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Developing a sustainable financing of protected areas: watershed-based payment for ecosystems services in Madagascar

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Acronyms

ANDEA	National Water and Sanitation Authority
CI	Conservation International
ERI	Eco-Regional Initiatives
ES	Environmental Service
IAD	Institutional Analysis and Development framework
ICTE	International
IFD	International Development Fund
MNP	Madagascar National Park
NGO	Non-Governmental Organization
PES	Payment for Ecosystem Services
PSDR	Rural Development Support Project (Projet de Soutien au Développement Rural)
PWS	Payment for Watershed Services
RNP	Ranomafana National Park
USAID	United States Agency for International Development
WCS	Wildlife Conservation Society
WTA	Willingness-to-accept
WTP	Willingness-to-pay
WWF	World Wildlife Fund

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Summary

In order to address its severe environmental degradation, the government of Madagascar adopted the creation of protected areas as the most important conservation strategies. According to the Foundation of protected areas, Madagascar has about 108 protected areas for a total cover of about 6 million ha. Although this strategy has helped to slow deforestation, protected areas are still under pressures from the surrounding communities.

Slash-and-burn agriculture is the primary cause of deforestation around protected areas. However, persuading farmers to abandon slash-and-burn has remained challenging over the years. Farmers living in the peripheral zone of a protected area are already compensated by receiving 50% of the park entrance fees through ecotourism, but this is insufficient to eliminate all pressures.

In addition, the national park service, called Madagascar National Park, is highly dependent on foreign aid and faces a financial gap to manage effectively the national park network. However, the USAID Bureau for Africa pointed out in its report after the political coup in 2009 that the scarcity of resources might lead donors to re-think about their priorities and invest in more urgent issues or other countries where their investments have more chance to bear fruits.

Therefore, it is more than ever urgent to develop a more cost-effective way to tackle the persistent threat from slash-and-burn agriculture on protected areas and seek a financial sustainability if it is to save and protect the remaining and highly threatened biodiversity and forests.

In this perspective, Payments for Ecosystems Services (or PES) were proposed by academics in 1995 as a possibly more cost-effective way of meeting rural needs around protected area compared to traditional and indirect conservation policy tools (Ferraro, 2001; Wendland, K.J., et al., 2009; Wunder, 2005; Pagiola et al., 2005). In fact, such direct payment is specifically targeted at project outcomes which will defray the costs of managing protected areas by strengthening the links between local communities' well-being, their actions and habitat conservation (Dudley, N. and Stolton, S., 2003, Ferraro, 2001).

Despite its promising potential to address more efficiently and effectively environmental issues, PES is still at its nascent phase in African countries due to certain barriers which hinder its development.

This research aims at assessing the potential of payment for ecosystem services as a sustainable financial tool for environmental conservation and poverty alleviation in Madagascar, and, at designing a payment scheme adapted to the local context. There are different types of ecosystems services but our research focus is on watershed-based services of forests for the following reasons:

- ♦ Payment for watershed-based services (or PWS) is rare in the country as all initiatives remain at the planning stage due to multiple barriers hindering their

development (Ferraro, 2009).

- ◆ PWS have deserved less attention compared to carbon services. In contrast with carbon services, markets for watershed services are largely unexplored.
- ◆ Due to time and resources constraints, assessing a payment for watershed services is more feasible technically since it has a local setting.

The Ranomafana National Park was chosen as a case study. Data were collected from existing publications and a fieldwork conducted in Madagascar from September to mid-October 2010. The fieldwork objectives were to understand the situation on the ground and interview key stakeholders to the development of the PWS mechanism, ranging from public to private institutions and individuals.

Based on a holistic analysis, it is concluded that a PWS mechanism can be put in place in Ranomafana for the following reasons:

- (a). The demand for the watershed services is clear and financially valuable to a potential buyer, namely the existing hydroelectric company
- (b). The provision of this watershed service is threatened by slash-and-burn practices, but abandoning this unsustainable land use has the potential to address the problem.
- (c). NGOs are active in the Ranomafana region and can serve as intermediaries to assist the villagers and the potential buyer in developing negotiations and sharing expertise on PES
- (d). Villagers have a clear land title
- (e). Existing policies and laws do not forbid the market-based mechanism under a PES scheme.

Two possible PWS scenarios could be suggested: (1) The PWS scheme is integrated with the National Fund for Water Resources or (2) the hydroelectric company could directly pay upland farmers.

Keywords: payment for ecosystems services, watershed services, slash-and-burn, financial sustainability, protected area, willingness-to-accept

INTRODUCTION

Background: Madagascar's environmental profile

Madagascar is one of the world's biodiversity hotspots as it has one of the richest but most threatened biodiversity in the world. Its flora accounts for about 12 000 species; 90% of which are endemic. 80% of its fauna, including mainly lemur, bird and reptile species, are also endemic. Since the biodiversity is mostly found in forest, losing a hectare of forest in Madagascar has more impact than anywhere else.

However, it is estimated that Madagascar has lost 80% of its original forest due to a massive deforestation soon after Madagascar's independence in 1960,. In order to address this severe environmental degradation, the government adopted the creation of protected areas as the most important conservation strategies. According to the Foundation of protected areas, Madagascar has about 108 protected areas for a total cover of about 6 million ha.

Despite of the attempts to protect the remaining forests, about 100 000 ha of forests continue to disappear every year (USAID, 2010). Slash-and-burn agriculture or "tavy" has been the primary cause of deforestation accounting for 80-95% of total forest loss (USAID, 2010). Not only slash-and-burn constitutes the traditional and predominant land use practice in Madagascar, but the fact that 80% of the population lives from subsistence agriculture exacerbates the situation. Slash-and-burn has become unsustainable due the limited fertile land and the rapid population growth which is among the highest in Africa at near 3% per year (World Bank, 2010; Styger et al. 2007). Pressures from the population growth is alarming since Madagascar had about 11 million ha of forest with 11 million people in 1990 compared to about 9 million ha of forest and 20 million people nowadays (USAID, 2010).

Persuading farmers to abandon slash-and-burn has remained challenging over the years. The Integrated Conservation and Development Program (ICDP) approach applied to protected areas has failed to significantly change farmers' behavior. In fact, the strategy based on the distribution of 50% of the protected area entrance fees to the surrounding communities to finance development activities with the hopes to persuade farmers to abandon slash-and-burn, has proven insufficient and not well-targeted (USAID, 2010).

Reducing threats on protected areas has also suffered from the lack of financial resources. The estimated financial gap would be about 2USD/ha/year giving a total annual deficit of 12 million USD with the total protected area network if considering the estimated cost of 5 USD/ha/year for an effective management of the protected area stated by Carret & Loyer (2003). In addition, Madagascar has largely depended on foreign aid to finance its environmental action plan since its independence in 1960. Most importantly, its National Environmental Action Plan (NEAP) adopted in 1989 and designed for a three 5-year phases would have been impossible without the financial support of international donors. Donors funded more than 80% of the total funding for more than 300 million USD of which about 110 million USD were granted and not loaned (Horning, 2008). This financial dependence on donors is risky and increases the vulnerability of environmental goals. There is already a strong shift from donors to

poverty alleviation at the expense of environmental issues (Lapham and Livermore, 2003 in Castro, 2003). Besides, the political turmoil in Madagascar since 2009 has led many international donors to dry up their funding which led to the collapse of park management. In addition, the USAID Bureau for Africa pointed out in its report after the political coup that the scarcity of resources might lead donors to re-think about their priorities and invest in more urgent issues or other countries where their investments have more chance to bear fruits.

Research objectives

Therefore, it is more than ever urgent to tackle the persistent threat from slash-and-burn agriculture and to develop a new and sustainable financing mechanism in order to protect the remaining forests and reduce pressures on protected areas. In this perspective, the objectives of my research are two-fold:

1. To assess the potential of payment for ecosystem services (PES) as a sustainable financial tool for environmental conservation and poverty alleviation of communities surrounding protected areas, by determining the favorable preconditions and key barriers to its development;
2. To design a payment scheme adapted to the local context.

My research focuses on Payment for Watershed Services (PWS).

Why is a PES thought to be a promising idea?

There is a set of reasons why my research focuses on a PES scheme.

PES were proposed by academics as a possibly more cost-effective way of meeting rural needs around protected area compared to traditional and indirect conservation policy tools (Ferraro, 2001; Wendland, K.J., et al., 2009; Wunder, 2005; Pagiola et al., 2005). Such a direct payment is specifically targeted at project outcomes which will defray the costs of managing protected areas by strengthening the links between local communities' well-being, their actions and habitat conservation (Dudley, N. and Stolton, S., 2003, Ferraro, 2001). By receiving directly a payment conditional to conservation performance, the local communities surrounding a protected area will have a direct incentive to voluntarily abandon their unsustainable land use practice.

PES is also considered to be more cost-effective than command-and-control approach or past incentives to conserve the environment because of its conditional compensation principle (Huang et al. 2009; Jack et al. 2008; Wunder et al. 2008). As a market-based mechanism, it can generate a new conservation funding (Wunder et al., 2008; Dillaha et al., 2007; Pagiola et al. 2002, Wendland et al. 2009) and can help to improve livelihoods (Engel et al. 2008; Wunder, 2007).

Most importantly, *“PES is a bridge between the complex dimensions of sustainability (...) because by definition, PES aims to provide incentives (i.e. the economic dimension) to preserve ecosystem services (i.e. the ecological dimension) such that they can*

continue to provide benefits to the society (i.e. the social dimension) (FAO, 2011).

However, despite its promising potential, PES mechanisms are still nascent in African countries and present different barriers to their development. Madagascar has only recently started to explore the potential of PES as a conservation mechanism for its protected areas (Wendland et al. 2009).

Why a Payment for Watershed Services?

My research interest in payment for watershed services is motivated by the following reasons:

- The unsustainable slash-and-burn agriculture has not only induced deforestation in Madagascar but it has caused increased sedimentation of rivers, lakes, wetlands and coastlines (USAID, 2008). This is alarming since water is a vital source for agriculture and thus for food security. Most importantly, as rice, the primary staple of Madagascar, requires a high amount of water, food security is therefore dependent on sound upstream watershed protection and management. In addition, increased sedimentation affects also adversely hydroelectric facilities.
- More than 20 of Madagascar`s protected areas have a hydrological function (Carret & Loyer, 2003) but the benefit from valuing economically this hydrological function has been overlooked over the years. Maintaining these protected areas will reduce the risk of sedimentation which implies to value the link between land use practices and hydrological systems.
- Payments for watershed services have deserved less attention compared to carbon services. In contrast with carbon services, markets for watershed services are largely unexplored.
- Due to time and resources constraints, assessing a payment for watershed services is more feasible technically since it has a local setting.
- No payments for watershed services exist in Madagascar as all initiatives remain at the planning stage due to multiple barriers hindering their development (Ferraro, 2009).

Thesis structure

This thesis is structured as follows. A brief literature review and theoretical perspectives on Payment for Ecosystems Services are presented in chapter 1. Then, the general methodology adopted and the study site, are described in chapter 2. An assessment of the socio-economic preconditions for the PES development is performed in chapter 3, followed by the institutional and technical capacity analysis in chapter 4. Lastly, the findings are discussed in chapter 5, where payment-models are also proposed before the conclusion.

CHAPTER 1: LITERATURE REVIEW AND THEORETICAL PERSPECTIVES ON PES

1. Literature review

Interests in developing innovative and long-term financing mechanisms for conservation have recently grown. Several studies have established an overview of potential mechanisms and described their advantages and drawbacks (Gutman, 2003; Johnson et al., 2001). Other studies reviewed the common practices and issues from existing mechanisms, and identified lessons for further implementation (Perrot-Maître & Davis, 2001; Johnson et al. 2001; Kiersch et al. 2005).

Compared to other long-term financing alternatives such as grants, local savings or funds, PES is quite a new concept and is still in an experimental stage (Dillaha et al. 2007, Wunder, 2005).

♦ *Research trends on PES on the global scale*

The theoretical literature on Payment for Ecological Services (PES) is mostly composed of elaborated guides to understand its mechanisms and design characteristics (Forest Trends, Katoomba Group, & UNEP, 2008; Engel et al. 2008; Smith et al. 2006). However, some researches seek to compare PES with other alternatives for environmental policies (Engel et al., 2008) or to analyze the dynamics between conditions for PES design with policy design and outcomes (Jack et al. 2008). The definition and key features of PES are given below (see section 2.1)

Most empirical studies on PES review practical experiences to:

- Understand its potentials and limitations in different regions of the world, such as in Latin America, in Asia and in Africa (Dillaha et al., 2007; Richards & Jenkins, 2007; Southgate et al., 2009; Huang et al., 2009; Ferraro, 2009)
- Understand its key characteristics and design elements (Asquith et al., 2008; Kosoy et al., 2007; Pierrot-Maitre & Davis, 2001)
- Analyze its impacts, mostly on poverty alleviation (Wunder, 2008; Asquith et al., 2008; Kosoy et al., 2007; Richards & Jenkins, 2007; Geoghegan, 2005) and define factors to help design pro-poor mechanisms (Grieg-Gran et al, 2005; Wunder, 2008; Rogger et al. 2004).
- Highlight the role of NGOs in PES mechanisms (Grieg-Gran et al., 2006)
- Determine factors for successful PES design (Perrot-Maître, 2006; Wunder S., 2007).

Few researches have tried to compile PES market trends, challenges, conditions and characteristics in a global scale (Landell-Mills & Porras, 2002; Johnson, et al, 2001).

The difficulty of valuing ecological services has also attracted researchers' attention since 1990s. Although the contingent valuation technique is broadly used, its application, especially in developing countries has been controversial (Portney P. R., 1994;

Whittington, 1998). However, lessons drawn from empirical studies have helped improved its performance (Whittington, 2002).

♦ *PES and poverty alleviation*

Most of the studies on the linkage between PES and poverty alleviation were conducted in Latin America as PES are mostly advanced there than in other developing countries (e.g: Costa Rica, Ecuador, Bolivia, and Brazil).

This linkage is however largely debated among researchers as it is still unclear and not systematic (Huang et al. 2009; Kosoy et al. 2007). Some authors like Engel et al. (2008) argue that a PES mechanism was initially conceptualized to improve natural resources management, which means that poverty alleviation is only a side objective. This is supported by Huang et al. (2009) who consider that poverty should not be the most important criterion for selecting PES participants as other factors such as land tenure security, the capacity to provide ecosystem services and the level of transaction costs are more substantial. Other studies concluded that trade-offs are needed between environmental service provision and poverty alleviation in order for a PES to be cost-effective (Kosoy et al., 2007; Ferraro J. , 2009).

However, most of government-financed PES programs consider poverty alleviation as a key objective (Wunder et al. 2008; Engel et al. 2008). This has triggered further researches to identify key factors for a pro-poor PES mechanism (Grieg-Gran et al, 2005; Wunder, 2008; Rogger et al. 2004). This is mostly based on a theoretical thought that the impacts of a PES mechanism on its participants are expected to be positive even though the benefits significance is unknown. In fact, PES participants are considered as rational individuals who will accept to participate to a PES scheme only if it matches their own interests (Wunder et al. 2008; Engel et al. 2008).

♦ *PES literature in Africa and Madagascar*

Despite worldwide interest in PES mechanisms, discussions of emerging PES in African countries remain rare. This stems from the fact that PES markets are the least developed in this continent. Existing literature focuses mainly on understanding the major barriers to PES development as many initiatives were abandoned.

Therefore, it is not surprising that publications on PES in Madagascar are especially very limited. Randimby et al. (2008) built an inventory of PES-like initiatives in Madagascar and provided an overview of the legislations and policies affecting PES development. In 2009, Ferraro reviewed PES schemes in Sub-Saharan Africa to assess why there are fewer PES initiatives than in Latin America. Only one carbon and biodiversity project was reported for Madagascar and there was no documented PWS scheme.

Incipient researches (Wendland et al. 2009) started to develop a spatial targeting method to bundle biodiversity conservation with carbon and water services at the national level. This study can be used as a basis for further researches at a local level. Recent studies by Sommerville et al. (2010) got onto a local context by assessing the social value of

community-based PES for biodiversity conservation, focusing essentially on the role of fairness and the impact of a PES on behavioral change.

2. Theoretical perspectives on PES

2.1. Definition and key features of PES

2.1.1. Definition

Payment for Ecosystem Services (PES) involves the sale of environmental services which are the processes through which natural ecosystems and the species they contain help sustain human life (Krebs & CSIRO, 2008).

From the perspective of a protected area, PES is a cost-effective way to reduce pressures on protected areas through a direct payment of local communities to change their land use practice (Pagiola et al. 2005; Ferraro P. J., 2001; Wendland et al. 2009; Wunder S. , 2005).

More specifically, a PWS consists in voluntary direct payments from downstream water users to upstream farmers for adopting land uses that limit soil erosion, or flooding risks, or other water quantity and quality issues (Kosoy, et al., 2007; Landell-Mills & Porras, 2002; Wunder S. , 2007).

2.1.2. PES criteria

The five most commonly-accepted criteria for PES are the following (Wunder, 2005):

1. There is a **well-defined** environmental service
2. There is at least one **buyer** of this service
3. There is at least one **seller**
4. Transactions between buyer(s) and seller(s) are **voluntary**.
5. Payments are **conditional** on provision of environmental services.

This conditionality clause is the critical feature that differentiates PES from other conservation payments (Southgate & Wunder, 2009; Engel et al., 2008).

2.1.3. Subsets of PES

There are 4 subsets of PES which are derived from 4 types of environmental services: carbon sequestration, biodiversity conservation, watershed protection and landscape beauty (Wunder S., 2005; Forest Trends, et al. 2008; Grieg-Gran et al., 2005; Wunder 2007).

The market trends and characteristics of each subset of PES are synthesized in table 1 based on the latest global review of PES schemes implemented around the world (about 300 schemes) during the past 15 years by Landell-Mills & Porras (2002).

**Table 1: Global review of market trends and characteristics of PES subsets
(Information source: Landell-Mills & Porras, 2002)**

	Biodiversity	Carbon	Watershed services	Landscape beauty
Market maturity¹	Nascent, experimental	Maturing quickly (rapid growth of participation)	Largely immature	Slow to develop, immature
Drivers	<ul style="list-style-type: none"> Public awareness of the benefits of biodiversity Threats of loss 	<ul style="list-style-type: none"> Kyoto protocol 1997 (carbon offsets) 	<ul style="list-style-type: none"> Growing willingness-to-pay amongst beneficiaries based on understanding of benefits and potential loss from threats. New regulations in developed countries 	<ul style="list-style-type: none"> Willingness-to-pay from tour operators
Constraints to market development	<ul style="list-style-type: none"> Significant transaction costs No clear identified clientele Lack of scientific evidence for biodiversity benefits 	<ul style="list-style-type: none"> International and national policy uncertainty Prohibitive transaction costs 	<ul style="list-style-type: none"> Significant transaction costs especially in developing countries: Number of stakeholders involved Weak governmental regulatory capacity Lack of reliable hydrological data Land tenure insecurity 	<ul style="list-style-type: none"> Inequity between poor land managers and powerful tour operators which resist to payments
Number of cases	72	75	61	51

¹ (Landell-Mills & Porras, 2002) used the following criteria to assess the market maturity: the time from initiation, the price discovery, the level of participation of the different stakeholders, the sophistication of payment mechanism

2.1.4. Types of PES agreements

PES agreements can be individual or collective. Contrary to individual agreements, group-based PES arrangements reduce significantly the transaction costs (Huang et al., 2009; Southgate & Wunder, 2009; Jack et al., 2008; Grieg-Gran et al., 2005) and can increase participation rate by helping the poor and weaker members of a community to join the mechanism (Huang et al., 2009). However, inequity risk or elite capture is high if payments are made in cash since powerful members will try to take more benefits (Huang et al., 2009).

