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Assessing the potential for synergy in the implementation of Payment for Environmental Services (PES) programs: an empirical analysis in Costa Rica

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Abstract:

Payment for environmental services (PES) is a promising mechanism for conservation. It also has the potential to contribute to social objectives such as poverty reduction. To promote synergy in the implementation of PES, however, a number of conditions on spatial, economic, ecological, and institutional feasibilities are essential. This study discusses factors affecting the synergy prospect of PES and provides a simple framework for assessing the potential for synergy in the implementation of PES, focusing on spatial correlation of thematic areas and funding availability for payments. We apply the framework to an empirical analysis of the "water funding" in Costa Rica, a new conservation financing source generated by water tariff revenue and will be channeled through the existing national PES program of Costa Rica (*Pago por Servicios Ambientales*, PSA). The analysis can help guide the re-allocation of the regular PSA budget in response to the water funding for synergy among conservation goals (watershed and biodiversity) and social development objective.

Key words:

Payment for Environmental Services (PES), synergy, poverty reduction, watershed conservation, biodiversity conservation, Costa Rica

Introduction

Synergy is the interaction or cooperation of two or more actions to produce a combined effect greater than the sum of their individual effects. By promoting coordination among objectives, a synergistic approach can potentially improve the overall cost-effectiveness of resources, reduce actual and potential conflicts among efforts, and avoid duplication of costs and efforts that would be incurred through individual implementation of each objective (CBD, 2004a). However, while the prospect of synergy is frequently invoked, it is seldom assessed. This paper uses data from Costa Rica to examine the potential for synergy between Payments for Environmental Services (PES) and poverty reduction.

Land uses can provide a variety of environmental services ranging from the regulation of hydrological flows to biodiversity conservation and carbon sequestration. The PES approach seeks to establish a conservation mechanism through which service users can compensate land users that provide the desired service, or that adopt land uses that are thought to provide it, thus increasing their incentive to conserve them (Wunder, 2005; Pagiola and Platais, 2007; Engel et al., 2008). As the PES approach has come into increasing use as a conservation instrument, particularly in Latin America, it has also been recognized to have the potential to benefit objectives beyond the management of the target environmental services.

The PES approach was conceptualized and undertaken as a mechanism to improve the efficiency of natural resource management (Pagiola et al., 2005). Targeting criteria for PES eligibility that do not deliver benefits to service buyers would likely undermine the performance of the approach. However, if the payment recipients are poor, the approach can potentially contribute to poverty reduction by providing them additional income. This positive impact of PES, however, does not always happen automatically. Poor service providers often face greater obstacles to participation than the wealthier applicants. This creates a window for collaboration between PES programs and poverty reduction objectives. By helping clear hurdles for poor service providers to participate, poverty-focused agencies can help channel additional income to poor land users, well beyond what their own resources would have allowed. At the same time, by removing obstacles to participation, they can help the PES program achieve its objectives. This potential synergy does not always exist, however.

In this paper, we first offer a simple conceptual framework to explore the potential for synergy in a PES program. We then conduct an empirical analysis of the spatial potential for synergy between PES and poverty reduction in Costa Rica. Specifically, we examine the degree to which payments financed by the recently established water tariff ("water funding") can contribute to poverty reduction, using the most recent geo-referenced data on the spatial distribution of water funding and of poverty.

The potential for synergy in PES

Considerable attention has been devoted to the potential positive impacts of PES on poverty reduction (Landell-Mills and Porras, 2002; Wunder, 2008; Pagiola et al., 2008a), but the quantitative-empirical basis for assessing results remains quite limited (Engel et al., 2008). Many have assumed that payments would go mostly to poor land users, and thus contribute to poverty reduction, while others have indicated that the linkages are more complex and can show mixed results (Kerr, 2002; Grieg-Gran et al., 2005; Pagiola et al., 2005; Ravnborg et al., 2007;).

This potential for synergy between PES and other programs can be broken into four feasibility conditions: (i) spatial feasibility, (ii) economic and financial feasibility, (iii) institutional feasibility, and (iv) ecological feasibility.

As PES programs are explicitly targeted to areas critical for the specific services being sought, the first condition for the feasibility of synergy with PES concerns spatial correlation between thematic areas. Put simply, are the areas that are important for service generation also important for other issues, such as poverty reduction? Spatial correlation between thematic areas has often been implicitly assumed (Pagiola et al., 2008a), but empirical studies have shown mixed results (Nelson and Chomitz, 2007; Pagiola et al., 2008b; Pagiola et al., 2008c). For example, Nelson and Chomitz (2007) find that watersheds in Guatemala and Honduras where substantial active deforestation is occurring on steep slopes tend to have the highest concentration of poverty, but Pagiola et al., (2008b) find that the watersheds that are most important for water service generation do not necessarily have high levels of poverty.

