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Payments for ecosystem services from watershed protection: A methodological assessment of the Oasis Project in Brazil

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ABSTRACT

This study evaluates the methodology of payment for ecosystem services (PES) adopted in the Oasis Project in order to compensate landowners that voluntarily accept to conserve natural forest areas associated with watershed protection, with special focus on the experience of Apucarana, in the state of Paraná, Brazil. It is argued that the establishment of a payment scheme combining the opportunity cost of land and indices for the quality and quantity of conservation (considering water resources, natural areas conservation, and best agricultural practices) guarantees more efficiency in terms of the conservation area that can be achieved using the same financial resources. This study also discusses other conditions for the successful implementation of new PES opportunities in Brazil, such as the involvement of local authorities, monitoring, and sources of funding.

Introduction

There is an increasing perception regarding the importance of conserving ecosystem services for human well-being, including biodiversity conservation, regulation of climate, soil conservation, carbon storage, nutrient cycling, and water resources, among many others. There are many different definitions for ecosystem services in the literature, for example, those that provide the conditions and processes to support life and, direct or indirectly, contribute to human survival and well-being (Medeiros & Young, 2011; FAO, 2007; ISA, 2007; Robertson & Wunder, 2005).

However, there is wide criticism to regulation restricted to command and control instruments, such as fines and other penalties for those that do not comply with the environmental legislation. The main reason presented is the lack of flexibility provided to economic agents to solve these problems. Some authors (Young *et al.*, 2009) discuss these issues in the context of Brazilian forest conservation, with the similar result that command and control policies have been insufficient to reach the desired goals of conservation.

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Therefore, the use of economic instruments is important to provide flexibility in the compliance of environmental targets, as a complementary tool to the command and control approach. In Brazil, there are already some interesting experiences of economic instrument in environmental policy, as demonstrated by Young (2005) and Medeiros & Young (2011), including the payment for watershed protection, described in this article. Although there has been some progress in the development and adoption of environmental policies (Nepstad *et al*., 2009), these efforts cannot counteract pressures from the driving forces of the country's economic model, such as urban expansion, increasing human populations, as well as energy and material intensive production patterns (Killeen, 2007). According to Balvanera *et al*. (2011), the study of the linkages between ecosystems and societies in Latin America started in the 1980s under the conceptual frameworks of ethnoecology, cultural ecology, political ecology, or societal metabolism. However, the term "ecosystem services" was first used in a Latin America publication in 1997 (Fearnside, 1997), shortly after the publication of the seminal study by Costanza *et al*. (1997).

A system of payments for ecosystem (or environmental) services (PES) has a very simple logic: to increase the income of economic activities compatible with conservation, in order to encourage the sustainable use of natural resources, while at the same time penalizing predatory activities. In an ideal system, the polluter or user must pay so that the protector or provider receives. Thus, there is an incentive to conserve the goods and services freely provided by the natural environment that are of interest, direct or indirect, to human beings. Hence, a PES is a self-interest system based on the economic assumption that agents tend to change their behavior and attitudes according to the incentives or penalties, in order to maximize their profits or utility, as far as those who benefit from the externalities provided by conservation are willing to pay (Wunder, 2005).

Furthermore, PES should also be aimed at reducing poverty; how that could be implemented has been the subject of heated discussion (Ferraro, Hanauer & Sims 2011; Rolón *et al*. 2011). Projects with emphasis in both services and poverty reduction are being implemented (Estrada-Carmona & DeClerk, 2009). However, poverty reduction will not be the focus of this study.

The main objective of this study is to analyze a PES program established in Brazil called the Oasis Project (Young *et al*., 2012), and to evaluate its main positive and negative aspects, in order to contribute to the establishment of similar initiatives in the present and in the future.