2.1.5. Payments under a PES scheme

2.1.5.1. Payment source

Payments under a PES scheme may have different sources: the government, direct fees from service consumers, NGOs, or a mix of funding (Wunder et al. 2008; Jack et al. 2008).

The sources of payment will affect the characteristics of a PES scheme. Most importantly, the major differences between user-financed and government programs are that user-finance programs are better targeted in their effects, however, government-financed programs have the merit to benefit from economies of scale and thus, presenting lower transaction costs (Wunder et al. 2008; Engel et al. 2008).

2.1.5.2. Forms of payment

There are two main forms of payment: (1) cash which is the most common form of payment, and (2) in-kind compensation such as technical training, provision of seedlings or food grains, conditional land tenure, beehives (Wunder et al. 2008; Huang et al. 2009; Asquith et al. 2008; Grieg-Gran, 2005).

2.1.5.1. Periodicity of payment

It is variable from place to place. In practice, payments can be on a monthly basis (e.g: the PWS scheme in Pimampiro in Ecuador, the Program for Hydrologic Environmental Services in Mexico) or on an annual basis (e.g: the Los Negros PWS program in Bolivia).

2.1.5.1. Payments variability over time

Payments can remain the same over time or be differentiated. Unlike fixed rate payments, differentiated payments can respond more flexibly when conditions change (Wunder et al. 2008).

2.1.5.2. Conditionality of payment

In theory, payments should be contingent upon the provision of ES. However, practical experiences have shown that they are based on the adoption of new land-use promoted by the PES scheme because the level of environmental service provided is not usually

observable by PES participants (Wunder et al. 2008; Engel et al. 2008; Pagiola & Platais, 2007).

2.1.6. Criteria for PES performance

A PES design should consider at least five important aspects: compliance, permanence, additionality, the risk of leakage and perverse incentives, which are described in table 2.

Table 2: PES performance criteria
(Information source: Wunder et al. 2008; Engel et al. 2008; Wunder 2007)

Aspects	Definition
Efficiency	The difference between the environmental benefits and the costs of providing these environmental services is maximized.
Permanence	ES provision continues over time, even beyond the period of payments
Additionality	The PES induced land use change will effectively increase the ES provision
Leakage	Environmentally-damaging activities are displaced elsewhere rather than reduced
Conditionality	Payments are contingent upon delivery of environmental service

♦ PES cost components

A PES program has theoretically 3 cost components (Wunder et al. 2008; Southgate & Wunder, 2009):

- The opportunity cost or benefits lost from alternative activities
- Implementation cost related to new land use, procurement, negotiation and monitoring
- Transaction costs covering informational needs and logistical costs.

Since these costs are not observable prior to the PES implementation, payments to PES recipients are used as a reference since they are normally rational individuals who will only accept a payment that exceeds his/her total costs in order to preserve his/her own interests (Wunder et al. 2008).

2.1.7. Compliance to PES contracts

Ensuring that participants comply with their contractual agreements is possible through monitoring activities, supplemented by enforced sanctions (Wunder et al. 2008; Grieg-Gran et al. 2005). Monitoring activities may consist of site inspection or

remote-sensing satellite imagery, while sanctions may consist of a temporary or permanent loss of payments.

3. Fundamental roles of NGOs in PES development

In practice, NGOs play fundamental roles in promoting PES development:

- NGOs can support poor participants to negotiate a PES deal, especially in Asia and Africa where potential service providers in rural areas are poor, are used to top-down development projects and have a low educational level (Huang et al. 2009; Forest Trends, Katoomba Group & UNEP, 2008).
- NGOs can provide external funding to cover the high start-up costs for a PES (Asquith et al., 2008; Southgate & Wunder, 2009).
- NGOs' involvement in PES schemes may partially compensate for weak state institutions (Jack et al. 2008).

4. Review of PES initiatives in practice

Despite the rapid growth in popularity of PES among academics and policy-makers, PES markets remain nascent (Landell-Mills & Porras, 2002). PES mechanisms are still rare but they are most advanced in developed countries and in Latin America (Huang et al. 2009; Dillaha et al., 2007) and least developed in Asia and Africa (Ferraro, 2009).

Most of existing initiatives are however PES-like schemes as they fulfill most but not all of the 5 PES criteria (see section 2.1.2; Southgate & Wunder, 2009; Wunder, 2007).

4.1.1. United States and Europe

The most pronounced form of PES in the United States and Europe is agri-environmental payments which consist in paying farmers to provide environmental services through a defined management practice (Baylis et al. 2008; Vakrou, 2010). Agri-environmental payments in the US and Europe differ from their key targets. While American payments seek to reduce negative externalities of agriculture such as soil erosion (Baylis et al. 2008), European schemes aim at increasing positive externalities such as landscape beauty, cultural heritage or preservation of the countryside (Baylis et al. 2008; Vakrou, 2010). The United Kingdom was the first to launch an agri-environmental program in Europe in 1986 (Dobbs & Pretty, 2008).

The United States and Europe are also interested in carbon markets. Buyers in the voluntary carbon markets are mainly driven by corporate social responsibility and public relations (Milder & Bracer, 2010). In addition, many large public PES programs tend to purchase bundled multiple environmental services (Milder & Bracer, 2010).

4.1.2. Latin America

Latin America has more favorable conditions for PES development compared to other developing countries. It has a better land tenure security and less ideological resistance to conservation payments by legalizing the rights to commercialize land use and land management practice (Dillaha et al. 2007).

PES development is uneven in Latin America because of political and ideological differences. Ecuador and Colombia are more advanced than Venezuela, Bolivia and Peru (Southgate & Wunder, 2009; Dillaha et al. 2007).

- Costa Rica pioneered the use of PES in developing countries with its internationally-known PSA National Program established in 1997 (Landell-Mills & Porras, 2002; Dillaha et al. 2007). The PSA program has aimed at the provision of four environmental services including carbon, watershed protection, biodiversity and landscape beauty by promoting a sustainable forest management (Grieg-Gran et al. 2005).
- Ecuador has also the largest number of PES initiatives in Latin America (Dillaha et al. 2007) and its Pimampiro Municipal watershed scheme is one of the few successful PWS initiatives with all the 5 criteria.
- Venezuela, Colombia, and Bolivia have a high potential PES demand because of the common practice of charging environmental users and the rapid urbanization. However, PES implementation lags due to skepticisms from strong indigenous culture or from the closed economies (Dillaha et al., 2007).
- Mexico has the largest PES program in Latin America with its Program for Hydrologic-Environmental Services (PSA-H). The total funding almost doubled from 2003 to 2004 to reach \$30 million (Dillaha et al., 2007).

4.1.3. Asia

Action research initiatives like the Rewarding Upland Poor for the Environmental Services (RUPES) program have helped promote PWS development in Asia. Interests in PWS are more developed in Indonesia, the Philippines, India, Nepal, Vietnam, and China:

- Indonesia has the largest number of PWS initiatives in Asia but they are small in size (Huang et al. 2009). It is followed by the Philippines (Dillaha et al. 2007).
- China has the world` s largest watershed protection programs through afforestation and protection of existing forests over 7.2 million ha of land and with 13 million contracting households in 2003.
- India has a vast watershed program but has no true PWS.
- Vietnam still explores the potential of PWS to protect mainly from sedimentation and flooding.

Asian PWS mostly have the government as major buyer of ES as payments from the private sector are very few (Huang et al. 2009). Indonesia, Nepal and the Philippines have started to explore private payments by focusing on hydroelectricity plants, water bottling companies or tourist companies. On the other side, sellers of ES are mostly groups of upland farmers.

4.1.4. Africa

Africa lags behind other areas of the world for all types of PES (Dillaha et al. 2007; Ferraro, 2009). PES development is still incipient as until 2006, there were no operational PES schemes in Africa although several initiatives to improve ecosystem management existed (Grieg-Gran et al. 2006).

Majority of PES initiatives are taking place in South Africa as it has better socio-economic and institutional conditions compared to other African countries (Ferraro, 2009). African PES initiatives are essentially public works programs with a main focus on poverty alleviation and equity.

Summary: Regional conditions and contexts shaping PES development in Latin America, Asia and Africa as well as their major challenges are compared in table 3. The scientific uncertainty on the linkage between a PES-promoted land use and environmental benefits represent a common challenge to the three regions. Wunder et al. (2008) noted that many PES programs are based on a limited scientific foundation.

5. PES in Madagascar

Madagascar has biodiversity payment initiatives but not any documented PWS schemes (Dillaha et al. 2007). Based on an inventory of initiatives/activities and legislations related to PES in Madagascar, Randimby et al. (2008) concluded that PES is a system that is still unknown to most public and private sectors. Since 2005, Madagascar has started to implement several payment mechanisms to enhance the provision of environmental services, mostly biodiversity protection (three identified initiatives), carbon sequestration (four initiatives) and water services (eight initiatives). However, since PES markets are not fully developed in the country, these initiatives cannot be identified as PES schemes as such. The context and conditions shaping these payments are unknown, such as the conditionality of payment, the conditions under which participants joined the agreement, the environmental service provided and so on.

International conservation NGOs such as Conservation international (CI), Wildlife Conservation Society (WCS), World Wildlife Fund (WWF) and Tany Meva Foundation play an important role in promoting especially PES mechanisms on carbon, water and biodiversity among the government, industries and local communities. They provide as well some technical and financial support to local communities.

According to Randimby et al. (2008), PES market in Madagascar would only develop if there is a better integration of the private sector and local communities, and an improved enforcement of existing policies.

Table 3: Comparative table of the regional conditions and contexts shaping PES development in Latin America, Asia and Africa and their major challenges (Recapitulated from: Grieg-Gran et al. 2006, Ferraro 2009, Dillaha et al. 2007, Wunder 2007, Huang et al. 2009)

	Latin America	Asia	Africa
Conditions and contexts shaping PES development	<ul style="list-style-type: none"> • Rural land tenure security • Less ideological resistance to conservation payments • Urbanization 	<ul style="list-style-type: none"> • Governance structure varying from command-and-control to decentralized • Small landholdings due to the high population density • State ownership of most forest and agricultural land 	<ul style="list-style-type: none"> • Reliance on external donors funding • Little involvement of private-sector
Regional challenges	<ul style="list-style-type: none"> • Uncertain environmental benefits • Lack of support from the national government to local PES schemes 	<ul style="list-style-type: none"> • Large number of small landholdings • Land tenure insecurity • Lack of hydrologic data • Low awareness of PES • Limited trust in market-based mechanisms • Weak enforcement of conditionality 	<ul style="list-style-type: none"> • Higher level of poverty • Lack of willingness to pay • Low ability to pay • Land tenure insecurity from overlapping customary and formal rights and systems of authority • Dispersed land ownership and smallholdings • Transboundary watersheds • Weak governance and institutional capacity • Lack of enabling legislations and policies • Lower scientific capacity on hydrology

CHAPTER 2: METHODOLOGY AND STUDY SITE

This research used a combination of quantitative and qualitative research techniques. Original and published data are used to assess the socio-economic, legal and institutional contexts. In-depth interviews were conducted with key stakeholders including private and public individuals and organizations.

1. Steps for developing a PES scheme

The methodology adopted to develop the PES scheme is based on a step-by-step approach proposed by the Katoomba group (Forest Trend et al. 2008). Four main steps are suggested:

- ◆ *Step 1: Identifying Ecosystem Service Prospects & Potential Buyers:* This step consists in assessing the ecosystem service in the studied area. That means evaluating its current and ongoing status, how it is affected by current land use practice and which practices are more sustainable and profitable for this ecosystem service. This step tries also to identify who benefits from this environmental service and whether it has therefore a possible marketable value.
- ◆ *Step 2: Assessing Institutional & Technical Capacity.* This covers the analysis of the legal, policy and land ownership context whether they can support or not the payment mechanism. In addition, the availability of PES-support services and organizations is also surveyed.
- ◆ *Step 3: Structuring Agreements.* This part is more related to the designing of the management plan after the local context's analysis which was covered in the first two steps. It analyses possible ways to reduce the transaction costs and to ensure equity and fairness of the payment options. The payment type, whether it will be provided in cash or in-kind is considered at this stage.
- ◆ Step 4: Finalizing the PES agreement

2. Study site: Ranomafana National Park

The Ranomafana National Park is chosen as my case study for the following reasons:

- It was identified as one of the potential sites where biodiversity conservation can be bundled with carbon and water services through a PES scheme. This is from a mapping analysis performed by Wendland and al. (2009) which could identify potential sites of 30,000 km² out of 134,301 km² of the natural habitat in Madagascar where PES schemes might be interesting. Three main criteria were used to identify these sites: the existence of ecosystem services such as biodiversity, carbon and water, the degree of threats and the opportunity costs level. These potential sites are presented in the colored area of the following map (Figure 1).

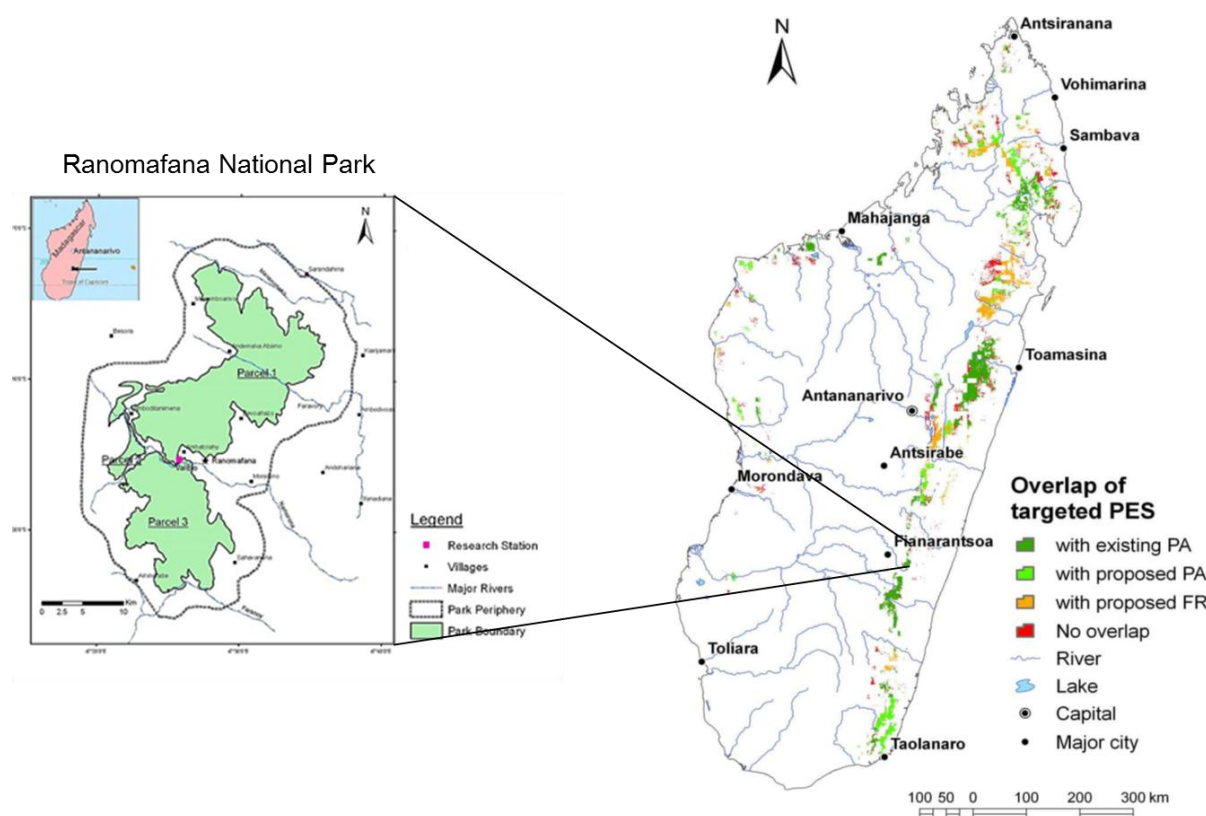


Figure 1: Potential PES sites in Madagascar (Wendland and al., 2009)

- It is also one of the most important watersheds of the southern region of Madagascar thanks to the Namorona River and enhancing this watershed's economic value might be interesting for conservation and development. As already mentioned earlier, surrounding communities still practice slash-and-burn agriculture (or *tavy*) but this has become unsustainable. Not only frequent burnings increases land pressures, but they have an adverse impact on hydrological functions. Although deforestation in tropical forests has no clear effect on hydrological services such as water yield or rainfall/climatic conditions, adverse land use practices such as frequent burnings will surely lead to erosions and a deterioration of river regimes characterized by diminished dry season (or minimal) flows (Brujinzeel 1990 and Brujinzeel 2004 cited in Hockley and Razafindralambo, 2006).

The close link between poor land use practice and hydrological functions presents an interesting perspective for the development of a PES mechanism in Ranomafana because those who benefit from the watershed services might have an economic incentive to influence the land use practice of the villagers, provided the latter are willing to change.

2.1. Climate, weather and geographical location

The Ranomafana National Park is located between the longitude 47° 18' - 47° 37' East and latitude 21° 02' - 21° 25' South, and its altitudes range from 500 to 1500 meters. The region is characterized by a hot, subtropical climate with an average annual rainfall of 1500 through 4000mm (Valbio). The rainy season falls between November and March but the central east of the park does not know any months without rains. The mean annual temperature is 20°C.

2.2. Topography, land use and landscape

The eastern area of the Ranomafana region has a mountainous topography with steep slopes of 40%-50% grade and narrow valleys (Peters, 1999). This topography has pushed the communities in this area to practice widespread *tavy* on forested hill slopes to supplement their insufficient irrigated rice production in the narrow valleys (Peters, 1999; Brooks et al., 2009). However, vegetation clearing from hill slopes combined with heavy rainfall has resulted in extensive erosion and accelerated deposition of sand and sludge in irrigation channels (Korhonen & Lappalainen, 2004).

The Namorona River, fed by many small streams, bisects the Ranomafana National Park (Valbio)

2.3. Background and research problem

2.3.1. Tavy: Unsustainable land use practice in the peripheral zone

The Ranomafana National Park is home to a rich and unique biodiversity. Despite the fact that the park is one of the well-protected areas in Madagascar, pressures from the surrounding communities are still persistent at the park boundaries. The local communities still practice slash-and-burn cultivation or “tavy” which is deemed to become unsustainable. In fact, due to the rapid population growth and the limited cropland, the fallow period has shortened from 18 years to less than 3 years, which will increase pressure on the land.

