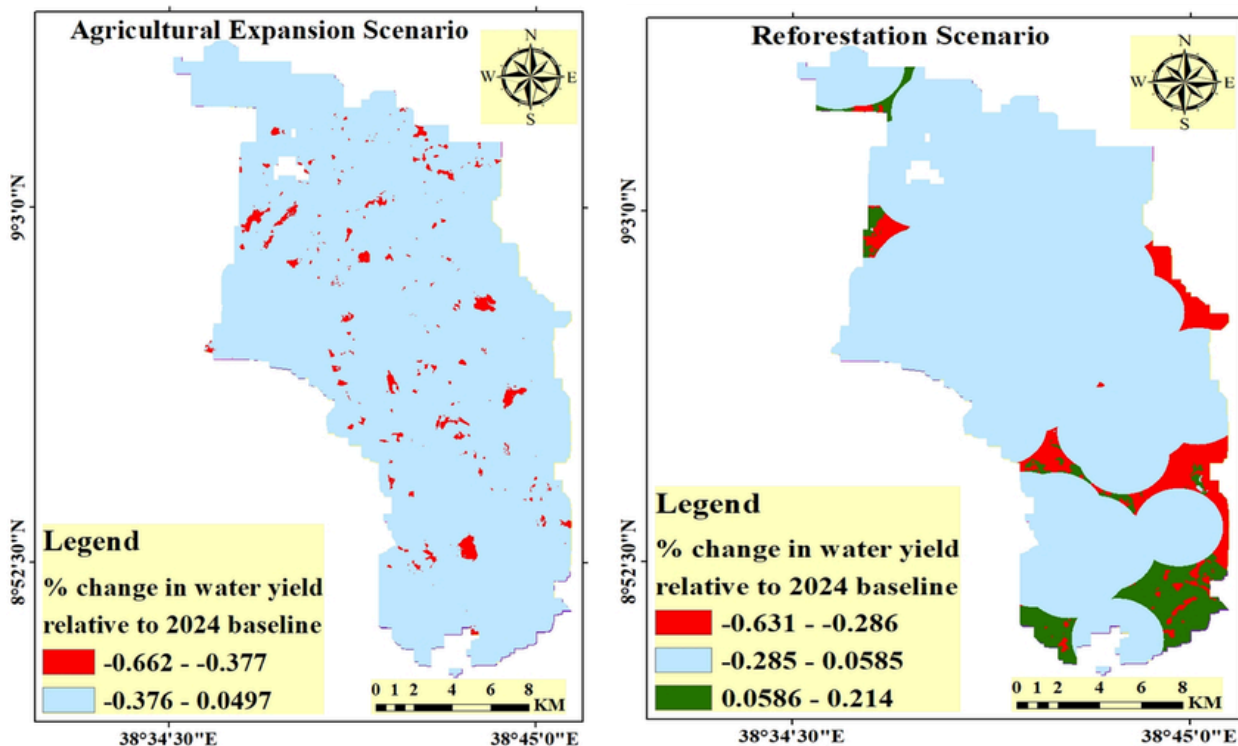


Fig 2. LULC map showing changes in annual water yield (%) with agricultural expansion scenario (left image) and reforestation scenario (right image)

Conclusion

The Little Akaki River sub-watershed faces pressing threats of habitat degradation and biodiversity loss, with anthropogenic activities continuing to undermine the provision of ecosystem services. Urgent action is needed to manage the pace and pattern of urbanization in order to prevent further watershed degradation and advance sustainable development. Strengthening urban green infrastructure and ecosystem restoration initiatives will be essential to safeguarding and improving the long-term delivery of ecosystem services within the sub-watershed.

CITED SOURCES

- Author's MSc. thesis (2026)
- Hailu, T., Assefa, E., Zeleke, T. (2024) Urban expansion induced land use changes and its effect on ecosystem services in Addis Ababa, Ethiopia. *Front. Environ. Sci.* 12, 1454556.