

# Conservation and development: Socioeconomic Impact evaluation of Terrestrial Protected Areas in Madagascar based on large national surveys

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## Abstract

Protected Areas are the most widely used tool for biodiversity conservation. However, their implementation raises concerns about the well-being of local populations, especially when they are very poor and dependent on natural resources, as is the case in Madagascar. This pre-analysis plan outlines the data, methods, and empirical strategies used to evaluate the impact of protected areas on local household well-being and the inequalities among them. Our study focuses on terrestrial protected areas and relies on Demographic Health Surveys spanning a 13-years period (2008-2021). We will also use data from the previous 11 years (1997-2008) to assess whether parallel trends prior to the study period confirm the validity of the comparisons. The data will be analyzed using spatio-temporal models, matching, and difference-in-differences methods.

Keywords : Biodiversity Conservation, Well-Being, Demographic and Health Surveys, Spatio-Temporal Models, Geospatial impact evaluation, Madagascar

JEL codes : Q57, I31, C31, Q56, O55

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## Proposed timeline

Phases	Dates
Literature Review, Conceptualization, and writing of the Registered report	May 2024 - January 2025
Retrieve data from selected sources	February 2025
Data cleaning and analysis	February - March 2025
Writing the scientific article	March 2025 - April 2025
Submission to the journal	April 2025

# 1 Introduction

The reconciliation between conservation and development has been a long-discussed issue within the scientific community (Adams et al., 2004), but its importance has grown considerably over the past decade with the rapid expansion of protected areas (PAs). This issue is particularly relevant for all 195 COP15 signatory states, which have committed to increasing protected areas coverage to 30% of terrestrial land by 2030.

In theory, protected areas can have significant impacts on local livelihoods, both positive and negative. They are recognized as an essential tool for biodiversity conservation (Maxwell et al., 2020), but their creation can deprive nearby communities of access to natural resources (gathering, hunting, fishing, and medicinal plants), reduce the amount of land available and restrict economic activities (agriculture, livestock, construction) (Kandel et al., 2022). Conversely, they can be accompanied by compensation measures (local development projects, cash transfers), generate economic benefits (jobs in protected areas, tourism), and enhance ecosystem services (increased water resources, erosion control, fire prevention) (Kandel et al., 2022).

Despite these ambivalent potential effects, empirical studies that rigorously assess the impact of protected areas on people’s livelihoods are still rare. Of the 1,043 studies reviewed by McKinnon et al. (2016), only 19 used quantitative methods to evaluate impacts on material living conditions or economic well-being. This meta-analysis shows that the results of studies vary widely depending on the methods used, the context studied, and the location. Kandel et al. (2022) have updated and extended this analysis by focusing on a corpus of 30 quantitative evaluations that specifically address the impact of protected areas on household income. They show that protected areas can have a positive impact on local economies, but that this effect is generally modest and depends on the local context. This variability in impacts highlights the importance of conducting context-specific studies using robust quantitative methods.

Madagascar stands out as a particularly relevant case study for analyzing the relationship between conservation and socioeconomic conditions. The country is the poorest in terms of the first target of the Sustainable Development Goals (SDG 1-1), with the highest proportion of the population living below the international poverty line in the world (Conceição (2024), p. 298-99). In 2008, terrestrial protected areas covered 3.6% of Madagascar and 9% of the population lived within 10 km of a protected area. Today, they cover 10.8% and 28% of the population live within 10 km of protected areas<sup>[1]</sup>. Madagascar is also characterized by a low state capacity (Hanson & Sigman, 2021), which makes it difficult to implement conservation and sustainable development policies and the social measures that should accompany them. These factors, combined with the high dependence of the rural population on natural resources, mean that the impacts of protected areas are potentially different from those observed in less precarious contexts.

However, empirical studies at the national scale are almost non-existent for Madagascar. None of the quantitative impact evaluations identified by McKinnon et al. (2016) covered the country. One of the references consolidated by Kandel et al. (2022) is a multi-country study that includes Madagascar, but it is based on an estimate of an aggregate impact at the commune level and covers only one

date. It uses the 1993 census data to match the country’s municipalities (Mammides, 2020), without a before-and-after comparison, and in a context where less than 3 % of the territory was covered by protected areas, most of which had been created several decades earlier.