Figure 1 presents a simplified conceptual framework for assessing the potential for synergy in PES implementation. The framework focuses on spatial correlation of thematic areas and funding availability for payments. We focus on PES programs that seek to provide water services to illustrate the framework. Funding availability depends on the willingness to pay of service users, if the program is user-financed, or on government funding decision or funding rules if it is government-financed (Pagiola and Platais, 2007; Engel et al., 2008). Funding availability is considered relatively high (or low) if the offered payment is above (or below) the value of alternative land uses. The quantification of spatial correlation requires the individual objectives to be clearly defined. For example, for the objective of poverty reduction, is it the incidence of poverty (poverty rate) or the concentration of poverty (number of the poor) that is the most relevant to the agency's agenda? These distinctions are often associated with different spatial distributions of thematic areas, resulting in different measurement of spatial correlation.

In this framework, the potential for synergy between PES and poverty reduction is high when spatial correlation and funding availability are both high. There will be little potential for synergy in areas that are important for service generation but have limited poverty (low spatial correlation). No matter how high funding availability is in these areas, it will provide few poverty reduction benefits. Areas where funding availability is low also have little potential to contribute to poverty reduction, as PES will not prove attractive to land users.

The PSA program in Costa Rica and the new water funding

Costa Rica established an elaborate PES program (*Pagos por Servicios Ambientales*, PSA), operated by the National Fund for Forest Financing (*Fondo National de Financiamiento Forestal*, FONAFIFO) in 1997 (Pagiola, 2008). Hitherto it has been financed primarily by an earmarked portion of fuel tax revenues, and to a smaller extent by voluntary agreements with individual water users who are paying to conserve their watersheds. The recent institution of a new conservation fee within the water tariff marks a major expansion from individual voluntary agreements with water users to a broader, compulsory approach in the use of water payments to finance the PSA program (Pagiola and Zhang, 2008). The PSA Program will receive 25% of the revenue from the water tariff. Once the tariff is fully implemented, in 2012, it is projected to generate some $4.7 million a year in financing for watershed conservation that will be channeled through the PSA program, about 9 times the funding provided by existing voluntary watershed conservation agreements (Pagiola and Zhang, 2008).[1] The decree specifies that revenue from the tariff must be used to benefit water users in watersheds within which it is generated. The influx of various amounts of geographically targeted conservation funding will interact with the existing PSA financing and generate opportunities for synergy among various conservation and social objectives and thus offering an interesting case to study.

The PSA program has a system of priority conservation areas (PCAs) that determine eligibility for enrolment (Map 1). The PCAs cover about 3 million ha, and are defined primarily based on biodiversity criteria (Pagiola et al., 2008d). In 2005, poor *cantones* that are not already included in the biodiversity conservation priority areas were added to the PCAs, adding 636,000 ha of relatively less developed areas. The poor *cantones* are defined based on a Index of Social Development (discussed in detail in the next section).

PSA contracts to date have primarily been targeted to the PCAs. Participants receive annual payments of US$64/ha for forest conservation (the most common PSA contract, accounting for 85% of enrolled area) (FONAFIFO, 2007). The empirical analysis will focus on PSA's forest conservation contract and assumes that watershed conservation can be achieved through the same conservation activities or land use practices as those prescribed in the forest conservation contract under the PSA program.

Although the PCAs offer a fairly good coverage of the country's land area (Map 1), funding is insufficient to cover all conservation needs (FONAFIFO, 2007; Pagiola et al., 2008d). A simple calculation shows that the PSA program's regular budget (about $12 million a year) can cover a maximum of 188,000 ha at a payment rate of US$64/ha, representing only a tiny fraction of the PCA area. The new water tariff

Map 2 shows the distribution of funding from the water tariff[2] in watersheds based on a 1:50,000 detailed watershed map. Variations in the intensity and nature of water use result in large variations in the availability of funds in each of these areas (Pagiola et al., 2008d). Despite the large aggregate amount generated, per hectare-based funding availability remains small (under US$5/ha/year) in the majority of the 766 watersheds with positive funding.[3]

The potential for synergy in the implementation of the water funding

Poverty and social development levels

Costa Rica has made considerable progress in increasing income, reducing poverty and improving social indicators (World Bank, 2007a). Only 9% of the population falls below the international US$2 per day per person purchasing power parity poverty lines compared to 25% in

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[1] The exchange rate of US$1 = CRC491 is used throughout the analysis.

