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Full Length Research Paper

Forest conservation and livelihood conflict in REDD: A case study from the corridor Ankeniheny Zahamena REDD project, Madagascar

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To be effective, the reducing emission from deforestation and forest degradation (REDD) initiatives must be driven not only by their potential climate and other environmental benefits, but also by the consideration of how they will affect rural communities. This study focused on the socioeconomic dimensions of the REDD mechanism and explored the extent to which the management system of a carbon sequestered forest affects the livelihoods of local forest communities. The study was carried out in the Corridor Ankeniheny Zahamena (CAZ) REDD project in the eastern section of Madagascar. A sampling of 118 respondents was selected from the communities located inside, adjacent, and in the immediate proximity of the forest. A sustainable livelihood approach and participatory rural appraisal tools, including direct interviews and questionnaire surveys, were used in data collection. The main purpose of the direct open-ended interview was to understand the historical and socioeconomic background of the community in the area. Closed-ended questions were used to understand the changes within the socioeconomic assets of the household and to determine the involvement and participation level of local people within the project. Our analysis revealed that the impact of the REDD project on the communities' livelihoods varies according to the socioeconomic characteristics of the households. The most disadvantaged households were the most affected, since their livelihood relied considerably on the forest resources. Nevertheless, all households had the same right regarding access to forest resources and benefits from the project. Regarding awareness and participation, the local people living inside the forest were the most active within the forest conservation activities. The majority of the local people were aware of the existence of the forest conservation project in their area, while only the elites in the communities at the local level were aware of the carbon issues within the forest that they were protecting. Therefore, an in-depth socioeconomic study should be conducted within the local community involved in the protected areas before implementing a forest conservation system. Moreover, the socioeconomic characteristics of forest communities should be considered as main criteria for the design of both benefit-sharing and incentive measures.

Key words: Deforestation, forest degradation, forest conservation, community livelihood, forest carbon, Ankeniheny Zahamena Corridor, Madagascar.

INTRODUCTION

Despite the considerable increase in protected areas (PA) across the globe (IUCN 1998), deforestation is order to reduce these emissions, the reducing emission from deforestation and forest degradation (here after responsible for an estimated 12 to 18% of global carbon emissions (Stern, 2006; Van Der Werf et al., 2009). In REDD) mechanism was agreed upon as part of the 2012 protocol of the United Nations Framework Convention on Climate Change (UNFCCC). The basic premise is that, developed countries will pay developing countries to reduce rates of deforestation or degradation by

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implementing a range of policies and projects as part of their obligation to reduce greenhouse gas (GHG) emissions. It has been estimated that REDD financing could result in the flow of billions of dollars annually from developed to developing countries (Stern, 2006; Ebeling and Yasue, 2008) and that this could provide important co-benefits, such as poverty alleviation and biodiversity conservation (Chomitz, 2007; Brown et al., 2008). As such, the REDD is being promoted globally to be a win-win option with 'co-benefits'; however, whether these 'co-benefits' will materialize remains uncertain (Rawles, 2008). The co-benefits of REDD have always been part of the REDD debate (Campbell 2009). Awareness of the importance of social issues has been growing (Smith and Scherr 2002), yet many commentators are already raising concerns that insufficient attention has been given to the possible socioeconomic implications for the communities who live in and depend upon the forests that REDD initiatives are trying to conserve (Peskett et al., 2006; IUCN, 2007; Griffiths, 2007; Peskette et al., 2008). Others argue that REDD could make poverty worse, deplete biodiversity even further (Hall, 2008), infringe upon the rights of indigenous peoples and forest-dependent communities, and undermining customary land tenure as more powerful actors seek to gain control over forests (Brown et al., 2008; Okereke and Dooley, 2010; Greenpeace International, 2008). Therefore, the results presented in this study are an attempt to better understanding of the earlier impact of the REDD on the local community's access to forest resources and general income. Two problems were examined in this study: i) What have been the preliminary livelihood implications of the forest conservation under REDD, with a focus on socioeconomic assets (income, land, and agricultural products), and ii); To what extent the local people are involved in the REDD initiatives both at the local and national level, with a large focus on participation and benefit sharing. To answer these questions, a case study of a REDD project was selected from the five projects that have actually been implemented in Madagascar.

REDD development in Madagascar

Before the creation of REDD, the concept of forest carbon projects emerged in Madagascar in 2003. During the 2003 world conference on PAs organized by the International Union for Conservation of Nature (IUCN) in Durban, South Africa, the government of Madagascar pledged to increase its PAs from 1.7 million hectare (M ha) in 2003 to 6 M ha within six years; this was achieved in 2008 (Green synergy, 2009) and expanded to 7.2 M ha in 2010 (SAPM, 2010). Large parts of the new PAs served as carbon sinks to mitigate the effects of climate change. During the thirteenth session of the Conference of the Parties of the UNFCCC (COP 13), held in Bali in 2007, followed by the COP 14 in Poznan, the REDD was recognized as a valid mechanism in the fight against climate change. Thereafter, several government funds were established to support the REDD activities, such as the Australian Forest and Climate Initiative, the Norwegian Government's fund, and the United Nations REDD program. The World Bank has recently initiated its Forest Carbon Partnership Facility (FCPF). Madagascar is among the beneficiaries of the FCPF to implement and prepare for REDD. Hence, funds from the commercialization of sequestered carbon from the forests through the REDD mechanism are timely for the management of these new PAs in the country (Green Synergy, 2009).

