A trade-off between conservation, development, and tourism in the vicinity of the Andasibe-Mantadia National Park, Madagascar

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Abstract

We investigated whether there is a trade-off between conservation and development in the vicinity of Madagascar's largest national park (Andasibe-Mantadia). The debate on this topic in Madagascar and other countries has focused on polarized questions protecting nature and forest resources or facilitating people's rights to exploit forest resources. The prevailing view is that both objectives cannot be achieved simultaneously and that a trade-off is inevitable. The key criterion used to select the four sites for this study was the distance from the entrance to the national park. Our survey data findings indicated that there was no correlation between restrictions on forest use and income or well-being. The villagers enjoy both direct and indirect benefits from the national park, namely the provision of jobs, electricity, water offered by the national park or by private tour operators. The national park and luxury hotels have replaced the state as service providers.

Keywords Madagascar · Conservation · Development · Livelihoods · Tourism income · Public services

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Introduction: the sustainability debate

The debate regarding conservation versus development has attracted much attention from researchers and the public in recent decades. Controversies have arisen over the establishment of protected areas, which have been considered the most effective method of achieving conservation goals. Critics of this approach have argued that the mere creation of sanctuaries or natural fortresses can generate either harm or benefits for the local communities concerned, depending on the natural resources in question (Brockington and Wilkie 2015). Since achieving independence, Madagascar has received several hundred million dollars in aid. Nevertheless, numerous evaluations have highlighted the country's loss of forest cover. Moreover, almost all of Madagascar's flagship lemur species are either endangered or critically endangered (IUCN 2019; Waeber et al. 2016). Madagascar has one of the highest poverty rates on the planet [90% of the population subsists on less than US\$3.1 a day (United Nations Development Programme 2018)] and significant forest loss [approximately 2% annual loss, which is the largest forest loss rate in the world (World Resources Institute 2019)] has resulted in severe threats to its rich biodiversity. Thus, Madagascar can be considered to be experiencing a classic lose–lose scenario.

Any understanding of nature by itself is political, and the protection of nature versus poverty alleviation debate is centered on four themes, according to Brockington and Wilkie (2015): the displacement of people living within parks; data and debate about whether eviction is good or bad for local people, and compensation related to eviction; and, finally, the governance model (i.e., national parks or community management).

This article situates the discussion of a possible trade-off around the national park within the debate about sustainable development, ecotourism, stakeholder theory, and poverty–well-being issues.

A quote from the Brundtland Report (1987, p. 43) is often used to define sustainability: “development that meets the needs of the present without compromising the ability to future generations to meet their own needs.” Adams (2009) discussed the feasibility of the phrase and, with reference to other authors' questions, examined whether it presents a coherent theoretical framework. Its appeal may be its usefulness to both people working with poverty and development and those interested in environmental issues. According to Adams (2009, p. 113), the global environmental agenda of the last three decades of the twentieth century and the beginning of the new century was shaped by the three international conferences and their debates on sustainability. Economic analysis based on market environmentalism cleared the way to include the environmental repercussions of economic growth in conventional cost–benefit analyses. By rejecting the notion that environmental crises and major trade-offs between protecting nature and alleviating poverty are unavoidable, market environmentalism divided the ensuing environmental debate. Political ecology contributed to the debate by directly linking environmental issues and social changes.

Sustainable tourism and ecotourism were proposed as a way to venture into natural areas while respecting nature and the well-being of the local people

(Dangi and Gribb 2018) and a means of achieving independence from international funding (Gezon 2014), although some observers have noted the irony of allowing rich tourists to enter national parks that local people do not have the money to exploit (Walsh 2005). Ecotourism can be based on a model conditioned on benefits accruing to marginal areas, and these studies often focus entirely on economic impacts (Agyeman et al. 2019). Boney et al. (2021) observed that any study of the benefits of ecotourism needs to re-evaluate whether the needs of local people are being covered. This study from Ghana found that the benefits of ecotourism there include access to electricity, employment, educational support, and medical support, whereas the costs of conservation involved result from a ban on fishing and hunting activities.

Building a stakeholder analysis is crucial in sustainable ecotourism studies (Dangi and Gribb 2018). The most used method for the identification of stakeholders is snowball sampling (Bendtsen et al. 2021). It is important to include all stakeholders (Dangi and Gribb 2018), although, as Bentsen et al. (2021) argue, attempting to involve too many stakeholders without clearly defining them can lead to poorer results. In a study from Rocky Mountain National Park, the stakeholders were defined in the research question (park managers and concessionaires operating in the park; Dangi and Gribb 2018). In two studies from Ghana, the stakeholders were households living around a national park and a protected area (Kalum National Park and Weichiau community project) and, to a lesser extent, the state (Agyeman et al. 2019; Boney et al. 2021).

Linking poverty to sustainable/ecotourism presents the last issue to situate our case study from Andasibe-Mantadia national park. Agyeman et al. (2019) criticized several ecotourism studies for privileging a narrow focus on the definition of poverty. Livelihood activities (less time for farming, with both positive and negative effects) and livelihood assets (community centers and health clinics) generate benefits to locals beyond the pure income variable. Berkes (2012) argued that a simple or one-dimensional definition of poverty excludes well-being aspects from the analysis. In another formulation, Coulthard et al. (2018) suggested that the one-dimensional poverty approach tends to focus on what people lack, not what they have, thus omitting important aspects of people's livelihoods. Well-being is a more inclusive term and allows for a multi-dimensional understanding of poverty.

Much of the debate on the trade-off between conservation and development in Madagascar has focused on the opportunity costs of conservation and on the compensation to be paid through conservation interventions. A World Bank project around a protected corridor (Poudyal et al. 2018) and a comparison of the profits from slash-and-burn agriculture versus avoided carbon emissions in a REDD+ perspective (Neudert et al. 2018) are two examples of this traditional approach. Our point here is that studies on the benefits and costs of conservation from an economics perspective focus exclusively on the one-dimensional poverty approach and fail to compare the situation of different communities, as we have already mentioned in the two cases from Ghana.

Andasibe-Mantadia National Park is an ecotourism site in Madagascar. We could have analyzed the site's sustainability in several different ways, although these would have required different sets of data. The simplest level of analysis would be to

compare income from tourism and non-tourism activities and discuss the extent to which ecotourism contributes to the protected area (Hunt et al. 2015). Other studies have aimed to identify sustainability indicators by asking experts and finally, after revisions, presenting a reduced list (Ocampo et al. 2018). Mai and Smith (2015) used a causal loop diagram to show how an increasing number of tourists can lead to more accumulation of waste, ultimately reducing the attractiveness of the ecotourism site. Users of ecotourism sites can also be interviewed to assign a value to indicators such as the amount of sewage, presence of endangered species, and visitors' level of satisfaction to compare otherwise reasonably similar ecotourism sites (Thomas et al. 2014). In our discussion, we look at which indicators could be candidates for inclusion in a study of ecotourism sustainability at Andasibe-Mantadia.