[2] All estimates are based on projected tariff revenue once it is fully implemented, in 2012.

[3] In watersheds with water funding that overlap with existing PCAs, actual funding availability will depend on how water tariff funds are combined with funds from the regular budget. Water funding could be used to (1) substitute for regular funds, which would then be re-allocated elsewhere; (2) complement regular funds, with payments to land users being shared among funding sources; and (3) add to regular funds, allowing higher payments to be offered.

Latin America, while only 2% fall below the US$1 extreme poverty line, compared to 10% regionally. Despite this achievement, the country still faces a number of important challenges such as stagnating progress in reducing poverty, income inequality, and distinct geographic differences in the incidence and concentration of poverty.

To assess the potential for the water funding to reach the poor, the distribution of poverty must be mapped at a spatial scale consistent with that of the payment scheme (i.e., watershed). There are three administrative levels in Costa Rica, including 6 planning regions, 81 cantons, and 470 districts, with the district being the smallest administrative unit (MIDEPLAN, 2007). Unfortunately, the most detailed data source, the Multipurpose Household Survey (*Encuesta de Hogares de Propósitos Múltiples*, EHPM), is not representative at the district level. The Index of Social Development (*Índice de Desarrollo Social*, IDS), which is estimated at the district level, offers an alternative non-income official measure of welfare and is adopted in this study. The IDS is a summary indicator that measures the heterogeneous distribution of the progress in social development across various geographic areas (MIDEPLAN, 2001). As the index represents relative, as opposed to absolute, levels of social development measured by a package of variables, the value of IDS ranges from 100 (representing the most developed position among surveyed) to zero (least developed).

The average national IDS score was 54.2 in 2007. Among the 469 districts included in the 2007 study (the district of Coco Island is excluded), half score between 40-60 points, 145 districts score between 60 and 80 points, and 16 districts score between 80 and 100 points (Table 2). 74 districts have IDS scores of less than 40, a practical rule-of-thumb cutoff level for an administrative unit to be considered poor.[4] Spatial autocorrelation test shows strong evidence of clustered pattern in the distribution of 2007 district IDS scores (Moran's I Index = 0.34). Map 3 shows a roughly concentric ring pattern with districts located further away from the center of the country (i.e., the Greater San José Metropolitan Area) in general falling behind in development. In particular, districts near the border of Nicaragua and in the Huetar Atlantica region in the north, near the border of Panama in the west, and many in the Brunca region in the south tend to fall into the lowest two quintiles.

Spatial correlation with the PCAs and social development levels

Since the spatial scale on which the availability of the water funding is calculated (i.e., watershed) does not align with the scale at which IDS is represented (i.e., district), we estimate area-weighted average IDS score for each watershed from the intersecting districts (Map 3). Figure 2 plots estimated watershed-level IDS scores against the projected funding availability from the water tariff. These plots indicate that there is a positive but weak correlation between the two across watersheds. We further break down funding availability into five categories: (1) Zero, (2) below US$1/ha, (3) US$1-2/ha, (4) US$2-5/ha, and (5) above US$5/ha. The overall social development level in watersheds that do not generate tariff revenue ("Zero") is significantly lower than those that do by a huge margin. The estimated IDS score for "Below US$1/ha" is significantly lower than the three categories with funding availability ≥ US$1/ha, whereas IDS scores are not significantly different among categories (3), (4), and (5). These results imply that areas that generate more water tariff revenue tend to coincide with areas with higher social development. They also imply that user fee-based financing instruments may not be able to provide sufficient conservation funding in less developed areas. Consequently, the

[4] This is the IDS level that FONAFIFO uses to define "poor cantons".

potential for user fee-funded PES to induce social development impact at a substantial scale is expected to be limited.

As shown in Table 1, over 1.2 million ha, or 23.7% of the total land area, do not coincide with PCAs ("non-overlapping watershed areas"). In these areas, water funding would be the only source financing conservation. At the rate of US$64/ha, no watershed has sufficient funding from the water tariff alone to pay for conservation of the entire watershed. We also explore two alternative scenarios for the payment rates of US$32/ha and US$16/ha, which are equivalent to financing conservation in half and a quarter of each watershed, respectively. At the rate of US$32/ha, only 0.3% of the non-overlapping watershed areas can potentially be conserved using the water funding alone. The percentage is increased to merely 2.8 if US$16/ha is adopted.