The World Bank identified the REDD to be a top priority in terms of forest conservation strategy in Madagascar (Green Synergy, 2009). Several initiatives were taken by the government and non-governmental organizations (NGOs) to implement the REDD at the national and local levels. In December 2010, five REDD pilots projects were officially implemented within 1.7 M ha in Madagascar; two of these projects, called "readiness projects," focused mainly on the methodological issues of REDD in approximately 0.8 M ha, and the other three, called "demonstration projects," sought to produce carbon credits through voluntary emission reduction mechanisms in approximately 0.9 M ha. The case study described here was selected from the demonstration projects. The government of Madagascar has deplored considerable efforts to combat deforestation through the implementation of these five REDDS projects, which makes the country a good model for ground operations. Therefore, Madagascar is among the most advanced countries in the African region in terms of REDD implementation and development processes (Johns and Johnson, 2009).

The main strategy used for the forest conservation in Madagascar is the decentralization of forest management. It began in 1996 through the launch of a policy known as secured local management ("Gestion Locale Securisee": GELOSE). The main goal of the policy was to transfer a portion of the natural resource management to local people. A policy particular to forest management, called contracted forest management, was amended in 2000. From these two policies, the management of some parts of the PAs was transferred to the local communities, which were organized as groups of households known as local communities ("Communaute de Base": COBA). One COBA is mainly composed of households that have the same interests concerning land use and tenure. The households are not necessarily related, but they share a given forest area under usus fructus rights or customary rights. One COBA is usually composed of 50 to 600 households, depending on the number of households that are using the same area. The COBA were implemented mainly for conservation and development purposes. They represent forest management units at the local level, and part of the

PA is transferred to them through a forest management contract established between the COBA, the forest administration, and the project developer. The communities participated directly in conservation activities such as; fire control, patrolling, ecological monitoring, and restoration. Therefore, community forest management has been identified as the building block for REDD in Madagascar (Ferguson 2009).

The management of the PA under REDD is based on the forest zoning policy. In general, each PA is categorized into three zones; a restricted zone for conservation, also known as the hard core, from where the carbon credit is targeted to be sequestered; the controlled inhabited zone, which is located inside the restricted zone, but includes the households that were already in place before the area was designated as hard core; and finally the zone for sustainable use, where the local people have access. According to the regulation established in the forest management contract mentioned above, access and resource extraction are prohibited within the hard core. The local community itself adopts such regulations, but the government representative at the local level validates the rules included in the management contract, and a violation of this regulation results in severe penalties from the local community through payment of a penalty fee. If the local community cannot handle a violation, the government representative at the local level takes responsibility according to the existing law. In the controlled inhabited zone, it is prohibited to extend cultivated land after the implementation of the PA. In the sustainable use zone, a community member can extract forest resources under permits from the community. The permits define a limited quantity for each resource. For example, the extraction of yams cannot exceed 10 kg per week per family.

MATERIALS AND METHODS

Description of the study site

This study was conducted in the CAZ REDD project, located between longitudes 48°15'E and 49°15'E, and latitudes 19°15'S and 17°20S, in the eastern part of Madagascar. The PA stretches over 425,000 ha and is home to 315,000 mainly rural inhabitants living within one hundred villages grouped into thirty communes (CI Madagascar, 2008). The traditional agricultural practice is slash and burn, known as "tavy," which means that after the primary forest or secondary vegetation is cut and burned, two seasonal crops (for example, rice and sweet potatoes) are cultivated, and after each harvest, the area is left fallow (Kiener, 1963; Vicariot, 1970; Styger, 2004, 2007). A large part of this PA was newly created with the expectation of fulfilling the government's promises during the IUCN congress in Durban to triple the extent of PAs. The government of Madagascar, with technical assistance from Conservation International (CI) and financial support from the World Bank through its Forest Carbon Partnership Facility (FCPF), cooperated to conserve the forest in this area using the REDD mechanism. After monitoring the forest carbon content of the area, 10,000,000 tons of CO_2 emissions will be avoided over a 30-year crediting period (2005-2035), with the goal of reducing CO_2 emissions by 4,000,000 by 2017 (CI, 2008). The stakeholders involved in the management of the PAs are composed of the Ministry of the Environment and Forest (MEF), Conservation International (CI) with its partners, and the local community. As legal owner of the forest, the state (and therefore its ministry) owns the full rights over the forest and the carbon. The main role of the forest administration is to ensure the development of a legal framework and project implementation, and to evaluate and control the effectiveness of the PA management. The second stakeholder is CI, which ensures the financial and technical support for the PA management and partially contributes to enhancing the local community's livelihood. The third stakeholder is the local communities, organized as groups of households or COBA as mentioned earlier.

Sampling frame

From the one hundred villages surrounding the CAZ PA, 9 villages (3 inside the forest, 3 in the adjacent part, and 3 outside the forest) were selected, which comprised the Didy commune. Within these 9 villages, 1100 households were registered with the commune board (commune census 2008); from this, 118 households (10.72% of the total households in the villages) were stratified and randomly selected for this study. A household was considered to be a family of people who lived in one homestead, shared the same food, and were registered under one name with the village local administrative unit (Obua, 1998). The selections of the 118 households were based on two criteria: proximity to the forest and wealth stratum. The inhabitants of the forest were classified into three categories based on proximity: i): Those who live inside the forest area, mainly composed of the natives of the region; ii): Those who live in the immediate proximity of the forest, composed mainly of a mixture of native people and former immigrants (> 20 years prior), and (iii): those who live outside the forest, who are mainly recent immigrants (< 20 years prior). Table 1 shows the repartition of the interviewed households within the three areas.