The Ghana papers (Agyeman et al. 2019; Boney et al. 2021) discussed the benefits and costs of living close to protected areas based on locals' perceptions of the positive and negative economic/sociocultural impacts. Our study compares economic livelihoods, incomes, and well-being among villages close to and far from the Andasibe-Mantadia National Park. The main research question is: Are households close to the Andasibe-Mantadia National Park better off than those living far from the protected areas? Authorities impose restrictions on the exploitation of forest resources close to the protected areas, but tourism offers both direct and indirect benefits to locals.

The conservation debate in Madagascar and tourism: linking conservation and livelihoods

There are two main conservation debates in Madagascar. The first is centered on the national parks and their legitimacy, whereas the second focuses on the effects of conservation on local populations. A key question raised in the first debate is whether the authorities have sought consent of the locals living around a potential protected area prior to declaring it protected from exploitation. "Green grabbing" is an extreme example of what critics of conservation regard as the appropriation of land for conservation purposes. Considered from this perspective, the appropriation of land entails dispossession and the impoverishment of locals who are fenced out, usually from forest land to which they previously had unlimited and unrestricted access (Fairhead et al. 2012). In cases where the consultations with local communities lacked credibility *ex ante* (Corson 2012), studies examining the outcomes are considered more reliable because locals sometimes welcome conservation efforts and the introduction of new agricultural practices in the very same sites where initial consultations failed (Casse et al. 2017).

The second debate regards eviction, or what researchers (Brockington and Wilkie 2015) have referred to as the economic displacement of locals from newly declared protected areas. This raises the question of where and how locals can sustain their livelihood around protected areas. Regardless of consultations or efforts to valorize agricultural activities, locals may face even greater hardship as a consequence of the establishment of a protected area. This will be even more severe if those in charge of the national park in question do not disburse compensation for land that has been

lost or for the reduced access to natural resources. Different forms of socioeconomic displacement resulting from a park creation can lead to local poverty (Ince 2014). Studies have found that households lacking financial and social resources benefit least from conservation efforts, especially in the case of energy projects that are linked to conservation (Karki 2013). Conservation projects can prompt strategic thinking among locals and among those who enjoy better communication with donors or non-governmental organizations (NGOs), who may seize the opportunity to capture potential benefits (Blanc-Pamard and Fauroux 2004).

In a study of a payments for environmental services (PES) program implemented in the Menabe region of western Madagascar, an annual sum of US\$8,500 was distributed among 10 communities. The villagers expressed a positive attitude toward the program, which was supervised by an international NGO (the Durrell Wildlife Conservation Trust), although they reported that members of the forest association received most of the benefits (Sommerville et al. 2010). In this case, distributional issues were at the heart of an unfolding conflict. The findings of the study, which focused on the behavioral differences between villages that participated in the program and those that did not, revealed that there were no statistical differences between villages in these two categories, although illegal hunting of lemurs declined throughout the study area.

The findings of another study (Desbureaux and Brimont 2015) indicated that despite the disbursement of compensation to one-third of the population concerned, the villagers did not demonstrate a positive attitude toward the incentives offered by conservation programs. Farmers in areas where NGOs had implemented an investment program, as opposed to in-kind compensation, displayed more enthusiasm. In another study, the deforestation rate was reduced during the period of 2007–2014 when the *fokontany*s (administrative sub-divisions of a commune) received investments from various conservation NGOs in eastern Madagascar (Tabor et al. 2017).

Interventions and perceived changes in the quality of life of local villagers have been investigated (well-being of villagers) by determining how protected areas impact livelihoods (Rasolofson et al. 2018). In a case study conducted in eastern Madagascar, there were no indications of any impacts (positive or negative) of either protection or community forest management on local well-being.

A more traditional approach to conservation is evident in a study by Poudyal et al. (2018), which compared the benefits associated with slash-and-burn agriculture that were foregone with the benefits received from a donor as compensation for conservation activities. The findings revealed that there was a negative reaction to this approach, indicating the distinct challenges involved in conservation initiatives. The authors argued that the compensation intended to keep forests intact covered less than 5% of the opportunity costs incurred by the affected households. A fundamental issue relates to the omission from the analysis of an estimation of household incomes in sites where there were no restrictions on forest use. In the absence of a genuine counterfactual scenario, the socioeconomic characteristics of households in these areas represented the post-forest situation. It cannot be assumed that farmers are better off at these sites.

Although there have been no studies on the impacts of conservation on poverty rates in Madagascar, with or without comparisons involving non-affected villages,

such studies have been conducted in other parts of the world. In one study conducted in Nepal (McLean and Stræde 2003), the authors found that villagers living in proximity to a national park faced problems of wildlife crop depredation. Another study in Tanzania found that wildlife crop depredation led to losses of approximately 5% of the villagers' incomes (Vedeld et al. 2012).

Andasibe-Mantadia National Park was established in 1989. Before the demarcation of the park boundaries, slash-and-burn agricultural activities continued to take place at the park edges. The park closed former agricultural land practices inside the demarcation lines. However, no people were displaced inside the newly established park. In 1996–1997, conflicts between park service staff and farmers arose in the buffer zone. To end the conflict, the park management proposed an acceptance of newly farmed land by expanding the park into a forest reserve north of the park. In this sense, families having converted forest inside the park could continue to crop the land without facing any sanctions from the authorities (McConell 2002). Today, compensation from the park exists in the form of building infrastructure (schools, electricity and water access, and a dispensary), but the park does not offer villagers any regular monetary compensation.

Whereas other studies have focused on earnings or compensation related to the establishment of national parks by comparing these benefits with the foregone benefits associated with forest exploitation from a cost–benefit perspective, we adopt an alternative approach here. We evaluate the advantages and disadvantages of contact between local people and tourist establishments in terms of income, well-being, employment opportunities, and indirect benefits.

