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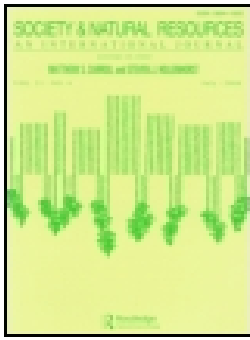
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Local Perceptions of the Livelihood and Conservation Benefits of Small-Scale Livelihood Projects in Rural Madagascar

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ABSTRACT

Small-scale livelihood projects are widely used in forest conservation and Reducing Emissions from Deforestation and Degradation (REDD+) initiatives; however, there is limited information on how effective these projects are at delivering livelihood and conservation benefits. We explored local perceptions of the effectiveness of small-scale livelihood projects in delivering livelihood and conservation benefits in eastern Madagascar. Our results suggest that small-scale livelihood projects vary greatly in their ability to deliver livelihood benefits, and that the type of livelihood project (e.g., agriculture, beekeeping, fish farming, or livestock production) has a significant impact on which livelihood benefits are delivered. Many small-scale livelihood projects, regardless of project type, are perceived to contribute to forest conservation efforts. Our study highlights that small-scale livelihood projects have the potential to contribute to both improved livelihoods and enhanced forest conservation, but also illustrates the need for more information on the factors that lead to project success.

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Introduction

Policymakers, donors, and practitioners are increasingly attempting to link sustainable development with tropical forest conservation by implementing small-scale livelihood projects that are designed to improve the livelihoods of rural communities while reducing pressure on forests (Cerbu et al. 2009; Blom, Sunderland, and Murdiyarto 2010;

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Lawlor et al. 2013). While these types of projects were originally championed as part of large Integrated Conservation and Development Programs (ICDPs) in the late 1980s (e.g., Hough 1994; Bauch, Sills, and Pattanayak 2014), more recently they have been promoted as a means of ensuring livelihood benefits in the context of ongoing REDD+ (Reducing Emissions from Deforestation and Degradation) and tropical forest conservation efforts (e.g., Cerbu et al. 2009; Lawlor et al. 2013). In most cases, small-scale livelihood projects focus on improving or diversifying agricultural production or providing alternative sources of livelihoods for local communities (Roe et al. 2015; Wright et al. 2016). Common project types include the promotion of agroforestry, sustainable agriculture, beekeeping, fish farming, livestock production, ecotourism and handicraft production (Scherl 2004; Wicander and Coad 2014). While their primary purpose is to deliver social benefits, many livelihood projects are also intended to decrease pressure on forests by reducing agricultural expansion into forests and reducing pressure for timber, firewood, charcoal production, bush meat, and other forest products (Brooks, Waylen, and Mulder 2012; Sainsbury et al. 2015). Thus, these livelihood projects have the potential to contribute to global environmental goals such as biodiversity conservation and climate change mitigation (Roe et al. 2015).

Although small-scale livelihood projects are widely implemented in ongoing forest conservation and REDD+ initiatives, evidence on the effectiveness of these projects in delivering benefits to local communities is only beginning to emerge. To date, the handful of studies that have specifically examined small-scale livelihood initiatives implemented as part of REDD+ or forest conservation efforts have shown mixed results. For example, an evaluation of the social and ecological impacts of an enterprise-based conservation strategy in the Tapajos National Forest of Brazil found positive impacts on household income, but no discernable impacts of household assets, livelihoods or forest conservation (Bauch, Sills, and Pattanayak 2014). A review of REDD+ projects concluded that most projects had insufficient information to assess the impacts of project activities on local livelihoods (Caplow et al. 2011). A study of the impacts of alternative income-generating activities in a forest conservation program in Tanzania found high heterogeneity in the social and ecological impacts delivered across activities, and stressed the need for more case studies to better understand the factors affecting livelihood outcomes (Sainsbury et al. 2015). Other authors have similarly highlighted the limited information on the effectiveness of livelihood projects and called for a better understanding of both the livelihood and conservation impacts delivered by different project types (e.g., Wicander and Coad 2014; Roe et al. 2015; Wright et al. 2016). Such information is critical for informing the design of effective policies, investments and programs to increase the well-being of communities in forested areas (Baylis et al. 2016).

Our study aims to help fill the knowledge gap on the effectiveness of small-scale livelihood projects in delivering livelihood and conservation benefits by providing a case study of small-scale livelihood projects in eastern Madagascar. Madagascar has a long history of efforts to conserve its tropical forests while improving the livelihoods of poor rural communities. Many small-scale livelihood projects have been implemented across the country, first as part of ICDPs (Hough 1994; Marcus 2001), and, more recently, as part of forest conservation and REDD+ initiatives (Gardner et al. 2013, MacKinnon et al. 2017). Many of the country's protected areas and REDD+ initiatives are being developed under a model of co-management with local community groups (Gardner

et al. 2013). Livelihood projects are a common feature of these conservation initiatives, as they promote community involvement and support for conservation.

One region that has received significant investment in livelihood projects is the Ankeniheny Zahamena Corridor (known by its French acronym, CAZ), a rural area with significant forest cover, rich biodiversity, and high poverty levels. The CAZ region has received more than 460 small-scale livelihood projects since 2006 as part of forest conservation activities and an REDD + pilot project (Conservation International 2013). Livelihood projects have also been provided to compensate vulnerable households for restricted access to forest resources due to the creation of the CAZ protected area, following the World Bank's safeguard policy (World Bank 2013; Poudyal et al. 2016). The livelihood projects were designed to improve the livelihoods of rural communities living near forests, and consisted of a range of activities, including beekeeping, fish farming, livestock, and agricultural projects, among others (MacKinnon et al. 2017). Given the large number and variety of livelihood projects implemented, the CAZ region provides a unique opportunity to assess whether small-scale livelihood projects deliver livelihood and conservation benefits, and to examine how the delivery of benefits varies across different project types.