Context

The Oasis Project, coordinated by the non-governmental organization Foundation Group Boticário of Nature Protection (FGBPN), in association with municipal governments and sponsoring partners, such as the Mitsubishi Foundation and the Water Supply and Sanitation Company of the State of Paraná (SANEPAR). Currently, the Oasis Project is established in three Brazilian municipalities: Apucarana (Paraná state – PR), São Paulo (São Paulo state – SP) and São Bento do Sul (Santa Catarina state – SC). Besides them, there are other municipalities in advanced negotiation to implement the Oasis Project in their territory. The Oasis Project consists of a PES focused on watershed protection through native forest conservation in privately owned land. The first experiences were implemented in São Paulo and Apucarana and thus were the subject of this study (the implementation in São Bento do Sul started only in 2012). The goal is to benefit landowners who historically conserve forests and springs on their properties, but also to encourage forest recovery, since both contribute positively to the protection of water flows (FGBPN, 2011a).

The Oasis Project started in São Paulo in 2006, with resources from the Mitsubishi Foundation and support from FGBPN (FGBPN, 2011b). The positive evaluation has encouraged the replication of the experience, and Apucarana joined the project in 2009, through the municipal laws No. 058/09 and No. 241/09, establishing a financial partnership with SANEPAR, in which SANEPAR transfers 1% of its receipts obtained in the municipality to the Environmental Municipal Fund. With these resources, the municipality pays the landowners participating in the project, with technical support from FGBPN.

The first Oasis Project in São Paulo, differs from the other two programs already in place because it has few properties (only 13), and because they have a relatively large size, about 60 hectares each, located in the extreme South of the municipality, in the Guarapiranga watershed (around 4 million people). Most importantly, these properties do not have agriculture as their main objective (they are usually leisure properties), and monthly payments oscillate between R$ 100 and R$ 7,000,00 per month, depending on environmental characteristics such as water density, forest conservation, and sanitation conditions.

Meanwhile, the Oasis Project in Apucarana (Paraná state) presents a contrasting reality, with smaller average area (24 hectares), but all of them are dedicated to agricultural production. The number of properties is much larger: at the end of 2011, there were 133 properties participating in the program, with a total of 385 identified springs. Monthly payments range from R$ 80 to R$ 597 with the current formula calculation. Since the net income per property is approximately R$ 500 per month, PES corresponds to an increase in income ranging from 18% to 100%, depending on the production and property characteristics (FGBPN, 2011a). However, a series of problems related to the methodology originally adopted to establish the value of these payments, such as the lack of proportionality to the forest conservation area and the opportunity cost of land, resulted in a demand for a revision in these criteria. A specific study was performed to propose a new formula for calculating the payments due to landowners, which is presented and discussed in this study.

Finally, it is important to note that, later, the Oasis Project was extended to São Bento do Sul and Brumadinho (Minas Gerais state). However, these are very recent experiences, with no data available at the time of the study. For these reasons, the present article has used only data from the Apucarana experience.

Material and methods

Original methodology to calculate payment values

The methodology originally adopted in Apucarana assumed that payments to landowners would be based only on

environmental aspects. Furthermore, the basic payment unit was the property, i.e., payments were equally paid for properties that have many different characteristics, including total area dedicated to conservation (see Appendix 1 for a detailed description of the methodology). This created a distortion in payment values, since there was no direct proportion between the conservation area and its opportunity costs. Therefore, the Oasis Project became very expensive, paying the highest value per hectare (on average) when compared to similar PES experiences in Brazil: Minas Gerais (Extrema) and Espírito Santo ("ProdutorES de Água"), where payment is made by hectare (Zanella, 2012). Another problem was the arbitrary system introduced to benefit properties according to the number of springs and the connectivity with other properties, since payments grew at a geometric ratio.

Table 1 shows how much was paid to landowners in Apucarana in 2011; R$ 576 was the highest value received per month per property, and R$ 76 was the lowest value.

Table 1 - Oasis Project in Apucarana, 2011.

Total properties	133
Total area of properties contracted (hectares)	3,199
Protected natural area (hectares)	799
Number of protected springs	385
Highest monthly payment (R$)	576
Average amount of monthly payment (R$)	176
Lowest monthly payment (R$)	76

Source: Own elaboration, based on FGBPN data.

Proposition of a new methodology

In order to solve these problems, a new methodology proposed changes in many aspects in the calculation of PES, nevertheless, without altering the main spirit of the Oasis Project: to benefit privately owned land with forest conservation that helps to protect watersheds (Young, Bakker, Ferretti, Krieck & Atanazio, 2012). Since 2012, this new methodology has been adopted as the standard approach in the Oasis Project (even though, for legal reasons, it was not possible to revise contracts that were already being executed before that date).