Tourism in Madagascar has developed slowly compared to neighboring countries (World Tourism Organization 2018). The small island of Mauritius receives six times more tourists, and South Africa receives 40 times more tourist arrivals than Madagascar. Despite hosting flora and fauna with a high degree of endemism, the tourist sector in Madagascar suffers from political instability, a poor road network, and an inconsistent or non-existent quality–price correlation (World Bank 2013). In recent years, roadside robberies and attacks on cars and buses commuting outside major urban areas have added to the sense of insecurity in traveling.¹ Three main categories of tourists visit Madagascar: the adventure and discovery tourist (43%), the beach tourist (15.3%), and the “green” tourist (41.7%), with the “niche” market of ecotourists also showing strong growth during the last ten years.²

Only one study has attempted to link tourism earnings to poverty, and it concluded that tourism development did not lead to poverty reduction in Madagascar (Rakotondramaro and Andriamasy 2016). The conclusions were based on nationally aggregated data from 1998 to 2013. A study from Ranomafana National Park indicated that park entry fees and technical staff salaries represented 60% of the local economy, although the figures were difficult to verify (Wright et al. 2014). In

¹ Personal experience.

² Average annual growth rate of 32% in terms of ecotourism, compared to 11.4% for all tourist arrivals (according to calculations based on statistics from the Ministry of Tourism of Madagascar, 2003 and the National Office of the Environment, 2002).

contrast, another study claimed that national park entry fees corresponded to only 8% of the cost of running the parks (Sarrasin 2013). A study of all the benefits of conservation in Madagascar, including both selective timber extraction and bushmeat production and sustainability, is unlikely to happen in Madagascar (Neudert et al. 2017). Tourism represents only one benefit that was considered in the study and by itself is not likely to be sufficient to ensure large-scale conservation in Madagascar.

Tourism has resulted in a reduction in poverty in Costa Rica, Ferraro and Hanauer (2014) noted in a quasi-experimental study. Nearly two-thirds of the reduction in poverty can be linked to tourism opportunities. Ecotourism can trigger negative effects if production and extraction activities in newly protected areas increase to an extent greater than the positive effects of tourism activities or if conflicts intensify because of worsening inequality within the villages. In a study from China (Ma et al. 2019), ecotourism earnings reduced poverty inside nature reserves, as the income difference between households residing inside and outside the reserves diminished over a short period (2014–2016). However, ecotourism may have aggravated the income inequality inside the natural reserves.

Other studies from Botswana, Kenya, and Nepal investigated the links between protected areas, tourism, and community livelihoods. In Botswana, locals created a trust fund that led to recognition by the park management of the communities as key stakeholders (Kope National Park). An additional step was taken when the trust fund entered into a contractual agreement with safari companies, including the establishment of a lodge. Tourism became the link between the park management and the communities (Stone and Nyapane 2016). A study in Kenya conducted a survey of three communities located closer to or farther away from the Maasai Mara national reserve and, not surprisingly, found that support for conservation was highest when the communities were involved in tourism (Holland et al. 2021). However, even in the closest community with a high degree of involvement in tourism, households expressed concern with restrictions on cattle raising inside the reserve and called for the establishment of a committee, perhaps one like the trust fund in Botswana. The communities continue to rely on traditional livelihood strategies, and they invite the national reserve management to recognize the need for other economic activities, including farming and cattle. In the Nepal study, Nepal et al. (2021) underscored the indirect benefits communities can achieve through conservation programs in terms of access to health care, school construction, and infrastructure. Villagers who had experienced direct benefits from tourism tended not to perceive the link to conservation as strongly as households who had indirectly benefited from tourism.

We learn from the sustainability debate; sustainable tourism issues; the discussion of opportunity costs versus conservation compensation; and the link between conservation, tourism, and local livelihoods that any study of local benefits from conservation should include at least three elements, i.e., a definition of poverty, a comparison of communities (with and without the project), and, finally, a quantitative–qualitative study with a broader perspective than simple cost–benefit analysis. Poverty should be defined on both a one-dimensional and a multi-dimensional scale (Agyeman et al. 2019; Rasolofson et al. 2018), and communities should be selected with locations close to and far from the main conservation area (Holland

et al. 2021). We depart from the general economics-based discussion in pursuing the idea of a quantitative–qualitative study and distinguishing ourselves from the narrow cost–benefit analyses of Poudyal et al. (2018) and Neudert et al. (2018). We believe that villagers are more focused on benefits in broad terms that take into account not just increased income but also the effect on the provision of public services, as we have seen with the study by Nepal et al. (2021) and the two papers on Ghana. Compared to the single study on tourism and poverty in Madagascar (Rakotondramaro and Andriamasy 2016), our study uses disaggregated data and compares different communities and their livelihoods.

We define the stakeholders as communities/villages, involved in tourism activities or not; the national park Andasibe-Mantadia; two local conservation initiatives (Mitsinjo and MMA, United Community of Andasibe, partly funded by USAID); a luxury hotel; and the state (local forest branch). The local conservation initiatives are in Andasibe town, close to the entry to the national park, and benefit from the presence of tourists who come to visit the national park. From 2010 to 2018, 20,000 tourists visited on average yearly the national park, 7000 Mitsinjo and 9000 MMA (personal communication). In what follows, we search for types of communication, dialogue, and competition among the various stakeholders.

Study area

We conducted our study in the Andasibe commune, which is located 145 km from Madagascar's capital, Antananarivo. Andasibe-Mantadia National Park is home to several notable lemur species, including *Indri Indri*, which is the largest of the lemurs. Tourist guides consider this national park the most important lemur habitat in Madagascar. Approximately 33,700 tourists visited the Andasibe region in 2018.³

We selected sites that met the following criteria:

- Villages located close to and far from the Andasibe-Mantadia National Park entrance

The present study involved a comparative investigation of the household-level effects of a protected area in four different sites: a village close to Andasibe-Mantadia, a national park located in eastern Madagascar (Andasibe village); a site situated farther away from Andasibe-Mantadia National Park (Ampangalantsary village, 3–8 km away); and two sites located quite far away from Andasibe-Mantadia. One of these sites benefits from a private tour operator and a luxury hotel (Falierana, 15 km away), and another village is located further from the park entry (Vatofotsy, 18 km away).

Table 1 presents a breakdown of the number of households by *fokotany* (low-level administrative unit in Madagascar) where we conducted a total of 101 household interviews. We also held focus group interviews with 30 individuals from

³ This figure represents 18% of all tourists visiting Madagascar in 2018 (National Institute of Statistics).

Table 1 Number of surveyed households by site in Andasibe, Madagascar

Site	Distance from the park (km)	Sample size
Andasibe	1	26
Ampangalantsara	3	25
Falierana	15	24
Vatofotsy	18	26

the study sites. We conducted interviews and collected household data through a questionnaire-based survey from November to December 2018.