The local community in this area has its own custom-based criteria of household affluence, which is mainly related to landholding, amount of rice harvested within a cropping year, and direct monetary income. According to these criteria, the selected households were classified on a scale of three levels of affluence; A: rich, B: medium, and C: poor. The poor households were those that were landless or had less than 2 ha, had less agricultural product, and had an insignificant source of other revenue; the medium households were those that possessed between 2 and 4 ha; and the rich were those that owned more than 4 ha of agricultural land and had other considerable income sources, such as trade or salary from NGOs or government organizations. The socioeconomic characteristics of the households are illustrated in Table 1, and the principal characteristic considered is highlighted in the table.

Research framework and questionnaire administration

The data collected during a survey conducted in July and September 2010 was analyzed using the household livelihood framework developed by (Chambers and Conway, 1991) (Figure 1). According to this framework, a livelihood comprises of the capabilities, assets (stores, resources, claims, and access) and activities required for a means of living; it is sustainable and can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and it contributes net benefits to other livelihoods at the local and global levels over short and long term periods. The term 'livelihood' here refers to the capabilities and assets that the households have at their disposal to cope with the change caused by the conservation policy and strategy within the

Table 1. Socioeconomic characteristics of households and their distribution according to their proximity to the forest (n = 118).

Socioeconomic criteria	Inside n = 66 (55.94%)	Adjacent n = 37 (22.88%)	Outside n = 35 (21.18%)
Monthly income Ariary(Ar)			
< 150,000	59	3	05
150,000-200,000	07	12	10
> 200,000	0	12	10
Ethnic category			
Native	38	5	3
Longtime migrants	22	14	7
Newly migrant	06	8	15
Literacy			
No formal education	24	4	4
Primary school	37	17	17
Junior high school	3	5	3
High school	2	1	1
Wealth category			
Poor	56	3	3
Medium	9	11	13
Wealthy	1	13	9
Land ownership(ha)			
< 2	5	21	1
2-3	24	2	1
3.1-4	32	4	6
> 4	5	21	17
Rice production (kg)			
< 1500	12	1	1
1500-2500	34	2	4
2501-3500	15	4	2
3501-4500	4	14	7
> 4500	1	6	11

1USD = 2000 Ariary.

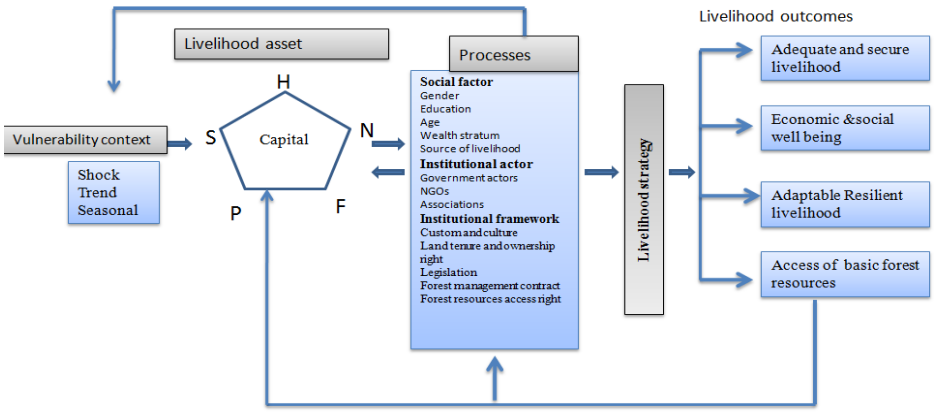

Figure 1. The sustainable livelihood framework adapted from Chambers and Conway (1992).

REDD project. The framework is illustrated explicitly in Figure 1. The forest resources considered were those frequently harvested or gathered by the local people in the case study, including timber, honey, eel, mine products, and yams.

The forest conservation income is characterized by the remuneration from patrolling and ecological monitoring activities and was comprised of approximately 10,000 Ariary (approximately US $ 5) every 3 or 4 months. The wage labor included daily wages from agricultural activities or from infrastructure construction as well as other income from mining activities, such as gold and nickel exploration. The five-year time-frame (2005 to 2010) was chosen to analyze the variation in household income and the forest resource access because this area received temporary status as a PA in 2005. Therefore, this period of time could potentially show any impacts that the change of management and regulation introduced may have had on the households' livelihood.

Direct interviews and questionnaire surveys were used in the data collection. The survey questionnaires were designed to illuminate the trends within livelihood assets after the implementation of the project, and closed-ended questions were used to determine the involvement and participation level of local people within the project. Therefore, the questionnaires were designed to be closed-ended. The open-ended interviews were conducted by government and NGO representatives involved in the REDD implementation in order to understand the actual state of the REDD implementation in the country and to investigate the dimension of the local community in the entire REDD implementation at the national level. Interviews were then organized at the local level to investigate the historical and socioeconomic background of the community in the area using open-ended questions. For this purpose, twenty key informants were selected for this research, including local leaders, mayors, village leaders, and community council members. These community leaders were considered to have more knowledge about the socioeconomic characteristics of the community as well as a higher awareness of the forest management issues. The results collected from the interviews were used to triangulate the information provided by the respondents from the household survey.

