Recovering positive mountain externalities: reversing land degradation through payment for environmental services at the local level

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SUMMARY

Hillsides and mountain areas are important in Central America because they produce agricultural and forest goods, as well as environmental goods and services, specially water and biodiversity. However, land degradation occurs in countries such as Honduras, Nicaragua and El Salvador, due to deforestation, slash-and-burn practices for food production, etc. Land degradation occurring up-stream is having an adverse effect in water production for different uses down-stream. During the dry season (6 months) water scarcity increases, specially in dry zones of the Pacifi Basin. Droughts and heavy rainfall are affecting individual farmers, communities and urban populations. Land degradation and restoration of positive externalities from hillsides in Central America require specific measures to avoid loss of soil fertility and water production capacity.

PASOLAC has undertaken several pilot actions of Payment for Environmental Services (PES) to enhance water management up-stream, at the municipal level. PES are considered economic instruments to finance conservation of natural resources. From the experiences of PASOLAC, it has been observed that PES actions contribute to the adoption of soil and water conservation technologies by farmers located in critical water catchment areas. Land management changes require a set of methodologies and strategies for SWC technology transfer and recovering positive mountain externalities. Water sources are showing signs of recovery, different land management practices have been introduced, stakeholder participation has led to conflict resolution and design of local policies for natural resources management. Implementing pilot actions is an effective instrument for developing sound policies at the local level an then at a national level. PES mechanisms are contributing to institutional, social and environmental sustainability, but further cost-benefit analysis is needed to verify economic viability.

INTRODUCTION

The Program for Sustainable Agriculture in the Hillsides of Central America (PASOLAC)[1] has been promoting the adoption of soil and water conservation (SWC) techniques through collaborative work with >60 institutions working with hillside farmers of Nicaragua, El Salvador and Honduras. The main clients of the Program are >75,000 small-scale farmers working in the hillsides of the above three countries, to produce different agricultural goods: coffee, food (maize & beans), fruits and vegetables.

Hillsides cover between 60% and 80% of the continental territories of Nicaragua, Honduras, and El Salvador. These areas are characterized by severe soil and landscape degradation. Due to overall deterioration of the watersheds, water infiltration rates have decreased, groundwater levels have lowered and springs have dried out. Water shortcomings as well as floods are becoming more frequent and dry seasons appear to become more often unusually long. Losses in agricultural production due to droughts have had severe impacts on hillsides livelihoods:

[1] PASOLAC is a Program of the Swiss Agency for International Development and Cooperation (SDC) executed by INTERCOOPERATION (Swiss Foundation for International Cooperation) in Central America

Decrease on agricultural productivity, yield losses, malnutrition and even death of starvation, particularly in children, have been reported in recent years.

The main objective of PASOLAC is to increase the adoption of sustainable land and water management (SLWM) techniques, and to increase the income of small-scale farmers that are engaged in Program activities. Since the year 2000, PASOLAC has been devoted to building the technical and methodological capacities of technicians and farmers working with partner institutions. A participatory evaluation by farmers conducted in 2003, showed an adoption rate of 60.6% (from a sample of 17,208 ha) in communities attended by the Program (Table 1).

PASOLAC promotes adoption of different SWC technologies (Table 2) by individual farmers or their organizations. The main instrument for technology transfer has been the SWC technology guide[2] which describes more than 40 SWC techniques. However, after designing and developing a multitactic technology transfer strategy, several methodologies and approaches have been used based on demand driven systems. One of these approaches tested since 2000 is a mechanism of Payment for Environmental Services at the municipal level, to enhance the water catchment's environmental functions in upper areas of specific micro watersheds. These watersheds supply water for different purposes, including domestic use in urban communities located in mountain areas.

THE PAYMENT FOR ENVIRONMENTAL SERVICES APPROACH IMPLEMENTED BY PASOLAC IN CENTRAL AMERICA

Four main environmental services have been defined as "more important" in Central America, based on Law 7575 from Costa Rica: i) Carbon sequestration, ii) Hydrological services; iii) Ecotourism or scenic views from particular landscapes; and iv) Biodiversity conservation. There are other environmental services which are also important, and may be of special interest in different situations; some examples are: erosion control, pollination of different crops, disaster prevention, among others. Following a discussion with stakeholders and PASOLAC partners, it was decided that the Program should concentrate on hydrological services given the strategic importance of water for different uses. Besides, the episodes of water shortages due to environmental degradation in key watersheds required an intervention scheme which would integrate all stakeholders.