The overall objective of our study was to explore local perceptions of the livelihood and conservation benefits provided by small-scale projects in CAZ and to compare the effects of different types of projects (e.g., fish farming, agricultural production, beekeeping, and livestock production) on the benefits provided. Understanding the effectiveness of small-scale livelihood projects in delivering social and ecological outcomes is of interest to policymakers, donors and practitioners who are grappling with the challenge of improving the well-being of local rural communities while protecting forests for global environmental benefits (Wicander and Coad 2014; Baylis et al. 2016).

Methods

Study Area

We conducted our study in the Ankeniheny Zahamena Corridor, a forested region of eastern Madagascar which is part of a 370,000 ha REDD + pilot (Conservation International 2013). The landscape is a mosaic of protected areas, community-managed forests, and smallholder agricultural systems, and is important for biodiversity conservation (Critical Ecosystem Partnership Fund 2014). The main drivers of deforestation are swidden agriculture ("tavy") and charcoal production (Ratsimbazafy, Harada, and Yamamura 2011). Multiple efforts have been underway to reduce deforestation in the region. The CAZ area is part of an REDD + pilot initiative that began in 2006. The area has a new protected area that has a co-governance arrangement that formally includes multiple stakeholders in management decision-making. At the most local level, communities are represented by community-forest management organizations (known in Madagascar as Vondron'Oloha Ifotony or VOIs) that have responsibility for conservation actions in their local area (Rajaspera et al. 2011). Subsistence farmers inhabit the area, cultivating rice, maize and other crops in smallholdings (typically less than 1 ha). Most farmers live below the national poverty line, lack access to basic services (clinics, electricity, potable water, etc.), experience seasonal food insecurity, and are highly dependent on forest resources for their livelihoods (Harvey et al. 2014; Poudyal et al. 2016).

Livelihood Projects

Since 2006, more than 460 small-scale livelihood projects have been implemented in CAZ by Conservation International (CI, an international conservation organization) and its partners as part of forest conservation efforts, the CAZ REDD + project (Conservation International 2013) and a safeguard process to compensate vulnerable households for restricted access to forest resources due to the creation of the CAZ protected area (Poudyal et al. 2016). The livelihood projects have included a wide range of activities ranging from beekeeping to agricultural projects to providing support for teachers' salaries (MacKinnon et al. 2017). Projects were chosen jointly by community groups and project implementers, and were then designed by local NGOs, private contractors specializing in rural development, or by local CI staff. The projects were implemented through a variety of approaches including direct implementation by CI, implementation through grants provided by CI to local partners (NGOs or associations), implementation of projects by a third-party contractor (following the World Bank's safeguards procedure) and implementation through conservation agreements. In all cases, projects were implemented together with established community-forest management associations (VOIs). Although all projects were implemented within the context of forest conservation efforts, individual livelihood projects were independent efforts, delivered in different locations by several different organizations. Most projects lasted less than a year, involved approximately 50 people, and cost an average (SE) of US \$2746 (\pm 246) to implement (MacKinnon et al. 2017).

Assessment of the Livelihood and Conservation Impacts of Small-Scale Livelihood Projects

To examine how perceived livelihood outcomes varied across project types, we sampled four common types of livelihood projects: (1) bee keeping, (2) support to small-scale agricultural production (primarily rice, corn, and beans), (3) livestock production (mainly chickens) and (4) fish farming. Table 1 provides a general overview of the project activities of each of these project types. We sampled from projects included in CI's database of 463 projects implemented in CAZ from 2006 to 2014 (see MacKinnon et al. 2017 for details). Specifically, we identified all agriculture, beekeeping, fish farming, and livestock projects done between 2010 and 2014 ($n = 317$ projects, including 146 agricultural, 42 beekeeping, 25 fish farming, and 104 livestock projects), and then randomly selected 10–18 projects from within each project type for assessment. We focused on the most recent projects (2010–2014) to improve local people's recall ability. For each selected project, we compiled a list of known project participants (both men and women) from participant lists in project reports and from information provided by village chiefs. We then used these lists to randomly select 10 people per project to participate in the household survey. In total, we surveyed 61 projects (611 participants). Table 1 provides a breakdown of the distribution of surveys between project types, while Figure 1 shows the location of the 61 projects.

We used a structured household survey to explore local perceptions of both the livelihood and conservation benefits delivered by different types of projects. We focused on documenting "perceived" benefits because the perceptions of local people of the social

Table 1. An overview of the four types of small-scale livelihood projects which were assessed using household surveys in the Ankeniheny Zahamena Corridor, Madagascar.

Project type	Project activities	Examples of inputs provided ^a	Examples of the training provided ^a	No. of projects of surveyed	No. of people surveyed
Agriculture	Support to participants in the cultivation of rice, beans, and corn, using improved practices and improved seed varieties	Seeds, fertilizers, agricultural tools, mechanical weeders	Training on land preparation, soil conservation, composting, biological control, use of improved riziculture practices and cultivation of new crops	16	161
Beekeeping	Development of bee-keeping activities	Materials for constructing bee hives	Training on care and management of bee colonies and honey storage	10	100
Fish farming	Creation of communal fish ponds for fish production	Fish fry (Tilapia) Fish food (cornmeal)	Training on pond construction and fish production	17	170
Livestock	Production of small-scale livestock, primarily chickens (but in one case, pigs)	Materials for hen houses or pig pens; Vaccinations; cornmeal (for chicken feed)	Training on livestock production, including construction of hen houses or pig pens, livestock management, and breeding practices	18	180
Total				61	611

^aThe exact characteristics of inputs and training varied slightly across individual projects, depending on the implementing organization and community involved.

or ecological benefits of projects shape their support for project activities and are fundamental to project success (Bennett 2016). In addition, it was not possible to measure actual benefits due to the lack of baselines and systematic data on the benefits received.