Figure 1 shows the location of the four sites. The four sites are shown on the map, which indicates that Andasibe town and Ampangalantsara are close to the park. Falierana and Vatofotsy are located north of the park, further from the park entrance, and they belong to the same *fokotany* (Falierana). The gray zone represents the study area. Entry to Andasibe national park is right in the town/village Andasibe and entry to the conjunctive park Mantadia is indicated as ‘point d’entrée de Mandatia’ on the map.

Andasibe

The town of Andasibe is located approximately 145 km from Antananarivo, nearly 230 km from Toamasina and 27 km from Moramanga. The *fokotany* contains the Andasibe-Mantadia National Park. In terms of infrastructure, this area contains markets, hotels, high schools, and public and private primary schools. In addition, the inhabitants have access to electricity, drinking water, and even a railway. People in this area are better educated than in the other three sites (Table 2). Andasibe town had 13,700 inhabitants in 2010.

Ampangalantsara/Ampangalantsary

Ampangalantsara is a village located 3 km from Andasibe. There are over 2500 inhabitants. As there is no school in this village, students have to travel 3 km to access the nearest schools, a high school and a primary school donated by NGOs. The village has no access to electricity or drinking water. The area is rather poor, in part because of the degraded agricultural fields. As an anthropogenic pressure, the use of wood to make charcoal and firewood is very common. However, the main source of fuel is eucalyptus plantations. Locals gather small branches and twists that are then used for burning and subsequently turned into charcoal. Many villagers collect firewood illegally in the park. The state has not intervened to provide local infrastructure. Among the four sites used in the study, the level of education was the lowest in Ampangalantsara (Table 2).

Fig. 1 Location of the study sites in proximity to Andasibe-Mantadia National Park, Madagascar. Source: Author's map

Table 2 Levels of education in the four sites of the study

Site	Education				Total
	None	Primary	Secondary	Tertiary	
Andasibe	4	1	17	4	26
Ampangalantsara	10	11	4	0	25
Falierana	2	5	14	4	25
Vatofotsy	9	10	6	0	25
Total	25	27	41	8	101

Falierana

Falierana has access to electricity thanks to the existence of the private Vakona Hotel, which also provides households with water. The hotel, which now has more than 200 employees, was previously a graphite company and was owned until recently by French settlers. In addition to hotel activities, it offers ecotourism opportunities to visitors due to the existence of a park (a vestige of the natural forest) that is included on the property. The park is divided into islets to facilitate the viewing of wildlife species. As with the other sites, some villagers collect firewood illegally in the national park. Villagers have no other access to forest resources. Approximately 1500 inhabitants live in the village.

Vatofotsy

The villagers have no access to electricity or drinking water. Those who can afford it use solar panels. Wood is used to make charcoal and firewood. The most exploited species are *Eucalyptus* sp., *Faucherea* sp., and *Homalium* sp. The total population is 1200 inhabitants. The Vatofotsy *fokontany* is located at the border of the Andasibe-Mantadia National Park. Madagascan national parks offer facilities to households, such as infrastructure like roads, income-generating activities, and seeds.

Andasibe-Mantadia National Park includes two separate protected areas: the Analamazaotra Special Reserve and Mantadia National Park. Andasibe-Mantadia National Park is only about three hours from the capital. It is located 1.5 km from Andasibe, 140 km from Antananarivo (i.e., Tananarive), and 200 km from Tamatave. It has an area of 16,310 ha (Analamazaotra Special Reserve 810 ha, Mantadia National Park 15,500 ha). The climate is very humid, with an average annual temperature of 18 °C and average annual rainfall of 1700 mm distributed over 210 days.

Methodology

We took a mixed-methods approach. We conducted interviews with the manager of the national park, the owner of the Vakona Hotel, representatives from local communities, and staff members of community conservation projects. We either went to local offices or organized focus group meetings in the villages.

First, we asked the village leader questions related to the characteristics of the villages in terms of access to basic public services and exploitation of forest resources. A major lesson from this exercise was the quasi-absence of a state. The selection of households took place in conjunction with the village leader to show diversity in gender, income, and ethnicity. We selected 25 households in each village based on a stratified random approach.

Second, we conducted a questionnaire-based survey among the villagers in the selected sites. Those interviewed in the households included the village chief, women (farmers), and men (farmers or employed in tourism businesses). Out of a total of 101 households, 40 were headed by a female. The survey questionnaire consisted of three sections: an assessment of the household's economic situation (agricultural income by major crops, cattle, timber products, charcoal production, tourism-related activities, and others), the perceived importance of natural resources (land categories; forest access; relations with forest authorities or the national park, especially concerning forest restrictions; benefits from the national park) and their exploitation (collection of medical plants and hunting) and use by members of the household, as well as the well-being of household members (overall assessment, purchase of necessities, basic public services, quality of housing, crime level in community, etc.). The questions used in this paper are listed in Appendix A.

We first compiled data on the village sites, including the number of household members, their level of education, main economic activities, income, and changes in income between 2016 and 2018, as well as their ethnicity and migration status. The interviewees mostly had a secondary school background in the case of Andasibe and Vatofotsy villages, whereas people responding to the questionnaire from Ampangalantsara and Falierana tended to have left school after the primary level or to have had no education at all.

We applied non-parametric methods to study the differences in living conditions among the four sites. We considered variables for income and overall well-being, as well as some more specific variables for dimensions of well-being such as access to education and the material quality of the home.

We attempted to validate our answers by asking qualitative and quantitative questions about the villagers' relationships to the national park management, the Vakona Hotel, and the forest agency. In terms of reliability, we considered the answers related to economic income as being on the low side. Households rarely reported income from tourism, although we know that quite a few households hosted family members who were working in the hotel, served as guides for the hotel and the national park, or worked in restaurants serving tourists in Andasibe town. Most households answered the qualitative questions regarding their relationships to the national park (including jobs) and forest agency, meaning we suspect

an undervaluation of the direct economic impact of tourism income. The question of whether people would be interested in creating a forest that could attract tourists remained largely unanswered, with one exception. A protected forest close to Falierana hosts at least two species of lemurs, and this household was in favor of the forest being promoted as a new tourism destination. Our sample was small, and as we are not aware of many other studies of conservation, ecotourism, and livelihood conditions using this approach to compare villages close to or far away from the protected areas, we should be cautious not to generalize the findings.

Our hypotheses on basic village characteristics, income, household well-being, park benefits, and forest regulation

The first question that we addressed concerned the poverty levels of the residents of villages located close to national parks or protected areas who were denied access to forest resources to a greater or lesser extent relative to the inhabitants of villages who did not face restricted access to forest resources.

