THE JONES CENTER AT ICHAUWAY

Publication Brief

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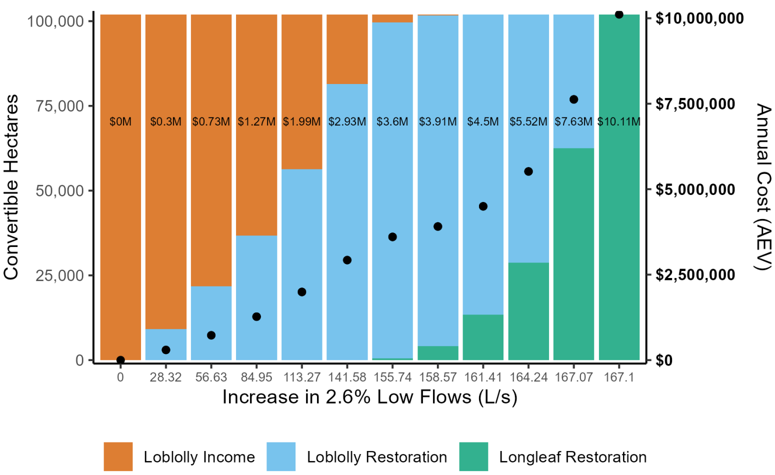
Balancing economic and ecological tradeoffs of forest restoration for water

Competing demands from agriculture and population growth place increasing pressure on water supplies. This problem is especially acute when declining streamflows threaten biodiversity and water security. We explored how restoration of open-pine woodlands could be optimized as a nature-based solution to enhance water quantity. Specifically, we asked if forest management could improve low streamflows in the Ichawaynochaway Creek basin in southwest Georgia.



Demonstration of forest land use optimization in the Ichawaynochaway basin. Figure shows convertible hectares under three management scenarios and cost in Annualized Equivalent Value (AEV; black dots and labels) to achieve simulated increases in 7-day low flows in liters per second (L/s).

Converting dense, upland forests to open woodlands reduces tree density, encourages a grass-dominated understory, and favors trees with adaptations to drought. We evaluated how different forest management scenarios of longleaf pine and loblolly pine influence water yield. We also considered financial returns along with hydrological and ecological benefits that maximized restoration impacts. Our goal was to equip policymakers and practitioners to make informed decisions about natural resources based on economic and ecological reality and enhance the long-term viability of conservation efforts.

Our results indicate that restoring longleaf pine forests produces the greatest increase in streamflow (up to 3.8 million gallons per day) but came with higher costs. In contrast, moderate flow increases (up to 1.9 million gallons per day) could be achieved more cost-effectively by converting a smaller portion of the watershed's upland forests to low-density loblolly pine savannas. These scenarios demonstrated higher cost efficiency than a full longleaf restoration. This suggests that fire-maintained, open-canopy pine woodlands – whether longleaf or loblolly – can increase water yield while supporting ecological goals.

Our findings offer a framework for integrating ecological restoration with hydrologic and economic planning. Optimization modeling can help prioritize restoration efforts and support the design of ecosystem service markets like the Georgia Flow Incentive Trust (GA-FIT). This study demonstrates the importance of science-based, strategic land use planning that balances economics with ecological needs.

MORE INFORMATION

English, C.J., Younger, S.E., Brantley, S.T. et al. 2025. Forest land cover optimization for water management in the Ichawaynochaway creek basin. Scientific Reports. doi.org/10.1038/s41598-025-05677-8

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KEY POINTS

There are tradeoffs of managing forested uplands for economic and hydrologic values in watersheds where low flows are a conservation concern

A full longleaf restoration (100% of the watershed's convertible upland forests) produced the greatest increase in streamflow

Moderate increases in streamflow could be achieved by converting a smaller portion of the watershed's upland forests to low-density loblolly pine savannas

Although longleaf pine ecosystems were the historically dominant ecosystem in the study region and are of primary restoration interest, loblolly pine, when managed as an open woodland with frequent fire, maintains many of the same ecological benefits