Method for data analysis

Answers recorded from the survey questionnaires were coded and entered for statistical analysis using SPSS (version 17.0; IBM, USA). Chi-square tests were performed to test the relationship between household dependency on the forest and their demographic and socioeconomic characteristics. Two types of variable were selected: (i) the socioeconomic factors, namely income, land ownership, rice production, and proximity from the forest; and (ii) the quantity of forest products harvested or consumed by the household for each category. The chi-square test was also used to test the relationship between household distance from the forest and their level of awareness regarding the project. In addition, it was also used to test the relationship between the household distance from the forest and their level of participation within the project.

RESULTS

The households' sources of livelihood

Agriculture is the main livelihood type for all households in the study area; however, as illustrated in Table 2, the characteristics of the households' livelihood source varied according to their proximity to the forest: the closer to the forest the households were, the lower their income from agriculture and the stronger their dependency on forest resources. The communities residing inside the forest had the lowest agricultural production and highest harvest of forest resources. Their agricultural production accounted for approximately 68.8% of their total income (Table 2). Rice was the principal agricultural product, and the average annual rice production was 1650 kg per household. Rice production represented 58.6% of the total income, while other crops represented 10.2%. The other livelihood source came from the forest resources (23.1%), and daily wages accounted for 4.8% of the total income. Compared to the first group, the two other groups held a wider area of agricultural land and harvested more agricultural products. The agricultural products for the group living in the area adjacent to the forest contributed to 72.5% of their total income. The household's rice production ranged from 2,500 to 4,000 kg. As for other crops, households mainly cultivated beans, ginger, and cassava. Fifty percent of the households from this group produced more crops than they needed, and therefore they sold part of their production. The income generated by trading activities represents 6.5% of the total income of the household in this group. Direct resources from the forest were insignificant to their livelihood (Table 2).

The group living outside the forest areas was the wealthiest, and their agricultural products represented 80.5% of their total livelihood. In 75% of the household's studied from this group, the household's agricultural productions largely exceeded the household's need. Their income from trade represented 8.1% of the total income. Regardless of the wealth stratum or proximity to the forest, household's were selected on a monthly basis to conduct forest patrolling; most household's sent the head of household or the eldest son. For this work, the households receive remuneration, which represented 2.7% of annual income of the first group, 1.7% for the second group, and 0.1% for the third group.

Use of forest resources by local people

The importance of forest resource consumption is well demonstrated in many studies, such as Banana and Turiho-Habwe (1997), Byron and Arnold (1999), and recent publications by CIFOR and the IUCN (1998). Those publications investigated the significance of the forest resources on sustaining a forest community's livelihood need. In this study, there were five main resources that the households gathered from the forest: yams (*Dioscoreaceae*), honey, eel, metal (gold and nickel), and timber for both furniture and fuel.

Two-thirds of the households interviewed used forest resources for their livelihood, but the need and the importance of the forest resources to the livelihood varied largely from one group to another according to the basic socioeconomic factors (Table 3) and the household's

Table 2. Livelihood source of households.

Household location	Percentage of livelihood source											
	Agriculture			Forest					Wage labor			Annual income(Ariary)
	Rice	Crops	Farm	Wood	charcoal	Honey	Eel	Yam	Conservation	Mining	Trade	
Inside	58.6	10.2	4.1	5.7	3.6	3.1	3.8	4.8	2.7	2.1	1.3	1,080,000
Adjacent	61.3	11.2	4.9	3.1	3.5	2.9	1.3	2.5	1.7	1.1	6.5	1,960,000
Outside	70.2	13.0	6.2	1.6	0.7	0.1	0.0	0.1	0.01	0.0	8.1	2,205,000

1USD = 2000 Ariary.

Table 3. Relationship between demographic, socioeconomic factors, and forest resource use in the study area.

Demographic and socio-eco factor	Forest resource	χ^2	df	Probability	Significance
Ethnic background	Yam	32.09	4	0.002	***
	Honey	8.64	6	0.08	ns
	Eel	27.37	4	0.04	**
	Timber	10.84	6	0.09	ns
	Forest land	32.46	4	0.002	***
Distance from forest	Yam	34.28	6	0.001	***
	Honey	22.36	4	0.05	**
	Eel	26.72	6	0.02	***
	Timber	10.63	6	0.07	ns
	Forest land	36.59	4	0.003	***
Land ownership	Yam	16.83	4	0.002	***
	Honey	9.34	6	0.12	ns
	Timber	6.74	4	0.07	ns
	Forest land	5.56	6	0.10	ns
Income	Yam	32.67	6	0.004	***
	Honey	14.23	4	0.06	ns
	Eel	31.46	6	0.005	***
	Timber	26.84	4	0.03	**
	Forest land	10.46	6	0.09	ns

Table 3. Contd.

Educational level	Yam	34.66	4	0.008	***
	Honey	11.26	4	0.12	ns
	Timber	5.74	6	0.15	ns
	Forest land	26.88	4	0.04	***

Ns = not significant, *significant at p 0.05, ** significant at p at p 0.01, *** at p < 0.001.