We formulated the following hypotheses based on our review of the literature and how critics of protected areas interpret local reactions to nature protection.

- (1) Villagers living far away from the protected areas are better off than those located in proximity to protected areas (the null hypothesis is that there is no link between income/well-being and distance to park entrance). Of the 101 households interviewed, only one responded positively to the question about financial support received from the Madagascar National Parks. This observation strengthened our expectation that we would not expect villagers to be in favor of the presence of a national park.
- (2) Villagers regard park benefits as insufficient and respond negatively to the question of perceived benefits (the null hypothesis is that villagers do not regard benefits as important).
- (3) The local people perceive the forest regulations as restrictive (the null hypothesis is the local people are indifferent to forest regulations).

Results

Hypothesis 1: living conditions in villages located far from the national park/hotel are better off

In the survey, we included several questions related to well-being concerning issues such as education, work, etc. All these questions were constructed on a 5-point scale ranging from 1 = “none at all” to 5 = “almost all,” see Appendix A for the formulation of the questions. The total income includes all sources of income, that is, salaried work, sales of agricultural products, and even self-consumption of self-grown products. There are significant differences in total income between the four sites.

Fig. 2 Distribution of annual income data by household and site

Table 3 Goodness-of-fit tests for lognormal distribution

Test	Statistic		p value	
Kolmogorov–Smirnov	<i>D</i>	0.08168992	<i>Pr</i> > <i>D</i>	0.105
Cramer–von Mises	<i>W-Sq</i>	0.06949223	<i>Pr</i> > <i>W-Sq</i>	0.295
Anderson–Darling	<i>A-Sq</i>	0.51163553	<i>Pr</i> > <i>A-Sq</i>	0.200

Table 4 Results of ANOVA for logarithmically transformed income

Source	DF	Sum of squares	Mean square	F value	Pr > F
Model	3	11.70828637	3.90276212	6.96	0.0003
Error	94	52.68977748	0.56052955		
Corrected total	97	64.39806385			

The total incomes (in Madagascan Ariary) for each of the four sites are presented as box plots in Fig. 2 in Madagascan Ariary.

The wealthiest family identified in the study lived in Ampangalantsara and had an annual income of 20 million Ariary (the village leader, but also generated from charcoal production and transport of charcoal for sales elsewhere), though this single observation is an outlier (observation 8 in Fig. 2).

Table 5 Normal pairwise comparisons based on a normality assumption for logarithmically transformed income

Means with the same letter are not significantly different			
t grouping	Mean	N	Sites
A	15.2384	22	Falierana
A			
A	14.9792	26	Andasibe
B	14.4320	25	Vatofotsy
B			
B	14.4293	25	Ampangalantsara

Table 6 Kruskal–Wallis test for overall well-being

Kruskal–Wallis Test		
χ^2	DF	Pr > ChiSq
24.0514	3	< .0001

Table 7 Pairwise comparisons for well-being using the Dwass–Steel–Critchlow–Fligner method

Sites	Wilcoxon Z	DSCF Value	Pr > DSCF
Ampangalantsara vs. Vatofotsy	−2.3591	3.3363	0.0851
Ampangalantsara vs. Falierana	−4.2931	6.0714	0.0001
Ampangalantsara vs. Andasibe	−4.0680	5.7530	0.0003
Vatofotsy vs. Falierana	−2.1327	3.0161	0.1427
Vatofotsy vs. Andasibe	−1.5910	2.2500	0.3837
Falierana vs. Andasibe	0.7513	1.0625	0.8761

The distribution of income is heavily skewed to the right, so we create a log transformation to convert data to follow a normal distribution. Table 3 (goodness-of-fit) shows that all tests lead to acceptance of the normality distribution. Therefore, we compare site incomes by a usual ANOVA F-test, which rests on a normality assumption, see Table 4. This test shows significant differences in income among the four sites.

Table 5 reports the results of tests based on log-transformed data using *t*-tests; the letters in the left column show which means are insignificantly different, and the grouping into two levels of log-transformed data shows clearly in the text. According to the test, there is no significant difference in average income between Falierana and Andasibe (4,937,650 Ar and 3,929,711 Ar, respectively), according to the test based on the assumption of normality for log-transformed numbers. The average income in these two villages is significantly larger than in Ampangalantsara and Vatofotsy (2,910,733 Ar and 2,388,508 Ar, respectively). The difference in income between Ampangalantsara and Vatofotsy is not significant.

Table 8 Comparison of well-being and total income

Well-being	Total income			
	Number of observations	Average	Minimum	Maximum
Not at all	25	1,894,369	195,100	8,735,035
No	14	3,186,273	1,159,862	7,280,690
Not sure	13	2,589,215	1,040,862	4,897,783
Yes	29	5,147,260	370,000	20,880,000
Yes very much	17	4,022,613	801,350	8,400,000

The various variables for well-being are reported using a five-point scale. This means that an assumption of normality is dubious. Tests for the assumption of normality also lead to rejection. For that reason, we compared well-being in the four sites using Kruskal–Wallis rank test. The level of the overall well-being variable differs significantly between the four sites ($p < 0.0001$; see Table 6).

Rank tests for pairwise two-sided multiple comparisons using the Dwass–Steel–Critchlow–Fligner method are given in Table 7. The score for overall well-being is large in Falierana and Andasibe, but significantly lower in Ampangalantsara. The difference between Ampangalantsara and Vatofotsy is borderline significant $p = 0.09$, while the difference between Vatofotsy and Falierana is insignificant $p = 0.14$.

In the tables in Appendix B, we present in brief similar rank-based test results for the variables for more specific dimensions of well-being. The answers to the two dimensions of material well-being, access to basic services (Tables 13 and 14) and housing quality (Tables 15 and 16), both tell the same story. The living conditions in Falierana are much better than in Ampangalantsara and Vatofotsy.

Regarding the question about access to basic services such as electricity, health, and water, there are clear differences among the sites. Access to such services is clearly best in Falierana, significantly lower in Andasibe, and significantly lower again in Ampangalantsara and Vatofotsy. This is to be expected, as the park offers basic facilities to people living near the park and the hotel. For the question on housing quality, it is highly significant that the quality in Ampangalantsara (2.6) is lower than in the three other villages, and that the quality in Vatofotsy (3.4) is lower than in Falierana (4.3).

A possible explanation for this is that access to work is best in Falierana (Tables 17 and 18). The score in Falierana (2.3) is significantly higher than in Ampangalantsara (1.5) and Vatofotsy (1.2), however the difference is hardly significant, with $p = 0.08$ for the difference between Falierana and Ampangalantsara; Ampangalantsara and Vatofotsy show no significant difference.