To document local perceptions of the livelihood benefits, we asked project participants the extent to which the livelihood project they had participated in had delivered the expected livelihood benefits (“none,” “some,” or “most”). For those who indicated the project had delivered some or most of the expected benefits, we then asked which types of livelihood benefits they received and how important (“not important,” “somewhat important” or “very important”) these benefits were for their livelihoods. We specifically asked about the following livelihood benefits: improvements in food security, market access, household well-being, and community cooperation, access to salaries or stipends, and strengthened community organizations. We also asked about how long participants received livelihood benefits after the project ended.

To document local perceptions of the potential conservation benefits of small-scale livelihood projects, we first asked all participants whether they thought the livelihood projects were meant to deliver conservation outcomes. For those that believed that the livelihood projects were designed to deliver conservation outcomes, we then asked them which specific conservation outcomes they thought the project was intended to influence. We specifically asked about the following potential conservation impacts: reductions in charcoal production, firewood extraction, hunting, mining, non-timber forest product (NTFP) extraction, timber extraction, and tavy, and improved forest

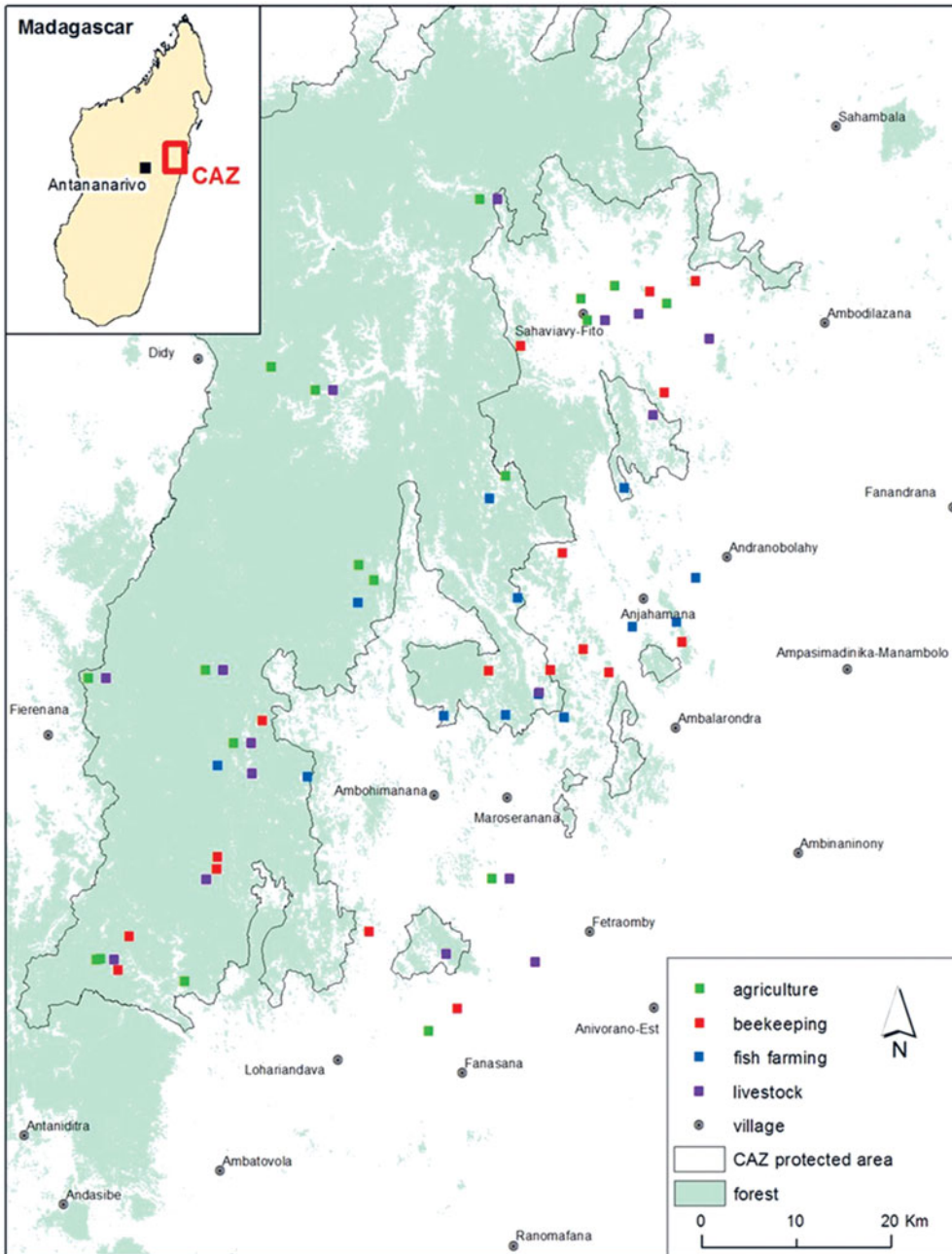


Figure 1. Map showing the location of the 61 small-scale livelihood projects of four project types (agriculture, bee keeping, fish farming, and livestock) that were surveyed in the Ankeniheny Zahamena Corridor in Eastern Madagascar.

management. Finally, for those participants who indicated that the livelihood projects were designed to deliver a specific conservation outcome (e.g., reduction in hunting), we also asked them if the project had contributed to achieving this conservation goal (e.g., whether the project had contributed to a reduction in hunting). A summary of the

variables used to document local perceptions of the project livelihood and conservation impacts can be found in [Table 2](#).