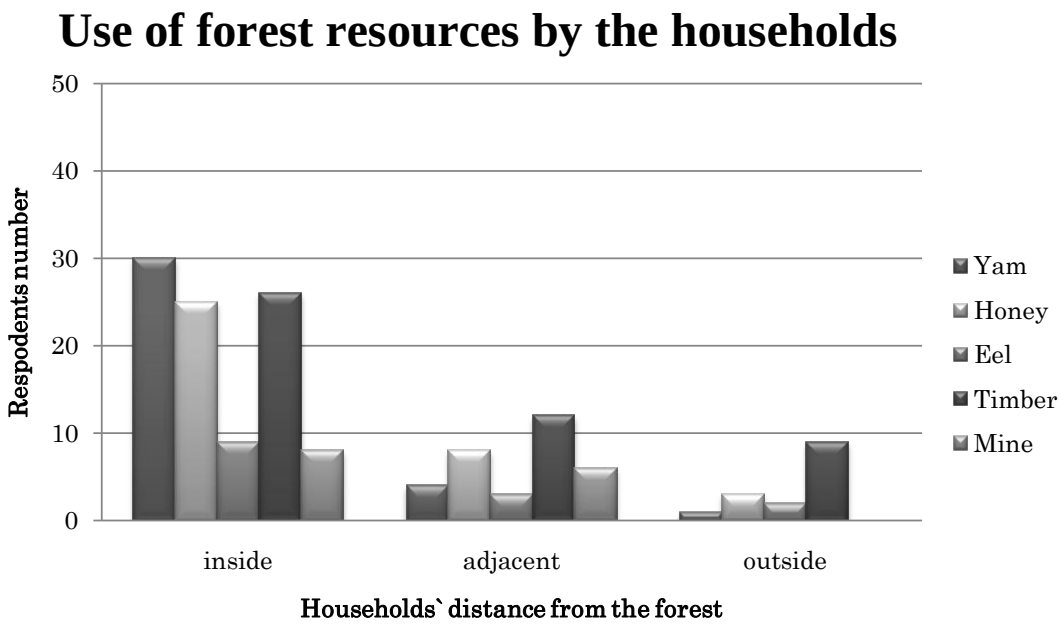

Figure 2. The main forest product used by households as for 2010.

distance from the forest (Figure 2). The first group, those living inside the forest, was the most dependent on forest resources. To fill the gap between the household need and the agricultural production, the households belonging to this group had to collect yams. Depending on the number of people in the household, one household living inside the forest harvested approximately 8 kg of yams per week. In addition, they had to find other sources of livelihood, such as daily wages and the sale of forest resources, including honey, eel, and yams (Table 3). Mining activities represented a considerable source of income for the local people in this area; however, with the introduction of new conservation rules, such activity became prohibited inside the forest area (the hard core), although it was still allowed within the sustainable use zone. Hence, some of

Table 4. Comparison of the forest resource` s percentage in the livelihood mean before (2005) and after the implementation of the PA (2010).

Household location	Percentage of income from forest						Average annual income
	Yam	Honey	Timber	Charcoal	Eel	Mining	
Inside pre-PA	6.2	4.1	10.7	4.6	4.8	10.5	1,479,600
Inside post PA	4.8	3.1	5.7	3.6	3.8	2.1	1,080,000
Adjacent pre-PA	4.2	3.9	6.1	4.5	2.4	7.1	2,411,200
Adjacent post PA	2.5	2.9	3.1	3.5	1.3	1.1	1,960,000
outside pre-PA	0.0	0.1	2.2	2.5	0.0	10.0	2,883,850
outside post-PA	0.1	0.5	1.2	0.7	0.0	0.0	2,405,000

1USD = 2000 Ariary.

the people living inside the forest were still able to mine. The income from this activity represented 2.1% of the total income for this group. In total, the resources from the forest represented 23.1% of the total income of the households living inside the forest.

The second group was somewhat dependent on resources from forests. Compared to the first group, their dependency on primary resources was less pronounced and accounted for 14.4% of the total income. One household from this group gathered approximately 4 kg of yams per week during the lean period. They also gathered other resources, such as eel and honey, essentially for commercial purpose. The third group was only slightly dependent on forest resources (2.5% of total income); they mainly used hard wood for house construction and furniture fabrication, and firewood for cooking.

Effect of the forest conservation system to the local people's livelihood

The initial impact that the project has had on household livelihood varied largely among community members. In terms of forest resource access, prior to the PA status, the forests had been functioning as an open access resource (Skutsch and Murdyiarso., 2006). With the commitment to avoid deforestation and forest degradation, new management systems and new rules were introduced. The new management systems were driven essentially by forest zoning. At the field level, the PA was divided into three zones: the strict conservation zone (50-70% of the total area), the controlled inhabited zone (5 to 10% of the total area), and the zone for sustainable use (20 to 30% of the total area). With the implementation of the forest zoning, the areas that could be accessed by local people decreased considerably. In addition, local communities were mandated to implement rules regarding the use of forest resources, such as a limitation on the amount and type of resources that could be harvested within a certain period, and a payment or fee for resource gathering. Before the implementation of the forest conservation rules, the income from the forest contributed to 40.9% of the general income for households located inside the forest. One of the most tangible changes was the reduction in income from mining and extraction activities. Before the implementation of the current forest conservation measure, the income from such activities accounted for 10.5% of total household livelihood for those communities living inside the forest (Table 4); by 2010, it only accounted for 2.1% of total household livelihood. Another large change was the reduction in income from timber extraction activities. Either by working for logging companies or extracting it themselves, timber extraction activities represented 10.7% of the total income of the same group before the implementation of the new rules. After the new conservation measure was introduced, such activities became highly restricted, resulting in the limitation of logging activities to only those necessary for the household itself and representing only 5.7% of the total income. However, the extraction fee imposed by the local management committee was still required for logging operations to proceed, even if they were for personal use. The forest management committee at the ground level fixed the amount of this fee. For the households living in the adjacent area, the income from the forest resources contributed to 28.2% of the annual income but fell to 14.4% in 2010. As for the households that were located in the immediate proximity of the forest, the forest resource-related activities accounted for 14.8% of the total income, mainly from mining and forest logging businesses. In 2010, the income from the forest resources represented only 2.5% of the total income for this group. As a general result, there was an average reduction of 18.38% of general income within the surveyed households; the trend of the households' income from the forest and the trend of the households' general income are illustrated in Figures 3 and 4.