Thus, PASOLAC has tried to utilize the following definition of payment for environmental services: "it's an economic instrument to promote conservation of natural resources, combining the socio-economic and ecological dimensions". It promotes participation of multiple stakeholders to engage in treatments of ecosystem functions to enhance water production, considering both, quantity and quality. Following this discussion, the scheme drawn in Figure 1 was conceptualized and then implemented at the municipal level, two cases in each of the countries: Nicaragua, El Salvador and Honduras. Three basic principles are required to implement the scheme in Figure 1 at the micro watershed level: i) The watershed produces water for a particular population of water consumers; ii) There is a clear demand from an institution (public, private or mixed) which clearly represents the demand for an intervention in the water catchment area of the micro watershed; and iii) The institutional and judicial system at the municipal level will allow a particular payment for environmental service mechanism to operate. Based on Figure 1, an explanation of the key components of a PES mechanism at the

[2] PASOLAC 2000. Guía Técnica de Conservacion de Suelos y Agua. Documento No. 241, Serie Técnica 17/99. Nicargua, Honduras, El Salvador. 222 p.

local level is presented below. Notice that each element has been marked with a number which will be used as a reference for its description in connection with Figure 1.

No.	Key Components	Component description
1	Demand for environmental services	This is the most important element of the mechanism. Usually the demanding population (i.e.: a city) is represented either by the municipal government or the municipal water enterprise. In PASOLAC´s case, it has been through municipal water boards, where consumers and the municipal government are represented
2	Types and sources of Funds for payment for environmental services	Once the demand for environmental services has been identified, all types of fund sources are identified, from the demanding population. Some examples are given in box n. 2, of Figure 1. It is important to know that a specific study is conducted to estimate the willingness-to-pay by the consumers, and identifying payment mechanisms.
3	The Fund for Environmental Services (F.E.S.)	This is the most critical element. A particular account must be opened in a bank. In PASOLAC´s cases, it has required a specific municipal law (Municipal Ordinance) since it has to do with tariffs, additional charges, or fund allocation to the particular bank account entitled “Fund for Environmental Services”. The Municipal Ordinance clearly states how the fund will be nourished, managed, and how contracts will be signed, and by whom.
4	The municipal board for administering the Fund for Environmental Services	The Municipal Ordinance states who are the board members and how the board will operate. Representatives from the municipal government, the farmers and water consumers become members of the board or committee for Water Resource Management.
5	The contracts between the FES and the farmers	This element is the bridge between the fund administration and the farmers. It states what are the technologies and land management expected from the farmers, and the funds that will be paid by the FES administration. It´s a key instrument for PES implementation and follow up for technology implementation and land management changes, in accordance with the water catchment management plan.
6	The role of private and non-private environmental service providers	Water catchment areas (up stream) are usually under private use. Thus, it is important to have a contractual relationship with farmers that will be paid for introducing new land management practice (SWC technologies like in Table 2, reforestation, natural forest re-growth management, etc.). Prior to implementing contracts, a “Management Plan” is designed for the water catchment area, which includes the name of all farmers, their land area, technologies or practices that should be introduced, and the cost of introducing those new practices. In PASOLAC cases, most of the farmers are small, but it may happen that medium to large farmers are also present in the water catchment area. All of them are included in the “Management Plan”. There may be a concern if rich farmers also get PES but this is unavoidable; it is the change in land management practices that is important and the contract should be very clear in all cases.
7	The flow of environmental services	In hillsides with “urban-rural” relationships, the flow of goods and environmental services goes from the hillsides (upstream) to the urban area (downstream where the demanding population is located). It may take 3 to 5 years to see changes in water quantity; it may take only one year to see changes in water quality, depending on introduced technologies

The P.E.S. approach explained above is aimed at developing strong urban-rural relationships through displaying the importance of hillside or mountain ecosystems. Increasing rainfall water infiltration at the micro watershed level is a measure that is expected to restore water availability for domestic use, agricultural production, hydroelectric power, and other uses.

A CASE FROM THE FIELD: THE PES EXPERIENCE IN SAN PEDRO DEL NORTE, NICARAGUA

The municipality of San Pedro del Norte (SPN) has a population of 5,053 habitants, of which 1,200 are living in the town of the same name and considered urban. The municipality belongs to the Department of Chinandega, Nicaragua (blue circle in Figure 2), located next to the Honduran border of San Marcos de Colon.