The idea is to combine a compensation value for the opportunity cost of land devoted to conservation with a bonus system for the ecosystem services identified in the property and/or best agricultural practices adopted. Therefore, not only are environmental variables considered, but economic criteria are also included in the calculation of the payments.

Groups of variables

The first stage was to elaborate groups of variables that are related to one of the three elements considered as crucial for the project: water protection, forest conservation, and best agricultural practices. Hence, three grades are given (G1, G2, and G3) to summarize these different criteria:

- G1: Water protection
- G2: Conservation of natural ecosystems
- G3: Agricultural practices

Inside each grade, weights are given to variables so that each property receives financial resources due to its overall performance according to environmental, economic, and social criteria (Table 2).

Table 2 - Grades and respective components.

Grade	Variable
Water protection	Protected springs; protected rivers, streams, and lakes.
Conservation of natural ecosystems	Formation of corridors; natural area; existence of private reserves (RPPN); % of conserved area.
Agricultural practices	Certified organic agriculture; rotation of cultivations; contour plowing/farming, and land with increased productivity.

Source: Own elaboration.

Reference variable – X

A proxy for the opportunity cost of land was defined based on the reference value of the land: the variable "X" was set to correspond to a minimum compensation value that would be received for the area devoted to conservation. An initial value for "X" as 25% of the rent value of the land is suggested, but this value may change according to specific circumstances in each municipality. This reference value "X" would compensate, at least partially, the potential revenues from alternative low productivity activities, such as extensive cattle ranching. The idea is that it is easier to compensate a landowner dedicated to low productivity cattle ranching than to high productivity cultivation, and thus PES is more likely to become effective where the opportunity cost of land is cheaper.

The "X" variable represents the minimum compensation unit per hectare of land, but depending on other characteristics of the property (factors G1, G2, and G3), the total value received per hectare of conservation can increase considerably, as discussed below.

Forest conservation variable – Z

The variable Z refers to the area under forest conservation or restoration practices in hectares, in each property. This information is important since payments are made based on area under conservation or restoration, based on Equation (1):

$$\text{Value PES} = Z^{*}X^{*}[(1+ (G1)+(G2)+(G3)] \quad (1)$$

Differently from the original model adopted in the early Oasis Project experiences, this new standard formula includes weights for each grade, suggesting (but not imposing, since municipalities are free to choose the specificities in the application of the equation) the following values:

- G1 (Water protection) ranges between 0 and 1;
- G2 (Conservation of natural ecosystems) ranges between 0 and 2.5;
- G3 (Agricultural practices) ranges between 0 and 1.5;

Hence, the minimum value that a property would receive per hectare of conserved area is (suggested as) 25% of the

renting price for cattle ranching (usually the lowest price for land use) if the property follows only the minimum requirements necessary to be accepted in the Oasis Project (essentially, to follow the environmental legislation and the specific demands imposed by each municipality). Conversely, according to the suggested weights, the maximum value can reach up to 1.5 times the renting price for cattle ranching (or six times the minimum value, per hectare). Hence, a positive incentive is established to induce landowners to increase not only the size of the forest conservation in their properties, but also to improve the quality of this conservation and to adopt best agricultural practices that are identified as more adequate to conserve ecosystem services. Appendix 2 details all the variables presented in the suggested calculation.

Results and discussion

Simulating payments in Apucarana using the new PES formula

A simulation exercise was conducted for the municipality of Apucarana, using the existing data basis of properties enrolled in the Project, but with the proposed equation (1).

To calibrate the model, the "X" variable (land reference value) was set at R$ 24/month (equivalent to 25% of the average land rental price in the region). According to the characteristics of the properties in Apucarana, the minimum value to be paid, per hectare, if equation 1 were applied, would be R$ 24/hectare/month, while the maximum value (i.e. the property that is closest to the objectives of the Project) would be R$ 43/hectare/month.

The average value in Apucarana would be approximately R$ 31/ha/month. In absolute terms, considering the total conservation area in the property, the maximum payment would be R$ 862/month, while the minimum would be R$ 24 /month (the disparity is a consequence of the difference in properties size), with an average value of R$ 176/property/month.