Our contribution to the literature is twofold, both empirical and methodological. Empirically, this study provides an unprecedented national analysis, covering 71 protected areas established between 2008 and 2021, to evaluate the socioeconomic impacts of conservation in contexts of extreme poverty and weak governance. Methodologically, it articulates the state of the art in econometrics, incorporating recent developments to adapt these methods to the study of protected areas. The procedure we propose here could be replicated in other countries, starting with the 39 countries that have at least three geolocated DHS surveys. This approach paves the way for a more systematic evaluation of the impact of protected areas, taking into account the specific context of each country.

[1] Calculations by the authors based on the location of the DHS survey clusters. The detailed calculation is provided as supplementary material to the study.

## 2 Research Design

### 2.1 Hypothesis

Our first hypothesis concerns the overall impact of protected areas in the Malagasy context. In their meta-analysis of 30 studies, Kandel et al. (2022) report a slightly positive average impact, but highlight a large heterogeneity of results across context. Several parameters are likely to influence impact, as represented graphically in [Figure 1](#) in the form of directed acyclic graph (Hünermund & Bareinboim, 2023; Imbens, 2024)

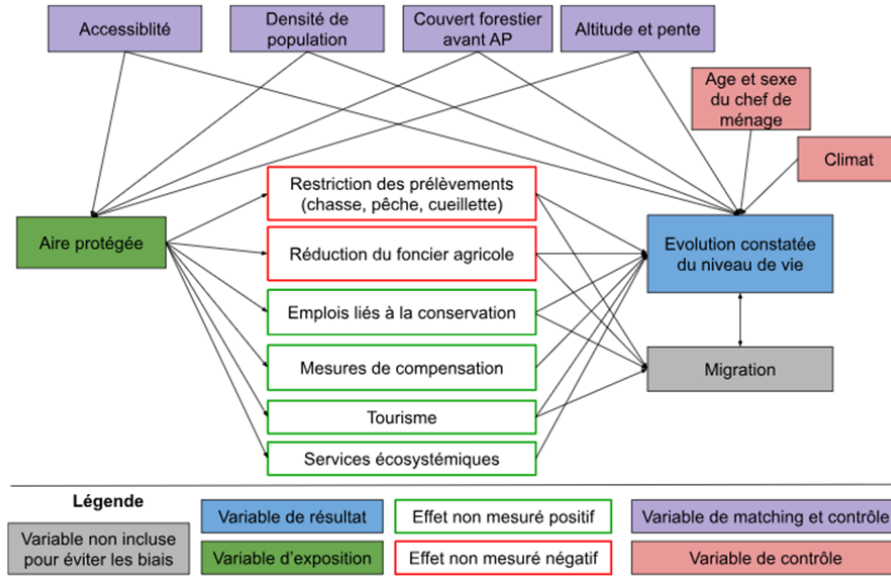


Figure 1: Logic diagram of the theory of change tested in the study

Source: Authors

The factors likely to lead to a decline in well-being seem particularly significant in the Malagasy context, where the population is predominantly rural and living in extreme poverty (the last assessment was in 2012, with 80.7% of the population below the \$2.15 a day threshold at 2017 PPP). Six studies conducted in Madagascar between 1995 and 2006 estimated the opportunity cost of losing access to protected areas (slash-and-burn agriculture, hunting, gathering, timber, etc.) at between USD 39 and 177 per household per year (Neudert et al., 2017). Golden et al. (2014) estimated that income from hunting accounted for 57 % of household cash income in areas adjacent to the Makira and Masoala protected areas. Another survey of people living near Makira estimated the value of pharmaceutical use at USD 30-44 per year per household, based on the subsidized price of equivalent treatments in the malagasy market (Golden et al., 2012).

Several factors that could help improve livelihoods through conservation appear to be fragile in Madagascar, starting with tourism. Naidoo et al. (2019) aggregate data from DHS surveys conducted between 2001 and 2011 in 34 developing countries. Their study is based on matching households near and far from protected areas, but with no pre-post conservation comparison. They highlight positive impacts, but only for a subset of protected areas ‘with documented tourism’<sup>1</sup>. According to their study, households living near the protected areas ‘with tourism’ are 17% wealthier and 16% less likely to be poor than similar households living far from these areas.