Like other mountain municipalities in the region, a sustained deforestation has been performed for several decades to extract pine timber. Upon deforestation, farmers have either shifted to cattle production or food production by using slash-and-burn practices. The weather is characterized by a precipitation of 800 – 1000 mm/year, with a marked dry season which extends for 4 – 6 months (130 – 140 days are critical), usually from December through the third week of may of the following year. The hillsides in SPN range from 500 – 800 m.a.s.l., with slopes from 15 – 35% steep.

Situation prior to PES in San Pedro del Norte

Water shortages occurred during the dry seasons of 2002 – 2004 due to a reduced water production in the upper micro watershed "Paso de Los Caballos", totaling ≈600 ha. From this watershed, water used to flow to a reservoir by gravity, and then the water is distributed to more than 150 houses of the local town. To make up for the water shortages during the dry seasons of 2002 – 2004, the municipality had to invest in purchasing an electricity powered water pump, to get water from a nearby creek, which was located at a lower plain than the municipal water reservoir.

The SPN municipal government had the initiative for designing a PES mechanism to reverse land degradation in the micro watershed catchment area. A proposal was submitted to PASOLAC early in 2001, and after following the different screening steps, the proposal was approved. A total of USD 12,000 were destined to support several activities, including the design of the catchment area management plan, an economic valuation of goods and environmental services, negotiations with stakeholders, creation of the water management association, and an initial fund for the local PES fund, under a co-finance statement. The latter meant that the municipality also had to put a similar amount into the PES fund for PES contracts.

Since 2003, PES contracts have been signed between the municipal government and fiver farmers, totaling 13 ha under PES treatment. This area represents 18% of the critical water catchment area (73 ha). Only five farmers are currently under PES due to limited availability of funds, but it expected that by the end of 2005 five additional farmers will be under PES contract. For each hectare under PES contract, the municipal government pays USD 27.4 dollars/year to the farmer, for introducing different land management practices. The payment scheme used is 50% upon contract signing, and 50% upon completion of agreed practices. Payment continues for five years to ensure maintenance of the catchment area.

SWC Technologies and better land management in hillsides

PES contracts have been signed during 2003, 2004, and still continue during 2005, between the municipal government and five farmers. The newly introduced land management practices are: control of forest fires and avoid any other type of burning, allow re-growth of natural vegetation, building rows of stone barriers in critical water infiltration points, and stone ditches in creeks

where there is risk of soil erosion due to rainfall. The ditches also improve water infiltration capacity (Figures 3 & 4).

Recovery of water sources, results after two years under PES

A field survey was conducted by PASOLAC during the first two weeks of May 2005, before the start of the rainy season. In fact, no rainfall had been observed in San Pedro del Norte since January of the same year. This was a typical year, with about 135 days of dry season already occurring during the time of the survey.

It was found that the municipal government had already created, by Municipal Ordinance recognized by the National Assembly, the Association of Water Users and Resource Management, which is to be in charge of future PES contracts, water tariff collections, and resource management at the local level. A total of 15 water sources were also registered, including the main source, which provides water to the town of SPN. The change in water sources, considered temporary or permanent is listed in Table 4 below.

The results shown in Table 3 indicate an increase in availability of water from natural springs and creeks. It is important to note that during the critical period of the dry season (December – May), springs and creeks dry, if no SWC techniques are used in the catchment area. In the case, of the micro watershed Paso de Los Caballos, the five families total 25 persons, and there was estimated an additional 1.25 m^3/day of water available during the dry season, for a total estimated of 162.5 m^3 of water during 135 critical days.

For the creek that provides water to the main town reservoir, it was observed during the survey a water production of 6.05 m^3/day, for a total of 780 m^3 during 135 critical days. However, this amount of water is not sufficient for 140 families registered, which require at least 42 m3 of water per day, to cover basic needs. It is estimated that a family of six members require aproximately 300 lts of water per day. The main water source has shown good signs of recovery but there is a need to increase the catchment area with conservation measures to ensure an additional water production during the dry season. During the rainy season the water shortage is significantly reduced due to more water production in the creek and water storage from rooftops by rural families.