As far as the Ranomafana Commune is concerned, the population growth rate averaged 2.3% during the last 5 years. Considering that valleys are very narrow in the region, the local communities are used to practice slash-and-burn agriculture upland. However, not only the soil fertility is among the lowest in the world (Johnson, 2000), around 0.2t/ha for rice in 2007, but the rapid population growth causes also frequent burning in the region. A study conducted by Styger and al. (2007) which analyzed the influence of slash-and-burn farming practices on fallow succession and land degradation in the rainforest of Madagascar, concluded that this traditional practice is collapsing. Their result can apply to Ranomafana region too. They found out that with the shortened fallow period, actually less than 3 years, upland rice yield will reach only 2t/ha up to the third cycle. This yield will continue to decline until reaching zero in the following cycles (See Figure 2).

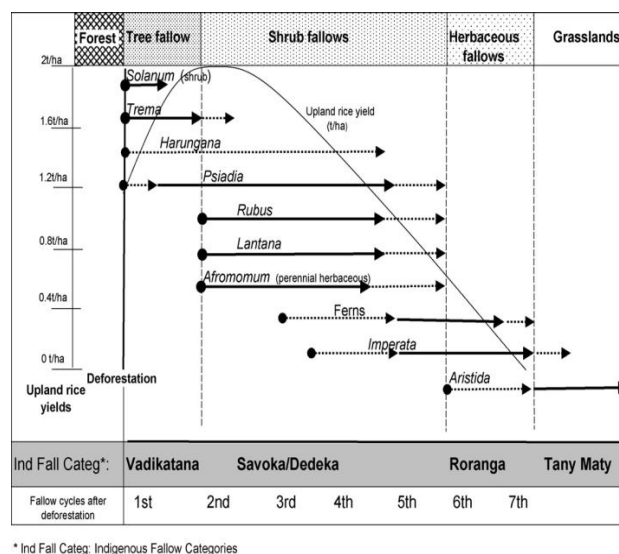


Figure 2 : Fallow species succession as a function of cropping/fallow cycle and time since primary forest, and in relation to Betsimisaraka fallow characterization and upland rice yields (t/ha) (Styger and al., 2007)

Therefore, through frequent burnings, the villagers will inevitably search for new agricultural land at the expense of the forests due to rapid loss of soil fertility, which implies an increasing pressure on the protected area.

2.3.2. Weakness of current conservation strategy

Certain efforts are carried out to reduce the pressures on the park. Apart from the intervention of environmental NGOs in the peripheral zone, one of the main and permanent strategies is the compensation of the surrounding communities by giving them 50% of the park entrance fees as development assistance.

Data obtained from the Madagascar National Park in Ranomafana showed that a total of 812 972 849 Ariary (about 406 486 USD) was distributed as development assistance to 115 villages in the peripheral zone from 1994 to 2009, the total micro-projects number being 384. Based on a simple statistical and descriptive analysis of the data at the village level, the following table summarizes the total project number per village as well as the total project value (Table 3).

Table 3: Descriptive analysis of the project number and amount financed at the village level from 1994 to 2009

Variable	Unit	Obs.	Mean	Std. Dev.	Min	Max
Total project per village	Project	115	3.34	3.19	1	17
Total received funding	USD*	115	3,535	4,925	28	25,467

* Rate 1USD equivalent to 2000 Ariary. Data for 2010 were not available.

A brief analysis of the results allows concluding that this financing strategy is insufficient to address the situation because:

- Not all the villages benefited from the program. Only 115 villages out of 123 received development assistance from the park from 1994 to 2009.
- The very low frequency of financed micro-development projects and low financing in 15 years failed to have a significant impact on the villagers. Indeed, in 15 years, a village received on average projects valued at about 3535 USD regardless of the number of villagers (Table 3). Further analysis revealed also that 50% of the villages received only about 1000 USD (or 2 million Ariary) which is far smaller than the average. Regarding the frequency of project, the average project number per village was only 3. In addition, when considering the project distribution, 42% of the villages benefited from only one project and 64% of them are below the average (Figure 3).

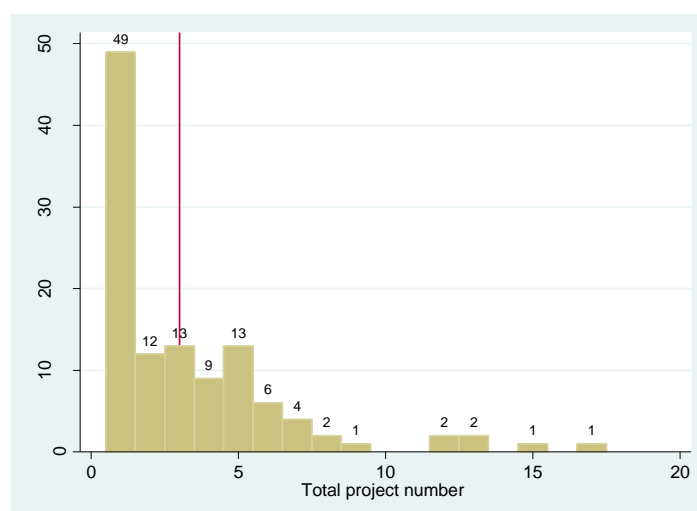


Figure 3: Distribution of micro-projects number from 1994 to 2009 among 115 villages in the RNP peripheral zone

2.4.Causal loop diagram of slash-and-burn in RNP

As seen before, current conservation strategy in Ranomafana region is insufficient to eliminate pressures from slash-and-burn from the communities in the peripheral zone. This is one of the reasons why I explored PES scheme in my research, particularly focusing on PWS, by valuing the hydrological functions of the Ranomafana National Park. Based on the background information, I drew figure 4 to show the dynamics of slash-and-burn in the RNP peripheral zone; the pink loop shows the link between the frequent burnings on hydrological functions. My research tried to value economically this link which has been overlooked over the years.

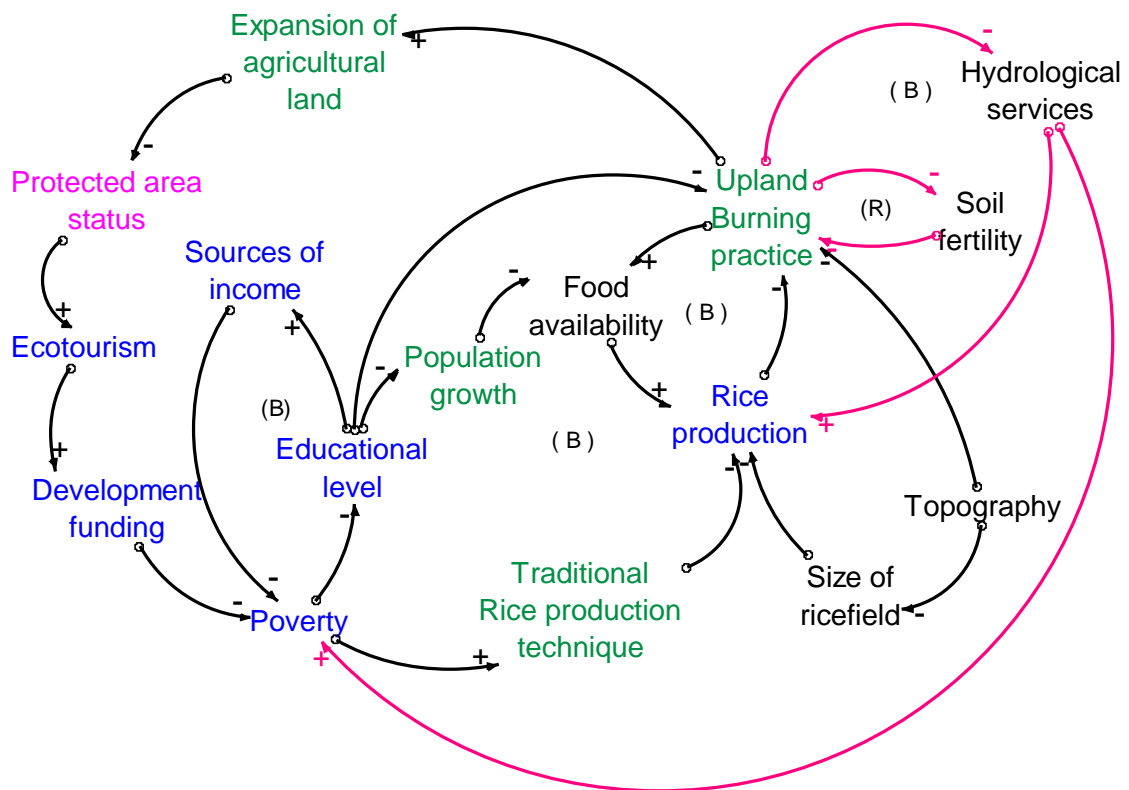


Figure 4: Causal loop diagram of slash-and-burn agriculture in RNP peripheral zone

3. Research hypothesis

My study explores the development of a PWS mechanism in Ranomafana with the following features:

- The environmental service is watershed-based services of forests, in particular, sedimentation control and/or seasonal regulation of waterflow of the Namorona River.
- The service provider is expected to be the upland communities surrounding the protected area.
- Those who are willing to abandon slash-and-burn agriculture and adopt a more sustainable land use practice will receive a payment from the water services beneficiaries. In fact, the adoption of a more sustainable land use practice would have a positive effect on sedimentation control or seasonal regulation of waterflow (Hockley, N.J. & Razafindralambo, R., 2006).
- The payer is expected to be the beneficiaries of the water services: the hydroelectric company JIRAMA is targeted in this scheme.

This hypothetical payment scheme can be depicted as in Figure 5.

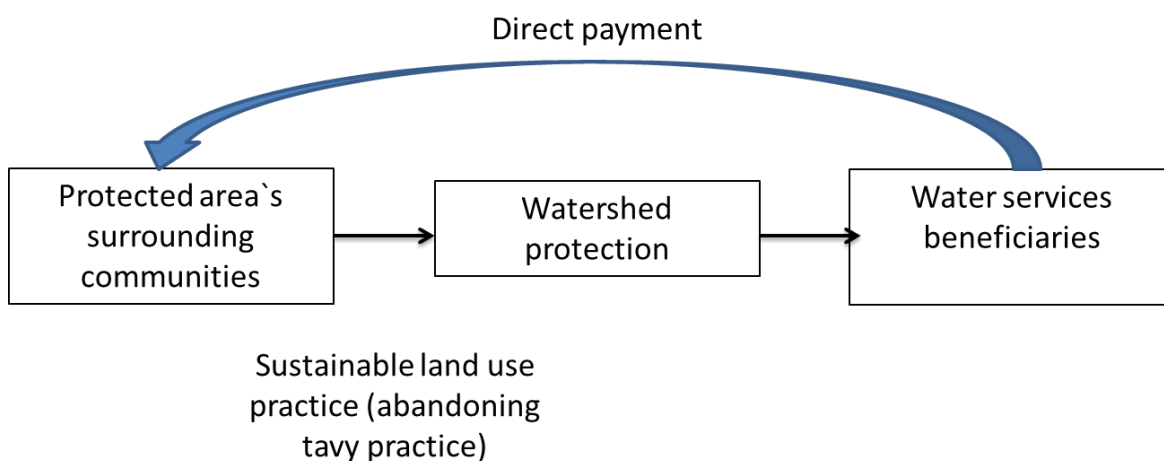


Figure 5: Hypothetical payment scheme for watershed-based services in Ranomafana

Such payment has a triple purpose: (i) preserve hydrological functions of forests, (ii) reduce pressures on the Ranomafana National Park, and (iii) alleviate poverty of the surrounding communities.

4. Fieldwork

4.1. Fieldwork objectives

A socio-economic survey in the Ranomafana Commune was required in order to understand the perceptions of the villagers related to the possible development of a PWS in the region. The villagers' willingness to change their unsustainable land use practice would constitute the starting point of the payment mechanism. If the villagers have no intention to change their land use even under a direct economic incentive, then any type of payment mechanism will lose its purpose.

4.2. Target survey

Villages in the Ranomafana Commune practicing *tavy* with adverse impacts on the Namorona River were targeted. The survey targeted mainly heads of household, regardless of the gender.

4.3. Interview process

Heads of household were randomly selected. They were interviewed individually by using a face-to-face approach and a semi-structured questionnaire. The questionnaire was first pre-tested before final validation and being applied to the main sample. The

questionnaire had 5 main components:

- ◆ *Socio-economic characteristics of the household:* This component gathered variables such as age of the heads, gender, ethnicity, marital status, educational level, family size, main occupation, agricultural production, average annual income.
- ◆ *Land ownership and land management context:* It identified the rice production technique and the average annual rice production, the possession of land title or not, the land size, the determination of burned area per year and the reasons for practicing slash-and-burn cultivation.
- ◆ *Villagers' perceptions on the importance of forests:* It included the villagers' perceptions on the importance of forests, on the link between forest cover and water functions, and on forest cover change and water situation change in Ranomafana Commune over the last five years.
- ◆ *Villagers' opinions on the payment for watershed-based services as an economic incentive to forego tavy:* It consisted in the elicitation of the villagers' willingness to accept a compensation to forego tavy or not, the degree of certainty of the stated willingness, i-e with hesitation or not, the reasons for rejecting the payment mechanism when applicable, the villagers' contract type preference if the payment mechanism is implemented and their development needs.
- ◆ *Villagers' technical capacity in environmental projects:* The considered variables were the possession of any experience in environmental projects or not, the variety of experience and the frequency of involvement of the villagers in these projects.

4.4. Elicitation of the willingness to abandon slash-and-burn agriculture

The following question was asked to each head of household to elicit his/her willingness to abandon slash-and-burn agriculture: “*Suppose you are compensated not to practice tavy anymore because frequent burnings have an adverse impact on hydrological functions. Suppose you are compensated with baskets of rice every year but this compensation mechanism is only conditional to the abandon of tavy practice. If this payment mechanism is to be implemented, you are free to decide whether you will participate or not. Are you willing to give up tavy for compensation?*”

5. Sample description

The fieldwork was conducted from mid-September to beginning of October 2010. 5 villages located in 3 fokontany² were identified with the assistance of the Research Valbio Center and the validation of the Madagascar National Park: Ambodiaviavy, Ambodiriana, Andafy Atsimo, Masomanga and Nanetehana.

² Fokontany is the smallest administrative unit in Madagascar

Contributions of an education agent from the Valbio Research Center (Ramarjaona Richard) and native farmers in the villages were essential to receive the approval of the villages' elders before implementing the survey and to facilitate discussions with the villagers. To show our appreciation, symbolic gifts such as packets of salt and candies were given to the survey respondents. A collective ball was also offered to the youth in Ambodiaviavy.

Over a total number of about 185 households in the 5 villages, 91 respondents could be reached, which represent 49% of the total population. Two main factors explain this final sample size: (1) because of the growing season, some heads of household were not available as they stayed at the fields at the time of the survey (about 42 heads of household); (2) others were reluctant to answer the questionnaire (about 31 heads of household).

The final sample size is therefore 91 heads of households who are distributed among the villages and Fokontany of the Ranomafana Commune as follows (Table 4).

Table 4: Distribution of the heads of households interviewed per village and administrative unit

Village name	Fokontany			Total interviewed	Total number of HH (source: Valbio, 2009)	Sample representativeness
	Ambatolahy	Ambodiaviavy	Ranomafana			
Ambodiaviavy	0	38	0	38	69	55%
Ambodiriana	17	0	0	17	20*	85%
Andafy Atsimo	0	0	18	18	33	55%
Masomanga	0	0	9	9	51	18%
Nanetehana	0	0	9	9	12	75%
Total	17	38	36	91	185	49%

* Estimate

CHAPTER 3: SOCIO-ECONOMIC ANALYSIS

1. Demographic characteristics

Most of the heads of households are relatively young and are still economically active since about 87% are less than 54 years old. Three major ethnic groups are present in the studied area: Betsileo, Tanala which literally means people of the forests, and a mixture of them. Despite the random selection, it appears that proportions of female and male in the sample are quite similar as well as the proportions of migrants and natives. 89% of the heads of household are married and 50% did not complete the primary school which implies a low educational level. Besides, the family size averages 5-6 people with a maximum of 14 individuals. The major social characteristics are presented in table 5.

2. Economic characteristics

The main occupation of the villagers is subsistence agriculture. Targeted villagers are extremely poor because each household earns less than 2\$ a day. An analysis of the income structure (Figure 6) showed that the sale of non-tavy products such as fruits, especially bananas, occupies the largest proportion of the total income (being 36%). After the sale of banana, the villagers rely also on off-farm income to ensure their livelihood mostly by working for other farmers during growing seasons through hoeing or by doing some part-time job at the hotels in the region for example as washerwomen, cleaning agents, gardeners or construction workers. The sale of tavy products, mostly cassava, pineapples and coffee represents also a non-negligible share (15%) of the household income.

Interestingly, the survey revealed that not so many villagers commercialize handicraft products.

It is noted that given the absence of sales records and low educational level of the villagers, we could obtain only a rough estimate of their income. Villagers provided only basic information for example, their weekly sales quantity, unit prices, sales seasons and a mathematical computation was performed to have a rough estimate of the household's annual income.

Table 5: Social characteristics of the heads of household

Social characteristics of the head	Freq.	Percent	Cum.
<i>Age of head (in years)</i>			
less than 25	21	23.08	23.0
25-34	23	25.27	48.3
35-44	16	17.58	65.9
45-54	19	20.88	86.8
55-64	5	5.49	92.3
65-74	4	4.4	96.7
75 or more	3	3.3	100
<i>Ethnicity of the head</i>			
Antaimoro	1	1.1	1.1
Antandroy	1	1.1	2.2
Betsileo	34	37.36	39.5
Mixed race from Tanala and Betsileo	22	24.18	63.7
Tanala	33	36.26	100
<i>Gender of the head</i>			
Female	48	52.75	52.7
Male	43	47.25	100
<i>Marital status of head</i>			
Divorced	3	3.3	3.3
Married	81	89.01	92.3
Single	2	2.2	94.5
Widowed	5	5.49	100
<i>Education of the head of household</i>			
Didn't finish the junior high school	10	10.99	10.9
Didn't finish the primary school	45	49.45	60.4
Didn't finish the secondary high school	5	5.49	65.9
Didn't go to school	10	10.99	76.9
Finished the junior high school	9	9.89	86.8
Finished the primary school	10	10.99	97.8
Finished the secondary high school	2	2.2	100
<i>Migration status</i>			
migrant	39	42.86	42.8
native	52	57.14	100

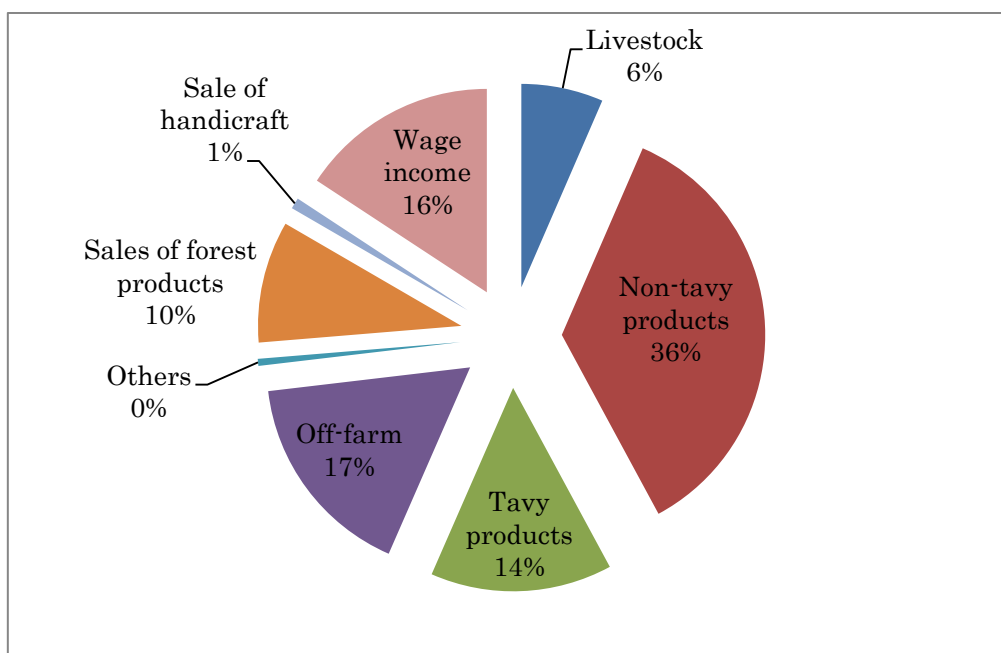


Figure 6: Household's annual income structure

Rice production

95% of interviewed households grow rice as it constitutes the main staple food; the remaining 5% did not intentionally choose not to do so but are rather limited by the inexistence of ricefield. The average rice production is 18 daba³ per year which is equivalent to 270kg. This annual production is insufficient since 95% of households declared that their rice production is not enough for the household's consumption all year round. In fact, the grown rice is consumed in only 3 months on average. Consequently, many households rely on cassava to survive during the lean period, noting that cassava is the most important tavy product.