<sup>1</sup>The source used to consider that a PA has ‘documented tourism’ is not reported in Naidoo et al 2019.

Adams, William. M., Aveling, R., Brockington, D., Dickson, B., Elliott, J., Hutton, J., Roe, D., Vira, B., & Wolmer, W. (2004). Biodiversity Conservation and the Eradication of Poverty. Science,

- 306(5699), 1146–1149. <https://doi.org/10.1126/science.1097920>
- Conceição, P. (Ed.). (2024). Breaking the gridlock: Reimagining cooperation in a Polarized world. UNDP.
- Golden, C. D., Bonds, M. H., Brashares, J. S., Rodolph Rasolofoniaina, B. J., & Kremen, C. (2014). Economic valuation of subsistence harvest of wildlife in Madagascar. *Conservation Biology*, 28(1), 234–243. <https://doi.org/10.1111/cobi.12174>
- Golden, C. D., Rasolofoniaina, B. R., Anjaranirina, E. G., Nicolas, L., Ravaoliny, L., & Kremen, C. (2012). Rainforest pharmacopeia in Madagascar provides high value for current local and prospective global uses.
- Hanson, J. K., & Sigman, R. (2021). Leviathan’s Latent Dimensions: Measuring State Capacity for Comparative Political Research. *The Journal of Politics*, 83(4), 1495–1510. <https://doi.org/10.1086/715066>
- Hünermund, P., & Bareinboim, E. (2023). Causal inference and data fusion in econometrics. *The Econometrics Journal*, utad008.
- Imbens, G. W. (2024). Causal Inference in the Social Sciences. *Annual Review of Statistics and Its Application*, 11(Volume 11, 2024), 123–152. <https://doi.org/10.1146/annurev-statistics-033121-114601>
- Kandel, P., Pandit, R., White, B., & Polyakov, M. (2022). Do protected areas increase household income? Evidence from a Meta-Analysis. *World Development*, 159, 106024. <https://doi.org/10.1016/j.worlddev.2022.106024>
- Mammides, C. (2020). Evidence from eleven countries in four continents suggests that protected areas are not associated with higher poverty rates. *Biological Conservation*, 241, 108353. [https://www.sciencedirect.com/science/article/pii/S0006320719312777?casa\\_token=1saHx-9SppkAAAAA:sw9KzbZvzqu2WLub5u-K06mA2kgTygSvTi5AEsjBz0rUm8h3h9SKsdId52pG5VEr4SobaFTfguA](https://www.sciencedirect.com/science/article/pii/S0006320719312777?casa_token=1saHx-9SppkAAAAA:sw9KzbZvzqu2WLub5u-K06mA2kgTygSvTi5AEsjBz0rUm8h3h9SKsdId52pG5VEr4SobaFTfguA)
- Maxwell, S. L., Cazalis, V., Dudley, N., Hoffmann, M., Rodrigues, A. S., Stolton, S., Visconti, P., Woodley, S., Kingston, N., & Lewis, E. (2020). Area-based conservation in the twenty-first century. *Nature*, 586(7828), 217–227.
- McKinnon, M. C., Cheng, S. H., Dupre, S., Edmond, J., Garside, R., Glew, L., Holland, M. B., Levine, E., Masuda, Y. J., Miller, D. C., Oliveira, I., Revenaz, J., Roe, D., Shamer, S., Wilkie, D., Wongbusarakum, S., & Woodhouse, E. (2016). What are the effects of nature conservation on human well-being? A systematic map of empirical evidence from developing countries. *Environ Evid*, 5(1), 8. <https://doi.org/10.1186/s13750-016-0058-7>
- Naidoo, R., Gerkey, D., Hole, D., Pfaff, A., Ellis, A. M., Golden, C. D., Herrera, D., Johnson, K., Mulligan, M., Ricketts, T. H., & Fisher, B. (2019). Evaluating the impacts of protected areas on human well-being across the developing world. *Science Advances*, 5(4), eaav3006. <https://doi.org/10.1126/sciadv.aav3006>
- Neudert, R., Ganzhorn, J. U., & Waetzold, F. (2017). Global benefits and local costs—The dilemma of tropical forest conservation: A review of the situation in Madagascar. *Environmental Conservation*, 44(1), 82–96.