

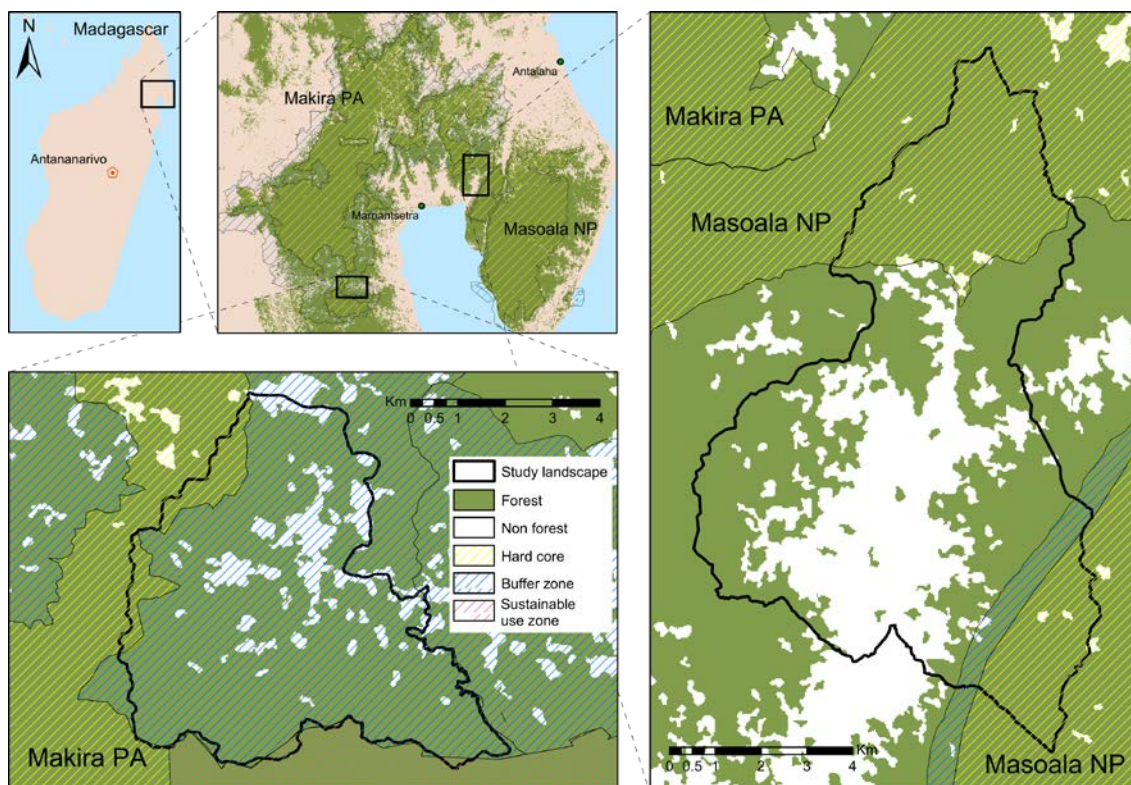
## Sustainable development and human well-being under telecoupling: insights from the biodiversity hotspot of northeast Madagascar

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Land-use change in the humid tropics plays a pivotal role across geographical scales and distant stakeholders, prominently visible in forest-frontier contexts. These regions are in the midst of a triple pressure: mounting demand to produce commodities for the international market, meeting the well-being needs and development aspirations of local populations, and serving global objectives of biodiversity conservation and carbon sequestration. These interlinked dynamics are giving rise to *telecoupled* situations, where external factors outpace local determinants of land-use change (Eakin *et al.* 2014). Some of these emerging processes hold the potential to constitute stepping stones towards sustainable development pathways, but at the same time might have unforeseen implications for human well-being.



Sources: forest: MEEF *et al.* 2013; PA boundaries: MNP and WCS 2017;

Figure 1. Location of the study landscapes in northeast Madagascar.

In this paper, we present results from research conducted in two highly dynamics landscapes in northeast Madagascar, a region that prominently illustrates the implications of telecoupled situations. On the one hand, several protected areas were implemented here in recent decades, meaning the closure of the forest frontier in an until recently shifting cultivation-dominated area. In the other hand, vanilla and clove, the main cash crops produced in the region and linking the local economy to global markets, are experiencing acute price fluctuations, which have unclear implications for local well-being and ecological systems.

For this research, we developed an integrative methodology combining participatory land-use change mapping based on very high resolution satellite imagery (Zaehringer *et al.* 2018), with a mixed methods toolbox operationalising the capabilities approach (Nussbaum 2000) to explore local well-being. This methodology allow us to reconstruct and quantify spatially explicit landscape dynamics over the last three decades, and crucially, to relate these trends with parallel changes in the well-being of local communities. Key findings relevant for supporting sustainable development endeavours include the following. First, that externally-led processes got deeply reflected in the local landscapes, with unexpected outcomes for environmental dynamics. And second, the realisation that these landscape dynamics relate to local populations' well-being in a non-linear manner, leading to increases in some capabilities but triggering decreases in others. While these trade-offs currently challenge efforts to sustainably manage these landscapes, better understanding on them possibilitate extracting important lessons from which to inform initiatives to steer socio-ecological systems in forest-frontier contexts towards sustainable development.

## REFERENCES

Eakin, H., R. DeFries, S. Kerr, E. F. Lambin, J. Liu, P. J. Marcotullio, P. Messerli, A. Reenberg, X. Rueda, S. R. Swaffield, B. Wicke and K. Zimmerer (2014). *Significance of Telecoupling for Exploration of Land-Use Change*. Rethinking Global land Use in an Urban Era. K. C. Seto and A. Reenberg. Cambridge, Massachusetts and London, England, The MIT Press: 141-162.

Nussbaum, M. (2000). *Women and Human Development: The Capabilities Approach*. New York, Cambridge University Press.

Zaehringer, J. G., Llopis, J. C., Latthachack, P., Thein T. T. & Heinimann A. 2018. A novel participatory and remote-sensing-based approach to mapping annual land use change on forest frontiers in Laos, Myanmar, and Madagascar. *Journal of Land Use Science*: 1-16.