Apart from the limited cropland, this low rice productivity might be attributed to the predominance of traditional rice production technique i-e 90% of the sample.

3. Land ownership and land management context

3.1.Land tenure security

Regarding the land ownership context, 84.62% of the interviewed households declared having an official title over their land. Additionally, 76% of them stated that they do not

³ 1 daba represents 15kg of rice

share this titling with any relatives (table 6). This land tenure security represents a positive factor for a PES development.

It is noted that only few households (12%) rent land for their rice production.

Table 6: Land title and control over land access

Land title	Land access by others				Total
	No	% of total sample	Yes	% of total sample	
No	8	9%	5	6%	13
Yes	68	76%	9	10%	77
Total	76	84%	14	16%	90

3.2.Reasons for practicing *tavy*

To most of the villagers (nearly 50% of the sample), reasons for practicing *tavy* are mainly technical: (1) to maintain an acceptable soil fertility level and (2) to facilitate land preparation for cultivation (see figure 7). 7% of the sample declared however, that they do not practice *tavy* anymore.

As for those who practice *tavy*, the fallow period has become less than 2 years which confirms the hypothesis that this land use practice has become unsustainable.

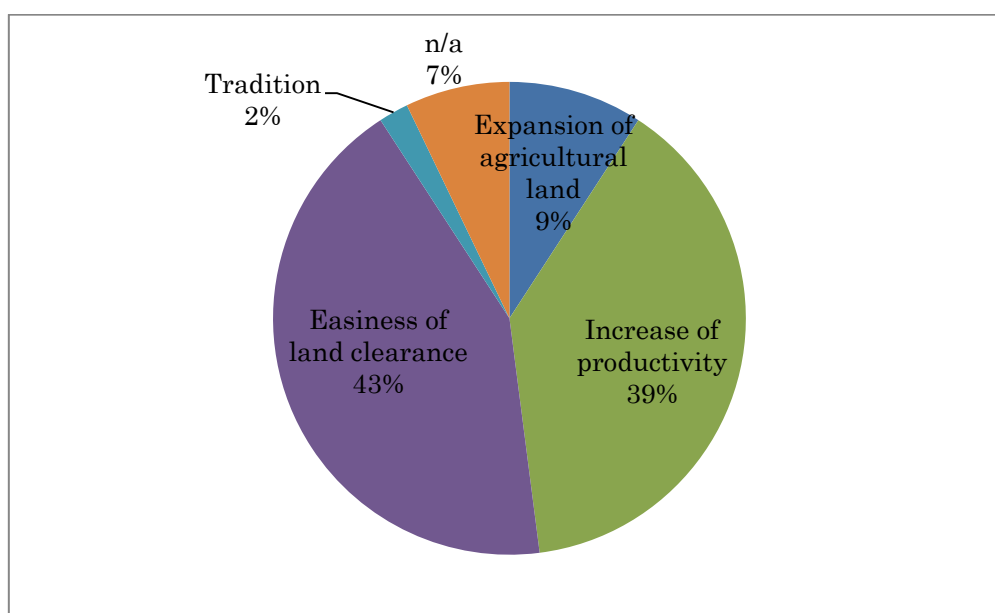


Figure 7: Stated reasons for practicing annual slash-and-burn agriculture

Besides, the fact that not so many villagers (only 10%) stated the expansion of agricultural land as the main reason for *tavy* is a positive point. Nevertheless, keeping this proportion as much lower as possible in the long-term is very challenging since after frequent burnings of current cultivated land, soil productivity will reach zero soon (see section 2.3.1 page 16) and the villagers will inevitably increase their land pressure.

4. Perceptions on forests

4.1. Perceptions on the importance of forests

Understanding the villagers` perceptions on the importance of forests is essential to determine, whether raising awareness among the villagers is required for the implementation or the success of a PWS mechanism.

Following the survey, water regulation constitutes one of the most important functions of forests to the villagers (See figure 8). Indeed, 87.91% of the sample recognized that forests protect water sources in the Ranomafana region. However, despite the fact that the Ranomafana National Park is one of the most attractive protected areas in Madagascar, only 26.37% of the villagers identified the function of biodiversity protection and the consequent potential for ecotourism as important. This is somewhat understandable because as we showed in section 2.3.2, development assistance from the park entrance fees has been insufficient to have a significant effect on the villagers or benefit all of them individually.

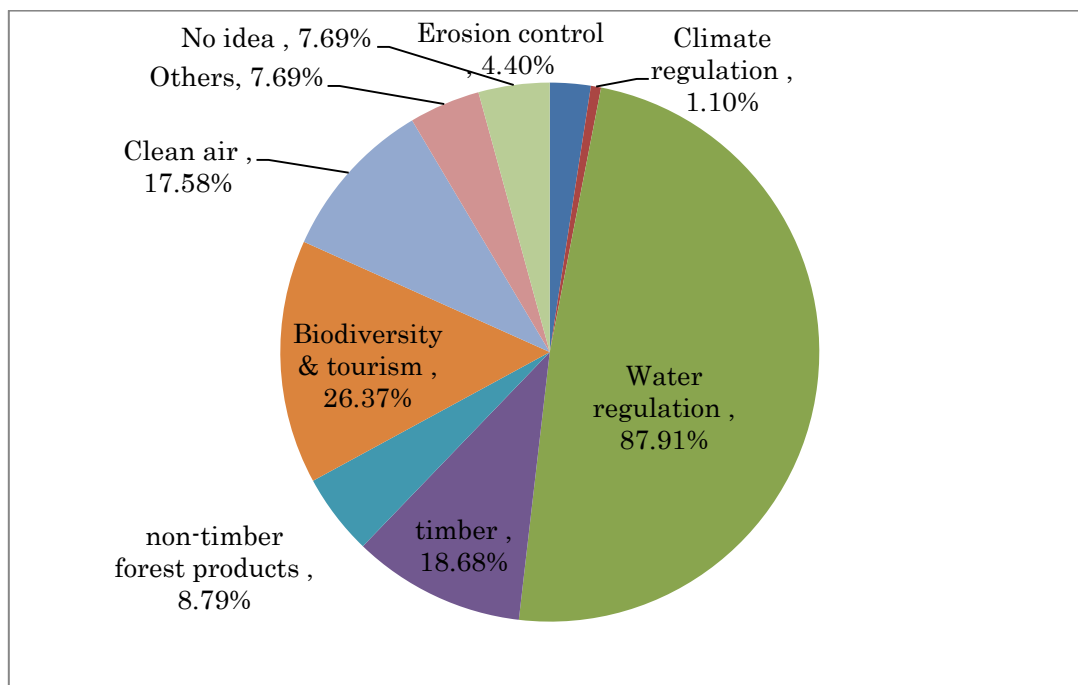


Figure 8: Perceptions on the importance of forest

4.2. Perceptions on forest cover change and water situation change in the Ranomafana Commune

48 villagers out of 91 think that forest cover in their region has not changed over the last 5 years and the water situation has also been more or less stable during the same period (table 7). These results should be confronted with real physical data to have more interesting meaning and implications. In fact, if the real situation has degraded but the villagers are not really aware of it, then this lack of awareness will constitute a key aspect of future conservation strategies.

Table 7: Perceptions on the forest cover change and water situation change over the last 5 years

Perception on forest cover status	Perception on water situation			Total
	Degraded	Improved	No change	
Degraded	16	1	6	23
Improved	2	6	12	20
No change	7	3	38	48
Total	25	10	56	91

5. Assessment of the willingness to abandon slash-and-burn agriculture

5.1. Willingness-to-change assessment

Over 91 interviewed heads of household, 83.5% would accept to forego slash-and-burn if they receive an economic incentive to do so under a direct payment mechanism. The remaining 16.5% have stated diverse reasons not to accept the mechanism (Figure 9). One of the main reasons is that the PES mechanism is not reliable. Others stated that they are unable to decide by themselves but will rather follow decisions of the village's elders, or they consider that changing the traditional land use practice is risky, or they have some land ownership issues or even admitted that clearing forests through *tavy* is needed for more agricultural land.

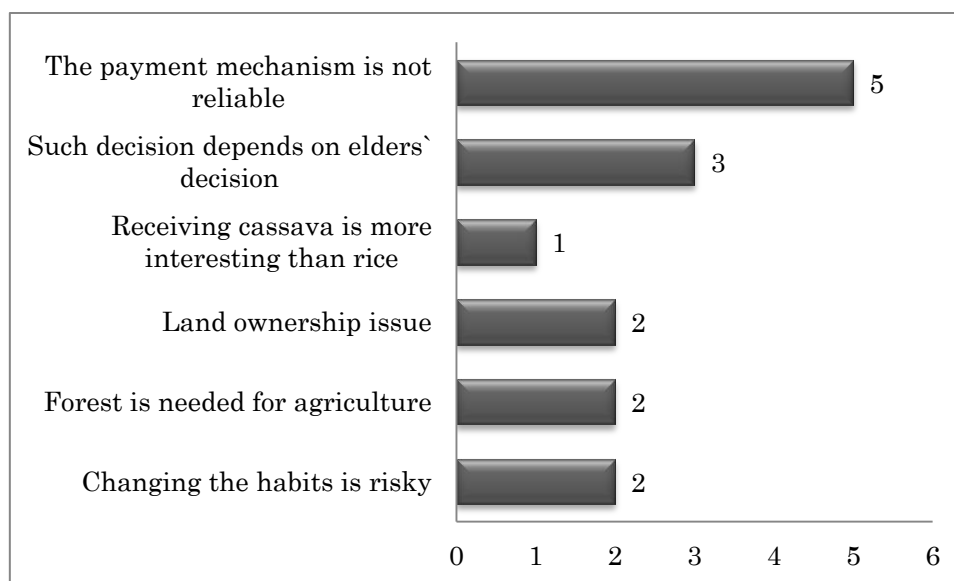


Figure 9: Reasons for rejecting the payment mechanism

5.2. Level of willingness-to-accept (WTA)

If a respondent was willing to give up tavy for compensation, he or she was then asked about the compensation level. Considering that the targeted population is extremely poor, using a monetary unit for the compensation was therefore inappropriate in such a less monetized area. That is why “baskets of rice” was used as the unit of the compensation level because rice constitutes the main staple food, its value is well-established and the transactions around rice are well-understood by the villagers (Shyamsundar P. & Kramer R., 1996; Minten B., 2003).

The willingness-to-accept level is presented in table 8 and figure 10. Further statistical analysis of these results will allow to understand the determinant factors which affect the villager`s decision on willing to abandon tavy for compensation or not for example, by considering the socio-economic characteristics of the respondents.

Table 8: Requested annual willingness-to-accept per household

Description	Unit	Obs.	mean	Std. Dev.	min	max
WTA	Daba	74	148.4189	119.6822	28	695
WTA	USD	74	610.0018	491.894	115.08	2856.45

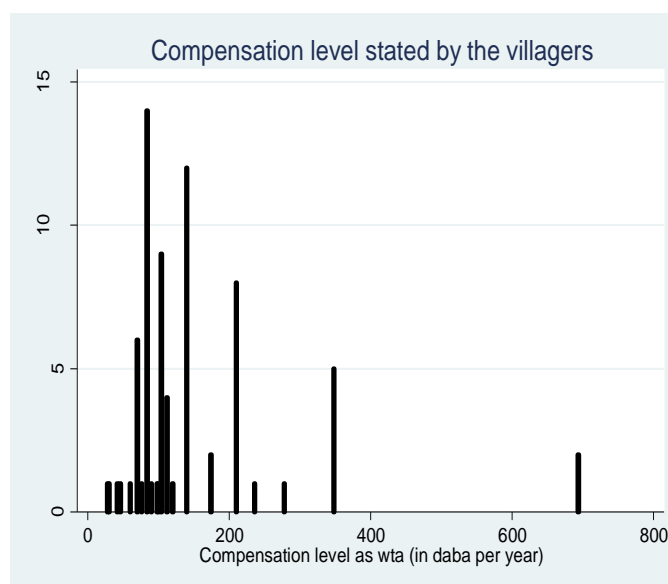


Figure 10: Distribution of the stated willingness-to-accept level

5.3. Prior knowledge on the payment mechanism

89.01% of the sample has never heard about a PWS mechanism before the survey. The fact that 83.5% of the villagers would still accept to receive an economic incentive to abandon unsustainable tavy implies that a prior knowledge on PES mechanism does not affect a favorable opinion towards the mechanism.

6. Contract type preference

Asking the villagers about their contract type preference if the PES mechanism is to be implemented was essential. Indeed, this affects future transaction costs level and having collective contracts will induce smaller costs. However, care should be taken not to systematically privilege collective agreements over individual ones.

44% of the sample would rather prefer individual contracts and another 38% would prefer collective one (Figure 11); the rest concerns villagers who are not willing to participate to the payment mechanism. Given that these proportions are not significantly different, it is preferable to conduct further analysis by considering factors such as geographical location or gender to have a more interesting result.

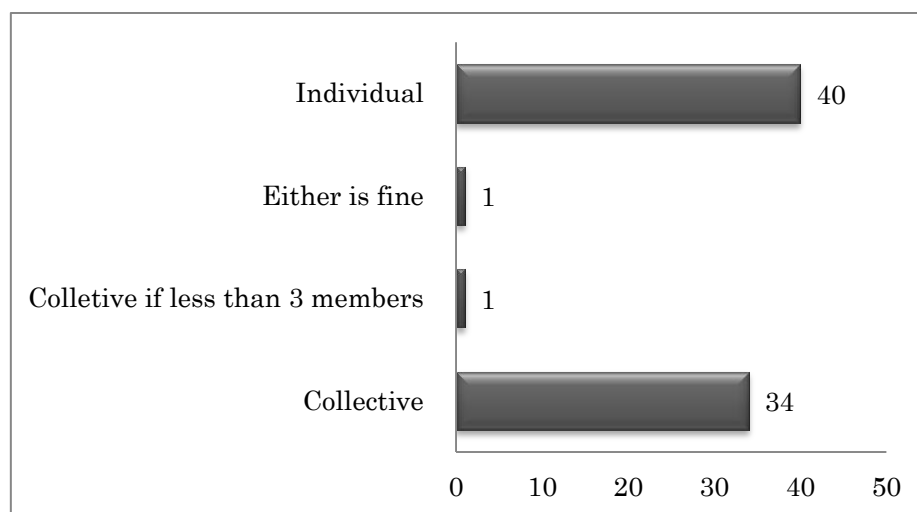


Figure 11: Contract type preference

7. Socio-economic findings

This chapter presented an assessment of the socio-economic context in Ranomafana Commune as well as the perceptions of the villagers towards the development of a PWS mechanism in the region.

The following potentialities could be identified based on the socio-economic characteristics of the villagers and their perceptions:

- Farmers in the Ranomafana Commune are willing to abandon tavy and practice a more sustainable land use contingent to compensation. This constitutes an essential point for the development of a PWS mechanism besides the existence of an environmental service.
- Villagers have control over their land use from the possession of land title.
- Villagers are aware of the positive link between forests and water functions. In that sense, trying to convince them on the impacts of tavy on hydrological functions is unnecessary in order to adopt the PWS mechanism by them.

On the other hand, the main socio-economic barriers to PWS development in Ranomanfana are:

- The general poverty
- The low educational level
- The relatively high transaction costs from the possible disparity of villagers' preferences, such as the type of agreements if a PWS scheme is implemented.

CHAPTER 4: INSTITUTIONAL AND TECHNICAL CAPACITY ASSESSMENT

1. Objective

Assessing the institutional context and the technical capacity of the two parties of the PWS agreement is substantial before designing the PWS model. The main objective is to determine whether existing laws, institutions and practices support or at least, do not obstruct to the implementation and development of the PWS (Forest Trends, Katoomba Group & UNEP, 2008). Following this institutional assessment, the final goal will be to define which institutional structure should exist to promote the sustainability of the PWS scheme.

2. Theoretical perspectives on institutions for PWS

2.1. Definition of institutions

Based on the literature, the definition of “institutions” varies from different perspectives. For instance, from an economic perspective, institutions are defined as rules, processes and organizations (Luckert, 2005) which, as “guiding norms”, enable the interpretation of social practices and interests (Diaw, 2005). Based on the new institutional economics, institutions constitute external rules that define the context for transactions (Vatn, 2005).

Since this study adopts a multidisciplinary point of view, institutions are therefore understood with their broader meaning: “Institutions are formal and informal rules that are understood and used by a community” (Hess & Ostrom, 2007). The rules are constituted and reconstituted by human interactions in frequently occurring or repetitive situations (Crawford & Ostrom, 1995). It is noted that this definition is used by the Institutional Analysis and Development framework which is described in the following section.

2.2. Institutional Analysis and Development framework (IAD)

2.2.1. Brief description

The Institutional Analysis and Development (or IAD) framework was developed by Ostrom and her colleagues in 1994 and presents a systematic and structured approach to institutional analysis. Its major attribute is the integration of different theories which are used by specific disciplines.

It identifies structural variables that are to some extent present in all institutional arrangements (Ostrom, 2011), which allows conducting comparative analyses between particular contexts.

Based on this framework, all institutional arrangements are characterized by interconnected elements (figure 12). The action situations are influenced by the biophysical conditions, attributes of the community and rules-in-use. They define the

interactions between the different actors whose actions generate in turn, outcomes. Finally, the framework suggests a variety of criteria which can be used to assess a particular institutional design and performance.