Ampangalantsara performed worse, both in terms of income and well-being, than any of the other three villages. The soil is poor, only small revenues accrue from tourism, and basic public services are lacking. In terms of income, Vatofotsy differs from both Andasibe (with 10% significance) and Falierana and shows

Table 9 Park benefits by village

Site Frequency row pct	Park benefits		
	Yes	No	Total
Vatofotsy	18 72.00	7 28.00	25
Ampangalantsara	14 93.33	1 6.67	15
Falierana	17 85.00	3 15.00	20
Andasibe	21 84.00	4 16.00	25
Total	70	15	85

lower levels of well-being than these other two villages. A pairwise comparison between Vatofotsy and Andasibe shows significant difference in income (Table 4) and a clear difference when focusing on access to basic services (Table 14). We conclude that villages far from the national park and the hotel are not better off than those close to protected areas, despite the restrictions imposed and strictly observed around these areas.

Table 8 shows the relationship between self-reported well-being and total income. The outlier was the village leader in Ampangalantsara, who had the largest income of all (20,880,000 Ar) but disturbed the picture by answering that he was not in the highest category for well-being. Otherwise, a clear connection is obvious.

Hypothesis 2: park benefits

Our findings indicated that the perceptions of the parks' benefits among the villagers were positive but differed by location. The responses are indicated in Table 9. The villagers who claimed that they had not received any benefits from the park were mostly from Vatofotsy. A statistical test (Chi-square) yielded a significant result; however, the small number of households claiming to have received no benefits or responding "don't know" means that 66% of the cells contained expected counts of less than 5.

The qualitative data collected during the survey revealed that villagers who were in favor of the national park tended to work as guides or restaurant employees. The data compiled on tourism-related incomes only occasionally included revenues generated from guide work (10 households out of a total 101 in the sample), and, therefore, income figures may have been underestimated. In addition, the villagers mentioned indirect benefits such as schooling and access to electricity and water supplies that were provided because of the establishment of the national park and Vakona Hotel.

The qualitative data obtained through household responses revealed differences according to their locations:

Andasibe

Park entry fees are too high for local people (even though Malagasy nationals pay lower fees than foreigners). The respondents felt that firewood collection should be permitted in the forests. Members of the households in [Andasibe](#) who work for the national park authorities are given free grain (sowing rice). The locals used the following wording: “park management has constructed the primary school and a library,” “park management has paid for a local gendarme office and a dispensary,” “development of courses in sewing.”

Ampangalantsara

It is difficult to find work, and schooling is expensive relative to incomes. The village is located far from the park entrance, but forest regulation is still very restrictive. Villages appear to face fundamental problems in [Ampangalantsara](#) because they have no access to electricity or water and schooling facilities are located a long distance from the village. In this village, the locals said: “the Vakona Hotel paid for rehabilitation of the road,” and “we get indirect support for the village through work at the hotel.”

Falierana

Despite the indirect benefits relating to services provided by Vakona Hotel, the employers at the tourist establishment show signs of prejudice (they do not like poor people, according to the respondents). In this village, the households interviewed expressed many opinions about the park’s benefits: “most assistance goes through the commune,” “the Vakona Hotel has paid for two school teachers, and they offer 50,000 Ariary per employee to pay for school fees,” “we got electricity and our school fees were paid,” although others said: “there’s no support to pay rent or electricity, even if you are employed by the hotel,” and “our village chief should complain to the hotel that we don’t receive any support from them.”

Vatofotsy

Knowledge of several languages (minimally French and English) is a requirement for guide jobs. For young, educated people, it is, therefore, relatively easy to find jobs. However, the local population has, on the whole, become overly dependent on tourism for their livelihoods and is affected by the preferences of the employees of the Vakona Hotel.

Table 10 Perception of forest rules by villages

Sites	Perception of forest rules			
	Frequency row pct	Restrictive	Acceptable	Total
Vatofotsy	12 48.00	13 52.00		25
Ampangalantsara	15 65.22	8 34.78		23
Falierana	9 40.91	13 59.09		22
Andasibe	6 23.08	20 76.92		26
Total	42	54		96

Table 11 Relations to forest management by site

Sites	Relations with forest responsible			Total
	Insatisfaisante_ Insufficient	Satisfaisante- Sufficient	Satisfaisante/insatisfaisante_ Sufficient/ Insufficient	
Vatofotsy	5 20.00	19 76.00	1 4.00	25
Ampangalantsara	8 34.78	15 65.22	0 0.00	23
Falierana	2 9.09	20 90.91	0 0.00	22
Andasibe	8 30.77	17 65.38	1 3.85	26
Total	23	71	2	96

Frequency missing = 2

General

The locals responded to the question about support by proclaiming: “the community requested support from the park management, but they never followed up,” and “the park management asked us to engage in handicraft work, but the raw materials are too expensive.”

The quantitative data revealed that most villagers at the four sites were satisfied with the benefits associated with the park. However, they all expressed modifications to their general level of satisfaction when asked for comments. There are few alternatives to tourism-related economic activities in the area, and several respondents referred to discrimination against the poor and uneducated. Villagers who know several languages have considerably more employment options, but to reach this stage in their education, they would need to attend schools outside the Andasibe commune. A few villagers mentioned that people originally from the capital, Antananarivo, found jobs more easily than locals do. From the questionnaire and the

qualitative comments, we can conclude that all four villages enjoyed some sort of support from either the national park or the Vakona Hotel. However, only the villagers in Andasibe were almost entirely positive.

Hypothesis 3: villagers' perceptions of the restrictiveness of forest regulations

Table 10 reports the answers to the question about whether people at the four sites find the forest rules acceptable. Two-thirds of the people in Ampangalantsara find the rules restrictive but only 25% in Andasibe do.

A chi-square test reveals that the difference in satisfaction between the four villages is significant ($p=0.028$). Many more in Ampangalantsara and Vatofofotsy claimed that the forest rules are restrictive, compared to the other two villages.

We asked villagers about their relations to the forest authorities and the national park (see Table 11). The number of dissatisfied households were much lower, only 13% of all participants. However, several households pointed to an increasing inequality due to the claim only the village chief or members of the community committee benefited from the restrictions to forest use. Rules apply to other villagers but the committee members. Inequality in villages was a focus of the study from China (Ma et al. 2019), and we identified different rule-setting according to the household status as one sign of inequality (leaders may not face restrictions). Employment at the national park or Vakona hotel creates a different type of inequality we return to in the discussion. On behalf of the authorities, the National Park representative expressed concern with the lack of state intervention and the periodic encroachment from villages surrounding the park not dependent on tourism earnings.