The survey was piloted in the field twice and received approval from the Bangor University College of Natural Sciences ethics committee (the overall lead on the interdisciplinary project under which this research was conducted) prior to implementation. To minimize the risk that participants would provide answers they thought the interviewers wanted to hear, all participants were given the option of participating in the study, were informed that there were no correct answers and that we wanted to hear their own perceptions of how the projects had affected their livelihoods, and were given the option of withdrawing from the interview at any point. Participants were also informed that their individual responses would be kept private and would not be attributed to them directly. To further minimize the risk of potential respondent bias, we contracted independent research assistants (with no prior connection to the study area or to CI) to conduct the interviews. All household surveys were conducted (in Malagasy) in either the respondent's house or farm, from September to November 2015.

Data Analysis

We used descriptive analyses to summarize responses and identify the key trends in the data across the 611 surveys administered. We compared differences among project types in terms of (a) the perceived livelihood benefits, and (b) perceptions of conservation goals and outcomes, using generalized linear mixed models with the variables summarized in [Table 2](#). We used generalized linear mixed models, as opposed to more traditional general linear models (e.g., ANOVAs or linear regressions), because most of our variables were binary (yes/no) or ordinal (e.g., “none,” “some,” “many”) and these types of variables generate high levels of type-1 errors in general linear models. To compare the effects of different project types on variables with ordinal responses, we used cumulative logit mixed models with a flexible threshold (Agresti 2010). We tested the significance of the project type using likelihood ratio tests and compared means across different project types using a post-hoc test (Tukey) with the `ls means` library (2016). These analyses were conducted using the `ordinal` library (Christensen 2015) in the R 3.1.0 statistical package (R Core Team 2015).

To compare the effects of different project types on binary variables (i.e., those variables with answers of yes or no), we used a Bernoulli distribution and the link logit (Agresti 2010). In cases where there were differences across project types for a given variable, we compared means using the multiple means comparison method (Di Rienzo et al. 2002). These analyses of binary variables were conducted using the `glmer` function of the `lme4` library (Bates et al. 2015) together with the statistical package `InfoStat` (Di Rienzo et al. 2016).

Results

Characteristics of Project Participants

We interviewed a total of 611 participants (407 men, 204 women), representing 61 projects. Most of the participants were of the Betsimisaraka ethnic group (85%), but



Table 2. A summary of the key livelihood benefits and conservation outcomes assessed across different types of projects implemented in CAZ, Madagascar, using household surveys.

Type of outcome	Variable	Description	Potential values	
Livelihood impacts	Delivery of livelihood benefits	Extent to which the microproject delivered the expected livelihood benefits (<i>benefit delivery</i>)	None, some, most	
	Duration of livelihood benefits	Duration of livelihood benefits received from project(<i>duration</i>)	During project only, for several months following end of the project, for several years following the end of the project, or still receiving benefits	
Conservation goals and impacts	Importance of the project for specific livelihood benefits:	-Increasing ability to generate income (<i>income</i>)	Not important, somewhat important, very important	
		-Providing a stipend for participation in the project (<i>stipend</i>)		
		-Providing a salary for project work (<i>salary</i>)		
		-Improving household's food security (<i>food security</i>)		
	Perceived conservation goals	-Improving access to markets for crop or livestock products (<i>market access</i>)		
		-Improving household well-being (<i>household well-being</i>)		
		-Improving cooperation between community members (<i>community cooperation</i>)		
		-Creating or strengthening community institutions (<i>community institutions</i>)		
		Whether the livelihood project had specific conservation goals		Yes/no
		Whether the livelihood project had the specific conservation goal of:		Yes/no
Whether the project contributed to the following conservation outcomes:	-Reducing tavy in forest areas			
	-Reducing timber extraction from the forests			
	-Reducing the extraction of firewood from the forest			
	-Reducing charcoal production in the forest			
	-Reducing the extraction of non-timber forest products			
	-Reducing wildlife hunting			
	-Reducing mining			
	-Reducing the establishment of new settlements			
	-Improving forest management by local communities			
	Use of tavy in forest areas was reduced		Yes/no	
Timber extraction from forests was reduced				
Firewood extraction from forest was reduced				
Charcoal production in the forest was reduced				
Extraction of non-timber forest products was reduced				
Wildlife hunting was reduced				
Mining was reduced				
The establishment of new settlements was reduced				
Forest management by local communities was improved				

Names of variables that appear in [Table 3](#) are listed in italics and parentheses.

members of other groups were also present. The mean age of participants was 45.5 ± 0.6 (SE) years, and most (71%) respondents were heads of their household. The main occupation of respondents was agriculture (95%) and agriculture was the main source of income. All participants grew rice, mainly for family consumption, however only 29% grew enough rice in a normal year to feed their households during the entire year. On average, households reported being food secure for $8 (\pm 0.2)$ months a year.

Types and Duration of Livelihood Benefits

Of the 611 participants, 272 (44.5%) indicated that the project had delivered “some” of the expected benefits and 80 (13.1%) indicated that the project had delivered “most” of the expected benefits. The remainder (42.4%) reported that the projects had delivered “none” of the expected livelihood benefits. There were no differences in responses among men and women participants in their perceptions of the extent to which projects had delivered livelihood benefits ($\chi^2 = 4.2$, $p = 0.12$). Participants mentioned a variety of reasons why some of the projects failed to deliver the expected livelihood benefits, including problems with project implementation (e.g., difficulties getting bees to stay in the hives, chickens or fish dying or crops failing) and insufficient capacity-building and technical support for project activities.

Across those participants who had received either “some” or “most” of the expected livelihood benefits, the importance of different types of benefits varied. The most commonly mentioned benefits were increased community cooperation, strengthened community institutions, increased food security, and overall improved household well-being, each of which was mentioned by more than 50% of participants who had received benefits as being either “somewhat” or “very” important (Figure 2a). Income generation and stipends for project work were mentioned as somewhat or very important by just under 40% of those who had received benefits. Project salaries and improved market access were less commonly mentioned.