When results are compared with the original payments distribution in Apucarana, in which the average payment per property was R$ 186.65/month, it is notable that the new formula would provide greater efficiency, allowing extra resources to expand forest conservation into new properties, since payments are due only to the conservation area, rather than the total property.

Other issues and lessons from the Oasis Project

The definition of the best formula to calculate payment values to rural landowners is not the only challenge to be addressed in the implementation of a PES scheme (Young *et al.*, 2012). This section discusses three other elements that are relevant to the successful implementation of the Oasis Project and also to other PES systems: the involvement of local authorities, the funding for the payments, and the monitoring of properties.

Involvement of local authorities with the Program

Forest conservation in private land requires setting aside land that would be used in alternative forms, such as ranching and cultivation. Therefore, local politicians tend to react negatively to environmental protection policies, and this explains the very poor enforcement of the Brazilian Forest Code in the last decades. PES schemes intend to remedy this by providing economic incentives for conservation, but it also represents a public policy issue. The effective involvement of local authorities in the implementation of PES systems is essential for their acceptance by the local communities.

Correct information is the first step, especially when the positive externalities of forest conservation in terms of benefits to agriculture are understood by rural producers in terms of watershed protection, pollination, pests control, and other ecosystem services (De Marco Jr. & Coelho, 2004; De Souza *et al.*, 2008: Medeiros & Young, 2011). Therefore, it is required that local authorities become involved in actions that can be presented as "best cases", and that PES systems are presented as a tool for rural development. In that sense, Apucarana is a good example, since the municipal agency (SEMATUR) has acted on two fronts:

i. Directly through the coordination of the program, enhancing the perception of rural landowners regarding the importance of ecosystem services, especially water and soil conservation. SEMATUR employees help explain how the payment values are calculated, and the program's success has resulted in an increasing number of candidates: at the end of 2010, there were 64 properties enrolled, and at the end of 2011, the number of properties had risen to 133.
ii. In the collaboration with the executive and legislative powers of Apucarana, including in the design of the Municipal Law (No. 058/09) that establishes the legal basis for the local implementation of the Oasis Project.

The presence of a well-known local coffee producer as coordinator of the Oasis project in Apucarana has helped to disseminate the information and to avoid mistrusts in the difficult relationship between program managers and landowners. Such direct involvement of a representative of farmers in the leadership of the PES is a measure that should be applied whenever possible, especially in more conservative rural areas.

Financing the project

The strategy adopted in the Oasis Project is to establish partnerships with water supply companies to finance the payments to the properties, since the focus has been on watershed protection. In that sense, the PES is an incentive to improve the stability of water flows, with direct benefits to the water supply companies. Indeed, the resources to finance the Oasis Project in Apucarana are provided by the state water supply company (SANEPAR).

However, there remains a strong resistance among the Brazilian rural sector in accepting that, as the main user of water resources, it is in their own benefit to establish a system where water consumers pay for forest conservation or best agricultural practices in upstream properties. Due to this resistance, resources for PES systems are restricted to a small share of urban and industrial consumers, but mostly from public budget allocations.

One example is the PES system established in the State of Espírito Santo (ProdutorES de Água), where resources come from tax collection and royalties from hydropower generation, oil, and natural gas. This establishes a clear limit to the expansion of PES, since public budgets are limited and, in the Brazilian case, suffer a relative stagnation for environmental functions (Young, 2005).

Therefore, for the widespread dissemination of water-related PES systems in Brazil, the effective implementation of water billing is fundamental, as considered by the Brazilian Federal Water Law (No. 9,433/2007). This could generate the required funding for a large-scale expansion of initiatives such as the Oasis Project.

Other possible funding sources are:

- Royalties from hydropower generation;
- Water resources funds;
- Resources from fines and other non-compliance charges from companies that are not properly adjusted to the environmental legislation and standards.

Thus, the identification of direct benefits of forest conservation (in this case, water supply and quality) is an important tool to convince companies associated to water resources (water supply, hydroelectricity, irrigation) to sponsor the Project and guarantee its financial sustainability. Conversely, the risks of future funding problems are higher where the sponsorship is made by donations or fiscal transfers dissociated from water services (for example, royalties from oil and gas exploitation).