The difference in satisfaction with forest authorities between the four villages is insignificant ($p=0.325$); however, the differences are rather large. Fisher's exact test, which is more relevant as the numbers in the column are very small, gives the same conclusion ($p=0.207$). If the category "Satisfactory/not satisfactory" is removed, the insignificance remains ($p=0.166$).

In the qualitative comments about the park restrictions, the villagers are divided. Some households referred to employment opportunities ("if jobs are announced, locals will get them"), negotiations with the forest service ("it is sometimes possible to collect firewood in the forest"), or sale to the Vakona Hotel ("milk and vegetables are sold to the hotel"). Others underlined the negative consequences of protection, such as strict regulations ("we cannot even collect firewood"—notice the different opinions), inequality ("only those close to the village chief benefit"), seizure of rice fields ("there are rice fields within the park, but we have no access to them anymore"), and questions about ownership ("the forest belongs to the family since generations back"). Villagers seem to favor restrictions in Andasibe and, to a lesser extent in Falierana, where most people have a secondary education, whereas households in Ampangalantsara and Vatofofotsy tend to be more negative, with most people in Ampangalantsara having little education and those in Vatofofotsy only some primary or secondary education. In the first two villages, tourism brought about direct and indirect benefits in the view of the inhabitants, in contrast to the views expressed in Ampangalantsara and also, to some extent, in Vatofofotsy (opinions are divided

Table 12 Deforestation rates in the Andasibe-Mantadia National Park, the forest corridor and in areas located outside of the national park (2006–2018)

Area	Surface area (ha)	Deforestation (ha)	Deforestation rate
Andasibe	849	8	0.83
Mantadia	7098	95	1.34
Forest corridor (Ankeniheny-Zahamena)	1580	270	17.09
Non-protected areas	10,670	3502	32.82
Total	25,255	6005	

Source: Landsat 5–8 images, LT05_L1TP_158073_20060615_20161121_01_T1, LC08_L1TP_158073_20180515_20180604_01_T1 (15/5/2006 and 15/5/2018)

here), where poor people were more concerned about the lack of firewood. A third version of inequality (different rule-setting and employment opportunities are the two first features of inequality).

The villagers who were in favor of forest rules often mentioned the alleged link between forest protection and water access or a higher degree of precipitation. A discussion of this possible link is beyond the scope of our study. However, we saw a great difference in water availability and coolness between the lush forest around Andasibe and the Vakona Hotel and the semi-arid conditions in the vicinity of Ampangalantsara.

Finally, we compared the deforestation rates within the national park and outside it. The deforestation rates were lower inside the Andasibe-Mantadia National Park (Table 12).

Discussion

We argued earlier that a study of the links between conservation, ecotourism, and livelihoods should include the elements of definitions of poverty; include sites with and without projects (tourism in our case study); and adopt a perspective that goes beyond pure cost–benefit analysis. In Hypothesis 1, we contemplated both one- and multi-dimensional definitions of poverty and showed higher incomes in two sites compared to Ampangalantsara and Vatofotsy. This fits with the argument that in two sites, villagers were involved in the tourism sector. Higher agricultural incomes in Andasibe and Falierana could follow from higher productivity in land surrounded by forest. However, we did not study variance in agricultural incomes among the four sites. In our larger definition of well-being, our results showed two villages (Andasibe and Falierana) with a high degree of satisfaction. Nevertheless, comparing Vatofotsy and Andasibe, the difference in overall well-being was not significant. Our observations are in line with the studies by Boney et al. (2021) and Nepal et al. (2021), which show that indirect benefits play a major role in all tourism-dependent communities. In the two other villages (Ampangalantsara and Vatofotsy), the level of perceived satisfaction is much lower.

One major issue is the absence of a state. Only the national park and Vakona Hotel provided an alternative to basic public services and were not at the same level. The two Ghana studies (Agyeman et al. 2019; Bonye et al. 2021) and the Nepal paper (Nepal et al. 2021) referred to indirect benefits, basic public services, and, in one of the papers (Bonye et al. 2021), the authors observed a difference in terms of provision of services among villages, as we noticed in Andasibe, Madagascar. The households in Ghana benefiting indirectly from tourism saw a clear link to conservation efforts and anticipated expansion of the protected area. In our case, the villagers were divided regarding the link to conservation efforts, and several households claimed that elite capture of benefits was an issue. The locals from Andasibe town had the privilege of having services, roads, electricity, and water of high quality throughout the town. We, therefore, conclude that a location close to a protected area is likely to translate into a high degree of well-being among villagers.

Villagers in Falierana (close to Vakona Hotel) experienced prejudice against poor people from senior staff at the hotel. One way they address the issue is through the establishment of other protected areas managed by local people (Mitsinjo, local NGO, and community conservation). In these places, they offer alternative guided tours, like night sightings, which are not allowed in the national park (Mitsinjo), or less strenuous walks in the forest (community conservation). Empowerment took place through the creation of new local and community conservation projects; however, in the authors' experience, all guides from the three parks were highly professional. The most professional guides can recall the names of plants and animals in four different languages (Malagasy, French, English, and Latin), a level unreachable for poor people. Small shops, cafes, and restaurants offer jobs throughout all three conservation forests close to the park entrance (national park, Mitsinjo and community conservation). Cooperation is limited among the three conservation forests in Andasibe and there is no contact between the national park and the Vakona hotel. Inequality among households is the issue raised in the study by Ma et al. (2019) from China. Ecotourism requires a skilled labor force in China, as well as in Madagascar.

Poudyal et al. (2018) demonstrated that opportunity costs of protecting the forest in a proposed forest corridor in Madagascar are significantly higher than compensation. The authors annualized agricultural income and compared the opportunity costs to the carbon value of the forest, and then linked the results to a compensation plan laid out by the World Bank. The conclusion was that the proposed compensation only covered 5% of the opportunity costs. Neudert et al. (2018) adopted a slightly different approach and reached a more balanced conclusion. Their questions were related to an estimation of opportunity costs and benefits obtained through carbon storage in a REDD+ context. The opportunity costs were lower in the last case study compared to the calculations presented by Poudyal et al. (2018) because Neudert et al. (2018) presented net opportunity costs (less labor costs) and even the gross figures differed by a factor of approximately 100. Poudyal et al. (2018, p. 17) estimated the median opportunity costs at \$2375 per household, and Neudert et al. (2018, p. 108) calculated opportunity costs at \$22–27 per hectare. Small-scale farmers in Madagascar do not dispose of 100 hectares per household; in our case, farmers possess rice fields of 1–2 hectares each.