As previously shown, people that are only slightly dependent on forest resources are those living outside the forest, and are mostly small restaurant owners, butchers, bar keepers, and store owners. During the interviews, these individuals claimed a considerable

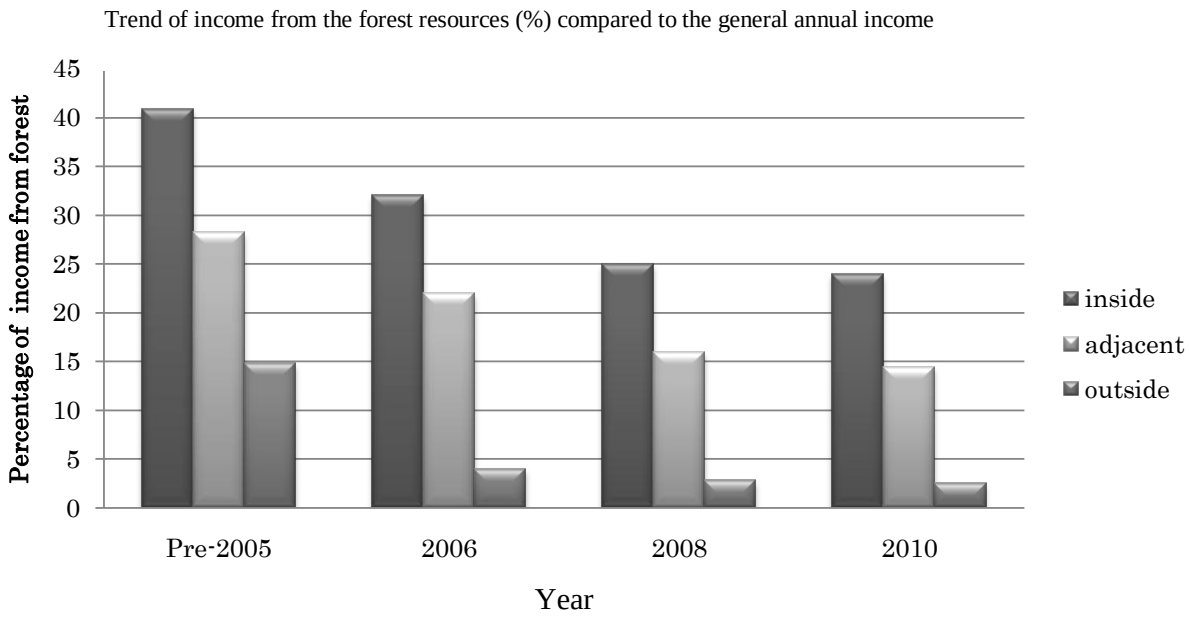

Figure 3. The trend of the percentage of forest resources within the household`s annual income prior to the implementation of PA (2005) and 2010.

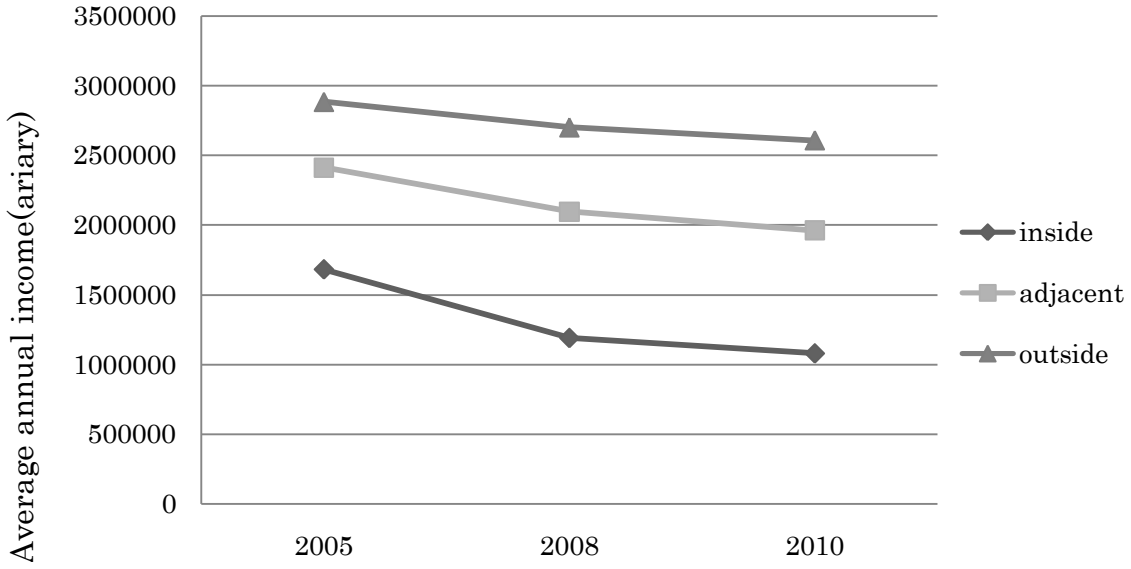

Figure 4. The trend of the households' general income (1USD = 2000 Ariary).

reduction of their income from trade and business because the number of customers had significantly decreased since the restriction of mining and logging activities inside the forest. Figure 3 illustrates how the access to these resources decreased after the implementation of restriction measures within the PA. As a compensation measure, the project developer implemented income-generating activities. These allowed the local people who were managing the forest to enhance development projects in order to compensate the losses that the restriction measures induced. One example of this was the awarding of grants to each local community group to implement an income-generating activity, such as fish farming, pig breeding, or training to improve agricultural production. In fact, the implemented alternative activities did not generate the expected flow of resources that would compensate communities for the foregone benefits from not using the forests. The

Table 5. Relationship between the distance from forest and household involvement in the project (n = 118).

