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## Enhancing Cost-Effective Watershed Management in the Brazilian Atlantic Forest by Valuing Forest Ecosystem Services Linked to Water Quality in the Guapi-Macacu Watershed

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### Abstract

The Guapi-Macacu watershed is located in the Brazilian state of Rio de Janeiro, has a drainage area of about 1.640 km<sup>2</sup>, and drains into the Guanabara Bay northeast of the metropolitan area. The upper catchment in the Serra dos Órgãos mountain range is covered by dense old-growth forest of high biological diversity, while pastures and agricultural land dominate in the lower catchment. Apart from its outstanding biological value, the watershed provides crucial services including water supply to 2.5 million inhabitants in five municipalities. Nevertheless, forests and soils in the lower watershed are highly degraded due to the expansion of the agricultural frontier, overexploitation, and suburbanisation processes. Several pressures on this ecosystem persist. Therefore payments for ecosystem services (PES) schemes are proposed by local initiatives and supported by international organizations as a suitable instrument to deal with the trade-offs between agricultural use and watershed services in a cost-effective manner. Studying the provision costs of and the demand for watershed services can support decision making process to evaluate the scope and economic feasibility of PES and alternative management options. Water resources in the watershed are of extreme importance for agriculture and also for industries, such as water bottle companies, breweries and the biggest Brazilian petrochemical complex, COMPERJ. Our study concentrates on calculating the opportunity costs related to the provision of watershed services under varying land use systems and evaluating the feasibility of PES related aspects, such as preserving or recovering forest areas and integrating good agricultural practices. Watershed services are valued in terms of controlling nutrients (Nitrogen and Phosphorus in surface water) and sediment loads (measured in terms of turbidity and total solids). Replacement and avoided cost methods are applied focusing on the local water treatment facility to estimate demand for service maintenance and improvement. To provide empirical evidence of the link between land use and water quality indicators, we rely on water quality modelling and monitoring specifically adapted to this area. Spatial conservation opportunity cost analysis is used to study the costs of watershed services maintenance and improvement and derive implication for cost-effective management on the basis of scenario analyses. The research activities take place within the framework of the multi-disciplinary German-Brazilian cooperation project DINARIO/MP2.

**Keywords:** Atlantic forest, cost-effective watershed management, ecosystem services, PES, land use systems, water quality

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