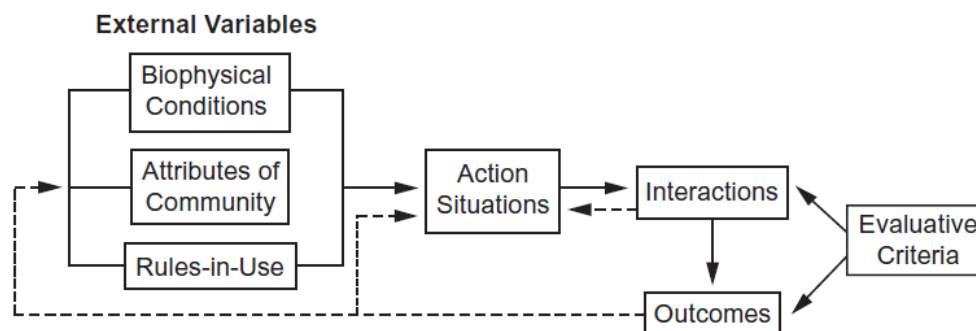


Figure 12: IAD framework for Institutional Analysis

(Source: Ostrom, 2011)

2.2.2. Using IAD framework for institutional analysis

The IAD framework focuses on rules, whether formal (e.g. laws, regulations and policies) or informal (e.g. behavioral norms). Based on the literature, analyzing institutional arrangements in a specific context by using this framework will require two key steps:

Step 1: Develop a comprehensive understanding of the local institutional settings

This can be done by considering the structural variables presented in the framework, which are:

- “*Action situation*”: this is the focus of analysis or conceptual unit. It represents a social space where actors, whether individuals or organizations, interact and make decisions based upon information they possess on the potential outcomes as well as the costs and benefits linked to these decisions and outcomes (Ostrom et al., 1994; Ostrom, 2011).
- “*External variables*”: The patterns of interactions between these actors are dependent on three major categories of external factors namely the rules-in-use within which situations occur, the biophysical conditions and the attributes of the community.
 - Rules-in-use: In this step, it is important to understand existing rules, either formal or informal, which govern inter-organizational relationships of the different actors, as well the structure of these rules. In fact, rules are defined as prescriptions on required, prohibited and permitted actions as well as sanctions authorized for noncompliance (Ostrom et al. 1994).

- **Biophysical conditions:** Since environmental conditions vary from place to place, they impose constraints in the development of rules governing interactions between the different actors. Koontz (2003) identified for example, the rate of growth, diversity of species present, climate and weather, terrain as potential variables in forest ecosystem assessment.
- **Attributes of the community:** Culture is an important factor influencing existing organizational interactions within a community. Important variables may include accepted norms of behavior, the community level of common understanding, the distribution of resources between the members, or the homogeneity of individual preferences.

Step 2: Evaluate the institutional performance and design

The objective is to use the evaluative criteria suggested by the IAD framework to identify the strengths and weaknesses of current institutional arrangements in terms of performance and design.

Institutional performance analysis

The IAD framework defined two temporal approaches to analyze institutional performance: the first one is at specific points in time and the second is for a sustained period of time. Each approach has specific variables which are respectively presented below:

- Transaction costs: These are costs associated with organizing interactions among the different actors. They include: (1) information costs related to the search and organizing of scientific information to support the inter-organizational relationships, (2) coordination costs related to negotiations, monitoring and enforcement of agreements and finally (3) strategic costs.
- Sustainability criteria (Ostrom et al., 1994): four evaluative criteria are used to assess whether existing institutional arrangements are sustainable or not.
 1. Efficiency: The main objective is to assess the effect of existing institutional arrangements on wealth generation and productivity.
 2. Equity: resources allocation is evaluated with this criterion, by determining for example, how proportional costs and benefits are.
 3. Accountability: This is related to the nature and existence of formal or informal sanctions as well as their application.
 4. Adaptability: Sustainable institutional arrangements are more resilient to change and should be more flexible.

In summary, structural variables used to analyze institutional performance with the IAD framework are presented in figure 13.

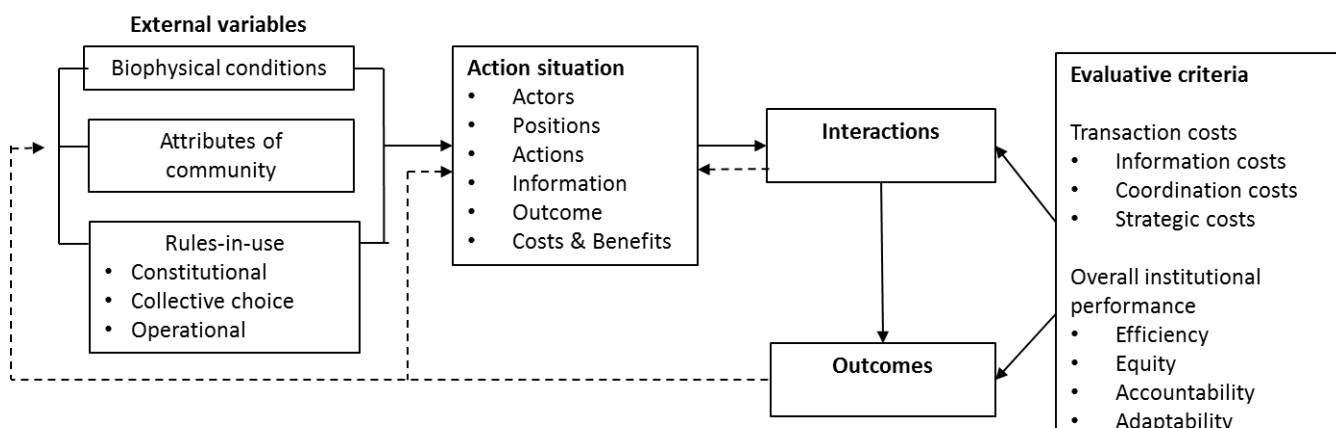


Figure 13: The IAD framework modified from Ostrom (2011) and Imperial (1999)

Institutional design analysis

The objective of this analysis is to assess the characteristics of potential institutional development and change, as well as the likelihood of adoption of this change.

The change consists in shift of formal and informal rules so that different behaviors are encouraged or constrained (Imperial, 1999; Ostrom et al., 1994). At the basic level, Ostrom (cited in Imperial, 1999) defined six main factors which enhance the probability of adopting new rules. These are the existence of common belief, shared generalized norms and trust within a community, equality before existing rules, low transaction costs and finally, a small size and stable participants in specific actions.

3. Application to the case study: Ranomafana National Park

3.1. Methodology

The IAD framework is used to analyze the institutional arrangements in Madagascar in general and in Ranomafana National Park in particular, regarding the possible development of PWS in the region, because of the following reasons:

- It has been tested and applied successfully in diverse types of research questions (Hess & Ostrom, 2007) and in diverse countries including Madagascar (Ostrom et al., 1994) for work on institutional analysis and design.
- It is particularly interesting for ecosystem-based management because of the latter's complexity and dynamism (Imperial, 1999).
- Its various criteria facilitate new institutional design by identifying strengths and weaknesses of existing institutional arrangements.
- It considers multidisciplinary variables (e.g. biophysical, social, economic and cultural) which condition institutional arrangements.

3.2. Understanding of the institutional context

3.2.1. Action situation: Developing a PWS mechanism

Identifying the action situation is particularly important to understand how different actors cooperate or do not cooperate with each other (Hess & Ostrom, 2007) in the Ranomafana National Park area to manage the Namorona watershed. In this case study, the IAD framework is applied to action situations involved in developing a PWS in the Ranomafana National Park region. The relevant actions would thus be trying to get villagers and water end-users to voluntarily agree on a payment mechanism. In that case, the villagers will be compensated for abandoning the practice of slash-and-burn agriculture in favor of a sustainable practice and the water users will benefit from the provision of watershed services.

Actors and roles/positions

Key actors are composed of individuals or organizations that affect the watershed management. They have diversified roles as presented in table 9.

Table 9: List of key actors and their roles in PWS

<i>Actors</i>	<i>Roles</i>
Villagers	They live in the peripheral zone of the Ranomafana National Park and are at the origin of slash-and-burn agriculture
Local Hydroelectric company	The hydroelectric company (JIRAMA) which has a facility in Ranomafana uses the Namorona River to generate electricity for the Southern region of Madagascar.
Madagascar National Park	It is the national agency managing the network of protected areas in Madagascar
Government agencies	<p>Considered government agencies are responsible for:</p> <ul style="list-style-type: none"> - the conservation of natural resources and environment, such as the Ministries or Departments of Environment, Water and Forest, - the integrated management of water resources in Madagascar, the establishment of a legal and institutional structure and the coordination of activities of all sectorial operators naming the National Water and Sanitation Authority (ANDEA) - the local administrative affairs such as the Ranomafana municipality
Conservation NGOs	This includes environmental NGOs operating in Madagascar or more specifically in Ranomafana (Valbio Centre, WWF, IFD, PSDR and ERI)

Interests/ incentives

Based on the field interviews, these actors are driven by diverse incentives/interests as recapitulated in table 10.

Table 10: Incentives and interests facing the different actors

<i>Actors</i>	<i>Incentives/ Interests</i>
Villagers	<p>The most immediate incentive facing villagers is their subsistence.</p> <p>Based on the field survey, slash-and-burn agriculture is mainly practiced to produce cassava as a complementary food because the annual rice production is not enough. Only 15% of the income come from slash-and-burn products which imply that the production is mostly consumed. However, 83.5% of the sample would accept to forego slash-and-burn if they receive an economic incentive under a PWS mechanism.</p>
Local Hydroelectric company (JIRAMA)	<p>It is driven by commercial interests and profit motive while constrained by taxation laws on water and electricity.</p> <p>The company stated that unless imposed by regulations, it is not willing to make additional payments for watershed protection as it considers that the water royalties already paid to the government should be used for this end. It suggested that water or electricity end-users i-e the lay people should be responsible to provide additional funding for watershed protection. The hydroelectric company pointed out also the need for an effective use of the National Fund for Water Resources by ANDEA.</p>
Madagascar National Park (MNP)	<p>MNP is interested in conserving the Ranomafana National Park jointly with local livelihoods improvement in the peripheral zone.</p>
Government agencies	<p>Public institutions are interested in facilitating PES development by promoting favorable technical conditions but only as a mainstream activity due to limited resources (Personal communication with the National Office for Environment).</p> <p>It was also highlighted that the government should reinforce its role and presence in environmental management because the lack of resources has shadowed its position compared with international environmental NGOs.</p> <p>The role of farmers in providing PWS payment should be more predominant over the private sector since they constitute the main water users through important irrigation. However, farmers' low ability to pay is perceived as the major barrier to this assumption.</p>

Conservation NGOs	<p>Designing strategies for a successful implementation of PES mechanisms constitutes the main interest of environmental NGOs. For example, WWF is interested in assessing the feasibility of PES as a sustainable financing mechanism (Personal communication with the Director of Conservation).</p> <p>Interviewed Environmental NGOs agreed also to say that assessing existing regulations to enable a reform should be a priority, especially concerning land ownership, ownership of ecosystem services and other specific regulations to promote PES mechanisms.</p>
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Information and control

These key actors have also different power and degree of influence (table 11).

Table 11: Scales of influence and sources of power by actor

<i>Actors</i>	<i>Scale of influence</i>	<i>Source of power</i>
Villagers	Local	Limited
Local Hydroelectric company	Local, National	Monopoly of water and electricity distribution in Madagascar
Madagascar National Park (MNP)	Local, National	Park Management; composition of the Board of Directors
Government agencies	National	Administrative and regulatory
Conservation NGOs	International	International funding

Compared with national and international stakeholders, local communities have limited access to resources and power. For instance, villagers' educational level is low (60.44% of the sample did not go to school nor finished the primary school) and many of them are not familiar with a PWS payment mechanism (89.01% of the sample).

On the other hand, international NGOs have more scientific knowledge and skills on the environment. They established a working group on PES in 2009 with private and public institutions to promote discussions on PES and faster its development. Nevertheless, government agencies have less power and influence than international NGOs as they have less resource (personal communication with Mr. Jean Roger Rakotoarijaona, Director of Environmental Information, National Office for Environment).

On the other side, the difference in information, influence and interest will inevitably

lead to different perceptions on the possible development of PWS development in Madagascar in general and in Ranomafana in particular. Table 12 summarized the perceived barriers to PWS development by actor and its proposed solutions for a successful implementation based on the fieldwork.

Table 12: Perceived barriers to PWS development and prioritized solutions by key actor

<i>Actors</i>	<i>Perceived barriers to PWS development</i>	<i>Prioritized solutions</i>
Villagers	See chapter 2	-
Local Hydroelectric company	<ul style="list-style-type: none"> ◆ Ineffective use of the National Fund for water resources 	<ul style="list-style-type: none"> ◆ Encourage payment from lay people ◆ Effective and transparent use of the National Fund for water resources
Madagascar National Park (MNP)	<ul style="list-style-type: none"> ◆ Poverty ◆ Absence of clear policy and regulations 	<ul style="list-style-type: none"> ◆ Create a discussion platform for all stakeholders ◆ Promote techniques for higher productivity
Government agencies	<ul style="list-style-type: none"> ◆ Low educational level ◆ Political instability & will ◆ Land ownership issue 	<ul style="list-style-type: none"> ◆ Enhance farmers' roles in providing payment ◆ Reinforce government leadership in environmental management
Conservation NGOs	<ul style="list-style-type: none"> ◆ Low educational level & Poverty ◆ Political instability & will ◆ Absence of clear policy and regulations ◆ High transaction costs ◆ Low ability to pay ◆ Low potentiality of PWS ◆ Ineffective use of the Water National Fund ◆ Land ownership issue ◆ Weak institutional framework 	<ul style="list-style-type: none"> ◆ Define strategies for integrated conservation and livelihood improvement ◆ Optimize the roles of existing institutions ◆ Provide technical support to villagers ◆ Decentralize responsibilities to ensure continuity of activities after NGOs' departure

3.2.2. Bio-physical characteristics

3.2.2.1. Soil fertility

The Ranomafana region has one of the most naturally infertile soils in the world (Johnson, 2002). Its soils are mostly red clay oxisols (Valbio) with extremely low level of nutrients and high aluminum saturation level (Johnson, 2002). Combined with shorter fallow period, agricultural yield per area becomes lower which leads to less production than required for subsistence (Brooks et al., 2009).

3.2.2.2. *Biodiversity and vegetation*

The Ranomafana region is especially dominated by lowland rainforest and cloud forests (Valbio; MNP; Korhonen & Lappalainen, 2004). The Ranomafana National Park is a world Heritage with an extremely high biological richness. To date, 2000 endemic species of fauna and flora have been identified (MNP; Brooks et al., 2009). The biological diversity of Ranomafana National Park is extremely high. Plant species density (number of species per ha) exceeds 100, representing 37 families in average. This is higher than elsewhere in Africa, although less than in South-American lowland rain forests (e.g., Colombia). Primate species richness is among the highest in the world, which includes 12 species representing five families. Importantly, all these primate species are endemic and, thus, of very high conservation value. Another remarkable group are snails: land snail species diversity is among the highest in the world (The park has 67 snail taxa of which 57 or 85% are endemic). There are only 110 bird species, which is a very low richness for this latitude, but this is characteristic for entire island of Madagascar. The combination of high primate diversity with low avian diversity suggests that pollination and seed-dispersal in the biota of Ranomafana may differ strongly from other rain forest sites; this feature generates considerable scientific interest to the ecosystem of the Ranomafana Park. As mentioned in section 3.2.2.1, soils in Ranomafana forests are very infertile (mostly red clay oxisols developed from parent rock with extremely low levels of nutrients), but this is a typically natural character for tropical rains forests elsewhere.

3.2.3. *Attributes of the community: Culture*

Apart from the socio-economic aspects already discussed in the previous chapter, culture which is also an important attribute to a community from the IAD perspective is discussed in this section. In fact, culture defines community members' behavior and lifestyle. Malagasy culture is unique in its own and the Ranomafana region in the Southeast of Madagascar is particularly defined by two major cultural characteristics: the respect of the traditional authority and the practice of slash-and-burn agriculture.

Respect of traditional authority - Traditional social order

Communities surrounding the Ranomafana National Park are dominated by the Tanala and Betsileo ethnic groups. Traditional hierarchies have always existed through the history within their communities. At the top of the social hierarchy is the king of the village or *mpanjaka*. His power is received from the ancestors and transferred through a symbolic wood called the *hazomanga*. The king has always the last word and members of the community vote according to his order (Henkels, 2001-2002). He has the power of requesting respect of traditional rules and plays the role of arbitration in case of litigation. After the king come the elders of the village, called *ray aman-dreny*, the latter are advisors and counselors to the king. A direct dialogue between the king and the members of the community is subject to a prior agreement or blessing of the elders.

However the creation of the National Park in 1991 has perturbed the traditional authorities with the coming of many outsiders in the region (e.g.: Malagasy from other

regions, foreign tourists, researchers (Henkels, 2001-2002). In fact, when villagers were asked during our fieldwork about their opinions on developing a PWS in their region, only 3.3% of the sample (3 out of 91) rejected the mechanism because they considered that such a decision should not be theirs but the king`s or elders. In addition, it seems that more villagers, 82% of the sample, would like to be more involved in any decision-making concerning their community (See details in Table 13).

Table 13: Villagers` perceived need for community involvement in decision-making

Need for community involvement	Freq.	Percent	Cum.
Always required	75	82.42	82.42
Not required	12	13.19	95.6
Variable	4	4.4	100
Total	91	100	

Tavy: ancestral agricultural practice

Particularly for the Tanala cultural group, slash-and-burn agriculture, or tavy, is an integral part of their ancestral customs (Henkels, 2001-2002; Peters, 1999). Nevertheless, it seems from the fieldwork in Ranomafana that the merits of slash-and-burn as described by the villagers are linked to technical aspects (Table 14).

Table 14: Stated reasons for practicing annual slash-and-burn agriculture

Reasons for practicing tavy	Freq.	Percent	Cum.
Easy land clearing	42	46.15	46.15
Increasing productivity	38	41.76	87.91
Expanding agricultural land	9	9.89	97.8
Tradition	2	2.2	100
Need for cash	0	0	100
Total	91	100	

3.2.4. Rules-in-use

It is reminded that rules-in-use are hybrids between state legislation (formal) and community devised-rules and norms (informal rules).

In this section, we will try to understand the historical evolution of environmental policy in Madagascar as well as the context in which its formal and informal rules are created. We will also review existing regulations relative to the development of PWS mechanisms in the country.

Belief in state rules

Madagascar has always believed in state rules to protect its natural environment despite difficulties in achieving its goals (Horning , 2008; Henkels, 2001-2002; Montagne & Ramamonjisoa, 2006; Duffy, 2006). Since the early 1800s, Madagascar has been concerned by the protection of its natural resources, especially forests, by establishing fire policies. Later on, its environmental strategy has been more focused on the creation of protected areas. For example, as early as 1930, first protected areas were created in Madagascar during the colonization. Many other protected areas were created since then, including the Ranomafana National Park. But the Durban Vision declared by the former President Ravalomanana in 2003, which was to triple the size of protected areas to reach 6 million ha was by far one of the most ambitious goal in Madagascar`s environmental history.