Since there are currently 13 ha under PES contract, the direct cost of conservation is aproximately USD 357.00 dollars/year, for a total of USD 704.00 dollars during the two years of PES implementation. This investment has already generated 943 m^3 of additional water during the critical season. Given these results, the municipality has already decided (by local law) that families will pay USD 1.90 /house as a monthly fee for water provision. From this, 5% will go the local Fund for Environmental Services. Five percent from all current revenues that the municipal government obtains throughout the year will also be deposited in the FES. This will allow the Water Association to obtain approximately 400 – 500 USD / year to invest in water catchment area management.

The economic impact of land management changes will be estimated next year, to determine, for a 10 years scenario, the cost-benefit of PES implementation. The transaction costs for PASOLAC are in the order of USD 12,000.00, for a living experiment that has already changed the way in which local stakeholders manage natural resources. A future economic impact analysis should considere different elements: the price for additional water produced during the dry season, savings for not using electricity powered water pumps, increased water availability for rural families which now are able to irrigate small areas and few cows/family, and the value

of vegetation recovered. For private farmers, the cost of opportunity for land under PES will also be estimated.

Results from other experiences under PES cases implemented by PASOLAC

PASOLAC is now supporting other six field experiences similar to that of San Pedro del Norte. The major concern for the Program is to observe the evolution of relations among stakeholders, and the introduction of SWC technologies based on contractual relations between the farmers and the water management institution. Results observed during the first semester of 2005 on SWC technologies implemented up-stream are shown below, as well as the observed effects. Notice that in some cases where coffee is the predominant hillside crop, water contamination from coffee mills located up stream is also critical. However, using the same mechanism, the municipality of Jesus de Otoro, Honduras, has arrived to introduce several technologies, including earthworm manure production from processing the coffee pulp, and have also introduced water treatment technologies. This has significantly reduced water pollution, and water treatment costs. PES has proved to be win-win model which makes stakeholders located up and downstream to discuss common problems and find sollutions based on agreements and contractual relations.

SWC technology adoption in municipalities that are implementing local mechanisms of PES to enhance hydrological ecosystem functions

Municipality	**SWC technologies adopted**	**Observed effects**
Municipal Water Board and Administration from Jesús de Otoro Department of Intibucá, Honduras	○ No burning, forest fire control, crop residue management ○ Organic manure production from coffee pulp processing with earthworm culture ○ Construction of letrines in coffee farms and households ○ Hedge rows of different plant species ○ Living fences of Erithryna sp ○ Native forest management and forest guards	Reduced tentions between the farmers upstream and the municipal government and local water enterprise. Water pollution from human organic wastes has been significantly reduced by introducing letrines and SWC techniques. Sanitation has improved livelihoods in upstream communities as well.
Municipal Water Board from Campamento Department of Olancho, Honduras	○ Coffee mills have been changed to ecological types, using less water and water treatment basins ○ Organic manure production from coffee pulp processing with earthworm culture ○ Reforestation with timber trees and perennial fruit species	Reduced contamination from coffee mill´s waterwaste and pulp; reduced water treatment costs and public health due to polluted water
Association of Water Consumers and Resource Management from San Pedro del Norte Department of Chinandega, Nicaragua	○ Regulated extraction of pine timber ○ Natural vegetation re-growth management ○ Forest fire control ○ Avoid slash-and-burn practices ○ Construction of stone ditches ○ Rows of stone barriers for water infiltration and soil erosion control	The main water source for the town of San Pedro del Norte has shown signs of recovery during the dry season of 2005. >900 m^3 of additional water were produced in the micro watershed. Reduced costs of water pumping using electricity.

Municipality of Achuapa, Department of León, Nicaragua	○ Avoid using slash-and-burn practices ○ Forest fire control ○ Natural forest re-growth management ○ Rows of stone barriers for water infiltration and soil erosion control ○ Barbedwire fences to protect native forests with water sources	Like in San Pedro del Norte, several water sources have shown signs of recovery, changing from temporary to permanent water sources.
Municipal Water Enterprise from Yamabal Department of Morazán, El Salvador	○ Avoid using slash-and-burn practices ○ Crop residue management ○ Construction of water cut-off drains ○ Hedge rows of different plan species ○ Improved agroforestry systems (140 a 200 trees/ha)	Farmers have already observed water sources recovering, with more water available during the dry season

Outcomes from PES experiences

Contribution to mitigation and adaptation to climate change. Based on a survey conducted in 2002[3], it was concluded that the adoption of SWC technologies through PES pilot actions and other technology transfer approaches implemented by PASOLAC, are contributing to climate change mitigation and adaptation. SWC technologies and natural forestry re-growth are prone to contribute to CO_2 sequestration and green house gases emission reduction, as well as to the reduction of the vulnerability to extreme climatic events (particularly droughts and possibly also extreme rainfall events) of agro-ecosystems and the people that depend on them. However, the magnitude of these contributions has to be quantified with more precise methods.