A lengthy discussion on how to calculate opportunity costs correctly goes beyond the scope of this article. Our point is that we need to understand the links between conservation, tourism, and livelihoods from a qualitative perspective to get the quantitative perspective right. Poor people do not react to opportunity-cost calibrations but contemplate the reality on the ground. In Andasibe, both income and well-being were positively affected, showing direct benefits in terms of better agricultural income and indirect benefits due to infrastructure facilities for tourists and schooling fees paid by the national park. The villagers from Ampangalantsara enjoyed neither of these facilities, and their levels of income and well-being were low. The inhabitants of Faliarana enjoyed both high incomes and high well-being, although an interpretation of Fig. 2, together with the comments about the parks, shows a higher level of dispersity in answers than in Andasibe.

We noted that the ecosystem's quality and resources are well protected in the national park and the surrounding small, protected areas. Only the human health systems should be further addressed in an overall plan for ecotourism in Andasibe. In Andasibe and Faliarana, dispensaries are funded by the national park and the private Hotel Vakona, whereas health access is limited in the two other villages.

We claim to add new insights to the debate on trade-offs between development and conservation by advancing two main observations. Households can gain from conservation through direct (higher land productivity due to more frequent rainfall) and indirect benefits (better access to basic public services). An opportunity costs study will get the household choices wrong in the case of Andasibe and presumably in other areas of ecotourism opportunities. Furthermore, we have shown that inequality is an undeniable fact connected to conservation efforts, in line with studies done in Ghana (Boney et al. 2021) and in China (Ma et al. 2019), the difference being that we can describe the inequality more precisely: job opportunities, alleged double standards between ordinary households and the village leadership, and concern about access to firewood (a challenge faced by poor people).

Conclusion

This study differed from many previous studies that adopted a restricted approach when measuring the benefits and costs of conservation, with the benefits being viewed solely from the perspective of land yields. It considered the possibility that a plot of land can reach its optimum value either through protection for conservation or by conversion into transformed land for agricultural purposes.

In terms of economic (livelihood) implications, we showed that villagers close to the entrance of the national park or a protected forest resort for luxury tourists were better off, whether measured in terms of income or well-being. This is the main observation from this study. Only modification is that the difference in well-being between Vatofotsy (further from the hotel and protected forest) and Andasibe (close to the park entrance) is not significant. Studies in the future will have to compare villagers who are depending on tourism income with nearby villagers who lack major tourism incomes. As tourism incomes seem to be underreported, the main difference between villages with/without projects (i.e., tourism dependency)

will be materialized in better agricultural income, indirect benefits (access to basic public services), and opportunities to attract tourists to alternative smaller parks (Mitsinjo and MMA). Compared to other African countries, Madagascar is far from having exploited its full tourism potential. Kenya, Tanzania, and Mauritius are faring much better, and the explanations may be institutional quality and human development (Folarin et al. 2020). Our conclusion on the poverty and conservation link departs from previous studies of poverty and conservation, and we cannot confirm the alleged non-existing relationship between the two factors (argued by Rakoton-dramaro and Andriamasy 2016). We see an increase in income due to the presence of tourist facilities. Our study confirms observations from Costa Rica (Ferraro and Hanauer 2014) and China (Ma et al. 2019) regarding the positive links between ecotourism and poverty reduction (in our case, we use higher incomes in villages close to tourism facilities).

In terms of social consequences, inequality is clearly a matter of concern. The challenges are fundamental when it comes to the access to firewood demanded by villagers with low education and income levels. Fast-growing species such as eucalyptus grown in plantations could provide a solution to this inequality issue. We obtained divergent, inconsistent claims about locals' access to existing plantations around Ampangalantsara. Certain households consider the forest regulations, even those for plantations, very restrictive. Other issues, like the education of locals to provide services for tourists (in guide jobs or small tourist shops) or the possibility of bias in who can access the forest without fear of sanctions, are more difficult to solve. In the past, USAID funded WWF to educate local guides hired by ANGAP (Association Nationale pour la Gestion des Aires Protégées), the predecessor to Malagasy Parks. In view of the weak Malagasy state, it is unlikely that funding will come from domestic sources. Communities could benefit more if they were involved in the management of national parks, as suggested in the Kenyan study (Holland et al. 2021).

In terms of environmental implications, the study did not conduct any specific investigation. Although income and employment opportunities have been created, they are not sufficient by themselves to guarantee that environmental objectives will be achieved. Following the logic of this study, we should have compared a biodiversity index or inventory in the national park and outside, so our comments here are only indicative. We managed to see all the lemurs in the national park, and our conversations with the guides left the impression that the national park was experiencing low pressure from illegal hunting. The deforestation rates were also low inside the national park (Table 12). Stronza et al. (2019) argued that ecotourism will fail in its environmental objective if the distribution of income is not equitable and secure land rights are absent; conditions which are either not the case (equal income distribution) or debatable (property rights is an inherent problem in Madagascar; see Bellemare 2012) in our case study. We believe the economic incentives to protect the forest in the national park and around Vakona Hotel were strong despite the conditions not being met in our case study.

Several researchers have framed the conservation debate in terms of hard choices (Gardner et al. 2013; McShane et al. 2011; Miller et al. 2011). Thus, nature conservationists defending the establishment of protected areas to maintain a wide

variety of biodiversity options are pitted against social conservationists, who are more inclined to embrace a sustainability-oriented approach to improving human well-being. The socioeconomic reality in the Andasibe commune was not one of hard choices between conservation and human well-being. Only studies employing the with/without approach in other places in Madagascar and in other countries will reveal whether the experience in Andasibe-Mantadia is unique.

How will ecotourism activities and park revenue/tourism revenue and possible use of renewable energy technologies contribute to achieving the SDGs and their indicators? The national park and the local conservation initiatives, Mitsinjo and MMA, have restored degraded forest, halted deforestation, and prevented the extinction of species (SDG targets 15.2 and 15.5). Most energy consumption is based on access to wood products, which are used for cooking (charcoal) and heating (fuel-wood), and there are no plans to look for alternatives. At present, access to timber products is not an issue because of their abundance, but this may not be sustainable in the long term (SDG target 7.a). COVID-19 could change the sustainability of Andasibe, although no study on this topic has yet been conducted. Tourist arrivals dropped nearly 30,000 (peak year) to just 300 for the national park and from 10,000 (peak year) to 200–300 for the two conservation initiatives in 2020.

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Declarations

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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