Of the people who indicated that they received benefits from the projects, 41% indicated that they only received benefits during project implementation. The remainder are continuing to receive benefits from the project activities, months or even years after the project’s end (Figure 2b). Despite the heterogeneity among projects in their delivery of livelihood benefits, 92% of all participants said they would be interested in participating in a similar type of livelihood project in the future.

Differences in Livelihood Benefits of Different Project Types

There were significant differences across project types in their ability to deliver the expected livelihood benefits (Figure 3 and Table 3). Agricultural and livestock projects had greater probabilities of delivering livelihood benefits than beekeeping projects (Figure 3a and Table 3). Projects also differed significantly in the duration of benefits, with agricultural projects delivering longer-term benefits than beekeeping projects (Figure 3b and Table 3).

There were also significant differences across project types in their ability to deliver specific livelihood benefits. Figure 4 shows the probability of different types of projects

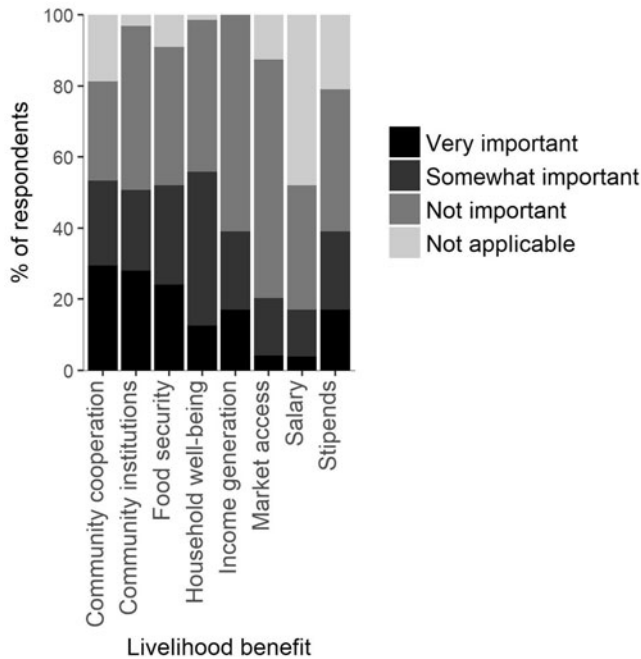


Figure 2. Participant perceptions of the relative importance (not important, somewhat important, or very important) of different types of livelihood benefits delivered by small-scale livelihood projects ($n = 353$ participants who indicated they received benefits from the projects).

in delivering specific livelihood benefits, while Table 3 shows the comparison of means across project types. Agricultural and fish farming projects had the higher probabilities of improving community cooperation than beekeeping projects, because agricultural and fish farming projects included community-wide activities (Figure 4a). The probability of projects strengthening community institutions was higher in agricultural projects than beekeeping projects (Figure 4b). The probability of improving food security was greater in agricultural projects than in either beekeeping or fish farming (Figure 4c). The probability of improving overall household well-being was greater in agricultural and livestock projects than in beekeeping projects (Figure 4d). Agricultural and livestock projects had higher probabilities of increasing income generation than beekeeping projects (Figure 4e). Fish farming projects were more likely to generate project-related salaries than beekeeping or livestock projects (due to salaries being paid to participants for transporting materials or helping with pond construction, Figure 4g). Project types did not differ in terms of their ability to increase access to markets (Figure 4f) or provide stipends for project work (Figure 4h).

Conservation Goals and Outcomes of Livelihood Projects

Interestingly, 90% of participants believed that projects had specific conservation goals. The most commonly reported goals (Figure 5a) were reducing use of tavy (mentioned by 87%), improving forest management (87%), reducing timber extraction (69%),

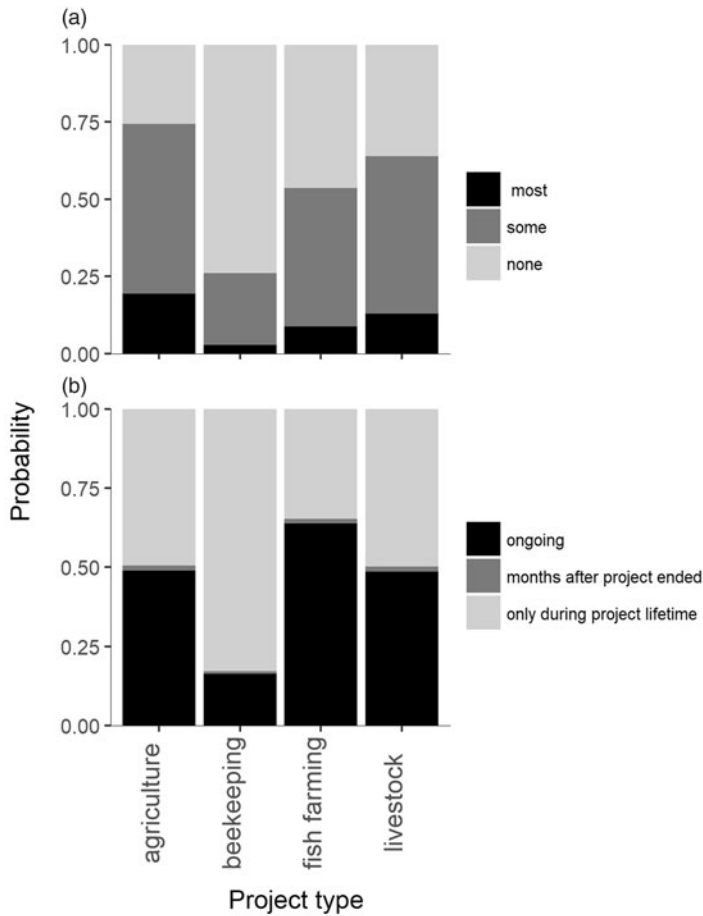


Figure 3. Summary of the probability of different types of projects in (a) delivering the expected project benefits, (b) the duration of benefits delivered, and (c) the distribution of benefits across project participants (the significance of the differences between project types is reported in Table 3).