Participation and conflict resolution. Participation of different stakeholders in local organizations such as municipal water enterprises or water associations, has contributed to strengthen relationships between up and downstream dwellers. In one case in Honduras (JAPOE), small farmers in the water chatchment area had been threatened by the municipal government due to water contamination from organic residues and agricultural practices leading to soil erosion. After the first agreements within the frame of the PES action, conflicts have been significantly reduced. Collaborative relations are now nurtured by contracts and understanding of urban-rural connections.

Policy dialogue. The most common policies (laws, regulations, etc.) now applied in Nicaragua, Honduras and El Salvador are of the type “Command-and-Control”. These policies require a tremendous apparatus for the execution of regulations, mostly punitive (fines, jail, etc.). PES it´s an economic instrument which internalizes environmental costs into the productive chain, or values positive externalities of ecosystem´s functions. It´s a “win-win” system.

The formulation of local laws in the form of Municipal Ordinances for natural resources is becoming an effective way of promoting better land management. Descentralization is now on its way in Nicaragua, Honduras and El Salvador, and current laws now permit the creation of local PES mechanisms. However, municipal governments are often limited by laws at the national level. Once convinced, local governments or organizations conduct policy dialogue at a

[3]Lucio Pedroni and Thomas Stadtmüller. 2002. Contribution of two SDC projects in Latin America to climate change mitigation and adaptation

higher level to allow the implementation of local PES mechanisms, specially the change in tariffs, and avoiding logging permits given by national organizations to entrepreneurs without knowing the implications for water management at the local level. In Honduras, the National Committee for Goods and Environmental Services (CONABISAH) has been created upon these experiences, and this committee has contributed to the design of a national PES strategy and the review of the current Forestry Law. In Nicaragua, the Office for Clean Development Mechanisms has conducted a survey on current development of PES experiences, to design a better institutional and legal frame which contribute to regulate these mechanisms.

Good governance for water management. In some of the cases, there was an abasence of institutional and legal framework for natural resources management or PES. In San Pedro del Norte, for instance, an Asociation for Municipal Watermanagement has been created; in Honduras, in both cases the Municipal Water Board are key players, similarly occurs in two experiences in El Salvador. The most important result is the existence of water resource management institutions where up and downstream stakeholders are represented, and the Municipal Ordinances (local laws) provide the framework for good governance for resource management at the local level.

CONCLUSIONS

PASOLAC has promoted the adoption of SWC using different technology transfer instruments, methods and approaches. The Payment for Environmental Services´ approach is proving to be an effective mechanism to promote technology adoption. The fact that people or water consumers have to discuss about a change in tariffs to provide even a minimum of the funds for conservation upstream, gives signs that PES is an effective mechanism for local governance in relation to natural resources management.

The introduction of SWC techniques for land management in critical water catchment areas, enhances water production, in both, quantity and quality. This is an excellent motivation for further SWC technology adoption. In addition to contribute to SWC adoption, PES experiences are contributing to reducing the vulnerability to climate change (droughts), bottom up policy dialogue, and the resolution of social conflicts. PES is proving to be a “win-win” system locally, and is providing policy lessons for the macro level.

PES mechanisms seek natural resources management in the territory. This means that in many cases, this economic instrument will be applied regardless of farmer´s size. In a watershed, small, medium and large farmers co-exist. This situation can lead to reflections at the local level, where low income people are paying for natural resources management in land owned by large farmers. In this case, early involvement of all stakeholders is very important, and a it is needed to demonstrate that the investment in better land management practices will bring benefit to all citizens, regardless of their socio-economic conditions.

