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Its work to develop scientifically credible methods for ecosystem accounting is guided by a policy and technical committee of experts in environmental economics, natural sciences, and national accounting.

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MADAGASCAR

Valuing Ecosystem Services in the CAZ Forestry Corridor

The CAZ Forestry Corridor

With an area of less than half a percent of the earth's landmass, Madagascar harbors nearly 5 percent of the world's biodiversity. The country is also one of the poorest countries in the world with 77 percent of households living under the poverty threshold.

The Ankeniheny-Zahamena Forestry Corridor (CAZ) located in the country's east contains the largest remaining contiguous patch of humid forest in Madagascar amidst a mosaic of land uses including agriculture, mining, forest plantations, and villages, as well as five government-managed national parks and reserves. With a surface area of 381,000 ha, its forests, wetlands, and rivers

are home to over two thousand species of plants as well as many species of mammals, amphibians and birds. CAZ is home to around 350,000 people; mostly rural communities who practice a mix of subsistence agriculture and cash crop production.

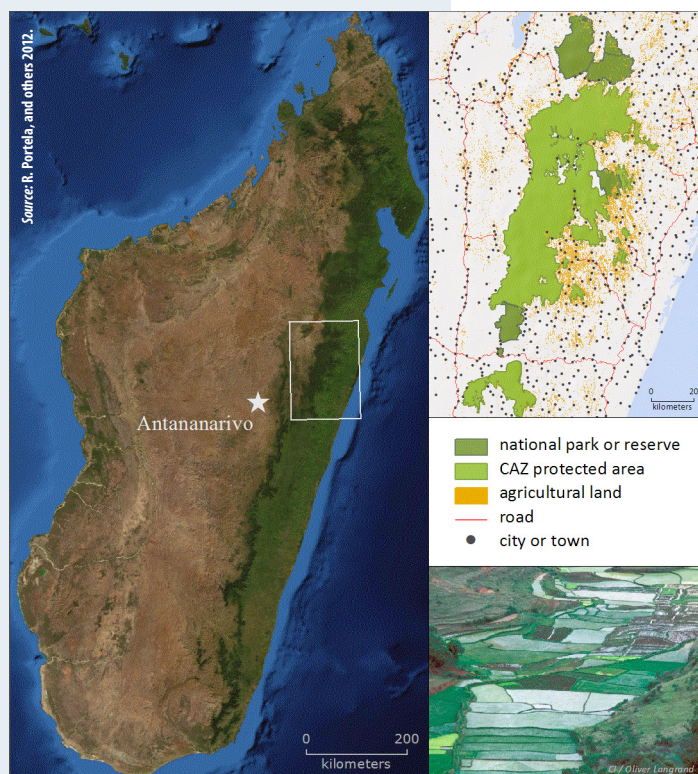
A case study was conducted in the CAZ area as part of WAVES activities in Madagascar to demonstrate the economic importance of key ecosystem services including water supply, sediment retention and climate regulation. State-of-the-art biophysical modeling and economic

analyses methods were used to address the complex nature of ecosystem service provision; as well as the role of ecosystem services as inputs to economic sectors such as agriculture, mining, tourism and hydroelectricity. The study represents a first effort to characterize links between the ecological and economic systems in CAZ, and to demonstrate new methodologies for assessing the contribution of natural capital to local people and economies.

Analysis of water supply and sediment regulation services in the CAZ protected area

The biophysical analysis of water regulation and sediment indicated that while current levels of water demand for irrigation, livestock, residential and tourism are essentially met both inside and outside of the protected CAZ corridor, areas within the CAZ corridor have the potential to sustain much greater water demand than sites outside the corridor, where critical levels of water demand are already being faced. The CAZ area also harbors a greater capacity to make precipitation available for irrigation of rice production; an important result given the high reliance of households on subsistence rice production.

Water quality, as represented by the contamination of freshwater by sediment, was estimated to be significantly better inside the CAZ corridor than outside. These results highlight the role of CAZ in preventing sediment contamination of the water supply; an important result in terms



of hydroelectricity generation that relies on low sediment levels in water supply.

The economic analysis, showed water use efficiency to be greater in the region's agricultural and tourism sectors. The marginal economic value of water—a measure of the value of water per unit of output of the production sector in question—was greater in the mining and hydroelectricity sectors.

These results are particularly relevant given the need for robust data to underpin the development of regional and national integrated water resources management (IWRM) planning in Madagascar. IWRM policies must address the competing needs of different economic activities, the industrial efficiency and profitability of a given operation, its impact on water flows and sediments, and equity in the distribution of resources.

Climate regulation services of the CAZ Forestry Corridor

Carbon sequestration levels (above and below ground) are very high in CAZ, suggesting that the area has high value as a carbon pool. However, results also showed the potential for even higher releases of carbon if the area is poorly managed. Livelihoods in this region are often based on unsustainable practices, such as slash and burn agriculture and illegal logging, both of which are associated with deforestation in CAZ. Failure to control such activities could tip the balance and quickly turn the area into a significant source of carbon emissions.

The analysis revealed high economic values of carbon sequestration for the region—measured as the marginal benefit accrued to society associated with the reduction of one tonne of carbon dioxide emissions through sequestration or avoided deforestation. If converted to financial revenues, this could represent an important source of revenues both for protected area management and to improve livelihoods.

The results point to the potential benefits of engaging in carbon markets, such as



Reducing Emissions from Deforestation and Forest Degradation (REDD+) and the Clean Development Mechanism (CDM). Although Madagascar's high deforestation rates and low forest cover appear to justify investments in both REDD+ and CDM, technical and institutional barriers remain. WAVES activities will assist in generating information on the potential economic contribution of carbon stocks and can inform dialogue on principles to underpin the distribution and investment of generated revenues, as well as the policy and legislative framework that could apply.

Policy implications

To date, there have been few analyses that assess both biophysical and economic values of ecosystem services in a robust, common framework and this remains one of the biggest challenges for WAVES. This preliminary and rapid assessment is an effort to demonstrate the feasibility of techniques to model and value ecosystem services in a data scarce environment. Collectively, results produced by the biophysical and economic analyses can help to inform policy development and the design of management alternatives for areas such as the CAZ corridor.

An important outcome of this analysis was the identification and development of methods to quantify four key dimensions of ecosystem services, each with a different relevance for the development of policy: input productivity, economic value, sustainability of supply, and quality of supply. In the absence of quantitative models a multiple criteria analysis of these factors could inform the design of policy by allowing comparisons among different sites, highlighting important trade-offs between

competing alternatives, and ultimately guiding decision-making based on locally determined priorities.

Conclusions

This case study has provided an assessment of the multiple benefits of Madagascar's forests to several economic sectors in the CAZ region, and provides a foundation for future regional or national level studies. It demonstrates the ability to quantify the contribution of natural capital to a regional economy. Better understanding of the magnitude of nature's contributions can help to demonstrate the trade-offs between natural resource exploitation, and the potential benefits of more sustainable management of natural resources. Understanding trade-offs is key to policies and management decisions that appreciate the economic benefits of protected areas, ensure the distribution of revenues from key economic sectors, and resolve management of conflicts over resource use. This is especially important in Madagascar given the global and regional significance of the country as one of the world's ten most threatened forested hotspots, and the need for significant and coordinated efforts to protect its natural capital.

References

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