Table 3. Summary of the means and standard errors of the cumulative logit function effects of different types of projects on the delivery of livelihood benefits.

Variable	Project type				<i>p</i> -values
	Agriculture	Beekeeping	Fish farming	Livestock	
Benefit delivery	$-0.24 \pm 0.60a$	$-3.22 \pm 0.79b$	$-1.71 \pm 0.63ab$	$-0.83 \pm 0.60a$	<0.0001
Benefit duration	$-0.37 \pm 0.59a$	$-2.78 \pm 0.78b$	$-0.85 \pm 0.60ab$	$-0.47 \pm 0.59ab$	0.0000
Community cooperation	$-0.56 \pm 0.48a$	$-3.33 \pm 0.68b$	$-0.94 \pm 0.48a$	$-1.41 \pm 0.46ab$	0.001
Community institutions	$-0.52 \pm 0.50a$	$-2.82 \pm 0.67b$	$-1.17 \pm 0.50ab$	$-1.14 \pm 0.47ab$	<0.0001
Food security	$-0.13 \pm 0.50a$	$-3.57 \pm 0.71c$	$-2.24 \pm 0.60bc$	$-0.89 \pm 0.51ab$	<0.0001
Household well-being	$-0.76 \pm 0.47a$	$-3.31 \pm 0.64b$	$-1.75 \pm 0.48ab$	$-1.06 \pm 0.52a$	<0.0001
Income generation	$-0.80 \pm 0.48a$	$-3.36 \pm 0.64b$	$-1.86 \pm 0.50ab$	$-1.17 \pm 0.49a$	<0.0001
Market access	-1.96 ± 0.50	-4.62 ± 0.72	-3.60 ± 0.71	-2.03 ± 0.57	0.1520
Salary	$-3.55 \pm 0.60ab$	$-4.99 \pm 0.79b$	$-2.06 \pm 0.53a$	$-4.68 \pm 0.63b$	<0.0001
Stipend	-1.95 ± 0.78	-2.53 ± 0.96	-1.33 ± 0.82	-2.35 ± 0.78	0.1033

Different letters indicate significant differences across project types ($p < 0.05$), using Tukey tests.

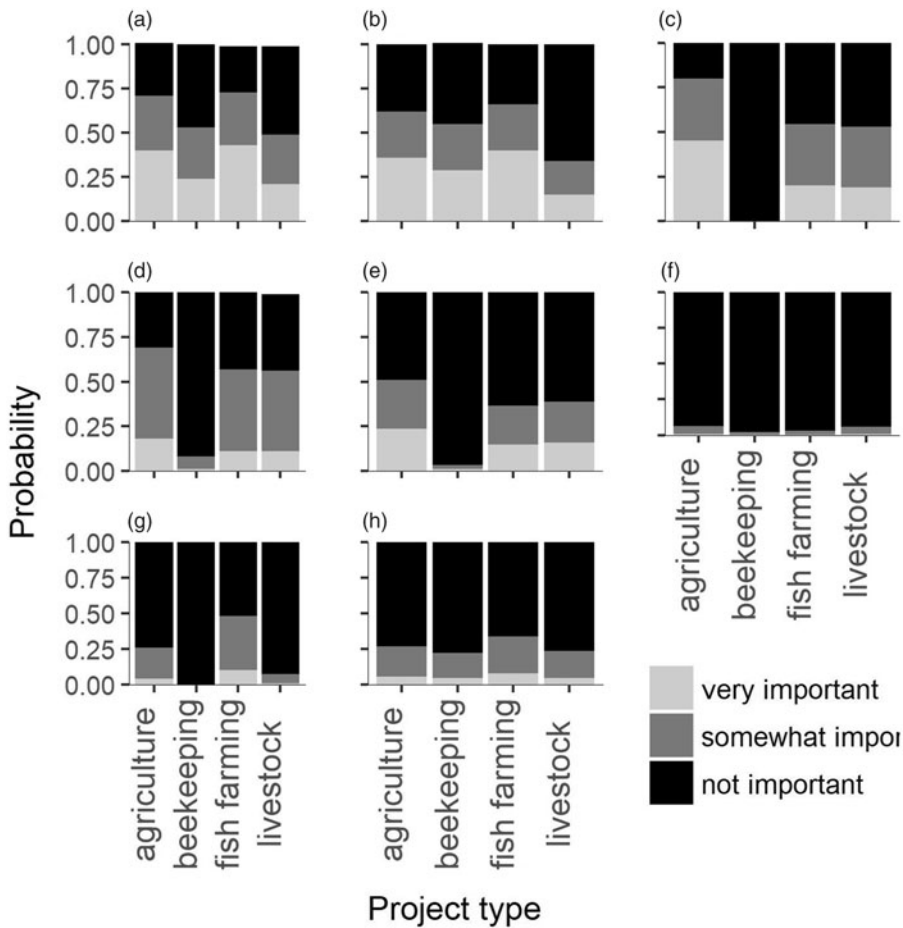


Figure 4. Summary of the probability of different types of projects in delivering specific livelihood benefits: (a) increased community cooperation, (b) strengthened community institutions, (c) improved food security, (d) improved household well-being, (e) enhanced income generation, (f) improved market access, (g) salaries for project work, and (h) stipends for project participation (see Table 3 for differences across project types).

reducing extraction of NTFPs (67%), reducing establishment of new settlements (63%), reducing wildlife hunting (61%), and reducing mining (61%; Figure 5a). Participants considered all four project types (agriculture, beekeeping, fish farming and livestock production) to contribute equally to conservation goals ($\chi^2 = 0.22$, $p = 0.97$; Table S1 in Supplementary Material). Except for the goal of “improving forest management,” there were no significant differences across project types in the types of conservation goals they contributed to (Table S1 in Supplementary Material).