Significant external influence in environmental policy-making in Madagascar

Nevertheless, since its independence in 1960, Madagascar`s environmental policy making has been significantly influenced by especially powerful foreign donors and international NGOs (Henkels, 2001-2002, 2008; Montagne & Ramamonjisoa, 2006; Duffy, 2006).

Since Madagascar Government had always and continues to suffer from the lack of human and financial resources required to create and maintain its conservation institutions, it has no other choice than complying with donors` conservation development vision to be able to secure foreign aid (Horning , 2008; Duffy, 2006). In fact, Madagascar has heavily relied on foreign aid to finance its conservation institutions and programs even under different political regimes (Duffy, 2006; Horning, 2008). France was the main donor during the post-colonial period but the coming of multilateral assistance, mostly from the IMF and World Bank, in the 1980s because of the major economic crisis in Madagascar (Horning, 2008) has weakened the French influence.

Besides, many international conservation NGOs became interested in Madagascar as they declared the country as a top priority global conservation site because of its rich and unique biodiversity threatened by the severity of environmental degradation (Duffy, 2006; Horning, 2008).

Consequently, the Charter for Environment adopted in 1990, which is the legal foundation of Madagascar`s modern environmental law (Henkels, 2001-2002) was developed with a strong support from international donors and NGOs. In addition, the 15-year National Environmental Action Plan (NEAP) to achieve the objectives in the Charter was funded at 84% by international donors and NGOs for a total amount of 300.3 million \$ (Horning , 2008). Madagascar`s institutional framework was therefore created in 1990s with this external support, including most importantly the National Office for Environment (ONE) and the national agency to manage the network of protected areas, called nowadays Madagascar National Park (the original name being ANGAP).

In other words, the international community influences or drives the country's environmental legislation.

Enforcement issues

Madagascar's government has had difficulties to enforce its state rules if we consider only the massive deforestation during the last 20 years with the disappearance of approximately 2 million ha of forest from 1990 to 2010 (USAID, 2010).

The lack of human and financial resources to monitor all forests in the country (Montagne & Ramamonjisoa, 2006), the exclusionary environmental policy adopted until 1990 and the failure to integrate the customary laws into the modern environmental (Henkels, 2001-2002) have constituted the major challenging issues to environmental law enforcement.

The ban of slash-and-burn agriculture or *tavy* during the colonization exacerbated deforestation as it was regarded as a sign of independence and liberty among the Malagasy people against the colonial rule (Jarosz, 1993). The same effect was noticed with unilateral decisions made by the government on the creation of new protected areas after the independence in 1960 as those decisions are regarded as oppressing like under the colonial power (Montagne & Ramamonjisoa, 2006).

Creations of protected areas used to be centralized decisions and repressed the local cultural use of forest resources (Henkels, 2001-2002; Montagne & Ramamonjisoa, 2006). Likewise, the Ranomafana National Park was imposed to the villagers in 1991 without any grassroots participation in the decision-making process on its creation. This created serious conflicts between the park and the villagers who were suddenly forbidden to access and use the park resources (Peters, 1999). Indeed, confusion arose among the local residents regarding the meaning and implications of the national park. Some villagers considered it as an attempt to take away their land while others thought of it as another form of colonial power since foreign scientists and tourists can still enter the park.

Therefore, the legitimacy of environmental state rules, which were solely focused on the protection of natural resources, was ignored by the local population.

All these enforcement issues brought the government to adopt a decentralization policy from 1994. The management of renewable forest resources was to be transferred to local communities, which represented an important step for the participation of local communities, as main resource users, in environmental protection. However, due again, to the lack of resources, it took 4 years, that was in 2000, to enforce the law on local contract-based management of forests and contracts management were also slow in development (Montagne & Ramamonjisoa, 2006).

Informal rules or customary law on natural resources management

Madagascar has a strong tradition of customary law which is considered more legitimate by the population. In the Southeastern region, including Ranomafana,

villagers are used to agree upon a traditional pact abiding them; this is called *dina* (Henkels, 2001-2002). This *dina* may concern crimes, community work, any contractual relations or the village security. In the same manner, villagers are used to create a *dina* on the natural resources in their territory.

This customary rule is democratically adopted between the village members: the latter constitute the general assembly and the quorum of 50% is required to execute a *dina* which is afterwards recorded on wood or a paper.

As we described in section 3.2.3 the king has the power to request respect of these traditional rules. In case of litigation, the situation is first solved between the village members and reported to the elders if unsuccessful. The king's deliberative authority is required at the last resort. Besides, punishments upon violations of the traditional rules may constitute of fines or any agreed-upon penalties such as a sacrifice of zebus or in the worst case, the loss of the right of living in the village (Henkels, 2001-2002).

It is noted that the government has tried to integrate this customary law into the modern environmental law to promote the latter's legitimacy among the local population but the existence of contradictions has limited and created some problems in their application (Henkels, 2001-2002). In fact, while trying to promote the local-contract management of renewable natural resources, the traditional rule *dina* was integrated in the institutional design. First, the decision to have such contracts should originate from a community interested in managing natural resources in their territory. Interested members are required by the law to organize themselves under a *dina*, but this should be ratified by the Mayor or representatives of the national government. This aspect has complicated the legitimacy and the easy enforcement of the law, as it is in contradiction with the foundation of the traditional *dina* and disrupts the traditional authority and social order.

Review of regulations for PWS in Madagascar

Madagascar has already passed different laws which regulate the exploitation of its ecosystems since 1999 but these laws are not fully applied due to the lack of awareness of the general public (Randimby et al., 2008).

The MECIE-Decree (*Mise en Compatibilité des Investissements avec l'Environnement-Decree n° 2004-167 of 04.02.03*) which is a set of rules governing environmental aspects of investments in Madagascar represents an important framework for the exploitation of ecosystems.

As far as PWS is concerned, two legal texts support particularly the sale of water services:

1. The Water Code (law n°98-029 of 99.01.20). It stipulates that although water is a common resource or a public good, it can be valued through diverse uses such as irrigation, industrial use or hydroelectricity generation, with a prior authorization from the state agencies.

The constitution of a National Fund for Water Resources was stipulated under the Water Code for water resources protection in Madagascar. This Fund will include taxes or royalties collected on uses of water resources, their deterioration or the disruption of their regimes.

2. The decree regulating the functions of ANDEA (Decree n°2005-502 of 07.07.19). ANDEA is the National Authority in charge of the integrated management of all water resources and sanitation in Madagascar and is directly linked to the Ministry of Water. Amongst its diverse attributions, it collects taxes and royalties from all water uses and decides the optimal management and allocation of the National Fund for Water Resources. ANDEA has the legal power to request other sources of financing by passing the required law. In that sense, according to the law, ANDEA should play a significant role in regulating payments for water services.

It is noted that based on the inventory work on initiatives and legislations pertaining to PES in Madagascar (Randimby et al., 2008), no available information exists so far whether current regulations and rules serve as obstacles to PWS.

Interestingly for PWS, landowners have also the legal right to sell water services and community organizations have the right to sell or approve deals (Randimby et al, 2008). This legal right, complemented by the possession of land title by farmers, is favorable to a PWS development in Ranomafana. In fact, 84.62% of the interviewed households declared having an official title over their land with 75% of them stated that do not share this titling with any relatives.

3.2.5. Patterns of interactions

Since all key actors will have their share of responsibility and interests if a PWS is implemented in Ranomafana, understanding the nature of interactions existing between them is therefore essential for a successful implementation of this PWS.

Some actors, especially the international conservation NGOs are especially powerful compared to others due to their degree of influence and close relationships with donors. Their prominence is reflected in their interactions with other actors as we will describe in the following paragraphs:

NGOs and State

International NGOs are more powerful in lobbying the Malagasy government to implement their vision. In fact, the government has little room to maneuver due to the lack of resources. Consequently, even though the Government is a nodal point in the network of actors, it is just a partner among others and is not necessarily the most important one (Duffy, 2006). This nature of interaction has become evident since late 1980s when environmental protection gained more prominence among external donors.

NGOs and MNP

MNP and international NGOs have close interactions which were born from the creation

of the MNP with external funding during the phase 1 of the National Environmental Action Plan. Even if MNP is a national agency whose board of Directors is drawn from government ministries, international NGOs have their seats on this board and thus run this agency.

NGOs and local communities

The integration of local communities in the environmental management schemes started in 1996 with the decentralization of environmental policy in Madagascar. This allowed the development of their interactions with NGOs. Since then, NGOs and local communities are more and more involved with each other. Indeed, in Ranomafana region for example, NGOs such as the Valbio Research Center, IFD, WWF are used to conduct environmental education and training and implement development activities with the local population.

However, it is worth noting that not all conservation NGOs approved this community approach. Indeed, CI and WCS considered for example, that science-based view of conservation practice would be more effective (Duffy, 2006).

Local communities and State

The State and local communities may agree or compete with each other depending on their interests on the use of forests or natural resources (Horning , 2008). Indeed, from the Local Management of Renewable Natural Resources (GELOSE) law enforced in 2000, the State and local communities can sign a contractual agreement whereby the first ones gain rights and responsibilities of local resources management. The local communities should take the first initiative to request the local resources management in their territory and should organize themselves as a NGO. However the success of such contractual relations is mitigated so far (Montagne & Ramamonjisoa, 2006).

Local communities and MNP

Relations between the local communities and MNP have developed from the promotion of development activities in the peripheral zone of the Ranomafana National Park. In fact, 50% of the park entrance fees are allocated to the surrounding communities for micro-project development as compensation from the creation of the national park which deprived the villagers from accessing natural resources within the park boundaries, once sources of their livelihood.

Interactions with the Hydroelectric Company

How to integrate the private sector constitutes one major challenge of environmental conservation in Madagascar (Randimby et al., 2008). So far, interactions between the hydroelectric company and the State about environmental conservation has been formalized by the tax payment for the National Fund for Water Resources. Besides, this company has started to interact more with other actors such as NGOs with the creation of the working group on PES in Madagascar. Its interactions with local communities in Ranomafana region are rather limited, adding to the fact that villagers have no

electricity in their house.

It is important to note that interactions within the same set of actors are also complex: for example, among NGOs or among the community members.

International NGOs and local NGOs

NGOs tend to have collaborative partnerships with themselves rather than with private or public entities for the implementation of their activities or prioritization for conservation (WWF Conservation Strategies Unit, 2002; Duffy, 2006). Based on previous conservation project collaborations, partnerships between NGOs are maintained, which allows them to improve their approaches to new programs by capitalizing on lessons learned. International NGOs together with donors have also constituted a Donor Consortium which meets every month to determine future funding priorities and policies for Madagascar.

Usually, interactions between NGOs constitute of informed dialogues or debates (WWF Conservation Strategies Unit, 2002) based on prior assessment work for example.

However, the scale of power between international and local NGOs is divergent. The latter have to conform to international NGOs or donors` vision to secure their funding, which means that local NGOs` power is limited and they can be neutralized easily (Duffy, 2006).

Relationships between village members

Village members have also their personal characteristics and motives which influence their relationships with others. Even though they are governed by the traditional social order, villagers want more involvement in decision-making relative to their community (See section 3.2.3).

The fieldwork did not allow concluding whether the villagers` preferences are homogenous or not. The difference between individual preferences for a PWS contract (44% of the sample) and the collective preference (38%) is not significant. It seemed that some villagers are more individualistic than others but further investigations are required to draw a conclusion.

3.3. Institutional performance analysis

3.3.1. Transaction costs

3.3.1.1. Information costs

The information costs relate to the costs of searching and organizing information on the PWS mechanism.

Need of site-specific scientific data

Important scientific data that the different stakeholders still need to acquire for establishing a PWS mechanism in Ranomafana region concern the watershed dynamics or hydrological dynamics to determine the quantity of services provided. In fact, buyers need to have a high degree of scientific certainty on the linkage between changed land use practice and the yielded water services (Forest Trends, Katoomba Group, & UNEP, 2008). This means that documenting the current status of the ecosystem which serves as a baseline of the services provided is an important aspect. On the other hand, assessing its ongoing status over time allows knowing whether the ecosystem will continue or improve its service provision under a specific land management practice.

Considering that collecting these scientific data is highly technical and site-specific, the spatial targeting of PES sites in Madagascar which already exists at the national scale such as the one done by (Wendland et al., 2009) constitutes an interesting starting point for work in the particular setting of Ranomafana.

Information asymmetry between the villagers and other stakeholders

Information costs will increase if the different stakeholders do not share a common understanding of the PWS mechanism or the nature of issues to be addressed.

NGOs and public agencies are more informed on PES mechanism than villagers because the formers have already taken many initiatives to promote PES schemes in Madagascar. Since 89.01% of the sampled villagers never heard about a PES mechanism, this will eventually increase the information costs because the villagers still need to be trained and educated about this payment mechanism, its characteristics and its enacting conditions.

At least, the villagers are aware of the importance of forests and water regulation: 87.91% of the sample recognized that forests protect water sources in the Ranomafana region. This water regulation function has been identified by the villagers as one of the major functions of forests, which will reduce the costs of sensitization activities.

3.3.1.2. Coordination costs

Coordination costs include mainly the negotiation and monitoring costs related to the contract agreement between the sellers (villagers) and the buyers of the watershed services.

The negotiation costs will vary with the villagers` preference on the PWS contract type

Out of the 76 villagers who were willing to forego slash-and-burn under a compensation mechanism, 40 (or 53%) would prefer individual contracts and 34 (or 45%) would rather prefer a collective one. These results show that the preferences of the villagers are not completely homogenous as the proportion of individualistic villagers does not differ significantly from the proportion of people opting for collective agreements.

In that sense, further investigations are required if a PWS is to be developed in the Ranomafana region. Providing that more villagers would favor individual PWS agreement, the transaction cost will likely to be enormous since negotiations would involve many smallholders.

The negotiation costs will also vary with the perceived development priorities

Besides the contract type preference, the development needs of the villagers can demonstrate the homogeneity of their preferences. Figure 14 shows the development needs per village based on the fieldwork. They can be classified in 6 main categories:

- income generating activities through technical training & assistance, job creation, village accessibility, markets for products,
- basic utilities such as electricity, water & sanitation,
- health through health center construction,
- education through the construction of schools,
- social activities with more community centers
- other development initiatives (church, leisure, houses, hotels or agricultural land).

It is noted that each respondent was asked about his/her needs in terms of development in his/her village without presenting him/her any prior choices. Each respondent could have therefore more than one answer.

The development needs vary from village to village. Therefore, the negotiation costs regarding the nature of payments, for example, in terms of development projects would vary between villages and care should be taken to focus on development priorities perceived by most of the villagers.

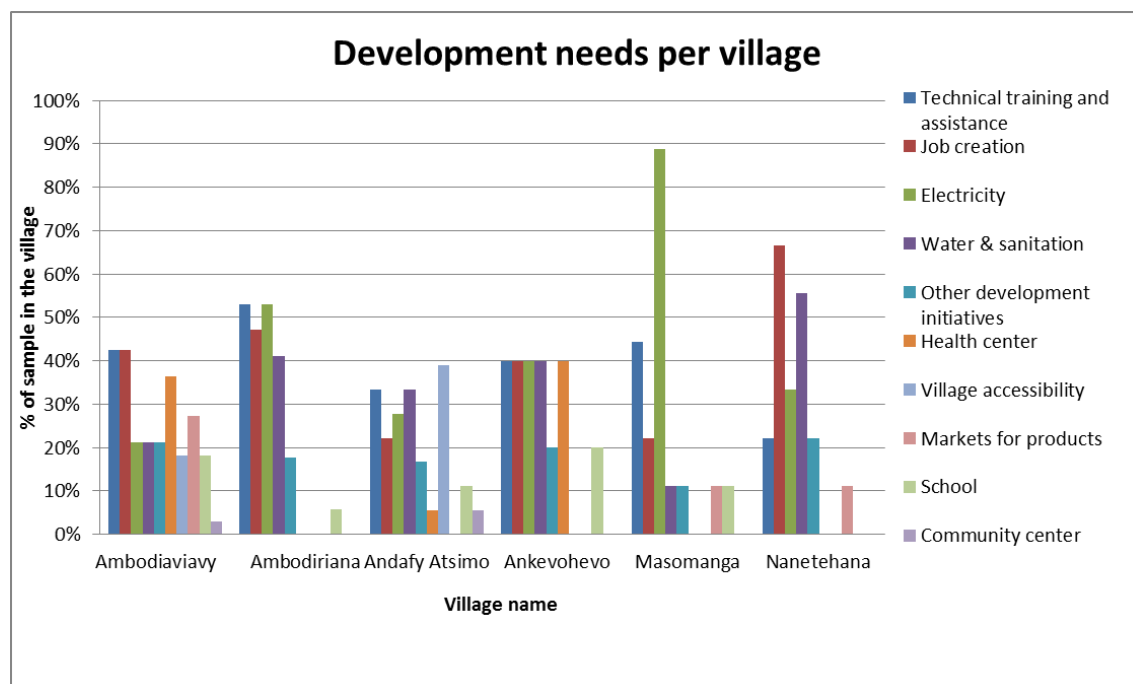


Figure 14: Development needs per village

The villagers need more technical support to negotiate a PWS deal

The last component of the survey questionnaire was to assess the technical capacity of the villagers, whether they have enough experience to manage environmental/development projects and agreements such as in the case of a PES mechanism.

They were asked whether they have already been involved in any environmental projects or activities such as environmental sensitization, reforestation, technical training or so on. Then, their frequency of involvement was evaluated as well as their degree of involvement, whether they contributed mostly to the implementation of the activities or whether they participated since project design.

Basically, 50% of the sample has been involved in at least one environmental project, mainly through a technical training, reforestation program or environmental sensitization (See Figures 15, 16 and 17).