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ANNEX: Tables and Figures cited in text

Table 1. Hillside small-scale farmers and areas with soil and water conservation (SWC) technologies in 56 communities

Growers and SWC adoption	Nicaragua	Honduras	El Salvador	Total
No. of growers surveyed (total)	4,412	989	4,218	9,619
Growers with SWC	3,574	608	2,379	6,561
Growers with SWC (%)	81.0	61.5	56.4	68.2
Agricultural area (ha)	8,682	2,138	6,388	17,208
Agricultural Area with SWC (ha)	6,541	445	3,448	10,434
Area with SWC (%)	75.3	20.8	54.4	60.6
Average farm area by grower (ha)	2.0	2.2	1.5	1.8

Source: Program Evaluation through Beneficiary Assessment in 2003

Table 2. Adoption of soil and water conservation technologies by hillside farmers in communities where PASOLAC has intervened

SWC Technologies	% of farmers implementing the technology for ≥3 years		
	Nicaragua (N = 60)	Honduras (N = 18)	El Salvador (N = 30)
No burning	100	50.0	100
Crop residue management	100	22.2	100
Hedge rows (different plan species)	71.6	77.7	73.3
Green manures (legumes)	13.3	16.6	20.0
Organic manures	N.D.[1]	11.1	13.3
Stone barriers	73.3	38.8	50.0
Hillside ditches	43.3	16.6	46.7
Terraces	21.6	5.5	33.3
Water sources protection[2]	67.2	N.D.	42.0

[1] Not Determined
[2] Water sources are protected by conserving trees surrounding the springs. The total amount of water sources registered in the 56 communities visited in Nicaragua and El Salvador was 376 and 138, respectively.
Source: Program Evaluation through Beneficiary Assessment in 2003

Table 4. Improvement of water sources after PES in San Pedro del Norte

Water sources	Before PES	Currently (with PES)	Change
Springs			
Permanents	8	13	**+ 5**
Temporary	6	1	**- 5**
Creeks			
Permanent	0	1	**+ 1**
Temporary	1	0	**- 1**
Total permanent	**8**	**14**	**+ 6**
Total temporary	**7**	**1**	**- 6**

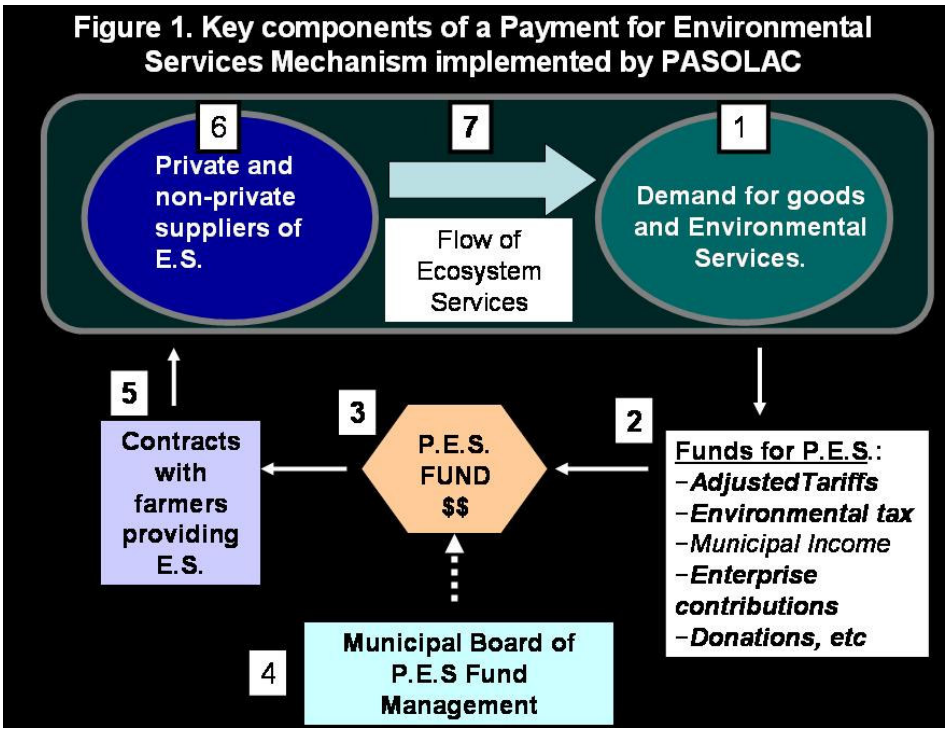

Figure 2. The municipality of San Pedro del Norte is located in the hillsides of northern Nicaragua, next to the Honduran border

Figure 3. Stone ditch enhancing water infiltration and avoiding soil erosion in a creek located in the water catchment area in Paso de Los Caballos micro watershed, San Pedro del Norte (May 12, 2005)

Figure 4. Farmers under PES contract building rows of stone barriers to enhance water infiltration and decrease soil erosion (May 12, 2005)