Statements samples	Inside		Adjacent		Outside		Chi square test			Significance
	Yes	No	Yes	No	Yes	No	X^2	df	p	
Awareness of the forest conservation project	44	22	22	5	14	11	5.948	2	0.13	ns
Awareness of forest resources access rules	43	23	20	7	12	13	6.423	4	0.14	ns
Participation in a specific conservation activities	52	14	3	24	5	20	12.423	4	0,02	*
Reception of remuneration or benefit from the forest conservation project	56	10	17	10	16	19	4.325	2	0.347	ns
Awareness about the "REDD "or forest carbon"	4	62	2	25	7	18	0.375	4	0.98	ns

ns=not significant, *significant at p 0.05, ** significant at p at p 0.01, *** at p < 0.001.

agricultural production increased considerably over the 5 years of analysis, but tangible effects on the income or the general livelihood of the community members were not yet perceptible.

As for individual or household compensation measures, the direct remuneration was still limited to patrolling activity and ecological monitoring. For this, each household received 10,000 are (5 US$) every three or four months; which still did not cover their losses due to the restrictions on forest resource access.

Local involvement in the REDD implementation at national and local levels

For all of the REDD projects currently implemented in Madagascar, the management of some portions of the PA was transferred to the local people. The community analyzed in this study managed 15,600 ha of forest within the PA. In total, 74% of the interviewed households were well aware of the existence of the PA in their surroundings, and 67.79% participated in the consultation process concerning the implementation of the PA at the local level. However, only 12% were aware of the carbon sequestration issues of the forest that they were protecting (Table 5), who were generally members of the management committee of the PA, public workers, or local NGO employees who were simply qualified as elite at the local level. At the national level, one representative from the local communities in the selected sites attended the regional consultation regarding the REDD but did not understand the process, how the communities would take part in the carbon sequestration project, or how they would be compensated.

In this study, staffs from the Ministry of the Environment and Forest and the project developer were interviewed about the exclusion of local communities from the consultation process of REDD at the regional and national levels. Eighty percent of those interviewed claimed that the local communities had a weak capacity to understand the long-term views of the forest conservation under REDD. In addition, they argued that since the REDD project was still a very new concept in its early stages, informing the local people about the REDD would create high expectations of monetary flow or development projects, so it was better not to disclose the information until the REDD framework was finalized. As such, despite rhetoric of local empowerment to make decisions about forest management, the governance arrangement was substantially controlled (Daniela, 2007). Forty-nine percent of the total households interviewed participated in the community activities, such as ecology monitoring, patrolling inside the forest, and forest restoration as part of management activities. The participation of households living inside the forest was significantly higher compared to the others (p = 0.02). Nevertheless, apart from the direct remuneration from forest patrolling and ecological monitoring activities, all households had the same rights regarding the reception of benefits or any other compensation measures (Table 5, p = 0.347) regardless of their distance from the forest and socioeconomic condition. This situation generated conflict amongst the local people, since those living inside the forest endured a greater cost to their livelihood in order to make the forest conservation a reality.

DISCUSSION

Challenges to making REDD a reality in the field

The combination of forest conservation with the enhancement of local livelihood is a permanent challenging aspect in forest conservation. This is even more challenging when a protected area is committed to carbon sequestration issues, as in the case of REDD. Forest-related incomes are vital economic buffers, particularly for women, children, and the poorest households in village communities (Byron and Arnold, 1999), and the local communities, in many cases, have a tradition of living off of the forest resources around their communities. If access to these lands is restricted in some way, projects must address the economic needs of communities to avoid negative impacts on the community and to minimize the risk that local people will have an impact on the project's forests carbon sequestration, which may result in the displacement of emission (Brown et al., 2000). It is already well accepted that the percentage

of poor households tends to be higher in remote areas where forests are often located (Pfaff et al., 2007). In this study, it has been demonstrated that the people who are closest to the forest are the poorest and are also the most affected by the project. The type of effort and the level of sacrifice that each group made for the forest conservation project were considerably different. Those that are close to the forest had more obligation and engagement to look after the forest compared to those in the adjacent part. In addition, the livelihoods of those closest to the forest were the most affected by the implementation of the project, since they relied considerably on the forest resources before the implementation of the project. Therefore, if such issues are not considered while designing the incentive and benefit sharing policies under REDD, the socioeconomically disadvantaged people will always be left behind.

Some economists have argued that the conservation of forested ecosystems in the tropics will be difficult unless people are compensated entirely for the environmental services they provide (Pearce et al., 1998). For this case study, improving the livelihood of local people was at the same priority level as carbon sequestration and biodiversity conservation. However, at the time the present research was conducted in the field, compensation measures were far from recovering the losses, especially for the poorest people who depend on the forest. The fact that the forest carbon project will significantly reduce the availability of forest resources for indigenous and forest dependent communities was mentioned in the declaration of the First International Forum of Indigenous Peoples on Climate Change in 2000; the results shown in this paper only emphasized this concern. However, this case study is still in its early stages and is too early to provide a definitive conclusion on this matter. The situation may get better if the actions implemented in the field can fulfill the objectives and the work plan established in the project management plan.