In terms of social development, 22.6% of the non-overlapping watershed areas have a relatively low IDS score (≤ 40). These are the areas where spatial feasibility exists for payment for watershed conservation to contribute to reducing social development gap. This prospect, however, is complicated by the limited availability of funding from downstream water users, which directly affects the extent to which PES can be implemented. In fact, the bulk of the low-development areas are raising less than US$16 of conservation funding per hectare of watershed area.

About 48% of the PCAs and 58% of the watershed areas where funding availability is positive overlap with each other, among which 82.8%, or nearly 1.4 million ha, are biodiversity conservation priority areas and 17.3% are of social development importance ("poor cantones"). Land users in these areas are eligible for both the water funding and the regular PSA budget. It is therefore more "cost-effective" for FONAFIFO to prioritize these areas in granting contract as it only pays the net of the fixed payment rate and what the water funding covers. Overall, funding availability from water users is slightly improved as compared to that in the non-overlapping watershed areas. In addition, the impact of conservation dollar on reducing social development gap in the overlapping areas (mean IDS=47.2) is expected to be slightly higher than that in the non-overlapping watershed areas (mean IDS=49.2). About 38% of the overlapping biodiversity conservation priority areas are relatively behind in development (IDS≤ 40), the vast majority of which, however, receive little funding from water users.

Over half of the PCAs do not coincide with watershed areas where funding availability is positive ("non-overlapping PCAs"), among which over 1.4 million ha are biodiversity priority conservation areas. Land users located within these areas are eligible for the regular PSA budget but not for water funding. With a mean IDS score of 34.2, the potential social development impact of increased allocation of regular PSA budget to these areas is expected to be much greater than that in the non-overlapping watershed areas or the overlapping areas.

Synergy potential among multiple objectives

Using the framework in Figure 1, we explore the potential for synergy for addressing multiple objectives (i.e., water service provision, biodiversity conservation, and reduction in social development gaps), taking into account the availability of the water funding. Map 4 shows the intersection between the watershed areas where funding availability is positive and the biodiversity conservation priority areas, ranked by FA from the water tariff and the estimated level of social development using two artificially chosen thresholds of FA=US$16/ha and IDS=40. Synergy among all three objectives is spatially feasible in 514,000 ha of the intersecting areas where the estimated IDS ≤ 40. The ability of the water funding to finance conservation activities varies dramatically across areas. Map 4 identifies 3,000 ha of "low-hanging fruit" areas for synergy where the water funding alone is sufficient to cover contract payment and the social development objective can potentially benefit (funding availability greater than US$16/ha, estimated IDS ≤ 40). Opportunities for synergy are also possible in 511,000 ha in which funding availability is positive > US$16/ha and IDS ≤ 40" areas if the implementation of the water funding helps attract the flow of the regular PSA budget into the region.

Discussion and Conclusion

A synergistic approach to addressing social and environmental objectives offers potential for more efficient and effective resource allocation, and PES represents a promising venue for implementing the approach. This study discusses factors affecting the synergy prospect of PES and provides a simple framework for assessing the potential for synergy in the implementation of PES, focusing on spatial correlation of thematic areas and funding availability for payments. We then apply the framework to an empirical analysis of water funding for conservation in Costa Rica. The analysis can help guide the re-allocation of the regular PSA budget in response to the water funding for maximum synergy, taking into account the potential impact of such re-allocation on conservation and poverty objectives.

We found a fair degree of spatial correlation among the thematic areas for watershed conservation, biodiversity conservation, and poverty reduction. Despite the spatial overlap, the per hectare availability of the water funding is limited compared to the prevailing rate of US$64/ha and will likely constrain the prospect for significant synergy among objectives. In a few rare cases, the water funding alone is sufficient to pay for forest conservation in the entire watershed. When excess funding is possible (i.e., funding availability exceeding US$64/ha), the use of the surplus would be of an interesting policy question. Strictly following the decree would require all funds to be spent in the watershed that generated them. This could only be accomplished in cases with excess funding by increasing payment levels. Given the high value of water services in these watersheds, this might well be justified. Alternatively, the surplus funding could be used elsewhere, either in other watershed to benefit other water users, or by adding the surplus to the regular PSA budget that can be spent on the conservation of PCAs. These options would require changing the decree, however.