Of the participants who believed the projects had specific conservation goals, a subset (32–72%, depending on the specific goal) thought that the livelihood projects had contributed to achieving these goals (Figure 5b). For example, of the participants who considered the projects to be aiming to reduce charcoal production, 71.4% thought the projects had helped to reduce charcoal production, and of those who considered the

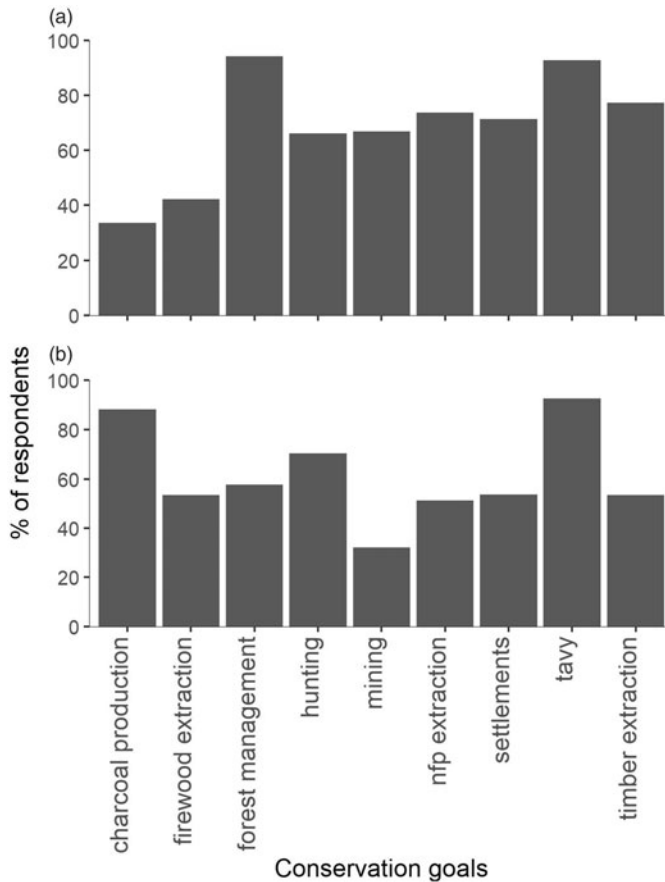


Figure 5. Perceptions of participants on (a) whether the livelihood projects had specific conservation goals ($n = 611$ participants) and (b) whether the projects helped to achieve specific conservation goals. The percentages in (b) refer to the percent of those people who said the livelihood project had the goal, who also said it had helped them to achieve the goal.

projects to be aiming to reduce hunting, 70.3% thought the project had helped reduce hunting. The percent of participants who indicated that the projects had contributed to reducing the extraction of timber, firewood, NTFPs, improving forest management, reducing the use of tavy, and decreasing new settlements, ranged from 51.3 to 51.7% (Figure 5b). In contrast, the percent of participants who thought the projects had led to a reduction in mining was much lower (32.1%). There were no differences across project types in their perceived ability to reduce conservation threats, except for mining (Table 1 in Supplementary Material).

Discussion

In the CAZ landscape, small-scale livelihood projects had mixed results in terms of their ability to deliver livelihood benefits to participants. While 58% of the participants indicated that the livelihood projects had provided them with some livelihood benefits such as improved food security or increased income generation, the remainder reported

receiving no livelihood benefits from the projects. There was also considerable variation in the types of livelihood benefits provided by individual projects, with some helping to improve food security or income generation, and others strengthening community cooperation. The few comparable case studies of small-scale projects have similarly reported substantial variation across stakeholders in their perceptions of livelihood outcomes (e.g., Bauch, Sills, and Pattanayak 2014; Clements and Milner-Gulland 2015; Sainsbury et al. 2015).

The heterogeneity in the delivery of livelihood benefits in CAZ is likely due to numerous factors. First, it is clear from conversations with participants that projects varied greatly in terms of how successfully they were implemented. In projects where chickens survived and multiplied, where fish grew and reproduced, or where adoption of new agricultural techniques led to increased yields, participants reported receiving important benefits, not just during the project but also in following months and years. However, in other cases, participants indicated that projects failed to deliver any livelihood benefits due to a combination of design or implementation flaws, or lack of technical support. A second reason that may account for the mixed results is that we measured perceived benefits, rather than actual benefits (e.g., the number of eggs produced, or fish harvested) and these perceptions are inevitably subjective. From our data, it is not possible to determine whether some of the livelihood benefits attained were actually low or whether participants had unrealistically high expectations of what projects would deliver and were subsequently disappointed by the results, as has been reported elsewhere (e.g., Sainsbury et al. 2015). Finally, the fact that many projects failed to deliver livelihood benefits or provided only certain types of benefits may reflect the small scale and short duration of the projects. Most participants fall below the national poverty line of 468,800 Ariary (or US\$234) per year (WFP and UNICEF 2011) and are highly vulnerable to both agricultural and climatic risks (Harvey et al. 2014). Against this backdrop of poverty, individual small-scale projects are likely insufficient to significantly improve local livelihoods unless they are part of a larger, sustained effort.