Readiness of local people to make REDD successful in the field

It has been almost twenty years since the development of the decentralization of forest management through the transfer of management to the local people; however, the resources and incentives to allow these people to manage the forest sustainably are apparently missing. In this case study, we found that some power was transferred to the local community through the management transfer of the PA according to the management contract, where the local community shares power with the forest administration and the project developer regarding forest management. However, resources and participation in the decision making process seems to be absent at the local level, which is characterized by the lack of compensation and incentive measures as well as participation and awareness of REDD implementation and forest carbon issues. A broader involvement of local community members in the design, implementation, and evaluation of forest carbon projects (May, 2004) brings numerous advantages, such as; recognition of the legitimate rights of the local people over the resources, better communication and relations between the community and government, and improvement of community managerial capacities (Shackleton et al., 2002). A lack of knowledge is often the main reason for not including the local community in the decision-making process cycle. In order to protect the rights of these people, their inclusion in the decision-making process is imperative, and active reinforcement of their capacity building is necessary. Nonetheless, the compensation or incentive measures to be implemented should be determined consensually. For this case study, diverse compensation measures, such as new agricultural production systems and income-generating activities, were provided to community members, but previously planned benefits do not appear to have reached them. The households perceive the lack of income or assets as a result of the loss or reduction of forest access, and therefore they tend to be reluctant to actively participate in the reduction of deforestation and forest degradation within their surroundings.

The emergence of REDD and other forest carbon enhancement projects has created a need for more power and resources in order for local communities to maintain those forests and protect them from possible destruction or degradation. To reduce deforestation and forest degradation, the enforcement of laws at the national level or introduction of new rules on forest use and access rights at the local level is compulsory. Nevertheless, law enforcement alone does not contribute enough to forest conservation; the participation of the local people in the design and implementation of such measures is a prerequisite to achieve fair and equitable compensation measures.

The dimension of equity in benefit-sharing within heterogeneous forest user groups

It is already recognized that incentive mechanisms such as REDD can substantially increase benefit flows to forest managers, including the local community (Agrawal et al., 2009). It is argued by Peskett et al. (2008) and Griffiths (2008) that equitable benefit sharing is a fundamental condition for REDD to work effectively. Importantly, equity is recognized as a key element when designing and implementing a benefit sharing mechanism for schemes like REDD (Pagiola and Platais 2007; Peskett et al 2008; Grieg-Gran, in press). The equity discussed in this study is related to a fair share of the relevant costs and benefits of conservation and to the opportunity of participating in decision-making on the basis of entitlements and rights. Although a concern has

been raised about the impact of benefit sharing on the effectiveness of REDD (Luttrell et al., 2007; Johns et al., 2009; Agrawal et al., 2009), scholars have been unable to reach agreement on how benefit sharing should be made more equitable. At the local level, a central premise of equity in benefit sharing is that local communities should not have to assume a disproportionate amount of the costs for establishing the protected area. In this study it was clear that poor people, which were generally those located in the core of the forest area, bear more cost of the forest conservation than the other groups (Figures 3 and 4). Before the creation of the PA, the livelihood of these individuals depended largely on the activities related to the forest; however, when the conservation activities started, the forest became more compromised than ever due to the carbon implications. The laws and regulations related to the forest resource access are enforced, and therefore the local people that depend on forest resources for their livelihood must bear the cost of losing access from those resources. The costs incurred by the households located in the adjacent section as well as outside the forest, which are discussed in this study, are largely insignificant compared to those incurred by households located inside the forest. Being wealthier, the dependency of these people on the forest and involvement in the forest protection are less pronounced as compared to those who are living inside. For example, illegal logging and forest fires occur inside the forest, and it is assumed that people living closest to the forest must bear more responsibility to control and report such situations to the community board. This can create tension between the person who reports the activity and the illegal logger. In addition, the conflict can be more serious when the illegal logger comes from the same village or a nearby one. The other two groups are only involved in fire and logging control during their patrolling activities. Despite this inequality of cost, all community members have the same access rights to the forest. These access rights are determined by the agreement between the local communities and the PA manager. Therefore, if such situations are not taken into consideration while designing the benefit-sharing system, REDD will simply emphasize the marginalization and lack of land of the poor and will increase the inequality among the local communities. It is a complicated task to practically determine and quantify all of the economic, social, and environmental costs involved in the establishment and management of a PA; however, there should be at least one policy aimed at setting up mechanisms to estimate the costs and provide the maximum compensation possible.

Conclusion

In this case study, we found that the socioeconomic characteristics of households are the determining factor of their dependency on the forest. Socioeconomically disadvantaged individuals are the most dependent on the forest, and therefore they are the most affected by the introduction of restrictive measures intended to avoid deforestation and forest degradation. Although compensation and incentive measures are implemented, they are not enough to recover the losses induced by the restrictive measures. In addition, despite the different levels of cost of the forest conservation measure on local people, all groups receive the same incentives and compensation. If this approach continues, there is a risk of the project creating conflicts among the local community members and cementing the elite's power at the local level. We found that the local community in the study area were still unaware of the REDD issues, and only the elite individuals of the communities at the ground level were aware of the REDD or the forest carbon. As such, the full inclusion of the local communities within the REDD implementation and design is still one of the most challenging tasks for the REDD in Madagascar. Full consideration and consultation of these local communities will create more incentives and responsibility to protect the forest. The project in this case study is still in the early stages, and therefore there is still adequate time to build a REDD mechanism that works for forest-dependent communities.

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