The more common case is when the water funding alone is not sufficient to cover forest conservation contract at the rate of US$64/ha for the entire watershed. If the watershed is located within the PCAs, meaning that the area is eligible for the regular PSA budget, it would be cost-effective for FONAFIFO to provide the rest needed funding as it costs the agency less than the regular price to enroll a unit of eligible land. If, however, a watershed does not overlap with the PCAs so that the water funding is the only financing source, flat-rate payment can still be imposed but would not offer full coverage of the watershed, and the selection of enrolled land parcels should be based on hydrological merits (although some other criteria such as poverty is also conceivable). Alternatively, if differentiated rates are allowed, payment should be targeted to the most cost-effective service providers. These particular areas may also be candidates for receiving surplus water funding if it becomes a policy option. All these interactions have important implications to the synergy potential that can be expected from the implementation of the water funding and PSA program.

Our analysis also shows significant variations in the potential social impact of PES activities, depending on the spatial location of the land as well as the availability of financing. The overlapping areas on average earn a slightly lower IDS score than the non-overlapping watershed areas where the water funding is available, implying a slight advantage in synergy potential because both financing sources are available where the social development level is relatively lower. However, areas, such as non-overlapping PCAs and those that are not eligible for any conservation financing, that show greater potential for social impact of PES activities tend to lack conservation resources.

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Table 1: Spatial correlation between the inland PCAs and the watershed areas where the water funding is available

Funding Availability from water tariff (US$/ha)	All				IDS≤ 40				IDS>40			
	Area ('000 ha)	% of total land area	% of category	IDS	Area ('000 ha)	% of total land area	% of category	IDS	Area ('000 ha)	% of total land area	% of category	IDS
Watershed areas (with FA>0) not located within PCAs												
Eligible for water funding only	1,211.0	23.7	100.0	49.2	274.0	5.4	22.6	33.7	937.1	18.3	77.4	53.5
FA≥ 64	0	0	0	-	0	0.0	0.0	-	0	0.0	0.0	-
32≤FA<64	3.8	0.1	0.3	48.8	0.5	0.0	0.0	39.7	3.3	0.1	0.3	51.0
16≤FA<32	29.9	0.6	2.5	56.5	2.3	0.0	0.2	34.6	27.7	0.5	2.3	57.1
FA < 16	1,177.3	23.0	97.2	48.8	271.2	5.3	22.4	33.7	906.1	17.7	74.8	53.2
PCAs and watershed areas (with FA>0) overlap												
Eligible for both water funding and regular PSA budget	1,646.5	32.2	100.0	47.2	687.5	13.4	41.8	33.4	959.6	18.7	58.3	51.8
(1) Biodiversity	1,362.9	26.6	82.8	47.4	517.6	10.1	31.4	33.6	845.4	16.5	51.3	51.9
FA≥ 64	1.0	0.0	0.1	46.2	0	0.0	0.0	-	1	0.0	0.1	46.2
32≤FA<64	11.4	0.2	0.7	47.9	2.7	0.1	0.2	39.7	8.7	0.2	0.5	49.5
16≤FA<32	47.7	0.9	2.9	56.3	0.3	0.0	0.0	34.6	47.5	0.9	2.9	57.0
FA < 16	1,302.8	25.5	79.1	46.8	514.6	10.1	31.3	33.6	788.2	15.4	47.9	51.6
(2) Poor cantones	284.1	5.5	17.3	43.8	169.9	3.3	10.3	33.6	114.2	2.2	6.9	48.4
FA≥ 64	0	0.0	0.0	-	0	0.0	0.0	-	0	0.0	0.0	-
32≤FA<64	0	0.0	0.0	-	0	0.0	0.0	-	0	0.0	0.0	-
16≤FA<32	0.2	0.0	0.0	54.0	0	0.0	0.0	-	0.2	0.0	0.0	54.0
FA < 16	284.0	5.5	17.2	43.5	169.9	3.3	10.3	33.6	114.1	2.2	6.9	48.2
PCAs not located within watershed areas (with FA>0)												
Eligible for regular PSA budget	1,785.0	34.9	100.0	34.2								
(1) Biodiversity	1432.9	28.0	80.3	36.7								
(2) Poor cantones	352.1	6.9	19.7	23.8								
Land areas not receiving any conservation payments												
	476.5	9.3	100.0	41.9								
Total land area												
	5119.0	100.0	100.0	53.8								