Our results also highlight the importance of the project type in determining whether and which-livelihood benefits were provided. In general, agricultural, fish, and livestock projects were more successful at delivering livelihood benefits than the beekeeping projects. According to participants, many of the beekeeping projects failed because of problems maintaining bee colonies and limited technical support. The different project types also varied in terms of which types of livelihood benefits they provided. For example, agricultural projects were the most effective for improving food security, as they increased crop yields. Agricultural and livestock projects were the most effective at improving household well-being and generating income, most likely due the fact that participants had prior experience with agricultural and livestock production and appeared to easily adopt new practices and crops. Agriculture and fish farming were the most effective at enhancing community cooperation, reflecting the communal nature of these activities (e.g., participants within a given community worked together to prepare and plant fields, or to dig communal fish ponds). Overall, these results indicate that the choice of which types of projects are pursued has significant impacts on what livelihood benefits are delivered and should be carefully considered in project design.

Although the livelihood projects focused on livelihood activities, rather than on activities that reduced threats to forests or promoted conservation *per se*, most participants believed that livelihood projects had specific conservation goals, irrespective of the type of project implemented. Participants perceived all the types of livelihood projects to have conservation goals. Even more interestingly, a significant subset of participants (32–71%, depending on the specific conservation outcome examined) perceived that livelihood projects had helped to achieve specific conservation outcomes, such as reducing charcoal use or hunting. There is a chance that these results reflect respondent bias, i.e., that participants told the research assistants what they thought they wanted to hear. However, since the research assistants were independent and not affiliated with the implementing organizations, and since participants seemed comfortable reporting that many projects failed to deliver livelihood benefits, we think that this is unlikely. Instead, we attribute these results to the fact that all participants in the livelihood projects were members of local forest management groups (VOIs) and were therefore aware of the links between the livelihood projects and ongoing conservation activities. We also think it is likely that their participation in the livelihood projects with other VOI members may have reinforced their commitment to conservation activities. Studies elsewhere have shown that participation in livelihood projects can lead to improved attitudes toward conservation and increased conservation behaviors (e.g., Blomley et al. 2008; Morgan-Brown et al. 2010). These findings are important for other conservation projects in Madagascar and elsewhere (e.g., Clements and Milner-Gulland 2015), where community-based organizations are directly involved in the governance of protected areas, as they suggest that small-scale support for livelihood activities can help enhance local “buy-in” for conservation.

Implications

Our study has several important implications for the use of small-scale livelihood projects in forest conservation and REDD+ initiatives in Madagascar and potentially elsewhere. First, our results suggest that local participants perceive small-scale livelihood projects to have the potential to both enhance local livelihoods and contribute to forest conservation efforts, if they are implemented successfully. The fact that 92% of participants were keen to participate in future projects, despite the mixed livelihood results of the projects they participated in, indicates they recognize the potential value of these projects for their livelihoods and demonstrates significant local support for their use. The perception that at least some of the livelihood projects have led to specific conservation outcomes also reinforces the value of these projects in building community support for conservation. However, since our study only examined the perceptions of local people who participated in the project and did not include a control, it will also be important to document how these projects affect non-participants and nearby communities to ensure that the projects do not reinforce any potential existing inequities or lead to negative spillover effects (e.g., McDermott and Schreckenberg 2009).

Second, because the type of project implemented has an important impact on which livelihood benefits are delivered, it is important that decisions about which types of

projects are pursued are made carefully and with active community participation. The choice of whether to pursue an agricultural project or a fish farming project, for example, has significant ramifications on the types and levels of benefits achieved. Actively involving local communities in project selection and design is critical for ensuring that the selected project meets local needs and is appropriate for local conditions (Boissière et al. 2009; Holmes and Potvin 2014). It is also important that participants are aware of the types and magnitude of the benefits they will likely receive from a given project, so that participants have realistic expectations about the project's potential impact.

Finally, it is important that more work be done to better understand how different aspects of project design and implementation (not just project type, but also project size, duration, level of funding, transaction costs, training activities, technical support, local capacity and institutional arrangements) affect livelihood and conservation outcomes and under what conditions these projects are successful (Naidoo et al. 2006; Brooks, Waylen, and Mulder 2012; MacKinnon et al. 2017). Cases studies of local perceptions (such as the one provided here) are critical for improving our understanding of the effectiveness of project activities in delivering livelihood benefits (Woodhouse et al. 2015; Bennett 2016). However, ideally, these assessments would also include quantitative information on the magnitude, economic value, and distribution of livelihood benefits among participants (Morgan-Brown et al. 2010; Milner-Gulland et al. 2014), as both qualitative and quantitative information are critical for decision-making and project management. There is also an urgent need to better understand the mechanisms through which small-scale livelihood projects lead to conservation outcomes (Roe et al. 2015; Woodhouse et al. 2015), the time frame over which these outcomes are achieved, and the permanence of these impacts (Milner-Gulland et al. 2014; Wright et al. 2016). A related study by Tabor et al. (2017) found that some evidence that investments in small-scale livelihood projects and conservation activities in CAZ were associated with reductions in deforestation and fire incidence, but also highlighted the complexities of conducting these types of impact assessments in highly dynamic forest landscapes that are typical of many locations where REDD+ investments are occurring. Rigorous assessments of the both conservation and livelihood impacts of small-scale livelihood projects will require greater collaboration among local stakeholders, practitioners and scientists (Gardner et al. 2013), as well as a greater willingness of project implementers to rigorously share both project successes and shortcomings (Redford and Taber 2008; MacKinnon et al. 2015).

Small-scale livelihood projects are likely to continue to be a key strategy in forest conservation, REDD+ and rural development initiatives in Madagascar and elsewhere, as countries continue to seek ways to reconcile sustainable development with forest conservation and meet global targets for sustainable development, biodiversity conservation, and climate change. Our study suggests that, despite some shortcomings, small-scale livelihood projects have the potential to make an important contribution to the dual goals of improving local livelihoods while conserving forests, but more studies are needed to understand the factors that lead to project success.

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