Monitoring

The establishment of a monitoring system is a key issue for the success of a PES initiative. It requires a precise definition of parameters to be evaluated in all the dimensions that are considered (environmental, economic, and social). These parameters should be defined *ex-ante*, in the planning stage of the program, in order to avoid conflicts due to changes in the evaluation criteria after the properties are enrolled.

The objective of these indicators is to provide the necessary information to verify the evolution of the program in terms of the desired targets. Conversely, these data, when crossed with information from other watersheds or micro-regions with similar characteristics, can provide evidence (or lack thereof) regarding changes that the PES implementation brings to environmental quality and human welfare in the affected areas. These indicators can be divided in five groups: water, forest conservation, financial, social, and agricultural practices.

Water indicators can be divided in two sub-groups: water quality and quantity. Forest conservation indicators include the proportion of the property area under conservation or restoration and whether privately established protected areas (RPPNs – *reservas particulares do patrimônio natural*) are present in the property. RPPNs are conservation units established in privately owned land, and regulated by the Brazilian Law on Protected Areas (Law No. 9,985/2000), and its existence reveals a strong commitment of the landowner to nature conservation.

The agricultural quality index can be composed by the presence of best practices, such as certified organic agriculture, rotation of cultivations, and contour plowing/farming. Financial indicators analyze the change in production costs due to the practices induced by the PES. Social indicators refer to changes in the quality of life within the families that are benefitted, including monetary income, consumption patterns, and indicators for health and housing conditions. Finally, there should be "satisfaction" indicators among the rural producers, based on their perception regarding whether perceived changes related to the PES are positive and negative.

With these indicators, aggregate performance indices can be constructed. The main problem is establishing weights in order to aggregate information. The international experience demonstrates that synthesis indicators are not necessarily the best method for evaluation, and multi-variable comparisons can be employed, such as the Costa Rican experience of PES evaluation (Moreno, 2011). Figure 1 presents a hypothetical example of a "radar" system on the evolution of different performance indicators.

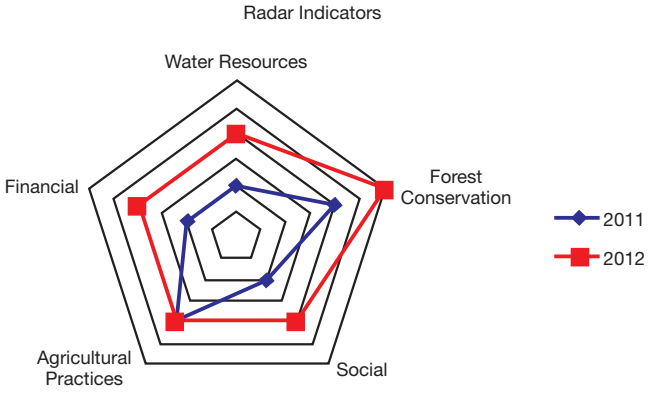

Fig. 1 – Hypothetical example of a radar indicators. Source: Own elaboration.

In practical terms, the costs of monitoring are an obstacle for its implementation. In the case of Apucarana, municipal staff visit rural properties twice a year to verify the status of conservation, and to certify that management measures are being taken at the proposed level. However, no monitoring of water flow indicators has yet been established. In order to avoid this gap, proper estimation of monitoring costs and the decision of who is responsible to pay for them are essential, and should be defined at the beginning of the project.

Conclusion

PES is a possibility for improving the efficacy of environmental policy through the establishment of incentives to economic agents that assume a pro-conservation attitude, usually doing more than required by the legal system. PES initiatives have a great potential as an alternative strategy for conservation activities in Brazil but, among other requirements, they require the definition of adequate methodologies to evaluate how much landowners should receive as compensation.

This study examined the formula adopted in the Oasis Project, one of the most widespread PES system in Brazil devoted to the water/forest conservation relationship. It is argued that the establishment of a payment scheme combining the opportunity cost of land and indices for the quality and quantity of conservation (considering water resources, natural areas conservation, and best agricultural practices) observed in the property guarantee more efficiency in the implementation of the PES, in terms of the conservation area that can be achieved using the same financial resources.