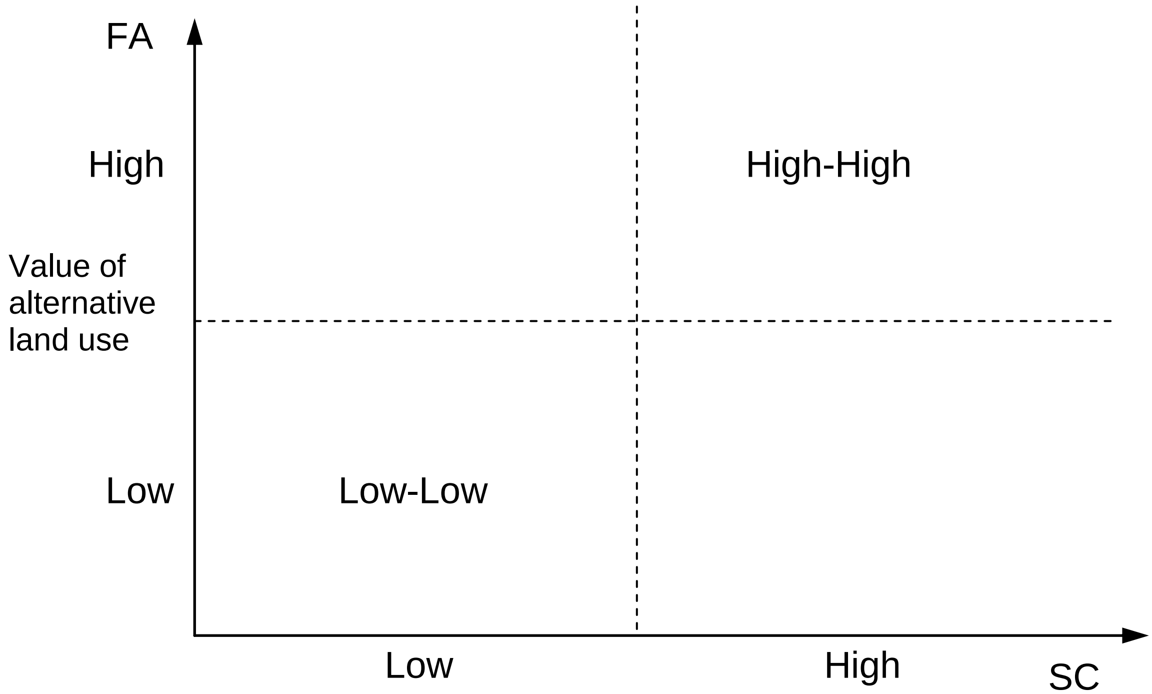


Figure 1: A two-dimension framework for assessing the synergy potential of PES programs