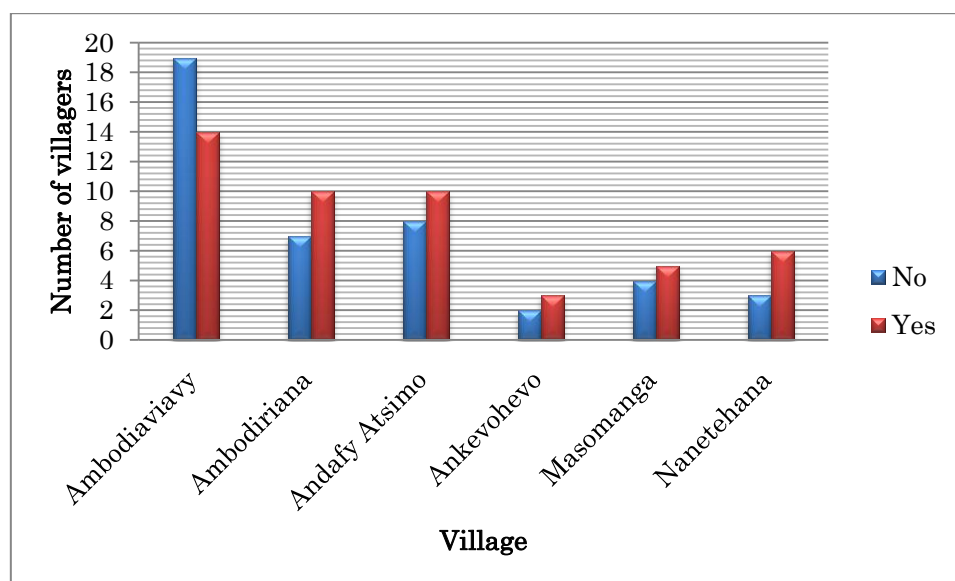


Figure 15: Analysis of the existence of the villagers' technical capacity per village

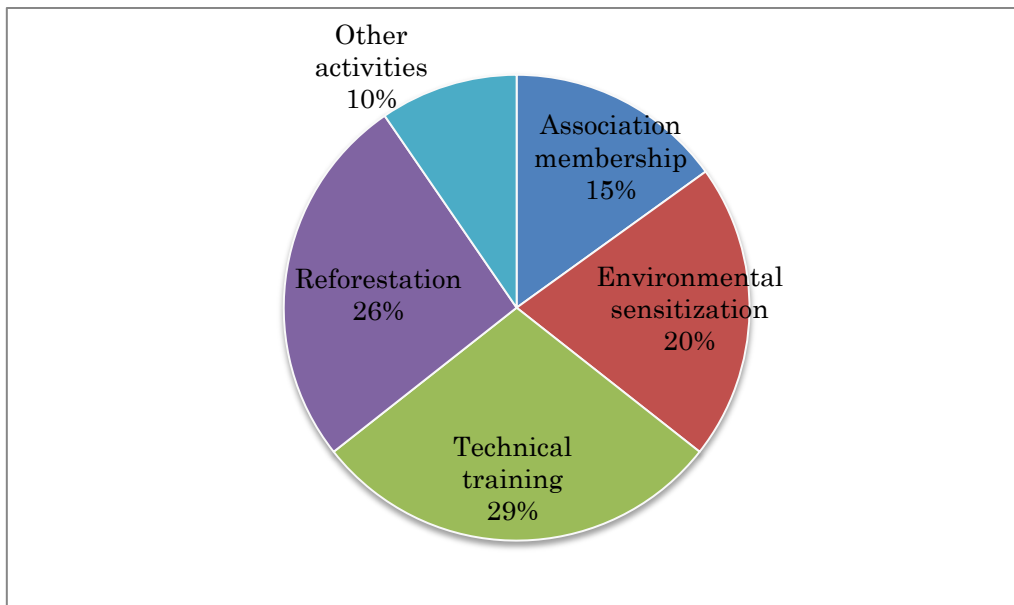


Figure 16: Variety of experience

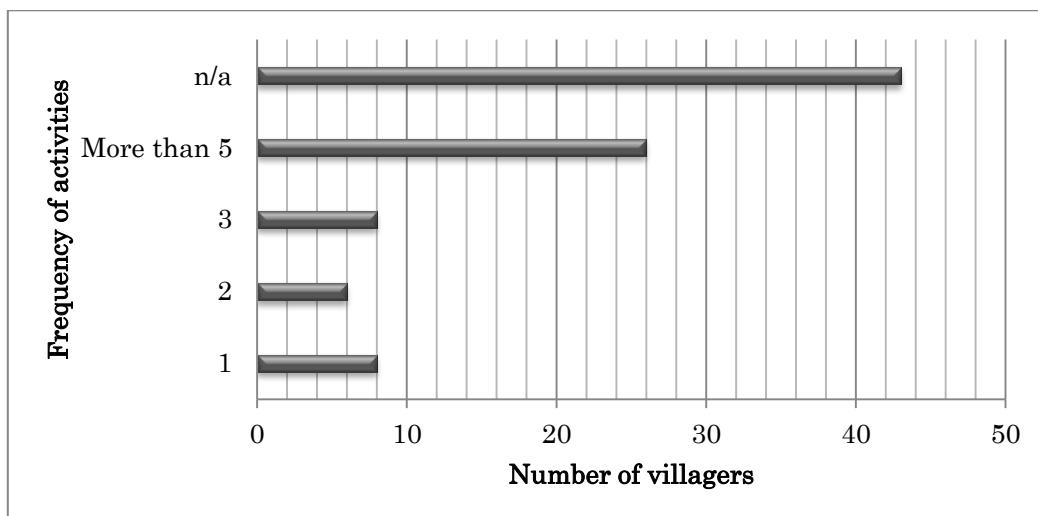


Figure 17: Frequency of activities

However, most of the villagers were used to implement activities rather than initiating ones by themselves (Figure 18). This implies that supports from institutions or organizations are highly required if it is to develop any PES agreement in the region or to make it successful.

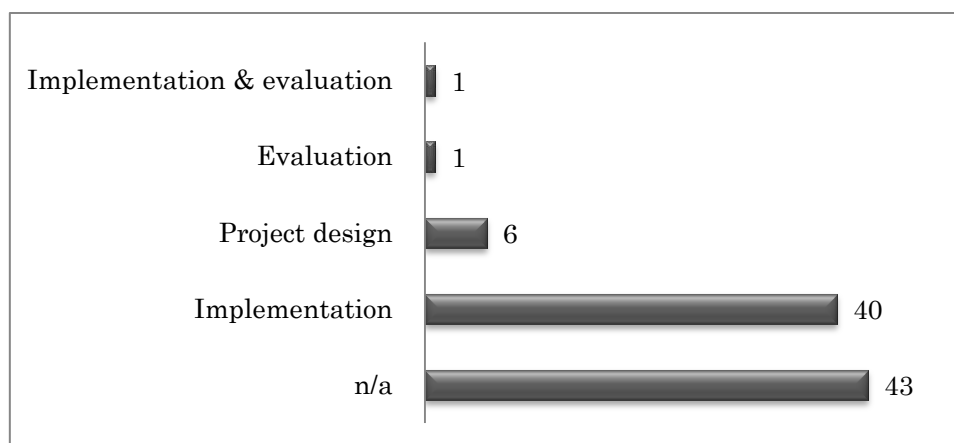


Figure 18: Degree of involvement in environmental activities

Surveying available PES-support services and organizations

All NGOs and development projects in Ranomafana region can assist the villagers in implementing a PWS scheme.

From a survey of available organizations and institutions in Ranomafana, possible support providers, as well as the main technical services they can provide, are summarized in Table 15. These are mostly NGOs and internationally-funded development projects which started to increase since the creation of the Ranomafana National Park in 1991.

Table 15: Possible support organizations and services in Ranomafana

<i>Technical support services</i>	<i>Description</i>	<i>Available providers</i>
Project Development	Preparation and training in PWS, developing business plans, and advising on implementation	<ul style="list-style-type: none"> • Park Management Service: MNP • NGOs: ValBio Research Centre, WWF, CI • Development projects : ERI, PSDR, IFD
Brokers	Facilitation of negotiations between the villagers (sellers) and buyers	
Measurement	Determination of the value of watershed-based service	
Technical Assistance for Improved Land and Resource Management	Expertise on sustainable land use and resource management	
Financing	Provision of necessary operating funds to implement activities	

Assessing PWS monitoring capacity and costs

The monitoring activity consists mainly in a regular collection and analysis of the watershed-based services data to ensure accountability and compliance (Forest Trends, Katoomba Group, & UNEP, 2008).

As stipulated in the Water Act, ANDEA is already responsible for coordinating watershed management in Madagascar. Its decentralized structure is supposed to facilitate monitoring activities at the regional and local level (see figure 19): a watershed agency is implemented at the province level, and watershed committees composed by representatives of the state, water users and local communities are present at the local level (CITE, PS-EAU, & GRET, 2011).

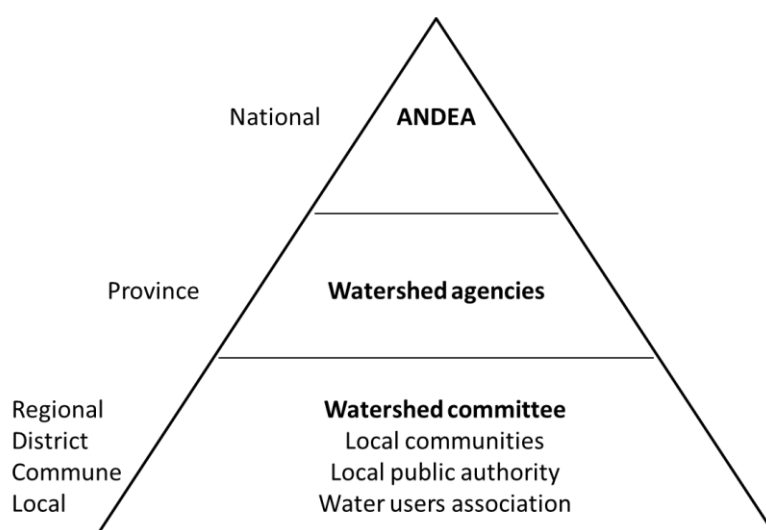


Figure 19: ANDEA and its decentralized structure

According to the Decree n° 2008-397, ANDEA is financed by the National Fund for Water Resources which is constituted by royalties collected from water users. As this fund was not yet operational in 2010, ANDEA could not fully operate (CITE, PS-EAU, & GRET, 2011). Its limited resources, in terms of human, finance and technology reduce its capacity to monitor all watersheds.

Besides, the monitoring costs will increase due to the small landholdings. This could be reduced by enforcing severe sanctions for non-compliance to the PWS agreements (Wunder et al. 2008). However, Madagascar has not yet any specific regulations or compliance provisions on PWS agreements as such.

3.3.1.3. Strategic costs

The strategic costs result mostly from power and information asymmetry. They mainly consist in free riding; rent seeking and corruption i-e some stakeholders will try to obtain more benefits at the expense of others (Ostrom et al. 1994). Strategic behaviors may prevent some villagers from participating in a community-based PWS deal. This

would be costly since the transaction cost increases with the number of actors involved. However, even if a community-based arrangement is possible, care should be taken to prevent community elites from capturing all benefits, for example, by deciding PWS funds allocation.

The positive and negative factors affecting the level of transaction costs in case of a PWS development in Ranomafana are summarized in Table 16.

Table 16: Factors affecting the level of transaction costs for PWS activities

<i>Positive factors for PWS transaction costs</i>	<i>Negative factors for transaction costs</i>
<ul style="list-style-type: none"> • Development of PES spatial targeting researches at the national level • Presence of possible technical support providers in Ranomafana and capitalization on their project experiences with the villagers (e.g.: NGOs, development projects...) • Pre-existence of monitoring agency (ANDEA) • Decentralized monitoring structure 	<ul style="list-style-type: none"> • Need of site-specific scientific information on PWS • Possible disparity of preferences in some villages (e.g.: contract type, development needs...) • Need of technical support and training on PWS for the villagers • Limited resources for monitoring activities • Absence of specific regulations on PWS agreements and compliance provisions • Large number of farmers with small landholding involved in the PWS negotiation and agreement

3.3.2. Overall institutional performance

Based on the IAD framework, the overall institutional performance is assessed with the following criteria: efficiency, equity or fairness, accountability, and adaptability.

3.3.2.1. Need of balance between efficiency and equity

In a PES mechanism, the efficiency and fairness of existing institutional framework are assessed based on how PES recipients are identified. According to Wunder (2007), for a PES to be efficient, only those who constitute a credible threat to service provision or are likely to actively increase provision should be paid. For a PES to be fair, one would like to compensate all losers from the implementation of the PES. However, this would be prohibitively expensive, and thus, inefficient. As many stakeholders are affected by the PES design (see section 3.2.1), it is therefore difficult to accommodate all their interests.

Challenges in spatial targeting of PES sites in Madagascar

The balance between efficiency and fairness can be achieved by clarifying the real “additionality” when targeting PES recipients: “additionality” implies clear incremental effects on conservation compared to the baselines (Wunder, 2007) i-e that scientific information on the linkage between a specific land use and its impact on ecosystem service provision is essential.

However, under current institutional framework, international conservation NGOs such as WWF and CI choose their PES sites among their existing project sites. This spatial targeting is based on the level of threats but not directly on the provision of ecosystem services (personal communication with WWF Conservation Director).

Nevertheless, researches on spatial targeting of PES sites started to develop at the national level. Three main criteria were used to identify potential sites: the provision of ecosystem services, the level of threat and level of opportunity costs (Wendland et al., 2009). However, one major limitation to existing studies is that site-specific data is still scarce, more importantly, scientific data on the linkage between a specific land use practice and the provision of ecosystem services.

Challenges in ensuring efficiency and fairness at a local site

Until now, no specific rules govern the identification of PES recipients among members of the same community. Questions arise on the selection criteria such as, the importance of land tenure security i-e possession of land title versus customary right. Some villagers may threaten to increase their frequency of slash-and-burn practices to receive watershed payments.

3.3.2.2. Accountability

Accountability under a PWS scheme refers to enforcing rules and assigning watershed payments to the correct actors.

Challenges in enforcing environmental laws

As seen before (section 3.2.4), Madagascar is characterized by a weak law enforcement and the environmental aspect is no exception. This is due to three main factors: limited resources, failure to integrate customary laws into modern environmental policy, and the exclusionary approach (Henkels, 2001-2002; Montagne & Ramamonjisoa, 2006).

These weak institutions will affect the success of new PWS deals. Institutions in place should be able to monitor and sanction any non-compliance for example by withholding payments when a farmer failed to comply with the PWS agreement.

Challenges in assigning watershed payments to private sectors

Current institutions prevent from promoting direct payments from private sectors under a PWS scheme. The hydroelectric company JIRAMA was targeted in my case study as

it is the major water user company in Ranomafana. However, based on our interview, JIRAMA is not willing to provide any additional payments under a PWS scheme as it pays already some royalties based on its sales revenue for the National Fund for Water Resources which should be used for watershed protection.

In addition, the stakeholders have competing views on the payment accountability, for instance, which of lay people, farmers or private companies should provide the payment (see table 10 in page 37). Lay people and farmers are important water end-users but poverty constitutes the main barrier to collect payments from them (Ferraro, 2009).

3.3.2.3. Adaptability

Institutional adaptability refers to the ability to change the rules quickly to address new problems. However, based on our previous analysis, current institutions have limited capacity for adaptation without the support of international donors and conservation NGOs

Madagascar has known serious environmental policy problems since its independence. These originate from a disagreement on the nature of the problems to be addressed (slash-and-burn) and disagreement on solutions. Interests of international conservation NGOs and the State competed with those of local communities who are used to ensure their livelihood through the use of natural resources.

Highly centralized and exclusionary environmental policies had problems in penetrating the institutional layers of the Society. Attributes of the community which manifested in its rules-in-use and traditional structure were not integrated in environmental decision-making processes. Consequently, as in the case of Ranomafana National Park, unilateral establishment of protected areas created conflicts with the local population in the peripheral zone.

Therefore, decentralization of resources management from 1996, as a new institutional form, has increased, yet slowly, the institutional adaptability by enhancing collaborative partnerships with local communities.

4. Findings on institutional framework and technical capacity

By using the IAD framework, we could develop a comprehensive understanding and assessment of the institutional context which affects the possible development of a PWS mechanism in Ranomafana. Following findings are identified:

- A complex network of actors, including public and private organizations and individuals are involved in the Ranomafana watershed management. Since they have different interests, it is difficult to accommodate all of them. Therefore, it is important to have a platform that will ease discussions and interactions between these actors to facilitate consensual agreement on solutions.

- International donors and conservation NGOs have always had a prominent influence over other actors and on environmental policy. Capitalizing on their technical assets and their access to information and resources will enhance the success of a new PWS implementation.
- Past experiences demonstrated that exclusionary approach for environmental policy-making will lead to conflicts and may exacerbate the practice of slash-and-burn. Failure to integrate factors such as bio-physical conditions, attributes of the community and rules-in-use will prevent from penetrating the institutional structure of a Society and from devising successful incentives for sustainable land use practices. Farmers in Ranomafana have already expressed their willingness to change their land use practice upon receipt of an economic incentive. The voluntary aspect of a PWS mechanism represents therefore a promising approach for a new and effective institutional design.
- The framework is already in place for the hydroelectric company to make payments by paying royalties for the National Fund for Water Resources. However, the main weakness is that payments are made to a public agency rather than directly to actual community members.
- One major institutional challenge for a sustainable PWS in Ranomafana region is the lack of scientific information clarifying the impact of slash-and-burn agriculture on the watershed quality and determining the real additionality from adopting a new land use practice. All actors share already a common belief on the linkage between slash-and-burn and the Namorona watershed quality, however, clear scientific information will favor efficiency and equity and will stimulate sustained payments.
- Other institutional challenges which increase the transaction costs concern the possible disparity of preferences in some villages for example, on the contract type or development needs; the need of technical support and training on PWS for the villagers, the limited resources for monitoring activities, the absence of specific regulations on PWS agreements and compliance provisions and finally, the possibility of a large number of sellers (households) with small landholding involved in the PWS negotiation unless a community agreement is used.

CHAPTER 5: DISCUSSION AND PWS DEVELOPMENT

♦ *PWS as a potential mechanism for diminishing threats from slash-and-burn agriculture in Ranomafana region*

In light of our socio-economic and institutional analyses, a PWS mechanism can be put in place in Ranomafana for the following reasons:

- (a). The demand for the watershed services is clear and financially valuable to a potential buyer, namely the hydroelectric company JIRAMA.
- (b). The provision of this watershed service is threatened by slash-and-burn practices, but abandoning this unsustainable land use has the potential to address the problem.
- (c). NGOs are active in the Ranomafana region and can serve as intermediaries to assist the villagers and the potential buyer in developing negotiations and sharing expertise on PES
- (d). Villagers have a clear land title
- (e). Existing policies and laws do not forbid the market-based mechanism under a PES scheme.

Nonetheless, a successful PWS design in Ranomafana has to capitalize on these potentialities and address the identified barriers. Our research findings are discussed and categorized under the main PES criteria.

♦ *Buyer*

The potential buyer, identified as the hydroelectric company JIRAMA, has no direct willingness-to-pay to the upland villagers unless new regulations force it to do so. This represents a key obstacle for a private PWS agreement. In fact, the company pays already a tax (royalties) to constitute the National Fund for Water resources which should be allocated for watershed protection. These mandatory user fees which should not be specifically earmarked directly to service providers are common in many developing countries (Dillaha, 2007). For example, hydropower plants in Colombia pay 6% of their gross sales revenue for environmental and watershed protection (Landell-Mills & Porras, 2002).

In practice, PES may be perceived as another unwelcome tax or fee when potential buyers are already paying various taxes to the national and local government and/or putting funds aside for community development activities (Dillaha et al. 2007). In addition, since JIRAMA has the monopoly in electricity and water supply in Madagascar, it may have less incentive compared to many private enterprises which voluntarily engage in PWS deals to improve their reputation through their corporate social responsibility activities (Ferraro J., 2009).

♦ *Sellers*

Two favorable preconditions would facilitate the implementation of a PWS in

Ranomafana when considering the sellers: (1) the potential sellers, identified as the upland communities in Ranomafana region are willing to abandon slash-and-burn under a conditional compensation; (2) most of the farmers have a land title which secures control over the land use practice.