Nevertheless, it is also recognized that there are other important challenges: the involvement of local authorities ("ownership") with the Project, obtaining sustainable sources of the funding necessary for the payments, and monitoring the performance of the properties and evaluating the program itself. These challenges are not specific to the Oasis Project, and represent a common issue with other PES programs. There remains considerable work in the improvement of these initiatives; the acknowledgment of the problems and gaps yet to be filled should be perceived as an incentive for further research and experimentation, rather than as obstacles to deter their implementation.

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Appendix 1
Variables and grades proposed to the Oasis Project.

Does the property have all the requirements for the project?	Yes
	No
Part of the property is private reserve (RPPN)?	Yes
	No
The permanent preservation areas are in good condition?	Mostly yes.
	Permanent area protection with predominantly forest vegetation, but with evidence of degradation in the past.
	Permanent area protection degraded, with restoration plan implemented.
	Permanent area protection degraded, with restoration plan not implemented or without restoration plan.
Are there legal reserves formed by native vegetation and in good condition?	Mostly yes and no management.
	Mostly yes and with low impact management.
	Legal reserve degraded but recovery plan implemented.
	Legal reserve degraded, with restoration plan not implemented or without restoration plan, or conventional management.
	Legal reserve in forest easement.
Is there an area of native vegetation beyond the permanent protection area and legal reserve? (indicate the size of the surplus area in hectares)	Yes, there is a large successional area.
	Yes, there is an average successional stage area.
	Yes, there is a small successional stage area.
	No
Do the areas of native vegetation in the property, besides the RPPN and the legal reserve, constitute a single block ≥ 10 hectares?	Yes
	No
Should areas ≥ 10 hectares that belong to more than one property be considered and the value proportionally divided?	Yes
	No
Are RPPNs not included in this matter?	Yes
	No
Areas of native vegetation (including legal reserve, but not permanent protection area) are connected to the native area of a neighbor?	No
	One neighbor
	Two neighbors
	Three or more neighbors
The legal reserve is connected with permanent protection area?	Yes
	No
Are there springs with a permanent conservation area preserved?	No springs on the property
	One spring with permanent protection area preserved.
	Two springs with permanent protection area preserved.
	Three springs with permanent protection area preserved.
	Four springs with permanent protection area preserved.
	Five springs with permanent protection area preserved.
	Six springs with permanent protection area preserved.
	Seven or more springs with permanent protection area preserved.
Is there organic production? (certified production)	Yes, only
	Yes, partly
	No

Has a system of sewage treatment more than 100 meters removed from the nearest watercourse?	Yes
	No
Has hedges or windbreaks made exclusively with native species?	Yes
	No

Has hedges or windbreaks made exclusively with native species?	Yes
	No

Appendix 2
Variables and grades proposed to the Oasis Project.

	Sub-Groups	Parameters	Answers	Other Information
SPRINGS	1.1) Protected springs	0.5	Yes	
		0	No	
	1.2) Existence of rivers, streams, or natural lakes protected	0.5	Yes	
		0	No	
CONSERVATION	2.1) Formation of corridors	0.25	Yes	Connectivity between internal natural areas (LR/RPPN/ surplus)
		0.25	Yes	Connectivity between natural areas inside and outside (with neighbors)
		0	No	
	2.2) Existence of private reserves (RPPN)	0.5	Yes	
		0	No	
	2.3) Natural area	1	Successional advanced/medium stage (x1)	x1/(x1 + x2)*1
		0.5	Early successional stage (x2)	x2/(x1 + x2)*0.5
		0	Degraded	
	2.4) % Conservation area	0.5	Yes	Relationship between conservation area (x1) and total area (y2): measures the effort (in area) for conservation of the producer, compensating for not using the area for production
		0	No	
AGRICULTURE	3.1) Certified organic agriculture	0.33	Yes	
		0	No	
	3.2) Straw	0.33	Yes	
		0	No	
	3.3) Contour plowing/ farming	0.33	Yes	
		0	No	
	3.4) Protective action of the natural area (supervision, information signs, etc.)	0.5	Yes	
		0	No	