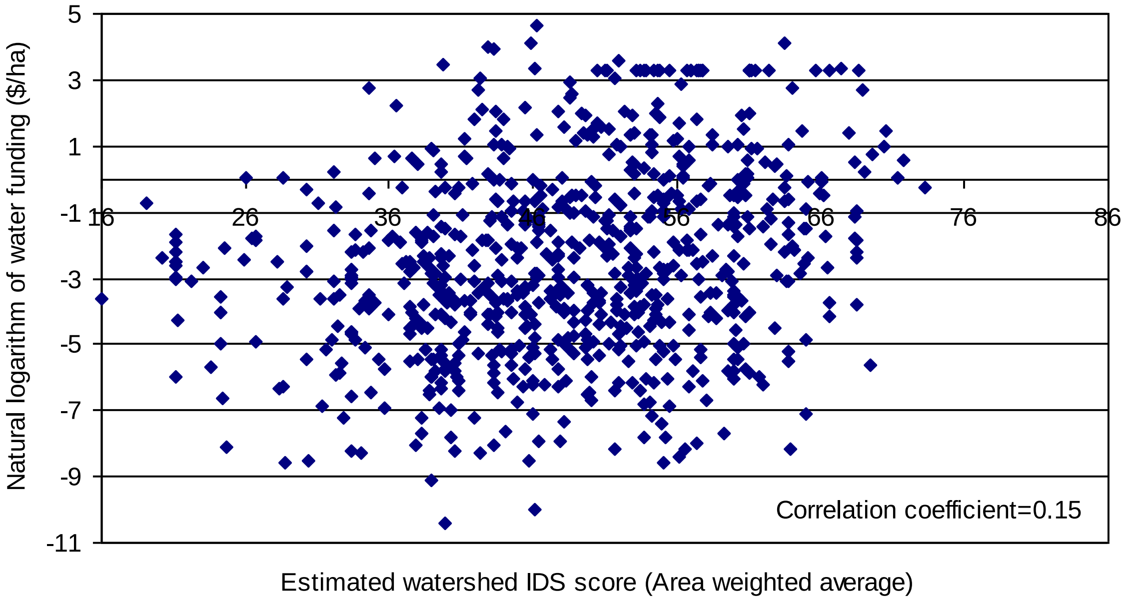
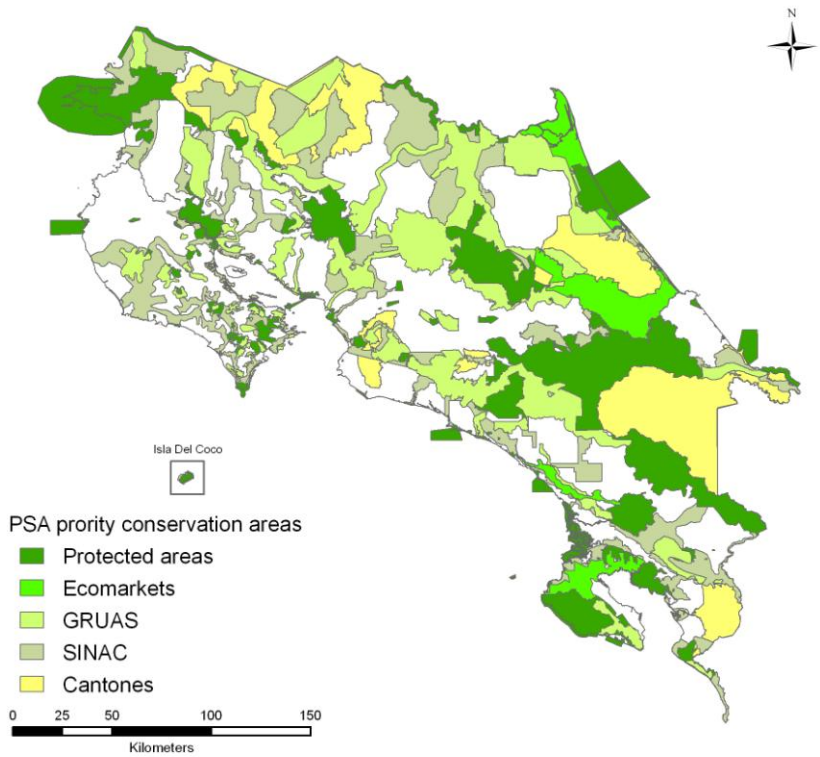
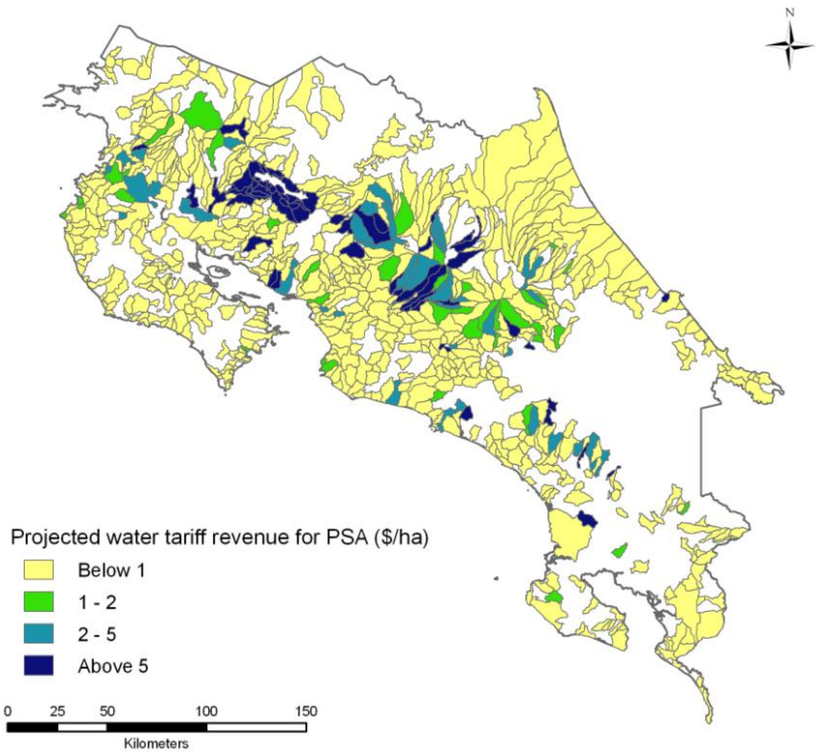