This land tenure security rejects general findings on developing countries where land tenure insecurity was often cited as a major barrier to PES development (Ferraro, 2009; Landell-Mills & Porras, 2002; Dillaha et al. 2007; Huang et al. 2009; Wunder S. 2007). In fact, communities in the peripheral zone of the Ranomafana National Park were one of the communities surrounding 5 protected areas which benefited from a free and individual land titling program between 1993 and 1996 under the first phase of the National Environmental Action Plan. The key goal of that program was to reduce pressures on the protected area based on the assumption that the possession of a land title would induce farmers to invest in intensive agriculture, and thus, reduce pressures from slash-and-burn. However, the program failed to achieve its goal since the determinants of the decision to adopt an intensive agriculture by farmers were more tied to resources availability, such as credit, tools, technical knowledge than land tenure security (Ramamonjisoa, 2001). Based on our survey, the situation has not reversed since farmers in Ranomafana region still grow rice in a traditional way due to the lack of resources and technical capacity.

Few barriers related to the potential sellers exist. Not only these farmers are poor and smallholders, but they have a low technical capacity and low awareness on PWS. Their preference for individual deals would also largely increase the transaction costs.

♦ *Conditionality and environmental service provision*

The key obstacles in Ranomafana undermining the possibility to enforce a real environmental conditionality are the lack of baseline on hydrological data and the lack of reliable methods for rapid assessment or monitoring systems.

Proposed PWS models and policy recommendations

Since the objectives of the National Fund for Water Resources and those of our proposed PWS scheme seem to overlap regarding watersheds protection, it is understandable that the hydroelectric company is not willing to provide a double payment under a PWS scheme. The two approaches differ however in that the water fund is managed at the national level whereas a PWS scheme is by definition a direct agreement between the beneficiaries of the watershed and the service providers, which is at the local level. My initial hypothesis was to promote a direct compensation mechanism from the hydroelectric company (JIRAMA) to upland farmers.

In that sense, two possible PWS scenarios are in Ranomafana:

- (1) The PWS scheme is integrated with the National Fund for water resources
- (2) The hydroelectric company directly pays upland farmers

Scenario 1: The PWS scheme is integrated with the National Fund for Water Resources

The major advantage of this scenario is to capitalize on the basic payment infrastructure and regulations that are already in place to channel payments from the hydroelectric company.

However, the existing institutional infrastructure presents some weaknesses. The compulsory payments to constitute the National Fund for Water Resources through royalties do not generate resourceful information from companies such as which watershed and services should be protected. Water users cannot withhold their payments if they do not receive the desired services and payments do not target any specific watersheds. Since ANDEA solely governs this National Fund, it decides its allocation to watershed agencies at the province level based on its conservation priorities which marginalize watershed users' needs. In fact, water funds are not necessarily returned to the province which generated them through royalties.

To address these issues, a new form of payment scheme can be introduced in the regulations for a successful PWS (See Figure 20). As in the case of PES schemes in Costa Rica (Pagiola, 2008), voluntary payments from water users such as hydroelectric companies or water bottlers, can be encouraged in parallel. Companies providing direct funding would build a financing agreement with ANDEA and can agree on the funds purposes. This structure would solve the problem of transparency under current institutions as the companies would be able to leverage the use of their funds.

To avoid double payments for conservation, the companies should be legally allowed to deduct their direct payments to ANDEA from the amounts due under the water royalties.

At the local level, watershed agencies can handle applications for the PWS scheme from the farmers, sign contracts and monitor implementation. Technical supports from local NGOs are needed to help villagers participate into the scheme.

Nevertheless, the main disadvantage of integrating the PWS scheme in the National Fund would be the lack of PWS efficiency. The hierarchical structure of ANDEA would increase transaction costs as the number of actors involved would increase and the payment process would be long and suffer from heavy bureaucracy. This would complicate the direct compensation of farmers.

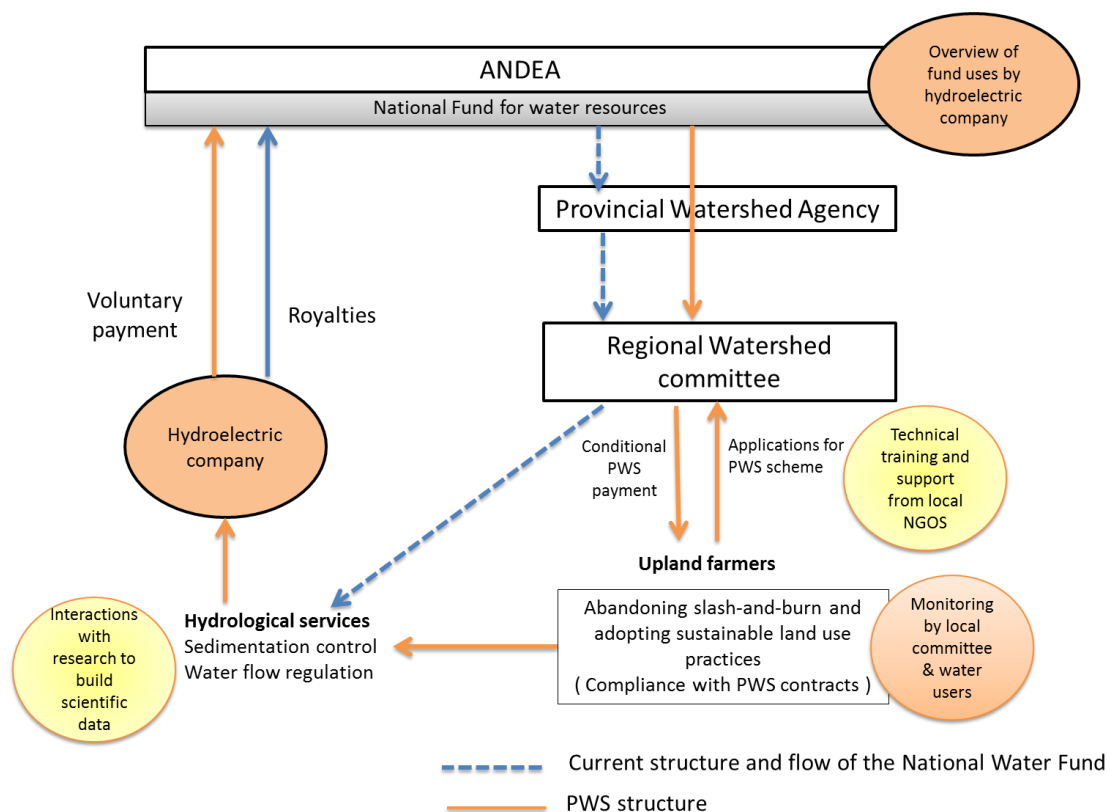


Figure 20: Scenario 1 of PWS model: The PWS scheme is integrated with the National Fund for Water Resources

Scenario 2: The hydroelectric company could directly pay upland farmers

The main motives behind this scenario are to encourage decentralized payments at the local level and promote more involvement of the local population (see figure 21).

The proposed scheme is inspired by the successful scheme in Pimampiro, Ecuador which is one of the rare PWS schemes in the world presenting the 5 PES criteria (Wunder, 2008). Under this second model, a local fund for watershed protection through a PWS scheme is suggested. This would include royalties from the hydroelectric company, and possible funding from the Commune and local NGOs. This fund would be overviewed by all stakeholders of the local PWS scheme, including the hydroelectric company, the Ranomafana Commune, local NGOs (assuming they bring some financial support) and representatives of the local community.

Royalties paid by hydroelectric company would be directly targeted for the watershed protection in Ranomafana.

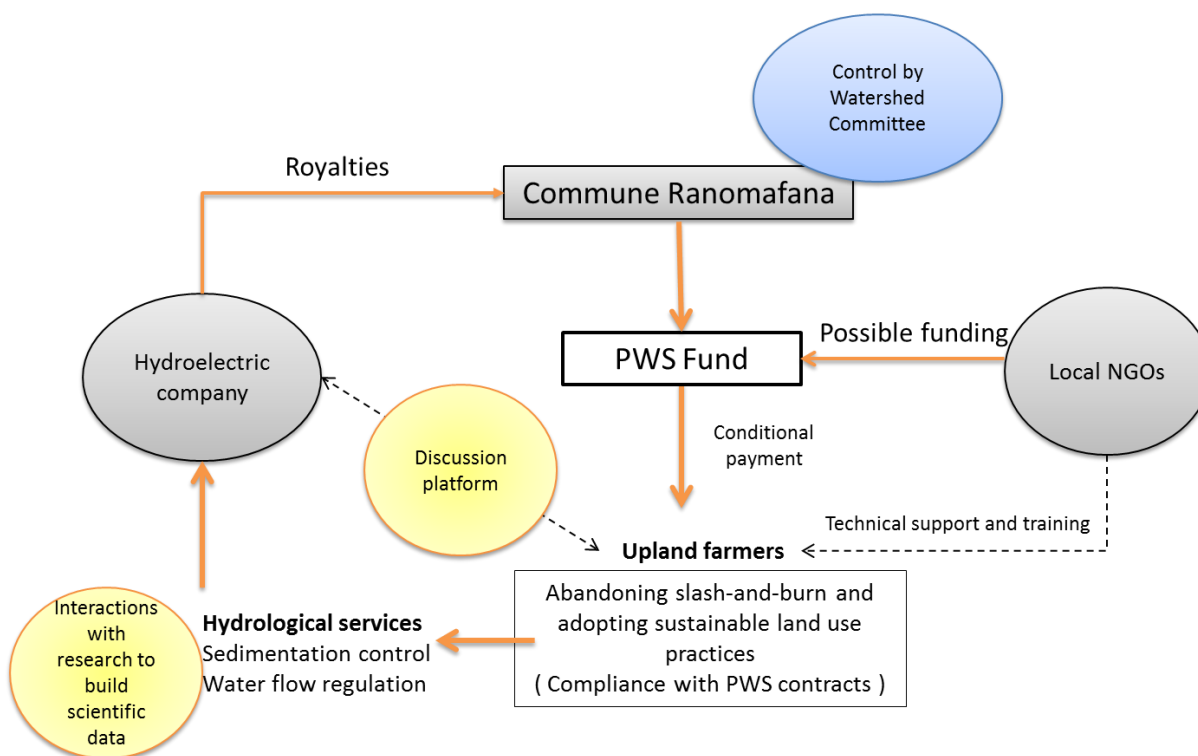


Figure 21: Scenario 2 of PWS model: Decentralized scheme

This model would have the advantages to be more effective and efficient. It can create a discussion platform between all the stakeholders and its local setting would especially facilitate local population's participation in the PWS design, noting that the role of local communities has been overlooked in past environmental strategies. Returning the funds to where they were generated would give more incentives to the company to be more involved in the PWS scheme. The simplified payment transfer would lower transaction costs.

Besides, PWS contracts may be managed at the Commune level. However, in case Ranomafana Commune has not yet the required competences and resources for such a new mechanism, supports from local NGOs would be beneficial.

However, the major obstacles to the feasibility of the scenario 2 are mainly political factors as it suggests important reforms of existing institutions. It challenges the current belief that watershed protection is the government responsibility. ANDEA and its decentralized structures (regional watershed committees) would have lesser power and influence in prioritizing watershed management even though they would monitor the PWS activities on the ground. Since the hydroelectric company would not be willing to pay twice for watershed protection, scenario 2 would be only possible if the payment for the National fund for water resources is substituted by direct payments at the local level. Dissolving this national fund which has just started to be operational or diverting its allocation from its conceptual goal seems therefore to be highly difficult.

In either scenario, the following recommendations are also proposed:

Recommendation affecting the sellers:

- *A pro-poor PWS scheme should be promoted in Ranomafana region to reverse the vicious circle between poverty and unsustainable agricultural practices.* Two main policy measures should be adopted: (1) reduce the transaction costs to allow poor landowners to participate (Landell-Mills & Porrás, 2002; Grieg-Gran et al. 2006); (2) remove inappropriate access restrictions to the PWS scheme (Grieg-Gran et al. (2006). Possible ways to reduce the transaction costs are to design simple contracts and to strengthen cooperative institutions within a community to allow poor landowners to share the costs. On the other hand, the scientific relationships between the new land use practice and watershed service should be used as the main criterion to select PWS participants as discriminating poor farmers without an official land title might be too excessive when they have *de facto* control over their land.

Nevertheless, since most of the farmers would like to join the PWS mechanism, they already expect to benefit from the scheme since PES participants are considered as rational individuals who will accept to participate only if it matches their own interests (Wunder et al. 2008, Engel et al. 2008).

- *A technical training is required to improve the farmers` capacity and PES knowledge.* Training can focus on market management, contract negotiation and management, conflict resolution and other technical skills related to sustainable agricultural practices.
- *A collective action should be promoted among the farmers.* Not only this will reduce the transaction costs but since these farmers are all small landholders, a high level of cooperation and coordination among them is required to secure desired watershed services. This was the case for most Asian PWS schemes which involve small landholdings (Dillaha et al. 2007)
- *The role of NGOs to achieve these goals is fundamental.* Technical and financing supports from NGOs or development projects in Ranomafana (see section: Surveying available PES-support services and organizations in 3.3.1.2) are essential to ease the implementation and negotiations of the PWS agreement, and also to generate collective actions. This important role of NGOs represents a successful factor for PWS schemes implemented in many other developing countries. For example, a local NGO, Fundación Natura Bolivia facilitated the success of a PWS scheme for the protection of the Los Negros watershed in Bolivia. This NGO provided technical capacity building, motivated landowners, and was an intermediary to the PWS agreement (Asquith et al., 2008). It is noted that in Asia, the potential of PES at many sites would not probably be realized, at least in the short term without intermediaries (Dillaha et al. 2007). Working with a third-party intermediary such as an NGO presents also the possibility to reduce the costs of working with a large number of farmers (Jack et al. 2008).

Recommendations on conditionality and environmental service provision:

- *It is urgent to conduct more precise hydrologic studies and have more precise data on the linkage between abandoning slash-and-burn and the provided watershed service.* Precise hydrologic studies would help to build a baseline on the level of watershed services prior the PWS implementation. International conservation NGOs may provide their expertise and resources to collect this key information since such studies would inevitably increase the transaction costs and constitute a significant impediment to the PWS development.
- *Until precise hydrologic studies are available, the change in land use should be the basis of payment to reduce the persistent threat from slash-and-burn.* This is also because it takes time for watershed functions to recover after soils have been disturbed (Southgate & Wunder, 2009).
- *Strict conditionality should be adopted for more environmental gains.* As demonstrated by the PWS scheme in Pimampiro, Ecuador, maintaining a strong conditionality would yield more environmental benefits by sanctioning infractions to the terms of the agreement. Farmers who fail to abandon slash-and-burn may temporarily or permanently lose payments and these should be stipulated in advance in the PWS agreement to prevent possible conflicts. For example, in the case of Los Negros in Bolivia infractions will exclude the PES recipients for 5 years (Asquith et al., 2008).

Recommendations to promote a voluntary approach

- *An information support center should be created.* This would be a contact point where potential PWS participants can get advice on contracts and also on the mechanism in place.
- *The buyer and the farmers should both have the option and the ability to re-negotiate at any points if conditions change* (Engel et al. 2008). Empowering the poor farmers is therefore essential as they have lower scale of influence compared to other stakeholders (see table 11). This reinforces the earlier need of technical supports from available NGOs or other supporting institutions.

PWS and new conservation funding

Due to the lack of willingness-to-pay, we could not determine the new potential source of funding from a PWS mechanism in Ranomafana. Yet, it is important that an average payment as low as 611\$/year is requested by the farmers. Nevertheless, it is important to emphasize that the key concept behind sustainability in here is not a continued financing. The financing should be a temporary intervention with the aim of changing the behavioral patterns of the villagers so that biodiversity can be conserved (Castro, 2003).

CONCLUSION

Had the environmental law been effectively enforced from the outset in Madagascar, assessing a PES mechanism would not have been required, at least not for environmental purposes. Slash-and-burn agriculture is much more than an environmental issue which could be addressed through the creation of protected areas. It is also deeply rooted in socio-cultural and economic issues. By definition, a PES mechanism has the potential to give an economic incentive to change land users behavior and is supposed to be more cost-effective than conventional command-and-control environmental strategies. This study tried to explore this possibility in Madagascar since such kind of mechanisms is still nascent in the country and in Africa in general.

Based on the Ranomafana National Park and its peripheral zone as a case study, this study has contributed to an assessment of the possible implementation of a PWS in the region through a holistic approach. The potential of a PWS scheme was preliminary assumed by structuring the dynamics of the slash-and-burn in the region and determining the weaknesses of current environmental strategy. The study highlighted the major barriers and favorable conditions in terms of socio-economic and institutional aspects for the PWS development. This holistic approach differentiates this research from existing studies and has provided a comprehensive understanding of the local context. At the end, two scenarios for the payment model could be suggested: one integrating the PWS scheme with the National Fund for water resources and one promoting decentralized payments through direct payments to the service providers (upland farmers) which represented my initial hypothesis. Choosing between the two scenarios requires a balance between efficiency and effectiveness of the PWS scheme. The political will appeared also to be an important determinant to this final decision. However, unless the interests of all stakeholders are integrated and effective incentives are created to encourage involvement to the PWS design, the PWS will be unsuccessful as were the conventional and exclusionary environmental strategies. In fact, participation of all stakeholders in the PWS design will ensure that the scheme has a large support as it evolves. Nevertheless, whichever scenario is adopted, the system should be able to learn from lessons and adapt to changing situations to be sustainable.

The holistic approach towards addressing slash-and-burn agriculture helped to determine a sustainable solution to complement existing ecotourism in Ranomafana: this is a PWS scheme. However, this research has some limitations. The existence of potential watershed services in Ranomafana was based on common belief and on general findings of a spatial targeting of PES sites at the national level by Wendland et al. (2009). Further site-specific studies are therefore needed to characterize this watershed service and to establish the scientific link between a specific land use practice and the watershed quality. Besides, the possible conservation funding from the water beneficiaries (the hydroelectric company) could not be determined and compared to the compensation required by the villagers due to the lack of willingness-to-pay.

Assuming that a PWS mechanism is adopted in Ranomafana, it should be however adopted as part of the broader policy approach (Engel et al., 2008; Wunder, 2007).

Further researches can consider the possibility to bundle PWS with other payment mechanisms for more effectiveness. The Ranomafana National Park has other significant ecological services that can be valued internationally, namely its landscape beauty and rich biodiversity. For example, payments from tour operators may be investigated for the landscape beauty valuation and pharmaceutical industries can be targeted for bio-prospecting. Attracting international buyers with higher willingness-to-pay will be more viable, as this seems to constitute a key challenge to the development of a PWS mechanism in Ranomafana. Van Beukering et al. (2003) estimated for example, that biodiversity conservation in a tropical rainforest park in Indonesia would yield \$1 per hectare from bio-prospecting fees. Since a drug discovery and biodiversity program has already been implemented in Ranomafana since 2003 with Stony Brooks University and ICTE by focusing on traditional cough remedy and anti-malarial ingredients, finding ways to attract international pharmaceutical industries and to structure a sustainable payment from bioprospecting will be beneficial, not only for environmental goals but also for poverty alleviation in the peripheral zone to the National Park.

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