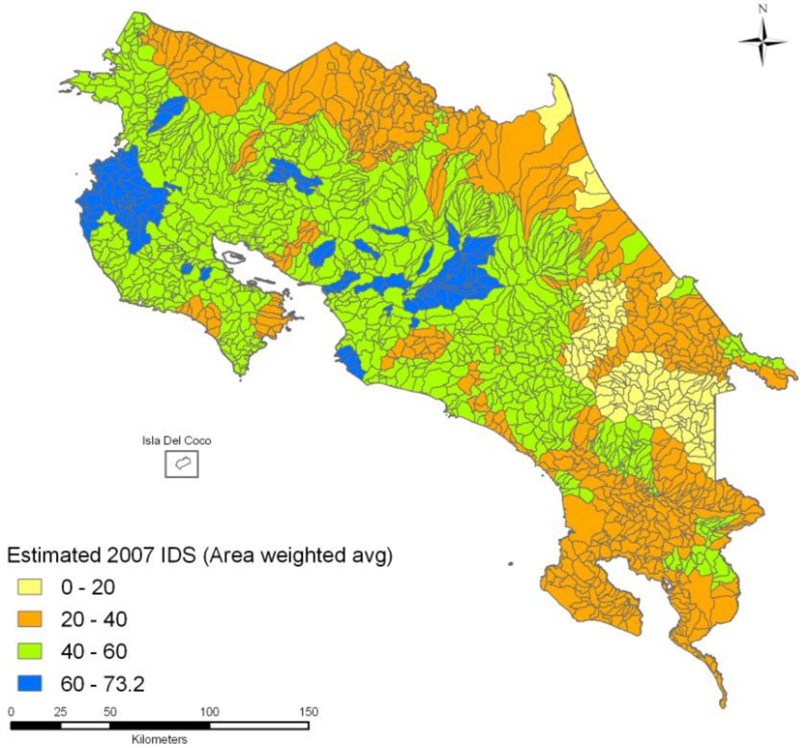
Figure 2: The correlation between estimated watershed-level IDS scores and the projected funding availability from the water tariff.



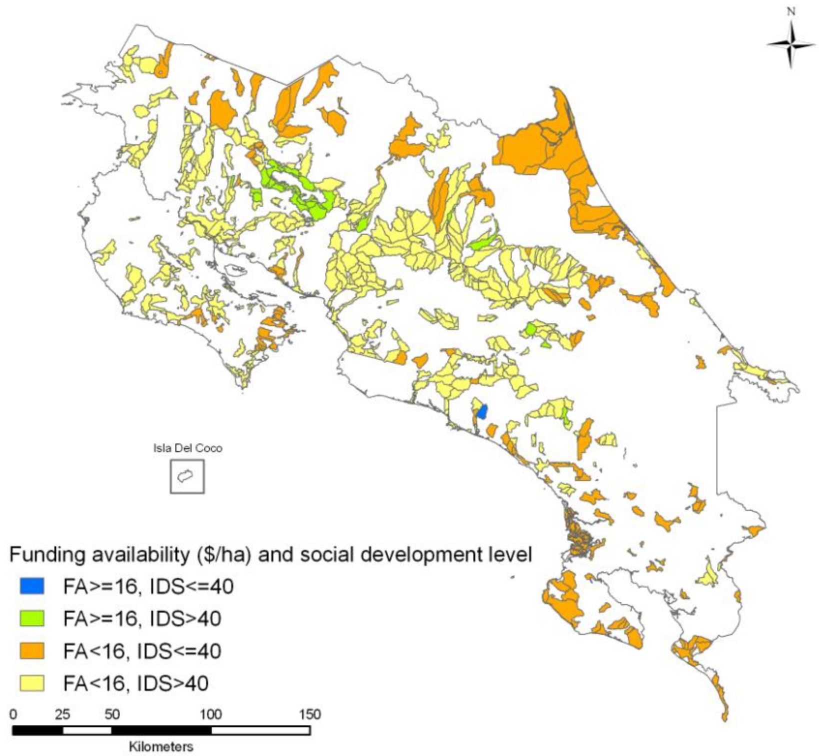
Map 1: The PSA's priority conservation areas



Map 2: Projected annual funding availability



Map 3: Estimated 2007 IDS scores at the watershed level



Map 4: Funding availability and social development levels in the intersected areas between biodiversity conservation priority areas and watersheds receiving the water funding